

APPENDIX F

Total Allowable Catch-Setting Process

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	The Total Allowable Catch-Setting Process	F-1-1
Section 2	Background on Harvest Controls	F-1-2
2.1	MSA Requirements	F-1-2
2.2	NPFMC Harvest Strategy	F-1-3
2.3	Structure and Composition of Management Categories	F-1-3
2.4	Overfishing and Acceptable Biological Catch	F-1-4
2.5	Optimum Yield and Total Allowable Catch	F-1-8
2.6	Minimum Stock Size Threshold	F-1-9
2.7	Ecosystem Considerations in the TAC-Setting Process	F-1-10
2.8	Annual Cycle	F-1-11
Section 3	FMP Policy Alternatives	F-1-12
3.1	Alternative 1 – Continue Management Under the Current Risk-Averse Management Policy	F-1-13
3.1.1	Description of Features Pertaining to the TAC-Setting Process	F-1-13
3.1.2	Evaluation of Policy from a Single-Species Perspective	F-1-14
3.1.3	Evaluation of Policy from an Ecosystem Perspective	F-1-19
3.1.4	Conclusions	F-1-20
3.2	Alternative 2 – Adopt a More Aggressive Management Policy	F-1-20
3.2.1	Description of Features Pertaining to the TAC-Setting Process	F-1-20
3.2.2	Evaluation of Policy from a Single-Species Perspective	F-1-21
3.2.3	Evaluation from an Ecosystem Perspective	F-1-21
3.2.4	Conclusions	F-1-22
3.3	Alternative 3 – Adopt a More Precautionary Management Policy	F-1-22
3.3.1	Description of Features Pertaining to the TAC-Setting Process	F-1-22
3.3.2	Evaluation from a Single-Species Perspective	F-1-23
3.3.3	Evaluation from an Ecosystem Perspective	F-1-24
3.3.4	Conclusions	F-1-24
3.4	Alternative 4 – Adopt a Highly Precautionary Management Policy	F-1-25
3.4.1	Description of Features Pertaining to the TAC-Setting Process	F-1-25
3.4.2	Evaluation from a Single-Species Perspective	F-1-26
3.4.3	Evaluation from an Ecosystem Perspective	F-1-27
3.4.4	Conclusions	F-1-27
Section 4	Comparisons of Alternative Policies	F-1-28
Section 5	Literature Cited	F-1-30

TABLES

Table 1.	The North Pacific Fishery Management Council tier system developed by the Alaska Fisheries Science Center as defined by Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plan Amendments 56/56, June 1998.	F-1-6
Table 2.	Comparison of Fishery Management Plan frameworks regarding the total allowable catch-setting process.	F-1-16

FIGURES

Figure 1.	Harvest control rules used in Tiers 1-3.	F-1-7

ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
AFSC	Alaska Fisheries Science Center
AP	Advisory Panel
B	Biomass
BSAI	Bering Sea and Aleutian Islands
EBS	eastern Bering Sea
EC	Ecosystem considerations
F	Fishing mortality rate
FMP	Fishery Management Plan
GOA	Gulf of Alaska
<i>M</i>	Natural mortality rate
maxABC	Maximum permissible level
MFMT	Maximum fishing mortality threshold
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSST	Minimum stock size threshold
MSY	Maximum sustainable yield
mt	metric tons
NOAA Fisheries	National Marine Fisheries Service (NMFS)
NPFMC	North Pacific Fishery Management Council
NSG	National Standard Guidelines
OFL	Overfishing level
OY	optimum yield
pdf	probability density function
SAFE	Stock Assessment and Fishery Evaluation
SEIS	Supplemental Environmental Impact Statement
SSC	Scientific and Statistical Committee
TAC	total allowable catch

This page intentionally left blank

Section 1 The Total Allowable Catch-Setting Process

The Fishery Management Plans (FMPs) for the groundfish fisheries managed by the North Pacific Fishery Management Council (NPFMC) incorporate a complex suite of measures. These include harvest controls, effort controls, time and/or area closures, bycatch controls, monitoring and enforcement measures, and rules responding to other constraints (e.g., regulations to protect Steller sea lions and to avoid seabirds). This qualitative impact assessment provides a broad overview of four proposed management policies specifically as they pertain to harvest control or the Total Allowable Catch (TAC)-setting process in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) groundfish fisheries of the North Pacific. Its goal is to provide the reader with a basic understanding of each of the four proposed policy alternatives regarding how TACs are now set and might be set in the future, and a qualitative assessment of the biological, physical, and socioeconomic consequences of each of these alternatives in relative isolation to other FMP components.

Before proceeding with the description and qualitative analysis of the four FMP alternatives under consideration, some background on the harvest strategy practiced by the NPFMC is provided. This background begins with a description of some of the key elements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the National Standard Guidelines (NSGs). It then provides an overview of the NPFMC's harvest strategy as it relates to the requirements of the MSA and NSGs.

Section 2 Background on Harvest Controls

2.1 MSA Requirements

From the perspective of the TAC-setting process, the most important part of the MSA is National Standard 1, which states, “Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the United States fishing industry (emphasis added).” The MSA defines overfishing to mean “a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis.” The MSA defines OY as the amount of fish which:

- “Will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems.”
- “Is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor.”
- “In the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.”

Note that the definitions of both overfishing and optimum yield refer to maximum sustainable yield (MSY). The MSA does not define MSY, but the NSGs define it as “the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.” The NSGs also introduce the concept of the “MSY control rule,” defined as “a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.” The MSY control rule can take a wide variety of forms. The NSGs offer the following advice regarding MSY control rules:

In choosing an MSY control rule, NPFMCs should be guided by the characteristics of the fishery, the FMP’s objectives, and the best scientific information available. The simplest MSY control rule is to remove a constant catch in each year that the estimated stock size exceeds an appropriate lower bound, where this catch is chosen so as to maximize the resulting long-term average yield. Other examples include the following: Remove a constant fraction of the biomass in each year, where this fraction is chosen so as to maximize the resulting long-term average yield; allow a constant level of escapement in each year, where this level is chosen so as to maximize the resulting long-term average yield; vary the fishing mortality rate as a continuous function of stock size, where the parameters of this function are constant and chosen so as to maximize the resulting long-term average yield. In any MSY control rule, a given stock size is associated with a given level of fishing mortality and a given level of potential harvest, where the long-term average of these potential harvests provides an estimate of MSY.

Under the NSGs, the MSY control rule plays a key role in making the MSA’s definitions of overfishing and OY operational. In the case of overfishing, the MSY control rule serves as an upper limit on permissible specifications of the “maximum fishing mortality threshold” (MFMT). The MFMT specifies the fishing mortality rate (F) above which overfishing is defined to be occurring (i.e., if $F > \text{MFMT}$, overfishing is occurring). The MFMT, in turn, plays a role in defining the “minimum stock size threshold” (MSST). The

MSST specifies the biomass (B) below which the stock is defined to be overfished (i.e., if $B < MSST$, the stock is overfished). Specifically, the MSST is defined as whichever of the following is greater: one-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the MFMT. Taken together, the MFMT and the MSST constitute the set of “status determination criteria” which the NSGs require each FMP to specify whenever possible.

In the case of OY, the MSY control rule is key to interpreting the MSA’s requirement that OY must be prescribed “on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor.” According to the NSGs, this requirement means, in part, that the OY in any given year “must always be less than or equal to the harvest level that would be obtained under the MSY control rule.” Therefore, if the MSY control rule were of the “constant catch” form, then a constant OY might be permissible, but if the MSY control rule were to associate different levels of catch with different stock sizes, then a constant OY would not be permissible (unless, perhaps, OY was set very conservatively).

2.2 NPFMC Harvest Strategy

Harvests in the BSAI and GOA groundfish fisheries are governed by the two FMPs, which constitute the overall “harvest strategy.” The NPFMC harvest strategy is complex and multi-faceted because it must address a myriad of issues related to sustainability, legislative mandates, and quality of information. This section presents a fairly detailed overview of the various elements that comprised the NPFMC harvest strategy as reflected in the FMPs. In later sections dealing with comparisons between alternatives and example FMPs (e.g., the FMP “bookends”), attention will be focused more narrowly on those particular elements of the harvest strategy that differ between two or more alternatives.

2.3 Structure and Composition of Management Categories

The FMPs define four management categories for which catch is constrained by various regulatory mechanisms: Target Species, Prohibited Species, Other Species, and Forage Fish Species. In addition to these four management categories, the FMPs define a “Nonspecified Species” category for which catch is not constrained by any regulatory mechanism. Stocks can be moved from one management category into another only by FMP amendment. The five management categories are described below.

Target Species are those species which are commercially important and for which a sufficient database exists that allows each to be managed on its own biological merits. Within the Target Species category, stocks are managed either individually or as part of a stock complex. Stocks within the Target Species category can be added to or removed from a stock complex within the same category as part of the TAC-setting process (i.e., without an FMP amendment). Catch of each species or complex must be recorded and reported. This category includes species such as walleye pollock, Pacific cod, sablefish, flathead sole, and Pacific ocean perch.

Prohibited Species are those species and species groups that, when caught, must be returned to sea with a minimum of injury except when their retention is authorized by other applicable law. Groundfish species and species groups under the FMP for which quotas have been achieved are treated in the same manner as prohibited species. This category includes species such as Pacific halibut, herring, and Pacific salmon.

Other Species are species groups that currently are of slight economic value and not generally targeted. This category, however, contains species with economic potential or species that are important ecosystem components, but for which sufficient data are lacking to allow the species to be managed separately. Catch of this category as a whole must be recorded and reported. This category includes species groups such as sharks, skates, sculpins, and octopus.

Forage Fish Species are those species not included in the target species category and that are a critical food source for many marine mammal, seabird, and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this species category are specified in regulations and may include such measures as prohibitions on directed fishing, limitations on allowable bycatch retention amounts, or limitations on the sale, barter, trade, or any other commercial exchange, as well as the processing of forage fish in a commercial processing facility. This category includes species such as capelin, eulachon, and smelts.

Non-specified Species are those species and species groups of no current economic value taken by the groundfish fishery only as an incidental catch in the target fisheries. Virtually no data exists that would allow population assessments. No record of catch is necessary. This category includes those species that do not fall into any of the other categories.

2.4 Overfishing and Acceptable Biological Catch

The overfishing level (OFL) constitutes an absolute upper limit on the amount of fish that can be taken from a stock or stock complex in a given year, and is prescribed by an explicit set of formulae in the FMPs. The acceptable biological catch (ABC) is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The ABC cannot exceed a maximum permissible level (maxABC), which is prescribed by an explicit set of formulae in the FMPs. In all cases, maxABC, and therefore ABC, is less than OFL. Strictly speaking, the only constraint that the FMPs impose on TACs is that their sum must fall within the OY range, meaning that, in principle, an individual TAC could be set higher than, equal to, or lower than the corresponding ABC. In practice, however, each individual TAC is always set equal to or lower than the corresponding ABC. Reasons for setting an individual TAC below the corresponding ABC may include various social, economic, or ecological considerations as well as the need to keep the sum of the TACs within the OY range. The following table describes the relationships between OFL, maxABC, ABC, TAC, the sum of the TACs ($\sum$ TAC) and OY in the current system.

<u>Quantity</u>	<u>Constraints imposed by FMP</u>	<u>Traditional, voluntary constraints</u>
OFL	Value is prescribed by formula	None
maxABC	Value is prescribed by formula (always less than OFL)	None
ABC	$0 \leq ABC \leq \text{maxABC}$	None
TAC	$0 \leq \text{TAC} \leq \text{upper OY}$	$\text{TAC} \leq \text{ABC}$
$\sum$ TAC	$\text{lower OY} \leq \sum \text{TAC} \leq \text{upper OY}$	None

The formal, quantitative methods for determining OFL and ABC begin with the assignment of each stock to one of six “tiers” based on the availability of information about that stock (Table 1). Tier 1 has the greatest informational requirements and Tier 6 has the least. Each tier contains a formula or set of formulae defining OFL and another formula or set of formulae defining maxABC. In Tiers 1-5, OFL and maxABC are defined in terms of their respective fishing mortality rates, F_{OFL} and $max F_{ABC}$. In Tier 6, OFL and maxABC are defined directly (i.e., in terms of catch rather than a fishing mortality rate). The OFL formulae correspond to the MFMT required by the NSGs. The current formulae were introduced as part of Amendment 56 to each of the FMPs, adopted by the NPFMC in June 1998 and implemented on March 8, 1999. The formulae make use of several biological reference points, which are defined below:

F_{MSY}	The fishing mortality rate at which long-term average yield would be maximized if the MSY control rule were of the “constant F” form
B_{MSY}	The long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate units, that would be achieved under an MSY control rule of the “constant F” form
μ_A	The arithmetic mean (i.e., average) of the distribution of the estimate of F_{MSY}
μ_H	The harmonic mean of the distribution of the estimate of F_{MSY}
$F_{35\%}$	The fishing mortality rate at which the equilibrium level of spawning per recruit would be reduced to 35 percent of the equilibrium level of spawning per recruit in the absence of any fishing
$F_{40\%}$	The fishing mortality rate at which the equilibrium level of spawning per recruit would be reduced to 40 percent of the equilibrium level of spawning per recruit in the absence of any fishing
$B_{40\%}$	The long-term average biomass that would be expected under average recruitment when the stock is harvested at a fishing mortality rate equal to $F_{40\%}$
M	The natural mortality rate

Tier 1 is used in those cases where the distribution of the estimate of F_{MSY} has been computed reliably. The theoretical background underlying the above reference points is described by Goodman *et al.* (2002). In this tier, F_{OFL} is set equal to the arithmetic mean of the distribution (the “risk neutral” point estimate) and $max F_{ABC}$ is set equal to the harmonic mean of the distribution whenever biomass exceeds B_{MSY} . The harmonic mean has the mathematical property that it is less than the arithmetic mean by an amount that increases with the spread of the distribution, thus establishing a margin between F_{OFL} and $max F_{ABC}$ that increases with the uncertainty surrounding the estimate of F_{MSY} . For levels of biomass below B_{MSY} , both F_{OFL} and $max F_{ABC}$ decline linearly down to an intercept, below which both F_{OFL} and $max F_{ABC}$ are zero (Figure 1). The default value for the intercept in Tier 1 is 5 percent of B_{MSY} , although the Scientific and Statistical Committee (SSC) can set a different intercept if warranted by the best scientific information available. Only one stock, eastern Bering Sea (EBS) pollock, is currently assigned to Tier 1.

Table 1. The North Pacific Fishery Management Council tier system developed by the Alaska Fisheries Science Center as defined by Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plan Amendments 56/56, June 1998.

-
- 1) Information available: Reliable point estimates of B and B_{MSY} and reliable probability density function (pdf) of F_{MSY} .
 - 1a) Stock status: $B/B_{MSY} > 1$

$$F_{OFL} = \mu A, \text{ the arithmetic mean of the pdf}$$

$$F_{ABC} = \mu H, \text{ the harmonic mean of the pdf}$$
 - 1b) Stock status: $\alpha < B/B_{MSY} = 1$

$$F_{OFL} = \mu A \times (B/B_{MSY} - \alpha)/(1-\alpha)$$

$$F_{ABC} = \mu H \times (B/B_{MSY} - \alpha)/(1-\alpha)$$
 - 1c) Stock status: $B/B_{MSY} = \alpha$

$$F_{OFL} = 0$$

$$F_{ABC} = 0$$
 - 2) Information available: Reliable point estimates of B , B_{MSY} , F_{MSY} , $F_{35\%}$, and $F_{40\%}$.
 - 2a) Stock status: $B/B_{MSY} > 1$

$$F_{OFL} = F_{MSY}$$

$$F_{ABC} = F_{MSY} \times (F_{40\%}/F_{35\%})$$
 - 2b) Stock status: $\alpha < B/B_{MSY} = 1$

$$F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1-\alpha)$$

$$F_{ABC} = F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1-\alpha)$$
 - 2c) Stock status: $B/B_{MSY} = \alpha$

$$F_{OFL} = 0$$

$$F_{ABC} = 0$$
 - 3) Information available: Reliable point estimates of B , $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.
 - 3a) Stock status: $B/B_{40\%} > 1$

$$F_{OFL} = F_{35\%}$$

$$F_{ABC} = F_{40\%}$$
 - 3b) Stock status: $\alpha < B/B_{40\%} = 1$

$$F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1-\alpha)$$

$$F_{ABC} = F_{40\%} \times (B/B_{40\%} - \alpha)/(1-\alpha)$$
 - 3c) Stock status: $B/B_{40\%} = \alpha$

$$F_{OFL} = 0$$

$$F_{ABC} = 0$$
 - 4) Information available: Reliable point estimates of B , $F_{35\%}$, and $F_{40\%}$.

$$F_{OFL} = F_{35\%}$$

$$F_{ABC} = F_{40\%}$$
 - 5) Information available: Reliable point estimates of B and natural mortality rate M .

$$F_{OFL} = M$$

$$F_{ABC} = 0.75 \times M$$
 - 6) Information available: Reliable catch history from 1978 through 1995.

OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information.

$$ABC = 0.75 \times OFL$$
-

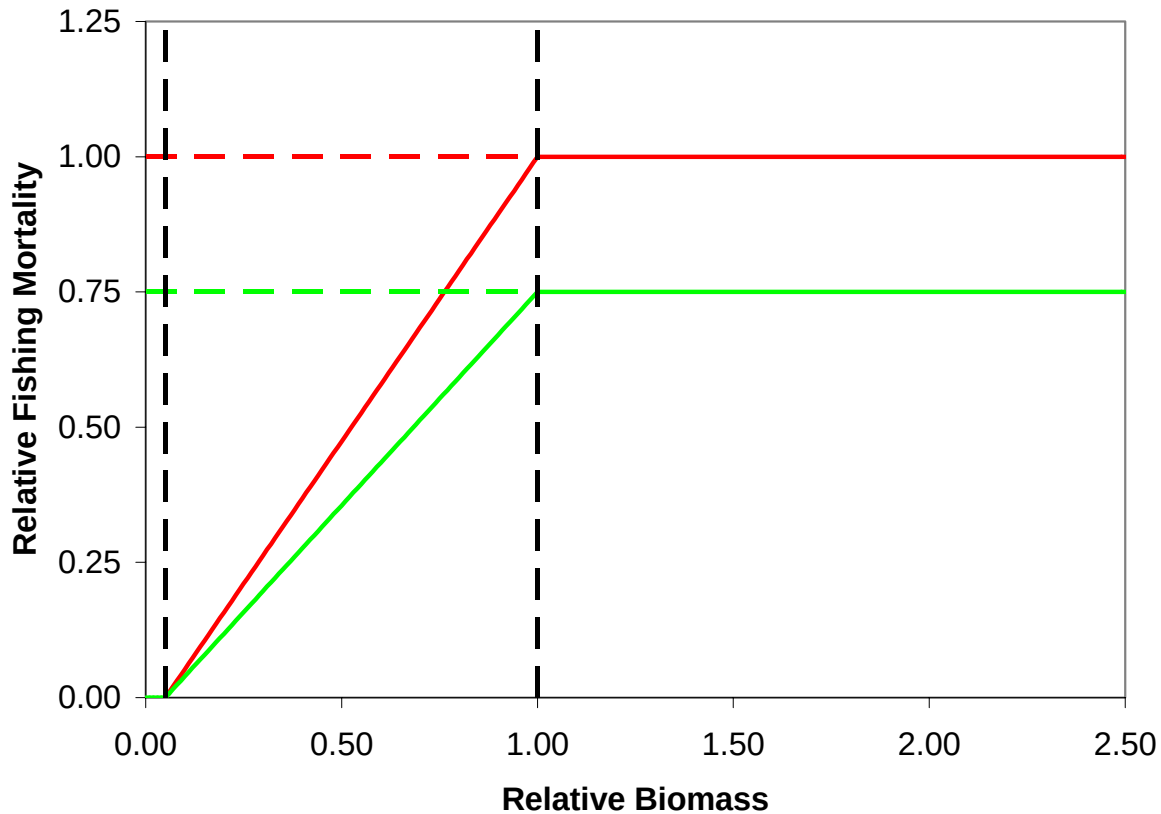


Figure 1. Harvest control rules used in Tiers 1-3.

Notes: The upper “kinked” line represents the F_{OFL} control rule. The lower “kinked” line represents the $maxF_{ABC}$ control rule. For any given stock, the ratio between $maxF_{ABC}$ and F_{OFL} is constant (a ratio of 0.75 is shown in the figure as an example). For both control rules, the following features apply: (1) Fishing mortality is constant whenever biomass exceeds a tier-specific reference level, represented in the figure by a vertical dashed line at a relative biomass level of 1.00. (2) Fishing mortality is zero whenever biomass is below 5 percent of the reference level, represented in the figure by a vertical dashed line at a relative biomass level of 0.05. (3) Fishing mortality varies linearly with biomass whenever biomass is between 5 and 100 percent of the reference level.

Tier 2 differs from Tier 1 in that only *point estimates* of the key population parameters are available; that is, the distribution of the estimate of F_{MSY} is not known. For a Tier 2 stock whose biomass is above B_{MSY} , F_{OFL} is set equal to the point estimate of F_{MSY} , much as in Tier 1, but a different formula (based on the adjustment used in Tier 3—see next paragraph) is used for adjusting the $max F_{ABC}$ downward from F_{OFL} .

Tier 3 differs from Tiers 1-2 in that the available information is insufficient for any estimation of MSY . For a Tier 3 stock whose biomass is above $B_{40\%}$, F_{OFL} is set equal to the point estimate of $F_{35\%}$ and $max F_{ABC}$ is set equal to the point estimate of $F_{40\%}$. According to the environmental assessment for Amendment 56, the $F_{35\%}$ reference point was intended to serve as a proxy for F_{MSY} (it was the *only* F_{MSY} proxy identified as such in the environmental assessment). Nearly all of the major target stocks in the BSAI/GOA are in Tier 3. Like the

control rules for Tiers 1-2, the control rules for Tier 3 decrease linearly with biomass when biomass is below a tier-specific reference level, which is $B_{40\%}$ in the case of Tier 3.

Tier 4 differs from Tier 3 in that information is insufficient for estimation of reference biomass levels. In this Tier, F_{OFL} is set equal to the point estimate of $F_{35\%}$ and $max F_{ABC}$ is set equal to the point estimate of $F_{40\%}$, regardless of biomass (i.e., the form of the control rules shown in Figure 1 does not apply to Tier 4).

Tier 5 differs from Tier 4 in that information is insufficient for estimating $F_{40\%}$ or $F_{35\%}$. In this Tier, F_{OFL} is set equal to the point estimate of the natural mortality rate (M), and $max F_{ABC}$ is set equal to three-fourths of that value, regardless of biomass (as in Tier 4).

Tier 6 differs from Tier 5 in that information is insufficient for estimating any of the stock parameters, and all that is known is the catch history. In this Tier, OFL is either the average historic catch from 1978 through 1995 or an alternative value established by the SSC on the basis of the best available scientific information, and $maxABC$ is three-fourths of OFL , regardless of biomass (as in Tiers 4-5).

2.5 Optimum Yield and Total Allowable Catch

Another element of the NPFMC's harvest strategy is the specification of OY and TAC. The FMPs specify OY as a constant range of total (i.e., across-species) harvest levels. The range for the BSAI is 1.4 to 2.0 million metric tons (mt); and the range for the GOA is 116 to 800 thousand mt. Within the Target Species category, a separate TAC is specified annually for each individually managed stock and each stock complex. A single TAC is specified annually for the entire Other Species category. No TAC is specified for the Prohibited Species, Forage Fish Species, or Nonspecified Species categories. Although the FMPs require the sum of the individual TACs to fall within the OY range, they do not otherwise constrain individual TACs. In practice, however, individual TACs are never set higher than the corresponding ABCs. The FMP gives the Regional Administrator authority to close an area to directed fishing for a stock or stock complex whose remaining TAC is needed as bycatch in other directed fisheries. If a TAC is reached, the FMP requires the Regional Administrator to publish a notice declaring that stock or stock complex to be prohibited, in which case any further catches of that stock or stock complex must be discarded. In practice, National Marine Fisheries Service (NOAA Fisheries) attempts to manage each fishery so that total catch (including all discards) is less than, but very close to, TAC. When a directed fishery is closed, bycatch of that stock is limited by a maximum retainable bycatch, which is determined as a percentage of retained catch. If it appears that a TAC may be exceeded due to unanticipated circumstances and ABC is being approached, the managers typically prohibit retention of that species in all fisheries, in order to eliminate "topping off." If ABC is exceeded and OFL is being approached, the managers can prohibit or close any fisheries that might possibly take that species as bycatch.

Originally, OYs were specified for each stock and stock complex in the Target Species category and for the Other Species category. The OYs were derived from MSYs provided by NOAA Fisheries scientists from the Alaska Fisheries Science Center (AFSC) and reviewed by the SSC. Essentially, the approach was a constant catch strategy, which was intended to be updated whenever new information indicated that a change was needed. Because data and sophisticated analytical tools were relatively scarce by today's standards, the stock assessments were fairly simple, often estimating MSY as the product of the most recent survey biomass estimate and half the natural mortality rate. Furthermore, the early assessments were based on data taken during a period of time that is now believed to have been a point of low productivity in the two regions.

The NPFMC soon learned that the FMP amendment process as established by the MSA was not prepared to deal with annual changes in OYs that were specified as fixed numerical values in the FMPs. Each change in OY required a plan amendment, which took several months to put into place. Yet the assessed status of the population could change dramatically due to new survey and catch data, recruitment variability, and other changes in population parameters. The FMPs were amended several times to make such changes, but a better solution was needed.

The solution the NPFMC chose was to specify OY as a constant (i.e., biomass-independent) range for each of the two groundfish complexes. The summed TACs of all species in the Target Species and Other Species categories would have to be within the range, but the individual TACs could be adjusted annually through a specifications process (i.e., a plan amendment would not be required). Amendment 1 to the BSAI FMP, which was implemented on January 1, 1984, set the OY range for the BSAI at 1.4-2.0 million mt (Amendments 1a, 2, 3, 4, and 7 were actually implemented earlier than Amendment 1). The OY range was set equal to 85 percent of the range of the summed species-specific MSYs in the BSAI. This range was chosen, in part, to ensure that future harvests would be sustainable. Also, the final environmental impact statement for the BSAI FMP (dated August, 1981), which also covered Amendment 1, stated that use of the 85 percent multiplier was “intended both to assure the continued health of the target species themselves and to mitigate the impact of commercial groundfish operations on other elements of the natural environment.” Thus, at the time it was specified, the BSAI OY range was believed to be conservative from both single-species and ecosystem perspectives.

Amendment 15 to the GOA FMP, which was implemented on April 8, 1987, set the OY range for the GOA at 116,000 to 800,000 mt. The upper end of the OY range was below the range of the summed species-specific MSYs in the GOA (805,000-1,000,000 mt). The lower end of the OY range was near the lowest historical catch over the period 1965-1985 (116,053 mt, taken in 1971). At the time of the lowest historical catch, pollock, cod, and Atka mackerel abundances were at low levels of abundance and, consequently, it was thought unlikely that catches lower than this value would be necessary during future instances of low abundance. The upper limit was selected in consideration of the volatility in pollock and flounder ABCs, the potential for harvesting at MSY, and the desire to allow for some moderate expansion in future flounder fisheries.

2.6 Minimum Stock Size Threshold

As noted above, the NSGs provide a standard definition of MSST, the criterion used to determine whether a stock or stock complex is overfished in the sense of the MSA. The NSGs require FMPs to specify MSST whenever possible. However, the BSAI and GOA Groundfish FMPs do not specify MSST. This has been a continuing source of confusion and controversy ever since the development of Amendment 56 (see Goodman *et al.* (2002) for a history). Although the FMPs do not specify MSST, the status of each stock in Tiers 1-3 is examined annually in the Stock Assessment and Fishery Evaluation (SAFE) reports with respect to the MSST definition contained in the NSGs. Based on this examination, no BSAI or GOA groundfish stock or stock complex managed under Tiers 1-3 is currently overfished. However, in the event that a stock or stock complex becomes overfished in the future, Tiers 1-3 contain provisions for “accelerated” rebuilding, meaning that reductions in both F_{OFL} and $max F_{ABC}$ are triggered whenever the estimate of stock biomass is below a tier-specific reference level (Figure 1). In Tiers 1-2, the reference level is B_{MSY} , and in Tier 3, the reference level is $B_{40\%}$. For the purpose of determining whether a stock is “overfished,” the NSGs set the rebuilding target equal to B_{MSY} . An estimate of B_{MSY} is available for Tiers 1-2 by definition. For Tier 3, the FMPs do not specify a B_{MSY} proxy, but the AFSC has traditionally used $B_{35\%}$ as the B_{MSY} proxy for Tier 3

stocks. The accelerated rebuilding schedule built into Tiers 1-3 may render specification of an MSST superfluous from a practical standpoint, because the management actions required for a stock which falls below its MSST may be identical to those that would take place automatically under the tier system.

Because it is not possible to estimate either B_{MSY} or any reliable proxy for B_{MSY} in Tiers 4-5, it is not possible to tell whether a stock or stock complex managed under either of these two tiers is currently overfished. Although Tiers 4-5 do not contain provisions for accelerated rebuilding, they *do* contain provisions for rebuilding under a constant fishing mortality rate. Thus, in the long run, stocks in Tiers 4-5 should tend toward the equilibrium biomass associated with the rate at which they are fished, but it is not possible to tell whether they have arrived at that equilibrium biomass or when they will get there. However, because biomass estimates are available for stocks in Tiers 4-5, it is at least possible to tell whether stocks managed under these tiers are increasing or decreasing over time.

As with Tiers 4-5, it is not possible to tell whether a stock or stock complex managed under Tier 6 is currently overfished. Unlike Tiers 4-5, Tier 6 does not contain provisions for rebuilding under a constant fishing mortality rate, but it does contain provisions for rebuilding under a constant catch level. Thus, in the long run, stocks in Tier 6 should tend toward the equilibrium biomass associated with the average catch so long as that catch is sustainable, but it is not possible to tell whether they have arrived at that equilibrium biomass or when they will get there. Furthermore, because biomass estimates are unavailable for stocks in Tier 6, it may not be possible to tell whether stocks managed under this tier are increasing or decreasing over time, unless measures such as commercial catch per unit effort are deemed to be reliable indicators of relative biomass.

2.7 Ecosystem Considerations in the TAC-Setting Process

Most of the above elements of the existing harvest strategy have implications for the ecosystem, at least indirectly. A few, such as the BSAI OY range, were adopted with ecosystem considerations (EC) explicitly in mind. Some other elements of the existing harvest strategy address EC directly. For example, since 1998, the existing policy has included provisions for protecting forage species. Forage species are generally small, abundant fishes (also krill) that are preyed upon by marine mammals, seabirds, and commercially important groundfish species. They are believed to perform a critical role in the BSAI and GOA ecosystems by providing transfer of energy from primary or secondary producers to higher trophic levels. Forage species have been estimated to comprise the principal diet for more than two-thirds of Alaska seabirds and are critical to many seabirds for raising their nestlings. Forage species have also been recognized as important prey items for a variety of marine mammals including the Steller sea lion, northern fur seal, spotted seal, bearded seal, humpback whale, and fin whale. They are presently relegated to bycatch-only status in the groundfish fishery. Maximum retainable bycatch limits are set at 2 percent for the entire group of forage species, regardless of the composition of the forage species taken. This percentage defines the maximum catch of forage species that may be retained aboard a vessel relative to amounts of other retained species open to directed fisheries. Forage fish taken within the 2 percent limit may be used for commercial purposes and are typically processed into fish meal. During the period 1997-1999, an average of 39 mt of forage species was taken annually in the BSAI region and an average of 61 mt was taken in the GOA.

Another example is the NPFMC's encouragement of ecosystem research and development of ecosystem-based management policies. An Ecosystem Committee was established by the NPFMC in 1995 and has developed a draft policy for ecosystem-based management of North Pacific fisheries (Witherell *et al.* 2000). The EC section of the SAFE reports continues to become more substantial. Multi-species modeling efforts

have been undertaken, mainly by AFSC personnel, and are being used as a primary analytical tool in this Programmatic Supplemental Environmental Impact Statement (SEIS). These models have allowed consideration of ecosystem impacts in ways that single-species models cannot (Goodman *et al.* 2002). Currently, these models are not viewed as a replacement for the single-species approach, but rather as a means of gaining better insight regarding potential ecosystem effects. The present FMP policy includes the goal of developing ecosystem indicators for future use in TAC setting, and the existing policy allows TAC to be set below ABC for a wide variety of reasons including EC.

A third example focuses on the groundfish species that figure most prominently in the diet of Steller sea lions: walleye pollock, Pacific cod, and Atka mackerel. In 2000, a Biological Opinion prepared under Section 7 of the Endangered Species Act on all aspects of the FMPs concluded that fisheries for these species jeopardized the continued existence of Steller sea lions and adversely modified their critical habitat due to competition for prey and modification of their prey field. To mitigate these effects, regulations now require, among other things, that the directed fishery for any stock of these species be closed if the biomass of that stock is projected to be less than or equal to $B_{20\%}$ (the long-term average biomass that would be expected under average recruitment when the stock is harvested at a fishing mortality rate equal to $F_{20\%}$) during the fishing year.

Many other aspects of the FMPs (e.g., Prohibited Species caps) also deal with EC, but they are not as directly related to the TAC-setting policy as the above items and so are dealt with in other sections of this appendix.

2.8 Annual Cycle

The TAC-setting process follows a regular annual cycle. Each year, scientists from the AFSC and the Alaska Department of Fish and Game collect data and compile and update databases on catch, age and size composition, and survey biomass. Stock assessment scientists from these agencies analyze the data and calculate estimates of population parameters, biomass, and age structure. Stock assessment models are used to integrate the scientific information, except when information is not sufficient to construct such a model. The processes of stock assessment and harvest strategy development are interrelated. Stock assessment models are used in development of the harvest strategy, and the current NPFMC biomass-based harvest strategy utilizes the most recent biomass estimates in determining ABC, OFL, and TAC.

The BSAI and GOA Plan Teams meet in September to discuss general methodological issues and any preliminary stock assessments that have been prepared. The SSC, the Advisory Panel (AP), and the NPFMC meet in October. The SSC focuses on assessment methodology, while the AP recommends and the NPFMC sets preliminary TACs based on extrapolations from the previous year. By November, the individual chapters of the SAFE reports have been prepared by the assessment scientists and another group of scientists has completed the EC section. The Plan Teams meet again in November to review the SAFE reports and make ABC and OFL recommendations. In December, the SSC reviews the SAFE reports and Plan Team recommendations, then formulates its own ABC and OFL recommendations. The AP recommends TAC values, traditionally lower than the ABC values recommended by the SSC. The NPFMC then sets final values of ABC, OFL, and TAC, subject to confirmation by NOAA Fisheries.

Section 3 FMP Policy Alternatives

Four FMP policy alternatives are under consideration by the NPFMC. Alternative 1 is the present policy. Each policy alternative contains two bookends to a range of management measures that illustrate how the framework could be implemented. These bookends provide a level of detail that allows analysis and provides contrastable policies. They also provide a means to commit the NPFMC action in implementing an alternative, while allowing the NPFMC, under the MSA, the flexibility to adaptively manage the fishery through FMP amendments.

Alternative 1 Continue Management Under Existing (Updated) Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The objectives of this policy are to adopt conservative harvest levels for single species fisheries and specify OY; continue to use existing OY cap for BSAI and GOA groundfish fisheries; and provide for adaptive management by continuing to specify OY as a range.

Alternative 2 Less Precautionary Management Policy: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. The objectives of this policy are to prevent overfishing by setting an OY cap at the sum of OFLs or the sum of the ABCs for each species and provide for adaptive management by continuing to specify OY as a range.

Alternative 3 More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community-based or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species. The objectives of this policy are to adopt conservative harvest levels for multi-species and single-species fisheries; provide for adaptive management by continuing to specify OY as a range or a formula; initiate a scientific review of the adequacy of F_{40} , and implement improvements accordingly; and to continue to collect scientific information and improve upon MSSTs including obtaining biological information necessary to move Tier 4 species into Tiers 1-3 in order to obtain MSSTs.

Alternative 4 Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but due to a lack of information and uncertainty, little is known about these impacts. The objectives of this policy are to prevent overfishing by transitioning from single-species to ecosystem-oriented management of fishing activities and to close an additional 20 to 50 percent of known spawning areas of target species across the range of the stock to protect productivity and genetic diversity.

3.1 Alternative 1 – Continue Management Under the Current Risk-Averse Management Policy

In the context of the TAC-setting process, this alternative is based on the premise that the best scientific information available is typically sufficient to manage fisheries so that they achieve long-term average yields close to MSY without excessive risk to the fishery or ecosystem.

3.1.1 Description of Features Pertaining to the TAC-Setting Process

The background section presented a fairly detailed overview of the various elements that comprise the NPFMC harvest strategy as reflected in the FMPs. Here, attention will be focused more narrowly on those particular elements of the harvest strategy, which differ in at least one of the other alternatives.

Structure and Composition of Management Categories

The FMPs define four management categories for which catch is constrained by various regulatory mechanisms: Target Species, Prohibited Species, Other Species, and Forage Fish Species. In addition to these four management categories, the FMPs define a “Nonspecified Species” category for which catch is not constrained by any regulatory mechanism (this category is composed of stocks which are of no current economic value and which are taken by the groundfish fishery only as bycatch). Stocks can be moved from one management category into another only by FMP amendment. Within the Target Species category, stocks are managed either individually or as part of a stock complex. Stocks within the Target Species category can be added to or removed from a stock complex within the same category as part of the TAC-setting process (i.e., without an FMP amendment).

OFL and ABC

The FMPs specify OFL and maxABC by means of a tier system wherein the amount of information available for a given stock or stock complex determines the formula that is used to define F_{OFL} and $max F_{ABC}$ (Tiers 1-5) or OFL and maxABC directly (Tier 6). The tier system is configured such that maxABC is always less than OFL except at very low stock sizes (where both maxABC and OFL are zero). The FMPs require that ABC

be set between zero and $\max ABC$. One of the central features of Tiers 1-3 is that F_{OFL} and $\max F_{ABC}$ decrease linearly with biomass whenever biomass falls below a tier-specific reference level. Most individual stocks are currently managed under Tier 3, where $\max F_{ABC}$ equals $F_{40\%}$ if biomass is above $B_{40\%}$. In Tier 1 (but not in any other tier), greater statistical uncertainty automatically results in a lower $\max ABC$. This adjustment implies a fixed level of risk aversion and is computed using the statistical uncertainty surrounding both the estimate of projected stock size and the estimate of F_{MSY} .

OY and TAC

The FMPs specify OY as a range, which is aggregated across all stocks and does not vary with biomass. Within the Target Species category, a separate TAC is set for each individually managed stock and each stock complex. A single TAC is set for the entire Other Species category. No TAC is set for the Prohibited Species, Forage Fish Species, or Nonspecified Species categories. Although the FMPs require the sum of the individual TACs to fall within the OY range, they do not otherwise constrain individual TACs. In practice, however, individual TACs are never set higher than the corresponding ABCs. The FMP gives the Regional Administrator authority to close an area to directed fishing for a stock or stock complex whose remaining TAC is needed as bycatch in other directed fisheries. If a TAC is reached, the FMP requires the Regional Administrator to publish a notice declaring that stock or stock complex to be prohibited, in which case any further catches of that stock or stock complex must be discarded.

MSST

In practice, the status of each stock in Tiers 1-3 is examined annually in the SAFE reports with respect to the MSST definition contained in the NSGs, but no MSSTs are specified in the FMPs for stocks in Tiers 1-3 and no MSSTs are specified anywhere for stocks in Tiers 4-6.

Ecosystem Considerations

The FMPs prohibit directed fishing for forage species. Regulations require the directed fishery for any stock of pollock, Pacific cod, or Atka mackerel (key Steller sea lion prey species) to close if the biomass of that stock is projected to be less than or equal to $B_{20\%}$ during the fishing year. Traditionally, the NPFMC has encouraged research regarding indicators of ecosystem health, but the conditions under which such indicators might actually be used in the TAC-setting process are unclear.

3.1.2 Evaluation of Policy from a Single-Species Perspective

Structure and Composition of Management Categories

In the context of the TAC-setting process, the central features of the existing management categories are that some stocks are afforded the protection of a stock-specific catch limit, other stocks are afforded the protection of a complex-specific catch limit, while the stocks in the Nonspecified Species category are not protected by any catch limit (based on the understanding that stocks in that category are taken in such small amounts that no catch limit is necessary). Recently, attention has been focused on the possibility of removing certain individual stocks or groups of stocks from their respective stock complexes, affording them the additional protection of a stock-specific or group-specific catch limit. In fact, the NPFMC has taken this step several times in recent years, for example, by sequentially removing rock sole, flathead sole, and Alaska plaice from the “other flatfish” complex in the BSAI. However, concern has been expressed regarding the absence of an identifiable policy governing such decisions. In addition, comparatively little attention has been focused on

the composition of the Nonspecified Species category. Presently, a committee composed of representatives from the SSC and Plan Teams is working to develop a draft policy that could be used to structure the management categories in a more consistent and scientifically justifiable manner.

OFL and ABC

Table 2 (reproduced from Goodman *et al.* 2002) lists the stocks and stock complexes comprising the Target Species and Other Species categories in each region, together with the tier assignment, OFL, *maxABC*, ABC, and other quantities for each in 2001. The relationships between these quantities can be summarized as follows:

- The *maxABC*s were always set below the OFLs, resulting in values, which averaged about 80 percent (range: 60-90 percent) of the OFLs; and
- The ABCs were often set below the *maxABC*s, resulting in values, which averaged about 75 percent (range: 10-85 percent) of the OFLs.

In the GOA, none of the 16 stocks or stock complexes were assigned to Tiers 1 or 2; seven were placed in Tier 3; five were in Tier 4 or Tiers 4-5 (some stocks in a complex were managed under Tier 4 while the other members of the complex were managed under Tier 5); and four were assigned to Tiers 5, 5-6, or 6. Thus, a suite of GOA stocks and complexes was managed under Tier 3. A similar situation existed in the BSAI region. In the BSAI, one stock (Bering Sea pollock) had sufficient information to be assigned to Tier 1. Of the remaining 20 stocks or stock complexes, 12 were in Tier 3; seven were placed in Tiers 5 or 5-6; and squid were placed in Tier 6. Thus, a majority of BSAI stocks and complexes was managed under Tier 3. As discussed earlier, $F_{40\%}$ plays a key role in the Tier 3 *maxABC* control rule.

Table 2. Comparison of Fishery Management Plan frameworks regarding the total allowable catch-setting process.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
FMP 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
- Set acceptable biological catch (ABC) < overfishing level (OFL). - Sum of total allowable catch (TAC) has to be within optimum yield (OY) range.	- Set ABC = OFL. - Sum of TAC has to be within OY range.	- Set ABC < OFL. - Same as FMP 2.1.	- Set ABC < OFL. - Set TAC = <ABC for all targets and "other spp." category.	- Same as FMP 3.1. - Same as FMP 3.1.	- No changes from FMP 1. - No changes from FMP 1.	- No changes from FMP 1. - TAC = 0 for all species unless fisheries are proven to have no adverse effect on the environment.
OY specified as range for Bering Sea and Aleutian Islands (BSAI): 1.4 - 2.0 million (mill) metric tons (mt) and OY specified as range for Gulf of Alaska (GOA): 116,000 - 800,000 mt; BSAI OY cap: If the sum of TAC > 2 mill mt then TAC will be adjusted down.	OY specified as range; OY cap = sum of OFL.	OY specified as range; OY cap = sum of ABCs.	OY specified as range for BSAI: 1.4 - 2.0 mill mt and OY specified as range for GOA: 116,000 - 800,000 mt; BSAI OY cap: If the sum of TAC > 2 mill mt then TAC will be adjusted down (No changes from FMP 1).	- No OY range in plan; OY = TAC which is = <ABC. - TAC is fishery specific.	- No OY range in plan; OY = TAC which is = <ABC. - TAC is fishery specific.	OY = 0; No fishery.
B ₂₀ rule for prey species (pollock, P. cod, Atka mackerel).	No changes from FMP 1.	No changes from FMP 1.	B ₂₀ rule for prey species (pollock, P. cod, Atka mackerel) (No changes from FMP 1).	Revise harvest control rule by incorporating a constant buffer.	Set F ₇₅ for prey species (pollock, P. cod, Atka mackerel).	TAC = 0 for all species.
ABC tier system (Amendment 56).	OFL management (Amendments 56 OFL definitions with inflection points removed in Tiers 1-3).	No changes from FMP 1.	Review F ₄₀ and adapt ABC tier system where F ₄₀ is maximum permissible for stocks without estimate of maximum sustainable yield (MSY).	When possible, biological reference points based on species-specific production patterns and ecosystem considerations.	Set F ₆₀₋₈₀ for vulnerable (e.g., long-life, slow-growing) species (will use F ₆₀ as proxy).	TAC = 0 for all species.
No directed fishery for forage fish (forage fish ban; Amendment 36/39).	No forage fish ban.	No changes from FMP 1.	No directed fishery for forage fish (forage fish ban, Amendments 36/39; No changes from FMP 1).	Same as FMP 3.1.	No directed fishery for forage fish (forage fish ban, Amendment 36/39; No changes from FMP 1).	Same as FMP 4.1.

Table 2 (cont.). Comparison of Fishery Management Plan frameworks regarding the total allowable catch-setting process.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
FMP 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Specify MSSTs for Tier 1-3 stocks.	No changes from FMP 1.	No changes from FMP 1.	Identify minimum required elements, resources, cost and a realistic time frame necessary to establish MSSTs for additional stocks and prioritize a list of candidate stocks.	Initiate analysis of MSSTs for priority stocks based on the time frame determined by additional availability of required resources.	Adopt MSSTs appropriate to the harvest policy for each stock, with B_{40} as the limit (rather than the target).	No changes from FMP 1.
Set group TAC for "other species" category.	No changes from FMP 1.	No changes from FMP 1.	Break sharks and skates out of "other species" group for TAC setting (Amendments 63/63).	Break sharks and skates and additional groups out of "other species" group for TAC setting.	Least Abundant Species Aggregate TAC: e.g., TAC of species complex is based on the TAC of the least abundant member of the group.	TAC = 0 for all species.
			Develop criteria for breaking out a species from a species complex.	Develop criteria to bring a non-specified species into a managed category.	Where possible, break species out of the complex.	
Precautionary adjustments exist, but vary with uncertainty only in Tier 1.	OFL management only.	No changes from FMP 1.	Conduct F_{40} review and adopt appropriate measures.	Develop, implement and update as necessary, procedures to account for uncertainty in estimating ABC.	Incorporate survey variance and uncertainty in ABC by a survey coefficient of variation for each stock.	In the face of uncertainty, set TAC = 0 for all species unless fisheries are proven to have no adverse effect on the environment.
Develop ecosystem indicators for future use in TAC setting.	No ecosystem indicators.	No changes from FMP 1.	Develop criteria for using key ecosystem indicators in TAC setting.	Adopt, update as necessary, and use ecosystem indicators in TAC setting.	Evaluate a range of ABCs using the lower bound of a confidence limit to address uncertainties in stock assessment advice.	
Target species closures when harvest limit reached.	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.	Harvest limit = 0.

There is a fairly widespread consensus in the scientific literature that, for a range of typical groundfish life histories, $F_{40\%}$ is a safe harvest rate. However, Goodman *et al.* (2002) raised concerns regarding the use of $F_{40\%}$ in managing the BSAI and GOA rockfish species. This concern was based mainly on results obtained by MacCall (2002) and Clark (2002) working with West Coast rockfish. However, only a few rockfish stocks in Alaska are being managed under a tier in which $F_{40\%}$ plays a role, and those which are managed in one of those tiers (Pacific ocean perch and GOA thornyhead) appear to be doing well. Dorn (2002) studied Alaska rockfish stocks in addition to West Coast stocks and found that, although $F_{40\%}$ was not always a safe harvest rate for the West Coast stocks, it appeared to be safe for the Alaska stocks included in the study. Thus, the concern raised by Goodman *et al.* (2002) appears to be more germane to rockfish stocks which are currently managed in Tier 5 but which might be managed under a different tier in the future, in which case the key question is whether the Tier 5 rockfish stocks behave more like other Alaska rockfish stocks or more like West Coast rockfish stocks. Goodman *et al.* (2002) also note that the Tier 3 maxABC control rule is not directly comparable to the control rules used in the studies by MacCall (2002) and Clark (2002). Under the Tier 3 control rule, fishing mortality decreases linearly with stock size if the biomass falls below $B_{40\%}$, whereas it was assumed in the West Coast rockfish studies that harvest rates would be kept constant regardless of stock size. All else being equal, the Tier 3 control rules are more conservative than the $F_{40\%}$ strategies in the referenced studies of West Coast rockfish.

Over time, the evolution of the tier system has tended towards increasing conservatism. By the standards of the world's other large commercial fisheries, the current tier system is conservative.

OY and TAC

In addition to OFL, maxABC, and ABC, Table 2 also lists TAC and the 1997-2000 average ratio of catch to TAC for each stock and stock complex in the Target Species and Other Species categories. The relationships between these quantities can be summarized as follows:

- The TACs were often set below the ABCs, resulting in values, which averaged about 65 percent (range: 0-85 percent) of the OFLs; and
- On average, catches exceeded TACs only rarely. The median ratio of catch to TAC (averaged over the period 1997-2000) was about 60 percent for both the BSAI and GOA. The range of the ratios across areas and species was 21-112 percent, with the highest ratio coming from the GOA sablefish fishery, where catches exceeded TACs in three of the four years examined.

As noted earlier, the MSA states that OY is to be prescribed “on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor.” According to the NSGs, this requirement means, in part, that the OY in any given year “must always be less than or equal to the harvest level that would be obtained under the MSY control rule.” Thus, in order to determine whether the OY specification complies with the MSA, it is necessary to know the form of the MSY control rule. This is problematic in the case of the BSAI and GOA Groundfish FMPs, because the NPFMC declined to specify an MSY control rule in Amendment 56. Based on the methods used to specify the current OY range and the fact that it does not vary with biomass, it could be inferred that the NPFMC’s implicit MSY control rule is of the “constant catch” form. However, this interpretation would mean that the OFL control rules in at least some of the tiers violate the NSGs’ requirement that the MSST not exceed the MSY control rule (in Tiers 1-2, for example, OFL exceeds MSY whenever biomass exceeds B_{MSY}). On the other hand, if it is assumed that the OFL control rules correspond to the NPFMC’s implicit MSY control rule, then the adequacy of the current OY

specification is called into question, because the entire OY range will exceed the harvest associated with the MSY control rule if biomass is low enough.

Previous reviews have identified similar concerns regarding the current OY specifications. For example, Goodman *et al.* (2002) compared the 1999 OFLs with the current OY specifications and found that, although the aggregate BSAI OFL of 3.7 million mt was higher than the BSAI OY range (1.4 to 2.0 million mt), the aggregate GOA OFL of 779,000 mt was within the GOA OY range (116,000 to 800,000 mt), leading the authors to recommend that the NPFMC might consider a review of the existing OY definitions so that they could be made consistent with the MSA in a more explicit way. In a draft review of the current OY specifications, Thompson (1998) concluded, “The GOA OY specification generally fails to address protection of marine ecosystems and may fail to insure that OY does not exceed MSY. The BSAI OY specification clearly attempts to address protection of marine ecosystems (though whether the attempt is sufficient is probably debatable) and most likely insures that OY does not exceed MSY. However, the fact that neither of the OY specifications has been formally reviewed for at least 10 years may mean that they need to be reanalyzed anyway.”

MSST

As noted above, the NSGs require FMPs to specify MSST whenever possible, but the BSAI and GOA Groundfish FMPs do not specify MSST, although the status of each stock in Tiers 1-3 is examined annually in the SAFE reports with respect to the MSST definition contained in the NSGs, using $B_{35\%}$ as a proxy for Tier 3 stocks even though no such proxy is identified in the tier system, all of which has caused considerable confusion and controversy. Confusion and controversy aside, however, the lack of an FMP-specified MSST for Tiers 1-3 has had no practical impact on the management or health of the stocks. As shown by the annual examination in the SAFE reports, no stock in Tiers 1-3 has ever fallen below the MSST since the examination began in 1999. Furthermore, in the event that a stock ever did fall below the MSST, the existing maxABC control rules might very well provide an acceptable rate of rebuilding under the MSA, meaning that no change in harvest strategy would be required.

Tiers 4-6 provide a different set of problems. These three tiers apply by definition to those stocks and stock complexes for which the available information is insufficient to estimate a reference biomass level such as B_{MSY} or $B_{35\%}$, making it difficult to determine directly whether such a stock or stock complex is above its MSST. An early draft of Amendment 56 included an alternative, which identified various proxies for B_{MSY} with fewer information requirements than a direct estimate of B_{MSY} or $B_{35\%}$, but the NPFMC asked that this alternative be omitted from the final draft. Instances of a stock or stock complex moving from Tiers 4-6 to Tiers 1-3 have been few since implementation of Amendment 56.

3.1.3 Evaluation of Policy from an Ecosystem Perspective

As discussed earlier, many elements of the existing harvest strategy have implications for the ecosystem, at least indirectly, and several were adopted with EC explicitly in mind, including the BSAI OY range, the prohibition of directed fishing for forage species, and the required closure of the directed fishery for any stock of pollock, Pacific cod, or Atka mackerel that falls below $B_{20\%}$. However, the actual impacts of these measures on the ecosystem are largely unknown.

Although the present FMP policy includes the goal of developing ecosystem indicators for future use in TAC setting, the conditions under which such indicators might actually be used in the TAC-setting process are unclear. The existing policy allows TAC to be set below ABC for a wide variety of reasons including EC. In practice, however, decisions to set TAC below ABC are seldom accompanied by explicit rationale of any kind, let alone an indication of the extent to which they are due to EC.

Goodman *et al.* (2002) concluded that, while the existing system had the potential to be highly considerate of ecosystem needs, the available data could be used for a more ambitious and formalized decision system, which might be more explicitly considerate of ecosystem needs. However, the authors of the study qualified this by observing that the available data have not proven sufficient to demonstrate conclusively whether more protection is actually needed.

3.1.4 Conclusions

The existing policy is conservative overall. It has resulted in catches that have been, on average, below those that would have been obtained from a strict F_{MSY} policy, for example. However, some concern has been raised regarding certain features of the existing policy, including the following: 1) The legal adequacy of the existing OY specifications is not clear; 2) The FMPs do not specify an MSST; 3) Some of the fishing mortality rates resulting from the existing policy have been found to be too high for certain stocks in other parts of the country; 4) The impacts of the existing policy on other components of the ecosystem are evaluated on an annual basis in our TAC EAs. These TAC EAs and analysis of the status quo policy in this Programmatic SEIS have shown that target stocks are not overfished and have shown insignificant impacts of TAC on some categories of non-target species (forage, prohibited, and protected species). The EAs also acknowledge that effects are unknown for other categories of non-target species that either are not well sampled in trawl surveys or for which there is no species-level information. The ecosystem analysis presented in Section 4 discusses these components.

3.2 Alternative 2 – Adopt a More Aggressive Management Policy

In the context of the TAC-setting process, this alternative is based on the premise that the best scientific information available is typically sufficient to manage fisheries so that they achieve long-term average yields very close or equal to MSY without excessive risk to the fishery or ecosystem.

3.2.1 Description of Features Pertaining to the TAC-Setting Process

The ways in which FMPs 2.1 and 2.2 differ with respect to FMP 1 are listed below.

Structure and Composition of Management Categories

Differences under FMP 2.1: None. Differences under FMP 2.2: None.

OFL and ABC

Differences under FMP 2.1: F_{OFL} would no longer vary with biomass over any portion of the range in Tiers 1-3 and ABC would be adjusted upward so as to equal OFL in all tiers. Differences under FMP 2.2: None.

OY and TAC

Differences under FMP 2.1: OY would be specified annually as a range aggregated across all stocks and would extend from the lower end of the current range to either the sum of the OFLs or the upper end of the current range, whichever is greater. Differences under FMP 2.2: OY would be specified annually as a range aggregated across all stocks and would extend from the lower end of the current range to either the sum of the ABCs or the upper end of the current range, whichever is greater.

MSST

Differences under FMP 2.1: None. Differences under FMP 2.2: None.

Ecosystem Considerations

Differences under FMP 2.1: Directed fishing of forage species would be permitted and use of ecosystem indicators in the TAC-setting process would be prohibited. Differences under FMP 2.2: None.

3.2.2 Evaluation of Policy from a Single-Species Perspective

By making F_{OFL} independent of biomass over the entire range in Tiers 1-3 and adjusting ABC upward so as to equal OFL in all tiers, FMP 2.1 would result in higher OFLs for all stocks in Tiers 1-3 that are below their tier-specific reference levels (B_{MSY} in Tiers 1-2, $B_{40\%}$ in Tier 3) and higher ABCs for all stocks, relative to values that would be obtained under FMP 1. This change would also make it more likely for stocks to be classified as “overfished,” which would in turn require the implementation of rebuilding plans that would constrain harvest to some level lower than ABC.

By specifying OY annually as a range that can extend as high as the sum of the OFLs (under FMP 2.1) or the sum of the ABCs (FMP 2.2), Alternative 2 would allow for the possibility of higher TACs than would be permissible under FMP 1. Whether Alternative 2 would actually result in higher overall catches than FMP 1 would depend in part on a variety of factors such as the biomass of the stocks, the relationship between TAC and ABC, and the extent to which management measures other than the OY cap (PSC limits, etc.) would constrain future harvests under Alternative 2.

Also, the revisions to the OY specification proposed under Alternative 2 could give the impression that the implied MSY control rule is of the “constant F” form, an impression which would be reinforced under FMP 2.1 by the fact that the OFL control rule under this FMP is also of the “constant F” form with F set equal to F_{MSY} or an F_{MSY} proxy wherever possible. Scenarios could be imagined wherein the biomass of the groundfish complex is much lower than at present and wherein the entire OY range exceeds the sum of the catches associated with an F_{MSY} control rule, thus calling into question whether this provision of Alternative 2 would comply with the NSGs’ interpretation of the statutory relationship between OY and MSY.

3.2.3 Evaluation from an Ecosystem Perspective

By permitting directed fishing of forage species, FMP 2.1 could result in higher harvests of forage species and, indirectly, result in decreased abundance of predator species including some target groundfish species, marine mammals, and seabirds.

By prohibiting use of ecosystem indicators in the TAC-setting process, FMP 2.1 would fail to mitigate any adverse impacts on the ecosystem that might arise if such impacts could not be detected using conventional stock assessments or other single-species approaches.

In addition to the above, many of the management measures proposed under Alternative 2 and discussed previously from a single-species perspective could also have impacts from an ecosystem perspective. Under certain circumstances, these measures have the potential to result in higher catches of individual species than would occur under FMP 1. Basically, any of the management measures that would result in higher harvests would also alter the community structure of the affected ecosystem to some extent. This would occur by several mechanisms. First, higher catches would result directly in a smaller remaining biomass of the targeted stocks as well as those stocks taken as bycatch. Second, higher catches would probably be associated with higher fishing effort, which would result in greater impacts on the habitat. Third, impacts resulting from either of the first two mechanisms would tend to propagate indirectly through the ecosystem, resulting in changes in the biomass of various species, including non-target species such as marine mammals and birds. However, as discussed above, it is difficult to predict from qualitative considerations alone whether Alternative 2 would necessarily result in higher catches than FMP 1.

3.2.4 Conclusions

Alternative 2 is intended to provide a less precautionary management policy than currently exists under FMP 1. It spans a spectrum of possible approaches. One possible approach, represented by FMP 2.2, is identical to FMP 1 except for a provision that would allow the upper end of the OY range to be as high as the sum of the ABCs. FMP 2.1 represents another possible approach, one which provides greater contrast with FMP 1. Under FMP 2.1, the upper end of the OY range could be as high as the sum of the OFLs, various non-precautionary adjustments would be made to the OFL control rule and the relationship between OFL and ABC, directed fishing of forage species would be permitted, and use of ecosystem indicators in the TAC-setting process would be prohibited. While each of these features of FMPs 2.1 and 2.2 carries the potential for increased harvests relative to what might be achieved under FMP 1, it is not possible to determine whether such increases would actually be realized on the basis of qualitative considerations alone.

3.3 Alternative 3 – Adopt a More Precautionary Management Policy

In the context of the TAC-setting process, this alternative is based on the premise that the best scientific information available is typically sufficient to determine how far below MSY fisheries should be managed in order to prevent excessive risk to the fishery or ecosystem.

3.3.1 Description of Features Pertaining to the TAC-Setting Process

The ways in which FMPs 3.1 and 3.2 differ with respect to FMP 1 are listed below.

Structure and Composition of Management Categories

Differences under FMP 3.1: Sharks and skates would be removed from the Other Species category and given their own TACs, and criteria for removing other stocks from a stock complex within the Target Species category would be developed. Differences under FMP 3.2: Sharks, skates, and additional groups would be removed from the Other Species category and given their own TACs, and criteria for moving stocks from the Nonspecified Species category into another management category would be developed.

OFL and ABC

Differences under FMP 3.1: The tier system would be re-examined in light of the findings presented by Goodman *et al.* (2002), but any future changes to the tier system would continue to allow $\max F_{ABC}$ in Tier 3 to be as high as $F_{40\%}$ for any stock whose biomass is sufficiently large. Differences under FMP 3.2: Biological reference points used in the tier system would be made taxon-specific where appropriate (for example, $\max F_{ABC}$ for Tier 3 rockfish stocks could be capped at $F_{60\%}$ rather than $F_{40\%}$), and scientifically justifiable methods for adjusting $\max ABC$ to account for statistical uncertainty in various tiers would be developed, implemented, and updated as appropriate.

OY and TAC

Differences under FMP 3.1: The FMP would require that the TAC for each stock or stock complex be set no higher than the corresponding ABC. Differences under FMP 3.2: The FMP would require that the TAC for each stock or stock complex be set no higher than the corresponding ABC; OY would be specified separately for each stock or stock complex and set equal to the respective TAC.

MSST

Differences under FMP 3.1: MSSTs for stocks in Tiers 1-3 would be specified in the FMPs, the resources and time frame necessary to specify MSSTs for stocks in Tiers 4-6 would be identified, and a list of Tier 4-6 stocks prioritized for future MSST specification would be developed. Differences under FMP 3.2: MSSTs for stocks in Tiers 1-3 would be specified in the FMPs, the resources and time frame necessary to specify MSSTs for stocks in Tiers 4-6 would be identified, a list of Tier 4-6 stocks prioritized for future MSST specification would be developed, and MSSTs would be specified in the FMPs for priority stocks in Tiers 4-6 as the necessary resources become available.

Ecosystem Considerations

Differences under FMP 3.1: Criteria for future use of ecosystem indicators in the TAC-setting process would be developed. Differences under FMP 3.2: A set of ecosystem indicators would be formally adopted and used in the TAC-setting process.

3.3.2 Evaluation from a Single-Species Perspective

By developing criteria for removing stocks from a stock complex within the Target Species category, FMP 3.1 would confer added consistency on decisions regarding which stocks to manage individually. Similarly, by developing criteria for moving stocks from the Nonspecified Species category into another category, FMP 3.2 would focus attention on the possibility of conferring increased protection on individual non-target stocks for which catch is currently unconstrained by any regulatory mechanism.

By re-examining the tier system in light of the findings presented by Goodman *et al.* (2002), FMP 3.1 would provide an opportunity to make further precautionary improvements to an already-precautionary system. FMP 3.2 would go further by committing to the use of taxon-specific reference points where appropriate and by reformulating the harvest control rules in various tiers (not just Tier 1) so that greater statistical uncertainty automatically translates into an appropriately reduced $\max ABC$. Whether adoption of any of the changes to the tier system proposed under Alternative 3 would result in lower overall catches relative to FMP 1 depends on a variety of factors such as the biomass of the stocks, the relationship between TAC and $\max ABC$, and

the extent to which management measures other than the harvest control rules (OY cap, PSC limits, etc.) would constrain future harvests under FMP 1.

By making the relationship $TAC \leq ABC$ into an FMP requirement rather than just a tradition, FMPs 3.1 and 3.2 would give added assurance that this relationship will continue to hold in the future. Also, compared to FMP 1, FMP 3.2 would specify OY in a way that more clearly satisfies the single-species requirements of the MSA: If the OFL control rule is interpreted as the MSY control rule, then the relationships $OY = TAC \leq ABC < OFL$ specified under FMP 3.2 would assure that OY is always less than the catch corresponding to the MSY control rule.

By specifying MSSTs for stocks in Tiers 1-3 in the FMP, FMPs 3.1 and 3.2 would bring the FMP more clearly into compliance with the single-species requirements of the NSGs. However, because the status of each stock in these tiers is already evaluated in the SAFE reports with respect to the MSST definition contained in the NSGs, this probably would not result in any new constraints on harvests in the foreseeable future.

3.3.3 Evaluation from an Ecosystem Perspective

By removing sharks and skates from the Other Species category and giving them their own TACs, FMPs 3.1 and 3.2 would confer greater protection on these two species groups (FMP 3.2 would also remove additional groups from the Other Species category).

By developing criteria for future use of ecosystem indicators in the TAC-setting process, FMP 3.1 would clarify what additional research needs to be undertaken in order to integrate EC into the setting of TACs. FMP 3.2 would go further by moving directly to the adoption of a set of ecosystem indicators and using them in the TAC-setting process.

In addition to the above, many of the management measures proposed under Alternative 3 and discussed previously from a single-species perspective could also have impacts from an ecosystem perspective. Under the right circumstances, these measures have the potential to result in either higher or lower catches of individual species than would occur under FMP 1. Basically, any of the management measures that would result in different harvest levels would also alter the community structure of the affected ecosystem to some extent. This would occur by several mechanisms. First, different catch levels would result directly in different remaining biomasses of the targeted stocks as well as those stocks taken as bycatch. Second, different catch levels would probably be associated with different levels of fishing effort, which would result in different impacts on the habitat. Third, impacts resulting from either of the first two mechanisms would tend to propagate indirectly through the ecosystem, resulting in changes in the biomass of various species, including non-target species such as marine mammals and birds. However, as discussed above, it is difficult to predict from qualitative considerations alone whether aggregate catches obtained under Alternative 3 would be higher or lower than aggregate catches obtained under FMP 1.

3.3.4 Conclusions

Alternative 3 is intended to provide a more precautionary management policy than currently exists under FMP 1. Like Alternative 2, Alternative 3 spans a spectrum of possible approaches. Unlike the two examples considered under Alternative 2, however, both FMP 3.1 and FMP 3.2 differ from FMP 1 in a variety of ways. The “more precautionary” designation here refers to the application of a higher degree of precaution where it is needed. It should be emphasized that this is not the same thing as reducing harvest rates across the board.

For example, under Alternative 3, it might be determined that $F_{35\%}$ is a satisfactory F_{MSY} proxy for all stocks except certain rockfish, in which case a special set of control rules might be established for those rockfish while leaving the existing control rules in place for the other stocks. Thus, as the various features of Alternative 3 work together, it is possible that aggregate catches could be either higher or lower than under FMP 1, but a greater degree of protection would be afforded to the stocks that need it most, while the remaining stocks would continue to be harvested conservatively. Alternative 3 would also be more proactive than FMP 1 in terms of incorporating EC into the TAC-setting process.

3.4 Alternative 4 – Adopt a Highly Precautionary Management Policy

In the context of the TAC-setting process, this alternative is based on the premise that the best scientific information available is typically insufficient to manage fisheries so that they achieve long-term average yields anywhere close to MSY without excessive risk to the fishery or ecosystem.

3.4.1 Description of Features Pertaining to the TAC-Setting Process

The ways in which FMPs 4.1 and 4.2 differ with respect to FMP 1 are listed below.

Structure and Composition of Management Categories

Differences under FMP 4.1: Individual stocks would be removed from stock complexes within the Target Species category whenever possible. Differences under FMP 4.2: None.

OFL and ABC

Differences under FMP 4.1: The $\max F_{ABC}$ would be capped at $F_{75\%}$ for all stocks of pollock, Pacific cod, Atka mackerel, and rockfish managed under Tiers 1-3, and the $\max F_{ABC}$ for each stock or stock complex in Tiers 1-5 would be adjusted downward based on the lower bound of a confidence interval surrounding the survey biomass estimate for that stock or stock complex. Differences under FMP 4.2: None.

OY and TAC

Differences under FMP 4.1: The FMP would require that the TAC for each stock be set no higher than the corresponding ABC and would require that the TAC for a stock complex be determined by applying the appropriate maxABC control rule to each of the component stocks and then setting the TAC equal to the minimum of the resulting values; OY would be specified separately for each stock or stock complex and set equal to the respective TAC. Differences under FMP 4.2: The FMP would require that each individual TAC be set at zero unless it is proven that a higher TAC would have no adverse effect on the environment; OY would be specified separately for each stock or stock complex and set equal to the respective TAC.

MSST

Differences under FMP 4.1: An MSST would be specified in the FMP for all tiers, and would be set equal to $B_{40\%}$ for Tier 3. Differences under FMP 4.2: None.

Ecosystem Considerations

Differences under FMP 4.1: None. Differences under FMP 4.2: None.

3.4.2 Evaluation from a Single-Species Perspective

By removing individual stocks from stock complexes within the Target Species category whenever possible, FMP 4.1 would confer added protection on those stocks relative to FMP 1, because harvests of each removed stock would be limited by a stock-specific TAC rather than a complex-wide TAC.

By capping $\max F_{ABC}$ at $F_{75\%}$ for all stocks of pollock, Pacific cod, Atka mackerel, and rockfish managed under Tiers 1-3, FMP 4.1 would result in lower $\max F_{ABC}$ values for all stocks of these species managed under Tier 3, compared to FMP 1. For stocks in Tiers 1-2, the resulting $\max F_{ABC}$ values could, in principle, be either higher or lower than they would be under FMP 1; however, based on the very limited experience to date (only one stock has ever been managed under Tiers 1-2), it appears likely that they would be lower. By adjusting $\max F_{ABC}$ for each stock or stock complex in Tiers 1-5 downward based on the lower bound of a confidence interval surrounding the respective survey biomass estimate, FMP 4.1 would incorporate some amount of risk aversion into the computation of $\max F_{ABC}$ for those stocks. The resulting $\max F_{ABC}$ values for stocks in Tiers 1-5 would be uniformly lower than they would be under FMP 1. However, it is not clear what scientific justification the specific adjustment would have, and it is likely that the implied level of risk aversion would vary between stocks, even if their respective survey biomass estimates were equally precise (or imprecise). Whether adoption of either of the changes to $\max F_{ABC}$ proposed under FMP 4.1 would result in lower overall catches relative to FMP 1 depends on a variety of factors such as the biomass of the stocks, the relationship between TAC and $\max F_{ABC}$, and the extent to which management measures other than the harvest control rules (OY cap, PSC limits, etc.) would constrain future harvests under FMP 1.

By making the relationship $TAC \leq ABC$ into an FMP requirement rather than just a tradition, FMP 4.1 would give added assurance that this relationship will continue to hold in the future. By requiring that the TAC for a stock complex be determined by applying the appropriate $\max F_{ABC}$ control rule to each of the component stocks and then setting the TAC equal to the minimum of the resulting values, FMP 4.1 would confer additional protection on these stocks, because it would preclude the possibility of harvesting any individual stock within a complex at a rate greater than would be allowed if it were removed from the complex and given its own TAC. By setting OY equal to TAC, FMPs 4.1 and 4.2 would specify OY in a way that more clearly satisfies the single-species requirements of the MSA than does the OY specification contained in FMP 1: If the OFL control rule is interpreted as the MSY control rule, then the relationships $OY = TAC \leq ABC < OFL$ specified under FMP 4.1 would assure that OY is always less than the catch corresponding to the MSY control rule. By requiring that each individual TAC be set at zero unless it is proven that a higher TAC would have no adverse effect on the environment, FMP 4.2 would confer complete protection on all stocks in the Target Species and Other Species categories.

By specifying MSSTs for stocks in all tiers in the FMP, FMP 4.1 would bring the FMP more clearly into compliance with the single-species requirements of the NSGs. How this would be accomplished, however, is currently unclear. By setting the MSST equal to $B_{40\%}$ for all stocks in Tier 3, FMP 4.1 would make it much more likely that individual stocks would be declared “overfished,” even if the stocks were being harvested conservatively.

3.4.3 Evaluation from an Ecosystem Perspective

Many of the management measures proposed under Alternative 4 and discussed above from a single-species perspective could also have impacts from an ecosystem perspective. Under certain circumstances, some of these measures have the potential to result in much lower catches of individual species than might occur under FMP 1. Basically, any of the management measures that would result in lower harvests would also alter the community structure of the affected ecosystem to some extent. This would occur by several mechanisms. First, lower catches would result directly in a larger remaining biomass of the targeted stocks as well as those stocks taken as bycatch. Second, lower catches would probably be associated with lower fishing effort, which would result in fewer impacts on the habitat. Third, impacts resulting from either of the first two mechanisms would tend to propagate indirectly through the ecosystem, resulting in changes in the biomass of various species, including non-target species such as marine mammals and birds. However, as discussed above, it is difficult to predict from qualitative considerations alone whether Alternative 4 would necessarily result in lower catches than FMP 1. In the case of FMP 4.1, the impact on overall catches relative to FMP 1 would depend in part on a variety of factors such as the biomass of the stocks, the relationship between TAC and *maxABC*, and the extent to which management measures other than the harvest control rules (OY cap, PSC limits, etc.) would constrain future harvests under FMP 1. In the case of FMP 4.2, it seems safe to assume that overall catches would initially be much lower than under FMP 1, but long-term catch levels under FMP 4.2 would depend on factors such as the rate of growth in scientific understanding and the standards of proof used to determine safe harvest levels.

3.4.4 Conclusions

Alternative 4 is intended to provide a highly precautionary management policy. Like Alternatives 2 and 3, Alternative 4 spans a spectrum of possible approaches. One possible approach, represented by FMP 4.1, suggests that harvesting should proceed very cautiously in the presence of uncertainty. Another possible approach, represented by FMP 4.2, suggests that harvesting should not proceed at all in the presence of uncertainty. In the context of the TAC-setting process, FMP 4.1 proposes changes in many of the present management tools such as MSST, *maxABC*, *ABC*, TAC, and OY, whereas FMP 4.2 focuses entirely on TAC and OY. Like Alternative 3, the precautionary adjustments proposed under Alternative 4 are aimed primarily at the individual stocks while aggregate management measures such as the current OY cap are relaxed, meaning that Alternative 4 would not necessarily guarantee lower aggregate harvests than FMP 1 (although FMP 4.2 seems likely to result in lower aggregate harvests, at least in the short run). Ecosystem effects of Alternative 4 would be mediated entirely through management of individual stocks and stock complexes. No provision is made for use of ecosystem indicators in the TAC-setting process.

Section 4 Comparisons of Alternative Policies

As has been noted previously, predicting how actual catches would compare between alternatives on the basis of qualitative considerations alone is a complicated undertaking. This is partly due to the fact that each of the alternatives except FMP 1 embodies a spectrum of possible management approaches and partly due to the fact that each alternative permits a considerable degree of management flexibility. For example, although each of the alternatives sets or implies some sort of upper limit on individual TACs, none of the alternatives sets a lower limit on individual TACs, meaning that, under any of the alternatives, future individual TACs could be set anywhere between zero and some alternative-specific upper limit. Further complicating matters is the fact that, under FMPs 1, 2.1, and 2.2, it would not be possible to set the individual TACs independently of one another because their sum would be constrained by the alternative-specific aggregate OY range. Thus, while it is possible to describe how management measures differ between alternatives, predicting how these management measures will translate into catches is difficult in the absence of some sort of quantitative analysis (see Chapter 4 of the Programmatic SEIS).

Although it is difficult to predict how actual catches would compare between alternatives on the basis of qualitative considerations alone, it is possible to describe how the various constraints on harvests compare between alternatives. Evaluated qualitatively in terms of their respective constraints on harvests, the alternatives may be ranked as follows, beginning with the least precautionary and progressing to the most precautionary:

- FMP 1:** All of the existing constraints would be retained.
- FMP 2.1:** Some of the existing constraints would be relaxed.
- FMP 2.2:** All of the existing constraints would be retained, except that the upper end of the OY range would be allowed to increase.
- FMP 3.1:** Some of the existing constraints would be tightened and criteria would be developed for using ecosystem indicators as part of the TAC-setting process. MSSTs for Tier 3 stocks would be specified in the FMPs, but this probably would not result in any new constraints on harvests in the foreseeable future.
- FMP 3.2:** Some of the existing constraints would be tightened, some others would be modified in ways that are more precautionary when stocks are relatively vulnerable but potentially less precautionary under other circumstances (e.g., if a stock is shown to be highly resilient to fishing or if biomass is high), and a set of ecosystem indicators would be formally adopted and used in the TAC-setting process. MSSTs for stocks in Tiers 1-3 and some other stocks would be specified in the FMPs, but this would probably not result in any new constraints on harvests for Tier 3 stocks in the foreseeable future.

- FMP 4.1:** Some of the existing constraints would be tightened and some others would be modified in ways that are more precautionary when stocks are relatively vulnerable but potentially less precautionary under other circumstances (e.g., if biomass is high). MSSTs for all stocks would be specified in the FMPs and set equal to $B_{40\%}$ for all Tier 3 stocks, meaning that several Tier 3 stocks would be declared overfished, thus necessitating the development and implementation of rebuilding plans which could impose additional constraints.
- FMP 4.2:** All of the existing constraints would be retained, except that the constraints on OY and TAC would be tightened to an extreme degree (OY and TAC would be set equal to zero unless it is proven that a higher catch would have no adverse effect on the environment).

Finally, while there are important differences between all of the alternatives, it should be remembered that a considerable degree of commonality exists in some cases as well. For example, with respect to the five subject areas addressed in the context of the TAC-setting process (structure and composition of management categories, OFL/ABC, OY/TAC, MSST, and EC), FMPs 2.2 and 4.2 are identical to FMP 1 with respect to four (SCMC, OFL/ABC, MSST, and EC), FMP 2.1 is identical to FMP 1 with respect to two (SCMC and MSST), and FMP 4.1 is identical to FMP 1 with respect to one EC. Only FMPs 3.1 and 3.2 differ from FMP 1 with respect to all five subject areas. Looked at another way, FMP 1 is identical to at least one other alternative with respect to each of the five subject areas except OY/TAC. All of the alternatives differ from one another to some extent with respect to OY/TAC. Such commonality is expected, since each example FMP must be consistent with the MSA and NSGs.

Section 5 Literature Cited

- Clark (2002). “F_{35%} Revisited Ten Years Later.” *North American Journal of Fisheries Management* 22: 251-257.
- Dorn, M.W. (2002). “Advice on West Coast rockfish harvest rates from Bayesian meta-analysis of stock-recruitment relationships.” *Canadian Journal of Fisheries Management*. 22:280-300.
- Goodman, D., Mangel, M., Parkes, G., Quinn, T., Restrepo, V., Smith, T., and Stokes, K. (2002). Scientific review of the harvest strategy currently used in the BSAI and GOA Groundfish Fishery Management Plans. Prepared for the North Pacific Fishery Management Council, Anchorage, AK. 145pp.
- MacCall, A. D. (2002). “Use of Known-Biomass Production Models to Determine Productivity of West Coast Groundfish Stocks.” *North American Journal of Fisheries Management* 22: 272-279.
- Thompson, G.G. (1998) “Evaluation of Current OY Specifications in the GOA and BSAI Groundfish FMPs with Respect to the Requirements of the Magnuson-Stevens Act.” NMFS, Alaska Fisheries Science Center, Seattle, Washington.
- Witherell, D., Pautzke, C., and Fluharty, D. (2000). “An Ecosystem Based Approach for Alaska Groundfish Fisheries.” *ICES Journal of Marine Science* 57:771-777.

APPENDIX F

Spatial and Temporal Management of Total Allowable Catch

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Spatial and Temporal Management of Total Allowable Catch	F-2-1
1.1	Regulatory Areas	F-2-3
1.2	Suballocation	F-2-7
1.3	Apportionment to Total Allowable Catch Reserves and Community Development Quota	F-2-7
1.4	Harvest Specifications and Initial Total Allowable Catch Allocation	F-2-8
1.5	In-Season Management	F-2-10
1.6	Historical Summary of Major Fishery Management Plan Amendments Establishing Current Spatial/Temporal Management Measures	F-2-10
1.7	Challenges in Seasonal Distribution and Apportionment of Target Species	F-2-16
Section 2	Analysis of Alternatives	F-2-22
Section 3	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-2-24
3.1	Gulf of Alaska Management Area	F-2-24
3.2	Gulf of Alaska Stocks	F-2-24
3.2.1	Stocks Managed Gulf-Wide	F-2-24
3.2.2	Gulf of Alaska Stocks Managed in the Southeast Outside District	F-2-25
3.2.3	Gulf of Alaska Stocks which are Managed in Western, Central and Eastern Districts	F-2-25
3.2.4	Gulf of Alaska Stocks Managed Spatially in Western, Central and East, Where the Eastern District is Further Subdivided into West Yakutat and East Yakutat/Southeast Outside	F-2-26
3.2.5	Gulf of Alaska Stocks Managed Spatially in Western, with Central Subdivided Further into Area 620, Area 630 and Eastern Districts with East Subdivided into West Yakutat and East Yakutat/Southeast Outside	F-2-27
3.3	Bering Sea and Aleutian Island Stocks	F-2-27
3.3.1	Bering Sea and Aleutian Islands Stocks Managed Bering Sea and Aleutian Islands-Wide	F-2-27
3.3.2	Bering Sea and Aleutian Islands Stocks Managed in the Aleutian Islands only (Aleutian Islands Split by Eastern, Central, Western)	F-2-28
3.3.3	Bering Sea and Aleutian Islands Stocks Managed with Spatial Split between the Bering Sea and Aleutian Islands	F-2-29
3.3.4	Bering Sea and Aleutian Islands Stocks Managed between Bering Sea and Aleutian Islands (with Aleutian Islands split Eastern, Central, Western)	F-2-29
3.3.5	Bering Sea and Aleutian Islands Stocks Managed with Bering Sea Split Out between Eastern Bering Sea and Bogoslof Regions, and Aleutian Islands (Managed Aleutian Islands-Wide)	F-2-30
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-2-32

TABLE OF CONTENTS (continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	This page intentionally left blank.	
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-2-33
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-2-36
6.1	Fishery Management Plan 4.1 Management Measures	F-2-36
6.1.1	Spatial Measures	F-2-37
6.1.2	Temporal Measures	F-2-37
Section 7	Comparative Analysis of Alternatives	F-2-39
Section 8	References	F-2-40

TABLES

Table 1.	Restrictions on the Bering Sea and Aleutian Islands other flatfish fishery from 1994 to 2002.	F-2-2
Table 2.	Bering Sea and Aleutian Islands pollock specifications (metric tons)	F-2-38

FIGURES

Figure 1.	Bering Sea and Aleutian Islands statistical and reporting areas.	F-2-4
Figure 2.	Gulf of Alaska statistical and reporting areas.	F-2-5
Figure 3.	Shelikof Strait regulatory areas	F-2-6
Figure 4.	The original five Gulf of Alaska management areas	F-2-13
Figure 5.	The Alaska Department of Fish and Game and NOAA Fisheries jointly manage the East Yakutat (EYK), north-southeast Outside (NSEO), central-southeast Outside (CSEO), and south-southeast Outside sections (SSEO), which comprise the southeast Outside Subdistrict (SEO). The north-southeast inside (NSEI) and south-southeast Inside (SSEI) areas are managed entirely by Alaska Department of Fish and Game.	F-2-15
Figure 6.	Ternary plot of the seasonal biomass distribution of walleye pollock in the Gulf of Alaska.	F-2-18

ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
BSAI	Bering Sea and Aleutian Islands
BSPRA	Bering Sea Pollock Restriction Area
CDQ	community development quota
CFR	code of federal regulations
CSEO	central southeast inside
CVOA	catcher vessel operational area
DAP	domestic annual processor
DSR	demersal shelf rockfish
EBS	eastern Bering Sea
EYAK	east Yakutat
FMP	Fishery Management Plan
FR	Federal Register
GOA	Gulf of Alaska
GSO	General Service Office
IFQ	individual fishing quotas
IPHC	International Pacific Halibut Commission
ITAC	interim total allowable catch
JV	Joint Venture
LLP	License Limitation Program
MRB	maximum retainable bycatch
mt	metric tons
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NRC	National Research Council
NSEO	north southeast outside
OFL	overfishing level
OY	optimum yield
PSC	prohibited species catch
SAFE	Stock Assessment and Fishery Evaluation
SCA	Steller sea lion Conservation Area
SEI	southeast inside
SEO	southeast outside district
SSC	Scientific and Statistical Committee
SSEO	south southeast outside
TAC	total allowable catch
WYAK	west Yakutat

This page intentionally left blank

Section 1 Spatial and Temporal Management of Total Allowable Catch

The spatial and temporal nature of the target fisheries in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) is determined by a complex management structure which accounts for biological, socioeconomic, and conservation concerns. The term “spatial” refers to how fisheries are managed over a geographic area. The term “temporal” refers to the timing of fisheries over the course of a year. Total Allowable Catch (TAC) is managed by target species, and allocation of TAC ranges from year-round and area-wide to relatively small spatial and temporal scales. The vulnerability of the stocks to fishing pressure, the bycatch of non-target species, socioeconomic concerns, as well as the degree of available scientific information about an individual stock all play a role in determining the scale (e.g., broadly or minutely) at which the TAC for individual stocks are managed.

The fisheries and groundfish resources of the BSAI and GOA¹ form distinct management units. These two regions differ in their history of fishery development, bathymetry, oceanography, target species, and the composition of the commercial catch. While many species occur over a broader range than the GOA or BSAI regions, stocks of common species in the GOA and BSAI are believed to be different than in adjacent regions (NPFMC 2002b).

The measures authorized for management of groundfish in the BSAI and GOA under the approved Fishery Management Plans (FMP) fall into two categories: framework measures and conventional measures. Framework measures are ones which often require adjustment on an annual basis, such as the setting of the annual yield to fall with an optimum yield range. These types of measures are administratively designed to allow the North Pacific Fishery Management Council (NPFMC) to respond rapidly to biological or socioeconomic changes within a fishery without having to amend the plan. Conventional measures, on the other hand, are specifically in their application and can only be altered by a formal amendment to the plan. These measures include permits, reporting requirements, gear restrictions, and allocations. Most of the current measures which implement the spatial and temporal management of the BSAI and GOA groundfish fisheries are conventional measures implemented through amendments to the FMPs.

Spatial and temporal management of TAC has evolved over time through these FMP amendments as different issues have been resolved by the NPFMC that required modification of various fisheries. These issues range in breadth and scope but generally fall into two categories of rationale: economic concerns and biological/conservation concerns. Some economic grounds for managing TAC in space and time include reducing competition between fisheries, dispersing the fishery in time, and increasing the access to the fishery resources for specific communities. Many early actions by NPFMC specifically dealt with allocation issues between certain fleets; for example, to allocate between foreign and domestic fleets, and later between inshore and offshore fleets. Other actions were specifically to disperse the fishery in space and time both to control the symptoms of the race for fish as well as to decrease bycatch in certain areas, as exceeding bycatch limits results in the closure of a fishery prior to reaching the target fishery TAC.

¹Excluding halibut which is managed by the International Pacific Halibut Commission (IPHC).

Biological and conservation concerns drive other spatial and temporal management decisions. Often when information on the impact on a stock is unknown, a precautionary response is to manage on smaller spatial and temporal scales in order to avoid the potential for localized depletion. This is particularly true during spawning seasons. Pollock is one of the key prey species in the BSAI and GOA, and specific spatial and temporal measures in both regions are intended to disperse the pollock fishery in space and time in order to avoid the potential for impacts on the endangered Steller sea lion. Prohibited species catch (PSC) are also allocated in space and time in order to protect small, localized populations of prohibited species (e.g., salmon, herring, crab), and target fisheries are closed when these caps are exceeded (Table 1).

Table 1. Restrictions on the Bering Sea and Aleutian Islands other flatfish fishery from 1994 to 2002.

Year	Dates	Bycatch Closure
1994	2/28 – 12/31 5/7 – 12/31 7/5 – 12/31	Red King crab cap (Zone 1 closed) Bairdi Tanner crab (Zone 2 closed) Annual halibut allowance
1995	2/21 – 3/30 4/17 – 7/1 8/1 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1996	2/26 – 4/1 4/13 – 7/1 7/31 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1997	2/20 – 4/1 4/12 – 7/1 7/25 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1998	3/5 – 3/20 4/21 – 7/1 8/16 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1999	2/26 – 3/30 4/27 – 7/04 8/31 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2000	3/4 – 3/31 4/30 – 7/03 8/25 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2001	3/20 – 3/31 4/27 – 7/01 8/24 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2002	2/22 – 12/31 3/1 – 3/31 4/20 – 6/29 7/29 – 12/31	Red King crab cap (Zone 1 closed) First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance

Note that in 1994, the other flatfish category included flathead sole. Unless otherwise indicated, the closures were applied to the entire BSAI management area. Zone 1 consists of areas 508, 509, 512, and 516, whereas zone 2 consists of areas 513, 517, and 521.

Source: Spencer *et al.* 2002

Managing TAC in space and time requires an in-depth knowledge of each stock biology and migratory patterns, and the relative impact that fishing will have on the stock biology. Often the knowledge of biomass distribution and migratory patterns is inadequate and the relative impact of fishing on these stocks is often unknown. Unlike many of the other issues under discussion in this Programmatic SEIS, there is no specific policy objective that relates spatial and temporal to our current management of TAC. The current management of TAC has evolved over time in response to changes in the fishery, both biologically and socioeconomically. Each action or amendment was intended to respond to a specific need, thus there was a specific individual objective to achieve for each subsequent change to the FMP. Thus, spatial and temporal effects are management outcomes, rather than being a policy goal or objective, per se. This will be discussed further in the sections regarding the FMP amendments; however, current management practices do not follow an overarching spatial and temporal management objective.

Our current management of TAC in space and time is a reflection of these combined amendments to the FMPs. In each amendment, spatial and temporal management of TAC is a tool by which specific objectives are intended to be achieved. Spatial and temporal management measures are implemented on a stock-by-stock basis according to concerns as they arise, not in accordance with an actual policy direction to manage in space and time. Similarly, across alternatives, while some measures change in the bookends of each alternative, these are measures which reflect a change in overall management policy but not a change according to a specific policy for spatial and temporal management of TAC. It is a management tool that is used to achieve often competing objectives and is thus not considered as a policy objective in and of itself.

The intent of this paper is to provide a broad overview of the current rationale behind the spatial and temporal management of TAC for target groundfish stocks in the BSAI and GOA FMPs. There will also be an examination of alternative measures for formalizing and expanding upon spatial temporal management of target stocks and the research and data needs which would be necessary in order to do so.

1.1 Regulatory Areas

Fishing areas correspond to the defined regulatory areas within the fishery management units. The BSAI is divided into 16 reporting areas (Figure 1), some of which are combined for TAC specification purposes. The Bering Sea subarea comprises all of the regulatory areas except the three Aleutian Island areas (543, 542, 541). The Bogoslof District is area 518. The eastern Bering Sea (EBS) as a regulatory region includes all of the regulatory areas in the Bering Sea region except for the Bogoslof District (area 518). The EBS is managed as a regulatory region separate from the Bering Sea region for EBS pollock. All other stocks, regardless of whether the stock is described as being in the EBS, are managed Bering Sea area-wide, indicating that the regulatory area incorporates all of the regions including area 518. The Aleutian Islands subarea is comprised of regulatory Area 541 (eastern Aleutian Islands), 542 (central Aleutian Islands), and 543 (western Aleutian Islands).

The GOA is divided into seven reporting areas (Figure 2): the western GOA is Area 610, the central GOA includes Areas 620 and 630, and the eastern GOA includes Areas 640 and 650. Area 640 is the West Yakutat District (WYAK) while area 650 is known as the East Yakutat/southeast Outside District (EYAK/SEO). For demersal shelf rockfish (DSR) management only, area 650 is further subdivided into subareas: East Yakutat (EYAK), north southeast Outside (NSEO), central southeast Outside (CSEO) and south southeast Outside (SSEO). Area 649 are state waters in Prince William Sound, while Area 659 encompass state waters within southeast Alaska. The Shelikof Strait District is a specific sub-management district for GOA pollock only (Figure 3).

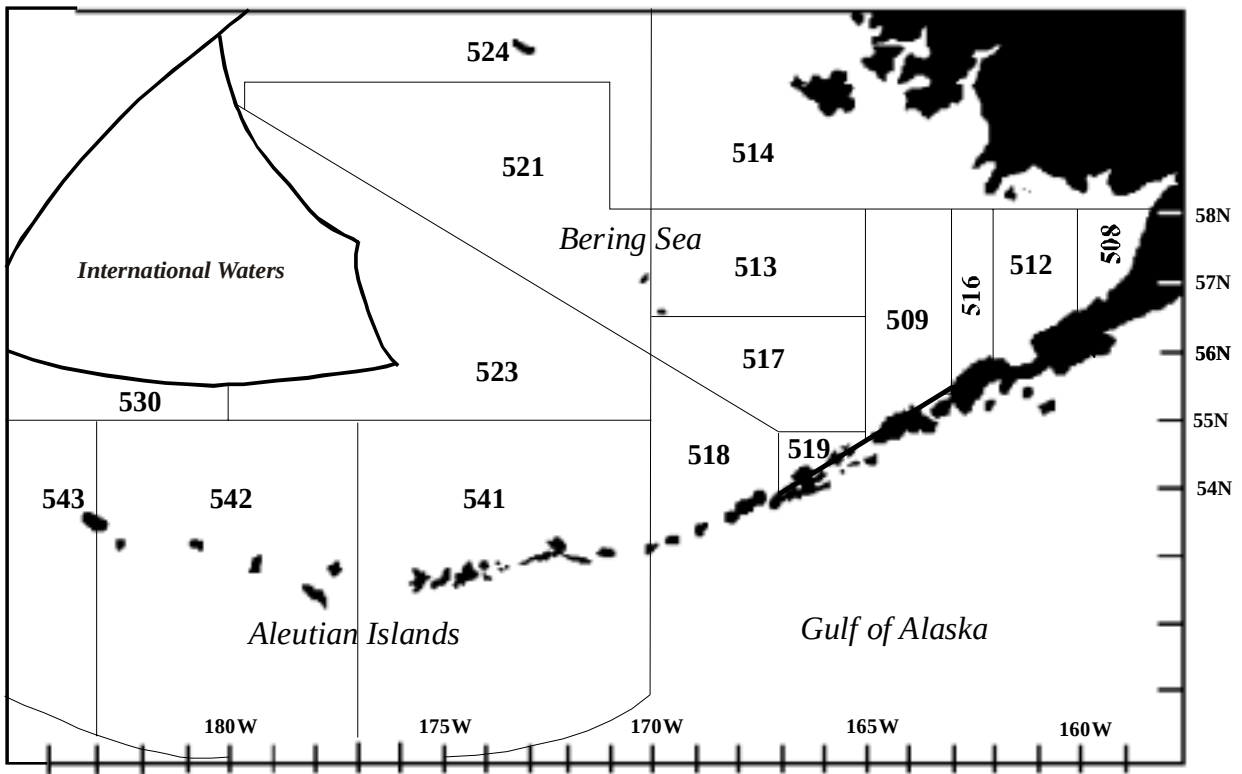


Figure 1.6-2 Bering Sea and Aleutian Islands statistical and reporting areas.

Figure 1. Bering Sea and Aleutian Islands statistical and reporting areas.

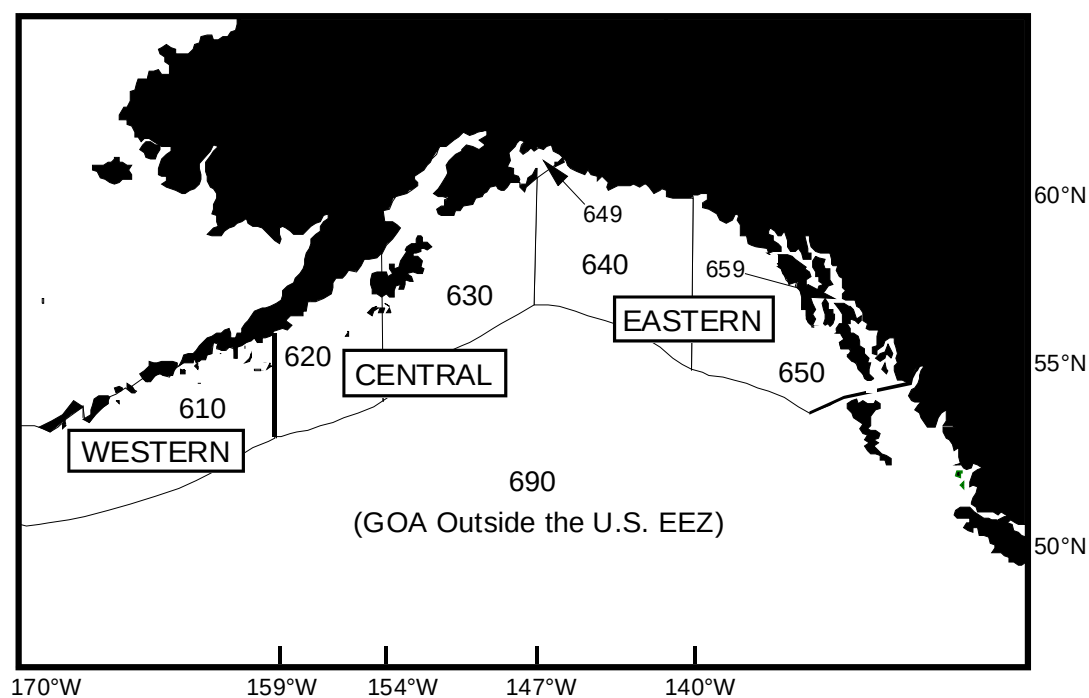
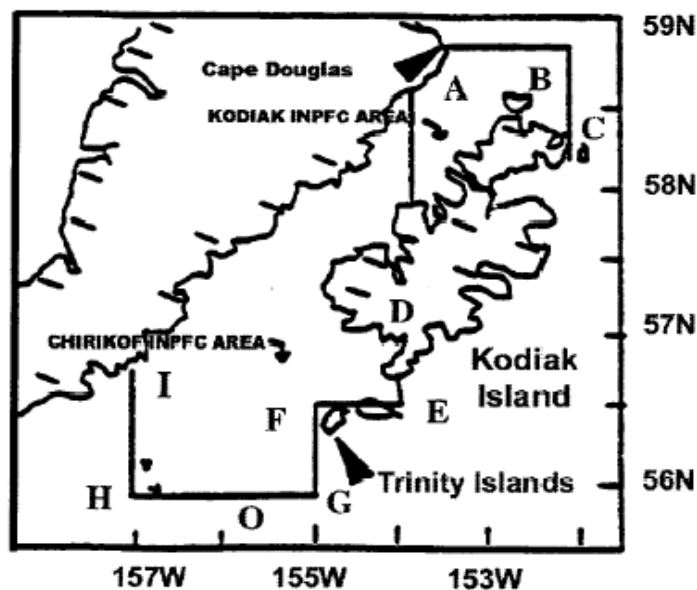


Figure 1.6-3 Gulf of Alaska statistical and reporting areas.

Figure 2. Gulf of Alaska statistical and reporting areas.



Boundaries of the Shelikof Strait District in the Gulf of Alaska.

The Shelikof Strait District means all waters of the EEZ enclosed by a line connecting the following points in the order listed:

<u>Reference point</u>	<u>N. Lat.</u>	<u>W. Long.</u>	<u>Description</u>
A	58°51' N.	153°15' W.	Cape Douglas then south to the intersection of 152°00'W. with Afognak Island, then counter clockwise around the western shorelines of Afognak, Kodiak, and Raspberry Islands to
B	58°51' N.	152°00' W.	
C			
D	57°00' N.	154°00' W.	Alitak Bay then south to then west through Trinity Islands to then south to
E	56°30' N.	154°00' W.	
F	56°30' N.	155°00' W.	
G	56°00' N.	155°00' W.	then west to
H	56°00' N.	157°00' W.	then north to
I			Intersection of 157°00'W. with the Alaska Peninsula.

Figure 3. Shelikof Strait regulatory areas. Source: Gulf of Alaska Fishery Management Plan.

1.2 Suballocation

Suballocations of TAC and PSC limits are made for biological and socioeconomic reasons according to percentage formulas established through FMP amendments. For particular target fisheries, TAC specifications are further allocated within regulatory areas (eastern, central, western Aleutian Islands; Bering Sea; western, central, and eastern GOA) among management programs (open access or community development quotas [CDQ] program), processing components (inshore or offshore), specific gear types (trawl, non-trawl, hook-and-line, pot, jig), and seasons according to regulations 50 Code of Federal Regulations (CFR) 679.20, 50 CFR 679.23, and 50 CFR 679.31.

Suballocations of TAC to the various gear groups, management areas, and seasons are made according to regulation-driven formulas or, for discretionary allocations, according to Secretary of Commerce-approved specifications. The National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) uses in-season management authority to open and close the fisheries (50 CFR 679.25). The entire TAC amount is available to the domestic fishery (50 CFR 679.20). The gear authorized in the federally managed groundfish fisheries off Alaska includes trawl gear, fixed-gear, longline gear, pot gear, and non-trawl gear (50 CFR 679.2 Authorized Fishing Gear). TAC is allocated amongst these gear types, and specific allocation by gear types varies by target fishery and region.

1.3 Apportionment to Total Allowable Catch Reserves and Community Development Quota

TAC Reserves

A groundfish reserve is established at the beginning of each fishing year. This reserve amount of TAC is equal to the sum of 15 percent of each target species and the other species TAC in the BSAI Pacific cod, flounders and other species in the GOA. This TAC reserve is set aside by the NPFMC prior to the beginning of the fishing year. This reserve is used for: (NPFMC 2002a):

1. Unexpected expansion of the domestic fishery.
2. Correction of operational problems of the domestic and foreign fishing fleets, promoting full and efficient use of the groundfish resources.
3. Adjustments of species TACs according to the condition of stocks during the fishing year.
4. Apportionments.

This TAC reserve is not designated by species or species groups and will be apportioned to the fishery during the fishing year by the Regional Administrator of NOAA Fisheries (NPFMC 2002b). The Regional Administrator will determine the appropriate amounts and species for allocation, consistent with the most recent stock assessments of the individual resource conditions unless socioeconomic concerns and/or specific fishery operational problems are determined to dictate otherwise (NPFMC 2002b). The Regional Administrator may also withhold reserves for conservation reasons.

CDQ Allocation

Of the total TAC, the CDQ Program in the BSAI is allocated 10 percent of the allowable catch for pollock; 7.5 percent of all other groundfish, except 20 percent of fixed gear allocation for sablefish; and 7.5 percent for prohibited species (50 CFR 679.31). The rest of the TAC is then apportioned to directed fishery or bycatch reserve according to spatial and temporal management measures that apply.

1.4 Harvest Specifications and Initial Total Allowable Catch Allocation

The fishing year coincides with the calendar year, January 1 to December 31 (50 CFR 679.2 and 679.23). Depending on the target species' spatial allocation (detailed below in the fisheries descriptions), additional specifications are made to particular seasons (quarters of the year or combinations of quarters) within the year. Fisheries are opened and closed by regulatory announcement. Closures are made when in-season information indicates the apportioned TAC or available PSC has been or will soon be reached, or at the end of the specified season if the particular TAC has not been taken (50 CFR 679.25).

Rules to establish harvest specifications are required for harvest in these federal groundfish fisheries to resume from one fishing year to the next. Specifying TAC and PSC limits follows the fishery regulation rule-making process. To conform with rule-making requirements, three separate rules are published per management area, per year. The published rules are, sequentially, 1) proposed specifications, 2) interim specifications, and 3) final specifications. This three-part process has been in place, with various refinements, since implementation of the FMPs. The process is explained in more detail below and in Appendix F-1, TAC-Setting Process qualitative assessment.

Proposed Specifications

Proposed acceptable biological catch (ABC), TAC, and PSC² specifications are typically recommended by the NPFMC at its October meeting and published in the *Federal Register* (FR) for public review and comment. The recommendations are based on the preliminary Stock Assessment and Fishery Evaluation (SAFE) reports prepared by the NPFMC's GOA and BSAI Groundfish Plan Teams during and subsequent to their September meetings. Any new data on stock levels obtained from the previous summer's surveys are generally not yet in a useable form; therefore, the proposed specifications are based on previous year's data. At their 2002 September meeting, the plan teams recommended using a new approach for proposed specifications. This new approach used the 2001 SAFE Report model projections for 2003 preliminary and interim specifications for groundfish stocks at Tier 3 or above and incorporated updated 2002 catch estimates rather than assuming that the catch is equal to the ABC as in previous years. This procedure is more in line with the intention to recommend preliminary and final specifications most likely to approximate the final specifications that will be recommended in November.

²BSAI crab and herring and GOA halibut only; BSAI PSC limits for halibut and salmon are established in regulations (50 CFR 679.21.)

Occasionally, given evidence of imminent population changes, recent data may be used to recommend proposed specifications (which may be different from the previous year's data). For example, in 2002, exploratory model results for GOA pollock using recent Shelikof survey data indicated a continuing decline of adult pollock. However, the model fit to the survey data at this time was poor and the model was unable to match the steep decline indicated by the survey results. While this was only a preliminary indication of stock decline, the stock assessment author was concerned regarding the stock status. At the October NPFMC meeting, the Scientific and Statistical Committee (SSC) concurred with the stock assessment author's recommendation and established the preliminary ABC as a rollover of the previous year's ABC for pollock. This represented a more conservative preliminary ABC than would have been recommended based upon the newly approved procedure in establishing preliminary ABCs. Preliminary SAFE reports are incorporated into the environmental analysis accompanying the proposed specifications rule.

Interim Specifications

Interim TAC specifications are mathematical determinations using the proposed specifications according to implementing regulations 50 CFR 679.20(c)(2). These regulations authorize one-fourth of each proposed interim total allowable catch (ITAC) and apportionment thereof, one-fourth of each PSC allowance, and the first seasonal allowance of GOA and BSAI pollock and BSAI Atka mackerel to be in effect on January 1 on an interim basis and to remain in effect until superceded by final specifications. NMFS publishes the interim specifications in the FR as soon as practicable after the October NPFMC meeting. There are some exceptions to setting interim specifications in this manner. For instance, retention of sablefish with fixed gear is not currently authorized under interim specifications. Further, existing regulations do not provide for an interim specification for the CDQ non-trawl sablefish reserve or for an interim specification for sablefish managed under the individual fishing quota (IFQ) program.

While interim specifications are superceded by final specifications, depending on the stock, the interim specification can be used to specify the TAC for the first seasonal allocation. Depending upon the timing of final specifications and the fishery, the entire allotted TAC can be taken before the final specifications supercede the preliminary specifications. Thus, if preliminary specifications are set too high or too low, it can severely impact the fishery in the first season.

In the case of the 2002 GOA pollock, the preliminary specifications were recommended as if the stock showed an increased decline at the time of final specifications. With the regulatory system in place, the entire resulting Season A interim TAC could have been taken before the final TAC, based on the most recent data that was in place. In some cases if the preliminary (and then interim) specification is too high compared to the final specification, this could result in the overfishing of a stock during the first seasonal allocation.

Final Specifications

Final TAC and PSC specifications are recommended by the NPFMC at its December meeting. The recommendations are based on SAFE reports prepared by the NPFMC's GOA and BSAI Groundfish Plan Teams during and subsequent to their November meetings. Final SAFE reports are incorporated into the environmental analysis accompanying the final rule (NMFS 2003a).

NOAA Fisheries packages the NPFMC recommendations into proposed or final rule specification documents and forwards them to the Secretary of Commerce for approval. Secretarial approval of final specifications usually occurs by March for the subject fishing year. Upon approval, the new TAC specifications replace the preliminary TAC specifications (50 CFR 679.20(c)(3)).

There is progress underway towards revising the TAC-setting process under Amendments 48/48. Under the current process there may be inadequate time allotted for the public to comment on the proposed specifications prior to the start of the fishery. (Under consideration are alternatives to the current process: publishing final specifications based on two-year stock projections; issuing specifications every two years; and changing the start of the fishing year from January to July.) Additional proposed alternatives may also be considered depending upon a legal assessment of their adequacy in satisfying the requirements of Administrative Procedure Act. Final action on these amendments should be taken by the NPFMC in April or June, 2003.

1.5 In-Season Management

While TACs are established by the NPFMC based upon the best biological, ecological, and socioeconomic information available, circumstances arise on occasion whereby new information or data relating to stock status may become available and established harvest quotas or limits may need to be adjusted. These adjustments are accomplished by the NOAA Fisheries Regional Administrator in consultation with the agency's in-season management staff. Using all available information, the Regional Administrator may extend, open, or close fisheries in any or part of a regulatory area, or restrict the use of any type of fishing gear in order to conserve the resource. The Regional Administrator may also change any previously specific TAC or PSC limit if such are proven to be incorrectly specific on the basis of the best available scientific information on biological stock status (NPFMC 2002b).

In-season adjustments may be necessary to prevent either the overfishing of any species or stock of fish (including those for which PSC limits are set) or the harvest or closure of any groundfish TAC or PSC limit that may have been improperly specified (NPFMC 2002b). The Regional Administrator must first consider the least restrictive adjustments to the fishery in his or her choice of management responses to potential overfishing. The order in which the Regional Administrator must consider in-season adjustments to prevent over-fishing are specified as 1) any gear modification that would protect the species in need of conservation protection but which would still allow fisheries to continue for other species; 2) a time/area closure which would allow fisheries for other species to continue in non-critical areas and time periods; and 3) total closure of the management area and season (NPFMC 2002b).

1.6 Historical Summary of Major Fishery Management Plan Amendments Establishing Current Spatial/Temporal Management Measures

There is a long history of enacting measures for spatial and temporal management of TAC and gear and fishery allocations in the BSAI and GOA fisheries. The FMPs were instituted in 1978 and 1981, respectively, and both the original FMPs as well as many subsequent amendments have dealt sequentially with time and area restrictions as needs have arose. The following provides a brief list of many of these amendments, which were instituted to respond to a specific problem, and have subsequently evolved over time. This is not a comprehensive list of every amendment that had an allocative result, but synthesizes many (together with some additional regulations) that set the stage for the spatial and temporal management as it is currently

pursued. The amendments are listed with their initial rationale as stated in their respective environmental impact analyses. An attempt is made to discuss first the BSAI amendments and then the GOA amendments. Although they are often discussed together in the FMPs, in some instances they are discussed as combined amendments in the text. The actual cumulative impacts of the amendments are not given here, only the intent of each individual amendment. More information on the cumulative impacts of these amendments may be found in Section 4.5.10 under Alternative 1. Most FMP amendments were multi-purpose in their intent, thus not all aspects of the amendments are discussed here. The emphasis is on the spatially and temporally relevant aspects of each amendment.

BSAI Amendment 11, implemented in 1987, enacted a split-season apportionment of Joint Venture (JV) pollock vessels. This amendment had both socioeconomic as well as conservation rationale behind it. It was an early amendment to the FMP to reduce the competitive disadvantage placed on domestic annual processors (DAP). This amendment also changed policy by prohibiting roe-stripping and reduced the concentration of the pollock harvest during the winter spawning season. While there was limited data at the time on the spawner-recruit relationship for pollock, there was a general consensus that prudent management by the NPFMC would require some limit on the harvests on spawning aggregations to alleviate the risk of reducing the stock's reproductive capacity. From an economic standpoint, it was more beneficial to the domestic industry to have exclusive access to the grounds during one month of spawning season. This amendment was limited to two years, in order for proper evaluation of the stock status and regime.

BSAI Amendment 12a, implemented in 1989, replaced Amendment 10 and revised the PSC limits for crab and halibut. Under this amendment, PSC limits were allocated among flatfish and other fisheries. Amendment 16 modified Amendment 12a by allowing for seasonal apportionments of the PSC caps, as well as by adding the DAP rock sole, DAP sablefish and turbot fisheries to those fisheries already managed under the PSC caps. This allowed for greater flexibility in managing bycatch more equitably and efficiently.

BSAI Amendment 13, implemented in 1990, allocated sablefish by gear type, dividing the TAC into fixed- and trawl-gear allocations for the Bering Sea (50/50) and Aleutian Islands (75/25). This amendment also established a procedure to set annual fishing seasons by regulatory amendment. The administrative aspect of this amendment was instituted to allow the NPFMC to respond more efficiently to an increasingly complex suite of management options that effect the timing of the various fisheries. In the GOA, this administrative procedure was established by Amendment 18. Amendment 13 also clarified the Secretary's authority to split or combine species groups within the target species management category by a framework procedure.

BSAI Amendment 14, FMP implemented in 1991, set forth a seasonal allowance schedule for pollock. While the impact of concentrated fishing on the stocks during spawning season was still unknown, it was deemed precautionary to mitigate against possible impacts by spreading out the pollock catch over a number of seasons. Pollock seasons were divided into roe-bearing and non roe-bearing seasons, with the percentage of the TAC allocated to each, determined during the annual TAC-specifications process.

BSAI Amendments 16a and 17, implemented in 1991 and 1992, respectively, again dealt with the BSAI pollock fishery. Amendment 16a specified the allocation of pollock TAC to bottom trawl in order to control crab and halibut bycatch. Amendment 17 established the Bogoslof Subarea District (area 518) in order to allow for specific management of the pollock fishery in this region during the roe season. The Bogoslof area, the new reporting area 518, was established as the section of area 515 west of 167 West longitude in order to allow for a separate TAC for pollock in this smaller region. The remainder of area 515 was designated as the new area 519. This area does not have a separate TAC for pollock and is instead combined with the other

reporting areas to make up the Bering Sea area for TAC allocation. The seasonal closures around the Walrus Islands were also permanently established under this amendment and occur from April 1-September 30.

BSAI Amendment 19, which supplemented Amendment 16, was implemented in 1992. This amendment, among other things, delayed the start of all trawl fisheries until January 20 with the exception of flatfish, which would begin May 1. This was done to address the high amounts of salmon bycatch and to address problems with bycatch in the pollock roe fishery as well as to reduce average bycatch rates for halibut. Also under this Amendment 19, allocations of PSC limits were respecified by more specific trawl fisheries and groups. This allowed for increased equity and accountability as the “other trawl” fisheries would also close down when their limit was reached. Prior to that, only bottom trawl pollock and Pacific cod closed when the PSC limits were reached. Similarly, under BSAI Amendment 21, the Regional Administrator is authorized to apportion non-trawl PSC limits by specific fishery categories; to apportion them seasonally; and, to exempt some non-trawl fisheries from PSC limits when appropriate.

BSAI Amendment 24, implemented in 1994, established seasonal allocations for Pacific cod by trimester for longline and pot gear only. These seasons were January to May, June to August, and September to December. This helped to decrease the halibut bycatch mortality. Amendment 46 further decreased bycatch mortality by allocating Pacific cod across gear types.

BSAI Amendment 28, implemented in 1993, divided the Aleutian Island management area into three districts for spatially allocating TAC (Figure 1). These districts are east (area 541), central (area 542), and west (area 543). This spatial division of the Aleutian Islands into three districts allowed for harvesting of potential TAC for species exhibiting limited movement (i.e., Atka mackerel) while mitigating against the potential for localized depletion.

BSAI Amendment 53, implemented in 1998, allocated shortraker/rougheye rockfish between the trawl and non-trawl gear sectors in the Aleutian Islands. Prior to this amendment, excessive bycatch of shortraker and rougheye in the Pacific ocean perch and Atka mackerel trawl fisheries would close those fisheries.

In the GOA, the initial FMP established five statistical areas over which the optimum yield was apportioned (Figure 4 Original 5 Areas). Under GOA Amendment 4, this was decreased to three in order to alleviate operational problems with maintaining these areas. These areas were named the western, central and eastern regulatory areas (Figure 2). Creation of the present day SEO/EYAK District area and WYAK District area was accomplished through a combination of four subsequent amendments: Amendments 8, 11, 14, and 22. Under Amendment 8, the eastern GOA was subdivided into three different districts: Yakutat, SEO (outside 3 miles), SEI (inside 3 miles). This was done to prevent localized depletion of sablefish. This amendment also redistributed the other species category GOA-wide (from distribution over management areas due to insufficient data available for management at smaller spatial scales), and established a non-specified species category.

GOA Amendment 11 further subdivided the Yakutat District into EYAK and WYAK Districts. This was done in order to better manage sablefish stocks by encouraging fishermen to extend their efforts over a wider area. Catch reporting in each district would enable more conservative management of local stocks. Under this amendment the area between 137° to 140°W was called the EYAK District (area 68) and 140° to 147°W is WYAK District.

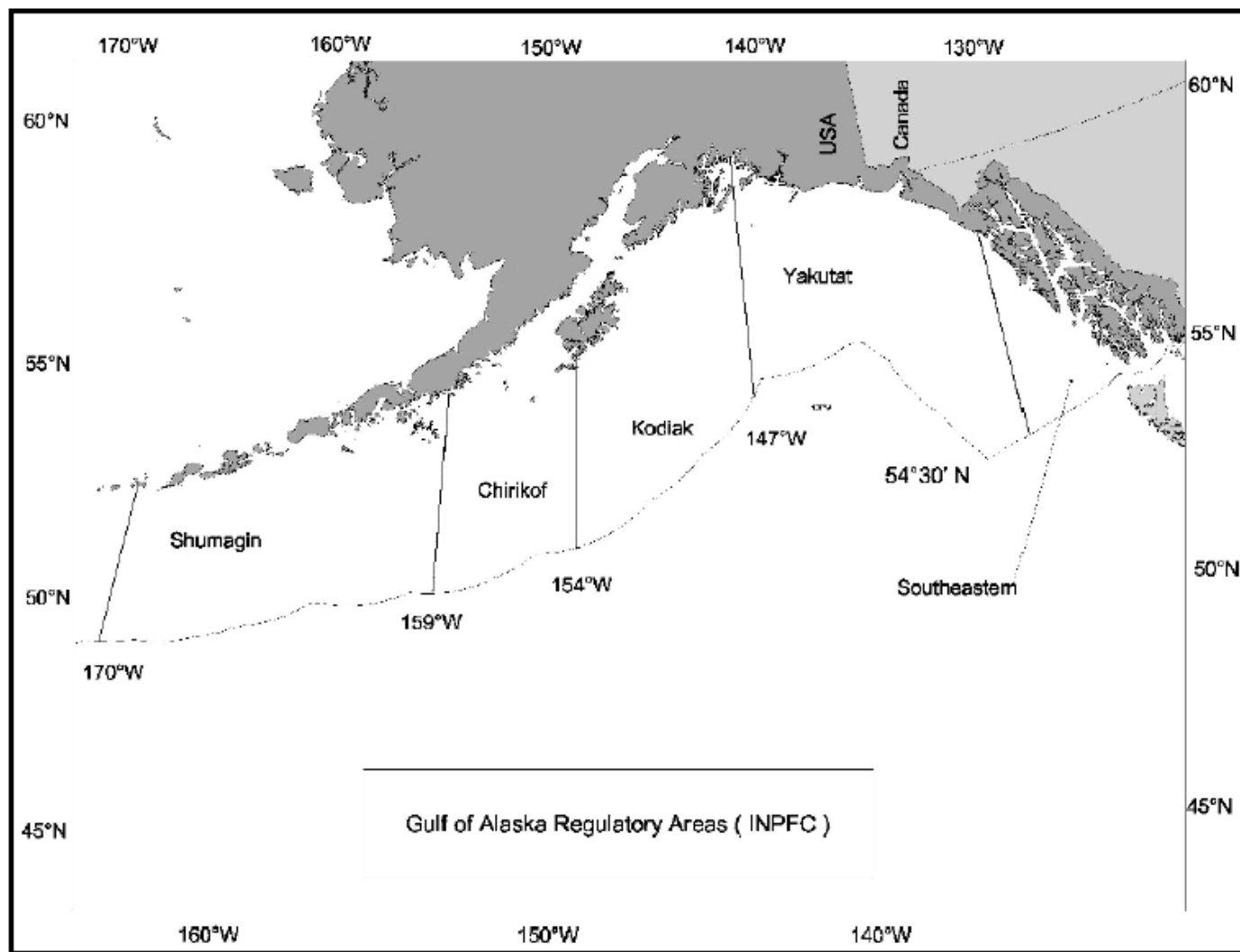


Figure 4. The original five Gulf of Alaska management areas.

GOA Amendment 14 defined a new regulatory district for better managing DSR (Figure 5). This new regulatory district was called CSEO District, located between 56°W and 57° 30'W. Amendments 17/22 collectively established a separate statistical area around the area of Bogoslof Island in BSAI, established closures around the Walrus Islands in northern Bristol Bay in BSAI and rescinded GOA statistical area 68, EYAK District. Area 68 was not deemed necessary for fishery conservation and management and was therefore imposing unnecessary record keeping and recording costs. Practically NOAA Fisheries had been managing the two districts, EYAK and SEO as a single, combined district since 1984. In 1987, a single harvest quota was established for these combined districts (52 FR 785, January 9, 1987).

GOA Amendment 22 simply formalized this by rescinding area 68 and making East Yakutat and southeast Outside a single, combined district for record keeping and recording purposes (Figure 5).

GOA Amendment 58 in 1998 prohibited trawling in the eastern GOA, in waters east of 140°W longitude. This trawl closure in the eastern GOA was instituted to preserve the small vessel fixed-gear fishery in this SEO region while the License Limitation Program (LLP) was being instituted in the GOA and BSAI. The closure also protects vulnerable rockfish stocks, which were seen to concentrate in this area. Due to this trawl closure, the ABC for northern rockfish in the eastern Gulf is combined with that of other slope rockfish in the West Yakutat District.

Amendments 16/21 (BSAI 16/GOA 21) provide a range of changes to the FMPs including modified crab and halibut bycatch management measures in the BSAI as well as the establishment of interim groundfish specifications. Crab and halibut bycatch management measures established in Amendment 12a were modified by apportioning PSC caps to additional fisheries; DAP rock sole and DAP deepwater sablefish and turbot, apportioning PSC caps seasonally, and providing for the imposition of sanctions on vessels with excessively high bycatch rates. The seasonal apportionment of PSC caps exerts the most significant spatial and temporal measure here; as once seasonal allocations of PSC caps are reached, these fisheries can be closed. This is discussed further under Section 3.5.1 of the Programmatic SEIS. These amendments extend 25 percent of the proposed TAC specifications, made at the September meeting, into the new fishing year until superseded by publication of the final specifications. This process of interim specification has been described in Appendix F-1, TAC-Setting Process qualitative assessment.

Steller sea lion protection measures have been implemented in a variety of forms since 1992. Current measures were implemented by emergency rule in 2002, and by final rule in 2003, in order to avoid the likelihood that the groundfish fisheries off Alaska will jeopardize the continued existence of the western distinct population segment of Steller sea lions or adversely modify its critical habitat (FR January 2, 2003). These measures were implemented through regulations and thus are not amendments to the FMPs. There are several measures which pertain to the spatial and temporal management of groundfish fisheries in the BSAI and GOA, specifically with respect to the management of the prey species pollock, Pacific cod, and Atka mackerel. The measures with spatial and temporal TAC management aspects are discussed below; however, the full listing of all the protection measures, including all relevant closures, are discussed elsewhere in this document.

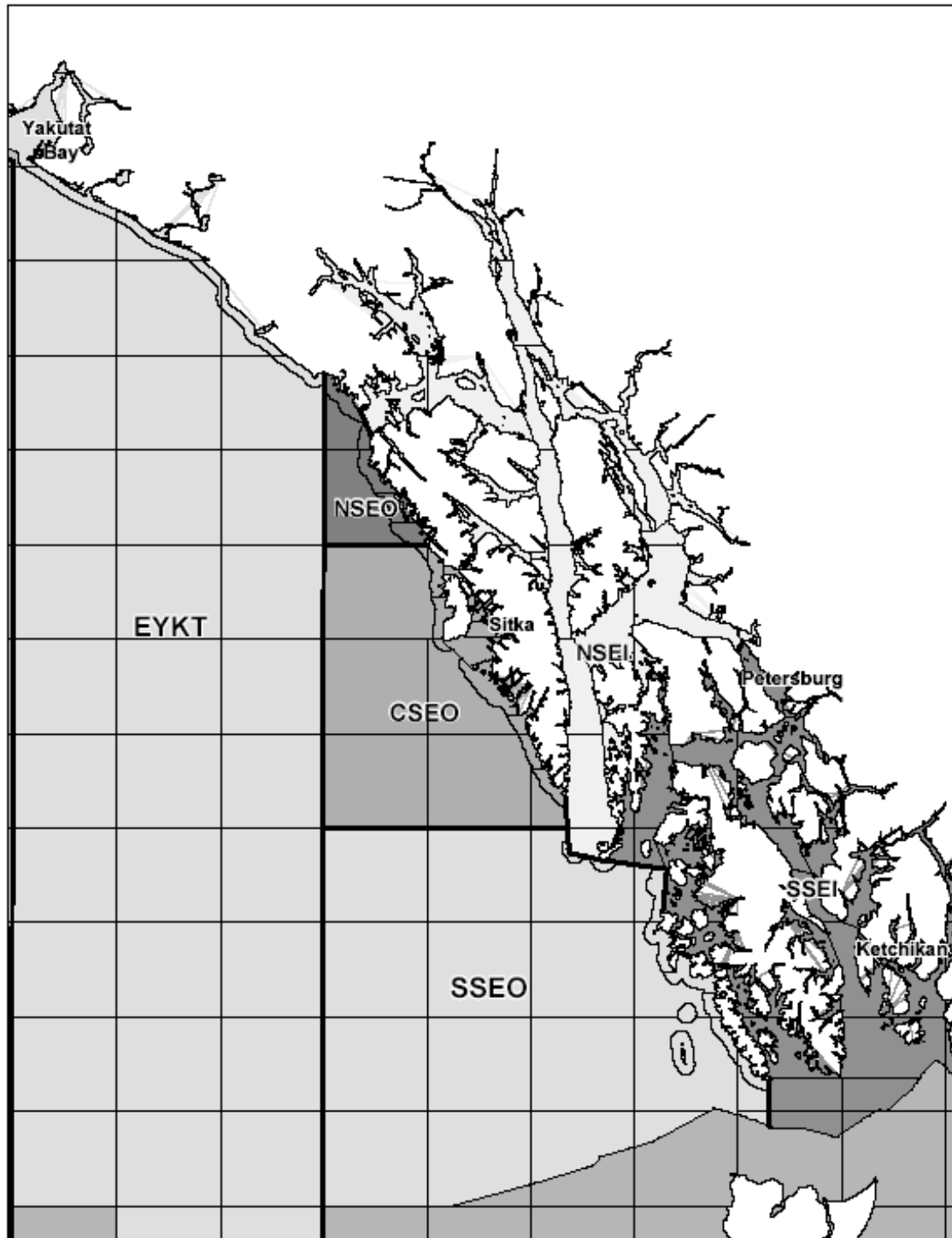


Figure 5. The Alaska Department of Fish and Game and NOAA Fisheries jointly manage the East Yakutat (EYK), north-southeast Outside (NSEO), central-southeast Outside (CSEO), and south-southeast Outside sections (SSEO), which comprise the southeast Outside Subdistrict (SEO). The north-southeast inside (NSEI) and south-southeast Inside (SSEI) areas are managed entirely by Alaska Department of Fish and Game. Source: O'Connell *et al.* 2002.

Spatial and temporal TAC management measures for Steller sea lion protection are implemented in the BSAI subareas and the GOA. In the Aleutian Island subarea, these measures include the apportionment of pollock to two seasons (40:60 percent to each), TAC apportionment by season and gear for Pacific cod, gear-specific area restrictions which alternate with the Atka mackerel fishery in critical habitat in waters west of 178°W. longitude, and a critical habitat harvest limit for Atka mackerel in waters west of 178°W longitude. In the Bering Sea, the measures include two seasons for pollock apportionment (40:60 percent in each), with an added restriction that no more than 28 percent of the TAC be taken from the Steller sea lion conservation area (SCA) before April 1, and Pacific cod TAC apportionments by season and gear. In the GOA, the measures include the apportionment of pollock evenly among four seasons and the apportionment of Pacific cod among two seasons (60:40 percent in each), as well as gear- and area-specific restrictions.

The combination of all of these and other amendments and regulatory changes sets the stage for the current spatial/temporal management of TAC. Many amendments build upon and modify previous ones. It is a complex system which also varies by region and by individual target species. Allocations and in-season management decisions are based on the best available science; however, they are also limited in the amount and depth of data available.

1.7 Challenges in Seasonal Distribution and Apportionment of Target Species

Each year during the stock assessment process when the plan teams for the BSAI and GOA meet to discuss the status of individual stocks and make recommendations for future management, there are issues raised regarding the spatial and temporal distribution of different stocks. The decision-making process for how stocks are managed spatially and temporally is based both upon the level of biological concerns and information available as well as socioeconomic concerns. There are levels of decisions made within each stock assessment regarding the technique used to allocate stock biomass (e.g., average over five surveys or 5 years of surveys). These individual stock assessment decisions are based upon the range of assumptions made about stock viability, seasonal movement, spatial distribution annually and seasonally, and the statistical means used by each stock assessment author in addressing these issues. For a variety of reasons based upon availability of information, different species characteristics and individual author preference, stock assessment authors use different methods for estimating spatial distribution of stocks across management areas. Decisions are made based on the number of years of survey data available and recent catch information. The degree of averaging can also vary by the amount of information available to a stock assessment author, with more sophisticated means used as additional stock information becomes available.

Two examples are provided below of the challenges faced in spatially and temporally allocating TAC amongst management areas for two different stocks: GOA pollock and BSAI rockfish. These two examples provide insight into the management challenges faced by stock assessment scientists and fisheries managers in the spatial and temporal management of TAC. For GOA pollock, the concern lies with how to best approximate seasonal migration amongst areas in the absence of seasonally explicit spatial information. For the BSAI rockfish example, the concerns are whether or not to spatially allocate amongst smaller areas, and the inherent management and accounting problems inherent in doing so. Additionally, in the discussion of the current management of individual stocks (Section 4.5.1 under Alternative 1) information is listed for the spatial/temporal allocation scheme for each stock assessment, with critical differences discussed as necessary.

GOA Pollock

GOA pollock is spatially apportioned amongst the regulatory areas: western, central, and eastern. The relative spatial allocation amongst areas is intended to approximate the relative proportion of the surveyed biomass in these regions. Since 1992, pollock TAC has also been seasonally apportioned in these areas in order to reduce impacts on Steller sea lion (Dorn *et al.* 2002). The TAC is apportioned spatially and temporally amongst these three management areas. Since 2001, four seasons were established to implement the Steller sea lion Protection Measures in the central and western GOA. These seasons begin on January 20, March 10, August 25, and October 1, with 25 percent of the total TAC allocated to each season. Both single species and ecosystem considerations provide the rationale for TAC apportioning, such that apportioning the TAC will spatially distribute the effects of fishing on other pollock consumers (i.e., Steller sea lions) and reduce the intensity of any adverse effects. Also, from a single-species perspective, TAC apportionment assures that no small component of the stock experiences higher mortality than any other (Dorn *et al.* 2002). While no sub-stock units have been identified yet in the GOA, it would be more precautionary to manage for their existence. Thus, if sub-units are identified, they are not subject to specifically high mortality. This potential protection of sub-stock units is particularly important during the spawning season when they are spatially separated (Dorn *et al.* 2002).

The Steller sea lion Protection Measures are intended to apportion the pollock TAC based upon the seasonal distribution of biomass, and thus reduce the potential impact of fishing on these endangered sea lions. However, it is important to recognize that apportioning TAC based upon inaccurate or inappropriate estimates of biomass distribution could have adverse impacts both on the pollock population as well as on the species that prey upon pollock (Dorn *et al.* 2002). For this reason, consideration is paid to the apportionment scheme for all stocks and especially for spatial and temporal allocation of pollock.

Because pollock undergo an annual migration between summer foraging habitats and winter spawning grounds, the biomass distribution in each area will change seasonally. The apportionment scheme needs to reflect this. However, since surveying effort has been concentrated during the summer months and prior to spawning in late winter, the timing of this migration is not well understood (Dorn *et al.* 2002). There is extensive summer survey information, but limited winter survey information, with surveys concentrated primarily in the Shelikof Strait spawning grounds. Dorn *et al.* (2002) recommended an apportionment scheme that attempts to synthesize and best use the available limited information on the summer and winter pollock distributions and the timing of the migration to and from spawning areas.

Apportionment Scheme

This apportionment scheme uses a ternary plot to show the seasonal distribution of walleye pollock biomass, and the distribution between areas for summer and winter (Figure 6). The ternary plot is then used to estimate the seasonal movement between areas. Relative biomass apportionment between areas 620 and 630 has been a particular problem, especially during the pollock season (Section 3.5 of the Programmatic SEIS). Previous recommendations were based on the assumption that the pollock stock on January 20 had the same spatial distribution as the mean distribution on the spawning grounds in mid-March. However, the experience of the fishing fleet since 2000 in these areas suggests that this is not accurate (Dorn *et al.* 2002).

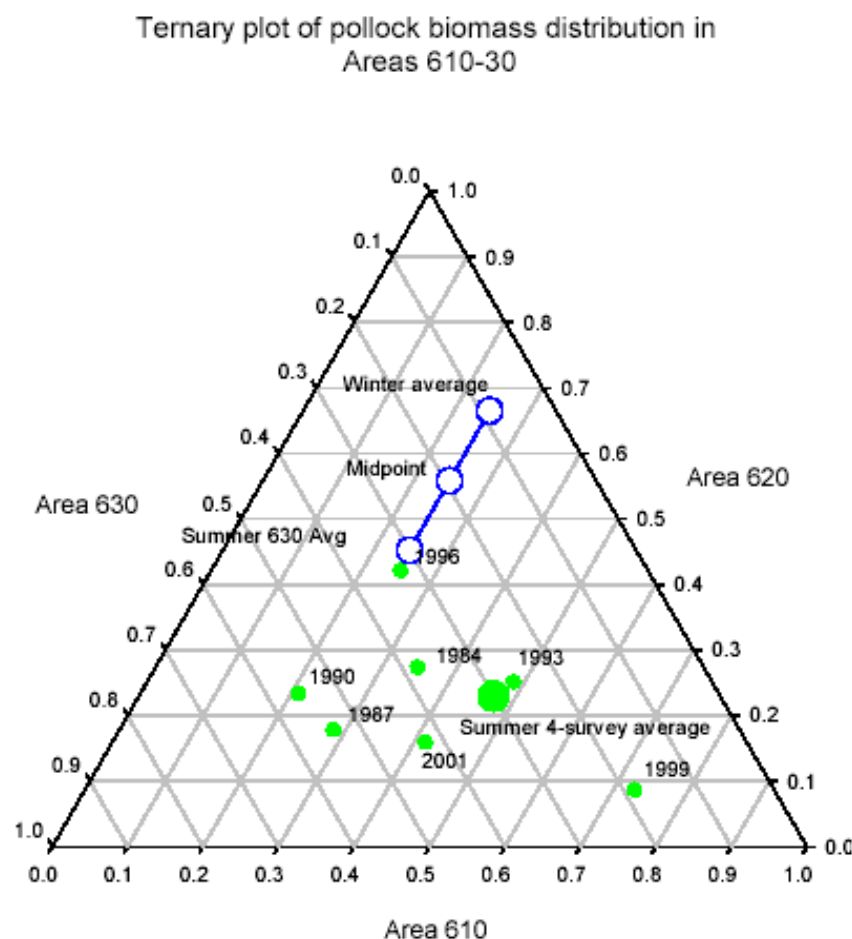


Figure 6. Ternary plot of the seasonal biomass distribution of walleye pollock in the Gulf of Alaska.
Source: Dorn et al. 2002.

Three alternative apportionment strategies were considered by Dorn et al. (2002), using relative percentages of biomass in each area from the summer distribution (Option A), the winter survey distribution (Option B), or the midpoint between summer and winter distribution (Option C). For all of these options, the distribution of biomass in area 610 remains the same (24.73 percent). This reflects the assumption that pollock targeted by the 610 fishery in the pollock season are fish that will spawn in 610 (Dorn *et al.* 2002).

Under Option A, the relative distribution of biomass in areas 620 and 630 was 45.23 percent and 30.05 percent, respectively. This represents the distribution of biomass obtained in area 630 in the summer with 620 biomass obtained by subtraction. This distribution assumes that the migration between areas has not begun by the start of the pollock season.

Option B results in relative apportionments between 630 and 620 of 66.46 percent and 8.81 percent, respectively, and assumes that the seasonal migration between areas has already been accomplished. This option is based on the relative winter distribution.

Finally, Option C takes the midpoint of these two assumptions, giving a relative distribution of 55.84 percent in Area 620 and 19.43 percent in area 630. This midpoint graphically represents the assumption that the fish are moving from one area to another during pollock season, thus the relative distribution of biomass should reflect neither the exact summer nor winter distribution.

At their November 2002 meeting, the plan team recommended Option C for an apportionment strategy and the use of a 4-year unweighted average to compute the survey biomass. The plan team also concurred with the assessment author's recommendation that any overage or underage of pollock harvest at the end of the pollock season be proportionately subtracted from or added to the western/central management areas based on the estimated distribution of pollock in the C/D seasons. The plan team further recommended that data collection efforts be increased in order to utilize the data more effectively for the actual seasonal apportionments.

This example of the strategy utilized in the GOA pollock apportionment, and the importance of recognizing the limited data available to choose apportionment schemes, highlights the inherent problems and trade-offs in spatially and temporally apportioning individual fisheries. For many fisheries data is lacking or insufficient to make decisions on seasonally spatial apportionment. As described above for GOA pollock, while some seasonal survey data is available, and thus innovative means are being used to extrapolate missing data, better data at specific seasonal migration times are necessary to validate the management schemes being utilized. Otherwise, apportionment schemes may not reflect the actual seasonal biomass distribution, and seasonal TACs may be over- or under-harvested accordingly.

BSAI Rockfish Management

Rockfish are a slow-growing, long-lived species that are particularly vulnerable to over-exploitation and slow to recover once driven below the level of sustainable yield (Leaman and Beamish 1984; Francis 1985). Thus, rockfish management has been a continual concern for the NPFMC. Specific concerns regarding the management of the other red rockfish complex has been under review by the NPFMC since October 2002. Concerns raised by the NPFMC regarding BSAI other red rockfish management include: (shortraker/rougheye rockfish and northern rockfish) reliable species identification within the shortraker/rougheye rockfish species group, the apportionment of this species group TAC among the Bering Sea subarea and the three Aleutian Islands subarea districts, and concerns regarding the overfishing level (OFL) and ABCs for northern rockfish by management area.

Pacific ocean perch rockfish species complex has been continually changing as different species groups are moved into separate species categories and more information becomes available. Specifically, the other red rockfish complex currently contains shortraker/rougheye rockfish and northern rockfish after the movement of sharpchin rockfish to the other rockfish complex in 2002. Currently, separate TACs are established for the BSAI management areas; however, the OFL pertains to the region as a whole.

The BSAI Groundfish Plan Team recommended in both 2000 and 2001 that a single BSAI-wide ABC be applied for each species of the other red rockfish complex, partitioned by management area according to recent survey biomass estimates (Reuter and Spencer 2002). While the NPFMC adopted this recommendation, it was hindered by the inability of observers to identify shortraker and rougheye rockfish to species level. The observer program implemented a number of changes aimed at increasing the ability of observers to identify shortraker and rougheye rockfish to the species level. Currently, shortraker/rougheye

are still treated as a complex. Improvements in observer identification should allow single-species ABC determinations in the future.

Additional Shortraker/Rougheye Management Concerns

The OFL and ABC for shortraker/rougheye is established for the BSAI and TACs are applied to the two subareas. There have been concerns raised that the Aleutian subarea should be apportioned by individual regulatory area to prevent the possibility of localized depletion. In 1997, the ABC for shortraker/rougheye in the Aleutian Islands was reached. Thus, to prevent overfishing of the complex, special reporting requirements were implemented, some fisheries were closed and other groundfish catch foregone. The estimated catch in 1997 was only 207 metric tons (mt) less than the OFL of 1,250 mt. In 1998, the NPFMC recommended and NOAA Fisheries implemented a revision of the maximum retainable bycatch (MRB) of this complex. Shortraker/rougheye was separated as a species category for MRBs (previously it was managed under “other red rockfish”) and retention was limited to 7 percent of deep water species and 2 percent of shallow water species.

Since October 2002, the NPFMC has been considering apportioning the shortraker/rougheye TAC in the Aleutian Islands subarea by individual districts, following public interest in this apportionment. The catch in 2002 by subarea did not show a disproportionate catch by subarea (NMFS 2002). This may be because the primary targets for trawl gear (Atka mackerel and Pacific ocean perch) are already apportioned by subarea in the Aleutians.

There are ramifications for management of apportioning the TACs by subareas in the Aleutian Islands for shortraker/rougheye. These problems include the potential change in the distribution of target species in the subareas and, thus, the chance for premature closures of these fisheries, and the increased complexity of inseason management measures on this smaller management scale (NMFS 2002). If the distribution of target fisheries or shortraker/rougheye abundance change significantly, the relative catch may also change in and among the subareas. This could result in the subarea-specific TAC being exceeded for shortraker/rougheye, requiring that this be given as prohibited species status and that any future catch be discarded. Given the difficulties of managing species complexes that are caught incidentally on such a small scale, it may require that management prohibit retention of shortraker/rougheye on a preemptive basis rather than waiting on current inseason data.

Northern Rockfish Management

Northern rockfish have also been a concern for fisheries managers particularly regarding the reliability of stock biomass information for northern rockfish stocks in the EBS and Aleutian Islands. Unreliable biomass estimates can lead to under- or over-fishing of stocks by management area and trigger inseason management measures to close fisheries. Under Tier 5 management, the biomass estimates for the northern rockfish complex relies solely on survey biomass estimates. In December 2002, the SSC set the northern rockfish stock in the EBS in Tier 6 as a precautionary measure due to unreliable stock biomass estimates. This resulted in a higher ABC but a lower OFL by regulatory area than was recommended by the stock assessment authors. A lower OFL puts many Bering Sea fisheries at risk of premature closures should the OFL be exceeded. The NPFMC, following information presented by the Alaska Fisheries Science Center (AFSC) scientists, as well as a report from the SSC, revised its 2003 northern rockfish TAC specifications by combining the BSAI ABCs and OFLs. More reliable information on northern rockfish biomass is necessary before this complex can be managed more effectively.

BSAI Rockfish Management Summary

The difficulties with BSAI rockfish management are related to the uncertainty in biomass information for each stock. Some specific concerns with acquiring reliable biomass estimates include the problems encountered with trawl survey gear and the general design of these studies. There are two primary problems: one relates to the inadequate sampling of rockfish habitat, and the second to the disproportionate sampling of biomass. Rockfish habitat is particularly difficult for trawl gear to sample as it is rocky and often the bathymetry is too rugged for most gear. Thus, difficult areas are not sampled, and rockfish biomass in these regions may be underestimated. Rockfish can also be patchily distributed in particular habitat types, thus if a survey catches large concentrations of rockfish in habitats that constitute a small fraction of overall strata, then the area-swept estimate would overestimate biomass. Conversely if the trawl survey misses patches of rockfish then it will underestimate biomass. Disproportionate over-sampling and under-sampling of rockfish patches would be exacerbated by inadequate sample size leading to large interannual variability in estimated biomass levels. More information on these problems and some on-going work to improve surveying of rockfish can be found in the Discussion Paper on Rockfish Research and Management, by the Rockfish Working Group (NMFS 2003b).

Spatial and temporal management of TAC is dependant upon the amount of available information on stock biomass and distribution. As mentioned in the sections above, the available data impacts management in a variety of ways, from the necessity of making assumptions regarding seasonal migration between areas for GOA pollock, to the ability to apportion rockfish on smaller spatial scales. Accurate management on small spatial and temporal scales requires specific data on each individual stock. However, in the interest of precautionary management, apportionment decisions are made on the best available science and vary across each stock. As current management practices show, stocks are managed on different spatial and temporal scales depending upon their perceived vulnerability to overfishing, socioeconomic concerns within the fishery, and the availability of scientific information on the stock.

Section 2 Analysis of Alternatives

The following four policy alternatives are under consideration by the NPFMC:

- Alternative 1** Continue Management Under Existing (Updated) Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The approach would be to continue the current strategy which relies upon spatial and temporal management of stocks according to individual stock concerns as well as interactions with other species (i.e., Steller sea lions) on a stock-by-stock basis and in consideration of such additional factors as bycatch, socioeconomic concerns, scientific data availability, and an assessment of the vulnerability of individual stocks.
- Alternative 2** Less Precautionary Management Policy: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. There would be no change to the current spatial and temporal management practices. However, because PSC limits would be adjusted or eliminated under this alternative, the seasonal spatial and temporal management of target species would be impacted.
- Alternative 3** More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increased habitat protection and additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment, not just a population of a given species. Under this alternative, objectives and criteria will be developed for allocating TAC in space and time. The spatial and temporal nature of some fisheries may be impacted by reducing PSC limits in the BSAI and GOA.
- Alternative 4** Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns. More emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces

adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. Under this alternative, TAC would be distributed on smaller spatial scales for all possible species. EBS pollock provides an example of how finer-scale spatial (and temporal) management might be approached. The spatial and temporal nature of some fisheries may also be impacted by the reduction in PSC limits in the BSAI and GOA.

Section 3 Alternative 1: Continue Under the Current Risk-Averse Management Policy

This alternative, as illustrated by the current BSAI and GOA FMPs, would maintain the existing spatial and temporal allocations of TAC for all stocks. Currently, there are no explicit objectives for managing TAC spatially and temporally. Rather, management varies according to the individual target stocks as well as the predators dependent upon these stocks (e.g., seabirds, Steller sea lions, and other marine mammals). Some stocks are managed at a single spatial and temporal level, while others are managed at a very fine spatial scale and have multiple seasons to disperse the fishery temporally. Generally, the ability to manage stocks at a fine spatial and temporal scale is dependant upon the biological concerns regarding the stock itself as well as the degree of scientific information available for the stock. Often decisions are made to change fishing seasons when targeting a certain stock may cause an unacceptable level of bycatch in another stock; thus, timing of the fishery is changed. The following is a description of how stocks are managed under the current system and a rationale for why certain stocks are managed on smaller spatial or temporal scales than others.

For all fisheries (unless otherwise noted), the fishing season for fixed gear runs from January 1 to December 31, and for trawl gear the season runs from January 20 to December 31. Many fisheries are further suballocated according to seasons, with the rationale for this suballocation varying according to the individual stocks. The spatial and temporal allocation schemes are listed below for each stock. If no temporal allocative scheme is listed specifically for the fishery, then this fishery is managed according to the fishing year only. Spatial allocative schemes often vary by individual stocks. Important differences in allocative schemes and the rationale thereof are noted.

3.1 Gulf of Alaska Management Area

The GOA is broken up into three management areas: eastern, central, and western (Figure 1). These regions are divided into individual statistical and reporting areas. The western GOA is completely contained within Area 610. The central GOA is made up of areas 620 and 630. The eastern GOA contains two management areas, the WYAK District (Area 640) and the SEO District (Area 650). Amendment 58 prohibits trawling in the eastern GOA east of 140°W. Two new subareas were created by this amendment, WYAK (147° 140°W) and EYAK/SEO (area east of 140°W). Trawling is prohibited in the EYAK/SEO subarea.

3.2 Gulf of Alaska Stocks

The stock-by-stock description of spatial allocation schemes begins with stocks that are managed Gulf-wide and proceeds on progressively smaller spatial scales to those stocks managed with separate TACs for each regulatory area.

3.2.1 Stocks Managed Gulf-Wide

In the GOA, only Atka mackerel and the other species complex categories are managed Gulf-wide. This indicates that for these species a single OFL, ABC, and TAC are set for the entire Gulf region.

Atka mackerel was separated from the other species category in 1994 through GOA Amendment 31. Since 1997, there is no directed fishery for Atka mackerel in the GOA. Instead, Atka mackerel's status has been bycatch-only. The stock population is low and believed to be vulnerable to fishing pressure due to its patchy distribution and sporadic recruitment patterns (Lowe 2002).

In the GOA there are no reliable biomass estimates of other species and no annual stock assessment. The TAC is set at 5 percent of the total groundfish TAC and other species are managed as bycatch only.

3.2.2 Gulf of Alaska Stocks Managed in the Southeast Outside District

DSR is only managed (and fished) in the SEO District due to the amendments to the FMP as mentioned in the introductory sections and the restrictions on trawling from Amendment 58 to protect rockfish. For this stock, which the NPFMC has deferred management to the Alaska Department of Fish & Game (ADF&G), the SEO District is further subdivided for DSR TAC into four smaller subareas: EYAK, NSEO, CSEO, and SSEO to prevent localized depletion (Figure 5). These areas are all part of SEO (Area 650). SEI (Area 659) are those state waters adjacent to Area 650. This area is managed by the state and is further subdivided into the north and south.

While the ABC for DSR is given for the SEO area-wide, this calculation is done by summing the individual ABCs by subarea (O'Connell *et al.* 2002). For DSR, 67 percent of directed fishery quota is allocated between January 1 and March 15, 33 percent between November 16 and December 31. Directed fishery quotas are set by management area and are based on the remaining ABC after subtracting for the estimated DSR bycatch in other fisheries. The bycatch limit of DSR during halibut fishing is equal to 10 percent of the halibut weight. The directed fishery in 2002 was pre-empted by the halibut fishery in East Yakutat subarea. The 2003 fishery is expected to be pre-empted by the halibut fishery again.

3.2.3 Gulf of Alaska Stocks which are Managed in Western, Central and Eastern Districts

Multiple stocks are managed spatially in western, central, and eastern districts: Pacific cod, northern rockfish, shortraker/rougheye and thornyheads. Individual apportionment of ABC amongst areas varies by each individual stock.

For Pacific cod, the ABC is spatially allocated amongst areas according to a calculation of the average biomass distribution from the three most recent trawl surveys. The TAC area allocation is within 1 percent of this average biomass distribution on an area-by-area basis (Thompson *et al.* 2002a). For 2003, the area allocation is western 39 percent, central 55 percent, and eastern 6 percent. Under measures implemented by the NPFMC to prevent potential competition with Steller sea lions, the TAC for the fishery is divided between the A Season and the B Season for the western and central regulatory areas. In these areas, 60 percent of the TAC will be allocated for the A Season, and the remaining 40 percent allocated for the B Season. Any Pacific cod harvested as bycatch between the closure of the A season and the opening of the B season is deducted from the B season apportionment.

For northern rockfish, the spatial apportionment of ABC among areas is by a weighted average based on survey biomass and relative variability in survey estimates/survey error. For 2003, this resulted in apportionment of 16.1 percent of the ABC in western area, 83.8 percent of the ABC in the central area, and 0.1 percent in the eastern area. The small eastern ABC for northern rockfish is combined with other slope rockfish in the WYAK for management purposes.

For shortraker/rougheye and Pacific ocean perch, the same method of apportionment is used as for Northern rockfish. In 2003, this resulted in an ABC apportionment for shortraker/rougheye of 13.3 percent of the ABC in the western GOA, 51.9 percent of the ABC in the central GOA, and 34.8 percent of the ABC in the eastern GOA.

For thornyhead rockfish, beginning in 2003, ABC will be apportioned by management area. Prior to this time it was managed Gulf-wide; however, given the historical concentration by foreign vessels in the central region (Ianelli and Ito 1995), the stock assessment authors were concerned that this pattern of concentration may reflect current trends as well (Gaichas and Ianelli 2002). Thus, the authors recommended management of thornyheads by region rather than Gulf-wide to avoid the potential for localized depletion due to concentration of the fishery. Observer coverage is not evenly distributed in this area thus it is impossible to determine the relative magnitude of removals in this region. Based upon the relative biomass in each area from four surveys (1990, 1993, 1996, and 1999), the relative apportionment of biomass by management area is as follows, western 18 percent, central 42 percent, and eastern 40 percent.

3.2.4 Gulf of Alaska Stocks Managed Spatially in Western, Central and East, Where the Eastern District is Further Subdivided into West Yakutat and East Yakutat/Southeast Outside

Stocks which are managed spatially in western, central, and eastern districts with the eastern district further subdivided into WYAK and EYAK/SEO include deepwater flatfish, rex sole, shallow water flatfish, flathead sole, arrowtooth flounder, sablefish, other slope rockfish, Pacific ocean perch, and pelagic shelf rockfish.

Deepwater flatfish are managed separately from shallowwater flatfish for purposes of differential halibut bycatch between the two fisheries. These fisheries are often closed quarterly as the halibut bycatch limit is approached (Table 1). Deepwater flatfish and rex sole were closed in each quarter in 2002 (on May 24, August 2, and October 13, respectively) to prevent exceeding the halibut bycatch limit (Turnock *et al.* 2002). The shallow water flatfish fishery was closed May 15, August 5, and October 13 due to attainment of the halibut bycatch limit.

Rex sole was split out of the deep-water management category in 1993 due to concerns regarding the Pacific ocean perch bycatch in the rex sole target fishery (Turnock *et al.* 2002). Rex sole is now managed with a separate ABC.

The flathead sole apportionment was estimated by calculating the fraction of the 2001 survey biomass in each area and applying that fraction to the model-estimated ABC.

Arrowtooth flounder was separated from the flatfish assemblage by the NPFMC in 1990 for management purposes given its high abundance and low commercial value (Turnock *et al.* 2002). The recommended 2003 ABC apportionment by area of arrowtooth flounder is estimated by calculating the fraction of the 2001 survey biomass in each area and applying that fraction to the total ABC.

Sablefish apportionment is currently based upon 5-year exponential weighting of the survey and fishery abundance indices in weight by region. Prior to 2000 the ABC was apportioned based upon the survey data alone; however, since 2000 the NPFMC approved an allocative scheme based upon both survey and fishery data. Sablefish is allocated by gear type according to Amendment 14, whereby 80 percent of the quota is to hook-and-line gear and 20 percent to trawl gear in the western and central GOA. In the eastern GOA the

quota is allocated 95 percent to hook-and-line gear and 5 percent to trawl gear. Amendment 8 to the GOA FMP established the WYAK and EYAK management areas for sablefish. The sablefish fishery since 1995 is an IFQ fishery, and as such, is largely dispersed in space and time (Sigler *et al.* 2002).

In order to protect vulnerable stocks such as Pacific ocean perch, shortraker, rougheye and northern rockfish from possible overfishing, the NPFMC divided the slope rockfish assemblage in 1991 (and again to separate northern rockfish in 1993) into management subgroups. Each subgroup, Pacific ocean perch, shortraker/rougheye, northern rockfish and other slope rockfish are assigned an individual ABC and TAC and apportioned amongst the three Gulf management areas based on the distribution of exploitable biomass (Heifitz *et al.* 2002). Amendment 58 prohibited trawling in the eastern GOA area in waters east of 140°W longitude. Most slope rockfish are caught exclusively with trawl gear. In order to not concentrate fishing effort for rockfish between 140° and 147°W longitude, the NPFMC subdivided this area in 1999 into subareas (WYAK (between 147° and 140°W) and EYAK/SEO (east of 140°W) with separate ABCs and TACs assigned to these subareas for Pacific ocean perch and other slope rockfish subgroups (Heifitz *et al.* 2002).

The pelagic shelf rockfish assemblage is comprised of dusky, widow, and yellowtail rockfish with the ABC computed separately for each and then summed for a Gulf-wide ABC for the entire assemblage. This ABC is then apportioned spatially by weighting the biomass according to the three most recent trawl surveys to compute biomass by area, yielding a percent distribution of approximately 9 percent in the western area, 63 percent in the central area, and 27 percent in the eastern area (Clausen *et al.* 2002).

3.2.5 Gulf of Alaska Stocks Managed Spatially in Western, with Central Subdivided Further into Area 620, Area 630 and Eastern Districts with East Subdivided into West Yakutat and East Yakutat/Southeast Outside

Pollock is the only fishery in the GOA which is managed with separate TACs by individual reporting areas in the central regulatory area (i.e., 620 and 630). Since 1992, GOA pollock has been apportioned spatially and temporally to reduce impacts on Steller sea lions (Dorn *et al.* 2002). The objective of the apportionment scheme is to allocate the TAC to management areas according to the relative distribution of the surveyed biomass. Four seasons were established in 2001 to implement the Steller sea lion Protection Measures in the central and western GOA. These seasons begin on January 20, March 10, August 25, and October 1 with 25 percent of the total TAC allocated to each season. Specific allocations amongst spatial areas (610, 620, and 630) are estimated according to the seasonal biomass distributions in these regions from the groundfish surveys. Information on the problems inherent in seasonally apportioning the Gulf pollock fishery have already been discussed above. In the eastern regulatory area, pollock is not divided into seasonal allowances.

3.3 Bering Sea and Aleutian Island Stocks

The stock-by-stock description of spatial allocation schemes begins with stocks that are managed BSAI-wide and proceeds on progressively smaller spatial scales to those stocks managed with separate TACs for individual regulatory areas as specified.

3.3.1 Bering Sea and Aleutian Islands Stocks Managed Bering Sea and Aleutian Islands-Wide

The following stocks are managed BSAI-wide, indicating that the stock is managed as a single ABC, OFL and TAC between the BSAI areas: Pacific cod, yellowfin sole, arrowtooth flounder, rock sole, flathead sole, Alaska plaice, other flatfish, squid, other species.

The Pacific cod fishery has been temporally dispersed across three seasons in 2001 and 2002, in an attempt to mitigate for possible impacts on Steller sea lions. These seasons are January through May, June through August and September through December (Thompson and Dorn 2002). Gear-specific TAC apportionments are established for these seasons and across all gear types. Bycatch of crab and halibut often cause the Pacific cod fisheries to close prior to reaching the TAC.

The yellowfin sole fishery is constrained seasonally by the PSC cap for the halibut fishery as well as the red king crab bycatch allowance. In 2002, the fishery was constrained twice for closures due to attainment of the halibut PSC cap (from May 11-21 and June 15-30) and Zone 1 was closed on May 21, 2002 for the remainder of the year to prevent exceeding the 2002 bycatch allowance for red king crab in the yellowfin sole target fishery (Wilderbuer and Nichol 2002).

The rock sole fishery in the BSAI is also closed periodically due to bycatch restrictions. In 2002, Zone 1 was closed from 2/22 to 12/31 due to exceeding the red king crab cap. The BSAI was closed for the following time periods after exceeding the first two seasonal halibut caps and the annual halibut allowance, respectively: March 1 through April 4, April 20 through July 1, July 29 through December 31 (Wilderbuer and Walters 2002).

Flathead sole was contained in the other flatfish assemblage prior to 1994. After this time it was separated out of that assemblage and assigned its own ABC, in order to comply with a request by the NPFMC and to comply with the change in the directed fishing standards to allow for improved retention of flatfish (Spencer *et al.* 2002).

Prior to 2002, Alaska plaice was managed as part of the other flatfish complex. Starting in 2002, it is being managed separately under its own ABC and TAC. Like the yellowfin sole and rock sole fisheries, the Alaska plaice fishery and the other flatfish fishery have also been closed due to the bycatch of halibut and a portion of the EBS has been closed in 2002 due to exceeding the red king crab bycatch allowance (Spencer *et al.* 2002).

The other species complex in the BSAI is currently managed based on Tier 6 criteria. Since 1999, discussions with the Plan Teams, SSC, and NPFMC have focused on better management of the other species complex. Separate ABC estimates have been proposed for squid and the remaining other species complex. Currently, the ABC for other species is managed as a single ABC for the whole complex.

3.3.2 Bering Sea and Aleutian Islands Stocks Managed in the Aleutian Islands only (Aleutian Islands Split by Eastern, Central, Western)

Atka mackerel is the only stock which is managed in the Aleutian Islands only, with the Aleutian Islands management split by eastern, central, western regulatory areas. Amendment 28 to the BSAI FMP divided the Aleutian subarea into three districts at 177°W and 177°E to spatially apportion TAC (Figure 1). Since 1994, BSAI Atka mackerel has been allocated to these three regions based on the four survey-weighted average of the biomass distribution from the Aleutian Island bottom trawl surveys.

Measures are currently in place to disperse the fishery temporally and spatially to reduce the level of fishing for Atka mackerel within Steller sea lion critical habitat. Temporally, the TAC is divided into two seasons. The A season runs from January 1 to April 15, and the B season runs from September 1 to November 1.

Spatially the fishery is further dispersed by regulations regarding maximum catch percentages of each of these seasonal allowances which can be caught within sea lion critical habitat in the central and western Aleutian Islands areas. There are no critical habitat closures established for the eastern subarea, although year-round 20-nautical mile trawl exclusion zones exist around Seguam and Agligadak rookeries. The percent distribution for 2002 TAC inside and outside critical habitat was 40 percent inside critical habitat, 60 percent outside for both western and central Aleutian Island regulatory areas (543 and 542, respectively).

3.3.3 Bering Sea and Aleutian Islands Stocks Managed with Spatial Split between the Bering Sea and Aleutian Islands

Stocks managed with a spatial split between the BSAI include: Greenland turbot (TAC only, no ABC split), northern rockfish, shortraker/rougheye, sablefish, and other rockfish.

The ABC for Greenland turbot is split between Aleutian Islands and Bering Sea regions according to survey biomass estimates in both regions.

Sablefish is allocated by gear type, according to Amendment 13, with 50 percent allocated to fixed gear and 50 percent to trawl gear in the EBS, and 75 percent to fixed gear and 25 percent to trawl gear in the Aleutian Islands. Amendment 15 of the BSAI FMP (amendment 20 to the GOA FMP) established IFQ management for sablefish beginning in 1995. Under these amendments, 20 percent of the fixed gear allocation was allocated to a CDQ reserve for the BSAI. Sablefish is allocated by area based upon a weighted average using survey and fishery information.

Northern rockfish and shortraker/rougheye rockfish are assessed together as other red rockfish complex. Separate ABCs are established for northern rockfish and shortraker/rougeye by BSAI management areas in proportion to recent survey biomass estimates. However, the OFL for each of these is for the entire BSAI combined area. This has been discussed previously in the section on BSAI other red rockfish management.

The other rockfish category is made up of 29 species, of which light dusky rockfish and shortspine thornyheads are the most abundant (Reuter and Spencer 2002). Sharpchin rockfish were moved into the other rockfish category in 2002. Separate ABCs and OFLs are set for the BSAI region. Concern was expressed by the SSC in 2001 regarding disproportionate exploitation of any one of the species in the other rockfish complex (Reuter and Spencer 2002). Light dusky rockfish are the predominate catch in the Aleutian Islands, despite the fact that 85 percent of the other rockfish biomass is shortspine thornyheads. The stock assessment author recommended that light dusky rockfish be split out from the other rockfish in ABC and OFL determinations (Reuter and Spencer 2002). Data on the spatial distribution of light dusky rockfish indicate that it may be a single stock in the BSAI region (Reuter and Spencer 2002). It was therefore recommended that a combined biomass estimate be used in the BSAI for this stock, and a subsequent ABC and OFL be determined for the combined BSAI management area (Reuter and Spencer 2002). The NPFMC did not separate light dusky rockfish at this time; thus it continues to remain within the other rockfish complex and is managed spatially between the Bering Sea and Aleutian Islands regions.

3.3.4 Bering Sea and Aleutian Islands Stocks Managed between Bering Sea and Aleutian Islands (with Aleutian Islands split Eastern, Central, Western)

Pacific ocean perch is the only stock managed between the BSAI, with the Aleutian Islands split into three regulatory units, (eastern, central, western). Pacific ocean perch and four other species of rockfish (northern, shortraker, rougheye and sharpchin) were managed as a complex, the Pacific ocean perch complex, until

1991. In 1991 the NPFMC separated Pacific ocean perch from the complex in order to provide protection from possible overfishing (Spencer and Ianelli 2002). For the EBS slope region, the Pacific ocean perch complex was divided into two subgroups: Pacific ocean perch, and an other red rockfish category made up of shortraker, rougheye, sharpchin and northern rockfish. In 2001, the other red rockfish in the Bering Sea was further subdivided into two additional subgroups, rougheye/shortraker and rougheye/northern. In 2002, sharpchin was assigned to the other rockfish category. In the Aleutian Islands regions, the Pacific ocean perch complex was divided into three groups: 1) Pacific ocean perch, 2) shortraker/rougheye, and 3) sharpchin/northern (Spencer *et al.* 2001). Each of these subgroups is assigned an individual ABC and TAC.

Since 2001, the BSAI area Pacific ocean perch stocks have been assessed and managed as a single stock; however, a separate ABC is established after the stock assessment calculations for each area. While age-structured models for both Aleutian Islands and Bering Sea stocks were being done prior to 2001, there were concerns regarding the lack of data upon which to base an age-structured assessment as well as the uncertainty that the Bering Sea Pacific ocean perch represent a discrete stock (Spencer and Ianelli 2001). The ABC for BSAI Pacific ocean perch is then split between the two management areas according to the percent of the combined biomass from surveys in both the Aleutian Islands and the EBS. For 2002, 16 percent of the ABC was allocated to the EBS region, while 84 percent was allocated to the Aleutian Islands region. The Aleutian Islands region is further partitioned amongst the Aleutian Islands management areas (E,C,W) according to the relative proportion of the estimated biomass from the five most recent trawl surveys.

3.3.5 Bering Sea and Aleutian Islands Stocks Managed with Bering Sea Split Out between Eastern Bering Sea and Bogoslof Regions, and Aleutian Islands (Managed Aleutian Islands-Wide)

Pollock is the only stock where the Bogoslof Region (area 518) is given a separate TAC for management purposes. The remainder of the Bering Sea regulatory areas are then combined into an area called the EBS.

The BSAI pollock comprises three stocks for management purposes: the EBS, which consists of pollock occurring on the EBS shelf from Unimak Pass to the U.S.-Russia convention line; the Aleutian Islands regions encompassing the Aleutian Islands shelf region from 170°W to the U.S.-Russia convention line; and the central Bering Sea-Bogoslof Island pollock (Ianelli *et al.* 2002). These three regions, EBS, Aleutian Islands, and Bogoslof, are given individual ABCs and OFLs. The Bogoslof region has been closed to directed pollock fishing since 1992 to rebuild stock.

In order to reduce the potential for competitive interactions with Steller sea lion, measures have been taken by the NPFMC and NOAA Fisheries to disperse the pollock fishery in space and time according to pollock biomass distributions. These measures included the closures of additional areas around sea lion rookery or haulout sites (see Appendix F-4, Steller Sea Lion Protection Measures for more details on closures) as well as TAC-specific reductions and temporal allocations. In 2000, the entire Aleutian Islands region was closed to pollock fishing, and phased-in reductions in the proportion of seasonal TAC within the SCA were instituted. The pollock fishery is prosecuted under two seasons, the A Season beginning January 20 to April 15 and the B season beginning September 1 and running until November. The A Season is apportioned 40 percent of the TAC and the B Season is apportioned 60 percent of the TAC. Regulations further state that no more than 28 percent of the the annual directed fishery allowance be taken from the SCA before April 1 (FR notice January 2, 2003). Other allocative measures in the Bering Sea include the establishment of the Bering Sea Pollock Restriction Area (BSPRA) during the A Season, and the closure of the Catcher Vessel

Operation Area (CVOA) to non-CDQ pollock trawl catcher processor during the B Season (FR notice January 2, 2003). These last two measures are discussed in more detail in Appendix F-4.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

Under this alternative there are no proposed changes to the spatial and temporal management of TAC from the current FMP. As discussed previously, there are no specific policy objectives relating to spatial and temporal management, thus any changes from one alternative to the next would be within the tools listed in the individual bookend frameworks. All TAC allocations and spatial and temporal management would remain as described above for FMP 1. However other aspects of this alternative may have an impact upon the temporal nature of some target stocks.

Spatial and temporal management changes under the FMPs 2.1 and 2.2.

FMP 2.1: No change from FMP 1

FMP 2.1: No change from FMP 1

Measures which may have a related impact on spatial and temporal management of the fisheries are discussed below.

Specifically, under the framework for FMP 2.1, PSC limits are eliminated. Many fisheries are currently timed to avoid excessive bycatch in prohibited and non-target species, specifically many flatfish fisheries (Table 1). The fisheries close for periods of the year over different seasons when they have exceeded their PSC caps, usually for halibut bycatch (Table 1). Consequently, many of these fisheries do not catch their allotted TAC since they are closed for halibut bycatch reasons prior to reaching their TAC. Eliminating these PSC limits would mean that many of these fisheries would remain open for the whole season until their allotted TACs are achieved.

Another measure under FMP 2.1 impacting spatial and temporal management of TAC would be repeal of the sablefish IFQ and the CDQs (except for pollock and crab as mandated under the American Fisheries Act). Repealing these programs from a TAC perspective frees up an additional 7.5 percent of the TAC for the directed fishery.

Section 5 **Alternative 3: Adopt a More Precautionary Management Policy**

Under this alternative, there are no specific management policies that would change for spatial and temporal management. Under the FMP 3.2, however, objectives and criteria to specifically allocate TAC in space and time would be developed. This would represent a departure from the current program, where TAC is allocated spatially and temporally under FMP 1. Under FMP 3.2, goals and objectives for allocating TAC in space and time would be developed, along with a sample uniform allocative scheme. There are also related measures within this alternative that would impact the spatial and temporal management of the individual fisheries. These related measures are the impact of fishery-specific TACs; breaking sharks and skates (and additional species) from the other species complex; reduced PSC limits on herring, crab, halibut and salmon; and establishing PSC limits in the GOA. While none of these measures directly change the spatial and temporal management of TAC they could all impact it.

Specific spatial and temporal management measures under the FMPs 3.1 and 3.2:

FMP 3.1: No changes from FMP 1

FMP 3.2: Develop goals and objectives for allocating TAC in space and time.

In order to allocate TAC in space and time, specific goals and objectives for spatial and temporal management need to be developed. As previously explained, spatial and temporal allocation of TAC is a tool by which other objectives are achieved. There are currently no policies which denote the specific objective to manage on smaller spatial and temporal scale for the explicit benefit of the target fishery. Under FMP 3.2, however, it is assumed that a general overarching goal is to manage stocks on smaller spatial and temporal scales. In addition to explicitly declaring this policy objective, reasonable mechanisms must be developed to both systematically manage stocks in time and space, as well as to account for the varying degrees of uncertainty in stock biomass information across all stocks. This mechanism would need to be adaptive to the level of available information for each stock.

Proposed Season and Area Proportionate Harvesting Scheme

A proposed means of seasonal and spatial allocation is provided by G. Thompson (Appendix A *Grant's P cod allocative scheme*) This allocative scheme was initially developed for Pacific cod but is here made applicable to all stocks.

In order to allocate TAC on the basis of time and space, it is necessary to partition the fishing year and area. For example, the year could be partitioned into a number of seasons, and the area could be partitioned into a number of subareas. The seasons could be of equal or different lengths, the subareas could be of equal or different sizes, and the numbers of seasons and subareas could be equal or different.

In current stock assessments, biomass estimates are typically available only on a start-of-year and area-wide basis (for example, in the case of an EBS stock, we typically have estimates of January biomass for the entire EBS, but we typically do not have estimates of August biomass for area 517). However, as assessment methodology continues to become more sophisticated, it is likely that season- and subarea-specific biomass estimates will become available for some stocks. When such estimates are available, they could form the basis for season-and-subarea-specific TACs. Such an allocation could be developed by first specifying the

fishing mortality rate corresponding to the overall TAC. Then, this fishing mortality rate could be applied to each season-and-subarea specific biomass estimate to produce an “equal exploitation” distribution of season- and subarea specific TACs which would sum to the overall TAC. Next, a limit on the acceptable deviation from this distribution could be specified. For example, it might be determined that the catch taken from any single season- and subarea-specific cell could not exceed 150 percent of the value from the “equal exploitation” distribution (the 150 percent figure is purely hypothetical). Of course, the overall TAC could still be viewed as a constraint on the overall catch.

When season-and-subarea-specific biomass estimates are not available, something else would have to be used. One possibility would be to use the distributions of season lengths and subarea sizes to approximate an “equal exploitation” distribution of season- and subarea-specific TACs. The seasons could be expressed as proportions of the year, so they would sum to one. Likewise, the subareas could be expressed as proportions of the area, so they would sum to one as well. A subarea-by-season matrix *R* could then be formed in which rows represent subareas, columns represent seasons, and each element of the matrix is equal to the product of proportional subarea size and proportional season length, so the elements of *R* would sum to one. Then, the “equal exploitation” distribution could be approximated simply as the product of *R* and the overall TAC. As in the case where season-and-subarea-specific biomass estimates are available, a limit on the acceptable deviation from the “equal exploitation” distribution could be specified, and the method would proceed in the same way.

A variant on the above approach would be to form the “equal exploitation” distribution on the basis of the fishing mortality rate corresponding to ABC or OFL, rather than TAC. That is, an “equal exploitation” distribution of season-and-subarea-specific ABCs or OFLs could be formed, and acceptable deviations could be calculated relative to that distribution. Of course, the overall TAC could still be viewed as a constraint on the overall catch. In this approach, as with other allocative schemes, more specific biomass estimates on smaller, subarea scales by season would improve these season- and subarea-specific allocations.

Additional measures which may have a related impact on spatial and temporal management of the fisheries follow.

- Under the FMP 3.2, there are proposed changes to the TAC-setting process which may impact spatial/temporal management. The establishment of biological reference points based upon species-specific production patterns, using F_{60} as a proxy for vulnerable species is proposed under FMP 3.2 (refer to Appendix B). Under this alternative, TACs will be less for these vulnerable species and thus the fishery may close sooner and/or impact the timing of other fisheries which catch this as bycatch.
- Under Alternative 3 for TAC setting, both FMPs 3.1 and 3.2 examine ways to break a species out of a species complex. FMP 3.1 proposes to separate sharks and skates from the other species groups. FMP 3.2 proposes to separate sharks and skates and additional groups from the other species groups. These changes would impact how the other species TAC for each of these measures is then calculated. Currently, the other species TAC is calculated as a percentage of the total TAC for all target species in the GOA. In the BSAI, the other species ABC is calculated as a Tier 6 stock for sharks and a Tier 5 for skates with the TAC set less than the combined other species ABC. With sharks and skates broken out as their own category, the other species ABC and TAC would need to be recalculated to account for this (refer to Appendix B).

- Additional impacts on spatial and temporal management of TAC by this measure could be the closure of many target fisheries when the shark and skate (and additional species in the case of FMP 3.2) TAC has been exceeded. There is currently no temporal nature to other species management however this may change by altering the species in the complex.
- Reducing PSC limits on herring, crab, halibut and salmon in the BSAI could impact the temporal nature of many fisheries. Fisheries which currently close seasonally due to exceeding seasonal caps, particularly the flatfish fisheries, would have even shorter seasons and possibly harvest less of their TACs with reduced PSC limits. However, under other measures in this alternative there are bycatch reduction incentive programs, increased rationalization and other means to harvest fish without exceeding this PSC cap regardless of whether or not it is reduced. It is possible, therefore, that this would not radically change the temporal nature of the fishery.
- In the GOA under policy Alternative 3, PSC limits for salmon, crab and herring are established (FMP 3.1) and then reduced (FMP 3.2). PSC limits for halibut are reduced under both example FMPs. Establishing crab, herring, and salmon PSC limits in the GOA fisheries could alter the temporal nature of these fisheries. Depending upon the amount of seasonal bycatch, some fisheries may have to rearrange their seasons and/or change the nature of their fishery to accommodate these caps. Some spatial management (area closures) may also be necessary as an in-season management measure in order to comply with PSC caps. Again, some closure areas will also be developed separately under this alternative; therefore, the cumulative impact of these closures would need to be considered in order to assess the importance on the spatial and temporal management of the fisheries. More information is in Appendix F-3, Essential Fish Habitat and Marine Protected Areas paper as well as Appendix F-5, Bycatch and Incidental Catch Restrictions paper.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

Under this alternative, in the FMP 4.1, TAC will be distributed spatially on smaller scales for all possible species except other species. The rationale for this alternative is that in the absence of scientific certainty that fishing is not causing an adverse impact, the burden of proof should be shifted such that it is assumed that it is causing an impact until evidence shows conclusively otherwise. Under this alternative, more precautionary measures are taken to mitigate for uncertainty in stock assessments and spatial allocative schemes. While no policy objectives specifically address spatial and temporal management, many of the objectives of managing on smaller spatial scales are covered under additional objectives.

Specific spatial and temporal management measures under the FMPs 4.1 and 4.2:

- FMP 4.1: Distribute TAC on smaller scales for all possible species. For analytical purposes, EBS pollock will be used as a proxy.
- FMP 4.2: TAC = 0, therefore, there is no spatial and temporal management of TAC for as long as the fisheries are closed.

6.1 Fishery Management Plan 4.1 Management Measures

Spatial and temporal management can be used as a tool to mitigate for the current limitations in both the stock assessment surveys and the models utilized. These limitations are associated with the degree of uncertainty in the stock structure in part due to seasonal rather than year-round surveys, and the degree of uncertainty in the spatial distribution of survey biomass. The objective is to disperse the fishery in both time and space to guard against localized depletion. Given the uncertainties regarding stock structure, a general concern is that concentrated fishing on a particular stock may result in the depletion of one segment of the stock population, as for example, when the fishery targets heavily on the spawning biomass.

Under this alternative, fishing effort would be proportional to the amount and distribution of biomass, provided this is consistent with essential fish habitat and other such mandates. Some problems with this approach, as discussed previously, are that it is very difficult to estimate the spatial and temporal distribution of stock biomass. Current surveys generally only cover limited timing within seasons. The difficulties of extrapolating between seasons for stock surveys (e.g., GOA pollock) where seasonal surveys exist, have already been highlighted in previous sections. However, under this alternative more precautionary management measures with respect to the spatial and temporal management of TAC will be taken using the best available scientific data until conclusive evidence shows that this is not necessary for managing these fisheries.

EBS pollock will be used as an example of a stock which could be managed on a smaller spatial and temporal scale. The National Research Council (NRC) (1996) noted that spreading out the large pollock fishery in time and area may prove beneficial to predators. One potential mechanism for further dispersing the fishery in the absence of detailed information is to use measures proposed in the 1998 Biological Opinion. The 1998 Biological Opinion provides an example of how the EBS pollock could be dispersed on a finer spatial and temporal scale.

6.1.1 Spatial Measures

The spatial scales designated in this Biological Opinion for EBS pollock were the following three broad areas (based on available summer survey information):

1. critical habitat in the eastern Aleutian Islands (Sea Lion Conservation Area, “SCA”)
2. areas outside of critical habitat to the east of 170°W longitude
3. areas outside of critical habitat to the west of 170°W longitude

6.1.2 Temporal Measures

Two key objectives were recommended for temporal dispersion of the pollock fisheries (NMFS 1998). The first objective was for temporal dispersion to avoid removal during the winter period, and the second objective was to distribute the catch more evenly over the course of the year. The following criteria were also recommended, including a quarterly approach to allocation of the EBS pollock TAC (NMFS 1998):

1. Continue prohibition of pollock fishing from November 1 to January 19 in the Bering Sea and GOA.
2. Distribute catch into at least four seasons, two from January to May, and two from June to October.
3. Limit combined TAC in winter/spring to a maximum of 45 percent.
4. Allocate single-season TACs to be no more than 30 percent of the annual TAC.
5. Prevent concentration of catch at the end of one season, beginning of the next.
6. Limit rollovers of unused TAC from one season to the next.

In addition to these measures, in order to slow the pace of the fishery on a daily basis, a cap of 5,000 mt is proposed on daily catch rates. This 5,000 mt cap dates back to the average catch rates in these areas by the foreign fisheries in the period between 1982-1985 (Table 2). During this period, the fishery was slower-paced and more widely dispersed outside of the current SCA, to the east and west of the 170°W longitude line in the EBS. (NMFS 1998).

One potential problem with these proposed measures is the ability of NOAA Fisheries to adequately enforce them. The 5,000 mt cap would be particularly difficult to enforce and could add an extreme burden to the inseason management staff. Impacts of these measures on target species are unknown but presumably these measures would be beneficial to the pollock population for which they are proposed, as well as to the endangered Steller sea lion population.

Table 2. Bering Sea and Aleutian Islands pollock specifications (metric tons).

Area	1999 biomass	1999 OFL	1999 ABC	1999 TAC	1998 TAC	1998 catch
Eastern Bering Sea	7,040,000	1,720,000	992,000	992,000	1,110,000	1,020,720
Winter seasons				40%	45%	
Summer/fall				60%	55%	
Aleutian Islands	106,000	31,700	23,800	2,000	23,800	21,945
Bogoslof	403,000	21,000	15,300	1,000	1,000	8

Notes: Recommended by NPFMC for 1999.

Source: NMFS 1998; Table 2.

Section 7 **Comparative Analysis of Alternatives**

Spatial and temporal management of TAC is utilized as a tool in all of the alternatives, as illustrated by their associated FMPs. Under the current system, TAC is managed spatially and temporally as a tool to achieve various objectives, both biological and socioeconomic. Potential changes to the current management occur in FMPs 3.2 and 4.1. Under Alternatives 3 and 4, this current management would also include specifically conceiving of goals and objectives for managing TAC in space and time (FMP 3.2), a conceptual approach to manage all species on smaller spatial and temporal scales, regardless of the level of knowledge of the stock (FMP 3.2), and managing on a smaller spatial and temporal scale for conservation reasons utilizing a different approach (FMP 4.1). These alternatives all assume that management of TAC on smaller spatial and temporal scales would be beneficial to the target species.

The ability to effectively manage on smaller spatial and temporal scales is tied to the availability of stock biomass data. A discussion of better spatial and temporal management necessarily includes highlighting the need for additional information to effectively manage stock. These data gaps which have been previously mentioned include better spatial and temporal information on individual stock migration, better identification to the species level of shortraker/rougheye rockfish, and more fine-scale, detailed information on the spatial and temporal distribution of every target species managed under these FMPs. The ability to effectively manage TACs on progressively smaller spatial and temporal scales necessitates the need for more information.

Section 8 References

- Clausen, D. M., Lunsford, C.R., and Fujioka, J.T. (2002). "Pelagic shelf rockfish." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 383.
- Dorn, M.W., Hollowed, A.B., Brown, E., Megrey, B., Wilson, C., and Blackburn, J. (2002). "Assessment of the Walleye Pollock Stock in the Gulf of Alaska". Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 1-1.
- Francis, R.C. (1985). Fisheries research and its application to west coast groundfish management. In T. Frady (ed.) Proceedings of the Conference on Fisheries Management: Issues and Options. p. 285-304. Alaska Sea Grant Report 85-2.
- Gaichas, S., and Ianelli, J.N. (2002). "Assessment of Thornyheads (*Sebastolobus* sp.) in the Gulf of Alaska." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 459.
- Heifetz, J., Courtney, D.L., Clausen, D.M., Hanselman, D., Fujioka, J.T., and Ianelli, J.N. (2002). "Slope Rockfish." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 295.
- Ianelli, J.N. and D.H. Ito (1995). Thornyheads. In: Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska as projected for 1996. Nov. 1995. N. Pac. Fish. Mgt. NPFMC, P.O. Box 103136, Anchorage, AK 99510.
- Ianelli, J.N., S. Barbeaux, T. Honkalehto, G. Walters, and N. Williamson (2002). Eastern Bering Sea Walleye Pollock Stock Assessment. In: Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Regions. North Pacific Fishery Management NPFMC, Anchorage, AK, Section 1:33-120.
- Leaman, B.M. and R.J. Beamish. (1984). Ecological and management implications of longevity in some northeast Pacific groundfishes. Int. North Pac. Fish. Comm., Bull. 42:85-97.
- Lowe, S.A. (2002). "Assessment of Gulf of Alaska Atka Mackerel." Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501, pp. 523-536.
- National Research Council (NRC). (1996). The Bering Sea Ecosystem, National Academy Press, Washington, DC. 307 pp.

- NMFS. (1998). "Endangered Species Act Section 7 Biological Opinion: Fishery Management Plan for the Bering Sea and Aleutian Islands and Gulf of Alaska Groundfish Fisheries and the 1999 Total Allowable Catch Specification and its effects to Steller sea lions.", DOC, NOAA, National Marine Fisheries Service, P.O. Box 21668, Juneau, AK 99802-1668. Available on-line at <http://www.fakr.noaa.gov/protectedresources/stellers/bio2/biop2.pdf>.
- NMFS. (2002). "Rockfish Working Group Report." Presented to the North Pacific Fisheries Management NPFMC, Agenda Item D-1b, December 2, 2002.
- NMFS. (2003a). "Environmental Assessment/Final Regulatory Flexibility Analysis for the Total Allowable Catch Specifications for the Year 2003 Alaska Groundfish Fisheries". NOAA, NMFS, Alaska Regional Office, P.O. Box 21668, Juneau, Alaska 99802. p. 104.
- NMFS. (2003b). "Discussion Paper on Rockfish Research and Management." Rockfish Working Group report to the North Pacific Fishery Management NPFMC, Agenda Item D-1b, January 3, 2003.
- NPFMC. (2002a). "Fishery Management Plan for the Groundfish Fishery in the BSAI Area." Updated through Amendment June 2002, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.
- NPFMC. (2002b). "Fishery Management Plan for the Groundfish Fishery of the GOA." Updated through Amendment February 2002, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.
- O'Connell, V., Brylinsky, C., and Carlile, D. (2002). "Demersal shelf rockfish assessment for 2003." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 419.
- Reuter, R.F. and Spencer, P.D. (2002). "Other red rockfish." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 559.
- Sigler M.F., Lunsford, C.R., Fujioka, J.T., and Lowe, S.A (2002). "Alaska Sablefish Assessment for 2002." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 229.
- Spencer, P.D. and Ianelli, J.N. (2002). "Pacific ocean perch." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 515.
- Spencer, P.D. and Ianelli, J.N. (2001). "Pacific ocean perch." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 10-1.

- Spencer, P.D., Walters, G.E., and Wilderbuer, T.K. (2002). "Other Flatfish". Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 437.
- Thompson, G.G., Zenger, H.H., and Dorn, M.W. (2002a). "Assessment of the Pacific Cod Stock in the Gulf of Alaska." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 89.
- Thompson, G.G., and Dorn, M.W. (2002b). "Assessment of the Pacific Cod Stock in the eastern Bering Sea and Aleutian Islands Region." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Region, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 121.
- Turnock, B.J., Wilderbuer, T.K. and Brown, E.S. (2002). "Gulf of Alaska Flatfish." Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p.169.
- Wildebuer, T.K. and Walters, G.E. (2002). "Rock sole." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Regions, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 321.
- Wilderbuer, T.K. and Nichol, D. (2002). "Yellowfin Sole." Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands Regions, North Pacific Fishery Management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252, p. 207.

APPENDIX F

Essential Fish Habitat

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Essential Fish Habitat and Marine Protected Areas	F-3-1
1.1	Definition of EFH and a Regulatory Overview	F-3-2
1.2	Management Measures Used to Protect Habitat in Alaska	F-3-4
1.3	Designation of EFH	F-3-8
1.4	Potential Impacts of Fishing on Marine Habitat	F-3-9
1.5	Recommendations for Establishing MPAs in Alaska	F-3-15
1.6	Non-Consumptive Factors Associated with Establishing MPAs	F-3-21
Section 2	Alternative Analysis	F-3-22
Section 3	Alternative 1 – Continue Under the Current Risk-Averse Management Policy . . .	F-3-24
3.1	Overview of Management Measures Specific to MPAs and EFH	F-3-24
3.2	Effects of EFH/MPA Management Measures of the Alternative 1 Policy	F-3-34
Section 4	Alternative 2 – Adopt a More Aggressive Management Policy	F-3-41
4.1	Overview of EFH/MPA Management Measures of FMP Bookend 2.1	F-3-41
4.2	Effects of EFH/MPA Management Measures of FMP Bookend 2.1	F-3-41
4.3	Overview of EFH/MPA Management Measures of FMP Bookend 2.2	F-3-47
4.4	Effects of EFH/MPA Management Measures of FMP Bookend 2.2	F-3-47
Section 5	Alternative 3 – Adopt a More Precautionary Management Policy	F-3-50
5.1	Overview of EFH/MPA Management measures of FMP Bookend 3.1	F-3-50
5.2	Effects of EFH/MPA Management Measures of FMP Bookend 3.1	F-3-55
5.3	Overview of EFH/MPA Management Measures of FMP Bookend 3.2	F-3-55
5.4	Effects of EFH/MPA Management Measures of Bookend 3.2	F-3-56
Section 6	Alternative 4 – Adopt a Highly Precautionary Management Policy	F-3-62
6.1	Overview of EFH/MPA Management Measures of FMP Bookend 4.1	F-3-62
6.2	Effects of EFH/MPA Management Measures of FMP Bookend 4.1	F-3-62
6.3	Overview of EFH/MPA Management Measures of FMP Bookend 4.2	F-3-68
6.4	Effects of EFH/MPA Management Measures of FMP Bookend 4.2	F-3-70
Section 7	Data Gaps and Information Needs	F-3-72
Section 8	Comparative Analysis of the Alternatives	F-3-74
Section 9	Summary Comparison of All Alternatives	F-3-77
Section 10	References	F-3-79

TABLES

Table 1.	Chronology of groundfish management measures and closure areas protecting habitat under the BSAI and GOA groundfish FMPs.	F-3-5
Table 2.	Descriptive statistics for closure areas under Alternative 1 (as of Jan. 23, 2002). .	F-3-26
Table 3.	Intended and indirect effects of closure areas under Alternative 1.	F-3-29
Table 4.	Descriptive statistics for closure areas under FMP Scenario 2.1.	F-3-43
Table 5.	Descriptive statistics for closure areas under FMP scenario 2.2.	F-3-49
Table 6.	Descriptive statistics for closure areas under FMP scenario 3.1.	F-3-52
Table 7.	Descriptive statistics for closure areas under FMP scenario 3.2.	F-3-58
Table 8.	Descriptive statistics for closure areas under FMP scenario 4.1.	F-3-65
Table 9.	Descriptive statistics for closure areas under FMP scenario 4.2.	F-3-70
Table 10.	Percent of fishable area (in square kilometers) closed under Alternative 1 and FMP scenarios.	F-3-75

FIGURES

Figure 1.	Groundfish closures presently enacted in Alaska's Exclusive Economic Zone. Source: Coon <i>et al.</i> 1999.	F-3-7
Figure 2.	Essential fish habitat delineation.	F-3-16
Figure 3.	National Oceanic and Atmospheric Administration Fisheries' fishery impact scientific interest and study areas	F-3-17
Figure 4	Programmatic SEIS Illustration: FMP 1	F-3-27
Figure 5.	Existing Closure Areas in FMP Bookend 2.1.	F-3-42
Figure 6.	Closure Areas for FMP Bookend 2.2.	F-3-48
Figure 7.	Closure Areas of FMP Bookend 3.1.	F-3-51
Figure 8.	Phase I - MPA design and selection process. The goal of Phase I is to select candidate sites based on best available science and employing early involvement of stakeholders. Source: ADF&G 2002 and NRC 2001.	F-3-53
Figure 9.	Phase II - MPA design and selection process. The goal of Phase II is to designate MPA sites utilizing a process that maximizes public input and stakeholder concurrence. Source: ADF&G 2002 and NRC 2001.	F-3-53
Figure 10.	Phase III - MPA adaptive management process. The goal of Phase III is to evaluate MPA effectiveness and allow for changes in management to further advance site objectives. Source: ADF&G 2002 and NRC 2001	F-3-54
Figure 11.	Closure Areas for FMP Bookend 3.2.	F-3-57
Figure 12.	Closure Areas of FMP Bookend 4.1 (monochrome).	F-3-63
Figure 13.	Closure Areas of FMP Bookend 4.1 (full color).	F-3-64
Figure 14.	Closure Areas for FMP Bookend 4.2.	F-3-69
Figure 15.	Comparison of closure area percentages by FMP scenario.	F-3-76

ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
BSAI	Bering Sea and Aleutian Islands
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	centimeters
DOI	Department of Interior
EAs	Environmental Assessments
EBS	Eastern Bering Sea
EEZ	Exclusive Economic Zone
EISs	Environmental Impact Statements
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FMPs	Fishery Management Plans
E.O.	Executive Order
ft	feet/foot
GOA	Gulf of Alaska
HAPC	Habitat Areas of Particular Concern
IFQs	individual fishing quotas
km ²	square kilometers
LLP	License Limitation Program
m	meters
MMA	Marine Managed Areas
MPAs	Marine Protected Areas
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
nm ²	square nautical miles
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NRC	National Research Council
PSC	prohibited species catch
SEIS	Supplemental Environmental Impact Statement
SFA	Sustainable Fisheries Act
SSL	Steller sea lion
TAC	total allowable catch
U.S.	United States (of America)
VMS	Vessel Monitoring System

This page intentionally left blank

Section 1 Essential Fish Habitat and Marine Protected Areas

Protection of marine habitats including areas defined as essential fish habitat (EFH) is an integral component of the Groundfish Fishery Management Plans (FMPs) for the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA). This section considers the proposed closure areas under the four policy alternatives, and their direct/indirect effects on EFH and other aspects of the biological, physical, social, and economic environments.

Historically, the North Pacific Fishery Management Council (NPFMC) and Alaska Board of Fisheries have adopted, and the National Marine Fisheries Service (NMFS or NOAA [National Oceanic and Atmospheric Administration] Fisheries) has implemented, closures of certain areas to fishing in order to achieve a variety of objectives, all of which provide some level of habitat protection or reduced levels of disturbance. These historical closures, along with other measures such as time/area controlled harvest quotas, bycatch limits and gear restrictions, are legitimate fishery management tools that support designations of EFH and Habitat Areas of Particular Concern (HAPC) (EFH Final Rule: 50 Code of Federal Regulations [CFR] Part 600). HAPCs are habitat types or areas that may require extra protection and are defined using specific considerations (see Section 3.6 of the Programmatic Supplemental Environmental Impact Statement [SEIS]). In Alaska, HAPC has been specifically defined as living substrate in shallow and deep water, and freshwater areas used by anadromous fish.

One way that impacts to EFH and HAPC can be mitigated is through the designation of Marine Protected Areas (MPAs). In May of 2000, President Clinton signed an Executive Order (E.O.) 13158 “Regarding Marine Protected Areas in the United States.” This order directs the Department of Commerce and Department of the Interior to develop a plan for enhancing existing MPAs and establishing or recommending new MPAs, as appropriate.

MPAs are geographically defined areas designated with special protections to enhance the management of marine resources (Alaska Department of Fish and Game [ADF&G] 2002, National Research Council [NRC] 2001 and E.O. 13158). Specifically, MPAs can include the following types of management areas:

- **Marine Reserve (No-Take)** – a general category that prohibits the extraction of all living resources and disturbance or destruction of habitats. This includes critical habitat areas established to protect threatened or endangered species. Included in the Marine Reserves are Ecological Reserves where removal or disturbance of living or non-living marine resources as necessary for monitoring and research to evaluate reserve effectiveness is allowed. Access and recreational activities may be restricted in Marine Reserves to prevent damage to the resources. In the Programmatic SEIS management alternatives, the term “no-take marine reserve” is used to describe this type of closure area as applied to the groundfish fishery. An example from existing management is the Sitka Pinnacles Marine Reserve where all groundfish fishing is prohibited, but commercial and recreational salmon trolling is allowed. If the no-take concept were to be applied more broadly (in this case outside of the groundfish FMPs), consultation within and outside of NOAA Fisheries and the NPFMC would be required along with possible regulatory action.

- **Marine Fishery Reserve** – a closure area where extraction of a specified fishery resource is prohibited. These long-term, but not necessarily permanent closure areas are used to rebuild stocks, provide insurance against overfishing, or enhance fishery yield. Under the current groundfish FMPs, the Bogoslof Groundfish Closure Area could be considered to have the secondary intent of improving the groundfish fishery resources in the area, even though the primary intent of this closure is protection of Steller sea lions (SSLs).
- **Marine Habitat Reserve** – a closure area where habitat disturbance, such as the use of bottom contact fishing gear of specified types, is prohibited. The Programmatic SEIS denotes these areas as “no-trawl MPAs”. Examples from existing management would be the Red King Crab Savings Area and Pribilof Islands Habitat Conservation Areas (see Section 1.2 below). Most of the closures discussed under existing management fall into this category.

Many of the existing closure areas fit one or more of these definitions of an MPA, but have not been specifically defined as MPAs in the existing groundfish FMPs and Amendments.

1.1 Definition of EFH and a Regulatory Overview

In October 1996, the United States (U.S.) Congress reauthorized the Magnuson-Stevens Fishery Conservation and Management Act (MSA) through the Sustainable Fisheries Act (SFA). The Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600) was promulgated in January 2002. The intended effect of the rule is to promote the protection, conservation, and enhancement of EFH.

EFH is defined by the MSA as those waters and substrate necessary to manage fish species for spawning, breeding, feeding, or growth to maturity. For Alaska groundfish, this includes the habitat for all target groundfish species, non-target species, prohibited species, other species, and their prey. When viewed in aggregate, across all species, EFH is all pelagic and benthic habitat in the Alaska Exclusive Economic Zone (EEZ). The EFH definitions for all managed species are currently being reviewed by the NPFMC and NOAA Fisheries through its EFH amendment process. A decision on the Alaska EFH definitions will be made by the end of 2004. For purposes of this PSEIS, we therefore provisionally defined EFH generally as all benthic habitat.

The Final Rule also includes provisions requiring Regional Fishery Management Councils (Council) to amend their FMPs to describe and protect EFH and to mitigate any adverse impacts potentially caused by fishing activities. Consistent with these provisions, this analysis focuses on the following question: Do the alternative management policies result in conditions that offer protection to and minimization of adverse impacts to EFH? As explained above, this analysis focuses on benthic EFH, which is generally believed to be at greater risk to the impacts of fishing than non-benthic habitat in the water column. In addition, much of the analysis focuses on the impacts of bottom trawling. It is recognized that fixed gear (longlines, pots, and jigs) or pelagic trawl gear that comes in contact with the sea floor can disturb benthic EFH. In some types of habitat, fixed-gear may cause an impact due to its ability to be more easily fished on rougher substrates (e.g., boulders with coral) than bottom trawl gear. However, most scientific studies of gear impacts have dealt with bottom trawls and dredging because this gear is the most controversial (Auster and Langton 1999, Jennings and Kaiser 1998, Hall 1999, NRC 2002).

The Final Rule requires that FMP components include mitigation measures for the adverse effects of fishing. Fishery management options may include, but are not limited to fishing equipment restrictions, time area closures, and harvest limits. At present, environmental and human variables that could affect habitat quality are now addressed in the FMPs for both the BSAI and GOA (NPFMC 1999). However, the EFH environmental assessment (EA) and FMP Amendments 55/55, along with similar actions prepared by five other Councils, were challenged by a coalition of seven environmental groups and two fishermen's associations. The plaintiffs' challenge was twofold: 1) to prove that the agency's evaluation was not in compliance with the MSA, and 2) to prove that the documentation (Eas) did not comply with NEPA. The U.S. District Court for the District of Columbia found that the agency's evaluation of fishing gear impacts on EFH in the FMP amendments was in accordance with the MSA. However, the supporting EAs failed to comply with the requirements of the National Environmental Policy Act (NEPA) and the regulations promulgated by NPFMC on Environmental Quality (CEQ) and the NOAA. The court determined that the EAs did not consider the full range of relevant alternatives, nor did they fully explain the environmental impact of the proposed action and alternatives. In addition, the EAs failed to address any mitigative efforts to reduce adverse effects from fishing activities.

The Assistant Administrator of NOAA Fisheries determined that the agency would prepare new regional environmental impact statements (EISs) to include all FMPs covered by the EAs. Following are several key areas of guidance provided in his determination:

- The selected range of alternatives should be developed by taking into account comments NOAA Fisheries receives during the scoping process; the EIS must evaluate a reasonable range of alternatives for developing the mandatory EFH provisions of the affected FMPs.
- The analysis should include alternative ways of identifying EFH.
- The analysis should discuss alternative areas or different approaches that could be used to designate HAPCs.
- The alternatives analysis should identify a range of approaches that could be taken to minimize the adverse effects of fishing on EFH. If information is lacking on the effects of specific fishing practices on EFH, the analysis should examine alternatives that could be taken in the face of uncertainty.
- To the extent feasible, NOAA Fisheries should use the NEPA process as the vehicle for reviewing and revising the information contained in the original EFH FMP amendments. Such a review should include information regarding the description and identification of EFH, threats to EFH from fishing and non-fishing activities, and measures that could be taken to minimize those threats.

The proposed action to be addressed in the EFH EIS is the development of the mandatory EFH provisions of all five FMPs of the NPFMC: the Bering Sea and Aleutian Islands Groundfish; GOA Groundfish FMP; Bering Sea/Aleutian Islands King and Tanner Crab FMP; Scallop Fishery off Alaska FMP; and the FMP for the Salmon Fisheries in the EEZ off the Coast of Alaska. At present NOAA Fisheries and the NPFMC are identifying feasible alternatives for analysis in the EIS for NPFMC's eventual selection of a preferred alternative. The Alaska Groundfish Programmatic SEIS is not intended to replace or supercede the EFH EIS, but will provide overarching policy guidance for EFH and will set the stage for future FMP actions.

1.2 Management Measures Used to Protect Habitat in Alaska

Habitat Protection

Passage of the MSA in 1976 marked the beginning of efforts to integrate habitat considerations into the fishery management process. The MSA directs the Regional Councils to recommend management plans for commercial and recreational harvests of fish in the EEZ. For the most part, the individual states have responsibility for managing fisheries within the territorial sea. Although some early efforts were made to address significant fishery habitat issues, NPFMCs and NOAA Fisheries concentrated largely on ocean harvest during the first decade after passage of the MSA.

In 1983, NOAA Fisheries adopted a National Habitat Conservation Policy, uniting its MSA authority with its advisory responsibilities and authority under the Fish and Wildlife Coordination Act and NEPA. The National Habitat Conservation Policy provides guidance to the agency regarding interactions with NPFMCs and with federal and state agencies. It also focuses NOAA Fisheries' habitat conservation efforts on specific habitat impacts potentially affecting fishery resources, marine mammals, and endangered marine species. Although the policy notifies other agencies and NPFMCs of NOAA Fisheries' intent, it does not clarify NPFMCs' role in fishery-related habitat issues.

In 1986, Congress amended the MSA, essentially codifying elements of the NOAA Fisheries Habitat Conservation Policy and giving NPFMCs new authority and responsibility to include “readily available” habitat information in all FMPs. The amendments to the MSA direct NPFMCs, with guidance from NOAA Fisheries, to evaluate fishery practices and assess any practices changing the habitat important to commercial fisheries. Furthermore, the 1986 amendments give NPFMCs the opportunity to recommend habitat management measures for ongoing and proposed federal and/or state activities that could potentially adversely affect fishery resources. Federal agencies are required to respond specifically and substantively to a Council's recommendations within 45 days. The amendments also encourage NPFMCs to monitor state activities and to comment on those activities that could adversely affect Council-managed fishery resources.

In September 1988, the NPFMC adopted a policy to guide the review of habitat issues. In light of this policy, the NPFMC and NOAA Fisheries have enacted certain measures that are consistent with protecting habitat and ecosystem components from potential negative impacts of fisheries. These measures include the use of closed areas to protect habitat. As a result, several areas of the Bering Sea were closed to groundfish trawling and scallop dredging to reduce potential adverse impacts on the habitat for crab and other resources. A chronology of management measures undertaken by the NPFMC with the primary intent or secondary effect of protecting habitat is provided in Table 1. Figure 1 depicts the groundfish closures presently enacted in Alaska's EEZ.

Table 1. Chronology of groundfish management measures and closure areas protecting habitat under the BSAI and GOA groundfish FMPs.

Year	Location	Season	Area Size	Notes
Bering Sea and Aleutian Islands (BSAI)				
1982 - BSAI groundfish Fishery Management Plan (FMP); descriptions of fish habitat, gear restrictions, and several no-trawl zones.				
1983 - National Oceanic and Atmospheric Administration (NOAA) Fisheries adopts a National Habitat Conservation Policy.				
1985 - Intentional discarding of fishing gear and debris prohibited.				
1986 - Magnuson-Stevens Act (MSA) amended to give Councils authority to protect habitat and recommend habitat protection measures.				
1986 - Habitat policy added to BSAI FMP.				
1987	Area 512	Year-round	8,000 square nautical miles (nm ²)	Trawling prohibited to protect king crab habitat.
	Area 516	3/15-6/15	4,000 nm ²	Trawling prohibited during crab molting period.
1995	Chum Salmon Savings Area	8/1-8/31	5,000 nm ²	Re-closed if 42,000 chum salmon bycaught.
	Chinook Salmon Savings Area	Trigger	9,000 nm ²	Closed if 48,000 chinook salmon bycaught.
	Herring Savings Area	Trigger	30,000 nm ²	Closed to specified trawl fisheries when trigger reached.
	Zone 1	Trigger	30,000 nm ²	Closed to specified trawl fisheries when trigger reached.
	Zone 2	Trigger	50,000 nm ²	Closed to specified trawl fisheries when trigger reached
	Pribilof Islands	Year-round	7,000 nm ²	Established to protect red king crab habitat.
	Red King Crab Savings Area	Year-round	4,000 nm ²	Bottom trawling prohibited by emergency rule, pelagic trawling allowed.
	Walrus Islands	5/1-9/30	900 nm ²	12-mile no-fishing zones around 3 haulouts.
1995	Steller sea lion (SSL) Rookeries	Year-round	5,800 nm ²	10-mile no-trawl zones around 27 rookeries .
	SSL Rookeries	Seasonal ext.	5,100 nm ²	20-mile extensions around 8 rookeries.
1996 - same closures in effect as in 1995.				
1997 - Red King Crab Savings Area permanently established as year-round closure area.				
1997 - same closures in effect as in 1995 and 1996, with two additions:				
1997	Nearshore Bristol Bay	Year-round	19,000 nm ²	Expanded area 512 closure.
	Opilio Tanner Crab Bycatch Limitation Zone	Trigger	90,000 nm ²	Closed to specified trawl fisheries when trigger reached.
1998 - same closures in effect as in 1995, 1996, and 1997				
1999 - same closures in effect as in 1995, 1996, 1997, and 1998				
2000 - Non-pelagic trawls prohibited in BSAI pollock fisheries.				
2000 - same closures in effect as in 1995, 1996, 1997, and 1998 with three additions:				
2000	Eastern Bering Sea (EBS) and Aleutian Islands (AI) Pollock Trawl exclusion zones	Year-round	11,900 nm ² (Inc. Gulf of Alaska [GOA])	Trawling for pollock prohibited for SSL protection.
	EBS and AI Pollock Trawl exclusion zones	Jan-June	14,800 nm ² (Inc. GOA)	Trawling for pollock prohibited for SSL protection.
	EBS and AI Trawl exclusion zones	Year-round	29,000 nm ² (Inc. GOA)	Trawling for Atka Mackerel restricted for SSL protection.

Table 1 (cont.). Chronology of groundfish management measures and closure areas protecting habitat under the BSAI and GOA groundfish FMPs.

Year	Location	Season	Area Size	Notes
2001- same closures in effect as in 1995, 1996, 1997, 1998, 1999, and 2000.				
2002 -same closures in effect as in 1995, 1996, 1997, 1998, 1999, 2000, and 2001.				
Gulf of Alaska				
1978 - GOA groundfish FMP; descriptions of fish habitat, gear restrictions, and area closures to foreign fishing.				
1985 - NOAA Fisheries habitat policy added to GOA FMP.				
1987	Kodiak	Year-round	1,000 nm ²	Trawling prohibited; Intended to protect juvenile red king crab habitat
	Kodiak	2/15-6/15	500 nm ²	Trawling prohibited; Intended to protect juvenile red king crab habitat
1990 - Kodiak trawl closures extended				
1993 - Kodiak no-trawl zones made permanent				
1995	SSL Rookeries	Year-round	3,000 nm ²	10–mile no-trawl zones around 14 rookeries
	SSL Rookeries	Seasonal ext.	1,900 nm ²	20–mile no-trawl extensions around 3 rookeries
1996 and 1997 same closures in effect as in 1995.				
1998 same closures in effect as in 1995, 1996, and 1997, with one addition:				
1998	Southeast Trawl areas	Year-round	52,600 nm ² (1,929 nm ² on continental shelf)	Adopted as part of license limitation program, all trawling prohibited East of 140°
1999 Additional closures to protect SSL critical habitat and:				
1999	Sitka Pinnacles Marine Reserve	Year-round	3.1nm ²	Closure to all commercial gear
2000 same closures in effect as in 1995, 1996, 1997, 1998, and 1999 plus:				
2000	GOA Pollock Trawl exclusion zones	Year-round	11,900 nm ² (Inc. EBS & AI)	SSL protection
	GOA Pollock Trawl exclusion zones	Jan-June	14,800 nm ² (Inc. EBS & AI)	SSL protection
	Cook Inlet Trawl Closure	Year-round	7,000 nm ² (inc. state waters)	Control crab bycatch and protect crab habitat in an area with depressed King and Tanner crab stocks.
2001 same closures in effect as in 1995, 1996, 1997, 1998, 1999, and 2000.				
2002 same closures in effect as in 1995, 1996, 1997, 1998, 1999, 2000, and 2001.				

Source: NMFS 2001a and Coon *et al.* 1999

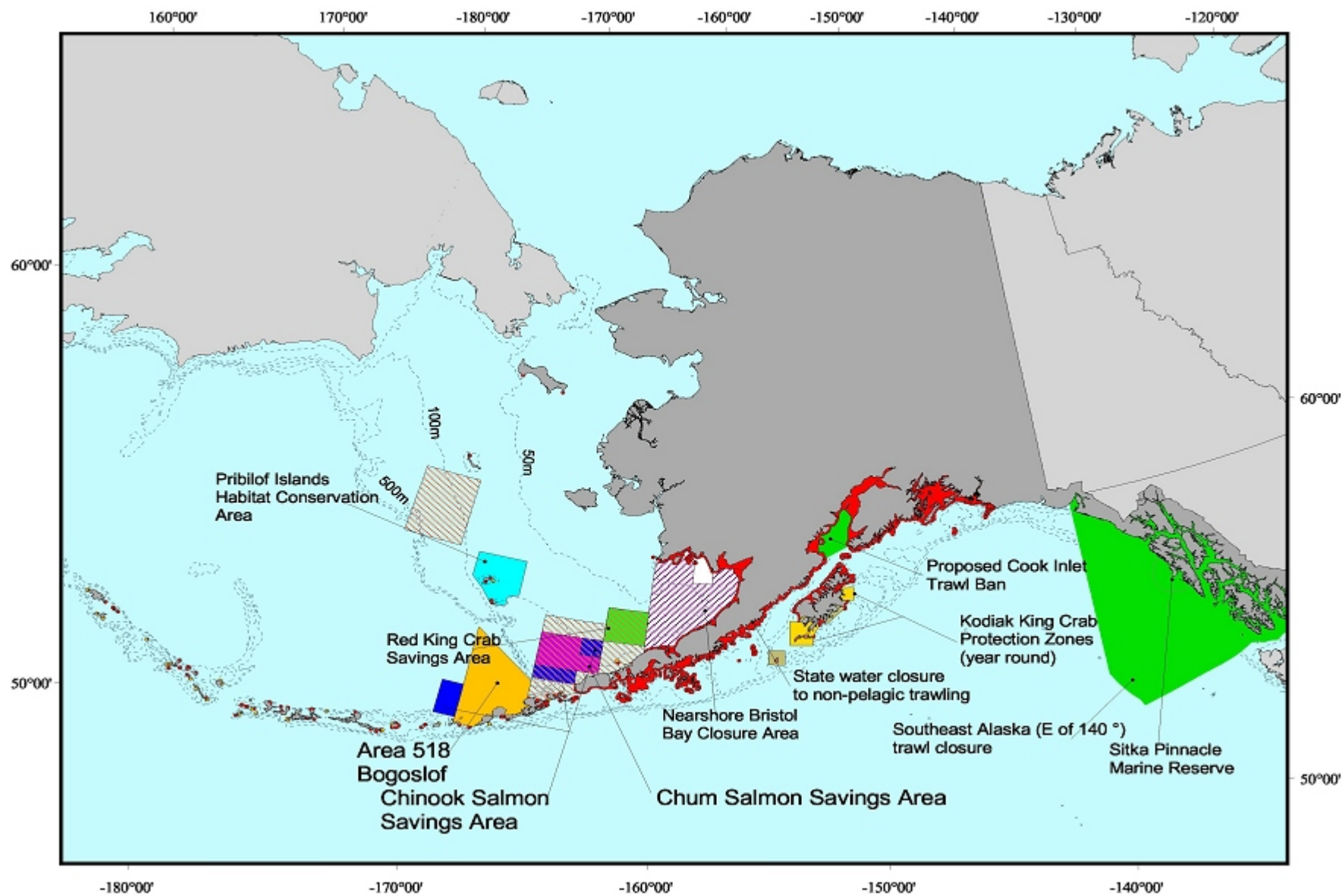


Figure 1. Groundfish closures presently enacted in Alaska's Exclusive Economic Zone. Source: Coon *et al.* 1999.

1.3 Designation of EFH

The 1996 re-authorization of the MSA mandated that NOAA Fisheries and NPFMCs specifically describe and identify EFH within the FMPs. The MSA also required that FMPs minimize, to the extent practicable, adverse effects on EFH caused by fishing. NOAA Fisheries and the NPFMC prepared one EA and a comprehensive set of Habitat Assessment Reports to address the new EFH requirements of the MSA (NPFMC 1999). EFH FMP amendments were submitted to the Secretary in October 1998. The amendments were reviewed and approved by the Secretary of Commerce and took effect on January 20, 1999 (64 CFR 20216). These FMP amendments identified EFH for 80 individual species including target and other fish, and for five species groups, incorporating a total of 115 individual species. In cases where information was available, EFH was identified by each particular life stage for a given species (34 of the 80 individual species fell into this category).

According to the Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600), to identify EFH, basic information is needed to understand the usage of various habitats by each managed species. Pertinent information includes the geographic range and habitat requirements by life stage, the distribution and characteristics of those habitats, and current and historic stock size as it affects occurrence in available habitats. Temporal and spatial distribution of each life history stage is necessary to understand each species' relationship to, or dependence on, its various habitats. Data summarizing all environmental and habitat variables that control or limit distribution, abundance, reproduction, growth, survival, and productivity of the managed species should be provided.

Councils must obtain this information to describe and identify EFH from the best available sources, including peer-reviewed literature, unpublished scientific reports, data files of government resource agencies, fisheries landing reports, and other reliable sources. The scientific rigor of the reports and species-specific data gaps and potential deficits in data quality should be taken into consideration.

To analyze habitat information, the EFH Final Rule specifies the following levels for organizing the data necessary to describe and identify EFH:

- **Level 1:** Distribution data are available for some or all portions of the geographic range of the species. Distribution data may be derived from presence/absence sampling and/or may include opportunistically collected information on species and life stages. In the event that distribution data are available for only portions of the geographic area occupied by a particular life history stage of a species, habitat use can be inferred on the basis of distributions among habitats where the species has been found and on anecdotal information about its habitat requirements and behavior. Habitat use may also be inferred from information on a similar species or another life stage.
- **Level 2:** Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life history stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.

- **Level 3:** Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life history stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).
- **Level 4:** Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production, consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

Councils should strive to obtain data sufficient to describe habitat at the highest level of detail (i.e., Level 4). If there is no information on a given species or life stage, and habitat use cannot be inferred from other means, EFH should not be designated.

The NPFMC (1999) identified EFH information levels for groundfish, crab, scallops, and salmon in the Alaska region. Level 2 data is available for some adult life history stages of groundfish, crabs, and shellfish. Level 2 data is also available for some stocks of red and blue king crab, and tanner and snow crab stocks in some regions, at the egg, larval, late juvenile, and adult stages. The remainder of the data for all other crab stocks is either at Level 1 or unknown. Level 1 data is available for the eggs, larvae, early juvenile, and late juvenile stages of pollock, and for the late juvenile stages of most other groundfish species. Even minimal (Level 1) data are not available for forage fish at all life stages, so distribution and habitat use are considered to be unknown. Salmon EFH data are highly variable and cross Levels 1 through 4 depending on species, stock, and life stage. The majority of the data available for adults in the freshwater stage ranges from Levels 1 to 3. The information levels for all EFH are continually being refined and updated and will be presented in the EIS currently being developed for EFH.

1.4 Potential Impacts of Fishing on Marine Habitat

It is important to distinguish between the direct and indirect effects of trawling and dredging on marine habitat (NRC 2002). Direct and immediate effects of fishing gear potentially include the following:

- Mortality either as intended catch or bycatch or incidental by killing benthic and demersal species or increasing their vulnerability to predators;
- Increased food availability for scavengers due to discarded fish, fish offal, and dead benthic organisms; and
- Loss of habitat due to scraping and plowing, thereby destroying seafloor habitat.

Indirect effects are removed in space and/or time from the actual fishing activity. These effects include post-fishing mortality and reductions in total biomass of target fish. The reductions in biomass could subsequently affect predators, prey, competitors of the targeted species, and the overall benthic community structure. Indirect effects also could be realized at the ecosystem level due to potential changes in energy flow and shifts in the processes of primary production, primary consumption, and secondary production (NRC 2002). An assessment of the potential effects (encompassing both direct and indirect effects) must include the following information.

- Effects of different types of fishing gear on different types of habitat;
- Frequency and geographic distribution of fishing effort; and
- Physical and biological characteristics of the seafloor in the areas being fished.

Effects of Fishing Gear on Habitat

Types of potential effects from fishing gear on habitat are outlined below.

- Alteration of the physical structure;
- Direct mortality of benthic organisms;
- Sediment suspension;
- Chemical modifications to the water column;
- Benthic community changes; and
- Ecosystem changes.

Alteration of Physical Structure

Physical effects of fishing gear such as plowing, smoothing of sand ripples, removal of stones, and turning of boulders can act to reduce the heterogeneity of the sediment surface. Boulder piles, crevices, and sand ripples can provide fish and invertebrates hiding areas and a respite from the need to swim against currents (Rose in prep.). Removal or alteration of these features and of taxa such as worm tubes, corals, and gorgonians that provide relief, and the removal or shredding of submerged vegetation, can also occur, thereby reducing structures available to biota as habitat (see NMFS 2002, Kaiser *et al.* 1998, Lindebloom and de Groot 1998, Auster and Langton 1999).

Any type of fishing gear that is towed, dragged, or dropped on the seabed will disturb the sediment and the resident community to varying degrees. The intensity of disturbance is dependent on the type of gear, sediment type, and frequency of disturbance. See Section 3.6 for a detailed description of different types of fishing gears and their relative disturbance. Heavy gears such as the shellfish dredge and the flatfish beam trawl disturb the seabed intensely. Lighter gears, such as the otter trawl, predominately used in Alaska, also cause disturbance mostly due to the trawl doors and foot ropes which can leave tracks or trenches up to several meters wide and can remove or displace boulders (Hall 1999). There are no studies of fishing gear effects that use gear that is directly comparable to Alaskan pelagic trawls. By regulation, these trawls must not use bobbins or other protective devices, so the footropes are small in diameter, and typically consist of bare chain. Pelagic trawls are fished with the doors above the seafloor, so door effects are not realized. Because the footrope is unprotected, these trawls are not used on rough or hard substrates and therefore do not contact some of the most vulnerable habitats (Rose in prep.).

A number of papers describe trawl marks on substrate, including Gilkinson *et al.* (1998), who describe the scouring process in detail as part of a model door study. It is not known if the trenches might compensate for the sediment smoothing actions of other gears (NMFS 2002). The actions of roller gear trawls can replace natural sediment structures (hummocks, biogenic features, and sand ripples) with other, anthropogenic structures (door, footrope, and roller tracks). In habitats with an abundance of such natural structures, this can represent a decrease in habitat complexity, while in naturally smooth areas, an increase in complexity would be apparent.

with an abundance of such natural structures, this can represent a decrease in habitat complexity, while in naturally smooth areas, an increase in complexity would be apparent.

Very little information exists regarding the effects of longlining on benthic habitat (see Section 3.6 of Programmatic SEIS). Rose (in prep.) postulates that due to the very light weight of the lines used with longline gear, effects on substrate and benthic organisms would be limited to the impact of anchors and weights. These make up less than 1/500th of the total length of the gear, so effects on the soft bottoms should be very small. However, effects in hard bottom areas could be realized through snagging on smaller boulder piles and other emergent structures. In a report presented by NPFMC (1992), the authors determined that setline gear often lies slack and can meander for a considerable distance along the bottom. During the retrieval process, the line sweeps the bottom for considerable distances before ascending. It snags on objects in its path, including rocks and corals. Invertebrates and other lightweight objects are dislodged and pass over or under the line. If a line becomes hung or breaks during the retrieval process, the other end, which also has a float, can be used to complete the gear retrieval.

Although little research has been conducted to document the impacts to physical structure from pot gear, it is likely that benthic structures (both living and non-living) could be impacted as the pots are dropped or dragged along the bottom (see Section 3.6 of Programmatic SEIS). Eno *et al.* (2001) observed that impacted sea pens were able to recover within 72 to 144 hours of the pots being removed. The study concluded that the use of pots and traps has no lasting effects on three different habitat types. However, this study used gear much smaller and lighter than that used in Alaska waters, so the results are not directly applicable. Alaska pots have mesh bottoms that are suspended 2.5 to 5 centimeter above the weight rails that initially contact the substrate (Rose in prep.). The greater weight of the pots is concentrated in a smaller area beneath the pot. Also of concern is the incidence of bottom disturbance by the weight rails as the pot is dragged across the seafloor by bad weather, currents, or during hauling. Rose (in prep.) assumes that the average pressure applied to the seafloor along the rails would be sufficient to penetrate into most substrates during lateral movement. This effect was speculated to be most similar to the effects of pelagic trawls. However, effects could be minimized by pot longline fishermen who retrieve gear by holding the vessel in deeper waters. This allows the gear and pot to be pulled up off the bottom and then be suspended pelagically until the completed set is brought aboard, thereby somewhat reducing bottom effects.

Direct Mortality of Benthic Organisms

In addition to effects on the physical habitat, trawling can cause direct mortality to emergent epifauna. In particular, erect, foliose fauna (fauna which build reef-like structures) can be destroyed by towed gear, longlines, or pots (Hall 1999). Within the trawl track, which could range up to several meters wide, epifauna such as sponges, corals, or gorgonians are often removed, crushed, or broken (Van Dolah *et al.* 1987). Large coral colonies may be hundreds of years old (Risk *et al.* 1998). The habitat created by these gorgonians may be occupied by communities with high biodiversity and may provide shelter for fish (Risk *et al.* 1998, Fossa *et al.* 1999). Given their size and longevity, gorgonian corals may be especially vulnerable to fishing impacts and may take over 100 years to recover (Andrews *et al.* 2002). Although scientists have a limited understanding of its importance as fish habitat, deep water coral clearly provides vertical structure for fish to use for protection and cover. This has been observed in Alaska during submersible dives (Krieger and Wing 2002).

Freese *et al.* (1999) found during experimental trawling studies in the GOA that no motile invertebrates showed reductions in density as a result of trawling. The researchers also note that apparent damage to echinoids, holothurians, molluscs, and arthropods was < 1 percent. However, the authors observed that sponges and sea whips are especially vulnerable to trawl damage, and extensive trawling over wide areas could impact spatial patterns of invertebrate diversity. More detailed information regarding impacts of trawling on marine benthic organisms is provided in Section 3.6 of Programmatic SEIS.

Sediment Suspension

Resuspension of sediment can occur as fishing gear is pulled along or immediately above the seafloor (NMFS 2002). The chronic suspension of sediments and resulting turbidity can affect aquatic habitat by reducing available light for photosynthesis, burying benthic biota, smothering spawning areas, and causing negative effects on feeding and metabolic rates. If occurring over large areas, resuspension can redistribute sediments having implications for nutrient budgets by burying fresh organic matter and exposing deeper anaerobic sediments (Messieh *et al.* 1991, Black and Parry 1994, Mayer *et al.* 1991, and Pilskaln *et al.* 1998). The effects may be more pronounced in shallower water.

Species' reaction to turbidity depends on life history characteristics of the organism. Effects are likely to be more significant in waters that are normally clear as compared with areas that typically experience high naturally induced turbidity (Kaiser 2000). Motile organisms can move out of the affected area and quickly return once the turbidity dissipates (Coen 1995). Even if species experience high mortality within the affected area, those with high levels of recruitment or high mobility can re-populate the affected area quickly. Sessile or slow-moving species would likely be buried and could experience high mortality. If effects are protracted and occur over a large area relative to undisturbed area, recovery through recruitment or immigration may be hampered. Furthermore, chronic resuspension of sediments may lead to shifts in species composition by favoring those species that are better suited to recover or those that can take advantage of the additional nutrient supply as the nutrients are released from the seafloor to the euphotic zone (Churchill 1989).

Chemical Modifications to the Water Column

Disturbance due to fishing gear can cause changes in the chemical composition of the water column overlying impacted sediments. In shallow water, the impacts may not be noticeable relative to mixing effects caused by tidal and storm surges, and wave action. However, in deeper, calmer areas with more stable waters, the changes in chemistry may be evident (Rumohr 1998). Increases in ammonia content and decreases in oxygen have been observed in the North Sea waters, along with pulses of phosphate. Although these changes have been documented, it is not clear how they affect fish populations. Increased incidence of phytoplankton blooms could occur during seasons when nutrients are typically low. The increase in primary production could have a positive effect on zooplankton communities and on organisms up the food chain. Eutrophication (the stimulation of algae blooms due to high nutrient concentrations), often considered to be a negative effect, could also occur. However, it is important to note that these releases of nutrients to the water act to recycle existing nutrients and thereby make them available to benthic organisms rather than add new nutrients to the system (ICES 1992). The recycling is thought to be less influential in the eutrophication process than the input of new nutrients from rivers and land runoff.

Changes to the Benthic Community and Ecosystem

Benthic community structure can be impacted due to direct mortality of benthic organisms, potentially causing a shift in the community from low-productive, long-lived species (k-selected species) to highly productive, short-lived, rapidly colonizing species (r-selected species). Motile species that exhibit high fecundity and rapid generation times will recover more quickly from trawl-induced disturbance than non-mobile slow-growing organisms, leading to a potential community shift in chronically trawled areas (Levin 1984, NMFS 2002).

The physical structure of the biota also determines their ability to withstand and recover from the physical impacts of fishing gear. For example, thinner shelled bivalves and sea stars often suffer higher damage than solid shelled bivalves (Rumohr and Krost 1991). Animals that can retract below the penetration depth of the fishing gear and those that are more elastic and can bend upon contact with the gear also fare much better than those that are hard and inflexible (Eno *et al.* 2001). In chronically trawled areas, a switch in dominant species based on these avoidance and survival traits could be evident.

Increased fishing pressure in a given area can also lead to changes in species distribution; changes could be evident in benthic, demersal, and even pelagic species (i.e., localized depletion). Specifically, McConnaughey *et al.* (2000) examined the effects of chronic trawling on soft-bottom benthos of the eastern Bering Sea (EBS). They found that overall species diversity and niche breadth of sedentary taxa were greater in unfished areas. The authors have also speculated that mobile fishing may lead to increased populations of opportunistic feeders in chronically trawled areas.

Frequency and Geographic Distribution of Fishing Effort

The continental shelf and slope region off the coast of Alaska comprises one of the most extensive fishing grounds in the world (NRC 2002). Bottom trawling in the Bering Sea began in 1929 with a Japanese operation and continued through the 1930s and early 1940s, recommencing in the 1950s after World War II. Soviet and other distant water trawl fishing operations intensely fished the Bering Sea and GOA through the 1960s and 1970s. Domestic bottom trawling began as joint ventures in the Bering Sea in 1978 after passage of the MSA in 1976. These U.S. trawl activities grew rapidly during the 1980s and had displaced foreign fishing by the end of the 1980s. Presently the groundfish fleet is divided into catcher vessels and catcher processors. In 1999, the catch was almost equally divided between the two sectors (NMFS 2001a).

Non-pelagic trawling (bottom trawling) in the Bering Sea during the early 1990s was most intense on the slope and shelf area north of the Aleutian Islands (NRC 2002). The Alaska peninsula in the area of Unimak Island, east of the Pribilofs west of Bristol Bay and off of Cape Constantine were also heavily fished. Virtually all areas of the Bering Sea have experienced some degree of exposure to bottom trawls (see Section 3.6 of Programmatic SEIS). However, the intensity of exposure, measured in trawls made per unit area, varies substantially. These patterns reflect the nonrandom behavior of fishing fleets, which is based on historical patterns of performance and regulatory restrictions. Relatively heavy trawling has occurred in three places: along the continental shelf edge, along the Alaska Peninsula near Unimak Island, and in Togiak Bay. The primary composition of the catch in these three areas, respectively, is 1) pollock, Pacific cod and Greenland turbot, 2) Pacific cod and pollock, and 3) yellowfin sole (Fritz *et al.* 1998).

However, large areas of the Bering Sea presently have no trawling activity because of closed management areas, less productive fishing grounds, or unobserved tows. Both the spatial extent and intensity of fishing effort decreased in the 1990s. Over large parts of the Bering Sea observations ranged from either no bottom trawls or only about four tows averaged over two years (NRC 2002). There were also significant reductions in the geographic extent and intensity of trawling the GOA also. The number of tows in the GOA region was reduced by about half due to management area closures and general reductions in fishing effort associated with fisheries management. The area experiences a relatively low intensity of trawling as compared with other regions of the United States (NRC 2002). Section 3.6 (of Programmatic SEIS) provides additional discussion on the frequency of trawling in the Bering Sea and GOA.

The relative significance of seabed disturbance by mobile and other fishing gear must be considered in light of the magnitude and frequency of seabed disturbance due to natural causes. De Alteris *et al.* (1999) found that in a shallow, sand substrate where natural processes are disturbing the seabed regularly, recovery of the substrate from gear-related disturbance was almost immediate. However, in deep, mud substrates the analyses indicated that natural processes are rarely capable of disturbing the seabed; therefore, recovery from gear-related disturbance was slow. Many studies summarized by NRC (2002) and NMFS (2002) indicate that more stable, biogenic, gravel and mud habitats experience the greatest impacts from trawling and have the slowest recovery rates. By comparison, those areas with less consolidated, coarse sediments that also typically experience high rates of natural disturbance, show fewer impacts. These habitats tend to be populated by opportunistic species that recolonize the area rapidly, thereby reducing recovery times. Section 3.6 (of Programmatic SEIS) provides additional discussion of the relative impacts of fishing on different habitats.

Physical and Biological Characteristics of the Seafloor

Most bottom fishing off the coast of Alaska takes place on the continental shelf and upper slope in water depths of less than 500 meters (m). The seafloor affected, or potentially affected, covers a wide range of habitats, from relatively featureless sand and mud to more complex rocky areas and HAPCs. As discussed previously under Alteration of Physical Structure, hard substrates and rocky areas provide the most habitat complexity for the benthic community and are likely to be more vulnerable to fishing disturbance.

Four habitat types in the Bering Sea shelf were defined by Rose (in prep.) using habitat sediment data in Smith and McConnaughey (1999). Figure 2 depicts these habitat strata. The first, situated around the shallow eastern and southern perimeter of the shelf and near the Pribilof Islands, consists of sand substrates with a small amount of gravel. The second lies across the central shelf out to the 500-m contour and is composed of mixtures of sand and mud. A third strata, west of a line between St. Matthew and St. Lawrence Islands, is composed primarily of mud (silt) substrates with some sand. The fourth strata, found north and east of St. Lawrence Island including Norton Sound, consists of a complex mixture of substrates that are not easily separated out or defined; however, these areas are subject to very little fishing effort.

A similar comprehensive substrate data set does not exist for the GOA and Aleutian Islands. Both of these areas have complicated substrates with mixtures of hard (pebbles, cobbles, boulders, and rock) and soft (silt, sand, and gravel) substrates, but data are not sufficient to describe the spatial distributions of these substrates. However, data collected from NOAA Fisheries groundfish surveys regarding "trawlability" were compiled to approximate percentages of hard substrate in the following depth strata (Rose, in prep.).

- Shallow waters (1-100 m) - 19 percent hard substrate.
- Deeper areas on the shelf (gullies; 100-300 m) - 5 percent hard substrate.
- Upper slope (200-500 m) - 10 percent hard substrate.

These areas are also depicted on Figure 2. As presented below, the percentages of hard bottom substrate as derived from “trawlability” data are limited in interpretation.

- A standard trawl may function well on hard substrate consisting of smoother pebbles and cobbles.
- Trawlable bottom may be found in areas of mostly hard substrate.
- Patches of soft bottom may exist in otherwise untrawlable areas.

As described above, there is a considerable lack of scientific information on benthic habitats found in the EEZ. Thus, NOAA Fisheries through the Alaska Fisheries Science Center (AFSC) is presently conducting research to map limited areas of the Alaska EEZ for geographic characterization. In 2000, 900 square kilometers of seafloor near Kodiak were mapped and during July 2002 an additional 500 square kilometers near Yakutat were mapped using a high-resolution multi-beam echo-sounder. Survey depths ranged from 100 m to 760 m and the seafloor consisted of irregular seabed with mixed sediments (sand, mud, gravel) and high-relief areas consisting of boulders. As it is completed, the mapping of the area will allow habitat characterization to be compared to fishing intensity for analysis of impacts. Figure 3 depicts scientific interest and research areas presently being studied by NOAA Fisheries.

1.5 Recommendations for Establishing MPAs in Alaska

In order to comply with the requirements of E.O. 13158 mandating the establishment of MPAs, NOAA, in conjunction with the Department of Interior (DOI) and other partners, has created the MPA Center, the mission of which is to facilitate the effective use of science and information in the management of MPAs (see <http://www.mpa.gov>). E.O. 13158 defines an MPA as “any area of the marine environment that has been reserved by federal, state, territorial, tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” Moreover, it defines “marine environment” to mean “those areas of coastal and ocean waters, the Great Lakes and their connecting waters, and submerged lands there under, over which the United States exercises jurisdiction, consistent with international law.”

Given the breadth of this definition and the wide array of potential sites it includes, the MPA Center has developed operational criteria to interpret the definition consistently and to decide whether to consider specific sites or entire classes of sites for inclusion in the official inventory. According to the MPA Center, to be included in the MPA List the site must meet the following criteria:

- Have defined geographical boundaries or a definable geographic location and: a) may or may not be associated with the underlying seabed and b) may be of any size, but must be a subset of the U.S. federal, state, territorial, local, or tribal waters.

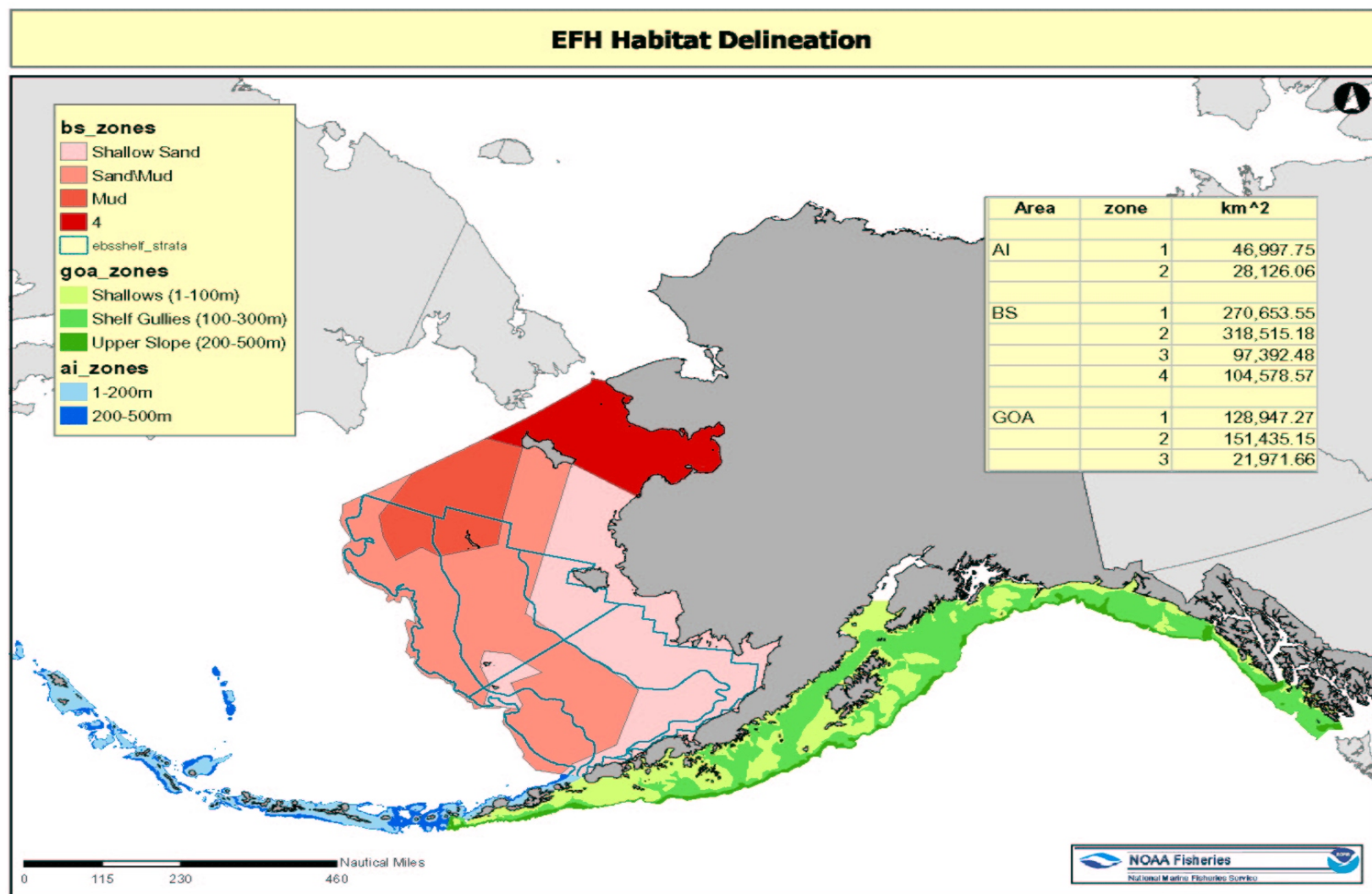


Figure 2. Essential fish habitat delineation.

NMFS Fishery Impact Scientific Interest and Study Areas*

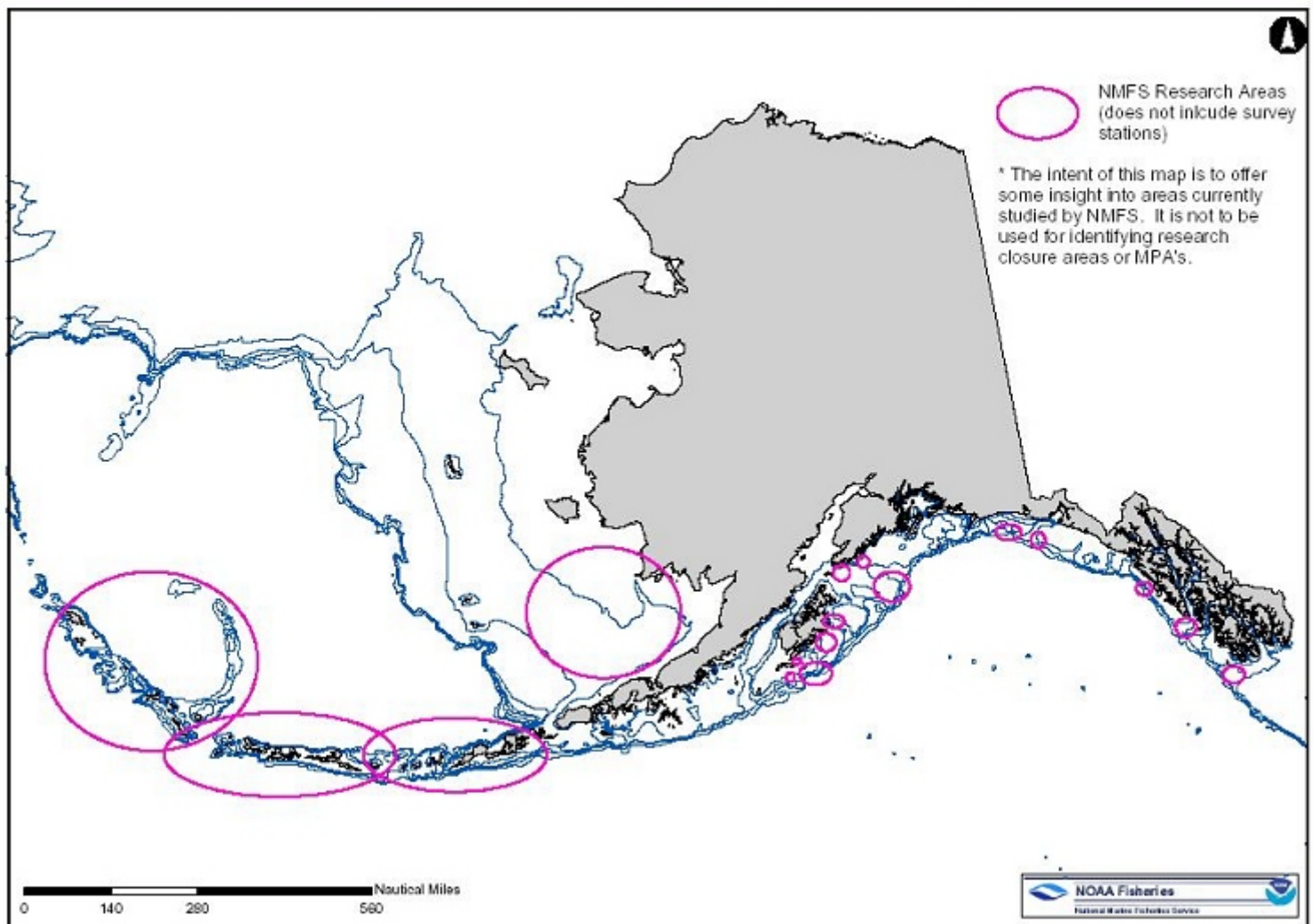


Figure 3. National Oceanic and Atmospheric Administration Fisheries' fishery impact scientific interest and study areas.

- Encompass: a) areas of the oceans, coastal waters, bays and/or estuaries; or b) the Great Lakes and their connecting waters.
- Have a marine component which may include an intertidal area and may have an associated land (terrestrial) component.
- Be authorized by some form of federal, state, territorial, local or tribal law, or regulations.
- Provide year-round (12 months) protection.
- Be established with an expectation of, or at least the potential for, permanence. Areas with a sunset clause must provide a minimum of four years of continuous protection and must have a specific mechanism to renew protection at the expiration of the sunset period.
- Have existing laws/regulations that apply to the MPA and that were designed to afford increased protection to part or all of the natural and cultural resources therein, beyond any general protections which apply outside the MPA.

Specifically, the MPA Center's working definition excludes sites that fit in the following categories:

- Areas of the U.S. EEZ that are covered under legal authorities but have no distinct boundaries with specific authorities for resource protection.
- Areas subject to generic resource management authorities linked to habitat type but without specific locations.
- Areas subject to species-specific conservation authorities that are not focused on a definable geographic area.
- Strictly freshwater areas outside the Great Lakes that contain marine species at certain seasons or life history stages.
- Privately created and maintained marine areas.
- Areas subject to emergency measures designated for fisheries or other purposes.
- Mitigation sites and other temporarily closed areas.
- Areas set aside to avoid fishing gear conflicts.
- Areas subject to single species management measures that do not have demonstrable benefits to a broader array of species or habitats.
- Areas subject to fisheries quota management tools.

Taken together, these criteria provide the basis for the MPA List Site Working Definition. The MPA Center will coordinate the implementation of the E.O. by developing “a framework for a national system of MPAs, and federal, state, territorial, tribal, and local governments with the information, technologies, and strategies to support the system.”

The Departments of Commerce and the Interior are the implementing agencies for developing the MPA List. A five-step process is proposed to determine which sites should be added to the official MPA List. While this process is still under agency review, it is presented here to illustrate the process that has been followed to date:

1. The implementing agencies, working collaboratively with federal, territorial, state, local, and tribal partners, identify potential sites for consideration as marine managed areas and MPA List Sites.
2. Basic information about the sites is gathered by the implementing agencies (see Initial Data Fields Available from the Inventory at <http://www.mpa.gov>) and is compiled in the Marine Managed Areas (MMA) Inventory.
3. A review panel of the implementing agencies considers each site in the MMA Inventory to determine if it meets the criteria for an MPA List Site. Those sites that meet all criteria will be forwarded for approval by the Secretaries of Commerce and the Interior or their designates. Those that do not will remain in the inventory database.
4. Sites approved by the Secretaries or their designates will be entered on the official MPA List.
5. The implementing agencies will initiate an expanded data collection effort for sites on the MPA List.

Additionally, the EFH Final Rule (50 CFR Part 600) offers options to manage adverse effects from fishing. One of these options is time and areas closures. Actions related to time and area closures may include designating zones or use as MPAs to limit adverse effects of fishing practices on vulnerable or rare areas, species, or EFH life stages, such as those areas designated as HAPCs.

The Final Rule also requires FMPs to identify specific types or areas of habitat within EFH as HAPC based on one or more of the following considerations. In designating MPAs, these HAPC considerations should also be addressed:

- Importance of ecological function provided by the habitat.
- Extent to which the habitat is sensitive to human-induced environmental degradation.
- Whether, and to what extent, development activities are, or will be, stressing the habitat type.
- The rarity of the habitat type.

Similarly, the National Research Council recommends that the task of designating MPAs follow four sequential steps (NRC 2001):

1. Evaluate conservation needs at both local and regional levels.
2. Define the objectives and goals for establishing MPAs.
3. Describe key biological and oceanic features of the region.
4. Identify and choose sites(s) that have the highest potential for implementation.

In Alaska, ADF&G is taking the initiative to develop a public process for establishing MPAs (ADF&G 2002). The ADF&G recommendations focus on closing areas to fishing. Despite this focus on fishing, the department recognizes a larger context and need for MPAs. Multiple objectives are to be considered: protection for marine life, protection from pollution, protection from adverse impacts of mineral extraction, protection of culturally important sites, and maintenance of pristine ecosystem structure and function. The recommendations contend that these issues must also be considered when evaluating MPAs that are initially proposed for fishery management purposes. While both the National Research Council and ADF&G focus on the designation of MPAs as tools to improve fishery management, both also recognize that there are other reasons for establishing MPAs (ADF&G 2002, and NRC 2001):

- Conserve biodiversity.
- Protect ecosystem integrity and sensitive habitats from disturbance.
- Preserve cultural heritage.
- Provide educational and recreation opportunities and establish sites for scientific research.

Taking into consideration the criteria, considerations, steps, and processes described above, specific actions to achieve the objectives for MPA establishment have been recommended by ADF&G:

- Adopting a policy for establishing MPAs with due considerations to realistic time frames and staff commitments.
- Establishing a public involvement process to involve stakeholders at the earliest reasonable opportunity.
- Conducting a needs analysis for reserves and habitat protection.
- Selecting reserve sites through an objective and transparent process so that stakeholders are included and decisions are well-justified. Identified sensitive marine habitats and use of experimental control areas should be considered and possibly receive priority for designation.
- Establishing buffer zones around reserves to help meet reserve objectives. For example, a no-take zone may be established with a larger MPA having seasonal gear or individual species closures.
- Facilitating coordination among federal and state agencies.
- Developing a management plan for designated reserves.

- Monitoring and evaluating reserve effectiveness.

The following chapters present the four policy alternatives. FMP 3.1 under Alternative 3 directs that a methodology for developing MPA designation criteria be created. Therefore, a methodology incorporating aspects of these papers is provided later in this section.

1.6 Non-Consumptive Factors Associated with Establishing MPAs

The above discussion provides recommendations and a process for the designation of marine reserves and protected areas as tools in fisheries management, particularly as applied to the identification and protection of EFH and HAPCs. However, there are other, equally important values associated with MPAs including recreation, tourism, education, and scientific inquiry.

The marine environment provides people with a range of benefits, even if marine resources are not specifically exploited from a given area (NRC 2001). Direct, on-site values are typically associated with consumptive uses (commercial and sport fisheries, shell and sponge collecting, resource extraction from the sea bed, etc.); however, non-consumptive uses such as tourism, diving, bird and whale watching, and the general aesthetics of wild areas can also be considered valuable to humans. Consumptive activities are more easily quantified since they usually provide income directly to participants and indirectly to coastal economies that service the activities. Non-consumptive uses related to tourism, diving and bird watching, and education can have measurable economic benefits as industries supporting these users are developed.

Less easily quantified are the heritage or existence values associated with the public's appreciation of unique and natural systems (NRC 2001). Also difficult if not impossible to adequately quantify are any potential or perceived benefits of MPAs to components of regional and global climatological, biological, and chemical systems.

Establishment of MPAs will directly curtail consumptive use such as fishing and other resource extraction. The potential increase in non-consumptive uses such as tourism and education, which can often have positive economic outcomes, may serve to balance any resulting economic disadvantages. However, due to the remoteness of Alaska and the likelihood that MPAs may be located in offshore/deep waters, economic gain from non-consumptive uses may be limited.

Section 2 Alternative Analysis

There are four policy alternatives under consideration by NPFMC:

- Alternative 1** Continue Under the Current (Updated) Risk Averse Management Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. Under this policy statement, specific goals to reduce and avoid impacts to habitat include responding to new scientific information regarding areas of critical habitat by closing those regions to all fishing; evaluating the impacts of trawl gear on habitat through the stepwise implementation of a comprehensive research plan to determine appropriate habitat protection measures; and continuing to evaluate candidate areas for MPAs as stipulated by E.O. 13158.
- Alternative 2** Adopt a More Aggressive Management Strategy: A more aggressive harvest policy would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases where there is sufficient information. Under this alternative, the evaluation of trawl gear impacts on habitat would continue through the implementation of the existing research plan. The identification of EFH, determination of appropriate habitat protection measures, and evaluation of candidate areas for marine protected areas (E.O. 13158) would also continue, but certain areas presently closed to fishing in order to protect habitat could be considered open to fishing.
- Alternative 3** Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management and ecosystem-based management principles, and, where appropriate and practicable, to increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment not just a population of a given species. Specifically, Alternative 3 seeks to reduce and avoid impacts to habitat by developing goals, objectives, and criteria to evaluate the efficacy of MPAs and no-take marine reserves as tools to maintain abundance, diversity, and productivity of marine organisms. This could be done by considering implementation of MPAs and, where appropriate, giving due consideration to areas already closed to various types of fishing operations. In addition, the policy would develop a research program to identify regional baseline habitat information and mapping, evaluate the impacts of all gear on habitat through the implementation of a comprehensive research plan, monitor habitat recovery, and use the information to determine habitat protection measures as necessary and appropriate.

Alternative 4 Adopt a Highly Precautionary Management Policy: This policy shifts the burden of proof to the user and would require that the agency certify that the intended fishery would not have a detrimental effect on the environment before significant fishing could be permitted. The policy, as illustrated by its FMP frameworks, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when reliable scientific information shows that there would be no significant adverse effect. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public; however, decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment. However, due to a lack of information and uncertainty, we know little about these impacts. Under this policy alternative, impacts to habitat would be reduced and avoided through zoning and limiting fishing gear use to the action area and establishing no-take marine reserves (both pelagic and nearshore) encompassing 20-50 percent of management areas. In fisheries that can be prosecuted with more selective gear, trawling would be prohibited and trawl closure areas would be established. Other policy objectives of Alternative 4 are to manage the fisheries in an explicitly adaptive manner to facilitate learning (including adding large no-take marine reserves that provide experimental controls); to protect marine habitats, including EFH, HAPC, Endangered Species Act-designated critical habitats and other identified habitat types; and to commit to funding a comprehensive research plan.

FMP Bookends: Each policy alternative contains two example FMPs that serve as bookends to a range of management measures that illustrate how the policy could be implemented. These bookends provide a level of detail that allows analysis and provides contrastable policies. They also provide a means to communicate the intended NPFMC actions for achieving a policy, while allowing the NPFMC, under the MSA, the flexibility to adaptively manage the fishery through FMP amendments and the public process.

The bookends are not stand-alone alternatives but rather illustrations that serve to define a range of management actions and potential environmental consequences of a policy alternative. This alternative structure recognizes that the resource being managed, as well as the marine ecosystem, is quite dynamic in nature, and only partially understood. Providing a range of management tools and analyzing their potential effects for each policy alternative attempt to take into account the dynamic nature of the fisheries as a whole and to provide enough management regime flexibility in each alternative to allow the decision-makers to base decisions on the best available science.

Section 3 **Alternative 1 – Continue Under the Current Risk-Averse Management Policy**

3.1 Overview of Management Measures Specific to MPAs and EFH

Adequate habitat is essential for maintaining the productivity of fishery resources, and some species or life stages require particular habitats for food, reproduction, and shelter from predators. Under this alternative, the numerous existing fishery closures and/or limitations that protect benthic habitat in the BSAI and GOA would continue (see Table 1 and Figure 1). Alternative 1 measures protecting habitat include fishing seasons and area quotas, fishing gear restrictions, time/area closures (including MPAs and HAPCs) and prohibited species restrictions. The primary focus of these past regulations has been to prevent potential damage to vulnerable crab habitat from bottom trawl gear, and therefore they do not necessarily cross a wide range of habitat types. Some of the trawl closures are in effect year-round while others are seasonal (see Table 1). In general, year-round trawl closures have been implemented to protect vulnerable benthic habitat. Seasonal closures are used to reduce bycatch by closing areas where and when bycatch rates have historically been high. Additional measures to protect the declining western stocks of the SSL began in 1991 with some simple restrictions based on rookery and haulout locations, and expanded to a more complex suite of fishery restrictions in 2000 and 2001. Most of the areas listed on Table 1 allow fishing by gear other than trawl gear and restrict only those fisheries that target SSL prey species (e.g., pollock, Pacific cod, and Atka mackerel). However, nine closure areas shown on Table 1 meet the E.O. 13158 criteria of providing lasting protection for part or all of the natural resources on a year-round basis:

- BSAI - Area 512, Pribilof Islands Conservation Area, Red King Crab Savings Area, Steller Sea Rookeries, Nearshore Bristol Bay Closure Area.
- GOA - Year-round Kodiak Trawl Closure, SSL Rookeries, Southeast Trawl Area Closure, Sitka Pinnacles Marine Reserve.

Expected to continue under the Alternative 1 FMPs are closure areas in the Bering Sea (Red King Crab Savings Area, Nearshore Bristol Bay encompassing Area 512, and Area 516), which together encompass 27,000 square nautical miles (nm²). These areas, along with the Pribilof Islands Conservation Area (7,000 nm²) and the Opilio/Tanner Crab Bycatch Limitation Zone, would continue to be closed to groundfish trawling and/or other specified fisheries such as scallop dredging on a seasonal or prohibited species catch (PSC)-trigger basis to reduce potential adverse impacts on crabs and crab habitat. The shallow areas in particular contain complex living and non-living substrates, which are essential for juvenile crab survival and are potentially sensitive to bottom trawling. Also continuing would be the Chum and Chinook Salmon Savings Areas, the Herring Savings Area, and the Zones 1 and 2 areas. These PSC-triggered closures reduce EFH disturbance for several species and encompass nearly 125,000 nm². The Walrus Islands seasonal closures and the SSL critical habitat and trawl exclusion zones would also continue. State waters (0-3 nm) are also closed to bottom trawling.

In the GOA, several discrete trawl closure areas (Kodiak No-Trawl Zones) covering about 1,500 nm² would continue around Kodiak Island to reduce crab bycatch, but also serve to protect crab habitat. In addition, fishing with all gear types except salmon trolling has been prohibited in an area around two nearshore

pinnacles identified as supporting rare, vulnerable, and ecologically important habitat (Sitka Pinnacles Marine Reserve). The year-round southeast trawl area closure, adopted as part of the License Limitation Program (LLP), prohibits all trawling east of 140° W longitude and closes about 53,000 nm², of which about 2,000 nm² is located on the shelf. SSL critical habitat and trawl exclusion zones are also identified in the GOA and would continue under Alternative 1. Also, Cook Inlet waters (7,000 nm²) are closed to bottom trawling in order to protect crab habitat; this would continue under Alternative 1.

Figure 4 depicts in detail the existing closure areas specifically described under the existing Alternative 1 policy (1a) and the current FMPs; Table 2 provides the descriptive statistics regarding no-trawl MPAs and no-take marine reserves. Table 3 shows the intended and indirect effects of the closures. As seen in Table 2 and Figure 4, the current FMP offers complete or partial habitat protection for 28.8 percent of fishable area (defined as continental shelf out to the 1,000-m isobath) in the BSAI and GOA combined. Of this 28.8 percent, most (28.5 percent) is designated as "no-trawl MPAs" that may allow seasonal trawling and/or other fishing activities, while only 0.3 percent is designated as no-take marine reserves closed to fishing year-round. Some of the bottom trawl closures are triggered by PSC bycatch limits, while others are seasonal-based on the need to protect certain life stages of crabs (see Table 3). As shown in Table 2, the total closures accounted for in the GOA encompass nearly 46 percent of the fishable area (closed to bottom trawling at one time or another). However, this GOA percentage is greatly influenced by the no-trawl closure in the eastern GOA that protects nearly 82 percent of the fishable area from trawl impacts. Comparatively, 43 percent of the Aleutian Islands and 19 percent of the Bering Sea fishable area is closed at one time or another. The most area that can be defined as no-take marine reserves is found in the Aleutian Islands (1.6 percent due to the SSL critical habitat closures).

Regarding the specific Alternative 1(b) policy goal of responding to new scientific information and evaluating candidate areas for MPAs, the NPFMC currently takes proposals from NOAA Fisheries, ADF&G, the public, and other stakeholders. Areas that are of high concern or are candidates for MPAs are investigated, then acted upon. A recent example of this process occurred with the designation of the Sitka Pinnacles Marine Reserve. In this case, the State of Alaska approached the NPFMC with a request to mirror in Federal waters the protection already in place in state waters. The request went through NPFMC process and the no-take marine reserve area was designated. This process would continue under the alternative.

Another policy goal of Alternative 1(b) is to support the implementation of a comprehensive research plan to evaluate the impacts of trawl gear on habitat and monitor habitat recovery. Since the 1980s, AFSC has been conducting research on the effects of fishing gear on benthic habitat. This research has led to important findings that increase the understanding of the effect of fishing gear effects on benthic habitat. Since 1991, research has specifically focused on four areas:

- Understanding the direct effects of bottom trawling on seafloor habitat.
- Studying the associations of fish and invertebrate species with habitat features that may be affected by fishing gear.
- Evaluating technology to determine gear effects and benthic habitat features.
- Analyzing the spatial and temporal patterns of bottom trawling, retrospectively.

Table 2. Descriptive statistics for closure areas under Alternative 1 (as of Jan. 23, 2002).

Current 2002 Trawling Closures^{1 2 3 4 5}			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of fishable area closed
Aleutian Islands (AI)			
No trawl	105,380,000,000	43,357,506,644	41.1%
No take reserve	105,380,000,000	1,662,800,000	1.6%
Total	105,380,000,000	45,020,306,644	42.7%
Bering Sea (BS)			
No trawl and Bogoslof	798,870,000,000	153,708,738,278	19.2%
No take reserve	798,870,000,000	567,620,000	0.1%
Total	798,870,000,000	154,276,358,278	19.3%
Entire BS & AI			
No trawl	904,250,000,000	197,066,244,922	21.8%
No take reserve	904,250,000,000	2,230,420,000	0.2%
Total	904,250,000,000	199,296,664,922	22.0%
Central \ Western Gulf - west of 144°			
No trawl	265,690,000,000	87,906,000,000	33.1%
No take reserve	265,690,000,000	1,266,300,000	0.5%
Total	265,690,000,000	89,172,300,000	33.6%
Eastern Gulf - east of 144°			
No trawl	90,509,000,000	73,958,000,000	81.7%
No take reserve	90,509,000,000	8,304,042	0% ⁶
Total	90,509,000,000	73,966,304,042	81.7%
Entire Gulf of Alaska			
No trawl	356,199,000,000	161,864,000,000	45.4%
No take reserve	356,199,000,000	1,274,604,042	0.5%
Total	356,199,000,000	163,138,604,042	45.8%
Totals			
Total no trawl	1,260,449,000,000	358,930,244,922	28.5%
Total no take	1,260,449,000,000	3,505,024,042	0.3%
Total FMP Area	1,260,449,000,000	362,435,268,964	28.8%

1 Closures include Steller sea lion (SSL) protection measures, Alaska Department of Fish and Game (ADF&G) restrictions, and No Transit Zones.

2 For consistency with other Programmatic Supplemental Environmental Impact Statement (SEIS) analysis, closures are cut at the 1,000 meter (m) boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.

3 Pelagic and non-pelagic trawl closures are included.

4 The Steller No Transit areas account for the No take reserves. Also includes Sitka Pinnacles (no take marine reserve for groundfish but salmon trolling is allowed).

5 With the complexity for the SSL measures in the AI, for this analysis, SSL rookeries and haulouts were buffered at 12.7 nautical miles (nm) to effectively close 50 percent of critical habitat.

6 Sitka Pinnacles - Percentage is about 0.01 percent so this number appears as 0 percent.

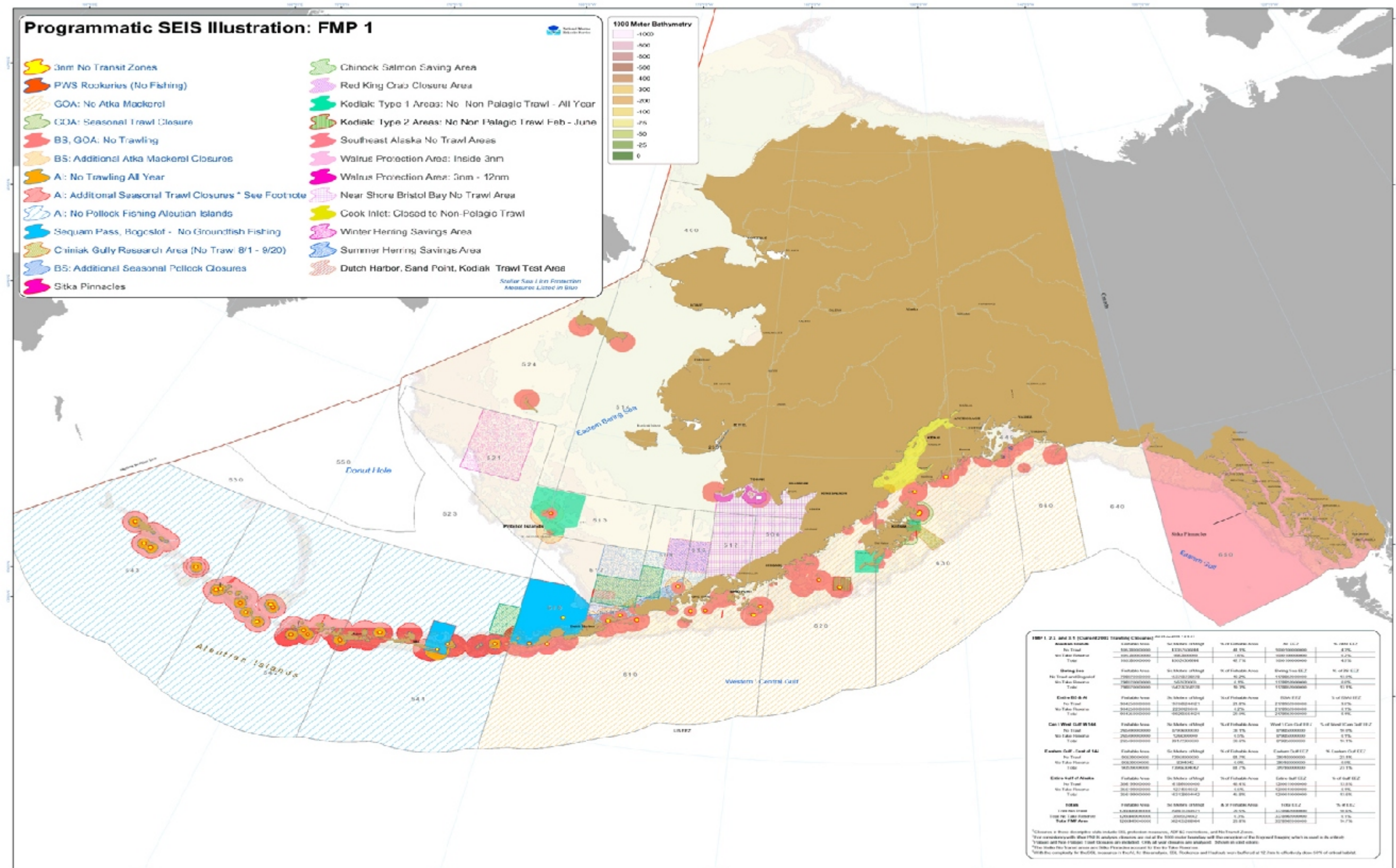


Figure 4. Programmatic SEIS Illustration: FMP 1.

This page intentionally left blank

Table 3. Intended and indirect effects of closure areas under Alternative 1.

Closure area	Year	Region	Closure type	Closure purpose	Major gear restricted	Main Fishery Management Plan (FMP) species protected	Direct intent of closure	Indirect effect(s) from closure on essential fish habitat (EFH) and habitat area of particular concern (HAPC)	Habitats protected (living and non-living)
Cape Edgcumbe Pinnacles Reserve (Sitka Pinnacles)	1999	Gulf of Alaska (GOA)	year-round	Habitat	bottom trawl gear jig gear hook & line gear anchoring	Rockfish spp. juveniles and adults.	Closure to all groundfish commercial fishing and vessel anchoring to protect rare and ecologically important habitat. Troll fishing for salmon is allowed.	None.	epifauna HAPC pinnacle
Southeast Alaska No-Trawl Area	1998	GOA	year-round	Habitat	all trawl gear	Corals Sponges Groundfish	Adopted as part of the license limitation program but covers a vast area of deep water living substrates, including red tree coral.	Benthic habitat, HAPC, groundfish, and non-FMP crab previously impacted by trawl gear are no longer subject to disturbance, damage, and/or direct and indirect mortality.	epifauna infauna nearshore slope shelf
Kodiak Red King Crab Savings Area	1986	GOA	year-round; seasonal	Habitat Species	bottom trawl gear scallop dredge gear	Red king crab adults	Closure to protect adult red king crab concentrations, juvenile rearing areas, migration patterns, and recruitment.	Benthic habitat, HAPC, and groundfish previously impacted by bottom trawl and dredge gear are no longer subject to disturbance, damage, and/or direct and indirect mortality.	epifauna infauna shell hash slope shelf
Pribilof Islands Habitat Conservation Area	1995	Bering Sea (BS)	year-round	Habitat	all trawl gear scallop dredge gear	Blue king crab juveniles	Closure to protect important areas for juvenile blue king crab survival.	Benthic habitat, HAPC, and groundfish previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	shell hash slope shelf
Bristol Bay Nearshore Closure	1997	BS	year-round	Habitat	all trawl scallop dredge gear	Red king crab juveniles	Closure to protect juvenile red king crab and rearing habitats. Expanded Area 512 closure (see below).	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	emergent epifauna shell hash HAPC shallows sand slope
Red King Crab Saving Area 512 (Middle Bristol Bay)	1987	BS	year-round	Species Habitat	all trawl gear scallop dredge gear	Red king crab juveniles and adults	Closure to protect high densities of red king crab adults and juvenile rearing habitats.	Benthic habitat, HAPC, juvenile crab, and groundfish previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	epifauna infauna sand shelf

Table 3 (cont.). Intended effects of closure areas under Alternative 1.

Closure area	Year	Region	Closure type	Closure purpose	Major gear restricted	Main Fishery Management Plan (FMP) species protected	Direct intent of closure	Indirect effect(s) from closure on essential fish habitat (EFH) and habitat area of particular concern (HAPC)	Habitats protected (living and non-living)
Red King Crab Savings Area 516 (Outer Bristol Bay)	1987	BS	seasonal; March 15 to June 15	Species	bottom trawl gear scallop dredge gear	Red king crab adults	Closure to protect high densities of red king crab adults and halibut.	Benthic habitat, HAPC, juvenile crab, and groundfish previously impacted by bottom trawl and dredge gear are no longer subject to disturbance, damage, and/or direct mortality.	epifauna infauna sand/mud shelf
Opilio and Tanner Crab Bycatch Limitation Zones	1997	BS	Inseason prohibited species catch (PSC) cap	Species	trawl gear	Tanner crab adults Snow crab adults	Closed to specified groundfish fisheries when crab bycatch trigger is reached in order to reduce mortalities to crab and egg-laden mature crabs.	Benthic habitat, HAPC, and groundfish, and crab previously impacted by bottom trawl gear are no longer subject to disturbance, damage, and/or direct mortality.	emergent epifauna shelf
Chinook Salmon Savings Area	1995	BS	trigger	Species	pelagic trawl gear	Chinook salmon late juveniles - marine Chinook salmon adults - marine	Areas closed to trawling should the chinook salmon bycatch exceed 48,000 chinook (a period of high chinook bycatch). For 2003 the cap is reduced to 29,000 and this applies only to vessels fishing for pelagic pollock. The accounting towards the cap begins Jan 1 st and the area will be closed for the remainder of the year should the cap be reached.	Maturing chinook salmon previously recruiting to pelagic trawl gear are afforded greater protection to potentially reach maturity and spawning areas. Seasonal timing directly corresponds with migratory patterns and concentrations of maturing salmon within fishing areas.	
Chum Salmon Savings Area	1995	BS	seasonal: closed August; limited Sept. through October 15	Species	trawl gear	Chum salmon late juveniles - marine Chum salmon adults - marine	To reduce excessive bycatch of other (mainly chum) salmon in groundfish trawl fisheries; the area is closed to trawling only during the month of August. The area is re-opened on September 1, but can be closed if the total bycatch of chum in the surrounding area should exceed 42,000 salmon.	Maturing chum (and other) salmon previously recruiting to pelagic trawl gear are afforded greater protection to potentially reach maturity and spawning areas. Seasonal timing directly corresponds with migratory patterns and concentrations of maturing salmon within fishing areas.	

Table 3 (cont.). Intended effects of closure areas under Alternative 1.

Closure area	Year	Region	Closure type	Closure purpose	Major gear restricted	Main Fishery Management Plan (FMP) species protected	Direct intent of closure	Indirect effect(s) from closure on essential fish habitat (EFH) and habitat area of particular concern (HAPC)	Habitats protected (living and non-living)
Herring Savings Areas	1995	BS	trigger	Species	trawl gear	Bycatch species	Established to limit the amount of herring taken as bycatch in the trawl fisheries. Two of the areas are closed in the summer and one in the winter.	An important prey resource of groundfish are afforded greater protection during spawning and migratory concentrations.	nearshore offshore
State of Alaska Nearshore Waters Closure	2000	GOA, Aleutian Islands (AI), BS	year-round	Habitat	all bottom trawl gear	Nearshore adult and juvenile salmon, crab, shellfish, and groundfish	Close all state waters (0-3 nautical miles [nm]) to commercial bottom trawling to protect nearshore habitats and species.	None.	nearshore nursery and adult areas HAPC slope
Cook Inlet No-Trawl Zone	2001	GOA	year-round	Habitat	bottom trawl gear	Bycatch species	Prohibit non-pelagic trawling in Cook Inlet to control crab bycatch mortality and protect crab habitat in an area with depressed king and Tanner crab stocks. Includes areas in state waters.	Benthic habitat, HAPC, groundfish, and non-FMP crab previously impacted by bottom trawl gear are no longer subject to disturbance, damage, and/or direct mortality.	shallows
Adak Scallop Closure Area	1995	AI	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Dutch Harbor Scallop Closure Area	1995	BS, AI	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud

Table 3 (cont.). Intended effects of closure areas under Alternative 1.

Closure area	Year	Region	Closure type	Closure purpose	Major gear restricted	Main Fishery Management Plan (FMP) species protected	Direct intent of closure	Indirect effect(s) from closure on essential fish habitat (EFH) and habitat area of particular concern (HAPC)	Habitats protected (living and non-living)
Kodiak Scallop Closure Area	1995	GOA	year-round	Habitat	scallop dredging	Scallops, groundfish	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Alaska Peninsula Scallop Closure Area	1995	GOA	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Bering Sea Scallop Closure Areas	1995	BS	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Bogoslof Groundfish Closure Area	1992	BS	year-round	Marine Mammal	bottom trawl gear	Walleye pollock, Pacific cod, Atka mackerel	Closure to Walleye pollock, Atka mackerel, and Pacific cod commercial bottom trawl fisheries associated with the Steller sea lion (SSL) protection measures.	Walleye pollock, Atka mackerel, and Pacific cod adults previously taken by their directed fishery are afforded greater protection to potentially reach maturity. Additionally, benthic habitats and HAPC will be subject to less bottom trawling intensity levels, but not total protection. Fisheries, other than these three, may still be prosecuted with bottom trawl gear.	nearshore nursery and adult areas HAPC nearshore slope shelf

Table 3 (cont.). Intended effects of closure areas under Alternative 1.

Closure area	Year	Region	Closure type	Closure purpose	Major gear restricted	Main Fishery Management Plan (FMP) species protected	Direct intent of closure	Indirect effect(s) from closure on essential fish habitat (EFH) and habitat area of particular concern (HAPC)	Habitats protected (living and non-living)
SSL Closure Areas	2000	GOA, BS, AI	year-round	Marine Mammal	bottom trawl gear	Walleye pollock, Atka mackerel, Pacific cod	Seller sea lion foraging areas for prey. Indirectly protecting EFH within the closed areas. 10-20 mile no-trawl zones around sea lion rookeries. Additional closures to protect critical habitat enacted in 1999.	Walleye pollock, Atka mackerel, and Pacific cod adults previously taken by their directed fishery are afforded greater protection to potentially reach maturity. Additionally, benthic habitats, HAPC, and other nearshore groundfish will be subject to less bottom trawling intensity levels, but not total protection. Fisheries, other than these three, may still be prosecuted with bottom trawl gear.	rock beaches pinnacles kelp nearshore
SSL Major Rookies	1995	GOA, BS, AI	year-round	Marine Mammal	all gear no vessel entry	Nearshore adult and juvenile salmon, crab, shellfish, and groundfish	SSL major rookeries and haulout areas used as foraging areas, reproductive areas, and social interactions.	Groundfish, shellfish, and crab are afforded protection from any disturbance, damage, or mortality.	nearshore
Walrus Islands Federal Closure	1995	BS	seasonal: April 1 through Sept. 30	Marine Mammal	all gear	Groundfish and crab	All fishing vessels prohibited between 3 and 12 miles offshore to protect walrus in the water.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by fishing are no longer subject to disturbance, damage, and/or direct mortality.	nearshore nursery and adult areas HAPC slope

Most of the field-oriented studies have focused on small geographic areas in specific habitat types (see Figure 3). Similarly, in the last few years, the U.S. Geological Survey Coastal and Marine Geology Program has applied high resolution mapping tools to map benthic habitats in Alaska. These mapping efforts address small specific areas and localized issues. With additional funding, expansion of NOAA Fisheries and U.S. Geological Survey research efforts over larger geographic areas and a variety of habitat types will provide fisheries managers the information needed to develop measures for minimizing impacts and determining appropriate habitat protection measures. Additional information concerning existing and planned research can be found at : <http://www.afsc.noaa.gov/abl/MarFish/geareffects.htm>.

3.2 Effects of EFH/MPA Management Measures of the Alternative 1 Policy

Specific impacts to habitat from different management regimes are very difficult to predict. To evaluate the effects of fishing on habitat features, detailed information on the distribution and abundance of habitat types, the life history of living substrates, and the natural disturbance regime is needed. This information is generally incomplete for Alaskan waters. Knowledge of how fishing affects different habitat types under a variety of circumstances has been summarized by NMFS (2002). Presently it is not possible to fully and quantitatively account for all factors involved in determining how an ecosystem will respond to fishing activities. Given those caveats, this evaluation of the Alternative 1 policy is illustrated by the current groundfish FMP. The subsequent evaluation of the additional alternatives and their respective FMP bookends provides a qualitative discussion of impacts, assuming that greater habitat disturbance is expected with less habitat protection. Therefore, in analyzing the effects of fishing gear on habitat, two simplifying assumptions are made:

- Closing areas to trawling, at least part of the time, or designating no-take reserves, benefits EFH by lessening the occurrence of the impact; thus the habitat becomes less vulnerable to disturbance-induced changes.
- Increasing fishing effort in an area puts additional stress on EFH in that area.

These assumptions are applied directly to the question of whether the alternative is likely to impact the physical, biological, or social and economic environments. They are used throughout this document to discuss potential impacts of each alternative policy through analysis of its associated illustrative FMP.

Effects on the Physical Environment

Non-living substrates and features such as boulders, cobbles and sand waves can be disturbed by bottom trawls (Auster and Langton 1999). For example, gear can overturn boulders and cobbles and smooth sand waves. In addition, boulder piles could be dispersed, thus reducing the number of crevices. In most cases the structural integrity, and hence the complexity of the habitat, would not be greatly reduced (NMFS 2001a,b). Therefore, any impacts of Alternative 1 on the physical environment (substrate) are expected to be neither beneficial nor adverse (e.g., no significant impact).

Effects on the Biological Environment

EFH - Benthic Biodiversity

Alternative 1 as illustrated through the current FMPs could impact biodiversity of benthic invertebrates and fish. The adverse effects of bottom trawling and other mobile fishing gears on benthic biodiversity have been documented for Alaska and other regions (Auster and Langton 1999, McConaughy *et al.* 2000, Freese *et al.* 1999, NRC 2002 and see Section 3.6). This conclusion is further supported by past recognition that the existing management regime (i.e., Alternative 1) has had impacts that justify year-round bottom trawl closure areas in order to provide some protection to EFH.

The spatial distribution of the closed areas under the current FMPs may not protect the full range of habitat types in the BSAI and GOA. This is because many fish species depend on particular habitat features during various life stages. One way to protect benthic biodiversity is to establish a properly designed network of marine reserves (NRC 2001, Murray *et al.* 1999). Given the limited information on distribution and abundance of habitat types in waters off Alaska, evaluation of the impacts of the Alternative 1 policy is based primarily on the size of bottom trawl closure areas and secondarily on the spatial distribution of these closure areas.

As shown in Figure 4 and Table 2, Alternative 1 closes nearly 29 percent of the total FMP area (BSAI and GOA combined) at various times throughout the year. Closures within various subareas range from 19 percent to nearly 82 percent. Although these percentages near, or greatly exceed, the 20 percent closure recommendation for marine reserves (Agardy 1994, Lauck *et al.* 1998, Allison *et al.* 1998), the primary focus of the current FMPs is protection of crab habitat and SSL critical habitat. These habitats are generally relatively shallow; thus, the closures do not encompass a wider range of habitat types and depths, which would protect a wide range of EFH for species that inhabit deep water. The exception is the bottom trawl closure in the eastern GOA, which encompasses a wide range of habitat types and depths. There are generally no area restrictions in the deeper waters that encompass the outer continental shelf and upper slope of the central and western GOA and BSAI. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002). Within the areas currently open to bottom trawl fishing, specific areas or "hotspots" are fished each year, while other areas are undisturbed or fished very lightly (Coon *et al.* 1999, Fritz *et al.* 1998). Presumably, an area is repeatedly trawled because there are high catches per unit of effort of target species, and the bottom topography is suitable (i.e., trawlable). In many cases, these areas likely correspond to the preferred habitat of adult groundfish species, and are often fished seasonally.

The closures to bottom trawling are in many cases not year-round, and do not restrict fixed-gear use. In some cases, fixed-gear may adversely impact benthic biodiversity. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under Alternative 1 as illustrated by the current FMPs, there is a near absence of year-round closures to all fishing, with no-take marine reserves constituting only 0.3 percent of the fishable area (see Table 2). A higher percentage of no-take marine reserves would provide a wider range of protection for EFH from disturbances caused by all gear at all times. (See the analyses of Alternatives 3 and 4, below, for a discussion of the environmental consequences of such an increase.)

EFH - HAPCs

HAPCs include living substrates that provide high micro-habitat complexity, which serves as cover for groundfish and other organisms. A detailed description of HAPC as related to EFH is provided in Section 3.6. Five groups of organisms have been identified as deepwater HAPCs in Alaska: coral, sponges, anemones, sea whips, and sea pens.

Documentation of localized depletions, changes in benthic community structure, and acute damage all indicate that HAPC biota and other living substrates are directly impacted by bottom trawl fisheries (Freese *et al.* 1999, McConaughy *et al.* 2000). Criteria to determine acceptable levels of mortality to HAPC biota have not been established. Such criteria would need to consider fishing-induced mortality relative to such characteristics as natural mortality, fecundity, abundance, and growth rates. Many of the deep water areas that HAPC biota inhabit are characterized as stable environments dominated by long-lived species. In such areas the impacts of fishing can be substantial and long-term (Auster and Langton, 1999). Species such as gorgonian red tree coral (*Primnoa*) are very long lived (can be over 100 years old), and would therefore not easily recover if damaged by bottom trawls or some other gear type (Risk *et al.* 1998, Andrews *et al.* 2002, Krieger and Wing 2002).

Gorgonian coral has been harvested throughout the world for use as jewelry. In general, corals and sponges are traded worldwide. Specific protective measures for HAPC biota (Amendment 65 in BSAI and GOA FMP), were developed and approved by the NPFMC to prohibit the sale of gorgonian coral and sponges, prior to the development of such a fishery in Alaska. However, in February of 2001, NOAA Fisheries informed the NPFMC that they would not be pursuing Amendment 65 regulations and instead suggested that the most efficient option would be for the NPFMC to request the State of Alaska to prohibit commercial fishing for these HAPC species in the EEZ outside of state waters. The MSA provides authority for the state to regulate a vessel in the EEZ, even if it is not registered under the State of Alaska laws. The state could use this authority to prohibit a commercial fishery for HAPC species in the EEZ, provided that the necessary determinations are made under MSA Section 306(a)(3). It is presumed that this process could move forward under the Alternative 1 policy.

Living substrate can be inadvertently impacted through fishing activities that are not directed on the HAPC itself (i.e., damage by bottom trawls, longlines, and pot gear, and bycatch of HAPC biota in other fisheries). Therefore, with respect to groundfish fisheries that use both mobile and fixed gear, a certain amount of bycatch, unobserved damage, and mortality to HAPC biota is expected to occur under the Alternative 1 policy and existing FMPs. Existing management measures under the current groundfish FMPs that were put into place to protect prohibited species and SSLs, close about 22 percent and 46 percent of fishable area in the BSAI and GOA, respectively, to bottom trawling (see Table 2). However, these areas are not necessarily closed year-round, do not incorporate concurrent reductions in total allowable catch (TAC), and do not close the areas to fishing with fixed gear. In addition, the trawl closures are specific only to three directed bottom fisheries: pollock, Pacific cod, and Atka mackerel. Thus, bottom trawling for other groundfish such as rockfish and flatfish may still occur in some of the closed areas. As such, the closures are likely to benefit EFH (including HAPC) in some areas by reducing the level and frequency of disturbance, but could possibly increase stresses on the habitat elsewhere, and at an unknown rate, where fishing is intensified. Some marginal grounds not previously fished could possibly now be disturbed due to the closures, particularly since concurrent reductions in TAC would not accompany the closures. Not having experienced as much fishing effort in the past, these areas could be more vulnerable to trawling impacts. In

addition, damage to HAPCs by pot and fixed gear; and by trawling for rockfish and flatfish; is not mitigated by the closures since this type of fishing is not restricted in these areas. Therefore, Alternative 1 policy as illustrated by the current BSAI and GOA groundfish FMPs has the potential to increase trawl effort in areas that could have high concentrations of HAPC species.

Target and Non-Target Species

The closure areas in place in the BSAI and GOA under the Alternative 1 policy as illustrated by the current FMPs generally have been designed to protect various prohibited species, but could provide indirect benefits to target and non-target groundfish species as well (see Table 3). As shown in Table 3, many of the existing seasonal and year-round closure areas are intended to protect the prohibited species (crab, salmon, halibut, and herring). The issue of localized depletion of pollock and other target groundfish species is also addressed indirectly by the Bogoslof closure, which was primarily designated as part of the SSL Protection Measures.

Forage Fish

Most of the forage fish bycatch is taken in pelagic trawls (74 percent in the BSAI, 93 percent in the GOA) (NMFS 2001a). The vast majority of forage fish taken as bycatch consists of osmerids (capelin, eulachon, other smelts). Collectively, forage fish form only a small part of bycatch of groundfish fisheries, typically comprising less than 1 percent of any directed harvests. The low volume of incidental catch of forage fish currently observed under the existing FMPs is anticipated to continue under Alternative 1.

Prohibited Species

The Alternative 1 policy as illustrated by the existing FMPs moves fishing effort outside of SSL critical habitat areas compared to the historic catch from 1997-1999. Chinook salmon, other Tanner crab (besides bairdi), and halibut bycatch rates appear to be lower outside of critical habitat, and the shift in effort outside of these areas leads to reductions in the expected bycatch of these three prohibited species (NMFS 2001b). Existing closures have been put into place to protect these species by reducing bycatch and protecting habitat.

Marine Mammals

Also shown in Table 3 are the closures intended to protect marine mammals, namely SSLs. One or more of the target species (pollock, Atka mackerel, and Pacific cod) have been identified as prey species of SSLs, certain whales, and fur and harbor seals. Trawl limitations described above for these prey species will indirectly benefit these marine mammals also (NMFS 2001b).

For example, trawl closures around the Pribilof Islands, established mainly for the protection of crab stocks, may offer positive benefits to fur seals by limiting prey removals in waters surrounding their Pribilof Island rookeries. However, only northern fur seals foraging close to the islands would benefit, and recent tracking studies show that foraging trips of both adult female and juvenile male fur seals extend well beyond the trawl closure boundaries. Therefore, while fisheries harvest prey of northern fur seals (i.e., pollock and Pacific cod), competition due to the harvest rates of those species may vary depending on the size range consumed by the seals.

Since fishing vessels would either be eliminated (no-take marine reserves) or reduced (no-trawl MPAs), direct effects such as mortality and direct disturbance of marine mammals would also be eliminated or reduced in the closure areas, depending on the type and season of closure. Therefore, it may be anticipated that protection from direct (mortality, direct disturbance) and indirect (loss of prey) effects would be provided.

Seabirds

None of the closure areas currently in place are specifically designed to protect or enhance seabird populations. However, some of the nearshore closures may indirectly benefit seabirds by benefitting forage fish populations. However, as described above, the small amount of average incidental catch in the BSAI and GOA, as occurs under the existing FMPs, is not likely to significantly affect the abundance of forage fish available for seabirds.

The incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels also would not occur in the year-round closed areas; however, these areas comprise only a very small percentage of the overall closure areas. The protection for seabirds would occur to a lesser extent, if at all, in the seasonally closed areas, since many of these areas remain open to longline fishing, which has the greatest potential for direct take of seabirds. Additional discussions on the impacts of Alternative 1 on seabirds are discussed in the Seabird Qualitative Impact Assessment (Appendix F-6).

Effects on the Social and Economic Environment

Under the existing FMPs, the BSAI and GOA groundfish fisheries are expected to continue to provide high and relatively stable levels of seafood products to domestic and foreign markets. However, as compared to a no-closure scenario, Alternative 1 would produce socioeconomic effects that would vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. While these effects are quantified and discussed in detail in Chapter 4 of the Programmatic SEIS, a brief qualitative discussion is provided herein.

Due to longer transit times to reach areas open to fishing, the critical habitat and other closures existing under the current FMPs likely lower catch and increase the cost of harvesting a given amount of fish. The existing closures affect the industry by increasing travel time to and from distant fishing grounds compared to prior years when such closures were not in effect. Time associated with learning how to fish new fishing grounds, reducing catch per unit of fishing effort from fishing less concentrated stocks, increasing down time and layups all contribute to increasing costs to processors. If the operating costs increase, these would be expected to have some impacts on the market. Catcher processors and inshore processors would face competition from and loss of market share to foreign fisheries and farmed fish if product price increases while product quality decreases. Operating costs for catcher vessels and product values for inshore processors would be exacerbated by adverse trends in salmon and crab fisheries, particularly in the Alaska Peninsula, Aleutian islands, and Kodiak Island Borough (NMFS 2001b).

Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels will incur an increased risk of accidents and injury (NMFS 2001b). Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel

further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch and exposing the vessels to additional risks due to hazardous weather conditions.

On the other hand, the Alternative 1 closures as illustrated by the current FMPs could benefit non-market issues such as existence values and eco-tourism. Studies have shown that the general public is willing to pay for the preservation of species (including endangered species) as well as the preservation of wilderness areas (NMFS 2001b). While estimates of non-consumptive and non-use values for various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs serve to enhance these values to an unknown extent.

Effects on the Ecosystem

As described previously in the section titled Benthic Biodiversity, the primary focus of the Alternative 1 closure areas is protection of vulnerable life history stages of crab, crab habitat, and SSL critical habitat. This habitat is generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths. While predator/prey relationships could be improved in closed areas, particularly in the year-round closure areas and "no-transit" areas, effects on the ecosystem as a whole are unlikely. If the closures were to cover a wider range of habitats, then improved protection for a wide range of species could be realized, eventually benefitting overall species diversity. Therefore, due to the narrow focus of the closures, beneficial effects on top predators, energy flow, and balance are also unlikely to be realized.

Effects on Management and Enforcement

Under existing management, it is unlawful for any person to operate a vessel authorized to participate in the Atka mackerel, Pacific cod, or pollock directed fisheries in any BSAI or GOA reporting areas, unless the vessel carries an operable NOAA Fisheries-approved vessel monitoring system (VMS) transmitter. The only exemption is for vessels using jig gear. This requirement would continue under the Alternative 1 policy as illustrated by the current FMPs.

As such, VMS is an essential component of monitoring and enforcement for closure areas. In the absence of VMS, enforcement of compliance with closed areas would be limited to random sightings by enforcement vessels or aircraft. To monitor critical habitat harvest limits, managers need to know which vessels fished in the area and how much fish they caught. VMS data provide real-time information on vessel location and indicate fishing activity. These VMS data can be matched with observer data or landing data for the trip to determine if the catch is counted against the catch limit.

By allowing fishing to continue, the VMS requirement has a positive economic effect on fishery participants and fishing communities. Many important fishing grounds are found within SSL critical habitat. The SSL Protection Measures, including VMS, were developed to afford vessels an opportunity for continued access to those grounds. Allowing that access, with addition of the VMS requirement, is preferred by the fishing industry to closing the areas entirely. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impact Assessment (Appendix F-11).

The observer program, which is discussed in detail in Appendix F-10 (see the Observer Program Qualitative Analysis), would also continue under this alternative and these FMPs. Under the program, vessels greater than 125 feet (ft) must carry an observer at all times; vessels between 60 ft and 125 ft are required to carry

observers for only 30 percent of the vessel's time at sea, and vessels that are less than 60 ft are exempt from observer coverage. With these levels of observer coverage, NOAA Fisheries is confident that most of the groundfish harvest is being observed and that with observers on board, fishing vessels are unlikely to venture into closed areas.

Section 4 Alternative 2 – Adopt a More Aggressive Management Policy

4.1 Overview of EFH/MPA Management Measures of FMP Bookend 2.1

This bookend to the Alternative 2 policy proposes that no MPAs be designated. This FMP is intended to illustrate a management regime where a more aggressive harvest strategy is employed with fewer restrictions on fishing. It would repeal all current closed/restricted areas intended to protect crab habitat and other prohibited species such as salmon and herring. In addition, the Sitka Pinnacles Marine Reserve, intended to protect sensitive habitat and HAPC, would be repealed. Only the SSL Protection Measures to avoid a determination of jeopardy under the ESA would remain in place.

Figure 5 depicts the existing closure areas under FMP bookend 2.1; Table 4 provides the descriptive statistics regarding no-trawl MPAs and no-take marine reserves. As seen in Table 4 and Figure 5, FMP 2.1 would provide limited protection to 14.6 percent of fishable area in the GOA and BSAI combined, with 14.3 percent designated as no-trawl areas, leaving just 0.3 percent as no-take marine reserve areas (SSL No Transit Zones). Also shown in Table 4, about 22 percent of the fishable area in the entire GOA would be closed to bottom trawling at one time or another under this FMP illustration. Comparatively, about 43 percent of the Aleutian Islands and nearly 8 percent of the Bering Sea fishable area would be closed. Most of the no-take marine reserve areas defined by FMP 2.1 are found in the Aleutian Islands (1.6 percent) due to the number of SSL critical habitat closures located there. Only a small percentage (0.5 percent) of fishable area in the GOA is afforded complete protection, again for the purposes of protecting SSLs.

4.2 Effects of EFH/MPA Management Measures of FMP Bookend 2.1

Effects on the Physical Environment

There will be additional impacts on the substrate under FMP 2.1 since areas presently closed to bottom trawling would be opened. Depending on the intensity of the trawling in a given location, the physical impacts on the substrate itself may be notable. However, as described for the Alternative 1 policy and current FMPs, the structural integrity and complexity of the overall habitat found in the BSAI and GOA would not be greatly reduced by this FMP, but there could be localized areas of significant disturbance as a result of concentrated fishing effort.

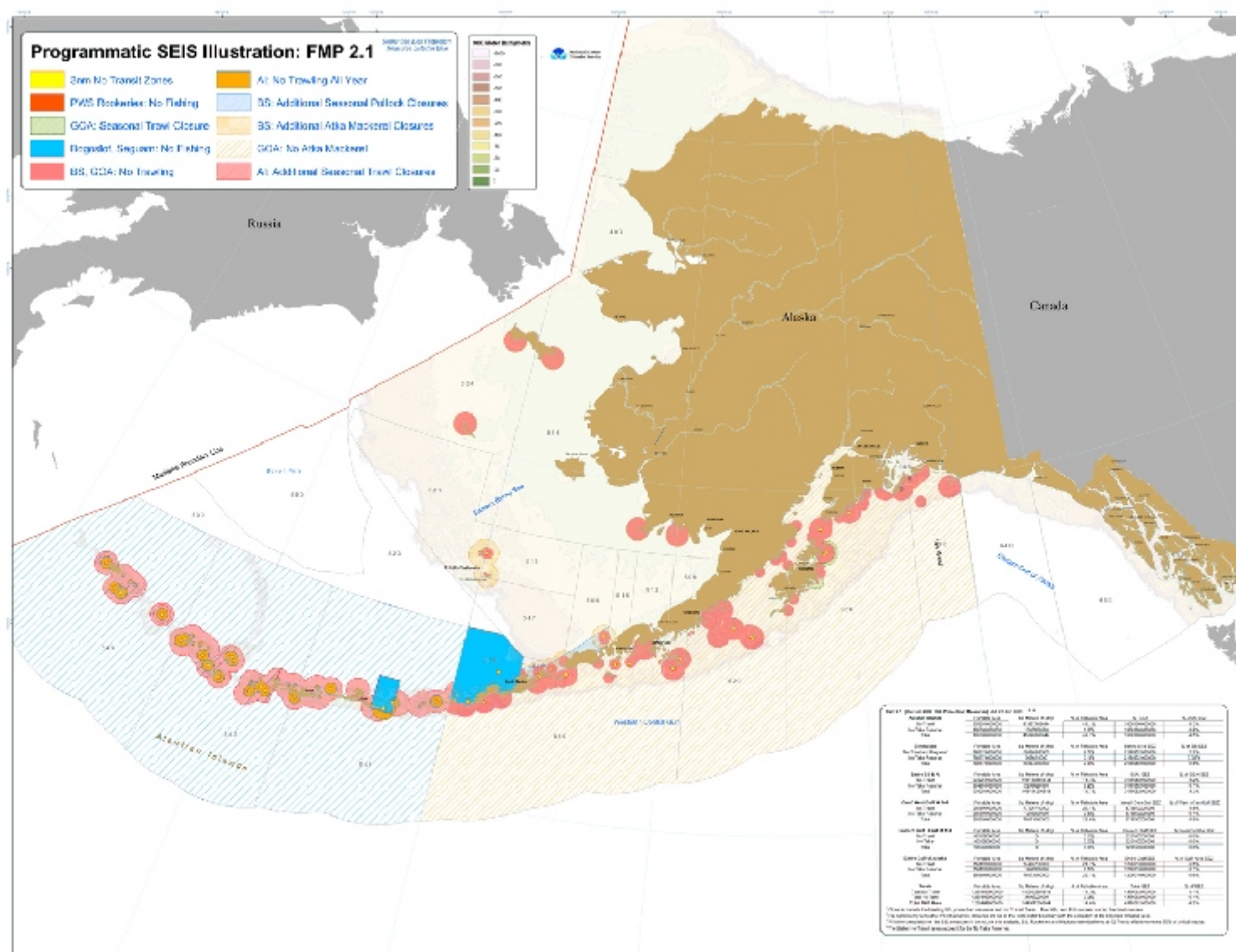


Figure 5. Existing Closure Areas in FMP Bookend 2.1.

Table 4. Descriptive statistics for closure areas under FMP Scenario 2.1.

Current 2002 Trawling Closures^{1 2 3}			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of Fishable area closed
Aleutian Islands (AI)			
No trawl	105,380,000,000	43,357,200,000	41.1%
No take reserve	105,380,000,000	1,662,800,000	1.6%
Total	105,380,000,000	45,020,000,000	42.7%
Bering Sea (BS)			
No trawl and Bogoslof	798,870,000,000	59,826,380,000	7.5%
No take reserve	798,870,000,000	567,620,000	0.1%
Total	798,870,000,000	60,394,000,000	7.6%
Entire BS & AI			
No trawl	904,250,000,000	103,183,580,000	11.4%
No take reserve	904,250,000,000	2,230,420,000	0.2%
Total	904,250,000,000	105,414,000,000	11.6%
Central \ Western Gulf - west of 144°			
No trawl	265,690,000,000	77,406,700,000	29.1%
No take reserve	265,690,000,000	1,266,300,000	0.5%
Total	265,690,000,000	78,673,000,000	29.6%
Eastern Gulf - east of 144°			
No trawl	90,509,000,000	0	0.0%
No take reserve	90,509,000,000	0	0.0%
Total	90,509,000,000	0	0.0%
Entire Gulf of Alaska			
No trawl	356,199,000,000	77,406,700,000	21.7%
No take reserve	356,199,000,000	1,266,300,000	0.5%
Total	356,199,000,000	78,673,000,000	22.2%
Totals			
Total no trawl	1,260,449,000,000	180,590,280,000	14.3%
Total no take	1,260,449,000,000	3,496,720,000	0.3%
Total FMP Area	1,260,449,000,000	184,087,000,000	14.6%

1 Closures include the trawling SSL protection measures and No Transit Zones. Most hook and line (H&L) and Pot closures overlap the trawl closures.

2 For consistency with other Programmatic Supplemental Environmental Impact Statement (SEIS) analysis, closures are cut at the 1,000- meter boundary with the exception of the Bogoslof and Seguam Pass foraging areas.

3 With the complexity for the SSL measures in the AI, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7 nautical miles (nm) to effectively close 50 percent of critical habitat.

Effects on the Biological Environment

EFH – Benthic Biodiversity

FMP bookend 2.1 could impact biodiversity of benthic invertebrates and fish. It is recognized that the spatial distribution of the closed areas under the scenario may not protect the full range of habitat types in the BSAI and GOA. This is because many fish species depend on particular habitat features. One way to protect benthic biodiversity is a properly designed network of marine reserves (NRC 2001, Murray *et al.* 1999). This scenario recommends repealing many existing MPAs and closure areas.

As shown in Table 4, FMP 2.1 closes about 12 percent of the BSAI and about 22 percent of the GOA with about 15 percent of the total FMP area (BSAI and GOA combined) closed at various times throughout the year. Although these percentages are near the 20 percent closure recommendation for marine reserves (Agardy 1994, Lauck *et al.* 1998, Allison *et al.* 1998), they are not true marine reserves as described above. The primary focus of the closure areas is protection of SSL critical habitat. The closures to bottom trawling are in many cases not year-round, and do not restrict fixed-gear use, and close fishing for only target certain species (pollock, Pacific cod, and Atka mackerel). Bottom trawling for flatfish and rockfish is still allowed within certain areas of the designated critical habitat. Also, in some cases, fixed-gear may adversely impact benthic biodiversity. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under FMP 2.1, there is a near absence of year-round closures to all fishing; no-take marine reserves constitute only 0.3 percent of the fishable area (see Table 4). These marine reserves areas would provide protection to EFH from disturbances caused by any fishing gear at all times.

EFH-HAPC

With respect to groundfish fisheries that use both mobile and fixed gear, a certain amount of bycatch and unobserved damage and mortality to HAPC biota is expected to occur under FMP 2.1. Management measures that were put into place to protect SSLs close to bottom trawling about 12 percent and 22 percent of fishable area in the BSAI and GOA, respectively. However, these areas are not necessarily closed year-round, do not necessarily incorporate concurrent reductions in TAC, and do not close the areas to fishing with fixed gear. As such, the SSL closures are likely to benefit EFH (including HAPC) in some areas, but could possibly increase stresses on the habitat elsewhere, and at an unknown rate. In addition, damage to HAPCs by pot and fixed gear is not mitigated by the closures since this type of fishing is not restricted in these areas. Therefore, FMP 2.1 has the potential for moderate to substantial impact in areas with high concentrations of HAPC species. The increase in fishing effort by all gear types is not offset by large, year-round closures, or any TAC reductions throughout the management area. Opening the Pribilof Islands Habitat Conservation Area and Sitka Pinnacles Marine Reserve could have adverse effects on HAPC.

Target and Non-target Species

The environmental consequences of the Alternative 2 policy, as illustrated by FMP 2.1 on target, non-target, prohibited species, marine mammals, and seabirds is not known. The elimination of the existing closed areas (with the exception of those required to protect SSLs) may result in increased impacts to these species. However, unless documented, the Alternative 2 policy presumes there are no significant adverse effects on the environment.

Forage Fish

Under this FMP scenario, many closed areas would be opened, TACs would be raised, and PSC limits would be removed; a higher volume of forage fish could be caught as bycatch in the groundfish fisheries. Although the extent of the effect on forage fish populations is unknown, adverse effects could be realized.

Prohibited Species

Since the closures and catch limits enacted to protect these species from excessive bycatch and habitat destruction would be repealed, prohibited species are likely to experience adverse effects.

Marine Mammals

While the SSL Protection Measures would remain in place and could provide benefits to other marine mammals, repeal of the prohibited species and other closures could indirectly adversely affect marine mammals.

Seabirds

Since many closed areas would be opened, additional incidental take and vessel strikes could impact seabird mortality. Also, impacts could be realized if forage fish populations are impacted.

Effects on the Social and Economic Environment

Due to the more aggressive harvest strategy of policy Alternative 2, FMP 2.1 would produce socioeconomic effects that are relatively similar among industry sectors (catcher vessel, catcher processor, and inshore processor), fishery, and region.

FMP 2.1 is intended to increase the level of harvest in all fisheries and therefore increase the short-term benefits for fishery participants. All three industry sectors are expected to see improved conditions, at least in the short-term (4-5 years) (NMFS 2001a). Positive impacts related to vessels, catcher processors, and inshore and offshore processors would accrue to all Alaska regions involved in the groundfish fishery: Alaska Peninsula and Aleutian Islands, Kodiak, southcentral Alaska, and southeast Alaska. Average costs per unit of catch for catcher vessels can be expected to decrease somewhat due to the increase in overall levels of production resulting from higher catches. Because revenues are expected to increase while costs decrease, the percentage increase in profits can be expected to be greater than the increase in revenues; however, quantitative estimates are unavailable at this time (NMFS 2001a).

Under Alternative 2 as illustrated by FMP 2.1, the BSAI and GOA groundfish fisheries are expected to continue to provide high and relatively stable levels of seafood products to domestic and foreign markets. Increases in productivity of several different products could result in lower consumer prices and increased consumer surplus (NMFS 2001a).

Because FMP 2.1 would remove some fishing restrictions in nearshore areas, it would allow vessels to spend more time fishing nearer to shore and would reduce the potential for the risk of accidents and injury due to hazardous weather and other conditions. This could be particularly true in southeast Alaska where repeal of the LLP would open all of the area east of 144° W longitude to trawling. Other positive impacts would be realized in the Bristol Bay area as the Nearshore Bristol Bay closures in areas 506 and 512 would be open; along the Aleutian Islands where the Chinook Savings Area, Herring Savings Area, and Red King Crab Savings Area would be open; and around Kodiak with the opening of the Kodiak Type 1 and Type 2 Areas.

Conversely, the aggressive strategy illustrated by FMP 2.1 could have a large impact on some species and the environment (NMFS 2001a). It is possible that a large reduction in non-use and non-consumptive values would result.

Effects on the Ecosystem

Under FMP 2.1, the increase in fishing effort and opening of all time/area closures except the SSL Protection Measures may increase the risk of local and temporal depletions that can be disruptive to ecosystems. The main predator-prey related effects of the FMP illustration would be an increase in short-term harvests of economically desirable species such as pollock (a key prey item) and cod (an important predator). Thus the bookend could provide less protection to pelagic forage ability (NMFS 2001a). Increased catches of pollock could also impact the spatial and/or temporal concentration of prey removals, especially since the Bogoslof area and Donut Hole would be open to fishing. However, since there would be little change in the trophic level of the catch under FMP 2.1 relative to trophic level of biomass, fishing-down effects on the food web would not be realized.

FMP 2.1 could induce an unknown level of decline in species diversity through increased catch levels of target species (NMFS 2001a). These increased catch levels could reduce protection of endangered species that rely on target species for prey. Increased bycatch of potentially sensitive species such as skates, grenadiers, and sharks would occur along with increased mortality of benthic invertebrates and HAPC biota such as corals, sponges, anemones, sea pens, and sea whips. Alternative 2, as illustrated by FMP 2.1, would provide less protection to genetic diversity because it would possibly increase fishing intensity on spawning aggregations (due to opening of closed areas such as the Seguam Pass/Bogoslof area) and on larger, more heterozygous fish.

Effects on Management and Enforcement

FMP bookend 2.1 eliminates the VMS monitoring system as part of illustrating a less precautionary management policy. As described for Alternative 1, VMS data provide real-time information on vessel location and indicate fishing activity. Without the system, enforcement of SSL Protection Measures would be difficult. Elimination of the current VMS requirement may have a negative impact on the fishing industry, as it could lead to the closure of all SSL critical habitat to fishing should it be determined by NOAA Fisheries, Office of Protected Resources, that without VMS monitoring the remaining SSL Protection Measures are no longer effective.

4.3 Overview of EFH/MPA Management Measures of FMP Bookend 2.2

Figure 6 depicts the closure areas for this bookend, while Table 5 provides the descriptive statistics. The FMP 2.2 bookend proposes no change to the existing closure areas as described under the existing FMPs. Therefore, a total of approximately 29 percent of the total FMP area in the BSAI and GOA combined (closures within various subareas range from about 19 percent to 82 percent) is closed to trawling at various times throughout the year.

4.4 Effects of EFH/MPA Management Measures of FMP Bookend 2.2

Impacts of the FMP 2.2 illustration on the physical, biological, and social and economic environments would be the same as under the Alternative 1 FMPs:

- While non-living substrates and features such as boulders, cobbles, and sand waves can be disturbed by bottom trawls (Auster and Langton 1999), in most cases the structural integrity and complexity of the habitat would not be greatly reduced (NMFS 2001a). Therefore, any impacts of FMP 2.2 on the physical environment are expected to be neither beneficial nor adverse (e.g. no significant impact).
- The spatial distribution of the closed areas under the FMP 2.2 may not protect the full range of habitat types in the BSAI and GOA. The primary focus of the closures is protection of crab habitat and SSL critical habitat. These habitats are generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths, which would protect a wide range of EFH for species that inhabit deep water. Under FMP 2.2, there is a near absence of year-round closures to all fishing, with no-take marine reserves constituting only 0.3 percent of the fishable area. A higher percentage of no-take marine reserves would provide a wider range of protection of EFH from disturbances caused by all gear at all times.
- Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels would incur an increased risk of accidents and injury (NMFS 2001b). Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions.

Table 5. Descriptive statistics for closure areas under FMP scenario 2.2.

Current 2002 trawling^{1 2 3 4 5}			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of fishable area closed
Aleutian Islands (AI)			
No trawl	105,380,000,000	43,357,506,644	41.1%
No take reserve	105,380,000,000	1,662,800,000	1.6%
Total	105,380,000,000	45,020,306,644	42.7%
Bering Sea (BS)			
No trawl and Bogoslof	798,870,000,000	153,708,738,278	19.2%
No take reserve	798,870,000,000	567,620,000	0.1%
Total	798,870,000,000	154,276,358,278	19.3%
Entire BS & AI			
No trawl	904,250,000,000	197,066,244,922	21.8%
No take reserve	904,250,000,000	2,230,420,000	0.2%
Total	904,250,000,000	199,296,664,922	22.0%
Central \ Western Gulf - west of 144°			
No trawl	265,690,000,000	87,906,000,000	33.1%
No take reserve	265,690,000,000	1,266,300,000	0.5%
Total	265,690,000,000	89,172,300,000	33.6%
Eastern Gulf - east of 144°			
No trawl	90,509,000,000	73,958,000,000	81.7%
No take reserve	90,509,000,000	8,304,042	0% ⁶
Total	90,509,000,000	73,966,304,042	81.7%
Entire Gulf of Alaska			
No trawl	356,199,000,000	161,864,000,000	45.4%
No take reserve	356,199,000,000	1,274,604,042	0.5%
Total	356,199,000,000	163,138,604,042	45.8%
Totals			
Total no trawl	1,260,449,000,000	358,930,244,922	28.5%
Total no take	1,260,449,000,000	3,505,024,042	0.3%
Total FMP Area	1,260,449,000,000	362,435,268,964	28.8%

1 Closures include Steller sea lion (SSL) protection measures, Alaska Department of Fish and Game (ADF&G) restrictions, and No Transit Zones.

2 For consistency with other Programmatic Supplemental Environmental Impact Statement (SEIS) analysis, closures are cut at the 1,000-meter boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.

3 Pelagic and Non-Pelagic Trawl Closures are included.

4 The Steller No Transit areas and Sitka Pinnacles account for the No take reserves.

5 With the complexity for the SSL measures in the A1, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7 nautical miles (nm) to effectively close 50 percent of critical habitat.

6 Sitka Pinnacles - percentage is about 0.01 percent so this number appears as 0 percent

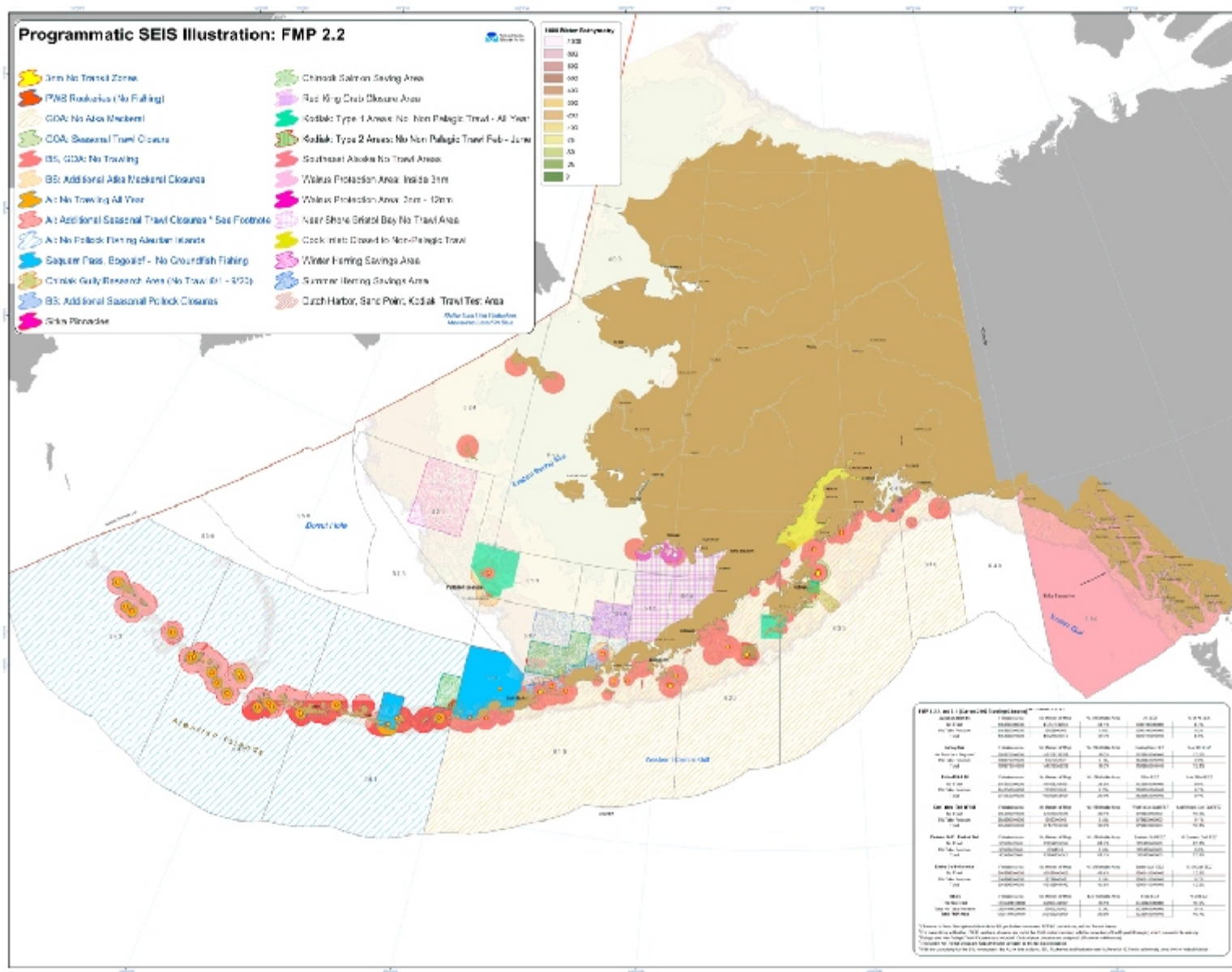


Figure 6. Closure Areas for FMP Bookend 2.2.

Section 5 **Alternative 3 – Adopt a More Precautionary Management Policy**

5.1 Overview of EFH/MPA Management measures of FMP Bookend 3.1

A goal of the Alternative 3 policy as illustrated by FMP 3.1 is to develop an MPA efficacy methodology including program goals, objectives, and criteria for establishing MPAs and no-take marine reserves. Specifically, the criteria should meet certain objectives:

- Consider that MPAs may include no-take areas.
- Review existing closures such as Sitka Pinnacles to determine if these areas qualify for MPAs under established criteria.
- Include restrictions of specific gear types or fisheries.
- Assume that existing closures (see Alternative 1) would remain in effect until the process is complete and MPAs are designated. Table 6 provides the descriptive statistics and Figure 7 depicts the closure areas proposed under this scenario.

Regarding the development of an MPA efficacy methodology, Figures 8 through 10 suggest a three-phase method for the MPA designation process that could be used under this framework. The methodology employs and expands upon EFH/HAPC considerations, the ADF&G (2002) recommendations, and suggestions provided by the NRC (2001). Figure 8 depicts the Phase I design and selection process for establishing an MPA. The goals of this initial phase are to select candidate sites based on the best available science, and to employ early involvement of stakeholders (ADF&G 2002). As shown in the figure, the public, recognized ecological and socioeconomic experts (organized into teams or forums), and interested federal and state agency representatives all have the opportunity to provide input into each step of the candidate selection process. The process follows ADF&G (2002) recommendations and the suggested steps include the following:

1. Adopting a statewide policy for MPA designation,
2. Developing MPA evaluation criteria, and
3. Identifying and evaluating potential sites using the developed criteria.

Phase I ends with the selection of a number of candidate MPA sites, each incorporating one or more of the objectives set at the policy stage.

Phase II, as depicted in Figure 9, advances the MPA designation process and has a goal of designating an MPA site using a process that again maximizes public input and stakeholder concurrence. As in Phase I, public stakeholders, agency representatives, and scientific and socioeconomic experts provide input in the establishment of the candidate MPA boundaries and buffer zones, and are instrumental in the development

Table 6. Descriptive statistics for closure areas under FMP scenario 3.1.

Current 2002 Trawling Closures^{1 2 3 4 5}			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of fishable area closed
Aleutian Islands (AI)			
No trawl	105,380,000,000	43,357,506,644	41.1%
No take reserve	105,380,000,000	1,662,800,000	1.6%
Total	105,380,000,000	45,020,306,644	42.7%
Bering Sea (BS)			
No trawl and Bogoslof	798,870,000,000	153,708,738,278	19.2%
No take reserve	798,870,000,000	567,620,000	0.1%
Total	798,870,000,000	154,276,358,278	19.3%
Entire BS & AI			
No trawl	904,250,000,000	197,066,244,922	21.8%
No take reserve	904,250,000,000	2,230,420,000	0.2%
Total	904,250,000,000	199,296,664,922	22.0%
Central \ Western Gulf- west of 144°			
No trawl	265,690,000,000	87,906,000,000	33.1%
No take reserve	265,690,000,000	1,266,300,000	0.5%
Total	265,690,000,000	89,172,300,000	33.6%
Eastern Gulf - east of 144°			
No trawl	90,509,000,000	73,958,000,000	81.7%
No take reserve	90,509,000,000	8,304,042	0% ⁶
Total	90,509,000,000	73,966,304,042	81.7%
Entire Gulf of Alaska			
No trawl	356,199,000,000	161,864,000,000	45.4%
No take reserve	356,199,000,000	1,274,604,042	0.5%
Total	356,199,000,000	163,138,604,042	45.8%
Totals			
Total no trawl	1,260,449,000,000	358,930,244,922	28.5%
Total no take	1,260,449,000,000	3,505,024,042	0.3%
Total FMP Area	1,260,449,000,000	362,435,268,964	28.8%

1 Closures include Steller sea lion (SSL) protection measures, Alaska Department of Fish and Game (ADF&G) restrictions, and No Transit Zones.

2 For consistency with other Programmatic Supplemental Environmental Impact Statement (SEIS) analysis, closures are cut at the 1000-meter boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.

3 Pelagic and Non-Pelagic Trawl Closures are included.

4 The Steller No Transit areas and Sitka Pinnacles account for the No take reserves.

5 With the complexity for the SSL measures in the A1, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7 nautical miles (nm) to effectively close 50 percent of critical habitat.

6 Sitka Pinnacles - percentage is about 0.01 percent so this number appears as 0 percent.

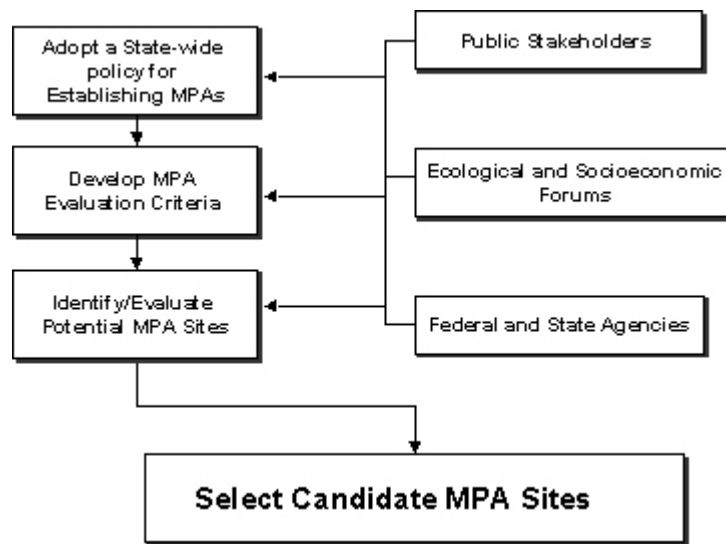


Figure 8. Phase I - MPA design and selection process. The goal of Phase I is to select candidate sites based on best available science and employing early involvement of stakeholders. Source: ADF&G 2002 and NRC 2001.

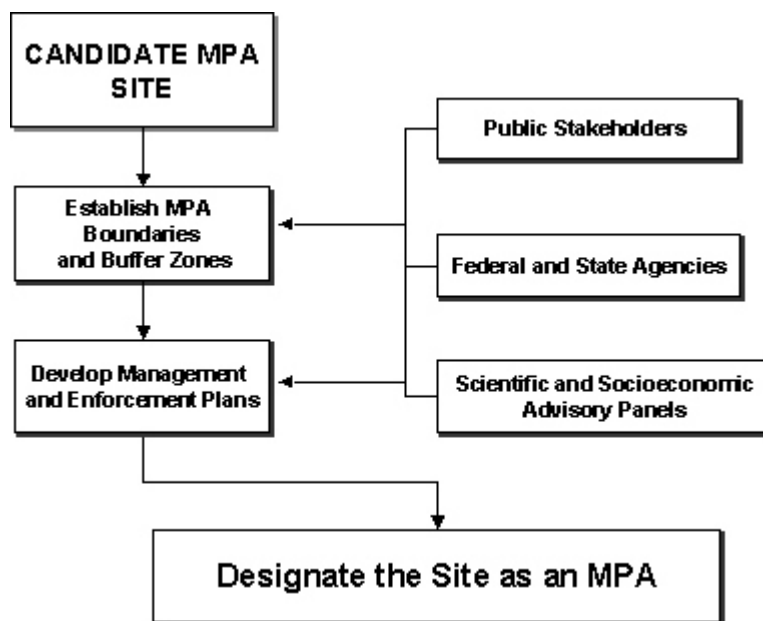


Figure 9. Phase II - MPA design and selection process. The goal of Phase II is to designate MPA sites utilizing a process that maximizes public input and stakeholder concurrence. Source: ADF&G 2002 and NRC 2001.

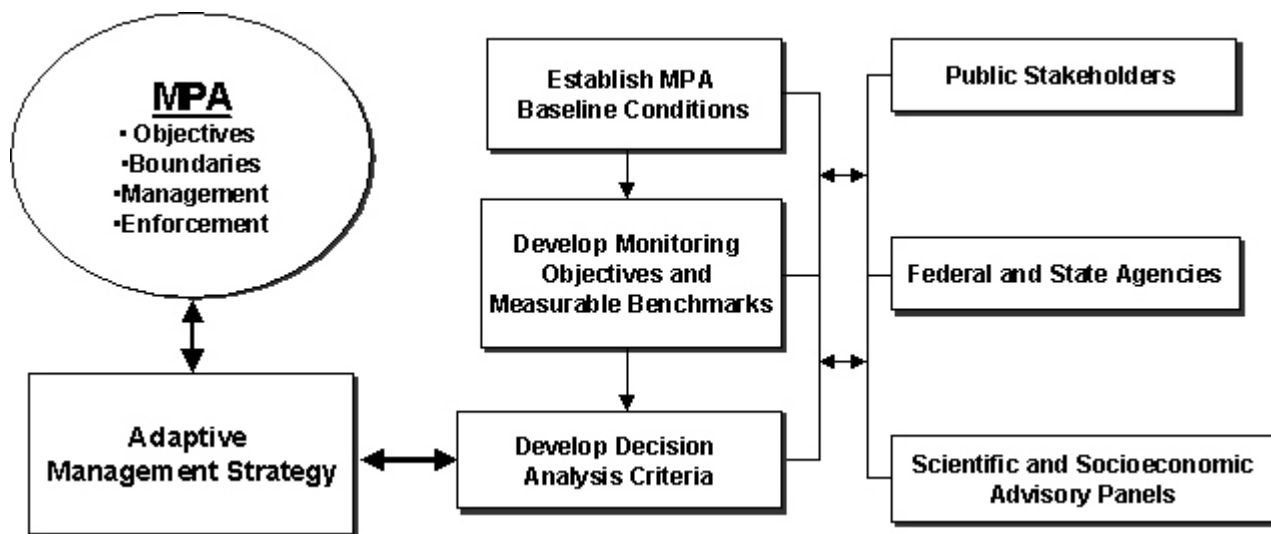


Figure 10. Phase III - MPA adaptive management process. The goal of Phase III is to evaluate MPA effectiveness and allow for changes in management to further advance site objectives. Source: ADF&G 2002 and NRC 2001.

of management and enforcement plans for the candidate MPA. The final step of the phase is to formally designate the candidate site as an MPA.

Phase III, as depicted in Figure 10 above occurs after designation and provides an adaptive process for management of the MPA. The goal is to evaluate the effectiveness of the reserve and allow for changes in management, particularly if site conditions change. Again, the public, federal and stage agencies, and experts in the subject matter have an opportunity to provide input throughout all steps in the process. The development of the adaptive management strategy should be viewed as a continuous, reciprocal process, where feedback from the existing strategy is provided to decision-makers and stakeholders through an interactive process.

Another goal of Alternative 3, as illustrated by FMP 3.1, is to evaluate the impacts of all gear on habitat through the implementation of a comprehensive research plan. A comprehensive research program would provide data on the following:

- Habitat type and structure,
- Productivity and biodiversity,
- Habitat recovery,

- Effects of fishing, and
- Effects of other human induced impacts such as pollution.

For example, a research program designed to provide regional shoreline information on habitat type would serve fishery managers and the public well by providing scientific information necessary to produce a regional marine habitat atlas. Such an atlas would allow scientists to more fully evaluate the impacts of fishing on habitat type and determine appropriate mitigation measures.

5.2 Effects of EFH/MPA Management Measures of FMP Bookend 3.1

The impacts of the FMP 3.1 closure areas on the biological, physical, and social and economic environments are the same as those for the current FMPs under Alternative 1:

- While non-living substrates and features such as boulders, cobbles, and sand waves can be disturbed by bottom trawls, in most cases the structural integrity and complexity of the habitat would not be greatly reduced (NMFS 2001a).
- The primary focus of the closures is protection of crab habitat and SSL critical habitat. These habitats are generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths. A higher percentage of no-take marine reserves would provide a wider range of protection for EFH from disturbances caused by all gear at all times.
- Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels would incur an increased risk of accidents and injury (NMFS 2001b).

Should the methodology developed under this FMP illustration provide for additional closures or specific gear restrictions, additional protection for habitat, prohibited species, and marine mammals could be realized.

5.3 Overview of EFH/MPA Management Measures of FMP Bookend 3.2

FMP bookend 3.2 provides an alternative FMP that could be implemented under the Alternative 3 policy. For example, it designates 0 to 20 percent of the BSAI and GOA as no-trawl MPAs and no-take marine reserves (e.g., 5 percent = no-take, 15 percent = no-trawl MPA) across a range of habitat types. The management regime would also designate no-take marine reserves to serve as research control areas; these areas could encompass existing closures. There are many possible permutations of this type of FMP that would vary both MPAs and the establishment of no-take reserves. For analysis purposes, Figure 11 has been developed to provide one illustration of the many scenarios possible under FMP 3.2; Table 7 provides descriptive statistics for the illustration.

As shown in Table 7 and Figure 11, the FMP 3.2 would close 47.8 percent of the fishable area covered by the FMPs in the BSAI and GOA combined. This area would be closed to bottom contact trawling (non-pelagic) or other fishing for at least part of the year. Of this 47.8 percent, 8.2 percent is designated as

no-take marine reserves closed to all fishing year-round. As shown in Table 7, bottom contact trawl closures in the GOA total 72 percent of the fishable area at one time or another with almost 14 percent of the fishable area designated as no-take marine reserves. The largest percentage of GOA closures takes place in the Eastern Gulf, where 92.2 percent of the fishable area is closed at one time or another with about 5 percent designated as no-take marine reserves. In the central and western Gulf, seasonal and other restrictions close about 66 percent of the fishable area, with about 17 percent designated as no-take marine reserves. Comparatively, nearly 80 percent of the Aleutian Islands is closed to bottom trawling for at least part of the year, with about 19 percent designated as no-take marine reserves. In the Bering Sea nearly 33 percent of the fishable area is closed at one time of year or another to various fishing gears, with about 4 percent designated as no-take marine reserves.

FMP bookend 3.2 breaks out percentages for two additional restricted areas:

- SSL No-Trawl MPA, where trawling for pollock, Pacific cod, and Atka mackerel (SSL prey species) is not allowed, but fishing by other methods for these fish, and fishing by all methods for other fish such as rockfish and flatfish is allowed. In the BSAI and GOA, these areas account for about 2 percent and 10 percent of the fishable area, respectively.
- SSL No Hook-and-Line, Pot, or Trawl MPA, where no fishing by any method is allowed for the sea lion prey species, but fishing by all methods for other species is allowed. These areas comprise nearly 7 percent of the fishable area in the BSAI and nearly 22 percent in the GOA.

Percentages for these closure areas, which are considered MPAs but do not meet the definition of no-take marine reserves, are shown in Table 7.

5.4 Effects of EFH/MPA Management Measures of Bookend 3.2

Effects on the Physical Environment

As described under Alternative 1 and FMP 3.1, the existing closure areas in the BSAI and GOA approach 20 percent coverage of the fishable area. However, the FMP 3.1 (existing) closures are not necessarily year-round and may not restrict all gear and protect all habitat types. The FMP 3.2 bookend illustrates a different management regime where an MPA program is established with a minimum amount of the fishable area designated either as a no-trawl or no-bottom contact MPA or a no-take reserve. It is predicted that there would be fewer impacts on the substrate under this regime, since more area would be closed to bottom contact, and a greater percentage of fishable area would be designated as no-take marine reserves.

Effects on the Biological Environment

EFH - Benthic Biodiversity

This FMP scenario has the potential for increased protection for EFH since it strives to protect a broader range of habitats, substrates, and depths. At present, much of the closed areas is used to protect prohibited species such as crab and halibut, or for sea lion critical habitat. Many of these areas require only seasonal closures or closures only when certain bycatch triggers are reached.

Table 7. Descriptive statistics for closure areas under FMP scenario 3.2.

Current 2002 Trawling Closures^{1 2 3 4}			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of fishable area closed
Aleutian Islands (AI)			
No trawl marine protected area (MPA)	105,380,000,000	37,021,000,000	35.1%
No take marine reserve	105,380,000,000	20,175,000,000	19.1%
No Steller sea lion (SSL) hook and line (HL) pot trawl MPA	105,380,000,000	19,345,000,000	18.4%
No SSL trawl MPA	105,380,000,000	7,650,200,000	7.3%
Total	105,380,000,000	84,166,200,000	79.9%
Bering Sea (BS)			
No trawl MPA	798,870,000,000	170,212,365,792	21.3%
No take marine reserve	798,870,000,000	34,247,800,000	4.3%
No SSL HL pot trawl MPA	798,870,000,000	41,941,000,000	5.3%
No SSL trawl MPA	798,870,000,000	14,231,000,000	1.8%
Total	798,870,000,000	260,632,165,792	32.6%
Entire BS & AI			
No trawl MPA	904,250,000,000	207,233,365,792	22.9%
No take marine reserve	904,250,000,000	54,422,800,000	6.0%
No SSL HL pot trawl MPA	904,250,000,000	61,286,000,000	6.8%
No SSL trawl MPA	904,250,000,000	21,881,200,000	2.4%
Total	904,250,000,000	344,798,365,792	38.1%
Central \ Western Gulf - west of 144°			
No trawl MPA	265,690,000,000	82,306,490,050	31.0%
No take marine reserve	265,690,000,000	44,057,000,000	16.6%
No SSL HL pot trawl MPA	265,690,000,000	13,529,000,000	5.1%
No SSL trawl MPA	265,690,000,000	34,410,000,000	13.0%
Total	265,690,000,000	174,302,490,050	65.6%
Eastern Gulf - east of 144°			
No trawl MPA	90,509,000,000	15,070,038,000	16.7%
No take marine reserve	90,509,000,000	4,811,664,379	5.3%
No SSL HL pot trawl	90,509,000,000	63,602,319,644	70.3%
Total	90,509,000,000	83,484,022,023	92.2%
Entire Gulf of Alaska			
No trawl MPA	356,199,000,000	97,376,528,050	27.3%
No take marine reserve	356,199,000,000	48,868,664,379	13.7%
No SSL HL pot trawl MPA	356,199,000,000	77,131,319,644	21.7%
No SSL trawl MPA	356,199,000,000	34,410,000,000	9.7%
Total	356,199,000,000	257,786,512,072	72.4%
Totals			
Total no take	1,260,449,000,000	103,291,464,379	8.2%
Total FMP Area	1,260,449,000,000	602,584,877,865	47.8%

- 1 Some areas extend past the shelf and since the fishable area is based on the shelf, analysis does not represent total fishable area closed.
- 2 The management areas are cut at the 1,000 meter shelf break but for clarity the AI closures are shown in total.
- 3 Bering Sea areas have been cut by the 1,000 meter bathymetry but the Bogoslof Foraging and small surrounding areas are included in management areas.
- 4 Since the Eastern Gulf does not contain SSL Protection Measures, combined GOA area calculations must be read carefully.

Under the Alternative 3 policy, no-take marine reserves could be established across a broad range of habitat types and water depths. These reserves would prohibit all commercial groundfish fishing year-round. FMP Bookend 3.2 illustrates one application where, in addition to no-take reserves, 47.8 percent of the fishable area would be closed to bottom trawling and or other gear for at least part of the year. Of this percentage, 8.2 percent is designated as no-take marine reserves (see Table 7). While the existing closures total about 29 percent of fishable area in the GOA and BSAI combined (see Table 2), which is more than the actual percentage defined by the Alternative 3 policy, these closures are generally trawl limitations enacted to protect specific prohibited species and SSLs rather than broadly protecting EFH. The existing FMP designates less than 1 percent of the fishable area as no-take reserves. Therefore, the more-focused, year-round closures recommended under FMP 3.2 are likely to benefit EFH by offering protection to a larger portion of the continental shelf compared to FMP 3.1, and by decreasing bottom contact from all gear types.

EFH - HAPC

As shown in Figure 11 and Table 7, FMP 3.2 illustrates an FMP where additional closure areas are used in the deeper waters that encompass the outer continental shelf and upper slope of the central and western GOA and BSAI. These deep water areas contain bottom features that have been found to be associated with juvenile rockfish. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002). This area would receive considerable protection under FMP 3.2.

Bottom trawl closures are, in many cases, not year-round and do not restrict fixed gear use under FMP 3.1 as well as under the current FMPs (Alternative 1). In some cases, scientific studies have shown that fixed-gear adversely impacts HAPC. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under FMP 3.2, there would be additional areas closed to all fishing year-round compared to FMP 3.1. These no-take marine reserves would provide protection of HAPC from disturbances caused by all gear at all times. While this FMP bookend still provides potential for moderate-to-substantial trawling effort in areas with high concentrations of HAPC species, the effects of disturbance to HAPC are offset in this FMP by year-round closures to all fishing across a broad range of habitats, along with reductions in TAC, so fishing effort does not merely move to and concentrate in another, possibly sensitive, area.

Target, Non-Target, Forage Fish, and Prohibited Species

Under the FMP bookend 3.2 the existing closure areas in the BSAI and GOA that generally have been designated to protect various prohibited species would remain in place and would be supplemented by additional no-trawl MPAs and no-take marine reserves. These closures may indirectly provide benefits to target and non-target species by protecting juveniles and important habitat. The use of additional, year-round no-take marine reserves could likely also provide benefits to prohibited species and forage fish.

Marine Mammals

The additional no-take marine reserves defined by FMP 3.2 would benefit marine mammals by lessening direct impacts (mortality, direct disturbance) and indirect impacts (loss of prey).

Seabirds

None of the closure areas currently in place are specifically designed to protect or enhance seabird populations. However, the additional near-shore closures proposed under FMP 3.2 may directly benefit seabirds by reducing the incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels. Also any beneficial effects for this FMP on forage fish could indirectly benefit seabirds. Additional discussions on the impacts of this scenario on seabirds are found in the Seabird Qualitative Impact Assessment (see Appendix F-6).

Effects on the Social and Economic Environment

Under policy Alternative 3 as illustrated by FMP 3.2, average costs per unit of catch for catcher vessels can be expected to increase (NMFS 2001a). Spatial displacement of fishing effort due to the extensive closure areas could lead to increased operating costs for vessels. The spatial displacement of fishing effort would be large for some bottom trawl fisheries. Operating costs would be increased as vessels travel further to harvest fish and may be required to fish in less productive areas in some cases.

It is reasonable to assume that, subject to regulatory constraints, harvesters target catch with the gear that maximizes its value either by increasing the quality of the fish or by decreasing the harvesting costs, or both. Therefore, the replacement of several bottom trawl fisheries with pelagic trawl and fixed-gear fisheries would result in an increase in cost per unit of catch. Preemption of some fishery sectors is possible as catch is shifted toward larger vessels and the plants to which they deliver fish (NMFS 2001a).

Alternative 3 as illustrated by FMP 3.2 could produce impacts beyond reducing profits in the harvest and processing sectors. Reductions in production of several different products could result in higher prices and a loss of consumer surplus to the American public; however, individual effects could be mitigated by increased production of other seafood products.

As compared to FMP 3.1 and Alternative 1 (existing closures under the current FMPs), the closed areas under FMP 3.2 could result in possibly greater distances between ports and open fishing grounds and require fishing even further offshore. Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions. Therefore, the closures would favor larger vessels over small. These effects could be mitigated somewhat if Individual Fishing Quotas (IFQs) for local fishermen were allowed in certain nearshore areas.

Positive impacts of the policy Alternative 3 closures as illustrated by FMP 3.2 include benefits to non-market issues such as existence values and eco-tourism. While estimates of non-consumptive and non-use values for various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs serve to enhance these values to an unknown extent. Since the closures illustrated under FMP 3.2 provide additional protection to habitat, an additional benefit above that achieved from the status quo is assumed.

Effects on the Ecosystem

The FMP 3.2 illustration could change predator-prey relationships by providing additional areas that would be totally closed to fishing. The no-take marine reserves would provide areas where prey populations would not be disturbed and could therefore benefit predators (NMFS 2001a). Reducing the disturbance of benthic prey through bottom trawling would provide a less disturbed prey base for benthic feeding animals. Scavenging animals that presently benefit to some degree from trawls that expose benthic prey would experience a decline; however, the actual magnitude of the positive benefits to non-scavenging predators is not known. Changing the selectivity toward gear that removes older fish would reduce energy flow at higher trophic levels which would shorten the food chain and decrease the lifespan of organisms. However, since there would be little change in the trophic level of the catch under FMP 3.2 relative to trophic level of biomass, fishing-down effects on the food web is not predicted.

FMP 3.2 could provide an unknown level of protection for species-level diversity since many benthic invertebrates that are vulnerable to high levels of mortality through gear impacts would be protected. The policy alternative, as illustrated by FMP 3.2, would provide additional protection to benthic trophic guilds that supply prey to many groundfish species (NMFS 2001a).

Effects on Management and Enforcement

The requirement that all vessels participating in the Atka mackerel, Pacific cod, or pollock directed fisheries carry an operable, approved VMS transmitter would continue under the FMP 3.2 bookend. VMS data provide real-time information on vessel location and indicate fishing activity and would be essential for enforcement under this bookend, which incorporates a complicated patchwork of closure areas and seasonality. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impact Assessment.

The Observer Program, which is also discussed in detail in a separate paper, would also continue under this bookend and would be extended to include 100 percent of vessels over 60 ft. The additional coverage would help to ensure that these larger vessels are not fishing in closed areas.

Section 6 Alternative 4 – Adopt a Highly Precautionary Management Policy

6.1 Overview of EFH/MPA Management Measures of FMP Bookend 4.1

This FMP component illustrates a plan that designates 20 to 50 percent of the management area as no-take reserves covering the full range of marine habitats. The emphasis is on closing areas where impacts of fishing are unknown due to insufficient data. Additional areas could be opened when information is available to show no or negligible impacts from fishing. There are many possible ways to apply a 20 to 50 percent rule. Each would vary the location and geographical extent of the seasonal closure areas and no-take reserves. For analysis purposes, Figures 12 and 13 depict the Alternative 4 policy as described by FMP 4.1. Figure 12 depicts the closures in a monochromatic scheme in order to emphasize the total area closed and the concept that all areas are closed (purple) until available information regarding impacts allows them to join areas which are already open to fishing (white). Figure 13 depicts the closure areas using the same color scheme that was used for the other FMPs.

Table 8 provides the descriptive statistics for the FMP 4.1 illustration. As shown, this FMP scenario would close 51.1 percent of the fishable area in the BSAI and GOA combined to trawling for at least part of the year. Under this illustration, in the combined BSAI and GOA 28.5 percent of fishable area would be designated as no-take marine reserves, closed to all fishing year-round. In the BSAI nearly 40 percent of the fishable area would be closed to trawling at some point during the year, with about 25 percent designated as no-take marine reserves. The majority of the closed areas would occur in the GOA where just over 80 percent of the fishable area would be closed to trawling at one time or another. This is due to the relatively limited continental shelf and slope in the GOA, and the higher abundance of vulnerable habitat in that region. No-take marine reserves covering about 38 percent of the fishable area would be designated in the GOA.

6.2 Effects of EFH/MPA Management Measures of FMP Bookend 4.1

Effects on the Physical Environment

As described above, the existing closure areas in the BSAI and GOA approach 30 percent coverage of the fishable area (e.g., continental shelf and slope to 1,000 m water depth) (See Table 2.) However, the existing closures are not necessarily year-round and may not include all gear and habitat types. FMP 4.1 would close additional, deeper areas to trawling and establishes a higher percentage of no-take marine reserves. Therefore, benthic substrates across a wide range of depths and habitats should be protected from impacts due to bottom contact gear.

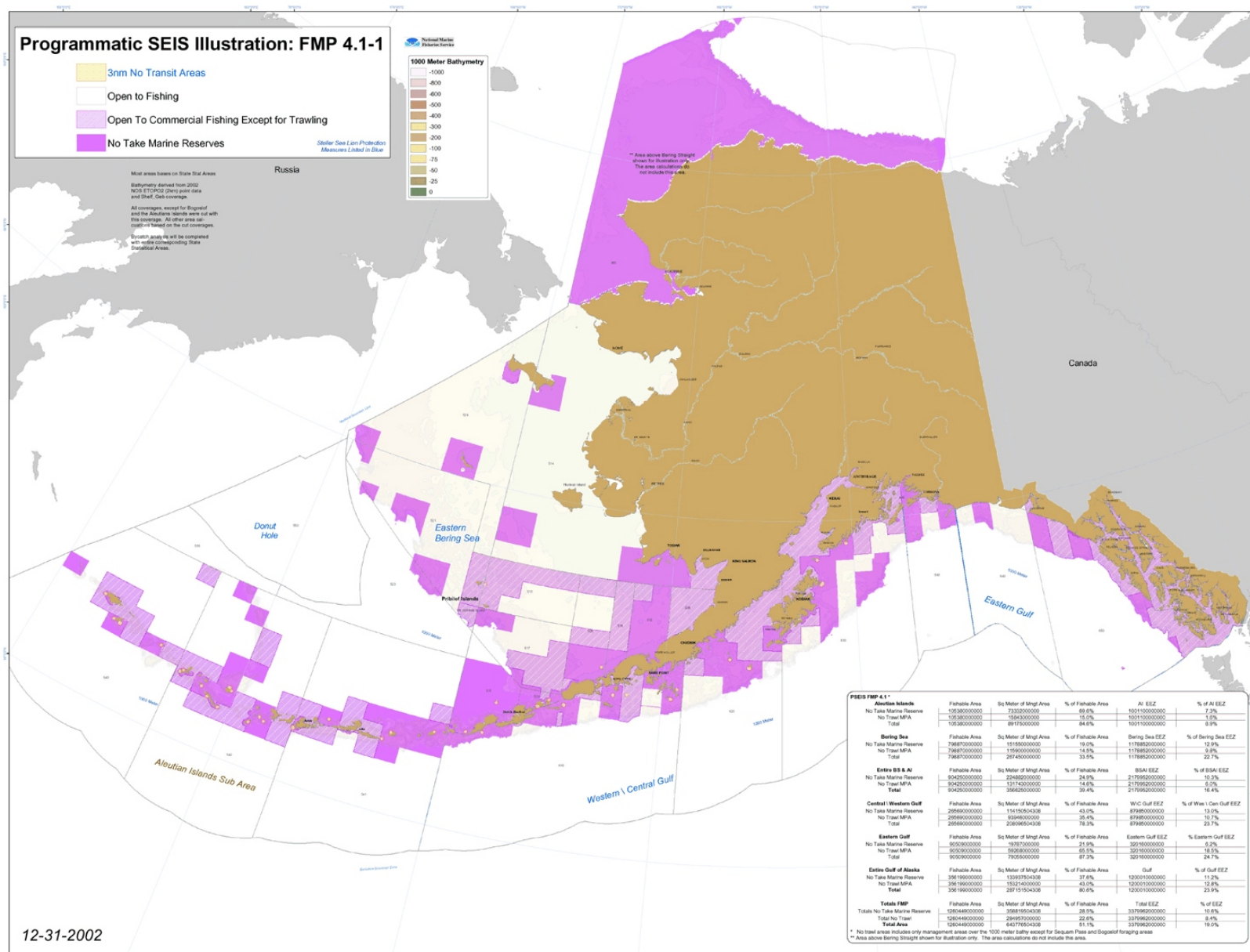


Figure 12. Closure Areas of FMP Bookend 4.1 (monochrome).

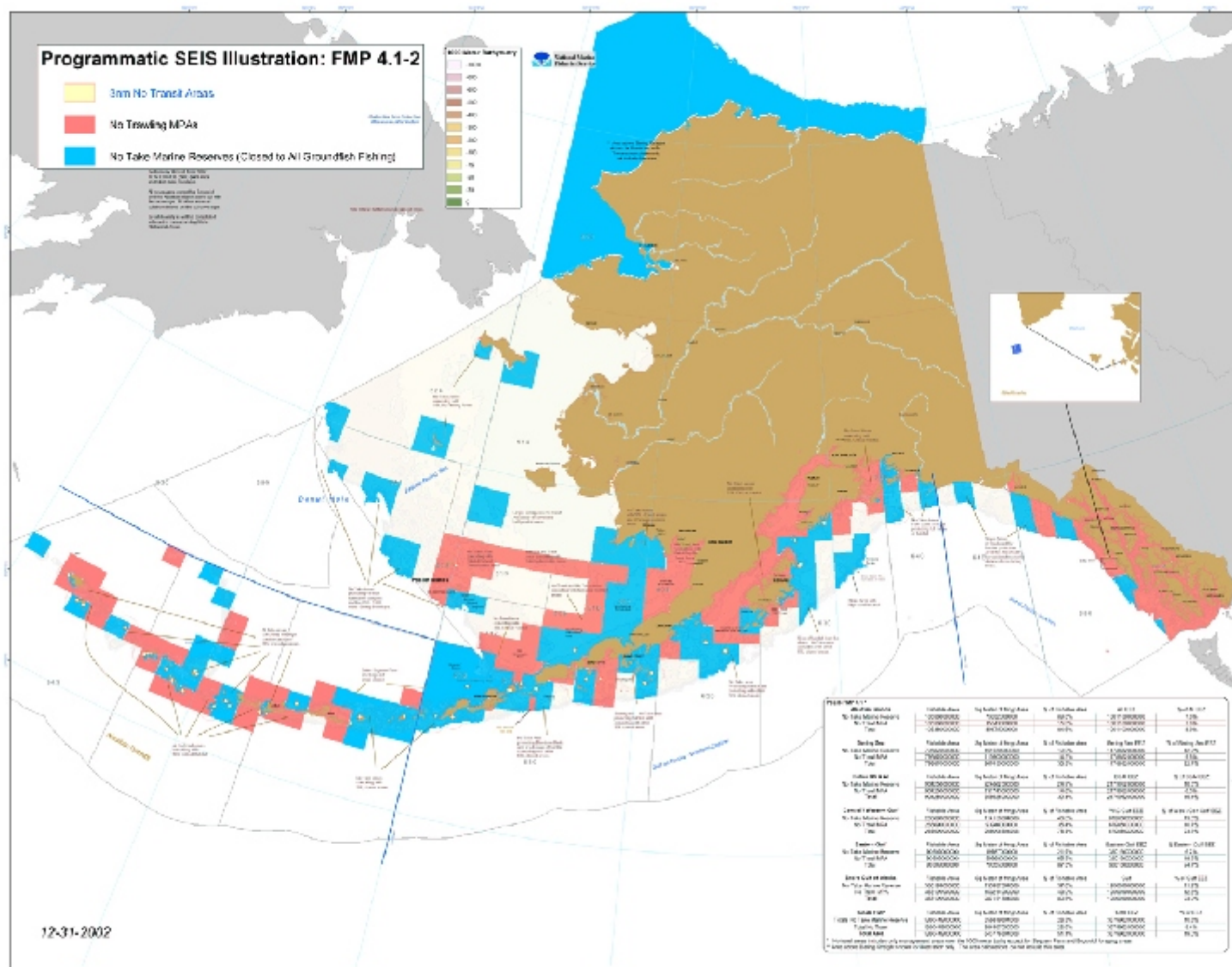


Figure 13. Closure Areas of FMP Bookend 4.1 (full color).

Table 8. Descriptive statistics for closure areas under FMP scenario 4.1.

Current 2002 Trawling Closures ¹			
	Fishable area (in square kilometers [km²])	Management area (km²)	Percentage (%) of fishable area closed
Aleutian Islands (AI)			
No take marine reserve	105,380,000,000	73,332,000,000	69.6%
No trawl marine protected area (MPA)	105,380,000,000	15,843,000,000	15.0%
Total	105,380,000,000	89,175,000,000	84.6%
Bering Sea (BS)			
No take marine reserve	798,870,000,000	151,550,000,000	19.0%
No trawl MPA	798,870,000,000	115,900,000,000	14.5%
Total	798,870,000,000	267,450,000,000	33.5%
Entire BS & AI			
No take marine reserve	904,250,000,000	224,882,000,000	24.9%
No trawl MPA	904,250,000,000	131,743,000,000	14.6%
Total	904,250,000,000	356,625,000,000	39.4%
Central \ Western Gulf - west of 144°			
No take marine reserve	265,690,000,000	114,150,504,308	43.0%
No trawl MPA	265,690,000,000	93,946,000,000	35.4%
Total	265,690,000,000	208,096,504,308	78.3%
Eastern Gulf - east of 144°			
No take marine reserve	90,509,000,000	19,787,000,000	21.9%
No trawl MPA	90,509,000,000	59,268,000,000	65.5%
Total	90,509,000,000	79,055,000,000	87.3%
Entire Gulf of Alaska			
No take marine reserve	356,199,000,000	133,937,504,308	37.6%
No trawl MPA	356,199,000,000	153,214,000,000	43.0%
Total	356,199,000,000	287,151,504,308	80.6%
Totals			
Totals no take	1,260,449,000,000	358,819,504,308	28.5%
Total no trawl	1,260,449,000,000	284,957,000,000	22.6%
Total FMP Area	1,260,449,000,000	643,776,504,308	51.1%

¹ No trawl areas include only management areas over the 1,000-meter bathymetry, except for Segum Pass and Bogoslof foraging areas

Effects on the Biological Environment

EFH - Benthic Biodiversity

As with FMP 3.2 this FMP bookend has the potential for additional benefits to accrue to benthic organisms (biodiversity) and EFH, especially since a broad range of habitats, substrates, and depths are protected (see Figure 11). The illustrated closures are more extensive and more focused than current management regimes. FMP 4.1 would close nearly 29 percent of the fishable area to all fishing on a year-round basis. In addition, the concept that areas be closed until adequate information regarding impacts can be collected to determine whether areas should be opened constitutes a paradigm shift in the way the groundfish fishery has been managed. The extensive designation of no-take marine reserves, along with the change in management concept, is likely to greatly benefit EFH by expanding the amount of benthic areas closed to bottom contact gear.

EFH - HAPC

As shown on Figure 13 and Table 8, FMP 4.1 provides for additional closure areas in the deeper waters of the outer continental shelf and upper slope of the central and western GOA and BSAI. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002).

The existing closures to bottom trawling are in many cases not year-round, and do not restrict fixed gear use. In some cases, fixed-gear may adversely impact HAPC. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. FMP 4.1 provides for additional closure areas in deeper waters of the outer continental shelf and upper slope. Many of these areas encompass high habitat complexity and high abundance of HAPC. There would be extensive areas closed to all fishing year-round. These no-take marine reserves would provide protection to HAPC from disturbances caused by the groundfish fishery. Under this bookend there is minimal potential for substantial trawling efforts in areas with high concentrations of HAPC species, and along with fishery-specific reductions in TAC, fishing effort is unlikely to move to and concentrate in another area. These combinations of effects will likely benefit HAPC in the BSAI and GOA under this bookend.

Target, Non-Target, Forage Fish, and Prohibited Species

Under FMP bookend 4.1, the closure areas in place in the BSAI and GOA that have been designated to protect various prohibited species would continue. These closures may also provide indirect benefits to target, non-target, and forage fish species. Additional year-round no-take reserves defined by FMP 4.1 will likely provide additional benefits to these species. The existing low volume of incidental catch of forage fish currently observed under the existing FMPs could go even lower under FMP 4.1 due to the extensive closures and reduction in TACs.

Marine Mammals

The additional no-take reserves, as illustrated by FMP 4.1, would likely benefit marine mammals by lessening direct (mortality, direct disturbance) and indirect (loss of prey) effects caused by the groundfish fishery.

Seabirds

None of the closure areas currently in place is specifically designed to protect or enhance seabird populations. However, the additional near-shore closures proposed under FMP 4.1 may directly benefit seabirds by reducing the incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels. Also any beneficial effects for this FMP on forage fish could indirectly benefit seabirds. Additional discussions on the impacts of this scenario on seabirds are found in the Seabird Qualitative Impact Assessment (see Appendix F-6).

Effects on the Social and Economic Environment

Policy Alternative 4 as illustrated by FMP 4.1 closes large areas of the BSAI and GOA to groundfish fishing. The closures would produce socioeconomic effects that vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. While these effects are quantified and discussed in detail in Chapter 4 of the Programmatic SEIS, a brief qualitative discussion is provided herein.

Due to longer transit times to reach open areas, the closures illustrated under FMP 4.1 decrease catch and increase the cost of harvesting a given amount of fish. As described for FMP 3.2, the extensive closure areas would lead to spatial displacement of fishing effort. The spatial displacement of fishing effort would be large for some bottom trawl fisheries. Operating costs would be increased as vessels travel further to harvest fish and may be required to fish in less productive areas in some cases. Under the illustration, average costs per unit of catch would be expected to rise dramatically while fixed costs (e.g., general office and accounting costs, vessel maintenance, and insurance) would be spread over a much smaller total catch (NMFS 2001a). However, the major reductions in catches should also result in increasing abundance of the affected fish stocks, which might eventually tend to increase catch rates. The greatest impact would be on trawl and pot catcher vessels, but hook-and-line catcher vessels would also be subject to substantially increased costs per unit of catch.

Trawl catcher vessels less than 60 ft would likely be the hardest hit by the closures illustrated under FMP 4.1. These vessels, which because of their size fish almost exclusively in nearshore waters in the GOA, would lose a substantial amount of groundfish revenue (NMFS 2001a). Because the open areas are farther from shore than the areas typically fished by trawl catcher vessels less than 60 ft, it is likely that they will not be able to fish at the same relative level as in the past. Even though these vessels are relatively diversified between groundfish and non-groundfish, their reliance on pollock and Pacific cod in the GOA makes them vulnerable to the closures and other components of the FMP 4.1 bookend.

The closures illustrated under FMP 4.1 result in greater distances between ports and open fishing grounds and require fishing further offshore. Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions. These effects could be mitigated somewhat if IFQs for local fishermen were allowed in certain nearshore areas.

Variable costs for inshore processors and motherships are also likely to increase. The total average costs per unit of production would rise, and it is possible that they would exceed the value of production and lead to a shutdown or permanent closing of some processing plants, motherships, and catcher processors.

Alternative 4 as illustrated by FMP 4.1 would produce impacts beyond reducing profits in the harvest and processing sectors. Reductions in production of several different products would result in significant decreases in supply of groundfish to the domestic market. The supply of surimi for the domestic market and other products might also be reduced. This would result in higher prices and a loss of consumer surplus to the public.

Positive impacts of the Alternative 4 closures as illustrated by FMP 4.1 include benefits to non-market issues such as existence values and eco-tourism. While estimates of non-consumptive and non-use values for various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs would serve to enhance these values to an unknown extent. Since the closures illustrated under FMP 4.1 provide extensive protection to habitat, an additional benefit above that achieved from the status quo and FMP 3.2 could be assumed.

Effects on the Ecosystem

As described above for the FMP 3.2 bookend, the extensive seasonal closures and no-take areas proposed under FMP 4.1 will benefit a wide range of habitats. While the percentages of shelf/slope afforded some level of protection are similar between FMPs 4.1 and 3.2, FMP 4.1 establishes more of the shelf/slope as no-take marine reserve. FMP 3.2 has most of the protected areas in MPAs (trawl restrictions). The no-take marine reserves would provide areas where prey populations would not be disturbed and could therefore benefit predators (NMFS 2001a). Reducing the disturbance of benthic prey through bottom trawling would provide a less disturbed prey base for benthic feeding animals. Also, habitat in the no-take marine reserves would be protected from continuing impacts and could recover from past fishing-related disturbances. The potential benefits of such closures include protection of ecosystem structure across the food web.

FMP 4.1 would provide an additional level of protection over FMP 3.2 for species-level diversity since many benthic invertebrates that are vulnerable to high levels of mortality through gear impacts would be protected. Therefore the policy alternative, as illustrated by FMP 4.1, would provide additional protection to benthic trophic guilds that supply prey to many groundfish species (NMFS 2001a).

Effects on Management and Enforcement

The 4.1 bookend requires that all groundfish vessels carry an operable, approved VMS transmitter. This FMP scenario would expand the existing VMS requirements that mandate the system in the pollock, Pacific cod, and Atka mackerel fisheries by requiring all groundfish vessels to use VMS. VMS data provide real-time information on vessel location and indicate fishing activity and are essential for enforcement under this FMP. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impacts Analysis (see Appendix F-11).

6.3 Overview of EFH/MPA Management Measures of FMP Bookend 4.2

The FMP 4.2 bookend establishes initial closure areas at 100 percent (i.e., no fishing). Areas could be open to specific fisheries only after review and certification that the fishery would have no significant adverse impacts on the environment. This FMP would require use of scientific information to determine what revisions might be appropriate to mitigate any adverse effects. Figure 14 and Table 9 illustrate a no-fishing scenario until fisheries are certified and issued fishery-specific regulations.

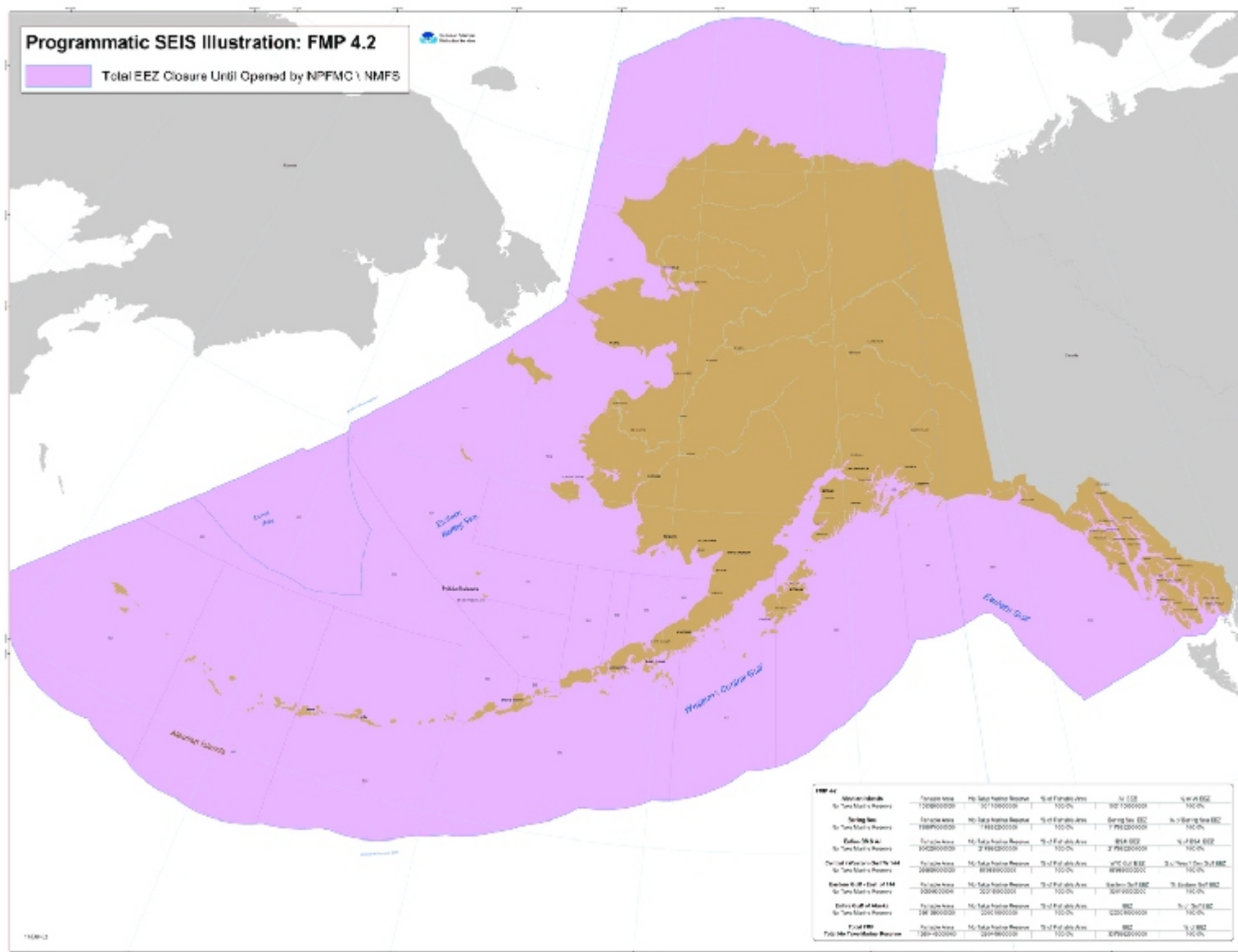


Figure 14. Closure Areas for FMP Bookend 4.2.

Table 9. Descriptive statistics for closure areas under FMP scenario 4.2.

	Fishable area (in square kilometers [km ²])	No take marine reserve (km ²)	Percentage (%) of Fishable area closed
Aleutian Islands (AI)			
No take marine reserve	105,380,000,000	1,001,100,000,000	100.0%
Bering Sea (BS)			
No take marine reserve	798,870,000,000	1,178,852,000,000	100.0%
Entire BS & AI			
No take marine reserve	904,250,000,000	2,179,952,000,000	100.0%
Central \ Western Gulf - west of 144°			
No take marine reserve	265,690,000,000	879,850,000,000	100.0%
Eastern Gulf - east of 144°			
No take marine reserve	90,509,000,000	320,160,000,000	100.0%
Entire Gulf of Alaska			
No take marine reserve	356,199,000,000	1,200,010,000,000	100.0%
Total FMP			
Total no take area - fishable	1,260,449,000,000	3,379,962,000,000	100.0%
Total no take area - Exclusive Economic Zone (EEZ)	1,260,449,000,000	3,379,962,000,000	100.0%

6.4 Effects of EFH/MPA Management Measures of FMP Bookend 4.2

Effects on the Physical Environment

Under this scenario, there would be no negative impacts from fishing on the physical environment in the short-term (up to 2 years), while the Alaska groundfish fisheries undergo the formal review and certification process.

Effects on the Biological Environment and Ecosystem

There would be no negative impacts on the biological environment during the short-term, if all groundfish fishing were suspended until review and certification. Indeed, benthic EFH and HAPC would likely benefit due to the complete removal of physical disturbance from fishery activities, and areas previously damaged from fishing activity could begin to recover. Also, there would be no bycatch of prohibited species. However, as areas are certified and open to groundfish fishing, minimal (not significant) environmental effects could be realized. The process of certification and development of fishery-specific regulations cannot be predicted; therefore, we cannot predict which areas and fisheries may be opened first or to what extent. However, since the fisheries would be slowly reinstated and regulated in a very precautionary manner, it is likely that biological and ecosystem effects would be less than those discussed above for the closures as illustrated by FMP 4.1.

Effects on the Social and Economic Environment

The impact of the initial FMP 4.2 scenario (no fishing) on the Alaska economy and on the economy of the United States would be severe. Catcher vessels would be shut down unless they could fish for species not managed under the groundfish FMPs (e.g., state fisheries, areas outside the U.S. EEZ).

Catcher processors and inshore processors would be negatively affected. For example, Dutch Harbor/Unalaska was ranked number one both in volume and value of fish landed in the nation for 1992 through 1996 and has netted the top landings spot for 13 consecutive years. Commercial fishermen brought 834.5 million pounds of fish to the port of Dutch Harbor-Unalaska, Alaska, in 2001, making it the port with the highest volume of fish landings in the country. This port was second in the United States in commercial fishery value for 2000 and 2001 with \$146 and \$151 million, respectively. The Port of Dutch Harbor strongly supports the commercial fishing industry, providing moorage and offering complete fleet services. Kodiak, Alaska, was the 6th ranked port in national commercial fishery landings in both 2000 and 2001 (290 and 286 million pounds of fish, respectively) and was third in fishery value for each of those years (\$98 and \$74 million each year, respectively). Revenue from landings at Kodiak and Dutch Harbor and the associated support services would disappear under the no fishing scenario.

These effects would prevail until each Alaska groundfish fishery was subjected to an environmental review and, if the results of that review allowed, permitted to operate under strict guidelines. Only fisheries certified by NOAA Fisheries to have no significant adverse effects on the environment would be authorized to operate in the EEZ off Alaska. Such a review and certification process would likely take up to two years based on the length of a recent environmental review of the Alaska pollock fishery conducted by an international organization. Since it is not possible to predict the time-line and extent of certification, it is not possible to predict the overall extent of the economic and social effects. It is likely that the regulations to operate the certified fisheries would be more restrictive, at least for some time, than those illustrated under FMP 4.1. Therefore, it is likely that the social and economic impacts would be more severe than those described above for FMP 4.1, until such time that the certified fisheries and their specific regulations equaled or exceeded the illustration provided under FMP 4.1.

Effects on Management and Enforcement

By prohibiting the harvest of groundfish until fisheries could be certified, this FMP scenario would effectively suspend the need for management and enforcement of groundfish fishing activities. The NPFMC and NOAA Fisheries would still need to manage other fisheries in the EEZ and conduct needed research. This scenario would prevail until each Alaska groundfish fishery was subjected to an environmental review and, based on the results of that review, permitted to operate under strict guidelines. The review and certification process could take several years to accomplish, and could include a wide range of enforcement requirements. As fisheries become certified, a management and enforcement program would be reinitiated.

Section 7 Data Gaps and Information Needs

As stated under Alternative 1, specific impacts to habitat from different management regimes are difficult to predict. Detailed information on the distribution and abundance of habitat types, the life history of living substrates, and the natural disturbance regime is generally incomplete for Alaskan waters. It is also unclear at present how fishing affects different habitat types under a variety of circumstances. Therefore, this qualitative analysis has assumed that greater habitat disturbance is expected with less habitat protection.

With respect to groundfish fisheries prosecuted with bottom trawl gear, bycatch, unobserved damage to living structures, and alteration of non-living structures have been attributed to the bottom trawl groundfish fishery through direct observation, local research, or as a result of scientific studies conducted outside Alaska. However, information is not available to determine whether or not this mortality constitutes significant damage to EFH or HAPC in the waters off Alaska. This should be the subject of future research. It is not known how such damage to EFH and/or removals of HAPC affect the productivity of groundfish species; this requires detailed knowledge of the role that benthic organisms play in life histories of target species and the ecosystem. Such information is not available and not easily determined, particularly in a marine environment such as the BSAI and GOA.

Evaluation of the indirect effects of bottom trawling is needed (NRC 2002). The evaluation should include studying the effects of habitat fragmentation on biological communities and the resulting productivity of fish stocks; determining rates and magnitude of sediment resuspension during trawling and the response of the plankton community to the resultant nutrient regeneration; and obtaining long-term trend data on benthic production versus fisheries production.

Additional research on all gear types and their effects on local marine habitat is needed to develop predictions that link gear type and effort to bottom disturbance, fish production, and recovery times in particular habitats (NRC 2002). For example, the forces that injure and dislodge a range of benthic organisms should be identified and a determination of the relationship between fish production and bottom disturbance is needed. This information could be used to develop fishing gear that is less damaging to habitat, helps to meet other conservation goals such as reduction of bycatch and maintenance of biological communities, is economical to the fleet, and reduces the incidence of derelict fishing gears.

The introduction to this qualitative assessment described the Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600), and includes a discussion of four levels of data that are necessary to describe EFH. At present for the BSAI and GOA fisheries, it is unlikely that data above Level 2 is available for a given species at a particular life history stage. In fact, for most BSAI and GOA species, only Level 1 data is available. Since the MSA mandates that Councils strive to obtain Level 4 data to describe EFH, the lack of higher level data in the groundfish fisheries is an identified, and potentially large data gap. (The data gap will be addressed in greater detail in the EFH EIS presently being prepared by NOAA Fisheries.)

An expanded research program that would seek to improve our understanding of marine habitat and its role in the health of the ecosystem is an integral component of the existing management regime (Alternative 1). Under policy Alternative 2, where we presume that commercial fisheries have no adverse environmental effects, this research program would be abandoned. Policy Alternatives 3 or 4 would place increasing

priority for this research and in the case of Alternative 4, fisheries would be suspended until the information is available.

Section 8 Comparative Analysis of the Alternatives

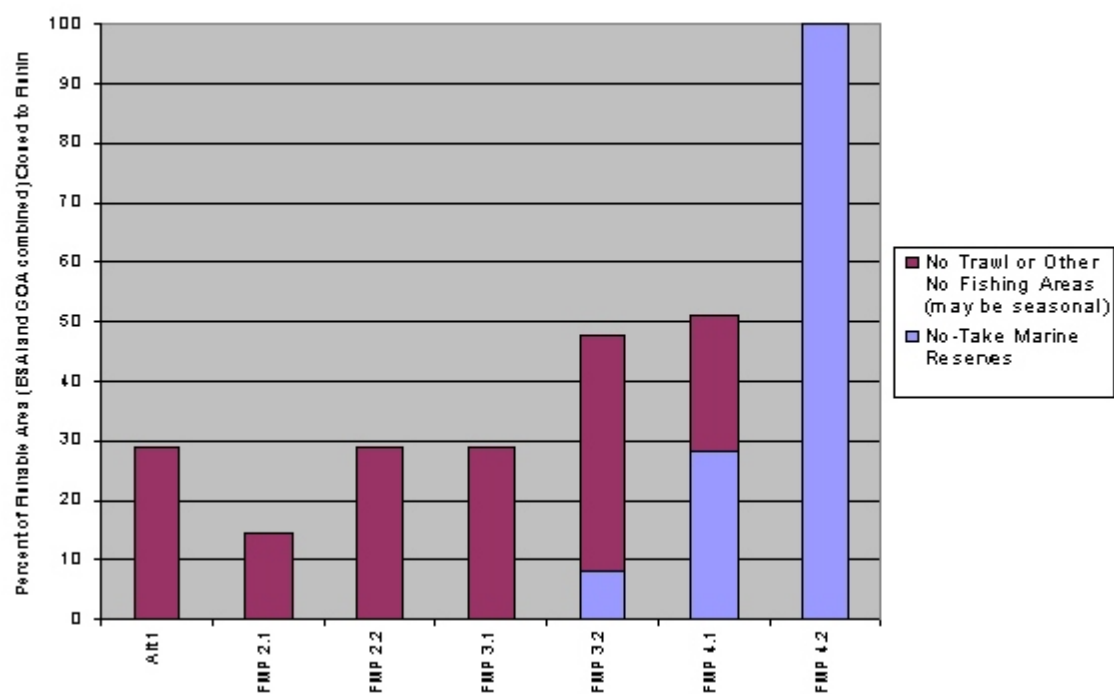
Table 10 and Figure 15 provide a comparison of the amount of area closed under each FMP scenario. As shown in Table 10 and Figure 15, all FMP scenarios with the exception of FMP 2.1 provide for 20 percent or more of the total fishable area (e.g., continental shelf and slope out to the 1000 m water depth) to be closed to bottom trawling for at least a portion of the year. However, the majority of the closure areas illustrated under the Alternative 1 FMP and under FMPs 2.2, 3.1, and 3.2 are not necessarily year-round, do not affect all gear types, nor do they focus on EFH. Therefore, these closures may not encompass the most sensitive habitat types and may not provide adequate protection of all life history stages of EFH species. In the case of Alternative 1 and FMPs 2.2 and 3.1, the total area proposed as no-take marine reserves on a year-round basis is less than 1 percent. With the exception of the Sitka Pinnacles closure area in Alternative 1 and FMPs 2.2 and 3.1, the no transit zones identified under the SSL protection measures are the only year-round, no-take areas designated under these alternatives.

FMP scenarios 3.2 and 4.1 close similar amounts of area (about 48 percent and 51 percent, respectively), but a larger percentage of the total area closed under FMP 4.1 is designated as no-take marine reserves and covers a broader range of habitat types. However, FMP 3.2, as illustrated here, exceeds the 0 to 20 percent rule for establishing MPAs because the suite of closures under this illustration attempts to optimize a number of FMP components (e.g., SSL protection measures, EFH protection). The Alternative 3 policy framework suggests an upper end range of closures at 5 percent of the fishable area as no-take marine reserves, with 20 percent being no-trawl MPAs. As shown in Table 10 and Figure 15, FMP 3.2 would close over 8 percent of the fishable area to all fishing and would designate nearly 50 percent of the fishable area as no-trawl MPAs. Protecting the marine environment through a system of MPAs and no-take reserves could have significant adverse effects on fishing communities, the fishing industry, and the economic health of the nation. Extensive care is needed in selecting candidate areas, and public input is critical.

The FMP 4.1 bookend also meets the recommended framework policy for Alternative 4. The bookend suggests 20 to 50 percent of the management area be designated as no-take marine reserves covering a full range of habitats. As shown in Table 10 and Figure 15, the scenario proposes to designate nearly 30 percent of the fishable area as no-take reserves with all closures totaling 51 percent. As discussed earlier, the concept of closures changes under this scenario. Previously, areas were considered open to all fishing until closed due to realized or perceived impacts. This alternative closes the GOA and BSAI and proposes that all areas be considered closed to fishing unless it can be shown that impacts from fishing would not be adverse. As shown on Figure 13, FMP 4.1 closes vast areas to all fishing (no-take marine reserves). However, many coastal areas would be open to commercial fishing other than trawl. These closures could cause economic hardships as trawl fishermen either have to go further from the community to fish, or have to switch to another type of gear. The economic effects of this illustration are likely to be significant to the participants and to the communities. The FMP 4.2 bookend essentially closes all areas of the EEZ to fishing until such time that impacts can be shown to be negligible. At that time, NOAA Fisheries would certify individual fisheries for operation in the EEZ under fishery-specific regulations. The actual mechanics of a certification process are unknown, and any process and subsequent regulation could take more than a couple of years to implement. Economic hardships associated under the scenario would be severe. While impacts on benthic EFH and HAPC would no longer occur, such benefits may be short-lived depending on which fisheries are subsequently permitted. It is not possible to predict these effects at this time.

Table 10. Percent of fishable area (in square kilometers) closed under Alternative 1 and FMP scenarios.

	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Aleutian Islands (AI)							
No trawl marine protected area (MPA)	41.1%	41.1%	41.1%	41.1%	35.1%	15.0%	100%
No take marine res	1.6%	1.6%	1.6%	1.6%	19.1%	69.6%	100%
No Steller sea lion (SSL) hook and line (HL) pot trawl MPA	n/a	n/a	n/a	n/a	18.4%	n/a	100%
No SSL trawl MPA	n/a	n/a	n/a	n/a	7.3%	n/a	100%
Total	42.7%	42.7%	42.7%	42.7%	79.9%	84.6%	100%
Bering Sea (BS)							
No trawl MPA	19.2%	7.5%	19.2%	19.2%	21.3%	14.5%	100%
No take marine res	0.1%	0.1%	0.1%	0.1%	4.3%	24.9%	100%
No SSL HL pot trawl MPA	n/a	n/a	n/a	n/a	5.3%	n/a	100%
No SSL trawl MPA	n/a	n/a	n/a	n/a	1.8%	n/a	100%
Total	19.3%	7.6%	19.3%	19.3%	32.6%	33.5%	100%
Entire BS & AI							
No trawl MPA	21.8%	11.4%	21.8%	21.8%	22.9%	14.6%	100%
No take marine res	0.2%	0.2%	0.2%	0.2%	6.0%	24.9%	100%
No SSL HL pot trawl MPA	n/a	n/a	n/a	n/a	7.0%	n/a	100%
No SSL trawl MPA	n/a	n/a	n/a	n/a	6.8%	n/a	100%
Total	22.0%	11.7%	22.0%	22.0%	38.1%	39.4%	100%
Central \ Western Gulf - west of 144°							
No trawl MPA	33.1%	29.1%	33.1%	33.1%	31.0%	35.4%	100%
No take marine res	0.5%	0.5%	0.5%	0.5%	16.6%	43.0%	100%
No SSL HL pot trawl MPA	n/a	n/a	n/a	n/a	5.1%	n/a	100%
No SSL trawl MPA	n/a	n/a	n/a	n/a	13.0%	n/a	100%
Total	33.6%	29.6%	33.6%	33.6%	65.6%	78.3%	100%
Eastern Gulf - east of 144°							
No trawl MPA	81.7%	0.0%	81.7%	81.7%	16.7%	65.5%	100%
No take marine res	0.0%	0.0%	0.0%	0.0%	5.3%	21.9%	100%
No SSL H&I Pot Trawl	n/a	0.0%	n/a	n/a	70.3%	n/a	100%
Total	90.1%	0.0%	90.1%	90.1%	92.2%	87.3%	100%
Entire Gulf of Alaska							
No trawl MPA	45.4%	21.7%	45.4%	45.4%	27.3%	43.0%	100%
No take marine res	0.5%	0.5%	0.5%	0.5%	13.7%	37.6%	100%
No SSL HL pot trawl MPA	n/a	n/a	n/a	n/a	21.7%	n/a	100%
No SSL trawl MPA	n/a	n/a	n/a	n/a	9.7%	n/a	100%
Total	45.8%	22.1%	45.8%	45.8%	72.4%	80.6%	100%
Totals							
Total no take marine reserves	0.3%	0.3%	0.3%	0.3%	8.2%	28.5%	100%
Total all closures	28.8%	14.6%	28.8%	28.8%	47.8%	51.1%	100%



n/a - not applicable

Figure 15. Comparison of closure area percentages by FMP scenario.

Section 9 Summary Comparison of All Alternatives

The following section summarizes the effects of each policy alternative with regard to EFH and MPAs, as determined through the analysis of the FMP framework bookends presented in previous sections. Table 11 summarizes the potential effects of each policy alternative bookend. A discussion of the policy level effects follows:

Alternative 1: Under this policy alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. While new effects are not expected, existing beneficial and/or adverse effects could continue as indicated in Table 11. Since the areas closed under the current FMPs may not protect the full range of habitat types, are not necessarily year-round, do not necessarily prohibit the use of fixed gear, and do not incorporate concurrent reductions in TAC, there is a potential for adverse effects on EFH (both due to fishing induced changes in benthic biodiversity and HAPC). The closures could possibly benefit target and non-target species and since, for the most part, they are designed to protect prohibited species and SSLs, prohibited species and marine mammals would benefit. As compared to a much more aggressive strategy, adverse and potentially adverse effects could be observed by catcher vessels, catcher processors, inshore processors, and consumers, while non-consumptive uses and non-use values would benefit.

Alternative 2: A more aggressive harvest policy would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. The identification of EFH, determination of appropriate habitat protection measures, and evaluation of candidate areas for MPAs would also continue, but certain areas presently closed to fishing in order to protect habitat could be considered open to fishing. Measures chosen to implement this policy could range from opening all areas presently closed (except those areas mandated as SSL Protection Measures) to maintaining existing closures under the current FMPs. As shown in Table 11, depending on the extent of the measures, all aspects of the physical and biological environments could realize adverse effects under this policy alternative. Again, depending on the extent of measures chosen to enact this policy, effects on the economic environment could be beneficial, while non-consumptive and non-use values would be negatively impacted.

Alternative 3: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles, and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Specifically, Alternative 3 seeks to reduce and avoid impacts to habitat by developing goals, objectives, and criteria to evaluate the efficacy of MPAs and no-take marine reserves as tools to maintain abundance, diversity, and productivity of marine organisms. Measures chosen to enact the Alternative 3 policy range from maintaining the existing closures under the current FMPs to designating 20 percent of the BSAI and GOA as no-trawl MPAs and no-take marine reserves (e.g., 5 percent = no-take, 15 percent = no-trawl MPA) across a range of habitat types. As shown in Table 11, the higher range of closures would have beneficial or possibly beneficial effects on all aspects of the physical

and biological environments and on the non-consumptive and non-use values. Conversely, the designation of extensive closure areas would have potentially adverse or adverse effects on the economic sectors and communities.

Alternative 4: This policy shifts the burden of proof from the resources to the user and would require that the agency certify that the intended fishery would not have a detrimental effect on the environment before significant fishing could be permitted. Under this policy alternative, impacts to habitat would be reduced and avoided through zoning and limiting fishing gear use to the action area and establishing no-take marine reserves (both pelagic and nearshore) encompassing 20-50 percent of management areas. In fisheries that can be prosecuted with more selective gear, trawling would be prohibited and trawl closure areas would be established. As shown in Table 11, management measures under Alternative 4 would provide possibly beneficial effects to all aspects of the physical and biological environments and non-consumptive and non-use values, while impacts on the social and economic environment would be severely adverse.

Section 10 References

- ADF&G. (2002). Marine Protected Areas in Alaska: Recommendations for a Public Process. Report to the Alaska Board of Fisheries by the Alaska Department of Fish and Game, Marine Protected Areas Task Force. Regional Information Report 5J02-08 Division of Commercial Fisheries, Juneau, AK.
- Agardy, M. T. (1994). "Advances in marine conservation: The role of marine protected areas." *Trends in Ecology and Evolution*, 9, pp. 267-270.
- Allison, G., Lubchenko, J., and M. H. Carr. (1998). "Marine reserves are necessary but not sufficient for marine conservation." *Ecological Applications*, 8(1 Supplement:), pp. S79.
- Andrews, A.H., E.E. Cordes, M.M. Mahoney, K. Munk, K.H. Coale, G.M. Caillet, and J.Heifetz. (2002). Age, Growth, and Radiometric Age Validation of a Deep-Sea, Habitat Forming Gorgonian (*Primnoa resedaeformis*) from the Gulf of Alaska. *Hydrobiologia* 471:101-110.
- Auster, P. J., and R. W. Langton. (1999). "The Effects of Fishing on Fish Habitat." *Fish habitat: Essential Fish Habitat and Rehabilitation*, L. R. Benaka, ed., American Fisheries Symposium, Bethesda, MD, pp. 150-187.
- Black, K. P. and G. D. Parry. (1994). Sediment transport rates and sediment disturbance due to scallop dredging in Port Phillipay. *Memoirs of the Queensland Museum* 36(2):327-341.
- Churchill, J. H. (1989). "The Effect of Commercial Trawling on Sediment Resuspension and Transport over the Middle Atlantic Bight Continental Shelf." *Continental Shelf Research*, 9(9), pp. 841-864.
- Coen, L. D. (1995). A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. Unpublished Report. South Carolina Department of Natural Resources. Marine Resources Research Institute.
- Coon, C., Shirley, T. C., and J. Heifetz. (1999). "Spatial and temporal patterns of bottom trawling in the Gulf of Alaska and Aleutian Islands." NOAA Technical Report, submitted, U.S. Department of Commerce.
- DeAlteris, J., Skrobe, L., and Lipsky, C. (1999). "The significance of seabed disturbance by mobile fishing gear relative to natural processes: a case study in Narragansett Bay, Rhode Island." pp.224-237 In L.Benaka (ed.), "Fish Habitat: Essential Fish Habitat and Rehabilitation." American Fisheries Society, Symposium 22, Bethesda, MD.
- Eno, N. C., D. S. MacDonald, J. A. M. Kinnear, S. C. Amos, C. J. Chapman, R. A. Clark, F. P. D. Bunker, and C. Munro. (2001) . Effects of Crustacean Traps on Benthic Fauna. *ICES Journal of Marine Science* 58:11-20.
- Fossa, J. H., D. M. Furevik, P. B. Mortensen, and M. Hovland. (1999). "Effects of Bottom Trawling on *Lophelia* Deep Water Coral Reefs in Norway." Poster presented at ICES meeting on Ecosystem

- Effects of Fishing, March 1999. Institute of Marine Research, Bergen, Norway. Megafauna associations with gorgonian coral (*Primnoa* spp.) in the Gulf of Alaska, K. J. Krieger and B. L. Wing, eds., Draft manuscript available from NMFS, Auke Bay Laboratory, 11305 Glacier Highway, Juneau, AK 99801.
- Freese, L., P. J. Auster, J. Heifetz, and B. L. Wing. (1999). "Effects of Trawling on Seafloor Habitat and Associated Invertebrate Taxa in the Gulf of Alaska." *Marine Ecology Progress Series*, 182, pp. 119-126.
- Fritz, L. W., A. Greig, and R. F. Reuter. (1998). "Catch-per-unit-, Length, and Depth Distributions of Major Groundfish and Bycatch Species in the Bering Sea, Aleutian Islands, and Gulf of Alaska Regions Based on Groundfish Fishery Observer Data." NOAA Technical Memorandum, NMFS-AFSC-88, U.S. Department of Commerce. pp. 179.
- Gilkinson, K., M. Paulin, S. Hurley, and P. Schwinghamer. (1998). "Impacts of Trawl Door Scouring on Infaunal Bivalves: Results of a Physical Trawl Door Model/Dense Sand Interaction." *Journal of Experimental Marine Biology and Ecology*, 224(2), pp. 291-312.
- Hall, S. J. (1999). *The Effects of Fishing on Marine Ecosystems and Communities*, Blackwell Science, Oxford. pp. 274.
- Heifetz, J. (2002). "Coral in Alaska: Distribution, Abundance, and Species Associations." *Hydrobiologia* 471:19-28.
- ICES. (1992). Report of the Study Group on Ecosystem Effects of Fishing Activities, International Council for the Exploration of the Sea. Working Group on Ecosystem Effects of Fishing Activities ICES CM 1993/G:4. 9 pp.
- Jennings, S., and Kaiser, M.J. (1998). "The effects of fishing on marine ecosystems." *Advances in Marine Biology*, 34, pp.201-351.
- Kaiser, M.J., D.B. Edwards, P.J. Armstrong, K. Radford, N.E.I. Lough, R.P. Flatt, and H.D. Jones. (1998). Changes in Megafaunal Benthic Communities in Different Habitats after Trawling Disturbance. *ICES Journal of Marine Science* 55:353-361.
- Kaiser, M. J. (2000). The implication of the effects of fishing on non-target species and habitats. Pp. 383-392 *In* M.J. Kaiser and S.J. de Groot, eds., "The Effects of Fishing on Non-target Species and Habitats. Blackwell Science.
- Krieger, K.J. and B.L. Wing. (2002). Megafauna Associations with Deepwater Corals (*Primnoa* spp) in the Gulf of Alaska. *Hydrobiologia* 471:83-90.
- Lauck, T., C. W. Clark, M. Mangel, and G. R. Munro. (1998). "Implementing the Precautionary Principle in Fisheries Management Through Marine Reserves." *Ecological Applications*, 8(1), pp. S72

- Levin, L.A. (1984). Life history and dispersal patterns in a dense infaunal polychaete assemblage: community structure and response to disturbance. *Ecology* 65(4):1185-1200.
- Lindebloom, H.J. and S.J. de Groot. (1998). Impact II. The Effects of Different Types of Fisheries on the North Sea and Irish Sea Benthic Ecosystems. NIOZ Rapport 1998-1. pp. 404
- Mayer, L.M., D.F. Schick, R.H. Findlay, and D.L. Rice. (1991). Effects of commercial dragging on sedimentary organic matter. *Marine Environmental Research* 31:249-261.
- McConnaughey, R. A., K. L. Mier, and C. B. Dew. (2000). "An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea." *ICES Journal of Marine Science*, 57, p. in press.
- Messieh, S. N., T. W. Rowell, D. L. Peer, and P. J. Cranford. (1991). "The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shelf seabed." *Continental Shelf Research*, pp. 11. 1237-1263.
- Murray, S. N., R. F. Ambrose, J. A. Bohnsack, L. W. Botsford, M. H. Carr, G. E. Davis, P. K. Dayton, D. Gotshall, D. R. Gunderson, M. A. Hixon, J. Lubchenko, M. Mangel, A. MacCall, D. A. McArdle, J. C. Ogden, J. Roughgarden, R. M. Starr, M. J. Tegner, and M. M. Yoklavitch. (1999). "No-take reserve networks: Sustaining fishery populations and marine ecosystems." *Fisheries*, 24, pp. 11-25.
- NMFS. (2001a). Alaska Groundfish Fisheries: Draft Programmatic Supplemental Environmental Impact Statement. National Marine Fisheries Service, Alaska Region, National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce.
- NMFS. (2001b). Steller Sea Lion Protection Measures: Final Supplemental Environmental Impact Statement. National Marine Fisheries Service, Alaska Region, National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce.
- NMFS. (2002). "A Review of National and International Literature on Th Effects of Fishing on Benthic Habitats" NOAA Technical memorandum NMFS-F/SPO-57. K.A. Johnson , ed., NMFS Office of Habitat Restoration, Silver Spring , MD.
- NPFMC. (1992). "Final Supplemental Environmental Impact Statement and Regulatory Impact Review/Initial Regulatory Flexibility Analysis of Proposed Inshore/Offshore Allocation Alternatives (Amendment 18/23) to the Fishery Management Plans for the Groundfish Fishery of the Bering Sea and Aleutian Islands and the Gulf of Alaska." North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.
- NPFMC. (1999). "Environmental Assessment for Essential Fish Habitat." North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252. pp. 364.
- NRC. (2001). "Marine Protected Areas: Tools for Sustaining Ocean Ecosystems." Committee on the Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas in the United States.

- Ocean Studies Board, Commission on Geosciences, Environment, and Resources. National Research Council. National Academy Press, Washington, DC. pp. 272.
- NRC. (2002). "Effects of Trawling and Dredging on Seafloor Habitat." Committee on Ecosystem Effects of fishing: Phase1 - Effects of Bottom Trawling on Seafloor Habitats. Ocean Studies Board, Division on Earth and Life Studies, National Academy Press, Washington, DC. pp. 125.
- Pilskaln, C.H., J.H. Churchill, and L.M. Mayer. (1998). Resuspension of sediment by bottom trawling in the Gulf of Maine and potential geochemical consequences. *Conservation Biology* 12(6):1223-1229.
- Risk, M. J., D.E. McAllister, and L. Behnken. (1998). "Conservation of Cold- and Warm-water Seafans: Threatened Ancient Gorgonian Groves." *Sea Wind*, 10(4), pp. 20-22.
- Rose, C. (in prep.). An analysis of the Effects of Fishing on Fish Habitats of the Waters off of Alaska. A Draft White Paper prepared for the Essential Fish Habitat Committee of the North Pacific Fisheries Management Council.
- Rumohr, H. (1998). Information on Impact of Trawling on Benthos in Kiel Bay. Annex Eighth Report of the Benthos Ecology Working Group. ICES CM 1989/L:19 pp. 80.
- Rumohr, H., and P. Krost. (1991). "Experimental Evidence of Damage to Benthos by Bottom Trawling with Special Reference to *Artica Islandica*." *Meeresforschung*, 33, pp. 340-345.
- Smith, K. R., and R. A. McConnaughey. (1999). "Surficial Sediments of the Eastern Bering Sea Continental Shelf: Ebssed Database Documentation." NOAA Technical Memorandum, NMFS-AFSC-104, U.S. Department of Commerce, NMFS Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115-0070. pp. 41.
- Van Dolah, R.F., P.H. Wendt, and N. Nicholson. (1987). Effects of a Research Trawl on a Hard Bottom Assemblage of Sponges and Corals. *Fisheries Research* 5:39-54.

APPENDIX F

Steller Sea Lion Protection Measures

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Steller Sea Lion Protection Measures	F-4-1
1.1	Regulatory Overview	F-4-1
1.2	Steller Sea Lion Decline	F-4-2
Section 2	Analysis of Alternatives	F-4-5
Section 3	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-4-7
3.1	Management Approach	F-4-7
3.2	Overview of the Current Fishery Management Plan Management Measures	F-4-7
3.3	Alternative 1 Effects	F-4-13
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-4-20
4.1	Management Approach	F-4-20
4.2	Overview of Management Measures	F-4-20
4.3	Fishery Management Plan 2.1 Management Measures	F-4-20
4.4	Fishery Management Plan 2.1	F-4-21
4.5	Fishery Management Plan 2.2 Management Measures	F-4-22
4.6	Illustrative Fishery Management Plan 2.2 Effects	F-4-22
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-4-23
5.1	Management Approach	F-4-23
5.2	Overview of Management Measures	F-4-23
5.3	Fishery Management Plan 3.1 Management Measures	F-4-23
5.4	Fishery Management Plan 3.1 Effects	F-4-24
5.5	Fishery Management Plan 3.2 Management Measures	F-4-26
5.6	Fishery Management Plan 3.2 Effects	F-4-27
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-4-31
6.1	Management Approach	F-4-31
6.2	Overview of Management Measures	F-4-31
6.3	Fishery Management Plan 4.1 Management Measures	F-4-31
6.4	Fishery Management Plan 4.1 Effects	F-4-32
6.5	Fishery Management Plan 4.2 Management Measures	F-4-34
6.6	Fishery Management Plan 4.2 Effects	F-4-35
Section 7	Data Gaps and Information Needs	F-4-38
7.1	Information Needed to Monitor and Quantify Effects	F-4-38
Section 8	Comparative Analysis of the Alternatives	F-4-41
Section 9	Conclusion	F-4-49

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 10	References	F-4-50

TABLES

Table 1.	Chronology of events leading to the Steller Sea Lion protection measures in the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans. . .	F-4-8
Table 2.	Summary of Steller Sea Lion protection measures for 2002.	F-4-11
Table 3.	Summary of potential effects of the policy alternatives and Fishery Management Plans.	F-4-42

ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
BiOp	Biological Opinion
BSAI	Bering Sea and Aleutian Islands
CDQ	community development quota
EBS	eastern Bering Sea
EFH	essential fish habitat
ESA	Endangered Species Act
F	theoretical unfished level
FMPs	Fishery Management Plan
FR	Federal Register
GOA	Gulf of Alaska
HAPC	Habitat Areas of Particular Concern
HCR	harvest control rule
MMPA	Marine Mammal Protection Act of 1972 (amended 1994)
MPA	Marine Protected Area
nm	nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NRC	National Research Council
OFL	overfishing level
OPR	Office of Protected Resources
PSC	prohibited species catch
RPA	Reasonable and Prudent Alternative
SAFE	Stock Assessment and Fishery Evaluation
SEIS	Supplemental Environmental Impact Statement
TAC	total allowable catch
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
VMS	Vessel Monitoring System
<	less than

This page intentionally left blank

Section 1 Steller Sea Lion Protection Measures

Since the listing of Steller sea lions under the Endangered Species Act (ESA) in 1990, Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Groundfish Fishery Management Plans (FMPs) have been modified to include measures designed to protect Steller sea lions from deleterious effects that may result from groundfish fisheries. These measures (referred to as the Steller sea lion Protection Measures) were developed and adopted to ensure that the groundfish fisheries would not jeopardize the continued existence of Steller sea lions or adversely modify their critical habitat, as required by the ESA. The purpose of this qualitative impact assessment is to evaluate the effects of the Steller sea lion Protection Measures on Steller sea lions and other resources under a series of four alternative groundfish management policies, including the status quo, and to evaluate the effects of associated FMP scenarios as a proxy for each alternative.

The organization of this analysis provides background on the decline of the Steller sea lion, hypotheses for the decline, and a description of the current protection measures. The effects of these measures are discussed qualitatively by alternative and FMP “Bookend” followed by a comparison among all the options. A description of current research is also provided.

1.1 Regulatory Overview

There are two major laws that protect Steller sea lions and require the North Pacific Fishery Management Council (NPFMC) to address their conservation in the FMPs. The first is the Marine Mammal Protection Act of 1972 (amended 1994) (MMPA). This law places Steller sea lions under the jurisdiction of the National Marine Fisheries Service (NMFS), Office of Protected Resources (NOAA [National Oceanic and Atmospheric Administration] Fisheries, OPR). The goal of the MMPA is to provide protection for marine mammals so that their populations are maintained as a significant, functioning element of the ecosystem. The MMPA established a moratorium on the taking of all marine mammals in the United States with the exception of subsistence use by Alaska Natives. Under the authority of the MMPA, NOAA Fisheries OPR monitors populations of marine mammals to determine if a species or population stock is below its optimum sustainable population. Species that fall below this level are designated as “depleted.” Populations or stocks (e.g., the western stock of Steller sea lions) listed as threatened or endangered under the ESA, are automatically designated as depleted under the MMPA.

The ESA was enacted in 1973 and reauthorized in 1988. This law provides broad protection for species that are listed as threatened or endangered under ESA. Steller sea lions were considered for protection under the ESA due to the rapid decline in the western portion of its range over the last 30 years (Loughlin *et al.* 1990, Loughlin *et al.* 1992, York *et al.* 1996). On November 26, 1990, the Steller sea lion was listed as threatened under the ESA (55 Federal Register [FR] 40204), and on August 27, 1993, critical habitat was designated based on observed movement patterns (58 FR 45269). In 1997, the Steller sea lion population was split into two separate stocks: the western stock, which occurs westward from Cape Suckling (144°W), and the eastern stock, which occurs east of 144°W from southeast Alaska to California (Bickham *et al.* 1996) (Figure 1). After separation of the two stocks, the western stock was listed as “endangered” in 1997 due to the continued precipitous decline in this portion of its range (62 FR 30772). The eastern stock remains classified as “threatened.”

The mandatory protection provisions of the ESA have led to numerous administrative and judicial actions and has brought the issue of fisheries-sea lion interactions under intense scrutiny. Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of its designated critical habitat. For federal fishery management actions, the action agency, the National Marine Fisheries Service, Office of Sustainable Fisheries (NOAA Fisheries), is required under Section 7(a)(2) to consult with the Steller sea lion expert agency, NOAA Fisheries OPR, to determine if the proposed action may affect Steller sea lions or their critical habitat. If the proposed action may affect Steller sea lions or their designated critical habitat, formal consultation is required. Formal consultation is a process between the action and expert agency that determines whether a proposed action is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. The process begins with the action agency's assessment of the effects of their proposed action on listed species and concludes with the issuance of a "Biological Opinion" (BiOp) by the expert agency. A biological opinion is a document which includes a) the opinion of NOAA Fisheries OPR as to whether or not a federal action (such as federally authorized fisheries) is likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat; b) a summary of the information on which the opinion is based; and c) a detailed discussion of the effects of the action on listed species or designated critical habitat. If the BiOp concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or adversely modify critical habitat, then the expert agency recommends Reasonable and Prudent Alternatives (RPAs) to avoid the likelihood of "jeopardy" or "adverse modification" of critical habitat. The resulting legal requirements limit the NPFMC from adopting FMP policies that result in a jeopardy finding for the Steller sea lions.

1.2 Steller Sea Lion Decline

Western Stock

The primary reason for listing the western stock of Steller sea lions was its dramatic decline (>15 percent per year) in their core breeding areas during the 1970s and 1980s, leading to their protection under the ESA in 1990 (Loughlin *et al.* 1990, Loughlin *et al.* 1992). The rate of decline has slowed since that time but the population has continued to decline by about 4.2 percent per year between 1991 and 2002 at 84 trend sites (SAFE 2002) (Figure 2). However, surveys at trend sites have shown a slight increase of 5.5 percent between 2000 and 2002, the first region-wide increase in the last two decades. A similar trend was also documented within the Kenai-to-Kiska subareas (70 sites between the Kenai Peninsula and Kiska Island, Western Aleutians), which showed an increase of 4.8 percent from the last surveys. The overall long-term trend, however, still showed a decline of 3.1 percent from 1991 to 2002 (SAFE 2002).

Eastern Stock

The eastern stock of Steller sea lions has been increasing in size since the 1990s and does not appear to be in any jeopardy of extinction. Since 1990, this stock has shown an increase of 15.4 percent based on adult and juvenile counts at trend sites (SAFE 2002). Recent surveys of non-pups at 10 trend sites in Southeast Alaska suggests no change in the long-term trend of regional increase at a rate of approximately 2 percent per year over the last decade (SAFE 2002). The eastern stock of the Steller sea lion may be at its highest

abundance in recent history (Calkins *et al.* 1999). While still protected under the ESA, the eastern stock has not been the subject of nearly as much administrative action as the western stock.

Hypotheses for Decline

Although factors and mechanisms for the decline of the western stock of Steller sea lions have been, and continue to be, the subject of intensive research, it is generally thought that the decline is due to a combination of factors. These factors may include nutritional stress resulting from competition with fisheries, disease/parasitism, predation, regime shift/climate change affecting prey, and anthropogenic factors such as entanglement in fishing gear, intentional killing, or pollution/contaminants (Kruse *et al.* 2001, Ferrero and Fritz 2002, NRC 2002). The magnitude or contribution of some of these factors may have changed over the course of the decline, specifically between the period of rapid decline from the 1970s to 1990 and the more moderated rate of decline from 1990 to the present (NRC 2002). Hypotheses for the mechanism behind the decline fall into two general categories:

1. Bottom-up theories - physical and biological factors that affect the capacity of the environment to support sea lions. Some of the major carrying capacity factors include the following:
 - Large-scale fishery removals have reduced the availability or quality of prey species
 - Climate change/regime shift in the late 1970s has changed the abundance or distribution of prey species
 - Non-lethal disease has reduced the foraging efficiency of sea lions
 - Pollutants concentrated through the food web have contaminated fish eaten by the sea lions, possibly reducing their fecundity or increasing mortality
2. Top-down theories - factors that affect the mortality of the sea lion independent of capacity of the environment to support sea lions. Top-down theories involve external forces such as predators, humans or pathogens. These mortality factors include the following:
 - Predators such as killer whales or sharks have switched their prey preference to sea lions
 - Incidental take of sea lions through capture or entanglement in fishing gear has increased as a result of the expansion of commercial fisheries
 - Takes of sea lions in the subsistence harvest have been higher than estimated
 - Shooting of sea lions has been underestimated in the past and/or present
 - Pollution or disease has increased mortality independently of effects of nutrition

The National Research Council (NRC) (2002) considered that the decline observed in the 1970s and 1980s were precipitated by one or more bottom-up factors, such as competition with fisheries or climate change. The more gradual downward trends in the 1990s appear to have been influenced by top-down factors, such as predation (NMFS 2001a, NRC 2002).

However, these factors may be acting most strongly against juveniles between the time they are weaned and when they are grown to adult size and foraging capability (Kruse *et al.* 2001, Ferrero and Fritz 2002). Adult females may also be affected because of the physiological stress and limited geographic mobility when caring for pups. Hence, much of the focus on minimizing human effects on these animals has been on protecting the integrity of food supplies near rookeries and haulouts (NMFS 2001a). This is a bottom-up factor that may be currently affecting Steller sea lions, a conclusion that the NRC (2002) also made. It is important to realize that the key issue for the survival and reproductive success of sea lions is not necessarily the total amount

of fish that are present, but how available the prey are to foraging sea lions (NMFS 2001a). Major changes in the abundance and distribution of preferred prey species or prey patches may decrease foraging efficiency, thus exposing them to increased predation pressure from killer whales and sharks.

NOAA Fisheries evaluates the impacts of all federal actions that could adversely affect Steller sea lions and if it is determined that an action potentially would adversely affect Steller sea lions, management measures to alleviate the adverse effect are recommended by NOAA Fisheries. Since NOAA Fisheries cannot control climate and oceanic changes, like ENSO Events, or the behavior of killer whales, their management efforts are necessarily focused on minimizing the potential for the fisheries to induce localized depletions of prey, even though other factors may be involved in the population decline. The allocation of total allowable catch (TAC) among different seasons, areas, and gear types and fishing closures near rookeries and haulouts has been the main thrust of these management measures (NMFS 2001a).

Public policy debates, and several legal actions, have focused on the uncertainty of scientific evidence for a significant fisheries impact. While new research was initiated to address some of the scientific uncertainty, NPFMC and NOAA Fisheries implemented a series of fishery management measures that assumed there were some adverse impacts from groundfish fishing to Steller sea lions as stated in the BiOps. The emphasis of the measures has been on distributing the fishery over broader temporal and spatial scales to minimize localized depletion of sea lions' prey, alleviating fishing pressure in nearshore zones around rookeries and haulouts and in important sea lion foraging areas, and instituting harvest limits to protect overall abundance of prey.

Along with these efforts to protect the food supply of Steller sea lions, the amount of acceptable incidental take of Steller sea lions by the fishery has also been greatly reduced. The previously legal and common practice of fishermen shooting at sea lions to kill them or chase them away from their gear has been prohibited.

Section 2 Analysis of Alternatives

Four policy alternatives are under consideration by NOAA Fisheries and NPFMC. Each policy alternative contains two “bookends,” or examples, containing a range of management measures that illustrate how the framework could be implemented. These bookends provide a level of detail that allows analysis and provides contrasting policies. They also provide a means for communicating to the public how NOAA Fisheries and NPFMC intends to implement its preferred alternative, while allowing, under the ESA, the management flexibility to adaptively manage the fishery through future FMP amendments.

Alternative 1 – Continue Under the Current Risk-Averse Management Policy: Under this alternative, NOAA Fisheries and NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The approach would be to continue the current Steller sea lion Protection Measures that are now in effect and continue to cooperate with United States (U.S.) Fish and Wildlife Service (USFWS) in regards to ESA-listed species under their jurisdiction to protect ESA-listed marine mammals and seabird species.

Alternative 2 – Adopt a More Aggressive Management Policy: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. Steller sea lion Protection Measures under the Alternative 1 policy would be included in order to avoid a jeopardy finding under the ESA.

Alternative 3 – Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species. Steller sea lion Protection Measures under the Alternative 3 policy would further marine mammal and seabird policy objectives to include maintaining or adjusting Steller sea lion Protection Measures to further reduce the risk of fishery-related impacts on Steller sea lions. Adoption of this policy would also result in continuing cooperation with USFWS to protect ESA-listed species and to initiate joint research programs.

Alternative 4 – Adopt a Highly Precautionary Management Policy: This policy places the burden on the resource user to demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information becomes available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of

non-consumptive use values. The overall premise is that fishing causes adverse impacts on the environment, but due to a lack of information and uncertainty, little is known about these impacts. Policy objectives under this alternative include increasing existing protection measures for Steller sea lions by further restraining fisheries in critical habitat and by setting more conservative harvest levels of prey species.

Section 3 Alternative 1: Continue Under the Current Risk-Averse Management Policy

3.1 Management Approach

Under Alternative 1, the NOAA Fisheries and NPFMC would continue working toward the goals of maintaining sustainable fisheries, protecting threatened and endangered species, and protecting, conserving and restoring habitats of living marine resources through existing institutions and processes. Fisheries are managed through the current risk-averse conservation and management policy that is based on a conservative harvest strategy. Under this policy, fishery impacts indicated by scientific evidence are mitigated as necessary. This management policy is based on the assumption that fishing produces some adverse impacts to the environment and, as these impacts become known, mitigation measures are developed and FMP amendments are implemented.

The goal of the present FMP in regard to endangered Steller sea lions is to maintain the current Steller sea lion Protection Measures in order to avoid a “jeopardy” determination under the ESA. To reach this goal, NOAA Fisheries and NPFMC rely upon ongoing scientific research to describe and quantify how the fisheries impact Steller sea lions and adjust their mitigation programs accordingly. Failure to maintain adequate protection measures not only harms the sea lions’ chances of recovery by failing to ensure an adequate and sustainable prey field for Steller sea lions, but opens the fisheries to legal challenges under the ESA, which may shut down the industry.

3.2 Overview of the Current Fishery Management Plan Management Measures

NOAA Fisheries, OPR issued a series of BiOps through Section 7 consultation from 1990 to 2001 that analyzed whether the groundfish fisheries were contributing to the decline of sea lion populations, causing adverse modification to their designated critical habitat and/or preventing their recovery (Table 1). The latest BiOp issued in October 2001, analyzed a series of protection measures developed by the NPFMC’s Steller Sea Lion Mitigation Committee (also referred to as the RPA Committee) to ensure that BSAI and GOA groundfish fisheries do not jeopardize the continued existence of Steller sea lions or adversely modify their critical habitat. A range of alternatives, including the alternative developed by the Steller Sea Lion Mitigation Committee were analyzed in the Supplemental Environmental Impact Statement (SEIS), in November 2001 (NMFS 2001b). The Steller Sea Lion Mitigation Committee was specifically charged with looking for ways to achieve several objectives:

1. protect waters around rookeries and haulouts to prevent localized depletion of prey and potential competition.
2. temporally disperse the fisheries to reduce the probability of localized depletion by pulse or derby fishing.
3. spatially disperse the fisheries to reduce the probability of localized depletions from concentrated catch in local areas.

The 2001 BiOp analyzed the impacts of the groundfish fishery as promulgated under the Preferred Alternative of the Steller sea lion SEIS, the “area- and fishery-specific approach.” This latest BiOp concluded that the federally-managed groundfish fishery and the parallel state-managed groundfish fishery (i.e., pollock and cod), if conducted according to the Steller sea lion Protection Measures, would not likely jeopardize the continued existence of either the western or eastern stocks of Steller sea lions, nor would the fisheries be reasonably likely to adversely modify Steller sea lion designated critical habitats (NMFS 2001a).

Table 1. Chronology of events leading to the Steller Sea Lion protection measures in the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans.

Date	Milestone
November 1990	Steller sea lion (prior to splitting eastern and western stocks) is listed as “threatened” under the Endangered Species Act (ESA). Protection measures include prohibition on shooting, reduced wasteful take, limited disturbance at rookeries.
August 1993	Steller sea lion “critical habitat” is designated around rookeries and haulouts (20 nautical miles [nm]) west of 144°, along with terrestrial and air zones around these areas. Three special aquatic foraging areas in Alaska are also classified as Steller sea lion critical habitat: Shelikof Strait, Bogoslof, and Seguam Pass foraging areas. Critical habitat for the eastern stock, east of 144°, includes 3,000-foot buffer zone around rookeries and haulouts.
January 1996	Biological opinion (BiOp) on the Fishery Management Plans (FMPs) for the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) on proposed 1996 total allowable catch (TAC) specifications and their effects on the Steller sea lion. Concluded these actions would not jeopardize Steller sea lion or adversely modify critical habitat.
May 1997	Western stock of the Steller sea lion is listed as “endangered” and the eastern population remains “threatened” under the ESA.
December 3, 1998	BiOp 1 on the FMPs authorizing the BSAI Atka mackerel fishery, BSAI pollock fishery, and the GOA pollock fishery. Found Atka mackerel fishery would not cause jeopardy. Pollock fisheries were found likely to result in jeopardy. Reasonable and prudent alternatives (RPAs) developed for pollock fishery. RPAs challenged in court.
December 22, 1998	BiOp 2 on the FMP for all groundfish fisheries in BSAI and GOA on proposed 1999 harvest specifications. Found no jeopardy if pollock measures to avoid jeopardy are enforced.
January 1999	National Oceanic and Atmospheric Administration (NOAA) Fisheries implements management measures as part of BiOp 1 RPAs and publishes emergency interim rule.
June 1999	NOAA Fisheries extends emergency rule for the remainder of 1999 season.
July 1999	Legal challenge to BiOp 1. Court upholds no jeopardy for Atka mackerel and jeopardy for pollock findings, but remands the RPAs.
October 1999	NOAA Fisheries revises RPAs and issues the Final RPAs for the 2000 fishery.
December 1999	BiOp on authorization of the BSAI and GOA groundfish fisheries, TAC for 2000, and American Fisheries Act. Concludes action would not cause jeopardy to Steller sea lions.
January 2000	NOAA Fisheries modifies Protection Measures to conform to revised BiOp 1 RPAs and puts out an emergency rule implementing them.
January 2000	Court finds BiOp 2 no jeopardy conclusion inadequate.
July 2000	Court issues an injunction prohibiting fishing with trawl gear in Steller sea lion critical habitat west of 144° until NOAA Fisheries comprehensive BiOp is completed.
November 2000	Comprehensive FMP BiOp (BiOp 3) for all groundfish fisheries and non federal fisheries published. Environmental baseline finds that the Pacific cod, Atka mackerel, and pollock fisheries results in jeopardy in regard to the Steller sea lion. RPAs are included to avoid jeopardy.

Table 1 (cont.).**Chronology of events leading to the Steller Sea Lion protection measures in the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans.**

Date	Milestone
January 2001	NOAA Fisheries issues an emergency rule containing a suite of management measures that phases in certain provisions of the RPAs.
January 2001	North Pacific Fisheries Management Council (NPFMC) establishes an RPA Committee to develop Protection Measures for rest of 2001 and for 2002 and seasons beyond. Amended RPA developed to meet the requirements of ESA.
June 2001	NPFMC recommends four alternatives to be analyzed in the Steller sea lions Protection Measures Supplemental Environmental Impact Statement (SEIS) with Alternative 4, the RPA Committee's recommendation, as the Preferred Alternative.
July 2001	NOAA Fisheries re-initiates Section 7 consultation under the ESA and draft 2001 BiOp. The preferred alternative in the Steller sea lion SEIS is analyzed in the 2001 BiOp, which is included as Appendix A in the Steller sea lion SEIS.
September 2001	NPFMC selects Alternative 4 with modifications as it met the requirements of the ESA and has the least impact on the human environment.
October 2001	Final SEIS on Protection Measures and 2001 BiOp is released. The conclusion in the 2001 BiOp in regard to Steller sea lions supercedes the conclusions in the FMP BiOp. Protection Measures are implemented by emergency interim rule.
January 2002	Emergency interim rule is extended through July 8, 2002.
May 2002	Emergency interim rule is extended through December 31, 2002.
September 2002	NOAA Fisheries issued a proposed rule to implement Steller Sea Lion Protection Measures.

Source: Federal Register January 8, 2002 Preamble to Interim Rule, Steller Sea Lion Protection Measures, Proposed Rule, September 4, 2002.

It is important to note that the 2001 BiOp does not predict the recovery of the western stock of Steller sea lions to any specific level. In fact, it predicts they will continue to decline even after all the protection measures are implemented (NMFS 2001a). This conclusion is based on the continuing presence of external environmental factors hypothesized to be contributing to the decline, such as killer whale predation and climate-induced oceanographic changes. The BiOp determined that the groundfish fisheries did not add any appreciable risk to the population's potential to exist or recover in the wild. In addition to the management measures described in the Steller sea lion SEIS preferred alternative, the BiOp required NOAA Fisheries to implement four additional management measures in order to remain in compliance with the ESA. These include the following:

- NOAA Fisheries will monitor the take of Steller sea lions in the pollock, Pacific cod, and Atka mackerel fisheries. NOAA Fisheries will maintain and utilize the existing Observer Program to assess the incidental take of sea lions in each fishery.
- NOAA Fisheries will monitor vessel location and compliance with gear and directed fishing restrictions for the pollock, Pacific cod, and Atka mackerel fisheries. NOAA Fisheries will require electronic Vessel Monitoring System (VMS) devices and other record-keeping and reporting measures in order to monitor directed fishing.
- NOAA Fisheries will monitor harvest of pollock, Pacific cod, and Atka mackerel in sufficient detail to determine appropriate fishery closures by sector, gear type, and area.

- NOAA Fisheries will manage critical habitat harvest limits in the Atka mackerel fishery using conservative management strategies to minimize the likelihood of exceeding a critical habitat harvest limit. This means that if any part of a haul occurs inside critical habitat or it is not clear where the fishing occurred, the entire catch will be counted against the critical habitat limit. Where the harvest limit is relatively small, NOAA Fisheries must project when the limit will be reached and pre-announce the closure date.

Final Steller Sea Lion Protection Measures

Current regulations for Steller sea lion Protection Measures can be found at the NOAA Fisheries website: <http://www.fakr.noaa.gov/protectedresources/stellers/protection.htm>. A summary of the major measures are presented in Table 2. These Steller sea lion Protection Measures were deemed necessary based on the hypothesis that the continued decline of the western stock of the Steller sea lion is due to nutritional stress and that groundfish fisheries contribute to this stress by competing with Steller sea lions for their key prey species. Management measures were specifically developed to reduce competitive interaction between Steller sea lions and the groundfish fisheries (NMFS 2001a). Mitigation efforts have focused on protecting the integrity of food supplies near rookeries and haulouts. Competitive interactions with the fishery may have the greatest effect on juvenile Steller sea lions between the time they are weaned and the time they reach adult size and foraging capability as the diving capacity of juveniles (and thus available foraging space) is less than that of adults (Burns *et al.* unpublished). Adult females may also be susceptible to nutritional stress due to reduced prey availability in the vicinity of rookeries because of the limited foraging distribution and increased energetic demands when caring for pups. Specifically, the intent of the protection measures was to avoid competition around rookeries and important haulouts with extra precaution in the winter, and to disperse fisheries outside of those time periods and areas.

These regulations reflect the proposed action analyzed in the latest BiOp (NMFS 2001a) with some minor adjustments by the NPFMC in October 2001 (Figure 3). Some of the major measures include the following:

- Fishery closures and no-transit zones within 3 nautical miles (nm) of 39 major rookeries.
- Fishery closures for Atka mackerel, pollock, and Pacific cod within 10 to 20 nm of specified haulouts and rookeries.
- Closure of the Seguam Pass foraging area and most of the Bogoslof area to all gear types.
- Gear and TAC restrictions in areas designated as Steller sea lion critical habitat (the areas within 20 nm of major rookeries and haulouts).
- TAC apportionments by gear type, season, and geographic area.
- Closure of the Aleutian Islands Management area to pollock fishing.

Table 2. Summary of Steller Sea Lion protection measures for 2002.

Areas or Category	Protection Measure
All federally permitted vessels- Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA)	Fishery closures and no-transit zones within 3 nautical miles (nm) of 39 major rookeries (considered the most sensitive for females with pups); the nearshore marine critical habitat is considered the most important to protect from the interactions between the groundfish fisheries and the Steller sea lion.
All directed fisheries for pollock, Pacific cod and Atka mackerel	Modified harvest control rule (HCR) to prohibit directed fishing when the biomass reaches 20 percent of its unfished level.
	Closures within 10 to 20 nm of selected haulout and rookery sites to pollock, Pacific cod, and Atka mackerel directed fisheries in BSAI and GOA.
	Closure of the Segum foraging area and most of the Bogoslof area to all gear types.
	A Vessel Monitoring System (VMS) requirement.
	Closure of the Chignik area for pot, trawl, and hook-line gear.
	Closure within 10 to 20 nm of 46 rookeries and haulouts for hook and line fishing for Pacific cod, and 44 rookeries and haulouts for pot fishing for Pacific cod.
	Modification of the community development quota (CDQ) groundfish program.
Aleutian Islands	Closure of the directed fishery for pollock
	Pacific cod total allowable catch (TAC) apportionment by season and gear, and specific area restrictions that alternate with Atka mackerel fishery in critical habitat (statistical areas 542 and 543).
	Critical habitat harvest limit of 60 percent for Atka mackerel (statistical areas 542 and 543).
	Grouping of vessel for Atka mackerel fishing in critical habitat (statistical areas 542 and 543).
	Two observers required for critical habitat Atka mackerel directed fisheries.
	At least a 3 nm closure around all haulouts for Atka Mackerel and Pacific cod trawl fishing .
	No Atka mackerel critical habitat fishing west of 178° west longitude.
Bering Sea	Two seasons (40:60 percent apportionment) for the pollock fishery with no more than 28 percent of the annual directed fishing allowance taken from the Steller sea lion conservation area before April 1.
	Continuation of BS pollock fishery cooperatives established under the American Fisheries Act.
	Establishment of the Bering Sea Pollock Restriction Area during the A season.
Bering Sea (cont.)	Closure of the Catcher Vessel Operation Area to non-CDQ pollock catcher processor during the B season.
	Pacific cod TAC apportionments by season and gear, as well as gear-specific area restrictions.
	Closure of all Bering Sea sub area critical habitat to Atka mackerel fishing.

Table 2 (cont.). Summary of Steller Sea Lion protection measures for 2002.

Areas or Category	Protection Measure
Gulf of Alaska (GOA)	Even distribution of pollock harvest among 4 seasons.
	Closure of directed fishing for pollock in areas that vary from 0 to 20 nm to 0 to 3 nm around rookeries and haulouts.
	Two seasons (60:40 percent apportionment) for Pacific cod fishing and area restrictions that are dependent on gear type and vessel size.
	Continuation of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Chiniak Gully Research Project to explore the effects of commercial fisheries on pollock abundance and distribution in the GOA.

Source: Proposed Rules, Federal Register Vol. 67, No. 171 September 4, 2002.

In addition, the harvest control rule (HCR) has been modified. Under the previous HCR, the Acceptable Biological Catch (ABC) for target species was calculated as the fishing mortality rate that would reduce the spawning biomass per recruit to 40 percent of its theoretical unfished level ($F_{40\%}$). When the biomass of the target species fell below that calculated level (designated as $B_{40\%}$ and defined as the level of Maximum Sustainable Yield [Appendix B]), fishing was allowed to continue but at a reduced rate. Only when spawning biomass per recruit was reduced to 2 percent of its unfished level was directed fishing for that species stopped. The new HCR, implemented by emergency rule in 2002, is essentially the same except that all targeted fishing is halted if spawning biomass per recruit is reduced to 20 percent of its unfished level.

The VMS is required on all groundfish and individual fishing quota halibut vessels in order to allow NOAA Fisheries to monitor the fishing activity of the fleet in relation to closed and regulated areas. VMS units are tamper proof and transmit a coded signal via satellite that gives NOAA Fisheries the position and identity of each vessel on a real-time basis. These records are used to verify fishing logs and calculate the amount of fish caught within designated critical habitat.

The VMS requirements would facilitate enforcement of the following Steller sea lion Protection Measures and other regulation restrictions:

- Closure of the Chignik area to pot, trawl, and hook and line gear.
- Closure within 10 to 20 nm of 46 rookeries and haulouts to hook and line fishing for Pacific cod and 44 rookeries and haulouts to pot fishing for Pacific Cod.
- Modification to the community development quota (CDQ) groundfish program.
- Revisions to the Federal Fisheries Permit requirements.
- Changes to the catcher vessel fishing trip definitions.

3.3 Alternative 1 Effects

The Steller sea lion Protection Measures under Alternative 1 are essentially the same as those analyzed under the Preferred Alternative of the Steller sea lion SEIS (NMFS 2001b). Therefore, when addressing the direct, indirect, and cumulative effects of the Steller sea lion Protection Measures on the Steller sea lion and other components of the physical, biological, and human environment, it is assumed that these measures would have similar effects as those described in that document. The potential effects of these measures are summarized below.

Physical Environment

The Steller sea lion Protection Measures, as implemented under Alternative 1, would have little, if any, impact on the physical environment except for preventing additional alteration of the physical structure of the non-living substrate and the suspension of sediments in the 3 nm buffer zones around rookeries, haulouts, and areas within critical habitat closed to non-pelagic trawling. Bottom trawling would continue to some extent in Steller sea lion critical habitat under the Alternative 1 FMP. Fishing effort would be displaced to other areas, thus potentially affecting other habitats. Overall, there would be no adverse effects on the physical environment from implementing the Steller sea lion Protection Measures.

Biological Environment

Threatened and Endangered Species

Steller Sea Lions: The primary focus of the Steller sea lion Protection Measures under Alternative 1 is to minimize the effects of groundfish fisheries off Alaska on the western stock of the Steller sea lions and ensure that they do not jeopardize the continued existence of Steller sea lions or adversely modify their critical habitat as defined under the ESA. As such, the management measures under the Alternative 1 FMP were designed to reduce adverse effects on Steller sea lions by dispersing fishing effort through area closures, catch apportionment, and fishery-specific restrictions in a manner consistent with the FMP BiOp and the 2001 BiOp (NMFS 2000, NMFS 2001a).

Direct effects on Steller sea lions resulting from take, either direct mortality or injuries leading to mortality, incidental to activities related to groundfish fisheries under the Alternative 1 FMP would be expected to be similar to past years. The incidental take rate is approximately 10 per year or 1 sea lion for every 140,000 mt of groundfish harvested (NMFS 2001b). Fishing closures in Steller sea lion critical habitat could result in a slight decrease in direct mortality if this is where a large proportion of animals are taken. But when there is an overall TAC increase in Steller sea lion critical habitat, incidental take would be expected to increase since the overall factor correlated with take is the level of TAC for key prey species (e.g., pollock, Pacific cod, and Atka mackerel). If TAC for these primary target groundfish is similar to recent years, incidental take would be expected to be the same. At this relatively low level of incidental take, direct mortality from the groundfish fisheries would not substantially contribute to the further decline of the species.

Under the Alternative 1 FMP, harvest of important Steller sea lion prey species is not expected to have large beneficial or adverse effects to Steller sea lions since region-wide TAC would be the same as recent years. Under the Alternative 1 FMP, some fishing effort is simply displaced to areas outside Steller sea lion critical habitat, but other efforts are more concentrated in Steller sea lion critical habitat. Overall effects of the Steller sea lion Protection Measures on harvest of prey were considered insignificant in the Steller sea lion SEIS (NMFS 2001b). Although decreased catch within Steller sea lion critical habitat theoretically leaves more fish for sea lions, catch outside critical habitat would increase to compensate for any forgone TAC within Steller sea lion critical habitat.

The indirect effects of the spatial and temporal provisions in Steller sea lion Protection Measures would be a reduction in competitive overlap of the fisheries with Steller sea lions in time and space. Elements of these measures are of some benefit to Steller sea lions, especially during the breeding season, in that the spatial and temporal dispersion of fishing effort spreads out the catch. However, the benefits to sea lions during other times of the year are equivocal. The effect of the closures on Steller sea lions would depend on the region. Closure of Management Areas 4 and 5, Seguam Pass, and Steller sea lion critical habitat (20 nm) around five northern haulouts would have little benefit for Steller sea lions, since fishing effort has been minimal in this area in recent years. Closure of the Aleutian Islands to pollock fishing would also have little effect since pollock makes up only a minor portion of the sea lion diet in this region. However, closures in the GOA, would be more beneficial considering the importance of pollock to the sea lions in this region. The Steller sea lion SEIS rated this effect as conditionally significant adverse for spatial and temporal concentration of fisheries, largely based on the lack of positive change from recent years. To the extent that competition with the fisheries is a key factor in the decline of the Steller sea lion, these measures would reduce this competition with groundfish fisheries during the breeding season in the vicinity of important rookeries and haulouts and benefit animals to varying degrees depending on geographic location.

The 3 nm closures around rookeries and haulouts decrease the level of disturbance to Steller sea lions around these areas to the extent that fishing had previously been conducted in these areas prior to 1990, but disturbance from fishing activities away from rookeries has not been demonstrated to have an adverse effect on Steller sea lions (NMFS 2001b). Overall, the 3 nm closures would not be expected to modify Steller sea lion behavior to the extent that population level impacts could occur and thus would likely be considered insignificant.

Eiders: The Steller sea lion Protection Measures would be expected to have little if any effect on the threatened spectacled eider populations. Eider winter habitat occurs within the ice pack of the northern Bering Sea and there is little overlap in habitat with the groundfish fisheries (Peterson *et al.* 1999). The Steller's eider winter habitat is typically inshore and also has little overlap with groundfish fisheries (USFWS 2002).

Short-tailed Albatross: The groundfish fishing closures of the Seguam Pass foraging area for Steller sea lions and the critical habitat east of 173° W to the western boundary of Area 9, could reduce the potential for incidental take of endangered short-tailed albatross in the cod longline fishery. In addition, the seasonal apportionment of TAC of Pacific cod in the BSAI could also avoid times when these albatross are present in higher numbers. But overall, incidental take of short-tailed albatross is very low (less than [$<$]4 albatross over 2 years) and is not directly correlated with spatial or temporal distribution of fishing effort (NMFS

2001b). Specific closures under the Steller sea lion Protection Measures themselves are unlikely to have any substantial effect on incidental take.

Cetaceans: The five endangered cetaceans in the BSAI and GOA would not be expected to be adversely affected by the Steller sea lion Protection Measures. Prey overlap between these whales and the groundfish fisheries is considered low. These fisheries target adult groundfish, whereas whales tend to target juveniles or smaller fish. The direct effect of incidental take, entanglement in fishing gear or disturbance from fishing activity on whales in the BSAI and GOA has not been found to have population-level effects (NMFS 2001b).

Target Species

Pollock: Under Alternative 1, the TAC for target groundfish species is managed to ensure populations and stocks are harvested below the overfishing level (OFL) by a harvest rule setting $F=0$ when $B=B_{20\%}$ (Appendix B). The Steller sea lion Protection Measures seek to reduce the potential for localized depletion of Steller sea lion prey by redistributing pollock catch to the eastern Bering Sea (EBS). However, the distribution of pollock is not static, and is dependent on various environmental conditions. If the distribution of pollock is different than predicted, there is the potential that partitioning of the harvest could lead to excessive local harvest rates within a region (NMFS 2001b). However, this is more a problem for predators, such as Steller sea lion, than for the pollock stocks.

In the Aleutian Islands, no fishing for pollock would be allowed in 2003. In the EBS, the 10 nm closure areas around rookeries and haulouts would ensure that some portions of the pollock stock are protected from directed fishing. The Steller sea lion Protection Measures do not necessarily reduce the temporal and spatial aggregation of fishing in all areas of Steller sea lion critical habitat. However, one objective is to increase the amount of pollock available to the ecosystem in coastal regions. More commercial sized pollock would be available as prey in critical habitat, also.

Overall, fishing as modified by the Steller sea lion Protection Measures would impact trophic interactions in coastal regions of the BSAI and GOA but the effect of these changes are difficult to predict because of the complex nature of the food web. Effects on pollock stocks were considered insignificant in the Steller sea lion SEIS (NMFS 2001b).

Pacific Cod: Under the target fish measure associated with the Steller sea lion Protection Measure under Alternative 1, the average fishing mortality imposed on the BSAI and GOA Pacific cod stock is well below the maximum sustainable yield. These measures also seek to reduce localized depletion by redistributing Pacific cod catch, although this is difficult because the stocks are very mobile.

The fishing seasons prescribed under the Alternative 1 policy Steller sea lion Protection Measures are expected to result in spatial and temporal distribution of catch similar to recent years with most of the catch occurring during January. The regions closed to the various gear types are regions that historically have had relatively low levels of fishing effort with those gears. Closed areas would ensure that some portion of the stock was protected from directed fishing. These actions are likely to ensure that BSAI and GOA cod stocks are harvested at a sustainable rate. Effects on cod were found to be insignificant in the Steller sea lion SEIS (NMFS 2001b).

Atka Mackerel: The Steller sea lion Protection Measures under the Alternative 1 policy are intended to reduce localized depletion by redistributing Atka mackerel catch within the BSAI by having two fishing seasons and specific catch limits within critical habitat. The TAC for Atka mackerel is apportioned 60 percent inside Steller sea lion critical habitat and 40 percent outside.

For BSAI Atka mackerel, the projected average fishing mortality rate under the Steller sea lion Protection Measures would increase from recent years but is still below the OFL and the spawning biomass level is maintained such that the stock would not be overfished.

With the additional fishing effort for Atka mackerel in Steller sea lion critical habitat under the apportioned TAC, the spatial aggregation of fishing in Steller sea lion critical habitat could increase but is not likely to affect the sustainability of the Atka mackerel stock. High catches of Atka mackerel in Steller sea lion critical habitat would impact the amounts of Atka mackerel available to the ecosystem. Fewer commercial-sized Atka mackerel would be available as prey in Steller sea lion critical habitat.

Other Target Species: The Alternative 1 FMP management measures under Steller sea lion Protection Measures would not be expected to have significant effects on flatfish, BSAI rockfish, GOA rockfish, and thornyheads. Measures are not likely to significantly affect the sustainability of these stocks, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability.

Non-Target Species

Non-target species include a wide range of species groups such as forage fish, other species, and non-specified. Since little is known of the seasonal distribution of most of the non-target species, the effect of changes in apportionment of harvest is also unknown. In addition, fishing closures and harvest limits in Steller sea lion critical habitat would likely result in the failure to fully harvest target fish TAC. This, in turn, would reduce the bycatch of non-target species in these areas. Changes to the fisheries under the Steller sea lion Protection Measures would likely not affect the non-target fish populations in the region (NMFS 2001b).

Prohibited Species

Chinook and other Pacific salmon are taken as bycatch in the groundfish trawl fisheries so any change in the distribution or time of fisheries could affect bycatch of these species. It appears that chinook salmon, other Tanner crab, and halibut bycatch rates are higher in Steller sea lion critical habitat (NMFS 2001b). The Steller sea lion 10 nm buffer in the vicinity of Unimak Island has been shown to have higher bycatch of chinook salmon (NMFS 2001b). Trawl closures under the Steller sea lion Protection Measures in nearshore areas around haulouts and rookeries would relocate fishing from areas of high bycatch and potentially decrease salmon bycatch as well as other protected species. However, the actual amount of change in the salmon bycatch would be difficult to predict and would not be expected to be radically different than in previous years (NMFS 2001b).

Halibut, Pacific herring, and crab bycatch in the groundfish fisheries would not be expected to be substantially different than recent years due to Steller sea lion closures or any displacement of fishing activity offshore (NMFS 2001b). Halibut bycatch is controlled by Prohibited Species Catch (PSC) limits (caps) for specific fisheries and if these caps are reached, the fisheries are closed. Thus, fishermen have a real incentive to avoid these species so as to maximize their groundfish harvest opportunity. Red king crab and Tanner crab in bycatch would be expected to remain at historic levels since PSC limits are in place for these species.

Essential Fish Habitat

The effects of the Steller sea lion Protection Measures on Essential Fish Habitat (EFH) are the indirect benefits to the benthic habitat that accrue as a result of the no-transit areas, no-fishing area closures and area-specific gear closures, especially for those that apply to non-pelagic trawling. Maintaining the closures within the 3 nm buffer zones around Steller sea lion haulouts and rookeries and restrictions within 10 to 20 nm of key rookeries, to the extent that these areas were fished in the past, would protect benthic communities in these areas from further disturbance. Under the Steller sea lion Protection Measures, areas closed to trawling for the three main target species, which are important prey for Steller sea lions, amount to approximately 50 percent of all Steller sea lion critical habitat. There is likely a wide range of benthic habitat types within the areas designated as Steller sea lion critical habitat, and protection of these areas provides additional areas of undisturbed benthic habitat. Closures of Steller sea lion critical habitat in the Aleutian Islands closely coincide with concentrations of Habitat Areas of Particular Concern (HAPC) biota in this area and also provide good habitat for Atka mackerel adults and late juveniles. However, the displacement of fishing effort out of Steller sea lion critical habitat and concentration of fishing effort in the areas remaining open may result in increased impacts to benthic habitat and EFH in other areas, some of which may have only been marginally fished in the past. Overall, the effects are likely a combination of decreased impact in some areas, and increased impacts in other areas. Effects of the Steller sea lion Protection Measures on EFH were considered insignificant in the Steller sea lion SEIS (NMFS 2001b).

Seabirds

Incidental take of seabirds in longline fisheries could be affected to some degree by any changes in the distribution and timing of the Pacific cod longline fisheries due to Steller sea lion Protection Measures since most of the incidental take of seabirds comes from these fisheries. Overall, the recently instituted seabird avoidance measures in the longline fisheries will produce greater benefits to the northern fulmar and other species in comparison to the benefits of closure of areas or restricted fishing under the Steller sea lion Protection Measures.

The 3 nm buffer zone, the no fishing closures, and the other Alternative 1 FMP groundfish fishing restrictions in Steller sea lion critical habitat would serve to further limit disturbance of forage fish schools in these areas and provide some level of benefit to piscivorous seabirds, especially where these closed areas overlap with seabird foraging concentration areas and large seabird colonies. However, this effect is difficult to quantify because of the very limited area involved and the ability of most seabirds to forage over a very large area. Overall, effects of the Steller sea lion Protection Measures on seabirds were considered insignificant in the Steller sea lion SEIS (NMFS 2001b).

Marine Mammals

Effects of the Alternative 1 FMP Steller sea lion Protection Measures on harbor seals relate to the spatial and temporal dispersion of the fisheries and the competition with the fisheries for prey species. Incidental take of harbor seal would be expected not to change from the relatively low level in the BSAI of 4 per year and GOA of <1 per year. Where the 3 nm buffer areas overlap with harbor seal haulouts and breeding areas, some protection is provided from fishery-related disturbance. However, coverage of important nearshore harbor seal habitats by these buffer zones is not global and many areas, such as the nearshore areas around Kodiak Island and the Alaska Peninsula, are not afforded protection under these closures. Where management measures displace the pollock, Pacific cod and Atka mackerel fisheries farther offshore and leave more fish in coastal areas, some benefits to harbor seals are expected. TAC of the major prey species for harbor seals would generally be similar to recent years.

For the northern fur seal, the primary effects of the current Steller sea lion Protection Measures are related to the spatial and temporal shift in fishing effort in the Bering Sea. The spatial shift in the Bering Sea pollock fishery northward from the closed Steller sea lion Conservation Area to the summer and fall foraging habitat of the northern fur seals results in concentration of the fishing effort in this area, increased disturbance, and a potential competitive overlap with the groundfish fishery for prey. Expanding the pollock fishery from fishing only in the fall to the entire period when the fur seals are breeding, potentially increases the competition for prey species. Overall effects would be considered negative, but whether it would be significant at the population level is difficult to predict. Concerns have been raised by Alaska Natives in the Pribilof Island region about the potential adverse effects of the pollock fishery on the northern fur seal population and subsequently on subsistence harvest. As a result, this effect was considered conditionally significant adverse in the Steller sea lion SEIS (NMFS 2001b).

Ecosystem

Effects of the Alternative 1 FMP Steller sea lion Protection Measures on the ecosystem were analyzed in the Steller sea lion SEIS using a range of environmental indicators (NMFS 2001b). With regard to predatory-prey relationships, effects were considered significantly beneficial in regards to forage availability when management measures result in more than a 10 percent increase in prey, such as pollock or other major prey species. Also considered significantly beneficial was the effect on species diversity, which was based on improved protection for a wide range of species. Indicators that were predicted not to change as a result of these measures were the effect on top predators, energy flow and balance, and the introduction of non-native species (NMFS 2001b).

Human Environment

Since the current Steller sea lion Protection Measures have the effect of greatly modifying the ways of fishing for groundfish, the effect on the human environment can be substantial, but some sectors and geographic areas are more affected than others (M. Hartley, Northern Economics, personal communications 2002). Economic effects of these measures have been analyzed in the Steller sea lion SEIS, and following is a general summary from this analysis (NMFS 2001b). Impacts generally fall into 3 main categories:

- Non-market impacts.
- Industry costs and market impacts.
- Indirect impacts.

The non-market effects caused by the Steller sea lion Protection Measures, such as existence value, subsistence, and eco-tourism, are generally considered beneficial in that anything that promotes the increase in recovery of the Steller sea lion would have a positive effect on these non-market activities. Subsistence costs would decrease with an increase in the number of animals. Rural residents would have more Steller sea lions to hunt and have to travel less to take them. The Steller sea lion SEIS found non-market effects of the Steller sea lion Protection Measures to be significantly beneficial (NMFS 2001b).

Industry costs and market impact were evaluated using an economic model (NMFS 2001b). Operation costs affect the fishing industry directly by increasing cost per unit harvested. The Alternative 1 FMP Steller sea lion Protection Measures affect the industry by increasing travel time to and from distant fishing grounds compared to prior years when such measures were not in effect. These impacts vary considerably between the various fisheries. The EBS pollock and cod fisheries are largely unaffected by changes under the Steller sea lion Protection Measures, whereas the changes to the GOA pollock, Pacific cod, and Atka mackerel fisheries have a much greater affect on industry costs. Time associated with learning how to fish new fishing grounds, reducing catch per unit of fishing effort from fishing less concentrated stocks, increasing down time and layups, all contribute to increasing costs to processors. If the operating costs increase, some negative impacts on the market would be expected.

The impact on markets for pollock, Pacific cod, and Atka mackerel are measured as changes in prices and product revenues. A market analysis conducted for the Steller sea lion SEIS found that implementing the Steller sea lion Protection Measures would have a relatively small effect on the markets of most of the product forms and the overall impact would be insignificant (NMFS 2001b).

Safety costs are an indirect economic factor affected by the current Steller sea lion Protection Measures. With the smaller boats, especially in the GOA, there would be operational costs for fishing farther offshore, in more remote fishing grounds, and operating during periods when weather conditions are more extreme. There is also an increased risk of accident and injury from working in unfavorable conditions (NMFS 2001b). However, it must be noted that many of these impacts can be mitigated by rationalization of the fisheries.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

4.1 Management Approach

The Steller sea lion-related goals of the Alternative 2 policy are the same as Alternative 1: to be compliant with the Magnuson-Stevens Fishery Conservation and Management Act, the ESA, and other applicable laws. This alternative is designed to maximize the biological and economic yield from the fishery resource through a more aggressive harvest strategy while avoiding jeopardy. Alternative 2 is based on the assumption that fishing has no adverse impact on the environment except in specific cases when science provides convincing empirical evidence of harm.

4.2 Overview of Management Measures

Under this management policy, no fishing restrictions beyond those mandated under the Steller sea lion Protection Measures would be implemented unless scientific research yielded clear evidence of adverse impacts from the fisheries or that new measures would be beneficial to Steller sea lions. Alternative 2 proposes to amend the current FMPs to establish a less precautionary management policy while still preventing overfishing of target groundfish stocks. To illustrate the environmental consequences of this alternative, an FMP framework was developed. This FMP framework is comprised of two FMPs that serve as bookends to portray a range of management actions. Adoption of the Alternative 2 policy would result in changes made to the groundfish FMPs that fall within the FMP bookends.

4.3 Fishery Management Plan 2.1 Management Measures

Changes to the Steller sea lion Protection Measures under the FMP 2.1 would likely be very minor since the groundfish fisheries would still have to avoid jeopardy under the ESA. In the FMP illustration, no changes are contemplated to the current Steller sea lion Protection Measures. There would be changes to other FMP components that could have an effect on the Steller sea lions, such as changes to the TAC-setting process resulting in increased harvest of Steller sea lion prey species, repeal of current closed/restricted areas, and elimination of all trawl closure areas and fixed gear restrictions.

No additional sea lion programs or research efforts beyond those established under FMP 1 would be required to implement FMP 2.1. However, at this end of the Alternative 2 policy spectrum, changes to some of the other FMP components illustrated in FMP 2.1, such as elimination of the Observer Program and VMS requirements, would alter the effectiveness of the existing Steller sea lion Protection Measures. Such changes in fishery management would likely require a new Section 7 consultation with NOAA Fisheries and OPR to determine if the new system places the Steller sea lions in jeopardy. It would then need to be demonstrated that the subsequent changes were either positive or inconsequential to Steller sea lions or its critical habitat to avoid jeopardy.

4.4 Fishery Management Plan 2.1

Physical Environment

FMP 1 policy Steller sea lion Protection Measures would remain in place under the FMP 2.1. Therefore, the effects on the physical environment (both positive and negative) would be the same as FMP 1. These effects include preventing additional alteration of physical structure to the non-living substrate and sedimentation in the 3 nm buffer zones and areas within critical habitat closed to non-pelagic trawling. These effects were found to be insignificant in the Steller sea lion SEIS (NMFS 2001b).

Biological Environment

Threatened and Endangered Species

The area and fishing closures under the Steller sea lion Protection Measures for FMP 2.1 would be the same as those under FMP 1, as required to avoid jeopardy (Figure 4). Therefore, effects of the area closures and other elements of the Steller sea lion Protection Measures on Steller sea lions would be the same. However, changes made to other FMP components would potentially have adverse effects, such as substantially higher TAC and the increased disturbance that would come with the higher harvest rate, changes to the Observer Program and repeal of the VMS requirements. These components, separate from the Steller sea lion Protection Measures, would likely trigger preparation of another BiOp to determine if the changes result in jeopardy.

The aggressive harvest strategy under FMP 2.1 would result in a substantially greater harvest of Steller sea lion prey through removal of the buffer between the ABC level and the OFL, removal of PSC limits, bycatch restrictions, and the optimum yield cap in the BSAI. This would potentially reduce the effectiveness of the Steller sea lion Protection Measures.

The amount of observer coverage in the fleet is an important consideration for determining the incidental take of sea lions. Since Steller sea lions are infrequently taken incidentally in the fishery, trying to extrapolate the number of sea lions taken by the whole fleet from only a small percentage of observed vessels is statistically problematic. Without VMS, NOAA Fisheries would have to rely on self-reported logs to determine the amounts of fish taken in Steller sea lion critical habitat. This could result in lower allowable catch levels to address concerns over unreported catch in these areas.

No change in effects on other ESA-listed species resulting from FMP 2.1 Steller sea lion Protection Measures would be expected since they are the same as FMP 1.

Target, Non-Target, and Prohibited Species

FMP 2.1 would establish a more aggressive harvest policy for the three main sea lion prey species (pollock, Pacific cod and Atka mackerel) while still preventing overfishing of these target groundfish stocks by maintaining harvest below the OFL for each species. More prey species would be harvested outside of critical habitat. Within critical habitat, harvest levels would be maintained at the current levels. Overall, the effects of the Steller sea lion Protection Measures on target, non-target, and prohibited species would be the same as those under the Alternative 1 policy.

Human Environment

Since the Steller sea lion Protection Measures under the FMP 2.1 would be the same as FMP 1, effects of these measures on the socioeconomic factors would also be the same.

4.5 Fishery Management Plan 2.2 Management Measures

Under the Alternative 2 policy range, FMP 2.2 would continue the current Steller sea lion Protection Measures similar to FMP 1 (Figure 5). No additional sea lion programs or research efforts beyond the status quo would be implemented under FMP 2.2. Most of the other FMP 2.2 components would also be the same as FMP 1 except that TAC may be set higher than current levels with a cap equal to the sum of all target ABCs. Although FMP 2.2 would likely retain the ban on targeting forage fish, the NPFMC would not need to account for changes in the food-web relative to the needs of marine mammals, or to include ecosystem-level considerations in fishery allocation decisions. The Observer Program and VMS requirements would be the same as Alternative 1 so monitoring of incidental take and harvest within Steller sea lion critical habitat would continue. For more information on the effects of these FMP components, see the TAC-Setting Bycatch Restrictions, and Observer Program discussions elsewhere in this section.

4.6 Illustrative Fishery Management Plan 2.2 Effects

Physical, Biological, Human Environment

Since FMP 2.2 Steller sea lion Protection Measures are the same as FMP 1, the effect of these measures on the physical, biological, and human environment would be essentially the same as described under the Alternative 1 policy and the current FMP.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

5.1 Management Approach

The Steller sea lion-related goal of the Alternative 3 policy is very similar to the adaptive management policy of Alternative 1 in that it seeks to maintain or adjust current Steller sea lion Protection Measures as necessary to avoid jeopardy, or adverse modification of their designated critical habitat. The Alternative 3 policy, however, would place more emphasis on incorporating ecosystem-based management principles into allocation decisions and would implement more precautionary management measures beyond those currently in place under the Alternative 1 policy. Specific objectives under the Alternative 3 policy are to develop indices of ecosystem health as targets for management, adjust ABCs as necessary to account for uncertainty, incorporate ecosystem factors such as predator-prey relationships and regime shifts into allocation decisions, and initiate research on the habitat needs of different species in the food web.

5.2 Overview of Management Measures

As part of the goal to accelerate incorporating ecosystem considerations into management of the fisheries, NOAA Fisheries would develop indices of key ecosystem processes that would be used to track ecosystem health. Environmental measurements involving population trends and abundance of prey species of Steller sea lions and other marine mammals may well be included in these new ecosystem indices. The development of ecosystem indices would likely benefit from collaboration with academic research institutions and efforts to incorporate traditional ecological knowledge into fisheries management.

An additional goal under the Alternative 3 policy would be to increase the rationalization of the fisheries in order to reduce the “race for fish.” Rationalization programs provide opportunities for tighter spatial-temporal controls on fishing effort, which are the basis of most of the Steller sea lion Protection Measures. For more information on how rationalization measures could effect the biological environment (see Appendix F-8, Overcapacity).

5.3 Fishery Management Plan 3.1 Management Measures

The Alternative 3 policy, as illustrated by FMP 3.1, would retain the Alternative 1 Steller sea lion Protection Measures that are designed to produce spatial and temporal dispersion of fishing effort within Steller sea lion critical habitat. These existing measures would be augmented by changes to other FMP 3.1 components such as setting TAC equal to or less than ABC for all target and other species categories, setting $ABC < OFL$ and a prohibition on bottom trawling for pollock in the BSAI (see Appendix F-1, TAC Setting Process).

Other FMP 3.1 components that could affect Steller sea lion Protection Measures include establishing goals and guidelines for selecting Marine Protected Areas (MPAs) and no-fishing zones (see Appendix F-3, Marine Protected Areas and Essential Fish Habitat). The MPA program would complement the effort to develop an index of ecosystem health. The establishment of no-fishing zones explicitly intended to benefit marine mammals such as the Steller sea lion would provide an opportunity to study the dynamics of fishery-ecosystem interactions. Reproductive success, foraging behavior, diet, physiological health, and other

parameters could be measured and compared between populations within no-fishing zones, and populations within areas where fishing was allowed. The results of such comparisons would provide scientific justification for future fishery management decisions, including those to protect Steller sea lions. These types of comparative studies would be greatly facilitated if protected areas could be matched with open-fishing areas that were similar in key respects such as similar habitats and fish communities. Establishing the criteria for selection of protected areas would be an important step in realizing this research potential.

The rationalization of fisheries under FMP 3.1 may benefit localized concentrations of fish that are important to Steller sea lions by spreading fishing pressure over time. It is thought that more dispersed fishing effort would cause less disruption of the prey field and, therefore, facilitate sea lion foraging success and reduce impacts on prey availability. Due to scientific uncertainty about this issue, the dynamics of fishing effort-prey field interactions would continue to be a research priority.

The Observer Program would be modified under FMP 3.1 to improve the collection of scientific data and to make it more independent from the fishing industry and NOAA Fisheries. The idea would remove any conflicts of interest and allow more third-party monitoring of the fishery data. While these changes would be oriented mostly toward data on target and non-target fish, they could impact Steller sea lion Protection Measures in at least two ways. First, improved scientific data on fishing effort and distribution may help refine future analyses of sea lion-fishery interactions. It would also contribute to an improved understanding of non-target fish and, therefore, to a better understanding of the food web. Second, the proposed changes would improve confidence in the accuracy of harvest data, which is important in Steller sea lion critical habitat considerations.

5.4 Fishery Management Plan 3.1 Effects

Physical Environment

Since the Steller sea lion Protection Measures under FMP 3.1 are the same as FMP 1, effects of these measures on the physical environment would be the same. (Figure 6). Substantive change to these measures as a result of research efforts would be difficult to predict at this point. Effects on the physical environment would include preventing additional alteration of the physical structure to the non-living substrate and suspension of bottom sediment in the 3 nm buffer zones and areas within critical habitat closed to non-pelagic trawling.

Biological Environment

Threatened and Endangered Species

The FMP 3.1 Steller sea lion Protection Measures would be the same as Alternative 1 in order to avoid jeopardy of Steller sea lions. Other FMP 3.1 components, such as MPAs and no fishing reserves, and use of other ecosystem indicators could offer additional benefits to the recovery of this species by limiting the competitive overlap of fisheries and Steller sea lions. The TAC-setting process component of FMP 3.1 would be the same as the Alternative 1 policy with the HCR prohibiting directed fishing when the biomass reaches 20 percent of its unfished level. Therefore, there would be no change in prey availability to Steller sea lions and other marine mammals as a result of this illustrative FMP.

Similarly, the effects of these measures on short-tailed albatross, Steller's and spectacled eiders, and endangered whale species would be expected to be similar to the Alternative 1 policy for this particular component. The development of ecosystem indices could potentially result in increased protection for these species, but it is difficult to speculate the degree and type of protection. The FMP 3.1 allows for adjustments to the Steller sea lion Protection Measures as appropriate based on new scientific research.

Target, Non-Target, and Prohibited Species

Since the FMP 3.1 Steller sea lion Protection Measures are the same as FMP 1, the effects of these measures on target, non-target, and prohibited species would be the same.

Essential Fish Habitat

The FMP 3.1 Steller sea lion Protection Measures would be the same as under the Alternative 1 policy; therefore, the effects on EFH, if any, would be the same. However, any adjustment to the current protection measures as a result of new research or application of ecosystem-based criteria would likely involve establishing new Steller sea lion Protection Measures, and this would indirectly benefit EFH in new areas to the extent they were disturbed by fishing in the past. Overall, effects of new or expanded Steller sea lion closures would be both positive and negative. As more EFH considerations are incorporated into the Steller sea lion closures and gear restrictions under the ecosystem-based approach, the more likely these measures will result in direct positive effects to Steller sea lions.

Marine Mammals

If the ecosystem-based approach takes into account important habitat of other key marine mammals, such as harbor seals and northern fur seals, Steller sea lion closures could also provide some benefits to these other marine mammals. As new research identifies additional areas important to marine mammals, some modification of existing Steller sea lion Protection Measures could occur and potentially reduce effects on other marine mammals in the region. Ecosystem-based criteria for new Steller sea lion Protection Measures would likely take into consideration unintended results of these measures. For example, the displacement of fisheries from Steller sea lion critical habitat to northern fur seal foraging areas in the EBS could result in adverse effects on fur seal foraging areas. A similar effect could occur in the GOA should new Steller sea lion closed areas overlap with sensitive harbor seal areas (e.g., the benefits that accrue to Steller sea lions could come at a cost to harbor seal).

Seabirds

Since the FMP 3.1 Steller sea lion Protection Measures are the same as under FMP 1, we predict no change in the effects on seabirds as a result of FMP 3.1.

However, other FMP 3.1 components that would afford additional protection to Steller sea lions such as increased area closures, development of MPAs/no-take marine reserves, rationalization of the fisheries, and spreading out the catch over a broader area could indirectly benefit seabirds by reducing disturbance of their prey. Changes in allocation from trawl to longline to protect EFH, however, would have the unintended effect of increasing seabird incidental take as a result of more hooks fished. These adverse effects will likely be mitigated through continued seabird avoidance measures currently in effect.

Ecosystem

Since the Steller sea lion Protection Measures would be basically the same as under the Alternative 1 policy, no difference in impacts on the ecosystem as a result of Steller sea lion Protection Measures is predicted. To the degree that the spatial and temporal separation of the groundfish fisheries from Steller sea lion critical habitat involves positive effects to the ecosystem and food web, we would expect these benefits to continue under the policy alternative. Effects on the ecosystem would be similar to what is described under Alternative 1.

Human Environment

The socioeconomic effects of Steller sea lion Protection Measures under FMP 3.1 would include additional or expanded closures should scientific evidence indicate that the existing Steller sea lion Protection Measures are inadequate and need to be revisited or expanded. In the event the closed areas are expanded, increased operating costs and/or reduced harvest levels would be expected, although the economic effects would be negative. In addition, if major changes in the time and area provisions of the existing Steller sea lion Protection Measures are proposed, such changes might require additional consultation under Section 7 of the ESA. This consultation could lead to additional protection measures that result in increased cost to fishermen and processors. Alternatively, improving the scientific data on the interaction of Steller sea lions and fisheries may allow for relaxation of some of the Steller sea lion Protection Measures and result in positive socioeconomic benefits.

5.5 Fishery Management Plan 3.2 Management Measures

At this end of the Alternative 3 policy range, the fishery management system is greatly influenced by ecosystem-based considerations and is much more precautionary in the face of scientific uncertainty. Steller sea lion Protection Measures illustrated in FMP 3.2 would be modified to increase the no-fishing buffer zones around rookeries and haulouts based on new telemetry data on sea lion foraging activity and customized for individual locations to reflect actual foraging behavior. For the purposes of this analysis, these new buffer zones are assumed to be 15 nm from shore in the Bering Sea and GOA, except where there is an overlap with MPAs and no-take reserves to protect EFH. Two types of MPAs would also protect Steller sea lion prey species and include “No Steller sea lion prey species hook and line, pot, and trawling MPAs” and “No Steller sea lion prey species trawling MPAs.” These MPAs are distributed in a patchwork of 30 nm by 35 nm blocks. In the Aleutian Islands, a 15 nm buffer was applied to each of the Steller sea lion rookeries and haulouts. All rookeries within the Aleutian Islands carry a 3 nm no-transit area with an additional 10 nm (or more) buffer of no trawling for Steller sea lion prey species.

In addition, the HCR would be revised to include a constant buffer biomass for Steller sea lion for the three key Steller sea lion prey species. This means that directed fishing for target species would be halted if biomass ($B_{x\%}$) reached a certain level. This minimum biomass limit would represent the level of fish stocks needed to sustain local sea lion populations under natural foraging conditions.

Under other FMP 3.2 components, indicators of ecosystem health would become important tools for setting TAC. TAC determinations would be more species-specific than they are now and ABC levels would be calculated using more precautionary procedures. It is likely that overall TAC would be considerably less than it is at present. Allocations of TAC among gear types, and in space and time would be based, in part, on protecting living marine resources, including Steller sea lions and other marine mammals. This could include a prohibition on non-pelagic trawling for pollock in both the BSAI and GOA.

Management efforts would also likely benefit from the increased contribution of traditional ecological knowledge anticipated under FMP 3.2. Contributions from academic institutions would also be necessary to help better understand the theoretical underpinnings of an ecosystem-based fishery management system. The collection of this information and its dissemination to the NPFMC and the public would require a new and innovative communication effort by NOAA Fisheries. More on the integration of traditional ecological knowledge can be found in Appendix F-9, Alaska Native Issues).

Under the EFH FMP 3.2 component, up to 15 percent of the BSAI/GOA would be included in MPAs and up to 5 percent of the area placed in no-take reserves to protect EFH. As explained above, these protected areas could also serve as marine mammal refuge and offer the opportunity for scientific research on the effectiveness of ecosystem-based management. Rationalization of all BSAI/GOA groundfish fisheries under the overcapacity FMP component would be a priority and could lead to substantial changes in the spatial-temporal distribution of fishing effort. New quota share programs could provide indirect benefits to Steller sea lions and other marine mammals.

5.6 Fishery Management Plan 3.2 Effects

Physical Environment

Steller sea lion Protections Measures under FMP 3.2 would include a very large increase in the size of the buffer zones; therefore, the area protected from increased non-pelagic trawling would be substantial. In these newly protected areas, effects on the physical environment would be benefits accrued from preventing additional alteration of the physical structure of the non-living substrate in areas previously fished. These new closures would also reduce the effects of suspension of bottom sediments from non-pelagic trawls.

Biological Environment

Threatened and Endangered Species

Increasing the buffer zones around the shoreline of the EBS and GOA, around rookeries and haulouts in the Aleutian Islands, and around the Steller sea lion no prey species MPAs, would further reduce the potential for competitive overlap of groundfish fisheries and Steller sea lion prey, and minimize the potential for localized depletion of prey species near and in Steller sea lion critical habitat (Figure 7). These new buffer zones are assumed to be 15 nm for this analysis, but it is anticipated that the size of these new zones would be based on telemetry data on various age classes of sea lions, conducted at individual sites, by such programs as the ongoing Satellite Telemetry and Steller Sea Lion Research Project (ADF&G and NMFS, 2002). Delineated areas would either be larger or smaller than the 15 nm zone but would likely contain the appropriate biological components of critical habitat for a specific area rather than be based strictly on distance from shore. The application of these new buffer zones, if delineated using a broad spectrum of

telemetry data, and the extensive areas within the no-take Steller sea lion prey species MPAs, would likely result in achieving the optimal separation of the fisheries and Steller sea lions during critical periods throughout the year in comparison to current Steller sea lion Protection Measures under FMP 1, FMP 2.1 and 2.2, and FMP 3.1.

These increased Steller sea lion buffer zones would be expected to have little positive effect on the incidental catch of the short-tailed albatross, especially if these measures resulted in displacing the fisheries further offshore. Effects on the spectacled and Steller's eiders and the endangered cetaceans would be expected to be similar to what is described under the Alternative 1 policy.

Target, Non-Target, and Prohibited Species

The Steller sea lion Protection Measures under FMP 3.2, which include the increased buffer zones, the extensive no-take Steller sea lion prey species MPAs, and a revised HCR for Steller sea lion prey species, would be expected to result in some positive benefits to certain target, non-target, and protected species stocks. A reduction in TAC would ensure that target fish stocks are harvested at a sustainable rate well below the OFL. The increased buffer zone in Steller sea lion rookeries and haulouts and the lower TAC under FMP 3.2 would further ensure that more commercial-size fish would be available as predators and prey in Steller sea lion critical habitat.

A reduction in TAC under FMP 3.2 would also decrease bycatch of non-target, forage fish, and other species. Since distribution of these species is generally not known, the effects of this reduction in bycatch are also unknown.

Effects on prohibited species would generally be similar to FMP 1 except that reductions in TAC for the groundfish fisheries would likely decrease prohibited species catch, assuming bycatch takes remained constant. Limits on prohibited species for individual fisheries would remain in place until it was determined they were no longer needed.

Essential Fish Habitat

Increases in Steller sea lion closures as illustrated in FMP 3.2 would increase the amount of benthic habitat protected from damage or modification by non-pelagic trawls. This would occur only to the extent that these areas were fished in past years. If TAC is not reduced proportionally to the areas closed to fishing, fishing effort would be displaced and some of these open areas could experience increased disturbance to fishing habitat. Long-term effects on benthic habitats are unknown. Other FMP 3.2 components, such as designating up to 20 percent of the BSAI and GOA into MPAs and no-take reserves and prohibition of bottom trawling for pollock GOA, would also have a substantial effect on the amount of EFH protected under this FMP. Overall, effects of the Steller sea lion Protection Measures on EFH under FMP 3.2 would be positive.

Seabirds

Effects of the FMP 3.2 Steller sea lion Protection Measures on seabirds would be similar to those under FMP 1, since all of the primary Steller sea lion management measures would remain in place. Additional Steller sea lion measures to increase buffer zone size in Steller sea lion critical habitat would have little effect on the incidental take of seabirds if fishing effort is displaced to other areas, especially if areas remaining open are seabird foraging areas. Other FMP 3.2 components, such as the substantial reduction in TAC, especially in longline fisheries, would reduce incidental take of seabirds such as the northern fulmar and gulls, although this would likely be overshadowed by the benefits of the current seabird avoidance measures.

Marine Mammals

Increasing the size of buffer zones around Steller sea lion critical habitat under FMP 3.2 would be beneficial to harbor seals based on the increased protection the expanded areas provide to nearshore habitats and the reduction in competition for prey as described under FMP 1. Harbor seals benefit from any management measures that displace the harvest of pollock, Pacific cod, and Atka mackerel farther offshore, and measures that reduce TAC of these species (NMFS 2001b). Areas where new Steller sea lion buffer zones overlap with important breeding habitat for harbor seals, such as Tugidak Island south of Kodiak, would further benefit these animals. This protection would also extend to major harbor seal areas on the Alaska Peninsula and Kodiak Island, since they would be either within the 15 nm band or an MPA. Increased closures of the nearshore areas would have the tendency to displace fishing effort farther offshore, and potentially increase the overlap with fur seal foraging areas. Overall, the Steller sea lion Protection Measures under FMP 3.2 would be somewhat more beneficial to marine mammals than those under the Alternative 1 FMP.

Ecosystem

Since the FMP 3.2 Steller sea lion Protection Measures would be modified by increasing the size of the Steller sea lion buffers, (no Steller sea lion prey species MPAs) these measures would result in substantial decrease in the effects of fishing on the ecosystem within Steller sea lion critical habitat. More prey would be available in time and space to a wide variety of predators; therefore, the Steller sea lion measures would have a positive effect on the predator-prey relationships. Effects on species diversity would also be positive because of the potential effects on the declining Steller sea lions. Overall, the effects on the ecosystem under FMP 3.2 would be generally similar to those described in FMP 1, although the intensity of the effects would be greater under FMP 3.2. Ecosystem parameters not expected to change are effects on top predators and energy flow and balance (NMFS 2001b). Overall, effects of the new Steller sea lion Protection Measures under the FMP 3.2, although positive to several species, are considered insignificant on the ecosystem, similar to the finding for all the alternatives in the Steller sea lion SEIS (NMFS 2001b).

Human Environment

The increase in buffer zones to 15 nm around all shoreline and outside of no-take MPAs and the creation of no Steller sea lion prey species take MPAs under FMP 3.2 would likely result in vessels, primarily in the GOA (Alaska Peninsula and Kodiak), spending more time fishing farther from port and fishing in more difficult areas. These effects would be more severe for smaller catcher vessels. Reductions in TAC would result in less income for the fleet. Effects on the economies of the small rural communities and fishermen in these communities would be significantly adverse. Fishermen would need to travel further from their

communities to fish (M. Hartley, Northern Economics, personal communication, 2002). Smaller boats would have to fish farther offshore and, therefore, experience higher operating costs and elevated safety risks, although these risks are difficult to quantify.

However, other FMP 3.2 components such as rationalization of all of the GOA and BSAI non-pollock/sablefish fisheries, can potentially mitigate many of these impacts on the human environment (see Appendix F-8, Overcapacity).

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

6.1 Management Approach

The goal of the Alternative 4 policy with regard to Steller sea lion Protection Measures is incorporated into a change in policy that transfers the burden of proof from the resource to the user when faced with uncertainty. This management policy is based on the same basic assumption as Alternative 1, that fishing produces adverse impacts on the environment but, due to incomplete data and scientific uncertainty, little is known about these impacts. Adoption of the Alternative 4 policy would require more information and conclusive studies to support large commercial harvests. Alternative 4 FMPs 4.1 and 4.2 illustrate two FMPs (a fishing strategy and a no fishing strategy, respectively) where results from scientific studies are used to mitigate any adverse effects on the biological environment. Effect would need to be understood prior to preceding with a fishery. This policy would result in a number of changes to the existing FMPs that would substantially reduce the groundfish fisheries until more information is known about the frequency and intensity of fishery impacts upon Steller sea lions and the marine environment. Expanded fisheries research and monitoring programs will fill critical data gaps. Once more is known about fishery effects on the ecosystem, scientific information would be used to modify and relax the precautionary measures initially adopted.

6.2 Overview of Management Measures

The conservative management measures specific to Steller sea lions under the Alternative 4 policy would involve continued enforcement of the Steller sea lion Protection Measures as described under FMP 1. New fishing restrictions would likely be instituted to further protect Steller sea lion critical habitat such as gear restrictions, time and area closures, reapportionment of catch among gear types, and TAC adjustments to compensate for area closures. Programs would be developed to evaluate the status of other marine mammals and their interaction with groundfish fishing. For example, management measures that reduce impacts to the northern fur seal and the northern right whale would be developed.

6.3 Fishery Management Plan 4.1 Management Measures

Steller sea lion Protection Measures illustrated under FMP 4.1 would include a comprehensive ban on all trawling in all designated Steller sea lion critical habitat. It would also prohibit trawling in all fisheries that can be prosecuted with other gear types (i.e., Pacific cod). These restrictions would relocate trawling to areas outside critical habitat. TAC for Steller sea lion prey species would be calculated based on an $F_{75\%}$ strategy (refer to Appendix B).

Other FMP 4.1 components, such as TAC-setting, would also have a substantial effect on Steller sea lions. The TAC-setting policies of FMP 4.1 would have the potential to positively impact the foraging ecology of marine mammals, including the Steller sea lion, through changes in the food-web. If TAC-setting policies were proven ineffective, they would be modified with measures more likely to achieve policy objectives. Target fishing rates for most species would be set at $F_{75\%}$ and $B_{40\%}$ and would become an actual limit rather than a target. ABC for a species complex would be based on the TAC of the least abundant member of the

group. ABCs would be calculated from the lower boundary of the confidence limits for the stock assessment rather than the center of the confidence range as is presently the case. Bycatch of prohibited species would have to be reduced by 30 to 50 percent or the fishing area would be closed.

Another FMP 4.1 component affecting Steller sea lions would be the establishment of no-take marine reserves in 20 to 50 percent of the BSAI/GOA. This would provide opportunities for scientific research on the impacts of fishing on Steller sea lions. Under FMP 4.1, the Observer Program would be expanded to include 100 percent coverage on vessels > 60 ft in length and at least 30 percent coverage on vessels < 60 ft in length and 100 percent observer coverage of the hauls. This would tend to increase the quantity and quality of marine mammal-fishery interaction data. The increases in observer coverage, along with mandatory VMS for all groundfish vessels, would improve the monitoring and enforcement of fishing effort in the many restricted fishing areas.

FMP 4.1 places a high value on protecting the ability of local communities, most of which are predominately Alaska Native communities, to harvest fish and wildlife for subsistence and community development purposes. This may mean that at least some areas closed to commercial fishing may still be open to subsistence harvests. Monitoring of subsistence take, including Steller sea lions, would likely be a function of agency-community co-management organization efforts.

6.4 Fishery Management Plan 4.1 Effects

Physical Environment

The Steller sea lion Protection Measures under FMP 4.1 would be modified by eliminating all trawling in Steller sea lion critical habitat. The comprehensive ban on trawling in Steller sea lion critical habitat, when added to other FMP 4.1 components such as areas closed to trawling for other reasons and the marine no-take reserves, result in the elimination of trawling in over 50 percent of the fishable area. Effects of this large reduction in on-bottom and pelagic mobile fishing gear would be the protection of these areas from further modification of the non-living substrate and suspension of bottom sediments where trawling had occurred in the past.

Biological Environment

Threatened and Endangered Species

FMP 4.1 would restrict certain gear types, such as trawls, in Steller sea lion critical habitat and would set more conservative harvest levels for important prey species (Figure 9). This would greatly minimize the potential for localized depletion of prey species such as pollock, Pacific cod, and Atka mackerel within 20 nm of rookeries and major haulouts and substantially reduce competition with the groundfish fishery for prey. Restricting all trawling for target fish that could be caught by other gear types would significantly reduce the rate of harvest and spread out the fisheries efforts for species such as Pacific cod.

ABC calculations for the key sea lion prey species under the Alternative 1 policy Steller sea lion Protection Measures are based on a fishery mortality rate of $F_{40\%}$ and a spawning biomass of $B_{20\%}$ (refer to Appendix B). Under FMP 4.1, more conservative calculations of ABC ($F_{75\%}$ and $B_{40\%}$) would be used instead. The results of these changes would be substantial reductions in the TAC of key Steller sea lion prey species (e.g., pollock, Pacific cod and Atka mackerel).

In the near term, take of Steller sea lions in the groundfish fisheries would be substantially reduced to levels approaching zero until research determines how fishing can be conducted in a manner that assures minimal harm to the environment. Currently, incidental take of Steller sea lions in the groundfish fishery is very low and not considered to have an effect at the population level. A majority of the incidental take occurs in the Bering Sea groundfish trawl fishery, so any major reduction in this fishery as a result of the reduced TAC would lower incidental take. Additional measures and modifications of fishing methods would be developed to try and reduce this further, but this would be difficult considering the level of take in the groundfish fisheries is already very low (mean of 10 per year) (Angliss and Lodge 2002).

New ecosystem-level research would be the focus of the Alternative 4 policy, although the details of such research efforts are as yet undefined. The ecosystem-level research objectives of FMP 4.1 would necessarily require extensive coordination between NOAA Fisheries, other research agencies, and academic institutions. These efforts would also need to include cooperative research programs with Alaska Native communities for data gathering and monitoring in order to enhance the use of traditional ecological knowledge in fishery management decisions.

Effects of the FMP 4.1 Steller sea lion Protection Measures on short-tailed albatross would likely be similar to FMP 1. If more of the target fish TAC from the trawl fisheries were taken using longline gear, the possibility for incidental take of short-tailed albatross would tend to increase. However, reductions in TAC would likely offset this increase. Proposed seabird avoidance measures would also likely compensate for any potential increase in incidental take of this endangered species. Further reducing the current take to levels approaching zero would require the design and implementation of even more efficient avoidance measures in the remaining fisheries. Such measures do not presently exist.

Target, Non-Target, and Prohibited Species

Effects of the FMP 4.1 Steller sea lion Protection Measures on target fish, including the new TAC-setting methods and gear restrictions, would generally be similar to those under FMP 1 in that stocks would not be overfished. However, under FMP 4.1, stocks would be maintained well above minimum stock size threshold, therefore, stocks would be much less likely to be over harvested. The effects of reducing TAC for target species would likely result in reduced levels of bycatch of non-target species. Prohibited species catch would continue to be limited by PSC limits for specific fisheries to achieve the reduction of 20 to 50 percent in bycatch of prohibited species. Lower limits would affect the ability of the fisheries to achieve the TAC before the fishery is closed because a prohibited species limit is reached. There would be substantial reductions in prohibited species catch from trawl gear closures in Steller sea lion critical habitat as well as in other areas closed to trawling. The trawl gear restrictions in specific fisheries such as Pacific cod would also reduce catch of prohibited species. These effects are all viewed as beneficial impacts on target, non-target, and prohibited species at this FMP.

Marine Mammals

Steller sea lion Protection Measures instituted under FMP 4.1 that would affect other marine mammals, would include a reduction in TAC and a ban on trawl gear in Steller sea lion critical habitat. Trawling would also be banned for species that could be caught by other methods. These measures would benefit other marine mammal species such as the northern fur seal and harbor seal. The level of reduction in TAC would be the major factor in determining the degree of benefit for these species. Banning trawling in all Steller sea lion critical habitat would further reduce competitive overlap between groundfish fishing and harbor seals. Reduction in TAC in areas outside of Steller sea lion critical habitat would particularly benefit the northern fur seal, which were affected by the displacement of fishing effort out of Steller sea lion critical habitat.

Seabirds

The existing and additional Steller sea lion Protection Measures under FMP 4.1, especially the no-trawl areas within Steller sea lion critical habitat, would have some beneficial effects on seabirds where these areas overlap with important foraging areas and major breeding colonies (Figure 8). These areas would provide undisturbed prey fields for several species of piscivorous seabirds and, to the extent that it benefits foraging success, effects would be positive.

The ban on trawling in Steller sea lion critical habitat, as well as other areas, and lower TAC levels would have the effect of reducing the bycatch of non-target species including forage fish. However, since bycatch of forage fish is currently already very low, reduction in bycatch would likely have an insignificant effect on seabirds (NMFS 2001b). Prohibitions on trawling in Steller sea lion critical habitat would likely result in a substantial increase in the use of longline gear and, therefore, potentially increase incidental take of seabirds, such as northern fulmars, in these fisheries. However, other FMP 4.1 components, such as the lower TAC, would offset some of the potential increase. This potential increase in longline incidental take, however, would also be offset by any new seabird protection measures. Therefore, the net effect on seabirds of any increased longline effort is presumed insignificant.

Human Environment

The effect of FMP 4.1 Steller sea lion Protection Measures would have negative effects on the fishing industry as the larger closed areas could redistribute fishing effort farther from port. It should be noted that the TAC component of FMP 4.1 would lower harvest rates and this component would likely result in more significant effects on the fishing industry than the expanded closed areas under the FMP 4.1 Steller sea lion Protection Measures. Non-market effects such as eco-tourism and subsistence likely would be positive.

6.5 Fishery Management Plan 4.2 Management Measures

Under FMP 4.2, all commercial groundfish fishing would be halted while research on environmental parameters continued and fisheries could be reviewed and certified as having no significant adverse environmental effects. Such a review and certification process could take up to two years. Without fishing during this time frame, there would be no Observer Program. All research would have to be either conducted with various agency personnel and vessels or contracted out to academic institutions and private consultants until fisheries are permitted. Although this scenario would essentially eliminate incidental take

of marine mammals in the near term, it is not clear what specific effect this would have on food availability for Steller sea lions and other marine mammals. This would undoubtedly be a major focus for ecological research after the fishery closures. Whether such changes in the food web could be measured on a population level for a given species would likely depend on the intensity of population monitoring for those species both before and after fishing is closed.

6.6 Fishery Management Plan 4.2 Effects

Physical Environment

The temporary closure of all commercial groundfish fishing activity would eliminate damage or modification to the non-living substrate in the short-term within Steller sea lion critical habitat as well as throughout the region. Groundfish fisheries, once certified by NOAA Fisheries, could be permitted to operate under fishery-specific regulations that mitigate all significant environmental effects.

Biological Environment

Threatened and Endangered Species

Under the FMP 4.2, there would be no fisheries in the near term, although research would continue (Figure 10). The research and development of protection measures and fishing methods to reduce incidental take of Steller sea lions and other marine mammals would require innovative approaches. Without an active groundfish fishery, research on the interactions between Steller sea lions and fisheries would likely not occur during the short-term but it would provide an opportunity to study Steller sea lion in the absence of fisheries. In the long-term, fisheries would need to be certified as having no adverse impacts before they could occur. Therefore, effects of these new fisheries would need to be either positive or insignificant in regard to Steller sea lions, considering their endangered status. After specific groundfish fisheries are certified as having no adverse effects on the environment, it would seem prudent to conduct Section 7 consultation to determine which of the current Steller sea lion Protection Measures were needed to avoid jeopardy under the Alternative 4 policy. The 3 nm no-transit zones around rookeries and haulouts would likely remain in place to minimize disturbance to these sensitive areas by non-fishing vessels.

Target, Non-Target, and Prohibited Species

It is assumed that limited fishing would resume within 2 years as a result of agency review, but in the near term, TAC would be reduced to zero. Effects on fish populations would be expected to be positive in the short-term due to the absence of fishing mortality, but beyond 2 years, effects are more uncertain since the nature of the fisheries at that time is uncertain.

Ecological research required under FMP 4.2 would need to involve harvest of fish under controlled conditions to collect the appropriate data on target fish stocks, non-target populations, ecological relationships, and effects of fishing on the Steller sea lions, as well as other components of the environment. This fisheries research would likely need to include some harvest areas and reference areas to be able to compare and define the actual effects. It is expected that there would be some harvest of target fish within Steller sea lion critical habitat under any research program, but harvest levels would need to be below any level that could adversely affect sea lions.

Essential Fish Habitat

Considering that all trawling, hook and line, and pot fishing would be stopped throughout the BSAI and GOA in the short-term, any area closures under the Steller sea lion Protection Measures be inconsequential. However, the overall effect on EFH of the closure of the fishery would be positive. It is presumed that regulations issued for those fisheries certified as having no significant adverse effects would contain restrictions based on EFH and HAPC considerations.

Marine Mammals

With no groundfish fisheries authorized in the short-term, the Steller sea lion Protection Measures would have little, if any, direct or indirect effect on other marine mammals, nor would there be any cumulative effect. The 3 nm no-transit zones around Steller sea lion rookeries and haulouts would likely remain in effect under FMP 4.2 and, to the extent that it provides some protection to other marine mammals, would likely be beneficial. Overall, effects of the Steller sea lion Protection Measures on other marine mammals would be negligible and are overshadowed by the closure of the entire groundfish fishery.

Seabirds

The closure of groundfish fisheries in the Exclusive Economic Zone (EEZ) under FMP 4.2 would greatly overshadow any effects of the Steller sea lion Protection Measures on seabirds. The elimination of all commercial fishing would necessarily decrease the seabird incidental take to almost zero.

Ecosystem

Under FMP 4.2, effects of the Steller sea lion Protection Measures on the ecosystem would be inconsequential without an active fishery.

Human Environment

The impact of eliminating the groundfish fisheries under FMP 4.2 on the Alaska economy, and on the U.S. economy in general, would be significantly adverse. The closure of these fisheries would eclipse all economic effects of the Steller sea lion Protection Measures. The absence of fishing activity for at least 2 years and a slow initiation of fisheries that could demonstrate no adverse impact, especially to Steller sea lions, would give a fairly clear picture of the fisheries contribution to the overall decline. If the populations showed a region-wide response in counts of pups and non-pups, some strong inferences could be made. But if the population continues to stabilize at its current low level or declines, other factors would be suspect.

Small communities that rely on the catcher vessel fleet for direct and indirect income would be economically devastated by the closure of the groundfish fisheries. These impacts would prevail until each Alaska groundfish fishery was reviewed and certified to operate. Catcher vessels in the groundfish fishery would be shut down in the short-term unless they could convert to other uses or fisheries for species not regulated under the groundfish FMPs. These economic impacts would remain in place until such time that the certified fisheries could begin operating under specific regulations. The certification process and the specific regulations, including any modification of the Steller sea lion Protection Measures for these fisheries, are

unknown at this time. Steller sea lion Protection Measures would be at least as effective as the current measures.

Section 7 Data Gaps and Information Needs

7.1 Information Needed to Monitor and Quantify Effects

Recent Research

A recent paper by Ferrero and Fritz (2002) outlines historical trends and recent developments in Steller sea lion research and describes how these efforts are coordinated for resource management needs. Research budgets have grown from less than \$1 million annually prior to 1992, most of which went to basic population censusing, to over \$40 million in 2002. The vast majority of this increase in funding has been instituted by Congress since 2000 in response to litigation that briefly halted the fishery and threatened to curtail it significantly. At issue was the scientific uncertainty regarding the mechanisms and magnitude of impact that the fishery had on Steller sea lions and a general lack of information on competing hypotheses regarding their population decline. The increase in funding was clearly meant to address this scientific uncertainty and its practical application to fishery management. There are presently over 150 separate research projects being conducted on Steller sea lions by a host of federal and state agencies, academic institutions, and non-governmental research organizations. NOAA Fisheries has worked with these various groups to develop a coordinated research framework that links individual project designs to the larger goal of explaining the continuing decline of Steller sea lions in part of their range. These projects have addressed one or more of the following areas of uncertainty that were specified in congressional appropriation documents and which may contribute to population declines:

- The availability of prey species.
- Predator-prey relationships.
- Predation by killer whales and sharks.
- Interactions between fisheries and Steller sea lions, including the localized depletion hypothesis.
- Regime shift, climate change, and other impacts associated with changing environmental conditions in the North Pacific and Bering Sea.
- Disease.
- Juvenile and pup survival rates.
- Population counts.
- Nutritional stress.
- Foreign commercial harvest of sea lions outside the Exclusive Economic Zone.
- Residual impacts of former government-authorized Steller sea lion eradication bounty programs.

- Residual impacts of intentional lethal takes of Steller sea lions.

In addition to these topics, NOAA Fisheries has initiated research on other crucial issues:

- The efficacy of management measures (e.g. no-trawl zones) designed to mitigate fisheries impacts.
- Expanded sea lion branding and tagging studies to investigate basic population demography.
- Expanded scat collection and telemetry studies to investigate diets and foraging behavior.
- Forage fish abundance and distribution surveys in sea lion habitats.
- Investigate effects of oil and other toxic contaminants on sea lions.

The research framework organizes the various projects in two different ways: according to the questions they are seeking to answer and according to the methodology and scientific discipline being used in the research. This system helps NOAA Fisheries monitor whether there are gaps or redundancies in coverage of the various topics and also helps communication and coordination among researchers. The sharing of information and collaboration among different scientific disciplines is very important to the research policy because the “answer” to the decline may be a combination of factors rather than any one cause. Perhaps the most succinct way to summarize these various research projects is to list the major questions they are asking, all of which could be considered separate hypotheses for the sea lion’s decline and lack of recovery (Ferrero and Fritz 2002).

It is important to note that much of the research now underway may not yield meaningful results for 5 to 10 years. The study of ecosystem interactions is not suited to quick and definitive experimental investigation. It is believed, however, that major data gaps are now being addressed in some fashion and that as information becomes available, the questions will be refined and the research will become more focused on those issues, which appear to be the most pertinent to the decline of Steller sea lions. In the meantime, the population trends of sea lions and direct fishery interactions will be monitored closely.

National Research Council Review

In 2000, the NRC was contracted to conduct a review of available information regarding the interactions between the groundfish fisheries and Steller sea lions and the role of the fisheries in trends of the Steller sea lion populations. Their review and analysis came up with a series of five general management options to address impacts of fisheries on the sea lions and ways to monitor their effectiveness. Most suggested management options are addressed to some extent in the Alternative Policies analyzed in this document.

1. Wait and see - give the Steller sea lion Protection Measures time to work.
 - monitor using annual surveys of trend sites and information from pup branding
2. Eliminate direct fisheries’ impacts with expanded closures.
 - monitor fish population dynamics, both locally and at the stock level, to determine effects of fisheries on distribution and community composition

3. Establish experimental spatial management units consisting of two sets of closed and open areas for fishing per region, where each treatment is centered on a rookery.
 - monitoring with detailed local Steller sea lion censuses and spatial analyses of fish population changes for each experimental unit
4. Implement a “titration” experiment - restrictions on fisheries are increased progressively over time until a positive response is achieved.
 - monitoring of sea lion population trends
5. Micro-monitor and manage localized interactions between sea lions and fisheries to reduce mortality where and when it occurs in the future.
 - expansion of all monitoring activities around all rookeries to pinpoint times and places of increased mortality so action can be taken

Of these five options, only Option 3 would directly test the role of groundfish fishing in the decline of the Steller sea lion and was recommended as the preferred option (NRC 2002).

Modeling

As the previous discussion indicates, a multitude of physical and biological interactions are presently under investigation. Fitting all these pieces together to see the “big picture” will require the development of new mathematical models that describe the bioenergetics not only of Steller sea lions, but also of their major prey species and the impacts of fishing and ocean changes. This effort is presently underway and is the first attempt toward a larger ecosystem model that is called for in some of the Alternatives policies. This ecosystem model would include non-target fish and seabirds and many other elements in the BSAI/GOA ecosystems. However, there are many smaller pieces of the puzzle that need to be worked out in modeling before these grand, unifying models are even feasible. These run the gamut from the impacts of climate change on ocean currents to the relative importance of killer whale predation at different sea lion population levels.

Section 8 Comparative Analysis of the Alternatives

The four policy Alternatives considered in this analysis cover the mandatory requirements of the 2001 BiOp and the subsequent Steller sea lion Protection Measures which keep the groundfish fisheries in compliance with the ESA. The Steller sea lion Protection Measures described in the Alternative 1 policy are also common to the Alternative 2 and Alternative 3 policies. Alternative 4 is different from the others in that the burden of proof is shifted to the user of the resource. The first three alternatives are similar in their application of the same risk-averse conservation and adaptive management approach used for the last 20 years by NOAA Fisheries and the NPFMC. In regards to Steller sea lion Protection Measures, the alternative policies differ in the degree of caution used in modifying these measures as scientific evidence becomes available and in how they deal with uncertainty in management decisions. A summary of major findings by alternative and resource category is presented in Table 3.

While certain biological and physical parameters can be sampled and estimated quantitatively, the impact of specific changes in fishing activities on particular species or ecosystem processes will always be subject to a substantial amount of uncertainty. The imprecise nature of fish and wildlife population estimates, plus natural fluctuations in population levels, makes it very difficult to say with certainty whether a given level of anthropogenic disruption is causing the population of a particular species to decline.

At one end of the policy spectrum is Alternative 2, a more aggressive harvest strategy, which has an underlying policy stating that impacts of the fisheries on Steller sea lions under the Steller sea lion Protection Measures are negligible and any additional regulations or restrictions on the fishing fleet are unwarranted unless new scientific research provides unequivocal evidence of adverse population-level impacts. Any change to the Steller sea lion Protection Measures would require the NOAA Fisheries, Office of Sustainable Fisheries to show through Section 7 consultations with NOAA Fisheries OPR, that the new set of measures still avoids jeopardy. The use of the Observer Program and VMS to monitor fishing effort in critical habitats is also integral to this issue.

Table 3. Summary of potential effects of the policy alternatives and Fishery Management Plans.

Effect indicator	Alternative 1.0	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1.0	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Physical environment							
Effect on non-living substrate	Potentially beneficial effect Steller sea lion Protection Measures prevent additional alteration of the physical structure of the non-living substrate and the suspension of sediments in the 3 nautical mile (nm) buffer zones around rookeries, haulouts, and areas within critical habitat closed to non-pelagic trawling.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Beneficial effect This FMP closes areas 15 nm from shore except where there are marine protected areas (MPAs) or no-take reserves. Additional area closed to trawling for Steller sea lion prey species.	Beneficial effect All Steller sea lion critical habitat closed to trawling and closure of all trawling for species that can be taken by other gear would prevent additional damage to non-living substrate.	Beneficial effect This FMP closes all fisheries until they are certified as having no adverse effects. New fisheries would likely not adversely affect the physical environment.
Biological environment							
Effects on threatened and endangered species	Potentially beneficial effect Steller sea lion measures result in a reduction in overlap of fisheries and Steller sea lion.	Potentially adverse effect Steller sea lion measures are the same as FMP 1 but other components such as increased total allowable catch (TAC), removal of protected area, and increased disturbance would have adverse effects.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Beneficial effect Near term closure of fisheries results in more Steller sea lion prey.

Table 3 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plans.

Effect indicator	Alternative 1.0	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1.0	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Biological environment (cont.)							
Effects on target fish	Potentially beneficial effect Steller sea lion measure help ensure stocks are harvested at a rate above minimum stock size threshold (MSST).	Potentially adverse effect Steller sea lion Protection Measures the same as FMP 1; However, harvest of target species substantially increased.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Beneficial effect Closure of the fishery in the short- term is beneficial and new certified fisheries would ensure stocks are maintained well above MSST.
Effects on non-target fish	Minimal effect Steller sea lion Protection Measures would have little effect on non-target species.	Potentially adverse effect Steller sea lion Protection Measures same as FMP 1. However, removal of bycatch limits could have adverse effects.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect New Steller sea lion measure would have some benefit to non-target species.	Potentially beneficial effect Increased Steller sea lion buffers and MPAs could provide some benefit. Bycatch is reduced as overall harvest is lower.	Beneficial effect Closure of fisheries would reduce bycatch of benefit non-target species.
Effects on prohibited species	Minimal effect Steller sea lion Protection Measures would not likely change the prohibited species bycatch limits.	Potentially adverse effect Steller sea lion Protection Measures same as FMP 1. However, other FMP components such as removal of prohibited species catch (PSC) limits could have adverse effects.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect New Steller sea lion measure would have some benefit to prohibited species by reducing harvest.	Beneficial effect Increased Steller sea lion Protection Measures and reduced TAC would reduce harvest of prohibited species.	Beneficial effect During the period of no fishing, until such time that certain fisheries are certified, there would be no bycatch of prohibited species. It is unlikely that fisheries having high bycatch or creating other impacts on prohibited species would be certified.

Table 3 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plans.

Effect indicator	Alternative 1.0	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1.0	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Biological environment (cont.)							
Effects on essential fish habitat	Potentially beneficial effect Steller sea lion Protection Measures closure of 3-nm around rookeries and haulouts provides protection to benthic habitat. Areas closed to trawling for the three main target species, all important prey for Steller sea lions, amount to approximately 50% of all Steller sea lion critical habitat.	Potentially beneficial effect Steller sea lion measures same as FMP 1.	Potentially beneficial effect Steller sea lion measures same as FMP 1.	Potentially beneficial effect Steller sea lion measures same as FMP 1.	Beneficial effect New Steller sea lion shoreline buffers and MPAs would increase protection for EFH.	Beneficial effect Expanded Steller sea lion buffers and MPAs would increase protection for EFH.	Beneficial effect During the period of no fishing, until such time that certain fisheries are certified, there would be no adverse impacts on essential fish habitat (EFH). Fisheries that adversely impact EFH or Steller sea lion would not be certified.
Effects on marine mammals	Potentially beneficial effect Steller sea lion closure could benefit other marine mammals where important habitats overlap with closed areas.	Potentially adverse effect Same as FMP 1; however, increased TAC of marine mammal prey could have negative effects.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect Same as FMP 1.	Potentially beneficial effect New Steller sea lion shoreline buffers and MPAs increase protection to some marine mammals.	Beneficial effect No trawling in Steller sea lion critical habitat around rookeries and haulouts, and reduced trawling outside critical habitat, and reduction in TAC increases protection for other marine mammal species.	Beneficial effect During the period of no fishing until such time that certain fisheries are certified, there would be no adverse impacts on marine mammals. Also, it is not likely that fisheries creating other impacts on marine mammals would be certified.

Table 3 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plans.

Effect indicator	Alternative 1.0	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1.0	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Biological environment (cont.)							
Effects on seabirds	Minimal effect Steller sea lion Protection Measures have little if any effect on seabirds.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Minimal effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1 with added shoreline buffer zones and MPAs.	Potentially beneficial effect No trawling in Steller sea lion critical habitat around rookeries and haulouts, reduced trawling outside critical habitat, and reduction in TAC increases protection for some seabird colonies and foraging areas.	Beneficial effect During the period of no fishing until such time that certain fisheries are certified, there would be no direct adverse impacts on seabirds. Also, it is not likely that fisheries creating other impacts on seabirds would be certified.
Ecosystem effects	Potentially beneficial effect Potential increase in prey species such as pollock, Pacific cod, and Atka mackerel. Potential increase in species diversity.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Creation of Steller sea lion shoreline buffer zones and MPAs potentially benefits several species.	Beneficial effect Steller sea lion Protection Measure to close all trawling in Steller sea lion critical habitat and in fisheries that can use other gear. Increase in forage availability for predators and potential increase in species diversity. Effect on top predator would be beneficial.	Beneficial effect During the period of no fishing until such time that certain fisheries are certified, there would be no adverse effects from the groundfish fishery on the ecosystem. Forage availability, effects on species diversity, and top predators would be beneficial.

Table 3 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plans.

Effect indicator	Alternative 1.0	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1.0	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Social and Economic Environment							
Non-market impacts	Potentially beneficial effect If Steller sea lion measures aid recovery of the species, impacts are beneficial to eco-tourism and subsistence.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Steller sea lion Protection Measures same as FMP 1.	Potentially beneficial effect Increased Steller sea lion measure could benefit eco-tourism and subsistence.	Potentially beneficial effect Increased Steller sea lion measure could benefit eco-tourism and subsistence.	Potentially beneficial effect Eco-tourism and subsistence would benefit from increased Steller sea lion numbers and very limited fishing.
Industry costs and market impacts	Potentially adverse effect Increased operation costs in some fisheries. Industry cost and market impacts would be negatively affected by Steller sea lion measures.	Potentially adverse effect Steller sea lion Protection Measure are the same as FMP 1; therefore, industry cost and market impacts are the same.	Potentially adverse effect Steller sea lion Protection Measure are the same as FMP 1; therefore, industry cost and market impacts are the same.	Potentially adverse effect Steller sea lion Protection Measure are the same as FMP 1; therefore, industry cost and market impacts are the same.	Adverse effect Creation of Steller sea lion shoreline buffers would negatively impact the fishing industry by increasing operating costs.	Adverse effect Closure of trawling within 15 nm of rookeries and haulouts and reduction in TAC would negatively impact the industry.	Adverse effect Closing fisheries would have adverse effects on rural communities and the catcher vessel fleet.

Under either the Alternative 1(a) or 1(b) policy statement, NOAA Fisheries and the NPFMC would continue to minimize and adjust fishery restrictions in order to avoid a jeopardy finding through conservative cautionary management and ongoing Section 7 consultations. Alternative 1(b) acknowledges that the groundfish fishery has an impact on various parts of the environment but prioritizes management actions based on the scientific evidence of significant impact. Steller sea lion Protection Measures may be expanded beyond what is absolutely necessary in order to account for some uncertainty in understanding the interactions between the Steller sea lions and the fisheries. Research is directed toward understanding how various fisheries could contribute to the Steller sea lion decline so that the role of fisheries is properly cast.

Under the Alternative 2 policy, the Observer Program and VMS requirements could range from being repealed (FMP 2.1) to having the same coverage and function as at present (FMP 2.2). It seems highly unlikely that, given the continuing decline of the western stock of Steller sea lions and the existing Steller sea lion Protection Measures, NOAA Fisheries OPR would concur with eliminating both of these programs to monitor the groundfish fleet. NOAA Fisheries would need to find a compromise within the range of the Alternative 2 policy that does not result in a jeopardy finding.

The Alternative 3 policy assumes that the groundfish fishery has a greater impact on a number of environmental factors than presently realized, but that not all of it is negative. Mitigation efforts would still be prioritized by scientific evidence of adverse impact. For Steller sea lion Protection Measures, increased restrictions on the fishing fleet would occur based on scientific research but would not require that the research be definitive before taking action. Alternative 3 would thus be more “precautionary” in dealing with uncertainty and more emphasis would be placed on researching indirect fishery interactions with the ocean ecosystem, and similar to Alternative 1, understanding how fisheries could contribute to the Steller sea lion decline to properly cast the role of fisheries. It would also expand the Observer Program and VMS requirements to improve monitoring and enforcement of fishing restrictions in Steller sea lion critical habitats.

The Alternative 4 policy would assume that the fisheries are having many adverse impacts on the marine environment, similar to Alternative 1 and 3, including detrimental impacts on the food web of marine mammals, but currently enough is not known about fishery interactions to know what they are. Existing Steller sea lion Protection Measures would be expanded to attempt to eliminate all adverse impacts of the fisheries on Steller sea lions. The fishery would be greatly restricted relative to Alternative 1 until scientific evidence could make certain that there were no direct or indirect adverse impacts on protected resources. Environmental research would receive a much higher priority than in any other scenario. In the first three Alternative policies, various degrees of uncertainty about an impact would be used to limit restrictions on the industry. Under the Alternative 4 policy, the burden of proof is reversed and uncertainty about an impact would be used to stop fishing until each fishery could be reviewed and certified as resulting in no significant environmental impacts. Those fisheries that are certified as acceptable” would be heavily monitored with observers and electronic gear to ensure compliance with any restrictions.

The fact is, no matter how much effort is applied to studying this dynamic marine environment, there will always be unanswered questions about the impacts of specific fisheries or mitigation efforts. This is not to say that the situation is hopelessly complicated and anything useful cannot be learned from ecological research. The policy alternatives vary in how much emphasis they place on understanding how the various system components, including marine mammals, respond to fishing, and how each alternative policy would try to incorporate this information into management decisions. From the least emphasis on ecosystem

function to the most, the policies would range in order from Alternative 2, Alternative 1, Alternative 3, to Alternative 4.

Section 9 Conclusion

Since the Steller sea lion Protection Measures under the Alternative 1(a) or 1(b) policy represent the level of protection necessary to avoid a jeopardy finding, the primary issue is how adaptable the alternative policies are to additional measures, such as expanded or fewer restrictions on fisheries as new information becomes available through scientific research. Anticipated modifications to the Steller sea lion Protection Measures under these alternative policies are difficult to predict since they rely on information not yet known.

Steller sea lion Protection Measures keep the groundfish fisheries in the BSAI and GOA in conformity with the ESA, and allow the fisheries to continue at a tremendous benefit to the economy. These measures are based on the principle that there are some adverse effects of the groundfish fisheries on Steller sea lions and these adverse effects include nutritional stress due to the indirect effects of localized depletion of prey species by the groundfish fisheries. The efficacy of these mitigation measures hinges on the validity of this theory. This theory is the underlying basis for Alternative 4.

The Alternatives examined in this paper represent a range of policy options but a key component of each alternative is the requirement to be in compliance with the ESA. The current Steller sea lion Protection Measures have been found to meet these requirements (NMFS 2001a). Changes to the management of the fisheries that substantially alter the underlying requirements would require further Section 7 consultations. Because the Steller sea lion Protection Measures range from Alternative 1 through 3, their effects on Steller sea lions, their critical habitat, and on other environmental resources are generally similar. The conservative management and Steller sea lion Protection Measures under Alternative 4 are substantially increased. The primary effect of the Steller sea lion Protection Measures is the separation of fishing effort in time and space to the extent that the competitive overlap between the groundfish fisheries and prey for the Steller sea lion has a minimal effect on their continued existence and chance for recovery.

Currently, a tremendous amount of monitoring and research is focused on a very wide range of issues concerning the decline of the Steller sea lion. The results of this research will likely be used to reevaluate all aspects of the current Steller sea lion Protection Measures and it is anticipated that additional Section 7 consultations will be required in coming years to bring the Steller sea lion Protection Measures in line with current scientific research.

Section 10 References

- Alaska Department of Fish and Game (ADF&G) and National Marine Fisheries Service (NMFS). 2002. Satellite telemetry and the Steller sea lion research. Overview of the use of satellite telemetry in Steller sea lion research.
<http://www.fakr.noaa.gov/protectedresources/stellers/biop2002/support/ADFGandNMFS2001.pdf>
- Angliss, R.P., and Lodge, K.L. (2002). "Alaska Marine Mammal Stock Assessments, 2002." National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115. pp.203.
- Beecham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). *Journal of Mammalogy* 77(1):95-108.
- Burns *et al.*, unpublished [F-4-10]
- Calkins, D.G, D.C McAllister, G.W. Pendalton, and K.W. Pitcher. 1999. Steller sea lion status and trend in Southeast Alaska, 1979-1997. *Marine Mammal Science* 15:462-467.
- Ferrero, R.C., and L.W. Fritz. 2002. Steller sea lion research and coordination: A brief history and summary of recent progress. NOAA Technical Memorandum NMFS-AFSC-129.
- Hartley, M. Northern Economics, personal communication. 2002 [F-4-18 and F-4-30]
- Kruse, G.H., M. Crow, E.E. Krygier, D.S. Lloyd, K. W. Pitcher, L.D. Rae, M. Ridgeway, R.J. Small, J. Stinson, and K.W. Wynne. 2001. A review of proposed fishery management actions and the decline of Steller Sea lions (*Eumetopias jubatus*) in Alaska: A report by the Alaska Steller sea lion restoration team.
- Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1990. Survey of northern sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands during June 1989. U. S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-176, 26 pp.
- Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. *Marine Mammal Science* 83(3):220-239.
- National Marine Fisheries Service. 1992. Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). Prepared by the Steller sea lion recovery team for the National Marine Fisheries Service, Office of Protected Resources, Silver Springs, Maryland. 92 pp.
- National Marine Fisheries Service. 1998a. Biological Opinion Section 7 Consultation on the BSAI and GOA groundfish management plans, 1999 and 2002. Alaska Regional Office and Alaska Fisheries Science Center, Juneau, Alaska.

- National Marine Fisheries Service. 2000. Biological Opinion Section 7 Consultation on the groundfish management plans, 1999 and 2002. NMFS, Office of Protected Resources, NMFS, Silver Spring, Maryland.
- National Marine Fisheries Service. 2001a. Endangered Species Act - Section 7 Consultation Biological Opinion and Incidental Take Statement. NMFS, Alaska Region Office of Protected Resources, Juneau, Alaska.
- National Marine Fisheries Service. 2001b. Steller sea lion Protection measures - Final Environmental Impact Statement. NOAA - National Marine Fisheries Service, Alaska Region, Juneau, Alaska.
- National Research Council, 2002. The decline of the Steller sea lion in Alaskan waters: Untangling food webs and fishing nets - Executive Summary. Committee on the Alaska groundfish Fishery and the Steller Sea Lion. The National Academies Press, Washington, D.C.
- Petersen, M. R., W. W. Larned and D. C. Douglas. 1999. At-sea distribution of spectacled eiders (*Somateria fischeri*): 120 year-old mystery resolved. Auk 116:1009-1020.
- SAFE. (2002). Stock Assessment and Fishery Evaluation (SAFE) Report. Ecosystem Considerations for 2003, 213 pp. NPFMC, 605 West 4th Avenue., Suite 306, Anchorage, AK 99501. November 2002.
- Sease, J.L., W.P Taylor, T.R. Loughlin, and K.W. Pitcher. 2001 Aerial and Land-based surveys of Steller Sea lions (*Eumetopias jubatus*) in Alaska, June and July 1999 and 2000. NOAA Technical Memorandum NMFS-AFSC-122.
- Sease, J.L. 2002. Steller Sea lions survey results, June and July, 2002. Memorandum for the record. National Marine Mammal Lab - Alaska Fisheries Science Center and the Southwest Fisheries Science Center. 7 pp.
- U.S. Fish and Wildlife Service. 2002. Steller's Eider Recovery Plan. Public Review Draft.
- Wolfe, R.J, and Mishler. 1993. The Subsistence harvest of harbor sea and sea lions by Alaska natives in 1992. Technical Paper No. 229, Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska. 443pp.
- York, A.E., R.L Merrick, and T.R. 1996. An analysis of the Steller sea lion metapopulations in Alaska. Pages 259-292 in D.R. McCullough, Editor. Metapopulations and Wildlife Conservation. Island Press, Covelo, CA.

This page intentionally left blank

APPENDIX F

Bycatch

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Bycatch	F-5-1
Section 2	Historical Perspective on Bycatch	F-5-4
Section 3	Species Categories Management Tools	F-5-8
3.1	Species Categories	F-5-8
3.1.1	Target Species	F-5-8
3.1.2	Prohibited Species	F-5-8
3.1.3	Forage Species	F-5-8
3.1.4	Other Species	F-5-8
3.1.5	Nonspecified Species	F-5-10
3.2	Management Tools	F-5-10
3.2.1	Total Allowable Catch	F-5-10
Section 4	Policy Alternatives and Rationale	F-5-13
Section 5	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-5-17
5.1	Target Species	F-5-17
5.2	Prohibited Species	F-5-17
5.3	Forage Species	F-5-28
5.4	Other Species	F-5-28
5.5	Nonspecified Species	F-5-29
5.6	Indirect Effects	F-5-29
5.6.1	Spatial and Temporal Concentrations in Bycatch	F-5-29
5.6.2	Socioeconomic	F-5-29
5.7	Cumulative Effects	F-5-29
5.7.1	Biodiversity	F-5-30
5.7.2	Predator-Prey Relationships	F-5-30
5.7.3	Ecosystem Energy Balance	F-5-30
Section 6	Alternative 2: Adopt a More Aggressive Management Policy	F-5-32
6.1	Policy Goals and Objectives	F-5-32
6.2	Direct Effects	F-5-32
6.2.1	Target Species	F-5-32
6.2.2	Prohibited Species	F-5-32
6.2.3	Forage Species	F-5-34
6.2.4	Other Species	F-5-34
6.2.5	Nonspecified Species	F-5-34
6.2.6	Observer Program	F-5-34
6.2.7	Improved Retention/Improved Utilization	F-5-35
6.2.8	Vessel Incentive Program	F-5-35
6.3	Indirect Effects	F-5-35
6.3.1	Spatial and Temporal Concentrations in Bycatch	F-5-35
6.3.2	Socioeconomic	F-5-35
6.4	Cumulative Effects	F-5-36
6.4.1	Biodiversity	F-5-36
6.4.2	Predator-Prey Relationships	F-5-36
6.4.3	Ecosystem Energy Balance	F-5-36

TABLE OF CONTENTS (continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 7	Alternative 3: Adopt a More Precautionary Management Policy	F-5-37
7.1	Policy Goals and Objectives	F-5-37
7.2	Direct Effects	F-5-37
7.2.1	Target Species	F-5-37
7.2.2	Prohibited Species	F-5-37
7.2.3	Forage Fish	F-5-38
7.2.4	Other Species	F-5-38
7.2.5	Nonspecified Species	F-5-39
7.2.6	Observer Program	F-5-39
7.2.7	Improved Retention/Improved Utilization	F-5-39
7.2.8	Vessel Incentive Program	F-5-39
7.3	Indirect Effects	F-5-39
7.3.1	Spatial and Temporal Concentrations in Bycatch	F-5-39
7.3.2	Socioeconomic	F-5-39
7.4	Cumulative Effects	F-5-40
7.4.1	Biodiversity	F-5-40
7.4.2	Predator-Prey Relationships	F-5-40
7.4.3	Ecosystem Energy Balance	F-5-40
Section 8	Alternative 4: Adopt a Highly Precautionary Management Policy	F-5-41
8.1	Policy Goals and Objectives	F-5-41
8.2	Direct Effects	F-5-41
8.2.1	Target Species	F-5-41
8.2.2	Prohibited Species	F-5-41
8.2.3	Forage Fish	F-5-42
8.2.4	Other Species	F-5-42
8.2.5	Unspecified Species	F-5-43
8.2.6	Observer Program	F-5-43
8.2.7	Improved Retention/Improved Utilization	F-5-43
8.2.8	Vessel Incentive Program	F-5-43
8.3	Indirect Effects	F-5-43
8.3.1	Spatial and Temporal Concentrations in Bycatch	F-5-43
8.3.2	Socioeconomic	F-5-43
8.4	Cumulative Effects	F-5-44
8.4.1	Biodiversity	F-5-44
8.4.2	Predator-Prey Relationships	F-5-44
8.4.3	Ecosystem Energy Balance	F-5-44
Section 9	Opportunities for Quantification	F-5-45
Section 10	Data Gaps and Information Needs	F-5-46
Section 11	Comparative Analysis of Alternatives	F-5-47
Section 12	Literature Cited	F-5-52

TABLES

Table 1.	Chronology of management measures to control bycatch of prohibited species in the groundfish fisheries of the Bering Sea and Aleutian Islands and Gulf of Alaska, 1935-2000.	F-5-5
Table 2.	Taxa listing for the five Fishery Management Plan management categories.	F-5-9
Table 3.	Comparative Fishery Management Plan frameworks of the four alternatives dealing with bycatch.	F-5-15
Table 4.	Total allowable catch allocations and groundfish harvests (metric tons) by target species for the 2002 fishing season.	F-5-18
Table 5.	Prohibited species catch allocations for the Bering Sea and Aleutian Islands Fishery Management Unit, 2003. Projected crab populations are denoted parenthetically.	F-5-19
Table 6.	Prohibited species bycatch limits for crabs in the Bering Sea and Aleutian Islands.	F-5-25
Table 7.	Summary of the effects of the alternatives on bycatch.	F-5-49

FIGURES

Figure 1.	Herring Savings Areas 1, 2, and 3, located in the Bering Sea	F-5-22
Figure 2.	Management areas involving prohibited species in the Bering Sea and Gulf of Alaska	F-5-23
Figure 3.	Management areas involving prohibited species and walrus in the Bering Sea. ...	F-5-24

ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
AFA	American Fisheries Act
BSAI	Bering Sea and Aleuttian Islands
CDQ	Community Development Quota
ESA	Endangered Species Act
EFH	essential fish habitat
EEZ	Exclusive Economic Zone
EFP	experimental fishing permit
FCZ	Fishery Conservation Zone
FMP	Fishery Management Plan
ft	feet/foot
GOA	Gulf of Alaska
IR/IU	Improved Retention/Improved Utilization
IFQ	individual fishing quota
IPHC	International Pacific Halibut Commission
JV	joint venture
MMPA	Marine Mammals Protection Act
MRA	maximum retainable amount
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	metric tons
NEPA	National Environmental Policy Act
nm ²	square nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fisheries Management Council
NPO	North Pacific Ocean
PSC	prohibited species catch
SCA	Steller Sea Lion Conservation Area
TAC	total allowable catch
U.S.	United States
VIP	Vessel Incentive Program

Section 1 Bycatch

The principal goal of the North Pacific Fisheries Management Council (NPFMC) and National Marine Fishery Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) is to maximize the benefits of North Pacific groundfish resources for the overall good of the people and the environment. NPFMC¹ decisions are based upon a number of biological and socioeconomic considerations all of which must be weighed when determining management and conservation strategies. A core objective of the NPFMC is to maximize the sustainable yield of the groundfish fishery at minimal cost, while at the same time ensuring the sustainability of targeted stocks. Management policies must also act in conjunction with other conservation goals such as the protection of non-target fish species, marine mammals, seabirds, and Essential Fish Habitat (EFH). Socioeconomic considerations include the effects that groundfish management policies might have on other commercial, recreational, and subsistence fisheries of the Pacific Northwest. Amid all of these concerns, the NPFMC must also comply with specific bycatch mandates in the Magnuson-Stevens Fishery Conservation and Management Act (MSA). These include: 1) National Standard 9 which states that “Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.” and 2) Section 303 which states that Fishery Management Plans (FMPs) are required to “establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided.”

Bycatch is defined in the MSA as fish that are harvested in a fishery but which are not sold or kept for personal use. This includes the portion of the catch that is discarded back into the sea and unobserved mortality due to a direct encounter with fishing gear that does not result in the capture of that species by a fisherman. The latter also includes dropoff and escapement mortality. Discards include species that must be returned to the sea by law (regulatory discards), and fish that are discarded at the discretion of the fisherman because they are not economically worthwhile to keep (economic discards). Fish taken as bycatch often suffer high mortality. Bycatch mortality can decrease the sustainability of a fishery and the net benefits provided by that fishery, in four ways. First, if bycatch mortality is not monitored adequately, it increases the uncertainty concerning total fishing-related mortality, which in turn makes it more difficult to assess the status of stocks of fish and other bycatch species, to set the appropriate optimum yield and overfishing levels for fish stock, and determine acceptable levels of bycatch for other bycatch species. Inadequately monitored bycatch mortality also makes it difficult to ensure that the optimum yields are attained, that overfishing does not occur and that the acceptable levels of bycatch for other species are not exceeded. Second, if discards are sufficiently concentrated in time and space, they will result in localized environmental degradation. Third, bycatch mortality precludes some other uses of living marine resources. For example, juvenile fish that are subject to bycatch mortality cannot contribute directly to the growth of that stock and to future catch. Nor can they be available as prey for other species. Bycatch is a wasteful use of living marine resources if it precludes a higher valued use of those resources. Fourth, in the absence of management measures designed to reduce bycatch, there will typically be too much bycatch; however, without adequate information concerning the biological, ecological, social, and economic effects of a set of bycatch management measures, it is difficult to ensure that those measures will not decrease the overall benefits to the Nation.

If the problem is due principally to uncertainty concerning fishing related mortality, improved bycatch monitoring systems should be considered and may be sufficient to solve the bycatch problem. If the problem is principally localized environmental degradation, it may be possible to solve the problem effectively and efficiently by controlling the temporal and spacial distribution of discards. If the problem is excessive human induced mortality for a particular stock and there are several sources of that mortality, the merits of reducing the alternative sources of mortality should be considered. For example, in the case of overfishing, the solution

¹ NPFMC decisions are subject to approval by NOAA Fisheries. For further detail on the relationship between the NPFMC and NOAA Fisheries, please refer to Section 2.4 of the Programmatic SEIS.

could be to decrease the catch or bycatch of that stock or both. The appropriate choice will depend on the marginal net benefit of each of these two uses of the stock that is being overfished.

If it is determined that the bycatch rate of a fishery is too high, there are two general types of solutions, both dealing with regulations. First, regulations can be developed and implemented that prohibit fishermen from fishing in ways that result in high levels of bycatch. For example, regulations can prohibit fishing in specific times or areas, can require the use of specific gear or gear modifications, and can restrict the use of catch or the level of bycatch. These are command and control solutions. Second, regulations can be developed and implemented to eliminate or decrease incentives (i.e., externalities) that result in fishermen taking high levels bycatch. Typically, much of the benefit of reducing bycatch accrues to others, not to the fisherman who modifies his fishing practices to decrease bycatch. The benefits others receive are external to the fisherman's decision-making process; therefore, from society's perspective, the fisherman does not do enough to reduce bycatch. The externalities are the source of the excess bycatch problem, and in some cases decreasing the externalities will be the appropriate solution. But that will require holding individual fishermen accountable for their bycatch, and the monitoring required to do that may not be feasible. The regulations that decrease incentives can be referred to as market oriented solutions.

With sufficient information, fishery managers could identify the best way for each fisherman to decrease its bycatch. The difficulty is that fishery managers have relatively limited and usually static information. Individual fishermen usually have more complete and more timely information concerning methods for decreasing bycatch, but as noted above, they may lack the appropriate incentives. In selecting the management approach that will be used to decrease bycatch, it is important to be realistic about information deficiencies and the difficulty of providing the correct incentives to fishermen. Research concerning the response of fish and other bycatch species to fishing gear and fishing operations can assist in developing effective and efficient methods for reducing bycatch and bycatch mortality. Such research is also necessary to determine the extent to which a change in gear or fishing practices decreases bycatch as opposed to, for example, just replacing discard mortality with unobserved fishing mortality.

Although the information required to precisely estimate the net benefits of bycatch reduction solutions will seldom be available, an effort should be made to consider both the benefits and costs of the alternative strategies, where the benefits and costs are broadly defined to address the biological, ecological, social, and economic effects of bycatch and bycatch management. Such an approach is required for obtaining good stewardship and to meet federal regulatory mandates, including those in the MSA, the Marine Mammals Protection Act (MMPA), the Endangered Species Act (ESA), the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act, and Executive Order 12866. Outreach and public debate to obtain information concerning the benefits and costs of the alternatives can be done through the NPFMC and NOAA Fisheries processes which may be used to develop and evaluate alternatives. In general, more complete information concerning the biological, ecological, social, and economic effects of bycatch and methods for reducing bycatch are required to develop more effective and efficient methods for managing bycatch. As more efficient methods for reducing bycatch are developed, further reductions in bycatch will become practicable.

Many of the species that are protected under FMP amendments that limit bycatch are the targets of other commercial, recreational, and subsistence fisheries in Alaska. Excessive bycatch mortality in the groundfish fishery could affect the viability of these other domestic fisheries and the people and economies that depend on them. However, bycatch restrictions place greater economic burdens on the groundfish industry either by limiting fishing or reducing fishing efficiency. Compliance with time/area closures and bycatch release standards can require considerable expenditures of time and effort by the fishermen.

Mortality is a key consideration when assessing measures that might decrease bycatch. If all discards could safely be returned to the sea unharmed, bycatch would be less of a conservation issue and higher levels of bycatch would be acceptable. However, because discard mortality rates for many species approach or equal 100 percent, efforts to reduce bycatch mortality typically focus on decreasing bycatch. But for some species, such as Pacific halibut, there have been substantial efforts to decrease discard mortality rates. In some instances, the adverse effects of bycatch were sufficiently high and the expectations for decreasing bycatch

were sufficiently low that specific fisheries have been prohibited; e.g., there is a total ban on the use of seines and gillnets in the groundfish fishery and bottom trawl gear is prohibited in the BSAI pollock fishery. In general, FMP policy attempts to minimize bycatch and bycatch mortality to the extent practicable, where practicality is determined by the broadly defined benefits and costs of decreasing bycatch and bycatch mortality.

This paper provides a broad qualitative overview of the four proposed management policies as they pertain to the regulation of bycatch in the North Pacific groundfish fishery of the Bering Straits/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) regions. Its goal is to provide the reader with a basic understanding of each potential policy and the biological, physical, and socioeconomic consequences of each alternative. It also identifies information gaps or other shortcomings that may impede specific components within any of the proposed alternatives.

Section 2 Historical Perspective on Bycatch

Management of bycatch in the North Pacific groundfish fishery has historically focused on Pacific halibut, Pacific herring, salmon, and crabs (Table 1). Prior to 1976, the groundfish fishery in the BSAI and GOA management regions was conducted almost exclusively by foreign fleets and management regulations were implemented through bilateral or multilateral agreements. The Fishery Conservation and Management Act of 1976, which later became the MSA, established a Fishery Conservation Zone (FCZ) which became the Exclusive Economic Zone (EEZ) extending some 200 miles off United States (U.S.) shores and fishing within this area fell under U.S. jurisdiction. Following passage of the MSA, preliminary FMPs established management measures to reduce bycatch by these foreign fleets. Measures included time and area closures; prohibitions on the retention of halibut, crabs, salmon, herring, and shrimp (prohibited species catch [PSC]); the establishment of a limited observer program; and restrictions on the use of bottom trawls. By the early 1980s, bycatch control measures began to be directed at the burgeoning domestic groundfish fishery. For the first time in the GOA, domestic trawlers had bycatch limits placed on halibut, which, when reached, prohibited fishing with other than off-bottom trawls.

By 1985, the presence of foreign fishing fleets within the EEZ had greatly diminished, and management attention began to focus on the rapidly developing joint venture (JV) fisheries and the completely domestic groundfish fisheries. Bycatch limits were applied to domestic fisheries operating throughout the GOA, while these limits were not mandated for the BSAI until later. Additional measures to reduce bycatch included requiring biodegradable panels on sablefish pots was, and that observers be present on all joint venture processing vessels.

From 1986 to 1990, major policy emphasis was placed on reducing bycatch of PSC in the domestic fishery. Extensive time and area closures were implemented around Kodiak Island and the eastern Bering Sea to protect red king crab. Bycatch limits were set in the BSAI for halibut, red king crab, and bairdi Tanner crab. In 1990, a bycatch limit was placed on herring for the trawl fleet. Bycatch limits were applied to the entire domestic fishing fleet based upon area, season, and fishery sector. PSC restrictions closed down select fisheries on several occasions.

By 1991, the groundfish fisheries were fully domestic. From 1991 to 1995, PSC bycatch reduction continued to be a major policy goal. Restrictions were placed on the construction and use of fishing gear to reduce the bycatch of both PSC species and juvenile components of target groundfish stocks. Other restrictions included a prohibition on the use of seine and gillnets, minimum mesh size for all trawls, a blanket requirement for biodegradable panels and halibut excluder devices on all groundfish pots, and careful release mechanisms for the longline fishery. In the Bering Sea, PSC limits were established for chum salmon and additional areas were closed to protect red king crab. A herring PSC limit was established for the BSAI trawl fishery. Halibut bycatch limits were redefined in terms of mortality instead of just total bycatch. The implementation of the individual fishing quota (IFQ) program for Pacific halibut and sablefish in 1995 was intended to provide a variety of benefits, including reductions in halibut bycatch. Similarly, the allocation of the Pacific cod total allowable catch (TAC) between trawl and fixed gear was, in part, implemented to reduce halibut bycatch.

Since 1995, conservation efforts to reduce bycatch in the groundfish fishery have continued. In recent years, additional closures in the Bristol Bay area to protect red king crab have been implemented. In the BSAI, PSC limits were established for opilio Tanner crab and chinook salmon, and revised for red king and bairdi Tanner crabs. The BSAI pollock fishery was restricted to the use of off-bottom trawls only. Groundfish retention and utilization programs have been implemented and improved.

Table 1. Chronology of management measures to control bycatch of prohibited species in the groundfish fisheries of the Bering Sea and Aleutian Islands and Gulf of Alaska, 1935-2000.

Effective year	Management action
1935	Trawls prohibited except for shrimp and flounder fishing in Bering Sea and Aleutian Islands (BSAI).
1937	Use of dynamite prohibited in BSAI.
1938	Use of gillnets prohibited for catching halibut in BSAI.
1942	Trawls permitted except for salmon and herring fishing in BSAI.
1944	Use of trawls prohibited for catching halibut in BSAI.
1948	Five-inch minimum mesh size required for trawls in BSAI.
1959	Trawls prohibited for taking any crab species in BSAI. Trawling prohibited in Bristol Bay and king crab pot sanctuary in BSAI
1967	Halibut nursery area closed to halibut fishing in BSAI. Foreign fisheries prohibited around Fox Islands in BSAI.
1969	Pribilof Islands area closed to foreign fishing.
1972	Pot gear prohibited for catching halibut in BSAI.
1973	Use of tangle nets prohibited for catching crab in BSAI.
1974	Catch quotas established for Japanese groundfish fisheries limited effort for BSAI pollock and flatfish and Gulf of Alaska (GOA) Pacific Ocean perch and sablefish.
1975	Catch quotas established for United Soviet Socialist Republic (USSR) groundfish fisheries in BSAI.
1976	Fishery Conservation and Management Act passed, providing National Standards and regulations for managing federal fisheries to 200 miles.
1977	Preliminary groundfish Fishery Management Plans (FMPs) implemented with groundfish optimum yields; closures of foreign fisheries when any one species limit is attained; several closure areas in BSAI and GOA extended from bilateral agreements; prohibited status for halibut, salmon, crabs, and shrimp.
1979	GOA FMP implemented with no retention of prohibited species (salmonids, halibut, shrimp, herring, crab, scallops); expansion of time-area closures to reduce halibut expansion of time-area closures to reduce halibut of total allowable level of foreign fishing (TALFF) taken December 1 to May 31 to minimize halibut bycatch; domestic trawlers restricted by halibut prohibited species catch (PSC) limits for five areas for December 1-May 31; halibut and Tanner crab PSC limits for domestic fishermen included; depth restrictions on use of foreign longlines seaward of 500 meters (m) May 1-September 30 to minimize bycatch of halibut. Created new species optimum yield (OY) for grenadiers (rattails) to protect them from bycatch (since rescinded, GOA-5). Pacific cod TALFF allocated to foreign longlines around Chirikov to reduce bycatch of other species, permitted directed longlining for Pacific cod to reduce halibut bycatch, required foreign vessel operators to report bycatch and discard of salmon and halibut.
1980	Set GOA OY, required biodegradable panels on sablefish pots to minimize bycatch of small sablefish, and established four species categories (target, PSC, unallocated, other) (GOA-8).
1982	BSAI FMP implemented with specific management objective to rebuild halibut; established PSC category for halibut, salmon, crabs; expanded time-area closures for foreign fisheries to reduce bycatch of juvenile halibut, set bycatch policy for domestic fishermen; set target observer coverage in foreign fisheries at 35-40 percent. Set chinook PSC of 65,000fish for foreign trawl fishery (BSAI-1a). Closed waters east of 140° W to West (GOA-10). Prohibited pot longline gear for sablefish, partially to eliminate ghostfishing (GOA-12).

Table 1 (cont.). Chronology of management measures to control bycatch of prohibited species in the groundfish fisheries of the Bering Sea and Aleutian Islands and Gulf of Alaska, 1935-2000.

Effective year	Management action
1983	PSC bycatch reduction schedule established for BSAI foreign trawl fishery, allowed domestic trawling in pot sanctuary and halibut savings area in BSAI, set 1986 goal of 17,473 salmon (BSAI-3). Closed GOA southeast to foreign trawl fisheries to protect halibut, allowed foreign longlines to fish shallower than 500 m in winter halibut savings area, until halibut bycatch reached 105 metric tons (mt).
1984	Set BSAI groundfish OY cap at 2 million mt, allowed domestic trawling in winter halibut savings area with observers and Bristol Bay pot sanctuary until halibut PSC limit is reached (BSAI-7). Raised halibut PSC to 270 mt in western GOA and 768 mt in central GOA and exempted domestic pelagic trawl fishery from halibut PSC limit.
1985	Set BSAI salmon PSC at 27,957 salmon (26,000 chinook) (BSAI-8). Established reporting requirements and directed fishing definitions (BSAI-9, GOA-14). Revised OYs and implemented framework for setting and revising halibut PSC limits (GOA-14).
1987	PSC bycatch limits and zones established in BSAI domestic and joint venture (JV) flatfish trawl fisheries, set Bristol Bay trawl closure area (Area 512) to all trawling year-round, allowed RD discretion to set target species as PSC once TAC is reached (BSAI-10). Established four red King crab bottom trawl closed areas during February 15-June 15 around Kodiak Island to protect crab, revised Oys, implemented framework for setting and revising PSC limits, revised reporting requirements (GOA-15).
1988	Began pilot observer program in Dutch Harbor and Kodiak, revised acceptable biological catch (ABC) definition (BSAI-11). Added steelhead and salmon to PSC list and established target, other, and nonspecified categories, required 30-day comment period for annual specifications and PSC limits (BSAI-11a/GOA-16).
1989	Required weekly reporting, established PSC limits for foreign and JV fisheries, set limits on retention of bycatch after target fishery closes (BSAI-12/GOA-17). Area 516 closed to trawling seasonally during crab molting period. Endorsed voluntary herring bycatch plan. Adopted policy on full utilization of BSAI and GOA groundfish.
1990	Established crab and halibut PSC limits (BSAI-12a). New observer program, data reporting system, and directed fishing standards implemented (BSAI-13/GOA-18). Pot, jig, hand, and troll gear exempted from GOA halibut PSC limits.
1991	Allowed seasonal apportionment of PSC limits, established vessel incentive program (VIP) to reduce bycatch rates of red king crab and halibut bycatch, refined overfishing, specification process and fishing gear definitions (BSAI-16/GOA-21). Established herring savings areas and hotspot authority (BSAI-16a). Season for BSAI yellowfin sole fishery changed to May 1. BSAI flatfish fisheries delayed to May 1 to reduce halibut and crab bycatch.
1992	Regional Administrator authorized to approve experimental fishing permits to reduce bycatch (BSAI-17/GOA-22). Established time and area closures for bycatch reduction, delayed rockfish trawl opening to Monday closest to July 1 to reduce salmon bycatch and groundfish trawl fisheries to January 20 to reduce salmon and halibut bycatch, expanded VIP for all trawl fisheries and GOA, halibut PSC limits established for BSAI non-trawl fisheries, and redefined VIP and PSC limits in GOA (BSAI-19/GOA-24).
1993	Gillnets and seines prohibited for groundfish fishing in BSAI. Careful release requirements established for halibut bycatch in groundfish longline fisheries in BSAI and GOA, halibut PSC limit set at 3,755 mt for halibut trawl fishery with regulatory framework for revisions (BSAI-21). Crab bycatch performance standards set for pelagic trawl fishery in BSAI. Kodiak Island crab protection zones made permanent (GOA-26). Set performance-based pelagic trawl definition in BSAI and GOA. Established a separate species category for Atka mackerel (GOA-31).

Table 1 (cont.). Chronology of management measures to control bycatch of prohibited species in the groundfish fisheries of the Bering Sea and Aleutian Islands and Gulf of Alaska, 1935-2000.

Effective year	Management action
1994	Allocations of Pacific Cod by gear are implemented in the BSAI (BSAI-24). The Allocations will provide fixed allocations for trawl (54 percent), longline/pot (44 percent) and jig gears (2 percent). Seasonal apportionments of Halibut PSC were also included allowing/forcing fishers to avoid high bycatch periods. NPFMC adopts minimum mesh-size requirements for trawl codends used in pollock, cod, and rock sole fisheries in BSAI. NOAA Fisheries published vessel specific bycatch rates on the Internet, required observers to monitor salmon discards, eliminated primary halibut PSC but kept 3,775 mt trawl limit (BSAI-25). Gillnets and seines prohibited.
1995	Halibut and sablefish IFQ program implemented (BSAI-15/GOA-20). BSAI chum salmon savings area, chinook salmon savings area, red king crab savings area, and Pribilof Islands Halibut Conservation Area established to protect crabs (BSAI-21a; 21b; 35). Established minimum trawl mesh size in BSAI. BSAI jig gear exempted from halibut PSC.
1996	BSAI Red King Crab Savings Area permanently established as year-round trawl closure area. Voluntary salmon donation program implemented to reduce bycatch and waste (BSAI-26/GOA-29).
1997	Nearshore Bristol Bay closed to all trawling year-round. PSC limits for red king crab and bairdi Tanner crab reduced and for opilio Tanner crab implemented (BSAI-37; 41). Over-fishing definitions implemented (BSAI-44/GOA-44).
1998	Established PSC limits for opilio Tanner crab in trawl fisheries and opilio Tanner crab bycatch limitation zone (BSAI-40). Improved retention/improved utilization program implemented for pollock and cod (BSAI-49/GOA-49). Prohibited species donation program redefined to include halibut (BSAI-50/GOA-50). Forage fish category and ban on fishing implemented (BSAI-36/GOA-39).
1999	Revised overfishing definitions implemented (BSAI-56/GOA-56).
2000	Bottom trawl ban in BSAI pollock fisheries (BSAI-57). Chinook salmon PSC limits reduced to 29,000 fish in four years (pending) (BSAI-58). GOA demersal shelf rockfish full retention to account for bycatch (pending). Sponge and coral identified as habitat area of particular concern-biota types under prohibited species category in BSAI and GOA (pending).

Section 3 Species Categories Management Tools

The management of bycatch in the North Pacific groundfish fishery involves a number of mechanisms that contribute to an integrated, and at times complex, regulatory framework for implementing the overall policy objectives of the NPFMC. Fishing restrictions such as harvest quotas and gear constraints may vary over time and space in response to population shifts, migratory patterns, and life-cycle characteristics of individual species or species complexes. When sufficient scientific information is available, bycatch measures may be applied to individual species within the BSAI and GOA. In cases where little is understood about the life-history and ecology of particular species, groups of species may be managed as a single complex. The following section provides a breakdown of two major bycatch management elements: 1) the five principal species management categories, and 2) the major bycatch tools used by NPFMC to manage bycatch within those species categories.

3.1 Species Categories

FMP policy is based on five species management categories: 1) target species, 2) prohibited species, 3) forage species, 4) other species listed in the FMPs, and 5) nonspecific species, which includes all remaining species of fish in the BSAI and GOA. Table 2 presents a listing of the species included in these first four categories.

3.1.1 Target Species

Target species are the species targeted by the fishing effort in the groundfish fisheries. The NPFMC may manage target species as individual species or species groups (complex) depending upon the commercial importance of a species and the amount of biological information that is available with which to manage each species or species complex. Species such as pollock, Pacific cod and sablefish are managed as distinct species in both the BSAI and GOA. In contrast, the numerous species of rockfish in the GOA and BSAI are managed as individual species (e.g., Pacific ocean perch) or as several species complexes, the makeup of which may change from year to year.

3.1.2 Prohibited Species

The category prohibited species is an FMP designation for non-groundfish species that are harvested in other domestic fisheries. Listed prohibited species include several species of crabs, Pacific halibut, Pacific herring, steelhead trout, and the five species of Pacific salmon. With the exception of Pacific halibut, fisheries for these species are not directly managed by the NPFMC. The fisheries for these species are managed by a number of state, federal, and/or international agencies or commissions.

3.1.3 Forage Species

Forage fish play a central role in the North Pacific Ocean food chain, consumed by a wide variety of fish, marine mammals, and seabirds. This category includes all species in the families Osmeridae, Bathylagidae, Myctophidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomidae, and euphausiid shrimps. Because of their trophic importance, the BSAI and GOA FMPs were amended to prevent the development of a directed fishery on these species, which limits the amount of these species that can be retained in the groundfish fishery.

3.1.4 Other Species

This category consists of species that are not currently commercially important to the groundfish fishery but which might have greater future economic potential. This group includes sharks, skates, sculpins, squids, and octopi. An aggregate TAC is set for these species.

Table 2. Taxa listing for the five Fishery Management Plan management categories.

Targeted Species - Harvested in the North Pacific groundfish fishery
Walleye Pollock (<i>Theragra chalcogramma</i>) Pacific cod (<i>Gadus macrocephalus</i>) Flathead sole (<i>Hippoglossoides elassodon</i>) Rock sole (<i>Lepidopsetta</i> spp.; 2 species) Greenland Turbot (<i>Reinhardtius hippoglossoides</i>) Yellowfin sole (<i>Limanda aspera</i>) Arrowtooth flounder (<i>Atheresthes stomias</i>) Other flatfish (8 species) Sablefish (<i>Anoploma fimbria</i>) Rockfish (32 species of the genera <i>Sebastes</i> and <i>Sebastolobus</i>) Atka mackerel (<i>Pleurogrammus monopterygius</i>)
Prohibited Species - Non groundfish species targeted in other domestic fisheries
Red king crab (<i>Paralithodes camtschaticus</i>) Blue king crab (<i>P. camtschaticus</i>) Golden or brown king crab (<i>Lithodes aequispinus</i>) Bairdi Tanner crab (<i>Chionoecetes bairdi</i>) Opilio Tanner crab (<i>C. opilio</i>) Pacific halibut (<i>Hippoglossus stenolepis</i>) Pacific herring (<i>Clupea harengus pallasii</i>) Steelhead trout (<i>Oncorhynchus mykiss</i>) Pink salmon (<i>O. gorbuscha</i>) Chum salmon (<i>O. keta</i>) Chinook salmon (<i>O. tshawytscha</i>) Sockeye salmon (<i>O. nerka</i>) Coho salmon (<i>O. kisutch</i>) Sponges and Corals
Forage Species - Important food fish for other fishes, mammals, and seabirds
Eulachon, Capelin and other smelts (<i>Osmeridae</i>) Deep-sea smelts (<i>Bathylagidae</i>) Lanternfishes (<i>Myctophidae</i>) Pacific sand lance (<i>Ammodytidae</i>) Pacific sand fish (<i>Trichodontidae</i>) Gunnels (<i>Pholidae</i>) Pricklebacks, Warbonnets, Eelblennys, Cockscombs, and Shannys (<i>Stichaeidae</i>) Bristlemouths, Lightfishes, and Anglemouths (<i>Gonostomidae</i>) Krill (<i>Euphausiid</i> shrimps)
Other Species - Non-forage species of no commercial value but with future commercial potential
Sharks Skates Sculpins Octopii Squids
Nonspecified Species - Not managed or monitored
All BSAI and GOA fish not listed above including invertebrates. Note that the MSA defines fish as "finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds."

3.1.5 Nonspecified Species

The "nonspecified" species category consists of all species not listed in the four groups above, including invertebrates. None of the species within this group are currently managed or monitored as with the other four categories of species. However, catches of these species in the commercial fishery are recorded by observers, as are catches during survey cruises.

3.2 Management Tools

The NPFMC employs two types of management measures for the BSAI and GOA: 1) framework measures and 2) conventional measures. Framework measures allow the NPFMC to more rapidly respond to biological and socioeconomic changes without amending an underlying FMP. They involve annual or seasonal adjustments such as those applied to TACs and the apportionment of PSC limits. Conventional measures can only be changed by formally amending an FMP. Conventional measures include permits, reporting requirements, gear restrictions, and allocations among user groups. The following subsection provides brief descriptions of major bycatch management tools that are utilized by the NPFMC.

3.2.1 Total Allowable Catch

The NPFMC sets annual TAC or quotas for target species and other species. The TAC defines the total tonnage of a species that may be taken by any means among all groundfish fisheries over the calendar year. TACs for target species include fish taken both as catch and as bycatch in the groundfish fisheries. The TACs can be apportioned by gear type and by season, in part to reduce bycatch and bycatch mortality. For example, seasonal apportionments of pollock TAC in the western and central GOA are intended to prevent the pollock fishery from occurring during periods characterized by high bycatch of salmon. Seasonal or area allocations of TAC also have the effect of directing fishing effort toward periods or areas of high target fish abundance. Therefore, harvests can be maximized while keeping bycatch levels in check. High bycatch rates in a fishery that targets a particular species, have been a factor in the decision to set lower TACs for some such species.

The NPFMC may set TACs for target species and other species either by individual species or species groups. The groupings are based on the commercial importance of a species or species group and the amount of biological information that is available to manage each group or species. The NPFMC may assemble or disassemble target species groups as they see fit based upon changes in population status and available information. The other species category requires an FMP amendment to break out a particular species or species group from a larger grouping.

Prohibited Species Catch Limits

Regulations governing the treatment of prohibited species (halibut, crab, salmon, and herring) seek to reduce the catch of these key non-groundfish species by banning their retention in all groundfish fisheries and requiring that all prohibited species taken in the groundfish fishery be returned to the sea with a minimum of injury. In addition to the general prohibition on retention, the total seasonal bycatch of individual PSC species is limited for red king crab, bairdi and opilio Tanner crabs, Pacific halibut, Pacific salmon, Pacific herring in the BSAI, and Pacific halibut in the GOA. When a PSC limit apportionment of the halibut or crab for a specific fishery and area is reached, that fishery is closed for the remainder of the season in that area even if the target groundfish quota has not been reached. For herring and salmon, the attainment of PSC limits triggers area-and-time specific closures of specific fisheries. Upon attainment of the PSC limit apportionment for a specific fishery, certain sensitive areas of high density and/or critical habitat are closed to that groundfish fishery. The area closure may be temporary, being applicable only to biologically sensitive times of the year (e.g., reproduction, molting, or migration).

Maximum Retainable Amount

Maximum retainable amount (MRA) limits determine the amount of a species by weight that may be retained. MRA is expressed as a percent of total retained catch by a fishing vessel of the species for which targeting is currently permitted. MRA limits are set for forage species, target species relegated to bycatch status, and other species groups relegated to bycatch status. The species or species group in question may be retained up to a level determined by its individual MRA. MRA serves as a management tool that limits the rate of removal of forage species and prohibited species, and slows the rate of harvest of a target species and other species once TAC quotas have been reached or are being approached.

Time/Area/Gear Restrictions

Closure of areas and seasons to fishing for some or all gear types has been an effective method for reducing bycatch since the 1970's when foreign fleets were first forbidden to fish in areas of high halibut and crab concentrations. Historically, area and seasonal closures have been implemented for selected members of the prohibited species category. Management measures have included the establishment of savings areas for herring, chinook salmon, chum salmon, and king crab, as well as permanent closures to protect crab stocks in the nearshore areas of Bristol Bay and around Kodiak Island. BSAI Amendment 57 permanently prohibits the use of non-pelagic trawl gear in the BSAI pollock fishery. Trawl gear is prohibited in the southeast portion of the GOA.

Gear Modifications

Modifications in gear construction and general application can also contribute to lowering bycatch. Minimum mesh sizes allow for escapement of juvenile fishes that would otherwise be taken as bycatch. However, in some cases, this may principally result in one type of bycatch (discards) being replaced with another (unobserved fishing mortality) which is much more difficult to monitor. Biodegradable panels and halibut excluder devices are required on all groundfish pots. Management use of future gear restrictions is largely dependent on the development of technological innovations that can be applied to the fishery in a practical and cost-effective manner.

Observer Program

Observer programs provide essential technical oversight for management of the EEZ groundfish fisheries. Observers provide estimates of total catch and species composition, which allows for inseason management of the fishery. They also collect biological data for individual species that are used in stock assessments. Observers are required aboard vessels greater than or equal to 60 feet (ft) in overall length. Vessels from 60 to under 125 ft in overall length are required to have observers for 30 percent of their fishing days, and larger vessels that use pot gear have the same observer coverage requirement. Other vessels greater or equal to 125 ft are required to have one or more observers 100 percent of the time. Observers are also required at shoreside processors that process more than 500 metric tons (mt) of groundfish in any single month. Processors that process 500-1,000 mt in a monthly period require 30 percent observer coverage while those that process more than 1,000 mt require observers 100 percent of the time. Vessels and processors involved in programs that use vessel specific fishing quotas, such as the Western Alaska Community Development Quota (CDQ) program or the American Fisheries Act (AFA) pollock fisheries, have additional observer requirements which include more than one observer on some types of fishing vessels, more senior observers on some vessels, flow scales or other motion compensating scales, and certified sampling stations.

Improved Retention/improved Utilization

Responding to what was considered unacceptably high levels of bycatch, the NPFMC adopted an improved retention/improved utilization (IR/IU) program for all groundfish target fisheries. In 1997, about 260,000 mt of groundfish were discarded in the BSAI groundfish fishery, which was equivalent to about 14 percent of the total catch of TAC groundfish species. Walleye pollock, Pacific cod, and flatfish comprised approximately

87 percent of this total. In the GOA, it was estimated that pollock, cod, and flatfish represented about 76 percent of discards of TAC species. The IR/IU program required 100 percent retention of pollock and cod in the BSAI and GOA, regardless of how or where they were caught (BSAI and GOA Amendments 49). The measure has dramatically reduced the discards of pollock and cod in the groundfish fishery. In 1998, the year the amendment was implemented, discards dropped dramatically from 1997 levels. In the BSAI, pollock discards dropped from 94,800 mt to 16,200 mt, and cod discards fell from 22,100 mt to 4,300 mt. Beginning in 2003, full retention was required for rock sole and yellowfin sole in the BSAI (BSAI Amendment 49), and for all shallow water flatfish in the GOA (GOA Amendment 49). When fully implemented, retention requirements are expected to reduce overall discard rates (all species) from about 15 percent to about 5 percent.

Vessel Incentive Program

Over the years, the NPFMC has implemented a number of incentive programs designed to promote the conservation and management of groundfish fisheries. One such program is the IFQ program (BSAI Amendment 15, GOA Amendment 20) for sablefish and halibut. The program allows qualified individuals to harvest a certain percentage of the sablefish and halibut quota. Each fisherman has a quota that can be used at anytime during the open season and allows them to set their own pace. The intent of the program was to allow fishermen to become more efficient and quality conscious. Bycatch reduction was also inherent in the program. Halibut taken as bycatch in the sablefish fisheries can be retained under the yearly halibut IFQ. The source of the problem of excessive bycatch is the externalities that exist, which give fishermen the wrong incentives with respect to decisions that affect bycatch. If adequate monitoring is feasible, the externalities can be eliminated or substantially reduced and fishermen would have the incentives to minimize bycatch to the extent practicable. Eliminating the “race for fish” can decrease some of the perverse incentive fishermen currently have with respect to bycatch decisions. But additional measures can be taken to provide improved incentives to fishermen. For example, increasing the number of species for which there is accountability by individual fishing operations will address a larger number of externalities and result in, from the National perspective, better bycatch decisions by fishermen for a broader range of bycatch species.

The voluntary Salmon Donation Program (BSAI Amendment 26, GOA Amendment 29) authorizes the distribution of Pacific salmon taken as bycatch to economically disadvantaged individuals through a sanctioned distributor. Most salmon taken as bycatch are dead when brought on board the fishing vessel. Under PSC designation they must be returned to the sea, which is wasteful. The Salmon Donation Program permits the retention of this fish for the foodbank program. While the program does not reduce bycatch, it is effective at reducing bycatch waste. FMP Amendments 50 for the BSAI and GOA expanded this program to include halibut.

Experimental Fishing Permits

BSAI Amendment 17 and GOA Amendment 22 authorized the issuing of experimental fishing permits (EFPs) to persons for the purpose of obtaining information necessary to promote fishery conservation and the management of fisheries.

Record Keeping

Permitted catcher vessels equal to or greater than 60 ft in overall length must maintain a daily fishing logbook regarding fishing activity and location (50 CFR 679.50). Catcher processor vessels, motherships, shoreside processors and purchasing stations must maintain daily cumulative production logbooks that record information on fishing activity, haul receipt, production, and discards. Information on groundfish harvest, discard, receipt, and production are reported to NOAA Fisheries. Some of this data is used by the agency to manage groundfish and prohibited species quotas.

Section 4 Policy Alternatives and Rationale

All four of the alternatives under consideration by the NPFMC address the bycatch problem in the following manner.

- Alternative 1** Continue under the Current Risk-Averse Management Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse strategy. This strategy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The approach would be to continue the current strategy which relies upon management of bycatch through seasonal allocation of TAC, time and area closures, gear restrictions/modification and allocations, PSC limits, IR/IU requirements, vessel incentive programs (VIP), observer and reporting programs, and experimental or exempt fishing permits to ensure that bycatch is minimized to the extent practicable.
- Alternative 2** Adopt a More Aggressive Management Policy: Under this alternative a more aggressive harvest strategy would be implemented based upon the concept that the present strategy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This strategy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are documented and are known to be reoccurring. Bycatch would continue to be monitored, but PSC limits would be adjusted or eliminated. If necessary, bycatch would be managed by closures of areas to selected gear types.
- Alternative 3** Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management that would be extended to as many species as practicable (including a broad range of non-target species), ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment, not just a population of a given species. The main elements of this alternative would include development of incentive programs for reducing the bycatch of a broad range of species, encouragement of research programs to better define population estimates and appropriate bycatch limits for non-target species, and development of management measures that would encourage the use of gear and fishing techniques that would reduce discards.
- Alternative 4** Adopt a Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing would be allowed. The strategy would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would increase involvement of and agency responsiveness to the public, while decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing does produce adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. With regards to bycatch, this alternative would require that bycatch mortality would be included in TAC-accounting for all target, non-target and PSC bycatch species, including unobserved fishing mortality; bycatch and PSC limits would be reduced (e.g., by

10 percent per year for five years); fisheries having greater than 25 percent bycatch rates would be phased out; PSC limits would be established for salmon, crab and herring in the GOA; and that stringent bycatch limits would be imposed for vulnerable, non-target species. This strategy would greatly curtail the regional groundfish fisheries until more information was obtained about the frequency and intensity of fishing impacts on the environment.

Each of the three alternatives to the Alternative 1 (status quo) contain two endpoints, which represent the limits of fishery management measures within each alternative. These endpoints, referred to hereafter as FMP bookends, are not intended to be stand alone alternatives, but are instead examples of the management options within an alternative. For example, Alternative 2 contains FMP bookends 2.1 and 2.2, which presents a range of different possible management tools that NPFMC could use to implement the measures defined in Alternative 2. These FMP bookends also discuss predictions of the range of potential environmental effects from the use of these management tools. This alternative structure recognizes and accounts for the fact that the resource being managed, as well as the marine ecosystem, is quite dynamic in nature and only partially understood. The process of examining a range of management tools and their potential effects for each policy alternative is an attempt to take into account the dynamic nature of the fisheries as a whole and to provide enough management regime flexibility in each alternative to allow the decision-makers to base decisions on the best available science. Specific illustrative FMP measures for each alternative are summarized in Table 3.

Table 3. Comparative Fishery Management Plan frameworks of the four alternatives dealing with bycatch.

	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Bycatch and incidental catch restrictions	Prohibited species catch (PSC) limits for herring, crab, halibut and salmon in Bering Sea and Aleutian Islands (BSAI), and for halibut in Gulf of Alaska (GOA).	Eliminate PSC limits.	PSC limits as for FMP 1. Where sufficient stock status information is available, adjustable PSC limits established based on a percentage of the annual stock status.	BSAI: Reduce PSC limits for herring, crab, halibut and salmon to the extent practicable (0-10%). GOA: Establish PSC limits on salmon not to exceed (NTE) a 25,000 fish cap for chinook and a 20,500 fish cap for other salmon; establish PSC limits on crab and herring based on biomass or other fishery data. Reduce GOA halibut PSC limit 0-10% for those PSC species where annual population estimates exist, the Team will explore a mortality rate-based approach to setting limits.	BSAI: Reduce PSC limits for herring, crab, halibut and salmon to the extent practicable (10-30%). GOA: Establish PSC limits on salmon NTE a 25,000 fish cap for chinook and a 20,500 fish cap for other salmon; establish PSC limits on crab and herring based on biomass or other fishery data; reduce all by 0-10%. Reduce GOA halibut PSC limit 10-30%. For those PSC species where annual population estimates exist, the Team will explore a mortality rate-based approach to setting limits.	BSAI: Reduce PSC limits for herring, crab, salmon, halibut by 30-50%. GOA: Establish PSC limits on salmon NTE a 25,000 fish cap for chinook and a 20,500 fish cap for other salmon; establish PSC limits on crab and herring based on biomass or other fishery data; reduce all by 30-50%. For those PSC species where annual population estimates exist, the Team will explore a mortality rate-based approach to setting limits.	Prohibition on all fishing pending review.
	Improved retention/improved utilization (IR/IU) for pollock, P. cod.	Repeat IR/IU	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.	Extend IR/IU to all target species.	Prohibition on all fishing pending review.
	Current bycatch and incidental catch restrictions. Vessel incentive program (VIP). Demersal Shelf Rockfish full-retention.	No bycatch restrictions.	Same as 2.1.	Review effectiveness of coop-managed PSC reduction. Repeal VIP program. Control bycatch by closing hotspot areas when bycatch limits are attained.	Incentive program for incidental catch and bycatch reduction, e.g.: (a) Individual Bycatch Quota (b) Harvest Priority (10% of total allowable catch (TAC) reserved to reward clean fishing) (c) Bycatch reduction standards established (d) Coop managed Harvest Priority (0-10% TAC or PSC reserved to reward clean fishing) (e) Halibut Mortality Avoidance Program (HMAP).	Reduce bycatch: BSAI: reduce all by 30-50%. GOA: reduce all by 30-50%. Bycatch limits for non-target stocks as information becomes available.	Prohibition on all fishing pending review. Prohibition on all fishing pending review.
	Crab trawl closures Cook Inlet prohibition for bottom trawl.	Eliminate all closure areas and no Cook Inlet trawl ban.	No changes from FMP 1.	No changes from FMP 1.	Develop appropriate closure areas in GOA to address bycatch for halibut and/or crab.	Establish gear closure areas and marine reserves to reduce and avoid bycatch.	Prohibition on all fishing pending review.
	Inseason bycatch, management measures: (a) establishment of fishing seasons for bycatch mgmt (b) herring closures for areas (not fishery)	Eliminate all inseason bycatch measures.	No changes from FMP 1.	No changes from FMP 1.	Repeal maximum retainable amounts (MRAs) and establish a system of caps and quotas.	No changes from FMP 1.	No inseason mgmt measures. Prohibition on all fishing pending review.

Table 3 (cont.). Comparative Fishery Management Plan frameworks of the four alternatives dealing with bycatch.

	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Gear restrictions and allocations	Retain existing no-trawl zones and fixed gear restrictions; Bottom trawl ban in BSAI for pollock.	Eliminate all trawl closure areas and trawl and fixed gear restrictions.	No changes from FMP 1.	BSAI prohibition on bottom trawl for pollock.	BSAI and GOA prohibition on bottom trawl for pollock.	Prohibit trawling in all fisheries that can be prosecuted with other gear types (e.g., fisheries with > 25% bycatch).	Prohibition on all fishing pending review.
	No pot fishing in GOA for sablefish.	No changes from FMP 1	No changes from FMP 1.	No changes from FMP 1.	Restrict fishing to areas where fishing has previously been concentrated.	Restrict bottom trawling for flatfish to specific areas: No trawling in areas identified (previous) as marine protected areas (MPAs).	Prohibition on all fishing pending review.
	Retain existing gear restrictions and allocations	No changes from FMP 1	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.		
	Sablefish and Pacific cod allocated by gear in BSAI; sablefish allocated by gear in GOA	No changes from FMP 1	No changes from FMP 1.	No changes from FMP 1.	No changes from FMP 1.	See Gear Restrictions and Allocations above.	Prohibition on all fishing pending review.
Observer program	Fixed 0/30/100% coverage.	Repeal all observer programs except American Fisheries Act (AFA) and community development quota (CDQ).	No changes from FMP 1.	Observer coverage same as FMP 1 or modified based on data and compliance needs, and should be scientifically-based.	Extend to 100% > 60' CDQ & AFA to stay the same as FMP 1.	Expand level of observer coverage.	Prohibition on all fishing pending review.
	100% for AFA & CDQ catcher boats > 60 feet (ft) and 200% for AFA & CDQ catcher processors and motherships.			e.g., random placement, flexibility, variable rate.	(a) 100% coverage on vessels (vessels less than 60' = 30% coverage) (b) 100% hauls are observed.		

Section 5 Alternative 1: Continue Under the Current Risk-Averse Management Policy

Many of the management strategies established by the NPFMC to reduce bycatch in the North Pacific groundfish fishery have centered on prohibited species and more recently target species and forage fish species. Thirty-four BSAI and 20 GOA FMP amendments have been implemented in the past 20 years to control bycatch and associated mortality within these groups. Regulatory measures have established or modified bycatch limits, fishing seasons, gear restrictions and allocations, time and area closures, bycatch rate standards, record keeping and reporting incentive programs, retention/utilization requirements, retention restrictions or prohibitions, and observer requirements. A few of these restrictions are applied to target and other species once their seasonal TACs have been reached or exceeded. The direct effect of Alternative 1 provisions on the different species groups and management tools are detailed below.

5.1 Target Species

The TACs of target species are rigorously managed by the NPFMC and NOAA Fisheries under an elaborate system of data collection, inseason management, and stock assessments. Target species are subject to retention limits once the seasonal TAC quota has been met or is being approached. Thereafter, the species cannot be targeted but may be retained up to an MRA determined by the NPFMC. If the harvest of a given target species on bycatch status approaches the acceptable biological catch (ABC), that species is put on prohibited species status, which bans the retention of that species for the remainder of the year. Bycatch status effectively slows the rate of harvest of the TAC species in question once the TAC has been reached or is being approached. In 2002, the only groundfish fisheries for which seasonal TAC was reached were pollock and Alaska plaice in the BSAI (Table 4). The only other fishery for which harvests came within 5 percent of the seasonal TAC was sablefish in the GOA.

5.2 Prohibited Species

Pacific Halibut

Pacific halibut fisheries are managed by a treaty between the United States and Canada through recommendations by the International Pacific Halibut Commission (IPHC). Stock assessments conducted by the IPHC take into account all halibut removals, including bycatch in the groundfish fisheries. Catch and discard mortality data are provided by observers associated with the groundfishing fleet. Stock assessments are then used to allocate harvest quotas in the directed halibut fishery. Because IPHC stock management accounts for bycatch mortality, halibut quotas in the directed fishery compensate for bycatch in the groundfish fisheries. The halibut resource is considered quite healthy and directed harvests in recent years have been near record levels.

Halibut bycatch is controlled in the BSAI groundfish fishery using PSC limits applied to specific target fisheries. Unlike other PSC limits, which allocate total allowable bycatch, PSC limits for halibut bycatch are for mortalities only. Halibut returned live to the sea do not accrue toward the PSC limit. Most halibut taken as bycatch are juveniles, so the loss must be viewed not just as immediate tonnage, but also as fish that would have grown larger.

For the 2003 fishing season, total halibut PSC limits have been set at 3,675 mt for trawl and 900 mt for nontrawl fisheries (Table 5). Bycatch limits are apportioned by gear type and target species, and within target species, they are further apportioned by season. For example, 26 percent of the 2003 halibut PSC limit assessed to trawl fisheries operating in the BSAI was allocated to yellowfin sole. This 26 percent is further sub-allocated among four fishing seasons. Halibut bycatch allocations essentially direct fisheries, by area or time, to regions where the highest volume or highest value target species may be harvested with minimal halibut bycatch. When any fishery exceeds its seasonal limit, the entire Bering Sea is closed for that fishery.

Table 4. Total allowable catch allocations and groundfish harvests (metric tons) by target species for the 2002 fishing season.

Target fishery	2002		Percent of TAC
	Total allowable catch (TAC)	Catch	
BSAI			
Pollock	1,486,100	1,486,006	100.0
Pacific cod	200,000	184,937	92.5
Atka mackeral	98,000	87,986	89.8
Yellowfin sole	86,000	74,861	87.0
Rock sole	54,000	41,621	77.1
Other species	30,825	26,467	85.9
Pacific Ocean perch	30,600	22,392	73.2
Flathead sole	25,000	15,419	61.7
Greenland turbot	16,000	5,506	34.4
Arrowtooth flounder	16,000	4,010	25.1
Alaska plaice	12,000	12,291	102.4
Northern rockfish	6,760	4,010	59.3
Sablefish	4,480	1,887	42.1
Other flatfish	3,000	2,628	87.6
Squid	1,970	784	39.8
Other rockfish	1,037	946	91.2
Shortraker/rougheye rockfish	1,028	573	55.7
GOA			
Pollock	58,250	50,390	86.5
Pacific cod	44,230	40,524	91.6
Arrowtooth flounder	38,000	20,941	55.1
Shallow water flatfish	20,420	6,842	33.5
Pacific Ocean perch	13,190	11,735	89.0
Sablefish	12,820	12,246	95.5
Other species	11,330	3,748	33.1
Rex sole	9,470	3,009	31.8
Flathead sole	9,280	2,108	22.7
Pelagic shelf rockfish	5,490	3,318	60.4
Northern rockfish	4,980	3,335	67.0
Deepwater flatfish	4,880	558	11.4
Thornyhead rockfish	1,990	1,125	56.5
Shortraker/rougheye rockfish	1,620	1,291	79.7
Other slope rockfish	990	771	77.9
Atka mackeral	600	84	14.0
Demersal rockfish	350	182	52.0

Table 5. Prohibited species catch allocations for the Bering Sea and Aleutian Islands Fishery Management Unit, 2003. Projected crab populations are denoted parenthetically.

Species	Gear	Prohibited species catch (PSC) limits	Fishery	Season allowances
Halibut	Trawl	3,675 metric tons (mt) (mortality)	<u>Trawl</u> Yellowfin sole [24%]	1/20 to 3/31 [30%] 4/1 to 5/20 [22%]
	Non-trawl	900 mt (mortality)	N/A	5/21 to 7/3 [6%] 7/14 to 12/31 [43%]
	Pot gear	exempt	Rocksole, other flatfish, flathead sole [21%]	1/20 to 3/31 [58%] 4/1 to 7/3 [21%] 7/4 to 12/31 [21%]
	Jig gear	exempt	Turbot, sablefish, arrowtooth [0%] Rockfish [2%]	None 7/4 to 12/31 [100%]
	Hook-and-line (sablefish only)	exempt	Pacific cod [39%] Pollock, Atka mackerel, other [6%] Community development quota (CDQ) fisheries [7%]	None None None
			<u>Non-trawl</u> Pacific cod [86%] Other non-trawl [6%] CDQ Fisheries [7%]	1/1 to 6/10 [41%] 8/15 to 12/31 [59%] 5/1 to 12/31 None
Herring	Trawl	1,526 mt (1% of estimated biomass)	Yellowfin sole [9%]	None
			Rocksole, other flatfish, flathead sole [1%] Turbot, sablefish, arrowtooth [<1%] Rockfish [<1%] Pacific cod [1%] Pollock, Atka mackerel, other [87%]	
Red king crab (zone 1)	Trawl	97,000 crabs	Yellowfin sole [17%] Rocksole, other flatfish, flathead sole [62%] Pacific cod [12%] Pollock, Atka mackerel, other [2%] CDQ Fisheries [8%]	None

Table 5 (cont.). Prohibited species catch allocations for the Bering Sea and Aleutian Islands Fishery Management Unit, 2003. Projected crab populations are denoted parenthetically.

Species	Gear	Prohibited species catch (PSC) limits	Fishery	Season allowances
Opilio Tanner crab (Bycatch limitation zone)	Trawl	4,350,000 crabs	Yellowfin sole [64%] Rocksole, other flatfish, flathead sole [22%] Turbot, sablefish, arrowtooth [1%] Rockfish [1%] Pacific cod [3%] Pollock, Atka mackerel, other [2%] CDQ Fisheries [8%]	None
Bairdi Tanner crab (zone 1)	Trawl	980,000 crabs	Yellowfin sole [35%] Rocksole, other flatfish, flathead sole [37%] Pacific cod [19%] Pollock, Atka mackerel, other [2%] CDQ Fisheries [8%]	None
Bairdi Tanner crab (zone 2)	Trawl	2,970,000 crabs	Yellowfin sole [60%] Rocksole, other flatfish, flathead sole [20%] Rockfish [<1%] Pacific cod [11%] Pollock, Atka mackerel, other [1%] CDQ Fisheries [8%]	None
Chinook salmon	Trawl	29,000 fish		1/1 to 4/15
Other salmon	Trawl	42,000 fish		8/15 to 10/14

Source: DiCosimo (2002).

In recent years halibut PSC limits for the GOA have been 2,000 mt for trawl and 300 mt for nontrawl fisheries. PSC limits in the GOA may also be allocated by season, among fisheries, and among gear types. If some gear types have excessively high bycatch mortality rates, the NPFMC may withhold that fishery's halibut PSC limit in order to promote other gear types that might otherwise close prematurely. In both the BSAI and GOA, bycatch limits of Pacific halibut often prevent the annual TAC of many groundfish species from being harvested.

Other measures that have reduced halibut bycatch include seasonal and area allocations of TAC for selected target species, seasonal and year-round area closures, gear restrictions, careful release requirements, an IFQ VIP, public reporting of individual bycatch rates, and gear modifications. Examples of gear modifications include biodegradable panels and halibut excluder devices that are required on all groundfish pots. Implementation of the IFQ program (see Management Tools, Section 3.2) resulted in an immediate reduction in annual PSC limits for the GOA from 750 mt to 150 mt.

Pacific Herring

Directed fisheries for herring occur entirely in state waters and are managed by the Alaska Department of Fish and Game (ADF&G). Harvest quotas are determined by the Alaska Board of Fisheries and are based upon biomass forecasts as determined from landings data. Pacific herring bycatch limits (BSAI Amendment 16a) in the groundfish fisheries apply to trawl gear operating within three specified areas designated as Herring Savings Areas 1, 2, and 3, all of which are located in the Bering Sea (Figure 1). These areas are characterized by large seasonal aggregations of herring. The annual PSC limit determined by the NPFMC is set at 1 percent of projected herring biomass and is designed to fluctuate with herring abundance as estimated for each year. For the 2003 fishing season, the herring PSC limit has been set at 1,526 mt (Table 5). This bycatch limit is also apportioned among specified trawl fisheries. If a bycatch allowance is attained for a specific fishery, that fishery is prohibited from operating in Area 1 from June 15 to July 1, in Area 2 from July 1 to August 15, and in Area 3 from September 1 through March 1. These time/area closures are designed to track seasonal herring migrations and aggregations. In the BSAI, herring bycatch occurs primarily in the pollock and yellowfin sole fisheries.

In the GOA, bycatch is rather nominal and occurs almost exclusively in the pollock fisheries; 78 percent in pelagic trawls and 12 percent in bottom trawls. Herring bycatch is estimated to be such a small percentage of total herring biomass in the GOA that there are no PSC limits or area closures designated by the NPFMC.

King and Tanner Crabs

Many of the crab stocks in the BSAI are currently at or below critical levels. The Bristol Bay red king crab population is below critical stock size and the directed fishery was closed in 1994 because of depressed populations. Conditions were so dire that a red king crab savings area was established by emergency rule in 1995, and made permanent under BSAI Amendment 37. The blue king crab population in the Pribilof Islands is considered to be low (NMFS 1998d) and population in the Saint Matthew Island area is estimated to be below minimum stock size threshold (NMFS 1999b). The stock was declared overfished and the fishery was closed in 1999. The NPFMC considers the Bering Sea Tanner crab stock overfished and is likely that the population will continue to decline for years (Morrison *et al.* 1998).

In response to the depressed status of many crab stocks, the NPFMC established permanent year-round closures in areas deemed to be critical crab habitat (Figures 2 and 3). These include the 19,000 square nautical miles (nm²) nearshore Bristol Bay area (BSAI Amendment 37), the 7,000 nm² Pribilof Island Habitat Conservation Area (BSAI Amendment 21a), the 4,000 nm² Red King Crab Savings Area (BSAI Amendment 37), the 1,000 nm² Red King Crab Protection Area around Kodiak Island (GOA Amendment 26), and Management Area 512 closure (BSAI Amendment 10). In 2000, the NPFMC approved Amendment 60 which permanently prohibits nonpelagic trawling in a 7,000 nm² area of Cook Inlet that is considered critical habitat for depressed king and Tanner crab stocks.

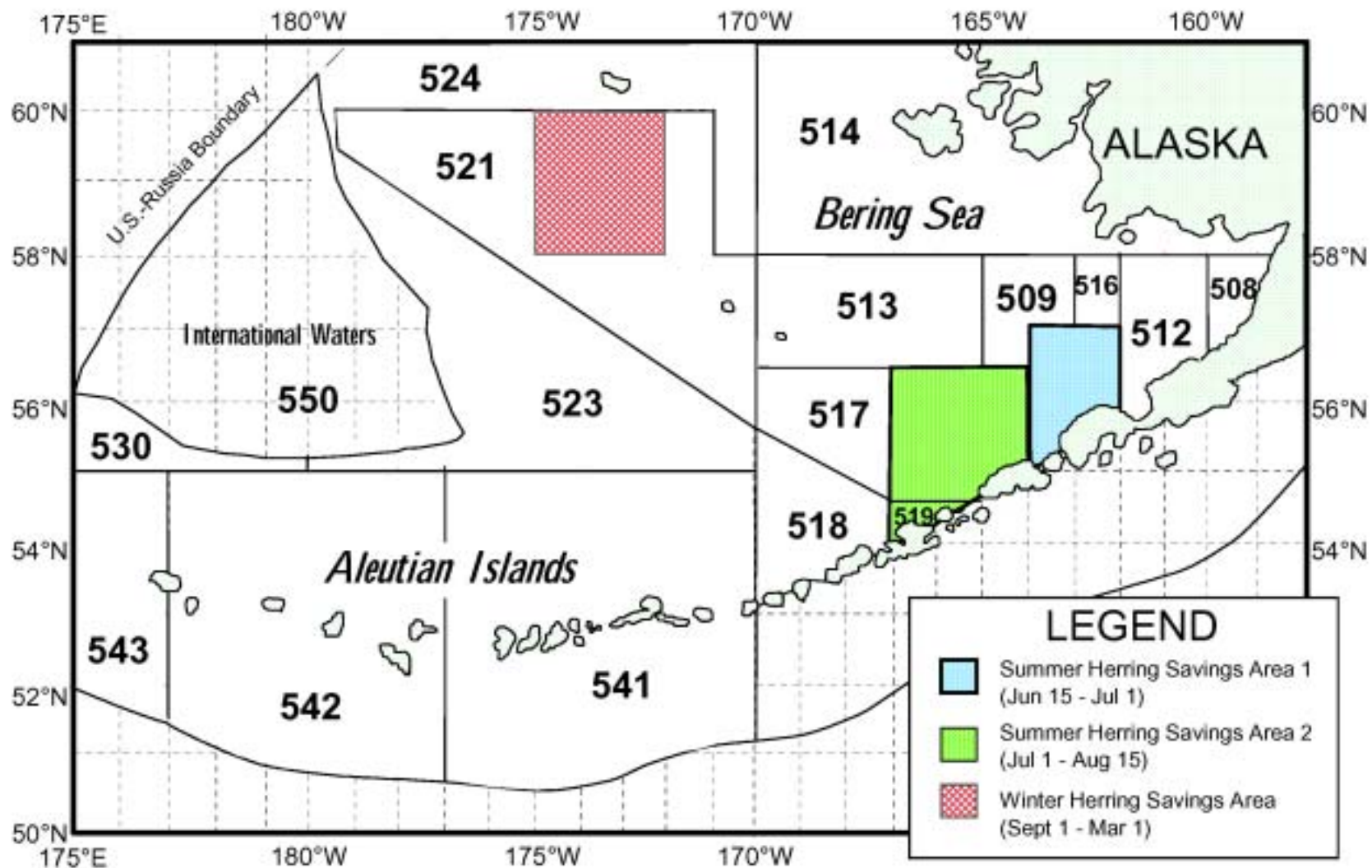


Figure 1. Designated Pacific herring savings areas.

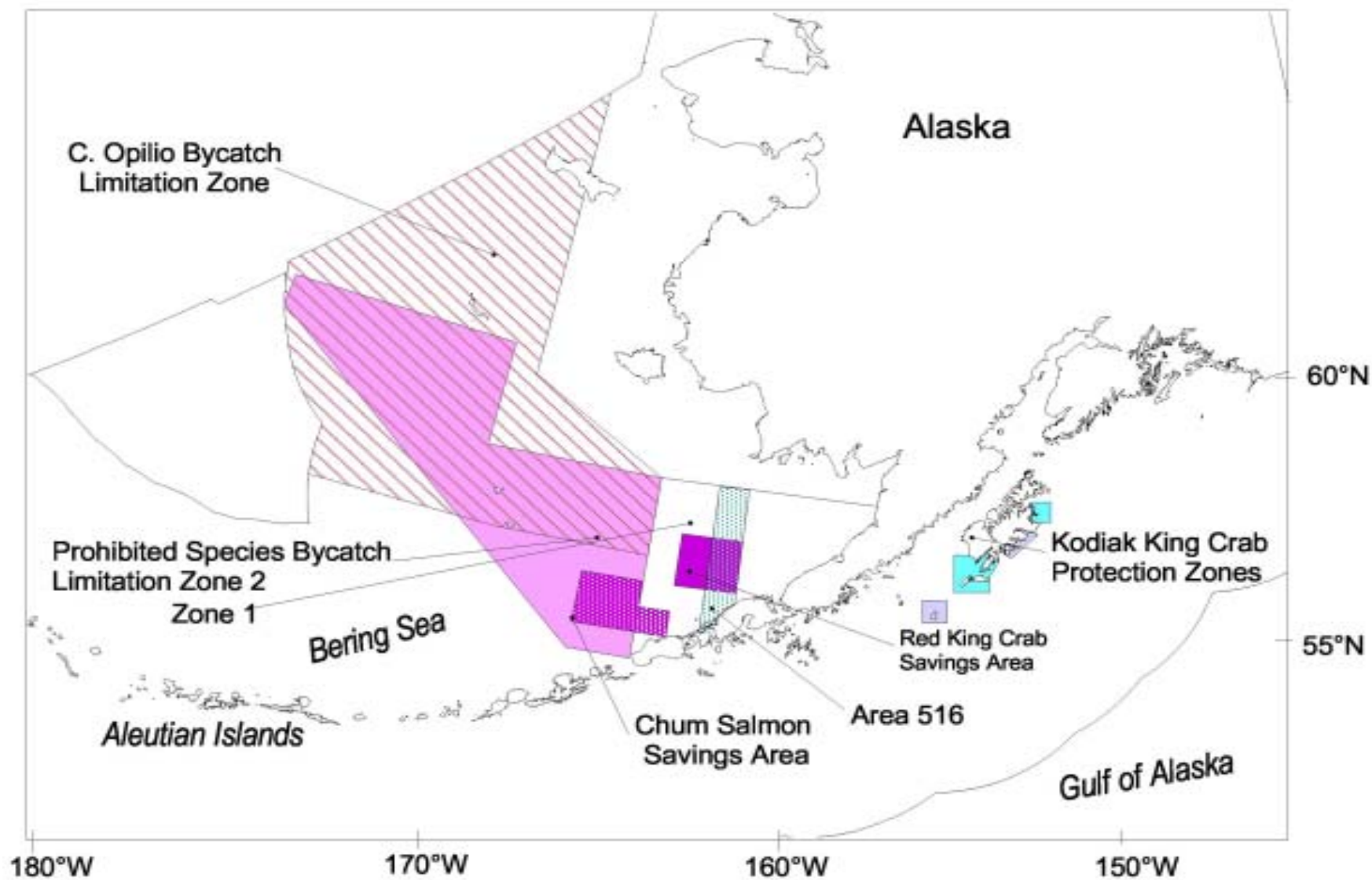


Figure 2. Management areas involving prohibited species in the Bering Sea and Gulf of Alaska. Source: NMFS.

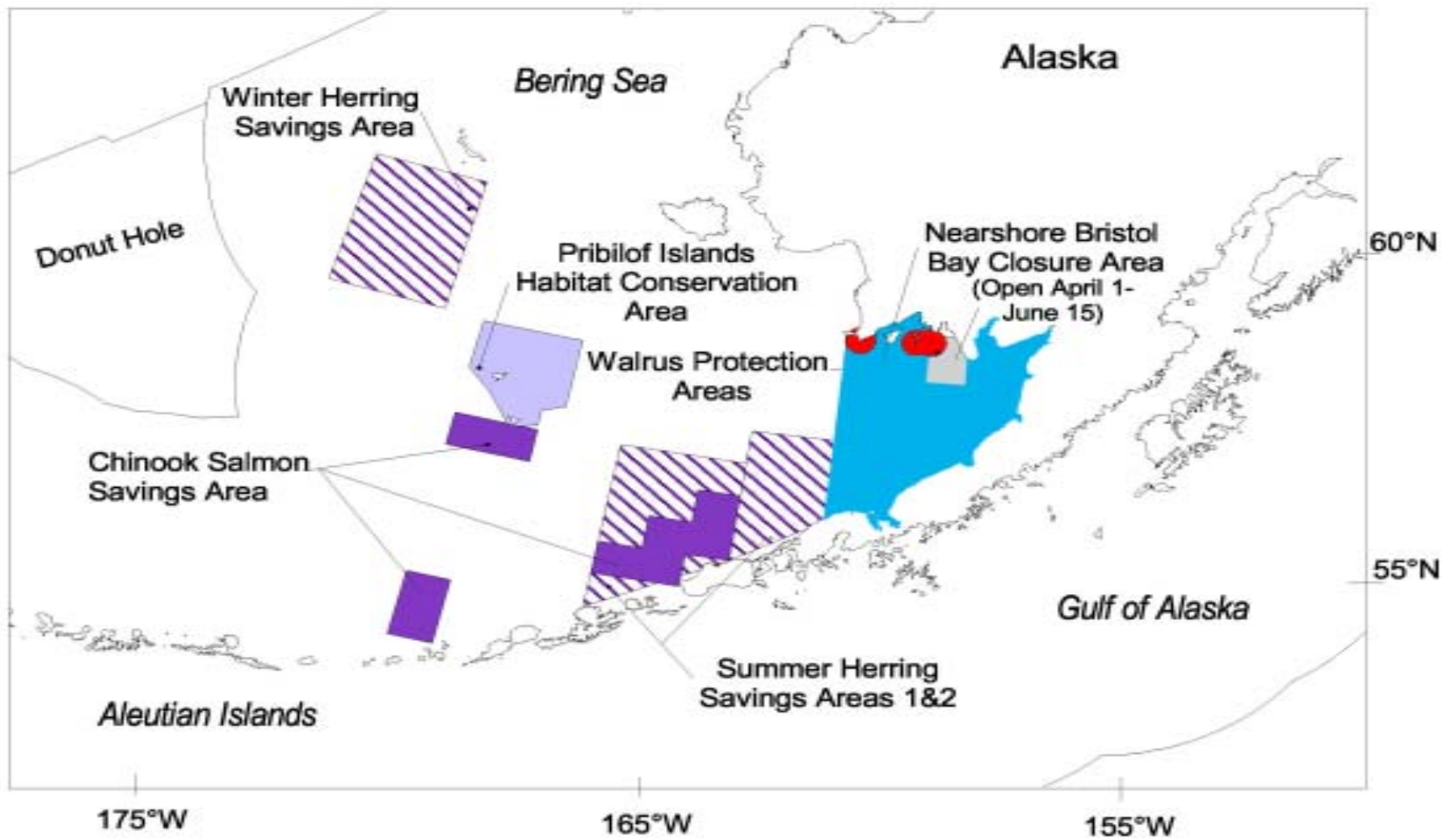


Figure 3. Management areas involving prohibited species and walrus in the Bering Sea. Source: NMFS.

Crab bycatch in the BSAI is also managed through the use of seasonal time and area closures and PSC limits (BSAI Amendments 40 and 41). Bycatch limits for king and Tanner crabs are generally a function of crab abundance as estimated from annual trawl surveys conducted by NOAA Fisheries (Table 6). Current PSC limits represent about 1 percent or less of the estimated annual abundance of each species. This fixed percentage approach means that annual PSC limits adjust in conjunction with increases or decreases in the underlying population. Bycatch limits are considered an acceptable loss rate that does not significantly deplete stocks or impede the recovery rates for rebuilding depleted stocks. BSAI Amendment 57, which prohibits the use of non-pelagic trawl gear in the BSAI pollock fishery, further reduces crabs bycatch limits as indicated in Table 5. PSC limits are also allocated among areas and target fisheries. When a PSC limit is reached for a specific fishery/zone, that fishery is closed in that zone for the season. Most of the bycatch of crabs in the BSAI comes from directed trawl fisheries for yellowfin sole, rock sole, flathead sole, and Pacific cod.

Table 6. Prohibited species bycatch limits for crabs in the Bering Sea and Aleutian Islands.

Species	Prohibited species catch (PSC) limits	Abundance
Red king crab (Zone 1)	35,000 crabs (-3,000 additional crabs)	Less than 14.5 million pounds of female spawning biomass in eastern Bering Sea
	100,000 crabs (-3,000 additional crabs)	From 14.5 to 55 million lbs of female spawning biomass in eastern Bering Sea
	200,000 crabs (-3,000 additional crabs)	Greater than 55 million lbs of female spawning biomass in eastern Bering Sea
Opilio Tanner crab Bycatch Limitation Zone	0.1133% of total crab abundance (-150,000 additional crabs)	Minimum: 4.5 million crabs Maximum: 13 million crabs
Bairdi Tanner crab (Zones 1 and 2)	Zone 1 (-20,000 additional crabs)	
	0.5% of abundance	0-150 million crabs
	750,000 crabs	150-270 million crabs
	850,000 crabs	270-400 million crabs
	1,000,000 crabs	Over 400 million crabs
	Zone 2 (-30,000 additional crabs)	
	1.2% of abundance	0-175 million crabs
	2,100,000 crabs	175-290 million crabs
	2,550,000 crabs	290-400 million crabs
	3,000,000 crabs	Over 400 million crabs

There are no PSC limits or time and area closures for crabs in the GOA. Although the bycatch of crabs in the GOA is very small relative to those in the BSAI, there is little information regarding the sizes and status of GOA stocks. Without such information, there is no way to determine the proportion of each stock being affected by bycatch or if critical crab habitat is being damaged.

Of the two principal management tools used to control crab bycatch -PSC limits and time/area closures- PSC limits are probably less effective in terms of decreasing the adverse effects of the BSAI groundfish fishery with respect to the crab stocks. Crab bycatch in the trawl fishery is not a major source of crab mortality, relative to other sources of crab mortality such as the directed crab fishery. However, because trawling negatively impacts crab stocks through unobserved mortality and habitat degradation, closed areas tend to be more effective than PSC limits in reducing the impact of trawling on crab stocks (Witherell and Harrington 1996). The critical importance of crab habitat to the success of crab populations was the key element that prompted the NPFMC to establish crab savings and conservation areas. These protected areas likely have a significantly beneficial effect on the conservation of crab stocks in the BSAI.

Pacific Salmon

Pacific salmon and trout fisheries are managed under a combination of domestic and international regulations and treaties. Fisheries are managed by ADF&G within state waters, where most of Alaska's commercial fishing occurs. Commercial fishing within the EEZ is limited to southeast Alaska and NPFMC management is deferred to ADF&G. Harvests of chinook, coho, and sockeye salmon in southeast Alaska are managed by agreement with Canada under the Pacific Salmon Treaty. Management of salmon fisheries in international waters of the Northern Pacific is under the auspices of the North Pacific Anadromous Fish Commission, which consists of a four countries (Canada, Japan, Russia, and the U.S.).

Within the State of Alaska, ADF&G manages salmon stocks for individual rivers of origin based upon escapement (the number of surviving spawners). Most salmon return to their natal rivers of origin to spawn and this fidelity leads to reproductively distinct stocks within the overall population. Each year, spawners are counted during their upstream migration. This means that escapement estimates are made after stocks have been reduced by natural mortality at sea, bycatch at sea, and directed fisheries downriver. If the perceived number of surviving spawners in a given river is below management goals, ADF&G limits or prohibits fishing in Alaska's commercial, subsistence, and recreational fisheries. Stock management by the state thus compensates for salmon bycatch in the groundfish fishery by reducing yields to directed salmon fisheries.

The five species of Pacific salmon are divided into two FMP bycatch management groups: chinook salmon, and "other" salmon (chum, sockeye, coho, pink). Steelhead trout have not been observed recently in either the BSAI or GOA and are not considered in this assessment. All groundfish fisheries in the BSAI and GOA are prohibited from retaining any species of salmon except for those retained under the Voluntary Salmon Donations Permit that authorizes their retention for local food banks (BSAI Amendment 26, GOA Amendment 29). In 1999, over 3 million pounds were donated.

Of the five salmon species, only the bycatch of chinook and chum salmon are of any serious concern in the BSAI and GOA. Pink, coho, and sockeye salmon populations in Alaska are considered healthy and bycatch in the groundfish fisheries represents only a minuscule portion of state harvests. These three species also are small components of bycatch in the groundfish fishery relative to chinook and chum salmon. The 926,879 Pacific salmon taken as bycatch in the BSAI from 1990 to 1997 consisted of 590,892 (64 percent) chum salmon, 331,759 (35 percent) chinook salmon, 3,557 (0.38 percent) coho salmon, 173 (0.02 percent) sockeye salmon, and 491 (0.05 percent) pink salmon. The 366,491 Pacific salmon taken as bycatch in the GOA from 1990 to 1997 consisted of 200,637 (55 percent) chum salmon, 160,264 (44 percent) chinook salmon, 3,952 (1.08 percent) coho salmon, 337 (0.09 percent) sockeye salmon, and 1,301 (0.35 percent) pink salmon. Most of these salmon are taken in pelagic trawl gear targeting pollock.

Although the overall bycatch of chinook and chum salmon is also very small relative to state harvests, bycatch take could pose a threat to specific stocks (rivers of origin). Some western stocks of chinook salmon are currently depressed. In 2000, there were fishing closures in the Yukon and Kuskokwim river systems and it is possible that ADF&G escapement goals may not be realized over the immediate future. If individual stocks become so depressed that full closure of direct fisheries is insufficient to enable a rebound in the population, then any additional mortality, including bycatch, could negatively impact the stock. It is estimated that 58-70 percent of chinook salmon bycatch in the BSAI groundfish fisheries may originate from western Alaska stocks, but it is unknown what proportion of these salmon are specifically from depressed stocks.

Analysts contend that there is insufficient information to determine the effects of BSAI bycatch and PSC limits on specific at-risk stocks within this western group.

The NPFMC adopted BSAI Amendment 21b, which established a PSC limit in the BSAI of 48,000 chinook salmon allocated between January 1 and April 15 for trawl gear. Upon attainment of the bycatch limit, all trawling was prohibited in the 9,000 nm² Chinook Salmon Savings Area (Figure 3). Chinook salmon bycatch tends to be high in this area during the January-April time frame. Trawl fisheries were reopened after April 16 for the remainder of the year. The PSC limit represents about 19.2 to 36.9 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. This is a substantial portion of the domestic harvest.

In 1999, the NPFMC adopted BSAI Amendment 58, which: 1) further reduced the chinook salmon bycatch limit from 48,000 to 29,000 fish by 2003, 2) implemented year-round accounting of chinook salmon bycatch in the pollock fishery, 3) revised the boundaries of the Chinook Salmon Savings Areas, and 4) set more restrictive closure dates. This reduced PSC limit represents about 11.6 to 22.3 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. Still a sizable proportion of the domestic harvest.

PSC limits have not been established for salmon in the GOA, however, seasonal fishing seasons for pollock in the central and western GOA have been adjusted to avoid periods of high chinook and chum salmon bycatch. Bycatch in the GOA groundfish fishery is presently only about 2-4 percent of directed chinook salmon landings in Alaska and is not likely have an effect on populations in general. Western stocks are thought to make up a smaller proportion of chinook salmon bycatch than in the BSAI, however, there is insufficient information to determine how much smaller and what proportion may actually consist of specific at-risk stocks.

Some western Alaska stocks of chum salmon are also depressed. In the BSAI (BSAI Amendment 35), a limit of 42,000 "other" salmon (primarily chum salmon) can be taken between August 1 and September 1 in the 5,000 nm² Chum Salmon Savings Area (Figure 2). Analysts estimate that about 19 percent of chum salmon bycatch in the BSAI is from western stocks. Because this is equivalent to only 1.3 to 1.5 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chum salmon landings reported between 1997 and 1999, bycatch represents a tiny fraction of landings even for depressed stocks. In all likelihood, bycatch of chum salmon in the BSAI has a negligible effect on Alaskan stocks. Further, there is considerable spatial overlap of the Chum Salmon Savings Area with the Steller Sea Lion Conservation Area (SCA), which, under provisions of the AFA, greatly limits pollock fishing in that region of the Aleutian Islands.

There are currently no bycatch limits or area closures for "other" salmon in the GOA. From 1997 to 1999, chum salmon comprised about 56 percent (5,000 fish) of "other" salmon taken as bycatch in the GOA. This amount of bycatch was equivalent to 0.02-0.03 percent of all chum salmon landings and only 0.34-0.82 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chum salmon landings reported between 1997 and 1999. Such low proportions suggest that chum salmon bycatch in the GOA will have little impact on any Alaskan stocks.

Although there are no salmon stocks in Alaska that are listed as either endangered or threatened under the Endangered Species Act (ESA), there are several listed stocks of chinook and chum salmon from rivers in Washington, Oregon, and California that could migrate into marine waters off Alaska. After detailed study, NMFS (1994) concluded, "the groundfish fisheries are not likely to jeopardize the continued existence of any ESA-listed salmon."

5.3 Forage Species

Direct fisheries for forage fish species are prohibited in the EEZ (BSAI Amendment 36, GOA Amendment 39). MRA limits are set at 2 percent for the entire group regardless of species composition. Fish taken within the 2 percent limit may be commercially retained and typically are processed into fishmeal. In all cases, most of the forage fish bycatch is taken in pelagic trawls; 74 percent in the BSAI, 93 percent in the GOA. The vast majority of forage fish taken as bycatch are osmerids (capelin, eulachon, other smelts). Collectively, forage fish form only a small part of bycatch of groundfish fisheries typically comprising less than 0.1 percent of the directed harvests. From 1990 to 1993, osmerid bycatch ranged from 127.2 to 530.7 mt in the GOA, and from 31.8 to 292.1 mt in the BSAI. In the most recent three years, 1997 to 1999, an average of 39 mt of forage species were taken annually in the BSAI and 61 mt in the GOA. Bycatch in the GOA was higher at 218 mt.

There are no biomass estimates for forage fish in the BSAI or the GOA and it is difficult to quantitatively determine the effect of bycatch on forage fish populations. For many forage fish species, little is known about their abundance, growth rates, maturity, migrations, and trophic relationships. Some of the more common forage fishes such as capelin, smelt, and eulachon are considered R-selected species, which is a term used in population analysis that refers to characteristics of a species' high reproductive rates, fast growth, and rapid maturity. These R-selected species may undergo considerable natural fluctuations in abundance. While this R-selective strategy may help stocks rebound quickly from depressed levels, variable abundance could make stock (impact) assessments that much more difficult.

Nevertheless, given the position that forage fish, particularly osmerids, occupy in the North Pacific ecosystem, it is unlikely that bycatch would have a significant effect on any of the forage fish species over time. The mere fact that forage fish play such a central role in the trophic chain, serving as food for a wide variety of fish, marine mammals, and seabirds, suggests that they must exist at biomass levels capable of sustaining such a vast biological system. Between the BSAI and GOA there are an estimated 48 million seabirds, nearly 230,000 seals and sea lions, a groundfish fishery that annually permits the harvest of 1.5-2.0 million mt of fish, a coastal halibut fishery that annually harvests nearly 40,000 mt, and an Alaskan salmon industry that in 1998, landed 154 million (330,000 mt) adult fish. The annual loss of a few hundred mt of forage fish is unlikely to have a significant effect on this system or forage fish stocks.

5.4 Other Species

Annual aggregate TAC limits are set for the group of other species, and separately for squid in the BSAI, based upon stock assessments. Based upon 1999 stock assessments, the NPFMC is considering an expanded FMP amendment that would specify TACs on individual species of sharks and skates. The NPFMC has also recommended that "other" species be placed on bycatch only status. These decisions are pending.

There is some concern that under the current management plan a species or species group could be disproportionately exploited within the aggregate TAC. The "other" species category includes species with diverse life histories, and in many cases little is known about their population dynamics and structure. Species that are long-lived and have low reproductive potential are particularly vulnerable to depletion because it takes them longer to rebound from natural and fishing mortality. In addition to the paucity of life history data, a lack of research and fishing data also hampers assessments of stock status and bycatch effects. Individual species within the skate and sculpin complexes are not identified aboard ship because of a lack of trained personnel and time constraints. This greatly limits the value of any catch data. A lack of biomass estimates for squid precludes stock status relative to bycatch. All of these data limitations make it difficult to determine the extent to which individual species are protected from the pressures of bycatch given the aggregate TAC allocation. Current NPFMC efforts to develop individual TACs and bycatch restrictions on individual taxa within the "other" species category could eventually prove beneficial to disproportionately exploited species should they exist.

5.5 Nonspecified Species

There is currently no management and only limited monitoring of the species in this category. Retention of any nonspecified species is permitted under current FMP policy. The same concerns about disproportionate exploitation of certain species expressed above for other species is also germane to nonspecified species. Little is known about the ecology of many of the species in this category and limited fishing data are recorded. For example, the bycatch of grenadiers is higher in the GOA than all species in the other species category combined, yet the extent to which this bycatch may affect these long-lived species is unknown.

5.6 Indirect Effects

5.6.1 Spatial and Temporal Concentrations in Bycatch

Indirect impacts caused by spatial or temporal concentrations of bycatch might include the overharvesting of a distinct genetic component of a stock, local alterations in predator-prey relationships, or adverse impacts to spawning grounds or aggregations. In many instances, particularly with species within other, nonspecified, and forage fish categories, so little is known about their population dynamics and life histories that it is difficult to determine the indirect impacts of the Alternative 1. The dynamic nature of the North Pacific ecosystem would make assessments equally difficult even for more well understood fish species. Assessments would have to contend with a host of variables such as natural fluctuations in population size, migratory patterns, shifts in population age structures, and localized productivity. Overall, there is insufficient information with which to assess the effects of spatial and temporal concentrations in bycatch.

5.6.2 Socioeconomic

FMP management measures have had some level of success in decreasing overall bycatch mortality, but not without cost to the groundfish fishery. Halibut bycatch mortality limits have resulted in numerous closures over the years and have reduced the commercial catch of target species. In part because of halibut PSC limits, portions of the annual TACs specified for most flatfish species have remained unharvested (Witherell 1995). Careful release requirements established for the long-line fishery have improved discard survival but have also increased the amount of time and effort expended by fishermen. Pacific herring PSC limits have repeatedly closed Herring Savings Areas 2 and 3 to trawl fisheries directed at pollock, rock sole, yellowfin sole, and other flatfishes. Area closures for salmon and crabs also impede commercial fishing efforts.

In general, many steps taken to reduce bycatch also reduce commercial harvests and/or the economic value of those harvests within the North Pacific groundfish fisheries. The extent of economic cost to the groundfish industry depends on a number of factors, the specifics of which are far beyond the scope of this overview.

Aside from promoting general conservation, protecting depressed species, and reducing waste, bycatch restrictions implemented for the groundfish industry confer positive economic benefits to nongroundfish fisheries. Regardless of the regulatory bodies involved, halibut, herring, and salmon fisheries are managed with the primary goal of maintaining healthy, productive, and sustainable populations that will support commercial, subsistence, and recreational fisheries over the long-term. Population declines systematically trigger regulatory restrictions on fishing while population expansions allow for increased harvests. Over the long-term, reductions in bycatch (mortality) in the groundfish fishery typically allow increased harvests in the other domestic fisheries. Whether the gain to domestic fisheries is substantial is a matter for more detailed economic analysis.

5.7 Cumulative Effects

The current analysis has identified three ways in which FMP policy might affect the diversity or stability of the BSAI and GOA ecosystems: 1) altering biodiversity 2) altering predator-prey relationships, and 3) altering energy flow.

5.7.1 Biodiversity

Biological diversity (or biodiversity) is a general term that defines the diversity of life and its processes (CEQ 1993). Biodiversity may be expressed in terms of species diversity, functional (trophic) diversity, or genetic diversity. Measures of species diversity include the number of species in a community (species richness) and the relative abundance among species (evenness). Functional diversity deals with the stability and relative abundance among interdependent taxa within the trophic web. Genetic diversity is the inherent genetic heterogeneity within a species. Species characterized by greater genetic diversity are generally more capable of responding and adapting to physical and biological changes in their environment. The removal of fish through bycatch could disproportionately affect one species over another thereby disrupting the natural balance in species or trophic diversities. Removal of localized spawning aggregations could alter genetic diversity if the particular aggregation of fish removed from the system is genetically different from other components of the population.

At present, there is insufficient information on the ecological and genetic diversity of fish species and benthic fauna in the BSAI and GOA to assess the cumulative effects of the alternative on biodiversity in terms of bycatch. Species characterized by long life spans, slow growth, late maturity, and/or low reproductive potential run the greatest risk of being depleted by bycatch removal. Whether the bycatch incurred under Alternative 1 is sufficient to substantially impact vulnerable species having these characteristics is unknown. Bycatch mortality is generally considered to have a negative effect because of increased loss to the ecosystem; however, the magnitude and significance of this loss cannot be accurately assessed at this time.

Factors unrelated to the groundfish fishery are far more likely to be the principal agents driving species diversity in the region. These would include the introduction of non-indigenous species, natural fluctuations in the relative abundance of species within the food web, and long-term climatic changes. The potential changes caused by global climatic changes alone could potentially dominate the system regardless of any groundfish management plan.

5.7.2 Predator-Prey Relationships

Predator-prey relationships can be altered by selectively removing predators or competing forage species from the food web, overfishing important forage species by concentrating fishing effort in time or space, removing top predators, or by introducing non-indigenous competitors into the food web. Given the natural and anthropogenic forces at work in the North Pacific, it seems unlikely that bycatch associated with Alternative 1 policy has any significant effect on the predator-prey relationships overall. The external pressures exerted directly on predator-prey components of the food web by all of the directed fisheries operating in Alaskan and North Pacific would more than overwhelm any effect of bycatch. Compared to bycatch, the removals of predator and prey biomass associated with seasonal harvests of salmon, halibut, herring, groundfish, and crabs are massive.

At a localized level, however, depletion of specific size or age groups could have short term effects on predator-prey relationships. Such impacts might be difficult to detect. Their ramifications to the ecosystem are uncertain.

5.7.3 Ecosystem Energy Balance

Fishing can remove energy (i.e., biomass) from an ecosystem. If sufficient energy is removed from or returned as discards to the system relative to total biomass, the energy balance of the system could be destabilized or changed with unknown consequences. In fact, it is likely that anthropogenically-induced changes have already occurred in the North Pacific ecosystem given the long history of commercial and subsistence fishing in the region. Nevertheless, it is highly unlikely that bycatch associated with Alternative 1 have significantly altered the energy characteristics of the BSAI and GOA. The amount of biomass being removed that is directly associated with these two components is minuscule compared to the biomass removal that results from the combined commercial, subsistence, and recreational fisheries operating in Alaska and the North Pacific. Further, the ecosystem energy balance in the North Pacific is dynamic and in a constant

state of flux in both time and space. Over time, the effect of bycatch removal and alterations of energy flow patterns associated with discarding of bycatch would be easily absorbed by such a massive oceanic system.

Section 6 Alternative 2: Adopt a More Aggressive Management Policy

6.1 Policy Goals and Objectives

Under this alternative a more aggressive harvest strategy would be implemented. Details of policy goals and objectives are outlined in Section 4 entitled Policy Alternatives and Rationale. Specific illustrative FMP measures for Alternative 2 are summarized in Table 3.

6.2 Direct Effects

The overall bycatch effect of Alternative 2 would be a general increase in bycatch mortality for all five species categories (e.g., target, prohibited, and forage, other, and nonspecified species). The severity of increased bycatch would depend upon the degree to which management policy would shift from Alternative 1 (FMP 2.2) toward the opposite Alternative 2 extreme (FMP 2.1). The increase in bycatch would be further exacerbated by provisions in Alternative 2 which allow for an increase in TACs for the directed fisheries from current levels (FMP 2.2) all the way up to a projected 15-20 percent increase in fishing (FMP 2.1). The gradual repeal of time and area closures across the Alternative 2 policy spectrum could increase mortality within crab, herring, salmon, and halibut populations. The direct effect of Alternative 2 provisions on the different species groups and management tools are detailed below.

6.2.1 Target Species

Normally, rigorous management of directed fisheries would allow target stocks to endure higher mortality associated with bycatch regardless of the management measures adopted within the range offered under Alternative 2. Any increase in mortality would eventually be incorporated into stock assessments that are used by the NPFMC and NOAA Fisheries to set TAC limits for subsequent fishing seasons. However, the alternative also provides for a downsizing of the present observer program (FMP 2.2) up to its complete elimination (FMP 2.1). Because information collected by the observer program is crucial to stock assessments, its elimination means that targeted stocks may not be efficiently managed. The net affect could be quite detrimental to groundfish populations particularly given the increase in fishing pressure under the alternative.

A more aggressive harvest strategy could increase economic discards. Easing of the IR/IU program (detailed below) up to its full elimination under FMP 2.1 would almost certainly increase the number of pollock and cod discards. In the BSAI, the original implementation of the IR/IU program resulted in an immediate decrease in the discard for pollock from 94,800 mt to 16,200 mt, and for Pacific cod from 22,100 mt to 4,300 mt. A combination of phasing out of the program and increased fishing under Alternative 2 could result in pollock and cod discard rates notably higher than pre-IR/IU levels. The mandatory retention program currently scheduled to take effect under Alternative 1 for selected species of flatfish would also be abandoned. Increased harvests of target species could result in proportionate increases in economic discards in many of groundfish fisheries.

6.2.2 Prohibited Species

Halibut

The elimination of bycatch restrictions is not likely to have a significant biological impact on the halibut population over the long-term regardless of the management measures adopted within the range offered under Alternative 2. The halibut population is presently healthy and total catch has been near record levels. Any increase in bycatch would be incorporated into IPHC stock assessments and harvest quotas. Lower harvest quotas would offset increased bycatch. The effect would be an economic loss to the directed halibut fisheries.

Herring

The Pacific herring population would be largely unaffected by increased bycatch mortality over the long-term regardless of the management measures adopted within the range offered under Alternative 2. ADF&G adjusts annual harvest quotas relative to projected herring biomass in the BSAI and GOA. Lower harvests in the nearshore state fisheries would offset increased bycatch mortality. The effect would be an economic loss to the directed herring fisheries.

King and Tanner Crabs

Crabs are the group most likely to be at long-term risk as the result of relaxed bycatch restrictions, particularly the elimination of time and area closures. Many of the crab stocks in the BSAI are currently at or below critical levels. As discussed under Alternative 1, agency analysts contend that the greater danger to crabs comes from trawls that disrupt essential crab habitat. Closed areas thus tend to be more effective than PSC limits in reducing the impact of trawling on crab stocks. If time and area closures and gear restrictions are lifted under Alternative 2, there is a real potential for damage to crab stocks in areas of high aggregation. It is a virtual certainty that the complete repeal of time area closures and gear restrictions that would be reached under FMP 2.1 would have serious detrimental consequences to crab stocks.

As was the case for Alternative 1, there is little information on the sizes and status of GOA crab stocks. There is no way to determine the proportion of each stock being affected by bycatch or if critical crab habitat is being damaged in any substantial way.

Pacific Salmon

Under Alternative 2, PSC limits in the BSAI would remain at the levels that currently exist under Alternative 1 (FMP 2.2) or be eliminated completely (FMP 2.1). There are currently no bycatch restrictions in the GOA so no change would occur.

For the reasons described under Alternative 1, it is possible that current PSC restrictions in the BSAI management region may not be providing adequate protection to some depleted western chinook salmon stocks. If this is the case, the removal of PSC limits could exacerbate the situation and more at-risk chinook salmon might be taken. Further, Alternative 1 PSC limit of 29,000 fish represents about 11.6 to 22.3 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. This is a substantial portion of the domestic harvest. Elimination of PSC limits would increase these proportions even further.

Western Alaska stocks of chum salmon are also depressed. Under Alternative 1, analysts estimate that about 19 percent of chum salmon bycatch in the BSAI is from western stocks and that this is equivalent to only 1.3 to 1.5 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chum salmon landings reported between 1997 and 1999. This bycatch represents a tiny fraction of landings, even for depressed stocks. Under FMP 2.1, there might be a 15 to 20 percent increase in the harvests of target species, which could result in a proportionate increase in chum salmon bycatch throughout the entire BSAI. This would still be equivalent to only a small fraction of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chum salmon landings reported between 1997 and 1999.

Current PSC restrictions on chum salmon are limited to the catcher vessel operation area where 42,000 "other" salmon can be taken between August 15 and October 15, a period when chum salmon bycatch in the trawl pollock fishery is very high. Even if the PSC limit were lifted, pollock fishing in the Savings Area would be limited by seasonal allocations of TAC which, under Alternative 2, remain the same as Alternative 1. Further, there is considerable spatial overlap of the chum salmon Savings Area with the SCA, which greatly limits pollock fishing in that region of the Bering Sea. It is unlikely that the removal of the PSC limits and increased pollock TAC would seriously affect at-risk western chum salmon stocks.

As discussed under Alternative 1, the bycatch of sockeye, coho, and pink salmon are insignificant in the BSAI and GOA relative to seasonal harvests in directed Alaskan fisheries. The bycatch of ESA-listed salmon stock for Washington, Oregon, and California are also nominal. These stocks would remain unaffected regardless of the management measures adopted within the range offered under Alternative 2.

6.2.3 Forage Species

Alternative 2 would affect the bycatch of forage fish in two ways: 1) under FMP 2.1, the repeal of bycatch restrictions would mean the elimination of 2 percent MRA limits for forage fish, and 2) the increase in groundfish fishing effort could result in a proportionate increase in bycatch.

In most instances, the bycatch for forage fish is far less than 1 percent in any of the targeted fisheries. From 1997 to 1999, the proportionate bycatch of forage fish relative to the total target fish harvest was less than 0.01 percent in the BSAI and 0.39 percent in the GOA. When averaged over the fishery, bycatch was well below MRA limits. If these trends are indicative of long-term bycatch trends in the groundfish fishery, then easing of the 2 percent cap, up to its full elimination under FMP 2.1, is not likely to substantially increase bycatch overall simply because the MRA limits are not normally reached anyway when averaged over the entire fishery. Because bycatch rates are so low, even an increase in harvest under Alternative 2, up to a maximum increase of 15-20 percent that would occur under FMP 2.1, is not likely to increase the bycatch of forage fish by more than that. For the reasons discussed under Alternative 1, it is unlikely that bycatch would seriously impact forage fish stocks regardless of the management measures adopted within the range offered under Alternative 2.

There is a provision under Alternative 2.2 for the establishment of a directed fishery for forage fish. Although the effects of a directed fishery is a TAC and not a bycatch issue, increased fishing pressure on any of the targeted species that would accompany such a measure could require re-evaluation of bycatch effects, particularly on a localized scale.

6.2.4 Other Species

The management of "other" species under Alternative 2 is the same as for Alternative 1. Although the "other" species group is currently managed as an aggregate, the NPFMC has proposed that TACs and bycatch restrictions be developed on an individual species basis for skates and rays. It is assumed that additional species may be singled out as additional information is gathered. Any enhanced focus on individual species within the "other" species category could eventually prove beneficial to disproportionately exploited species, should they exist.

6.2.5 Nonspecified Species

Under Alternative 1, there is currently no management and only limited monitoring of any species in this category. Little is known about the ecology of many of the species and it is difficult to assess the effects of this policy. No additional protection would be offered this group under Alternative 2. As with Alternative 1, there is insufficient information on the species within this group with which to assess the potential effects of the plan.

6.2.6 Observer Program

The alternative provides for a downsizing of the present observer program (FMP 2.2) up to its complete elimination (FMP 2.1). The observer program serves a crucial role in gathering data essential for monitoring bycatch in the groundfish fishery. Any reduction in the observer program would impede the effectiveness of what is essentially the onsite eyes and ears of the entire fisheries management system. Record keeping and reporting requirements mandated by the NPFMC for operational fishing vessels provide some essential management information, but they do not provide the kinds of detailed and independent catch data that is supplied by onboard observers. A repeal of the program could have a significantly adverse effect on bycatch management and, in turn, the health and stability of all groundfish stocks and other living marine resources.

6.2.7 Improved Retention/Improved Utilization

The alternative ranges from maintaining the present IR/IU program (FMP 2.2) up to its complete repeal (FMP 2.1). In 1998, the year the amendment was implemented, discards in the BSAI dropped for pollock from 94,800 mt to 16,200 mt, and for Pacific cod from 22,100 mt to 4,300 mt. Relaxation of the 100 percent retention policy up to full repeal would allow for a corresponding increase in economic discards. As discussed above under Target Species, pollock and cod populations are managed via stringent stock assessment models and TAC allocations, and discard losses are taken into account when determining yearly harvest quotas. The presence or absence of an IR/IU program would have no effect on stocks. However, the elimination of the IR/IU program would increase economic discards. The mandatory retention program currently scheduled to take effect under Alternative 1 for selected flatfish species would also be abandoned.

6.2.8 Vessel Incentive Program

There are no proposed changes in the VIP that is currently implemented under Alternative 1. However, it cannot be implemented without an observer program, and the observer program would be eliminated under FMP 2.1.

6.3 Indirect Effects

6.3.1 Spatial and Temporal Concentrations in Bycatch

Overall, there is insufficient information with which to assess the effects of spatial and temporal concentrations in bycatch (see Spatial and Temporal Concentrations in Bycatch under Alternative 1).

6.3.2 Socioeconomic

The primary benefit of Alternative 2 would be an economic boost to the groundfish industry at the expense of other fisheries (e.g., halibut, crab, and herring). The plan would gradually open the North Pacific to a less restrictive fishing environment and allow for larger and more economically-efficient harvests. Fishing would still be limited by management strategies to maximize the sustainable yields of targeted stocks but fishing efforts would be less encumbered by bycatch restrictions. Halibut PSC limits alone typically limit the harvest of some flatfish species. Virtually all herring bycatch occurs in the pollock fishery, which is the largest groundfish fishery in Alaskan waters.

The degree of economic benefit under Alternative 2 is problematic and would depend on a number of factors including the costs and benefits of extended fishing seasons, fishing seasons less constrained by specific time or area allocations, and the voluntary retention of marketable species. Some fisheries would benefit more than others. Pollock occur primarily in well defined aggregations and if fishing fleets encounter a hot spot they may be able to "top off" their seasonal TAC allocation rapidly (cost effectively) and with minimal bycatch. Some flatfish species that are more widely dispersed may be more costly to harvest even without bycatch restrictions.

The economic advantage conferred on the groundfish industry by Alternative 2 would come at the expense of other domestic fisheries in the region. Decreased fishing effort in the domestic fisheries would compensate for increased bycatch mortality in the groundfish fishery. Whether the economic loss to domestic fisheries would in any way be substantial is a matter for economic analysis.

6.4 Cumulative Effects

6.4.1 Biodiversity

There is insufficient information on the ecological and genetic diversity of fish species and benthic fauna in the BSAI and GOA to assess the cumulative effects of the alternative on biodiversity. Factors unrelated to the groundfish fishery are far more likely to be the principal agents driving species diversity in the region (see Biodiversity under Alternative 1, Section 5.7.2).

6.4.2 Predator-Prey Relationships

In general, it is unlikely that the increased bycatch that would occur under Alternative 2 would have any significant effect on predator-prey relationships (see Predator-Prey Relationships under Alternative 1, Section 5.7.2). At a localized level, however, depletion of specific size or age groups could have short term effects on predator-prey relationships. Such impacts might be difficult to detect and their ramifications difficult to ascertain.

6.4.3 Ecosystem Energy Balance

It is unlikely that the increase in bycatch associated with the alternative will have a significant effect on the energy budgets of the BSAI and GOA (see Ecosystem Energy Balance under Alternative 1, Section 5.7.3).

Section 7 Alternative 3: Adopt a More Precautionary Management Policy

7.1 Policy Goals and Objectives

Under this alternative a more precautionary harvest strategy would be implemented. Details of policy goals and objectives are outlined in the section entitled Policy Alternatives and Rationale. Specific Illustrative FMP measures for Alternative 3 are summarized in Table 3.

7.2 Direct Effects

The overall bycatch effect of Alternative 3 would be a general decrease in bycatch and bycatch mortality for all five species categories (e.g., target, prohibited, forage, other, and nonspecified species). The extent of bycatch reduction would depend upon the degree to which management policy would shift from a moderately more restrictive bycatch policy (FMP 3.1) to a substantially more extensive use of both market oriented bycatch reduction incentives and restrictive bycatch policy (FMP 3.2). Bycatch would further be reduced by provisions in Alternative 3 which would decrease TACs in the directed fisheries from current Alternative 1 levels (FMP 3.1) to lower levels with the TAC provisions outlined under FMP 3.2. More stringent management of individual species groups within the "other" and nonspecified categories would allow for more precise control of bycatch mortality and their effects on stocks. Expanded time and area closures would offer enhanced protection to crab, herring, salmon, and halibut populations and fisheries. The direct effects of Alternative 3 provisions to the different species groups and management tools are detailed below.

7.2.1 Target Species

Under a more restrictive management policy, fishing effort and harvests would decrease throughout the groundfish fishery. Change in the bycatch of a target species and adjustments in gear restrictions and allocations are not likely to have a significant effect on that population. Because bycatch mortality is incorporated into stock assessments that are used by the NPFMC and NOAA Fisheries to set TAC limits and to monitor total catch with respect to those TACs, the resulting decreases in discards will tend to be replaced with increases in retained catch. Therefore, compared to the target species stock effects for the TAC policies of Alternative 3, the effects of the bycatch policies are expected to be minimal.

7.2.2 Prohibited Species

Halibut

Under Alternative 3, PSC limits in the BSAI and GOA could be lowered from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2). The use of market oriented incentives to decrease bycatch would be expanded substantially under FMP 3.2. The expected reductions in halibut bycatch and bycatch mortality are not likely to have a significant biological impact on the halibut population over the long-term regardless of the management measures adopted within the range offered under Alternative 3. Any decrease in bycatch mortality would be incorporated into IPHC stock assessments and harvest quotas. Any benefit conferred on the halibut population by lower bycatch would eventually be offset by higher harvests in the halibut fishery. The halibut fishery would incur positive economic benefits, in some cases, at the expense of the groundfish fishery.

Herring

The Pacific herring population would be unaffected by the expected reductions in herring bycatch and bycatch mortality over the long-term, regardless of the management measures adopted within the range offered under Alternative 3. ADF&G adjusts annual harvest quotas in state domestic fisheries based upon herring stock projections. Any benefit conferred on the herring population by lower groundfish fishery

bycatch would eventually be offset by higher harvests in the directed state fisheries. Economic benefits would accrue to the herring fishery, in some cases, at the expense of the groundfish fishery.

King and Tanner Crabs

Under Alternative 3, PSC limits in the BSAI could be lowered from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2). PSC limits would be established for the GOA based upon stock and fishery data, then lowered 0-10 percent. Time/area/gear closures in the BSAI would remain consistent with Alternative 1. Appropriate closures would be implemented in the GOA based upon scientific study. Finally, the use of market oriented incentives to decrease bycatch would be expanded substantially under FMP 3.2. The expected reductions in crab bycatch and in the adverse effects trawling would have on crab habitat would allow a more rapid recovery of the crab stocks and fisheries.

As discussed under Alternative 1, closed areas tend to be more effective than PSC limits in reducing the impact of trawling on crab populations. Nevertheless, reduced PSC limits, and bycatch reduction incentives would help curtail bycatch and bycatch mortality. Maintaining closures in the BSAI would continue to have a significantly beneficial effect on crab stocks. The development of appropriate closures in the GOA could similarly be beneficial to crab populations in that region.

Salmon

Under Alternative 3, PSC limits in the BSAI would be lowered to the extent practical from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2). In the GOA, PSC limits would be established at 25,000 fish for chinook and 20,500 fish for other salmon. Finally, the use of market oriented incentives to decrease bycatch would be expanded substantially under FMP 3.2. Because salmon stocks in Alaska are rigorously managed by ADF&G and are generally considered healthy, any benefit conferred by lower bycatch would eventually be offset by higher harvests in the state's commercial, subsistence, and recreational fisheries. Economic benefits would accrue to these fisheries. Any additional protection afforded salmon populations under Alternatives 3 would, therefore, have no long-term effect on stock status.

The possible exceptions are at-risk western stocks of chinook salmon that may be taken as bycatch in the BSAI (see Alternative 1). At present, there is insufficient information with which to determine if these at-risk stocks are being seriously impacted by bycatch in the BSAI under Alternative 1. It would be equally difficult to quantitatively determine if increased protection offered under Alternative 3 would be sufficient to protect these stocks from further depletion. Qualitatively, reduced PSC limits ranging from 0-10 percent under FMP 3.1 to 10-30 percent under FMP 3.2 should offer proportionate protection to at-risk western chinook salmon stocks.

Alternative 3 would establish blanket PSC limits (FMP 3.1 to FMP 3.2) of 25,000 chinook salmon and 20,500 "other" salmon in the GOA. Since there is no indication that salmon stocks of any species are being adversely affected by the current absence of PSC limits in the GOA, it is unlikely that additional protection would have any effect on salmon populations.

7.2.3 Forage Fish

For the reasons outlined for Alternative 1, the bycatch of forage fish under Alternative 1 is not likely to have an effect on forage fish stocks. Additional reductions in bycatch under Alternative 3 would, therefore, provide no additional benefit to forage fish populations.

7.2.4 Other Species

Alternative 3 includes measures that would remove sharks and skates from the other species category and establish individual TACs for each. The NPFMC would also have the choice, based upon available scientific information, of removing the remaining species groups (sculpin, octopi, and GOA squid) from the other species category and likewise managing them via individual TACs (FMP 3.2). Enhanced focus on individual

species or species groups would provide for a more rigorous management of stocks both in terms of TAC and possible bycatch restrictions. In addition, the use of market oriented incentives to decrease bycatch would be expanded substantially under FMP 3.2. Such measures could offer greater protection to species that are disproportionately exploited under the current aggregate management plan if they indeed are at risk.

7.2.5 Nonspecified Species

Alternative 3 would seek to develop criteria to bring nonspecific species into a managed category. Because little is known about the population dynamics of many of the species in this category, it is difficult to assess the effects of this policy. However, the establishment of management practices typically promotes directed research toward specific species or species groups. This could enhance the NPFMC's understanding of population dynamics for species within this group and result in greater protection for stocks that may currently be at risk from unregulated bycatch take. In addition, the use of market oriented incentives to decrease bycatch would be expanded substantially under FMP 3.2 and could be applied to these species as a group or to identifiable subgroups.

7.2.6 Observer Program

Alternative 3 calls for an expansion in the observer program from Alternative 1 (FMP 3.1) to complete coverage of all vessels greater than or equal to 60 ft in length (FMP 3.2). The current FMP management plan requires 100 percent coverage on vessels greater than 124 ft, but only 30 percent coverage on vessels ranging from 60 to 124 ft in overall length. An expanded observer program could only enhance the ability of the NPFMC and NOAA Fisheries to monitor and regulate bycatch and to successfully implement market oriented solutions to the bycatch problems in the groundfish fishery. The key issue would be the cost of implementing such an expanded program.

7.2.7 Improved Retention/Improved Utilization

The provisions under Alternative 3 are the same as under Alternative 1.

7.2.8 Vessel Incentive Program

Under Alternative 3, the current VIP would be replaced with a number new conservation measures. Most options would include market oriented incentives to reduce bycatch and bycatch mortality. Such incentives would decrease the cost and increase the benefit of reducing bycatch for individual fishing operations and, therefore, make further reductions in bycatch practicable.

7.3 Indirect Effects

7.3.1 Spatial and Temporal Concentrations in Bycatch

Overall, there is insufficient information with which to assess the effects of spatial and temporal concentrations in bycatch (see Spatial and Temporal Concentrations in Bycatch under Alternative 1).

7.3.2 Socioeconomic

Alternative 3 includes more restrictive command and control solutions to the bycatch problems, as well as market oriented solutions. The latter would decrease the economic burden imposed on the groundfish industry by the former and could decrease substantially the need for the former. The direction and magnitude of the net effect on the groundfish industry is a matter for economic analysis and would depend on a number of factors including the costs and benefits of the specific restrictions and market oriented solutions that would be implemented. Some fisheries would be impacted more than others.

Decreased bycatch of groundfish or prohibited species by some groundfish fishing operations would benefit others and decreased bycatch of non-groundfish species would benefit those who participate in other fisheries in the region. Halibut, herring, crab, and salmon fisheries are managed with the primary goal of maintaining healthy, productive, and sustainable populations that will support commercial, subsistence, and recreational fisheries over the long-term. Reduced bycatch mortality in the groundfish fishery would eventually be realized as higher yields in domestic fisheries. Whether the gain to domestic fisheries would in any way be substantial is a matter for detailed economic analysis.

7.4 Cumulative Effects

7.4.1 Biodiversity

There is insufficient information on the ecological and genetic diversity of fish species and benthic fauna in the BSAI and GOA to assess the cumulative effects of Alternative 3 on biodiversity. Factors unrelated to the groundfish fishery are far more likely to be the principal agents driving species diversity in the region (see Biodiversity under Alternative 1).

7.4.2 Predator-Prey Relationships

It is highly doubtful that decreased bycatch associated with Alternative 3 will have any significant effect on predator-prey relationships (see Predator-Prey Relationships under Alternative 1).

7.4.3 Ecosystem Energy Balance

It is highly unlikely that the decrease in bycatch associated with the alternative will have a significant effect on the energy budgets of the BSAI and GOA (see Ecosystem Energy Balance under Alternative 1).

Section 8 Alternative 4: Adopt a Highly Precautionary Management Policy

8.1 Policy Goals and Objectives

Under this alternative an extremely precautionary harvest strategy would be implemented. Details of policy goals and objectives are outlined in the Policy Alternatives and Rationale section. Specific Illustrative FMP measures for Alternative 4 are summarized in Table 3.

8.2 Direct Effects

The overall bycatch effect of Alternative 4 would be a major decrease in bycatch and bycatch mortality for all five species categories (e.g., target, prohibited, forage, other, and nonspecified species). More stringent management of individual species groups within the "other" and nonspecified categories would allow for more precise control of bycatch mortality and their effects on stocks. A greater prevalence of time and area closures would offer enhanced protection to crab, herring, salmon, and halibut populations. Protections would be maximized under FMP 4.2 which would close the groundfish fishery altogether. The direct effect of Alternative 4 provisions to the different species groups and management tools is detailed below.

8.2.1 Target Species

Under a more restrictive management policy, fishing effort and harvests would decrease throughout the groundfish fishery. Any change in the bycatch of a target species is not likely to have a significant effect on that population. Because bycatch mortality is incorporated into stock assessments that are used to set TAC limits and to monitor total catch with respect to those TACs, the resulting decreases in discards will tend to be replaced with increases in retained catch. Therefore, compared to the target species stock effects of the TAC policies of Alternative 3, the effects of the bycatch policies of Alternative 4 are expected to be minimal. Decreased harvests and an IR/IU program for all target species could substantially reduce economic discards. FMP 4.2 would eliminate all bycatch. It would also eliminate the fishery.

8.2.2 Prohibited Species

Halibut

More stringent bycatch restrictions and a more limited groundfish fishery are not likely to have a significant biological impact on the halibut population over the long-term regardless of the management measures adopted within the range offered under Alternative 4. Any decrease in bycatch mortality would be incorporated into IPHC stock assessments and harvest quotas. Any benefit conferred on the halibut population by lower bycatch would eventually be offset by higher harvests in the directed halibut fishery. The directed halibut fishery would incur positive economic benefits at the expense of the groundfish fishery.

Herring

The Pacific herring population would be unaffected by more stringent bycatch restrictions and a more limited groundfish fishery regardless of the management measures adopted within the range offered under Alternative 4. ADF&G adjusts annual harvest quotas in state domestic fisheries based upon herring stock projections. Any benefit conferred on the herring population by lower groundfish fishery bycatch would eventually be offset by higher harvests in the directed state fisheries. The directed herring fishery would see positive economic benefits at the expense of the groundfish fishery.

King and Tanner Crabs

Under Alternative 4, PSC limits in the BSAI would be lowered to the extent practical from 30-50 percent (FMP 4.1) to PSC = 0, the complete closure of the fishery (FMP 4.2). In the GOA, PSC limits would be established based upon biomass and fisheries data, then lowered 30-50 percent. Additional closures would be established for the BSAI and GOA (FMP 4.1) and expanded to full closure of all crab habitats (FMP 4.2).

As discussed under Alternative 1, closed areas tend to be much more effective than PSC limits in reducing the impact of trawling on crab populations. Thus, the beneficial crab stock effects of more restrictive PSC limits are expected to be greater if those limits trigger area closures. Expanding closures in the BSAI and GOA would provide added protection to crab stocks. The closure of the groundfish fishery under FMP 4.2 would maximize this protection.

Salmon

Under Alternative 4, PSC limits in the BSAI would be lowered to the extent practical from 30-50 percent (FMP 4.1) to PSC = 0, or the closure of the fishery (FMP 4.2). In the GOA, PSC limits would be established at 25,000 fish for chinook and 20,500 fish for other salmon (FMP 4.1) and would remain in effect until complete closure of the fishery (FMP 4.2). Because salmon stocks in Alaska are rigorously managed by ADF&G and are generally considered healthy, any benefit conferred by lower bycatch would eventually be offset by higher harvests in the state's commercial, subsistence, and recreational fisheries. Domestic fisheries would benefit economically at the expense of the groundfish fishery.

The possible exceptions are at-risk western stocks of chinook salmon that may be taken as bycatch in the BSAI. There is insufficient information with which to determine if these at-risk stocks are being seriously impacted by bycatch in the BSAI under Alternative 1. Likewise, it is difficult to quantitatively determine if decreased bycatch under FMP 4.1 would sufficiently protect these stocks. Unless improved stock assessment and identification methods are developed, the no fishing provision under FMP 4.2 is the only measure that would guarantee full protection from the groundfish fishery to at-risk western chinook salmon stocks. It is not known how that high level of protection would affect the recovery of those salmon stocks.

8.2.3 Forage Fish

For the reasons outlined for Alternative 1, the bycatch of forage fish under Alternative 1 is not likely to have an effect on forage fish stocks. Additional reductions in bycatch under Alternative 4 would, therefore, provide no additional benefit to forage fish populations.

8.2.4 Other Species

Alternative 4 would set the TAC of species complexes within the other species category based upon the least abundant member of the group. It is assumed that any management strategy focusing on TACs could ultimately affect bycatch restrictions for that group. It is also assumed that the least abundant criterion is based upon the idea that least abundant, or rare, species are somehow at greater risk and that management strategy should center on protecting these most vulnerable stocks. While rare species may be more vulnerable to fishing pressures, sufficient scientific information would need to be gathered to verify such a conclusion for any given case. Low abundance of a particular other species could merely be the result of the directed fishery operating outside the primary distribution range of that species. Nevertheless, a more restrictive fishing policy could offer greater protection to species that are disproportionately exploited under the current aggregate management plan.

8.2.5 Unspecified Species

The FMP 4.2 extreme is a complete fishing ban; i.e., TAC = 0 for all species. Because little is known about the ecology of many of the species in the "unspecified species" category it is difficult to assess the effects of this policy. However, a no fishing alternative would completely eliminate the possibility of any unspecified species being overfished as bycatch.

8.2.6 Observer Program

Alternative 4 would expand observer coverage from 30 percent to 100 percent on all vessels 60-124 ft in length, and from 0 percent to 30 percent on all vessels less than 60 ft in length. It would also require that 100 percent of the hauls be observed. An expanded observer program could only enhance the ability of the NPFMC and NOAA Fisheries to monitor and regulate bycatch in the groundfish fishery and to successfully implement incentives to reduce bycatch. The key issue would be the cost of implementing such an expanded program.

8.2.7 Improved Retention/Improved Utilization

Alternative 4 calls for an expansion of the IR/IU program to all target species (FMP 4.1) up to the full prohibition on bycatch (FMP 4.2) which is effectively a no fishing alternative. Any expansion of the 100 percent retention policy would allow for a corresponding decrease in economic discards for all target species. Because target species are managed via stringent stock assessment models and TAC allocations, a reduction in discards would be taken into account when determining yearly harvest quotas. Any benefit conferred on target species would eventually be offset by higher harvests in the directed groundfish fisheries. Expansion of the IR/IU program up to a full prohibition on fishing would likely have no significant effect on groundfish stocks but would decrease discards. Full retention might also cause boats to top off sooner, which could result in shorter trips and less take overall.

8.2.8 Vessel Incentive Program

There are no proposed changes in the VIP as currently implemented under Alternative 1.

8.3 Indirect Effects

8.3.1 Spatial and Temporal Concentrations in Bycatch

Overall, there is insufficient information with which to assess the effects of spatial and temporal concentrations in bycatch (see Spatial and Temporal Concentrations in Bycatch under Alternative 1). FMP 4.2 would completely shut down the groundfish fishery and render the issue moot.

8.3.2 Socioeconomic

The primary impact of Alternative 4 would be to increase the economic burden on the groundfish industry. The plan would implement a more restrictive fishing environment and result in less economically efficient harvests. The degree of economic loss is a matter of economic analysis and would depend on a number of factors including the costs and benefits of more restricted fishing seasons, and fishing seasons more constrained by specific time/area allocations and closures. Some fisheries would be impacted more than others. FMP 4.2 would completely shut down the groundfish fishery.

Decreased bycatch of groundfish or prohibited species by some groundfish fishing operations would benefit others and decreased bycatch of non-groundfish species would benefit those who participate in other fisheries in the region. Halibut, herring, crab, and salmon fisheries are managed with the primary goal of maintaining healthy, productive, and sustainable populations that will support commercial, subsistence, and recreational fisheries over the long-term. Reduced bycatch mortality in the groundfish fishery would eventually be

realized as higher yields in the fisheries for those species. Whether the net gain to all regional fisheries combined would in any way be substantial is a matter for detailed economic analysis.

8.4 Cumulative Effects

8.4.1 Biodiversity

There is insufficient information on the ecological and genetic diversity of fish species and benthic fauna in the BSAI and GOA to assess the cumulative effects of the alternative on biodiversity. Factors unrelated to the groundfish fishery such as introduction of non-indigenous species, natural fluctuations in the relative abundance of species within the food web, and long-term climatic changes are far more likely to be the principal agents driving species diversity in the region (see Biodiversity under Alternative 1).

8.4.2 Predator-Prey Relationships

It is highly doubtful that decreased bycatch associated with Alternative 4, even up to the point of eliminating the groundfish fishery, will have any significant effect on predator-prey relationships (see Predator-Prey Relationships under Alternative 1).

8.4.3 Ecosystem Energy Balance

It is highly unlikely that the decrease in bycatch associated with Alternative 4 will have a significant effect on the energy budgets of the BSAI and GOA (see Ecosystem Energy Balance under Alternative 1).

Section 9 Opportunities for Quantification

The most likely species for which quantitative impact assessments of bycatch can be made are those high profile groups that are the target of major fisheries in Alaska and the North Pacific. These would include Pacific halibut, Pacific herring, Pacific salmon (with selected exceptions), king and Tanner crab (in the BSAI), and target groundfish species such as walleye pollock, Pacific cod, and yellowfin sole or any other species managed under Tiers 1-3 (Appendix B). Because of their inherent economic value, these species are typically the subject of the most intense research and monitoring efforts and, therefore, are the species for which the most comprehensive scientific information is available. The irony is that because these stocks are some of the most rigorously managed, they are the least vulnerable to losses attributable to bycatch. Any increase or decrease in bycatch would ultimately be offset by increased or decreased harvests in the directed fishery. Management effectively buffers the populations from the effects of bycatch. The major exceptions are crabs, in which loss or a gain in critical habitat under the different alternatives could tangibly affect stock health.

A second group for which nominal qualitative data may be available or compiled at a reasonable cost, is forage fish. While the forage fish category comprises eight fish families and euphausiid shrimp, the vast majority of fish taken as bycatch in the BSAI and GOA groundfish fisheries are osmerids (eulachon, capelin, and other smelts). Non-osmerids are, therefore, not a serious bycatch issue. Recent declines in North Pacific seabird populations have prompted research into the health and status of regional forage fish stocks that are such an important food source for seabirds. Because osmerids are R-selected, populations tend toward wide fluctuations in abundance. Nevertheless, even coarse estimates of osmerid abundance and predator biomass based upon Alaska Fisheries Science Center (AFSC) and NPFMC/NOAA Fisheries sponsored research, might be adequate to determine whether the bycatch of several mt of forage fish is truly detrimental to the North Pacific food web.

Section 10 Data Gaps and Information Needs

There are substantial gaps in our understanding of the biological, ecological, social, and economic effects of bycatch and of alternative methods for reducing bycatch. Therefore, it is difficult to determine the extent to which it is practicable to reduce bycatch. The problem is increased by the fact that bycatch is a multi-species problem in which a management measure that decreases the bycatch of some species can often increase the bycatch of other species.

There is very little scientific information available on the biology and ecology of individual species within the other species and nonspecified species categories. There is concern that species within these groups might be disproportionately impacted by losses attributable to bycatch. This is particularly true for long-lived species with low reproductive potential that are less resilient to fishing pressures. Other species are presently managed with an aggregate TAC and there is no way to determine if individual species are being overfished relative to their population level. Unspecified species may be taken without restriction. The NPFMC is presently trying to develop individual TACs and bycatch restrictions on individual taxa within the other species category in an attempt to protect vulnerable species. However, any realistic management plan will require more research into the population structure and community dynamics of individual taxa. One approach to the problem would be to prioritize species based upon their presumed risk. For example, bycatch of grenadiers is higher in the GOA than all species in the other species category combined. This alone would make this species a prime candidate for further research.

There is little information on the degree to which at-risk western stocks of chinook salmon have been affected by bycatch in the BSAI. Yukon and Kuskokwim river stocks are seriously depleted. Low stock sizes have resulted in reduced harvests that have seriously impacted some Alaskan fisheries in recent years. Excess bycatch in the groundfish fishery could further jeopardize these populations. The NPFMC has responded by adopting Amendment 58 which will 1) reduce the chinook salmon bycatch limit to 29,000 fish over a four-year period, 2) implement year-round accounting of chinook salmon bycatch in the pollock fishery, 3) revise the boundaries of the Chinook Salmon Savings Areas, and 4) set more restrictive closure dates. Future responses to localized salmon stock depletions could be enhanced through a comprehensive (genetic) stock identification program, which would allow for more precise identification and management of salmon populations. A stock identification program would be mutually beneficial to state and federal interests and, as such, would likely require a joint effort encompassing ADF&G, AFSC, NOAA Fisheries, the NPFMC, and Academia.

Obtaining the biological data needed to enhance bycatch management of other and nonspecified species would likely require a protracted research effort by NOAA Fisheries and AFSC. Given the number of taxa involved, species of interest or concern would need to be prioritized in terms of their importance to the ecosystem, their potential vulnerability to impact, the costs of obtaining the data required to manage individual species, and a determination would have to be made as to whether the resources are available to obtain such data. That determination would require detailed assessments by AFSC, NOAA Fisheries, and the NPFMC. In addition, a protracted research effort by NOAA Fisheries and AFSC would be required to obtain the data and develop the models necessary to estimate the social and economic effects of bycatch and of alternative methods for reducing bycatch.

Section 11 Comparative Analysis of Alternatives

The three groundfish fishery management alternatives to Alternative 1 call for a more aggressive harvest strategy (Alternative 2), a more precautionary harvest strategy (Alternative 3), and an extremely precautionary harvest strategy (Alternative 4). In terms of the direct effects of bycatch and discard waste on individual fish populations, none of these alternatives is likely to have a significant impact on target groundfish species, Pacific halibut, Pacific herring, forage fish species, coho salmon, sockeye salmon, pink salmon, chum salmon, or any North Pacific salmon stock currently listed as endangered or threatened under the ESA. Being the targets of directed fisheries, target groundfish and PSC (halibut, herring, salmon) species are rigorously managed to ensure that populations remain healthy and robust over time. Losses to the population resulting from directed harvests far outweigh any loss attributable to bycatch. Further, any increase/decrease in bycatch that might occur under any of the alternatives would be offset by harvest allocation adjustments within the targeted fishery. Refer to Table 7 for a summary of the direct, indirect and cumulative effects of the alternatives on bycatch.

The exception to the above is the fate of target species under Alternative 2 which provides for a downsizing of the present observer program (FMP 2.2) up to its complete elimination (FMP 2.1). Because information collected by the observer program is crucial to stock assessments, its elimination means that targeted stocks may not be efficiently managed. The net affect could be quite detrimental to groundfish populations particularly given the increase in fishing pressure which would also occur under the alternative.

The bycatch of forage fish under all of the alternatives, including Alternative 1, is presumed to be only a small fraction of North Pacific stocks, and none of the alternatives would likely impact these populations although local depleted would have to be considered.

The two species groups that are targets in other fisheries and which could be directly affected by the alternatives are king and Tanner crabs, and depleted western stocks of chinook salmon. The crab and chinook salmon stocks that are currently depressed are more vulnerable to fishing impacts. The more aggressive harvest strategy of Alternative 2 could remove some of the protections that are offered these stocks under Alternative 1. Crabs are particularly vulnerable to benthic trawl disturbances and any repeal of area closures could seriously affect localized crab stocks. Conversely, added protection under Alternatives 3 and 4 could increase protection to these at-risk populations.

The projected impact of the three alternatives on other and nonspecified species can only be considered speculative. Little is known about the life histories and population dynamics of many of the species within these groups, and this makes it difficult to assess the effects of bycatch on individual stocks. There is concern that bycatch may disproportionately exploit and possibly deplete individual species, but the extent to which this might occur under Alternative 1 or any of the alternatives is unknown. Because the species within the other and nonspecified categories are not targets of directed fisheries, bycatch is the principal source of fishing mortality. Since Alternative 2 would generally increase catch and bycatch in the groundfish fishery, its bycatch impact on other and nonspecified species would conditionally be considered adverse simply because more fish would be taken as bycatch. Conversely, Alternatives 3 and 4 would be considered conditionally beneficial merely because of the generally reduced levels of bycatch. The expanded observer programs under the latter two alternatives would also enhance bycatch management for all species.

The indirect and cumulative effects of the different bycatch alternatives are also difficult to predict. Under Alternative 2, increased spatial or temporal concentrations of bycatch could overharvest distinct genetic components of a stock, alter local predator-prey relationships, change biodiversity, and/or adversely impact spawning grounds or aggregations. However, the dynamic nature of the North Pacific ecosystem and the complex interaction of physical and biological forces that drive and influence that system make it extremely difficult to assess the long-term effect of localized impacts, whether they be adverse or beneficial. Factors unrelated to the bycatch are far more likely to be the principal agents governing species diversity, food webs, and marine energy budgets in the region. Over the long-term, the potential changes caused by global climatic

shifts alone are likely to dominate the North Pacific ecosystem regardless of any groundfish management plan.

Economic effects of the different bycatch alternatives might be substantial. The more restrictive bycatch limitations implemented under Alternatives 3 and 4 would place greater economic burdens on the groundfishing industry. Harvest quotas would be more difficult to achieve and would require greater expenditures of time and money. However, with FMP 3.2, the substantially expanded use of market oriented solutions to the bycatch problem and other related management problems would tend to decrease the cost and increase the benefit of reducing bycatch for individual fishing operation. This would make further reductions in bycatch practicable, address the source of the problem of excess bycatch, and decrease the need for less efficient command and control solutions.

The FMP 4.2 would eliminate the groundfish industry. Any economic benefits would go to other fisheries (e.g., halibut, herring, salmon) by allowing them to eventually realize any reduction in bycatch as increased harvests. Conversely, under Alternative 2, the groundfish fishery would operate in a less restrictive atmosphere with higher permissible bycatch. Other directed fisheries would have to compensate for that bycatch by lowering harvest quotas. Whether these economic tradeoffs would result in substantial changes in the net benefit from all fisheries in aggregate is a matter for biological and economic analysis. Alternative 2 might also have geopolitical implications. Increased bycatch might be incompatible with management goals mandated by international treaties and agreements.

Table 7. Summary of the effects of the alternatives on bycatch.

Effect indicator	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Direct Biological Effects							
Target species	None: managed fishery.	Adverse: elimination of observer program compromises ability to manage stocks.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.
Prohibited Species Effects							
Halibut	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.
Pacific herring	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.
Pink and sockeye salmon	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.	None: managed fishery.
Coho salmon	General: none, managed fishery.	General: none, managed fishery.	Same as FMP 1.	General: none, managed fishery.	General: none, managed fishery.	General: none, managed fishery.	General: none, managed fishery.
Chinook and chum salmon	At-risk BSAI stocks: unknown.	At-risk BSAI stocks: adverse; less protection than FMP 1.		At-risk BSAI stocks: beneficial; more protection than FMP 1.	At-risk BSAI stocks: beneficial; more protection than FMP 3.1.	At-risk BSAI stocks: beneficial; more protection than FMP 3.2.	At-risk BSAI stocks: beneficial; eliminate bycatch.
King and Tanner crab	BSAI: beneficial; area closures protect crab habitat, psc limits lower mortality. GOA: unknown, insufficient data.	BSAI: adverse; easing of area closures that protect crab habitat, eliminate psc limits. GOA: unknown insufficient data.	Same as FMP 1.	BSAI: beneficial; stricter psc limits than FMP 1. GOA: beneficial; develop management measures.	BSAI: beneficial; stricter psc limits than FMP 3.1. GOA: beneficial; develop management measures.	BSAI: beneficial; increase area closures and stricter psc limits than FMP 3.2. GOA: beneficial; establish area closures and psc limits.	Beneficial; temporary elimination of bycatch; fishing authorized only for environmentally safe fisheries.
Forage species	Adverse effect unlikely.	Adverse effect unlikely establishment of a direct forage fish fishery may require re-evaluation of localized bycatch loss.	Adverse effect unlikely.	Adverse effect unlikely.	Adverse effect unlikely.	Adverse effect unlikely.	Beneficial; temporary elimination of bycatch; fishing authorized only for environmentally safe fisheries.

Table 7 (cont.). Summary of the effects of the alternatives on bycatch.

Effect indicator	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Other species	Unknown: increased management focus potentially beneficial, enhanced species protection.	Same as FMP 1.	Same as FMP 1.	Beneficial: increased management focus relative FMP 1, enhanced species protection.	Beneficial: increased management focus relative FMP 1, enhanced species protection.	Beneficial: increased management focus relative FMP 1, enhanced species protection.	Beneficial; temporary elimination of bycatch; fishing authorized only for environmentally safe fisheries.
Nonspecified species	Unknown: unmanaged.	Same as FMP 1.	Same as FMP 1.	Beneficial: increased management focus relative FMP 1 potentially beneficial, enhanced species protection.	Beneficial: increased management focus relative FMP 1 potentially beneficial, enhanced species protection.	Beneficial: increased management focus relative FMP 1 potentially beneficial, enhanced species protection.	Beneficial; temporary elimination of bycatch; fishing authorized only for environmentally safe fisheries.
Management effects							
Observer program	Beneficial: monitoring enhances management.	Adverse: elimination detrimental to management.	Adverse: downsizing detrimental to management.	Beneficial: expanded coverage relative FMP 1, enhances management Consideration: cost.	Beneficial: expanded coverage relative FMP 3.1, enhances management Consideration: cost.	Beneficial: expanded coverage relative FMP 3.2, enhances management Consideration: cost.	Irrelevant; temporary elimination of bycatch; Beneficial for authorized fisheries enhances management.
Improved retention/ improved utilization	Beneficial: decrease discards (waste).	Adverse: elimination increases discards (waste).	Same as FMP 1.	Same as FMP 1.	Same as FMP 1.	Beneficial: expanded program decreases discards (waste).	Irrelevant; temporary elimination of bycatch; fishing authorized only for environmentally safe fisheries.
Vessel incentive program	Marginally beneficial.	Same as FMP 1.	Same as FMP 1.	New programs considered, possibly beneficial in reducing waste.	New programs considered, possibly beneficial in reducing waste.	New programs considered, possibly beneficial in reducing waste.	Irrelevant; temporary elimination of bycatch; Beneficial in reducing waste for authorized fisheries.

Table 7 (cont.). Summary of the effects of the alternatives on bycatch.

Effect indicator	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Indirect effects							
Spatial/temporal concentrations	Unknown.	Unknown.	Unknown.	Unknown.	Unknown.	Unknown.	Irrelevant: no fishery.
Socioeconomic	Adverse: groundfish fisheries Beneficial: non-groundfish fisheries.	Adverse: non-groundfish fisheries Beneficial: groundfish fisheries.	Adverse: non-groundfish fisheries Beneficial: groundfish fisheries.	Adverse: groundfish fisheries Beneficial: non-groundfish fisheries.	Adverse: groundfish fisheries Beneficial: non-groundfish fisheries.	Adverse: groundfish fisheries Beneficial: non-groundfish fisheries.	Adverse: groundfish fisheries (no fishery) Beneficial: non-groundfish fisheries.
Cumulative effects							
Biodiversity	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.	Unknown: influenced more by factors unrelated to bycatch.
Predator-prey	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.
Relationship	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.
Ecosystem energy	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.	General: no adverse impact.
Balance	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.	Localized: unknown.

Section 12 Literature Cited

- Council on Environmental Quality (CEQ). 1993. Incorporating Biodiversity Considerations into Environmental Impact Analysis Under the National Environmental Protection Act. Council on Environmental Quality, Executive Office of the President, Washington, DC.
- Morrison, R., Gish, R., Ruccio, M., and Schwenzfeier, M. 1998. Annual Area Management Report for the Shellfish Fisheries of the Bering Sea. State of Alaska, Department of Fish and Game, P.O. Box 25526, Juneau, AK 99802.
- National Marine Fisheries Service (NMFS). 1994. Endangered Species Act Section 7 Biological Opinion - Pacific Salmon. Reinitiation of Consultation on the Effects of the Groundfish Fisheries Conducted under the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans of the NPFMC. U.S. DOC, NOAA, NMFS, Alaska Region, 7600 Sand Point Way NE, Seattle, WA 98115.
- NMFS. 1998d. Results of the 1998 NMFS Bering Sea Crab Survey: Executive Summary. 1998 Crab Stock Assessment and Fishery Evaluation, NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.
- NMFS. 1999b. Environmental Assessment for 2000 Groundfish Total Allowable Catch Specifications Implemented under the Authority of the Fishery Management Plans for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area and Groundfish Fishery of the Gulf of Alaska Area. U.S. DOC, NOAA, NMFS, P.O. Box 21668, Juneau, AK 99802-1668.
- North Pacific Fishery Management Council (NPFMC). 1989. "Fisheries management Plan for the Commercial King and Tanner crab fisheries in the Bering Sea/Aleutian Islands Area". North Pacific Fisheries management NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.
- Witherell, D. 1995. Management of flatfish fisheries in the North Pacific. Alaska Sea Grant College Program Report, AK-SG-95-04, Alaska Sea Grant Program, 304 Eielson Building, University of Alaska Fairbanks, Fairbanks, AK 99775. pp. 573-589.
- Witherell, D., and Harrington, G. 1996. Evaluation of Alternative Management Measures to Reduce the Impacts of Trawling and Dredging on Bering Sea Crab Stocks in *High Latitude Crabs: Biology, Management, and Economics*. Alaska Sea Grant Report, AK-SG-96-02, Alaska Sea Grant Program, 304 Eielson Building, University of Alaska Fairbanks, Fairbanks, AK 99775. pp. 41-58.

**United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service Alaska Region**

**709 West 9th Street
P.O. Box 21668
Juneau, AK 99802-1668**

**Phone: (907) 586-7221
Fax: (907) 586-7249
www.fakr.noaa.gov**

APPENDIX F

Seabird Protection Measures

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Seabird Protection Measures	F-6-1
1.1	Overview of the Issue	F-6-2
1.2	Statutory Protection for Seabirds	F-6-3
1.3	Management Measures Used to Address Seabird Impacts	F-6-4
1.4	Historic Trends and Applications of Management Tools	F-6-6
Section 2	Overview of Policy Alternatives	F-6-9
Section 3	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-6-11
3.1	Overview of Seabird Protection Measures Under FMP 1	F-6-11
3.2	Effects of FMP 1 Seabird Measures on Seabirds	F-6-12
3.3	Effects of FMP 1 Seabird Measures on Other Resources	F-6-14
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-6-15
4.1	Overview of Seabird Protection Measures Under FMP 2.1	F-6-15
4.2	Effects of FMP 2.1 Seabird Measures on Seabirds	F-6-16
4.3	Effects of FMP 2.1 Seabird Measures on Other Resources	F-6-18
4.4	Overview of Seabird Protection Measures Under FMP 2.2	F-6-18
4.5	Effects of FMP 2.2 Seabird Measures on Seabirds	F-6-18
4.6	Effects of FMP 2.2 Seabird Measures on Other Resources	F-6-18
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-6-19
5.1	Overview of Seabird Protection Measures Under FMP 3.1	F-6-19
5.2	Effects of FMP 3.1 Seabird Measures on Seabirds	F-6-20
5.3	Effects of FMP 3.1 Seabird Measures on Other Resources	F-6-20
5.4	Overview of Seabird Protection Measures Under FMP 3.2	F-6-21
5.5	Effects of FMP 3.2 Seabird Measures on Seabirds	F-6-22
5.6	Effects of FMP 3.2 Seabird Measures on Other Resources	F-6-22
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-6-24
6.1	Overview of Seabird Protection Measures under FMP 4.1	F-6-24
6.2	Effects of FMP 4.1 Seabird Measures on Seabirds	F-6-25
6.3	Effects of FMP 4.1 Seabird Measures on Other Resources	F-6-26
6.4	Overview of Seabird Protection Measures Under FMP 4.2	F-6-26
6.5	Effects of FMP 4.2 Seabird Measures on Seabirds	F-6-26
6.6	Effects of FMP 4.2 Seabird Measures on Other Resources	F-6-26
Section 7	Data Gaps and Information Needs	F-6-28
7.1	Information Required to Monitor and Quantify Impacts	F-6-28
7.2	New Modeling Needs	F-6-30
Section 8	Comparative Analysis of the Policy Alternatives	F-6-32

TABLE OF CONTENTS (continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 9	References	F-6-36

TABLES

Table 1.	Summary of seabird protection measure effects.	F-6-34

FIGURES

Figure 1.	Seabird colonies of Alaska	F-6-1

ACRONYMS AND ABBREVIATIONS

BiOp	Biological Opinion
BSAI	Bering Sea and Aleutian Islands
CDQ	Community Development Quota
CFR	Code of Federal Regulations
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ft	Feet
FMP	Fishery Management Plan
FR	Federal Register
GOA	Gulf of Alaska
IFQ	Individual Fishing Quota
IPHC	International Pacific Halibut Commission
IRFA	Initial Regulatory Flexibility Analysis
LOA	Length Overall
MPA	Marine Protected Area
MBTA	Migratory Bird Treaty Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fisheries Management Council
Observer Program	North Pacific Groundfish Observer Program
RIR	Regulatory Impact Review
RPA	Reasonable and Prudent Alternative
SAFE	Stock Assessment and Fishery Evaluation
SEIS	Supplemental Environmental Impact Statement
TAC	Total Allowable Catch
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service

This page intentionally left blank

Section 1 Seabird Protection Measures

Over 70 species of seabirds occur over waters off Alaska and could potentially be affected by direct and indirect interactions with the Bering Sea Aleutian Islands and Gulf of Alaska (BSAI/GOA) groundfish fisheries. Thirty-eight of these species regularly breed in Alaska and waters of the Exclusive Economic Zone (EEZ). More than 1,600 seabird colonies have been documented, ranging in size from a few pairs to 3.5 million birds (USFWS 1998a; Figure 1 below). Breeding populations of seabirds are estimated at approximately 48 million birds and non-breeding migrant birds probably account for an additional 30 million birds (USFWS 1998a). Most of the migrant birds are present only during the summer months (May through September), although some non-breeding albatross have been sighted in all months of the year (USFWS 1999). The distributions of species that breed in Alaska are well known in summer, but for some species, winter distributions are poorly documented or completely unknown.

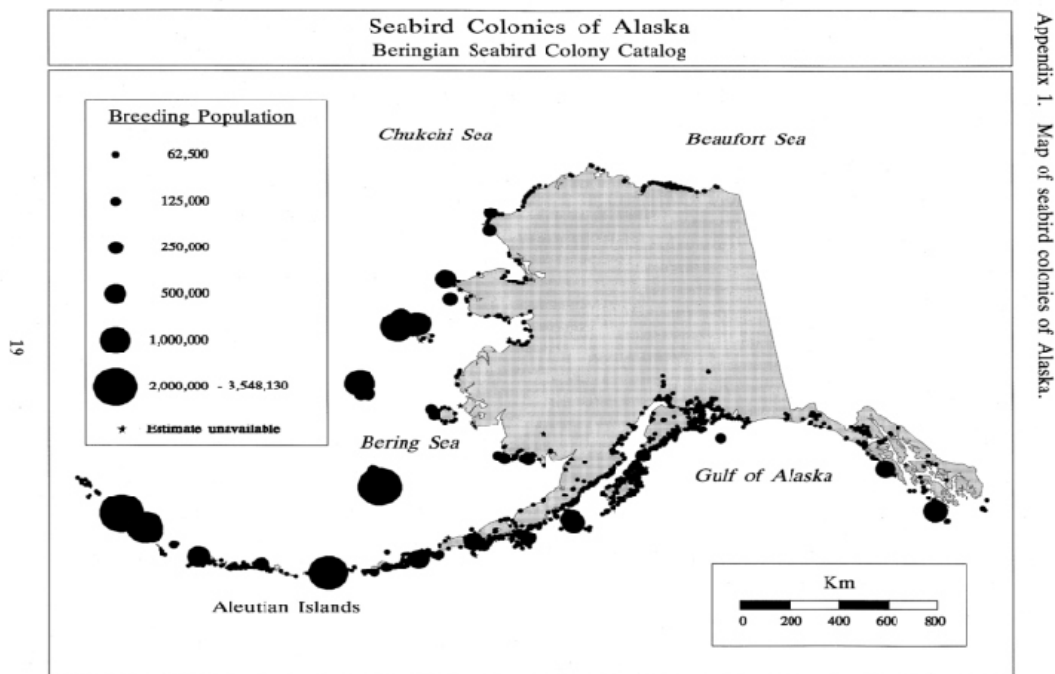


Figure 1. Seabird colonies of Alaska. Source: USFWS 1998a.

1.1 Overview of the Issue

Potential fisheries impacts on a given seabird species could theoretically be measured by changes in survival or reproductive rates and ultimately by changes in the population. For all of these biological parameters, one would expect fluctuations in time and space as part of “normal” or natural conditions. The ability to distinguish these natural fluctuations from potential human-caused fluctuations requires reasonably accurate measurements of several parameters over a long time period and in many different areas. Although the United States Fish and Wildlife Service (USFWS) surveys a number of large seabird colonies every year, present population estimates for most species are not precise enough to detect anything but the largest fluctuations in numbers. This is especially true for species that do not nest in dense concentrations. For some species, like the burrow and crevice-nesting alcids and storm-petrels, field methods for censusing populations are not available and require additional budgetary support for development (Dragoo *et al.* 2001).

Seabirds can interact with fisheries in a number of direct and indirect ways. Direct effects occur at the same time and place as the fishery action. Seabirds are attracted to fishing vessels to feed on prey churned up in the boat’s wake, fish escaping from trawl nets, baited hooks of longline vessels, and offal discharged from trawl, pot, and longline vessels. In the process of feeding, seabirds sometimes come into contact with fishing gear and are caught incidentally. A direct interaction is usually recorded as the injury or killing of a seabird and is referred to as an “incidental take.” Information on the numbers of birds caught incidentally in the various gear types comes from the North Pacific Groundfish Observer Program (Observer Program) and is summarized in the seabird section of “Ecosystem Considerations for 2003” report (Stock Assessment and Fishery Evaluation [SAFE] [NPFMC 2002], Tables 8,9,11, and 12).

Another direct fishery effect is the striking of vessels and fishing gear by birds in flight. Some birds fly away without injury but others are injured or killed and are thus considered incidental take. The Observer Program does not collect data on vessel strikes in a systematic way, but there are some records of bird-strikes that have been collected on an opportunistic basis. These sporadic observations of vessel strikes from 1993-2000 have been entered into the Observer Notes Database, which is maintained by the USFWS, but have only received preliminary statistical analysis (seabird section of “Ecosystem Considerations for 2003,” NPFMC 2002).

Indirect effects refer to either positive or negative impacts on the reproductive success or survival of seabirds that may be caused by the fishery action but are separated in time or geographic location. The indirect effect which has received the most attention is the potential impact of fisheries competition or disturbance on the abundance and distribution of prey species that seabirds depend on, thus affecting seabird foraging success. Of particular note would be those effects on breeding piscivorous (fish-eating) seabirds that must meet the food demands of growing chicks at the nest colony. Reproductive success in Alaskan seabirds is strongly linked to the availability of appropriate fish (Piatt and Roseneau 1998, Suryan *et al.* 1998a, Suryan *et al.* 2000, Golet *et al.* 2000). Although seabird populations remain relatively stable during occasional years of poor food and reproduction, a long-term scarcity of forage fish leads to population declines. Other potential indirect effects on seabirds include physical disruption of benthic foraging habitat by bottom trawls, consumption of processing wastes and discarded offal, contamination by oil spills, introductions of nest predators (i.e., rats) to nesting islands, and ingestion of plastics released intentionally or accidentally from fishing vessels. Some of these potential impacts are related more to the presence of fishing vessels rather than to the process of catching fish.

The quantitative effect of all past fishery impacts, if known, and other issues of concern are discussed for individual species and species groups in Section 3.7 of the Programmatic Supplemental Environmental Impact Statement (SEIS). The purpose of this paper is to compare the management measures specifically designed to protect seabirds as dictated by the alternative management policies and their associated FMP frameworks. Although many other management measures may influence the intensity of indirect impacts on seabirds, such as the ban on directed fishing for forage fish, the following discussion will focus on protection measures that are designed to reduce the incidental take of seabirds in fishing gear. Changes in other management measures that directly impact the effectiveness of the seabird protection measures will be briefly discussed.

1.2 Statutory Protection for Seabirds

There are two major laws that protect seabirds and require the North Pacific Fisheries Management Council (NPFMC) to address seabird conservation in their Fishery Management Plans (FMPs). The first is the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-712), as amended over the years. This law pertains to all of the seabird species found in the BSAI/GOA area (66 Federal Register [FR] 52282) and governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests. The definition of "take" in the MBTA is "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 Code of Federal Regulations [CFR] 10.12). In a fishery context, "take" refers to birds killed or injured during commercial fishing operations, whether in fishing gear or by striking some part of a vessel. Under the MBTA, take of migratory birds is illegal, even if it is accidental or inadvertent, unless permitted through regulations (such as hunting regulations or permit exemptions). Thus far, only certain forms of intentional take have been legalized in these ways. There are currently no regulations to allow unintentional take. The USFWS and the Department of Justice are vested with enforcement discretion, which has been used in lieu of a permitting program. Enforcement has focused on those who take birds with disregard for the law and the impact of their actions on the resource, particularly where effective conservation measures are available but have not been applied ("Fact sheet" on MBTA, K. Laing, USFWS). Executive Order 13186 (66 FR 3853-3856), "Responsibilities of Federal Agencies to Protect Migratory Birds," which was signed by the President on January 10, 2001, directs federal agencies to develop and implement a "Memorandum of Understanding" with the USFWS to promote the conservation of migratory birds affected by their actions, including mitigation of activities that cause unintentional take. National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) and USFWS are currently developing this framework document which will incorporate seabird protection measures designed for specific fisheries (K. Rivera, NMFS National Seabird Coordinator, personal communication).

The second law is the Endangered Species Act (ESA), which provides broad protection for species that are listed as threatened or endangered. Presently, there are three species listed under the ESA that spend all or part of their time in the BSAI/GOA and that may be affected by the groundfish fisheries: short-tailed albatross (endangered), Steller's eider (threatened), and spectacled eider (threatened). Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of habitat important to the continued existence of the species (critical habitat). For ESA-listed seabirds, the USFWS is the agency responsible for conducting an assessment of the proposed action and preparing the appropriate Section 7 document, a "Biological Opinion" (BiOp). If the BiOp concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or

adversely modify its critical habitat, then the agency must develop Reasonable and Prudent Alternatives (RPAs) to minimize or mitigate the effect of the action. Even if a “no jeopardy” determination is made, as has been done for all three listed species in the BSAI/GOA, the agency may require and/or recommend that certain mitigation measures be adopted. In addition, the agency may establish a threshold number of incidental takes that would trigger a new Section 7 consultation to reexamine the required mitigation measures. In the case of the short-tailed albatross, the number of incidental takes that could be reasonably expected, given the designated mitigation measures, has been adopted as a threshold value and is described in the Incidental Take Statement attached to the BiOp (USFWS 1999). These provisions of the ESA, as applied to the short-tailed albatross, have played a major role in the development of seabird protection measures for the longline sector of the BSAI/GOA groundfish fishery.

USFWS may designate critical habitat areas for each species under the ESA if it can determine that those areas are important to the continued existence of the species. Critical habitat may only be designated in United States (U.S.) territory, including waters of the EEZ. Short-tailed albatross do not nest in U.S. waters but have been sighted throughout the BSAI/GOA area. No critical habitat has been designated for this species. Spectacled and Steller’s eiders each have designated critical habitats in the BSAI where they concentrate in winter and during flightless molting periods (66 FR 9146 and 66 FR 8850, respectively; February 2001). Critical habitat designations do not automatically restrict human activities like fishing. They do require the lead agency, in this case the USFWS, to monitor activities that may degrade the value of the habitat for the listed species.

1.3 Management Measures Used to Address Seabird Impacts

Seabird protection measures in the BSAI/GOA groundfish fisheries were initiated in the 1990s and have focused primarily on collecting seabird-fishery interaction data and on requiring longliners to use specific types of gear and fishing techniques to avoid seabird incidental take. This emphasis on longline gear restrictions has been driven by conservation concerns for the endangered short-tailed albatross as well as other species. The history of these regulations is outlined in the next section. Although observers collect incidental take data in the trawl and pot sectors of the fishery and NOAA Fisheries is conducting research on some kinds of effects, there have been no regulatory or FMP-level efforts to mitigate seabird incidental take in these sectors.

For species listed as threatened or endangered under the ESA, the USFWS may establish a threshold number of incidental takes that are allowed before mitigation measures are reviewed and perhaps changed. Although this is sometimes viewed as a “limit” on the number of birds (e.g., short-tailed albatross) that can be taken, the result of exceeding this threshold number is a formal consultation process between NOAA Fisheries and USFWS, not an immediate shutdown of the fishery.

For non-ESA seabird species, NOAA Fisheries, in consultation with the NPFMC and USFWS, could theoretically establish a maximum number of a particular species that could be taken incidentally in the fisheries, similar to what is done for bycatch of prohibited fish species. The intent of this hypothetical management tool would be to slow the fishery or redirect it to other areas and times if that “limit” is approached. However, reducing take by redirecting fishing effort would require much better data on the spatial and temporal distribution of seabird species than presently exists and may require an expansion of the Observer Program. In addition, establishing an incidental take “limit” on biological grounds would require the determination of a quantifiable threshold of mortality above which a significant population-level

impact occurred. The present scale of the USFWS seabird population monitoring program does not provide precise enough abundance estimates or trend information to allow such a minimum mortality threshold to be calculated for any other species besides the short-tailed albatross.

Another management tool that may affect incidental take of seabirds is the regulation of who is allowed to fish. Limited entry and rationalization programs such as Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) may impact seabird incidental take if the number or size of fishing vessels change, because regulations on protective measures are based on the size of the vessel. Since different types of fishing gear are more prone to take different kinds and numbers of seabirds, allocation of total allowable catch (TAC) among the different gear sectors can also have a substantial impact on incidental take.

Spatial/temporal restrictions of fishing effort could potentially be used to protect concentrations of seabirds from fishery interactions. This management tool would be most effectively applied around seabird colonies during the breeding season, since that is where most species are consistently concentrated and when they are most susceptible to food shortages, especially given the increased demands of raising chicks. However, many species can forage over large distances, even during the breeding season, so they are less susceptible to the localized and temporary disruptions of their prey fields that may be caused by fishing activities.

Food web impacts can be addressed with several management tools. The NPFMC has designated particular species and size classes of fish as being important prey for seabirds and marine mammals and has prohibited directed fisheries on these forage fish (BSAI FMP amendment 36 and GOA amendment 39). The NPFMC may also manage the allocation, biomass, and species of fish targeted by the industry through the TAC-setting process. These factors impact the food web and could thus alter the availability of food to seabirds. While more information is available for the dynamics of fish populations than for invertebrate prey, food web interactions are very complicated, and there is a great deal of scientific uncertainty regarding the specific effects of different management options.

Each of the management tools listed above requires reliable data to monitor the extent of fishery interactions and the effectiveness of mitigation efforts in accordance with management policy objectives. The NPFMC established the Observer Program in order to collect fishery information. Beginning in 1993, the Observer Program was modified to provide information on seabird/fishery interactions. Observers are presently required on vessels 125 feet (ft) or more in length overall (LOA) for 100 percent of their fishing days and aboard vessels 60-124 ft LOA for 30 percent of their fishing days. Vessels less than 60 ft LOA do not have to carry observers.

Observers receive training in seabird identification, at least to the level of being able to place birds into the categories requested by the USFWS. Some of these categories identify individual species and others lump species under generalized groups (e.g., “unidentified alcid.”). In many cases, birds that were caught as the gear was being deployed have soaked at depth for hours and have been eaten by invertebrates. By the time they are retrieved on board they may be identifiable only to a generalized group level. NOAA Fisheries is currently working to improve the training of its observers in identifying birds from their feet and bills, which are often the only parts of the bird that are recognizable (S. Fitzgerald, Observer Program, personal communication). When the Observer Program data is analyzed and reported (as in the Ecosystem Considerations reports in SAFE documents), individual species with relatively few records are often lumped into larger categories. For example, the “gull” category contains many “unidentified gulls” but also various

numbers of five different gull species that observers have identified to species. Similarly, the “alcid” group contains separate records of seven different alcid species.

For those vessels operating without observers, regulations require captains to report the taking of any ESA-listed species and to retain and deliver the body to USFWS for positive identification. Unfortunately, such self-reporting is unreliable due to the inability or unwillingness of some crews to identify and retain species of concern. Other existing fishery record-keeping and reporting requirements provide data on the distribution of fishing effort which could potentially be used in conjunction with directed research to analyze potential food web and seabird population impacts. Electronic monitoring of fishing vessel locations could also be used to monitor and enforce spatial/temporal restrictions of the fleet if such measures were implemented.

1.4 Historic Trends and Applications of Management Tools

USFWS issued its first BiOp concerning the effects of the BSAI/GOA groundfish fisheries on the endangered short-tailed albatross in 1989. It identified several possible adverse effects of fishing activities, including incidental take, oil pollution, and contribution to plastics ingestion, but concluded that the BSAI/GOA FMPs were not likely to jeopardize the continued existence of the short-tailed albatross (USFWS 1989a and 1989b). The BiOp did, however, establish a threshold number of incidental takes (two birds per year) that would be allowed in the fishery and required NOAA Fisheries to begin monitoring incidental takes more closely and reduce them as much as possible. NOAA Fisheries began collecting seabird-fisheries interaction data through its Observer Program in 1993 and expanded that coverage in the 1997, 1999, and 2000 seasons in consultation with the NPFMC and USFWS.

Although the ESA has provided some statutory motivation for the NPFMC to address seabird protection measures, agency biologists, longline fishing associations, and non-governmental conservation organizations have all advocated for more research and mitigation of seabird-fisheries interactions. There are many fishermen who have a strong sense of stewardship and work to conserve the natural resources of the sea, including species that they do not harvest. They have developed many ways over the years to avoid or deter seabirds from attacking their baited hooks. Effective methods get passed around among the fleet and are further refined and adapted for particular vessels. NOAA Fisheries has worked with longliners to develop the existing seabird avoidance techniques, relying on their experience of what works and what is safe and workable. Many of the measures, once proven to be effective, were proposed to the NPFMC where they were revised and approved, and implemented by NOAA Fisheries.

In 1997, the USFWS amended its 1989 BiOp on short-tailed albatross by revising the incidental take threshold to four birds per two-year period (rather than two per year). It also added two RPAs that required NOAA Fisheries to institute mandatory seabird protection measures for the BSAI/GOA longline fleet and to test the effectiveness of seabird avoidance measures (USFWS 1997). Based on the recommendations of NOAA Fisheries biologists and the longline fleet, the NPFMC directed NOAA Fisheries to enact regulations that required longliners to use at least one of several different options to avoid incidental seabird takes. These regulations were published in 1997 (62 FR 23176) and amended in 1998 (63 FR 11161). While this action was prompted primarily by concern over the short-tailed albatross, all surface-feeding and shallow-diving species that are attracted to these vessels are afforded some protection from these measures. In fact, the species that likely benefit the most from these protection measures are northern fulmar, Laysan albatross, and black-footed albatross, since they are the most frequently taken species.

Within a range of criteria, fishermen were allowed to experiment with different techniques to see what worked best for their fishing style. As of the end of the 2002 fishing season, all vessel operators using hook-and-line gear to fish for groundfish and Pacific halibut must conduct fishing operations as follows:

- Use baited hooks that sink as soon as they are put in the water.
- Discharge offal in a manner that distracts seabirds from baited hooks (if discharged at all during the setting or hauling of gear).
- Make every reasonable effort to ensure that birds brought on board alive are released alive.

In addition, all applicable hook-and-line vessels at or more than 26 ft LOA, must employ one or more of the next four measures:

- Set gear at night (during hours specified in regulation).
- Tow a streamer line or lines during deployment of gear to prevent birds from taking hooks.
- Tow a buoy, board, stick, or other device during deployment of gear at a distance appropriate to prevent birds from taking hooks.
- Deploy hooks underwater through a lining tube at a depth sufficient to prevent birds from settling on hooks during the deployment of gear.

The Observer Program was changed in 1998 to collect data on the seabird avoidance techniques that different vessels used and their effectiveness in avoiding seabird incidental take. In September of 1998, two short-tailed albatross were taken by longline vessels that were using required avoidance measures in the BSAI cod fishery. However, at least one of these takes was the result of a poorly deployed avoidance technique. Concerned that the incidental take threshold could be exceeded, the longline fleet petitioned the NPFMC to improve the seabird avoidance measures and to specify performance standards for their deployment. In 1999, the NPFMC recommended revising the existing regulations to make the most effective avoidance techniques mandatory. They also recommended that NOAA Fisheries undertake a comprehensive scientific study to experimentally determine the effectiveness of seabird deterrent measures for the first time. This research was conducted by the Washington Sea Grant Program in 1999 and 2000 in the IFQ halibut and sablefish fishery and in the BSAI Pacific cod freezer-longliner fishery. This research was a cooperative effort funded by NOAA Fisheries, USFWS, and the Washington Sea Grant Program, with major support by the North Pacific Groundfish Observer Program and the longline industry.

The final report from the Washington Sea Grant study (Melvin *et al.* 2001) indicates that paired streamer lines of specified performance and material standards successfully reduced seabird incidental take in both years and in all regions and fleets by 88 to 100 percent relative to controls with no deterrent. These reductions in incidental take occurred without impacting catch rates of target species. Single streamer lines of specified performance and material standards were slightly less effective than paired streamer lines, reducing overall seabird incidental take by 96 percent and 71 percent relative to controls with no deterrent in the sablefish and cod fisheries, respectively. While the study participants took special precautions when short-tailed albatross were sighted and none of these birds were caught during the study, the dramatic

reduction of incidental take of similar-feeding species with the use of paired streamer lines indicates that the risk of incidental take to the endangered species would be greatly reduced if this avoidance measure was widely adopted. However, despite their effectiveness in reducing overall take, single streamer lines were five times more likely to take Laysan albatross compared to paired streamers. The Washington Sea Grant study did not recommend use of single streamers to reduce the potential for taking short-tailed albatross.

Although spectacled and Steller's eiders are listed as threatened under the ESA and have designated critical habitats in the BSAI, the USFWS has determined that they do not interact with the groundfish fisheries to a significant extent and have not established any restrictions on the groundfish fishery to protect these species (USFWS 1993 and 1994).

Section 2 Overview of Policy Alternatives

Four policy alternatives are under consideration by the NPFMC. Each policy alternative contains two bookends with a range of management measures that illustrate how the framework could be implemented. These bookends provide a level of detail that allows analysis and provides contrasting policies. They also provide a means to commit the NPFMC to action in implementing an alternative, while allowing the NPFMC, under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the flexibility to adaptively manage the fishery through FMP amendments.

Alternative 1 – Continue Management Under Existing (Updated) Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The seabird-related goals are to continue working with USFWS to protect ESA-listed species and to conserve/restore other seabird species while maintaining sustainable fisheries. Under this management strategy, fishery impacts to seabirds are mitigated as scientific evidence indicates that the fishery is adversely impacting particular species.

Alternative 2 – Less Precautionary Management Policy: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases. For this reason, protection for non-ESA-listed species is not considered in this alternative. Both ends of the Alternative 2 policy spectrum, FMP 2.1 and FMP 2.2, include the same seabird protection measures mandated by the ESA to protect short-tailed albatross from incidental take on longline gear.

Alternative 3 – More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community- or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment, not just a population of a given species. The seabird-related goals of the Alternative 3 policy are to continue working with USFWS to protect ESA-listed species, to initiate non-ESA-mandated efforts to conserve or restore other seabird species, and to increase research on fishery-impacted seabird populations and ecosystem interactions.

Alternative 4 – Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns, and more emphasis would be

placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. For seabirds, this means that protective measures would be implemented immediately for all species. Research would be initiated to evaluate current population estimates for all seabird species that interact with the groundfish fisheries. The goal of research on seabird avoidance techniques would be to develop, in cooperation with the fishing industry, measures that reduce incidental takes to levels approaching zero for all threatened or endangered species and for USFWS's list of species of management concern.

Section 3 **Alternative 1: Continue Under the Current Risk-Averse Management Policy**

The existing BSAI and GOA FMP policy statements, Alternative 1(a), do not specifically call out the protection of seabirds as a policy goal. Nonetheless, these policies do prioritize the general protection of the marine environment against irreversible or long-term adverse effects, and they recognize stewardship responsibilities. Additionally, these management policies must be consistent with all federal laws that mandate seabird protection.

Policy Alternative 1(b) specifically affirms the current practice of incorporating seabird considerations in fishery management. The seabird-related goals are to continue working with USFWS to protect ESA-listed species and to conserve/restore other seabird species while maintaining sustainable fisheries. Under this management strategy, fishery impacts to seabirds are mitigated as scientific evidence indicates that the fishery is adversely impacting particular species. The management process will be adaptive to new information and reactive to new environmental issues; incorporate and apply ecosystem-based management principles; and consider the impact of fishing on predator-prey, habitat, and other important ecological relationships. This strategy is based on the assumption that fishing produces some adverse impacts on the environment and that as these impacts become known and are determined to be significant, mitigation measures are developed and implemented through FMP amendments.

The Groundfish Plan Teams make recommendations to the NPFMC in an annual report that details progress on ecosystem management efforts, including those pertaining to seabirds. These “Ecosystem Considerations” reports are incorporated into the annual SAFE reports and are available at NOAA Fisheries, Alaska Region website: <http://www.fakr.noaa.gov/npfmc/safes/safe.htm>. This is also the report that discusses and evaluates the effectiveness of previous seabird protection efforts.

3.1 Overview of Seabird Protection Measures Under FMP 1

Based on the results of their research (Melvin *et al.* 2001), the Washington Sea Grant Program, USFWS, and NOAA Fisheries jointly developed recommended changes to the existing seabird avoidance regulations required in the groundfish and halibut hook-and-line fisheries off Alaska. At its October and December 2001 meetings, the NPFMC reviewed these recommendations, made some changes, and requested NOAA Fisheries to implement the necessary regulations. NOAA Fisheries is presently preparing the documents necessary to enact these new measures (Draft Environmental Assessment [EA]/Regulatory Impact Review [RIR]/Initial Regulatory Flexibility Analysis [IRFA], NMFS 2002). The NPFMC's recommendations include the following:

- Vessels over 55 ft LOA in the EEZ would be required to use paired streamer lines of specified performance and materials standards.
- Vessels between 26 ft LOA and 55 ft LOA would be required to use less stringent measures such as a buoy bag line or single streamer line, each with its own specified performance and materials standards. The requirement would depend upon fishing location, vessel type, and gear type.

- The performance and material standards for measures required on smaller vessels would be guidelines for an interim one-year period, at which time they would become required.
- Directed discharge (through chutes, pipes, or other similar devices suited for purpose of offal discharge) of residual bait or offal from the stern of the vessel while setting gear would be prohibited.
- A Seabird Avoidance Plan would be required onboard the vessel.
- Vessels less than or equal to 32 ft LOA fishing for halibut in International Pacific Halibut Commission (IPHC) Area 4E within 0 to 3 miles of shore would be exempt from measures.
- Vessels less than or equal to 26 ft LOA would continue to be exempt from seabird measures.

The incidental take threshold for short-tailed albatross, as established in the 1999 BiOp, was originally supposed to be reviewed after the 2000 season, but USFWS decided to wait for the results of the Washington Sea Grant study before conducting a new Section 7 consultation. The incidental take threshold of 4 short-tailed albatross per two-year period was extended for the 2001-2002 fishing seasons. No short-tailed albatross incidental takes have been recorded in the Observer Program data or self-reported since 1998. The USFWS is presently conducting a Section 7 consultation with NOAA Fisheries based on the recommended seabird protection measures outlined above. These measures are expected to greatly reduce the chances of the longline fleet reaching the incidental take threshold for short-tailed albatross.

The expected effects of the FMP 1 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

3.2 Effects of FMP 1 Seabird Measures on Seabirds

The Washington Sea Grant study (Melvin *et al.* 2001) found that paired streamer lines of specified performance and material standards successfully reduced seabird incidental take in both years and in all regions and longline fleets by 88 to 100 percent relative to controls with no deterrent. It should be noted that these percent reductions in take are not relative to incidental take rates using the existing avoidance measures. The use of paired streamers will likely reduce incidental take compared to the present situation, but the amount of that reduction will depend on what optional techniques are presently being used and how effective they are relative to no deterrent. The Observer Program has been collecting some of this information since 1999, but inconsistencies in the way deterrence gear is deployed limit the usefulness of the data for comparative purposes.

Single streamer lines of specified performance and material standards were slightly less effective than paired streamer lines, reducing overall seabird incidental take by 96 percent and 71 percent in the sablefish and cod longline fisheries, respectively, compared to controls with no deterrent (see cautionary notes above). However, Laysan albatross were able to attack the groundline five times more frequently with single streamers than paired streamers. This means that the potential for catching albatross on longline gear, including the short-tailed albatross, remains when using single streamer devices.

Single and paired streamers were most effective in reducing incidental take of surface-feeding and shallow-diving seabird species such as northern fulmar, gulls, and albatross. They did not reduce catch rates for species that could dive deeper on baited lines such as shearwaters. The requirements of the proposed regulations depend on the size of the fishing vessel. The overall effectiveness of the regulations in reducing incidental take will thus depend on the distribution of fishing effort between large vessels that must use paired streamers, medium-sized vessels that have a choice of deterrent devices, and small vessels that are not required to use any deterrent devices.

The seabird protection measures currently in place do not address or mitigate incidental take in the trawl or pot sectors of the groundfish fisheries or with another source of incidental take in all sectors, vessel strikes. Although research is being conducted on some of these interactions under FMP 1, the effect of not mitigating these sources of incidental take can be assessed from recent trends.

Estimates of the numbers of birds killed in trawl fishing gear are reported as a range because observers have been inconsistent in recording which of the different types of sampling methods they have used for seabird counts. These inconsistencies are currently being addressed through the observer training program (S. Fitzgerald, Observer Program, personal communication). Surface-feeding seabirds make up the great majority of birds taken in trawls and are apparently captured as the net is deployed or retrieved (NPFMC 2002). Northern fulmars are the most frequently taken species with an estimated average range of 274 to 5,891 birds per year (1997-2001). The number of fulmars taken in trawl gear appears to be increasing. Looking at just the high end of the estimated range, the number of fulmars taken in trawl gear increased from 343 in 1997 to 9,255 in 2001. Substantial numbers of shearwaters, Laysan albatross, unidentified tubenoses, and gulls are also taken in trawls. Although alcids are taken more frequently in trawls than they are on longline gear, the numbers taken in trawls (estimated average range of 178-340 birds per year, 1997-2001) are still very small compared to their overall abundance in the BSAI/GOA. The overall estimated average take in the BSAI/GOA trawl fisheries has increased from 528-2,343 birds per year in 1997 to 741-12,488 birds per year in 2001.

Incidental take in the pot fisheries has remained very low over the years, with an average total take of 48 birds per year in the combined BSAI/GOA from 1993-2001 (NPFMC 2002). Many of these recorded takes may actually be the result of vessel strikes, with the birds falling into the pots while they are on deck, rather than as they are fishing.

Seabirds sometimes strike vessels and fishing gear in flight. Some birds fly away without injury but others are injured or killed. The Observer Program records of bird-strikes from 1993-2000 have been entered into the Observer Notes Database (USFWS, Anchorage). Statistical analysis of the bird-strike data has not been completed but some preliminary summaries can be made (NPFMC 2002). There are 120 definitive records of birds striking the vessel ($n = 101$) or the rigging ($n = 19$). The main species involved in vessel strikes were northern fulmars (564 birds in 38 incidents), Laysan albatross (21 birds in 15 incidents), storm-petrels (631 birds in 19 incidents), crested auklets (1,305 birds in 7 incidents), and sooty shearwater (526 birds in 6 incidents), with almost half of the birds being killed or injured. As the last three records indicate, collisions of large numbers of birds occasionally occur. In one historical account, approximately 6,000 crested auklets were attracted to lights and collided with a fishing vessel near Kodiak Island during the winter of 1977 (Dick and Donaldson 1978). Bird strikes are probably most numerous during the night and during storms or foggy conditions when bright deck lights are on, which can cause the birds to be disoriented.

Many trawl vessels deploy a cable ("third wire") from the vessel to the trawl net monitoring device (sonar transducers). There are 16 records of birds striking the "third wire" in the Observer Notes Database. These incidents involved 79 birds, mainly fulmars and Laysan albatross, with approximately 90 percent mortality (NPFMC 2002). However, these cables are not typically monitored by groundfish observers and any birds killed by such collisions would not be likely to make their way into the trawl net and would therefore not be recorded in observers' haul samples. The distribution and extent of seabird mortalities or injuries by species are therefore unknown. NOAA Fisheries is currently pursuing the possibility of using video technology to evaluate this issue and working with trawl fishermen to develop potential mitigation equipment and techniques. NOAA Fisheries and USFWS are presently trying to determine if this impact poses a threat to short-tailed albatross (USFWS 2000b).

3.3 Effects of FMP 1 Seabird Measures on Other Resources

The proposed seabird protection measures will not impact the physical environment or benthic habitats. Marine mammals are rarely caught on longlines and it is unlikely that paired streamers or any other devices used to deter surface-feeding seabirds would alter the frequency of catching diving marine mammals. The experimental fishing trials used to develop the proposed seabird avoidance measures demonstrated that they did not affect catch rates for target or non-target fish species (Melvin *et al.* 2001).

From an economic standpoint, paired streamer lines are estimated to cost \$100 to \$500, depending on materials used (NMFS 2002). A USFWS program has been reimbursing the cost of paired streamer lines to applicants for the past two years although future funding for this program is uncertain. Deploying this gear requires additional crew time and there are some safety and "fishability" concerns. However, these methods were developed in conjunction with the fishing industry to address these concerns and there are regulatory exceptions for not deploying deterrent gear when weather conditions would place the crew in danger. These costs may be at least partially recovered in better fishing success from having more baited hooks reach their intended depth. One potential economic benefit of the seabird protection measures is that they reduce the chance that the fleet will exceed the ESA incidental take threshold for short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

The seabird-related goal of the Alternative 2 policy is to maintain the current measures to protect ESA-listed species while maximizing the biological and economic yield from the fishery resource. This management strategy is based on the assumption that fishing does not have an adverse impact on the environment except in specific cases when science provides convincing evidence of harm. For this reason, protection for non-ESA-listed species is not considered in this alternative. Both bookends of the Alternative 2 FMP framework, FMP 2.1 and FMP 2.2, include the same seabird protection measures to avoid a “jeopardy” determination for short-tailed albatross under the ESA. The FMP scenarios differ in some other management measures that may affect seabirds indirectly, these effects are discussed in Section 4.6.7 of the Programmatic SEIS.

4.1 Overview of Seabird Protection Measures Under FMP 2.1

Under FMP 2.1, the incidental take threshold of 4 short-tailed albatross taken in a two-year period would remain in effect unless it was changed as part of a new Section 7 consultation and resulting BiOp. The seabird avoidance regulations on longline vessels would remain the same as at present (outlined previously in Section 1.4) and would not include the changes recommended by the NPFMC in December 2001 (Section 3.1). However, USFWS is currently reviewing the results of the Washington Sea Grant study (Melvin *et al.* 2001) and may require changes in the longline regulations to reflect this research as part of a new BiOp. FMP 2.1 would have to conform to any changes in mandated ESA regulations. No other seabird avoidance measures or restrictions on fishing effort would be implemented to protect any other species or groups of seabirds under FMP 2.1.

Overall TAC would likely be increased in FMP 2.1 to maximize economic gain from the fishery. However, in a previous BiOp concerning short-tailed albatross (USFWS 1995), the USFWS stated that any increase in TAC of 10 percent or more from the level considered in that BiOp would constitute a significant change in fishing effort, thereby threatening to increase the incidental take of short-tailed albatross, and would require a new Section 7 consultation. The goal of increasing TAC may thus be tempered by USFWS determinations regarding jeopardy to short-tailed albatross.

This alternative would include changes in data collection and reporting programs that would impact seabird protection measures. The Observer Program would be greatly reduced except as mandated by laws such as the ESA and American Fisheries Act. As part of the most recent BiOp regarding short-tailed albatross, USFWS required NOAA Fisheries to establish independent monitoring of incidental take rather than rely on self-reported takes by fishing vessels (USFWS 1999). The amount of observer coverage in the fleet is an important consideration for determining the incidental take threshold. Since short-tailed albatross are so rarely seen and even more rarely taken incidentally in the fishery, trying to extrapolate the number of birds taken by the whole fleet from only a small percentage of observed vessels is statistically problematic. For this reason, the incidental take threshold is currently triggered only by actual numbers of birds taken rather than extrapolated numbers. If the amount of independent monitoring provided by the Observer Program was substantially reduced, or if seabird identification training for observers was eliminated, another Section 7 consultation would be triggered. USFWS may then require a specific level of observer coverage and other conditions in order for the fishery to remain in compliance with the ESA. NOAA Fisheries would therefore

need to balance the objective of reducing the Observer Program under this alternative with the need to abide by mandated BiOp RPAs.

The expected effects of the FMP 2.1 and 2.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

4.2 Effects of FMP 2.1 Seabird Measures on Seabirds

Since FMP 2.1 would retain the seabird avoidance measures that have been in place since 1997, the impacts of this policy can be inferred from recent incidental take data (Tables 8 and 9 from the seabird section of the NPFMC 2002). Comparisons of the average estimated incidental take in the BSAI longline fisheries from 1993-1996 (when no avoidance measures were required although some may have been used voluntarily) and 1997-2001 (when the existing rules were in place), indicate that the numbers of the four major species/groups caught on longlines actually increased since 1997. Northern fulmars, which make up the majority of birds caught, increased from an estimated average of 6,000 birds taken per year (1993-1996) to 10,700 birds per year (1997-2001). In those same time periods, the incidental take of gulls increased from 2,000 to 3,300 birds per year, Laysan albatross increased from 400 to 640 birds per year, and shearwaters increased from 390 to 580 birds per year. The total of all birds taken from the BSAI longline fishery increased from an estimated average of 11,600 birds per year (1993-1996) to 16,600 birds per year (1997-2001).

These average numbers of incidental take in the BSAI longline sector appear to show that the seabird avoidance measures enacted in 1997 did not have their intended effect. However, the number of birds caught per unit effort was almost the same in the different periods, with 0.085 birds caught per 1,000 hooks set in 1993-1996 and 0.090 birds per 1,000 hooks in 1997-2001 (NPFMC 2002). The higher overall incidental take in 1997-2001 is thus partly a result of increased fishing effort in this sector (average of 135 million hooks set per year from 1993-1996 and 186 million hooks set per year from 1997-2001). An examination of the data on a year-to-year basis indicates that there is a great deal of annual variation, with 1998 having a very high take rate (0.14 birds per 1,000 hooks) and 2001 having a very low take rate (0.04 birds per 1,000 hooks). It is not clear why there is such high variability between years but one reason may be related to the nutritional state of birds in general. In 1997 and 1998, oceanographic conditions did not favor species that fed close to the surface of the water and several large scale die-offs were recorded (Hunt *et al.* 1999, Baduini *et al.* 2000). In these same years, fishermen reported that flocks of birds attacked their lines with great intensity and were not deterred despite their best efforts (S. Fitzgerald, Observer Program, personal communication). The large reduction in take rate in 2001 may be due in part to some of the longline fleet's voluntary adoption of paired streamer line avoidance techniques in advance of their regulatory implementation.

In the GOA longline fishery, the overall take of birds is much less than in the BSAI, and the avoidance measures enacted in 1997 had a mixed impact on incidental take (NPFMC 2002). Take of northern fulmars decreased from about 570 birds per year (1993-1996) to 410 birds per year (1997-2001). Take of black-footed albatross decreased from about 230 to 160 birds per year while take of Laysan albatross remained essentially the same at about 130 birds per year and gulls increased from 70 to 150 birds per year. The total of all birds taken from the GOA longline fishery decreased from an estimated average of 1,250 birds per year (1993-1996) to 870 birds per year (1997-2001). Incidental take per unit effort is also much less in the GOA than the BSAI, with an overall take rate of 0.03 birds per 1,000 hooks from 1993-2001 (NPFMC 2002).

While overall incidental take has gone down in the GOA since seabird protection measures were implemented in 1997, the take rate has remained the same with an average of 0.028 birds per 1,000 hooks taken in 1993-1996 and 0.027 birds per 1,000 hooks taken in 1997-2001. The average number of hooks set in the GOA declined from 45 million per year in 1993-1996 to 32 million per year in 1997-2001. The GOA data show a similar pattern in annual variation of catch rates as described for the BSAI above. Take rates in 1998 were relatively high at 0.05 birds per 1,000 hooks and relatively low in 2001 at 0.01 birds per 1,000 hooks.

It is not known whether the differences in incidental take rates between the BSAI and GOA longline fisheries is due to differences in avoidance techniques used, sizes of vessels involved, composition of seabird flocks attending vessels, sea or weather conditions, seasonal concentration of the fisheries, or any other variable that might impact the effectiveness of deterrence measures. The problem with using the Observer Program data to analyze the effectiveness of avoidance techniques is that the present regulations do not have specific performance standards. Some deployments may have met the legal requirements for deterrent devices but were poorly executed and hence were rather ineffective in keeping birds away from baited hooks. Although the Observer Program is presently making improvements in their procedures, observers have not had any way to assess deployment performance on their data sheets, so past records will be of limited value in analyzing regional differences in effectiveness.

Statistically analyzing the effectiveness of the present regulations in preventing incidental take of short-tailed albatross on longlines is problematic given the rarity of encounters. The issue would be even more difficult to resolve if observer coverage of fishing effort was decreased as proposed in FMP 2.1. It is clear, however, that the existing regulations did not eliminate the incidental take of short-tailed albatross. Even though no short-tailed albatross have been reported taken since 1998, the fact that two short-tailed albatross were caught in one month in 1998 by vessels using the existing avoidance techniques indicates that the threat remains.

There are presently no regulations that require any mitigation of seabird incidental take in either the trawl or pot sectors of the groundfish fleet. Since no restrictions on these sectors would be implemented under FMP 2.1, the effects on seabird incidental take can be deduced from recent trends. As described previously in Section 3.2, incidental take in trawls appears to be increasing since 1997, especially for northern fulmars. The overall estimated average take in the BSAI/GOA trawl fisheries has increased from 528-2,343 birds per year in 1997 to 741-12,488 birds per year in 2001. With the goal of increasing TAC under FMP 2.1, incidental take of seabirds in trawl gear would be expected to increase in proportion to trawl effort.

Research on seabird-fishery interactions would not be a high priority under FMP 2.1. Present research on trawl third wire collisions and possible mitigation techniques would likely be discontinued or reduced in scope unless mandated by USFWS under Section 7 ESA consultation. Determining if any seabird-fishery interactions led to significant population-level effects would require much more research on seabird population trends and distribution than presently exists. Under FMP 2.1, NOAA Fisheries would not place a high priority on collaborating with USFWS on this type of research.

4.3 Effects of FMP 2.1 Seabird Measures on Other Resources

Maintaining the present seabird protection measures will not impact the physical environment or benthic habitats. Incidental take and entanglement of marine mammals does not appear to be affected by the present seabird deterrent devices. Catch rates of fish species on longlines should not be affected because there would be no new restrictions or requirements on the fleet's operation.

The longline fleet has been operating under the same requirements since 1997 so there should be no additional costs involved under FMP 2.1. One potential economic benefit of the seabird protection measures is that they reduce the chance that the fleet will exceed the ESA incidental take threshold for short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet. Considering the fact that the existing avoidance techniques have not eliminated the take of short-tailed albatross, the possibility of exceeding the incidental take threshold remains.

4.4 Overview of Seabird Protection Measures Under FMP 2.2

FMP 2.2 would be the same as FMP 2.1 with regard to seabird protection measures and would include only those measures currently in place as mandated by the short-tailed albatross BiOp (USFWS 1999). One important difference between FMP 2.1 and FMP 2.2 is that the Observer Program would be the same under FMP 2.2 as it is at present. Monitoring of short-tailed albatross incidental take would thus be the same as at present and would therefore not trigger any new Section 7 consultations with USFWS.

4.5 Effects of FMP 2.2 Seabird Measures on Seabirds

Since FMP 2.2 is the same as FMP 2.1 with regard to seabird protection requirements, the impacts on seabirds are the same as listed previously in Section 4.2.

4.6 Effects of FMP 2.2 Seabird Measures on Other Resources

Since FMP 2.2 is the same as FMP 2.1 with regard to seabird protection requirements, the impacts on other resources are the same as listed previously in Section 4.3.

Section 5 **Alternative 3: Adopt a More Precautionary Management Policy**

The seabird-related goals of the Alternative 3 policy are to continue working with USFWS to protect ESA-listed species, to initiate non-ESA-mandated efforts to conserve or restore other seabird species, and to increase research on fishery-impacted seabird populations and ecosystem interactions. This management strategy would accelerate the incorporation of precautionary management measures and ecosystem-based management principles in order to provide sound conservation of living marine resources, including seabirds. This policy will strive to maintain a balanced and sustainable fishery and will adopt new conservation measures when scientific evidence indicates that the fishery is negatively impacting the environment.

Alternative 3 places more emphasis on research and management of potential effects of the fishery on a broader range of seabird species than does the present policy. Since seabirds are an important element of the marine ecosystem, both in numbers of animals and in energy flow through the food web, and there is presently a great deal of uncertainty regarding population estimates and ecological interactions, this alternative would initiate an expansion of joint research programs designed to investigate seabird biology and more closely monitor seabird-fishery interactions.

5.1 Overview of Seabird Protection Measures Under FMP 3.1

At one end of the Alternative 3 management framework, represented by FMP 3.1, the incidental take threshold of 4 short-tailed albatross within a two-year period would remain in effect unless it was changed as part of a new BiOp. The seabird avoidance measures would be the same as in FMP 1 and would thus follow the joint recommendations of the Washington Sea Grant Program, NOAA Fisheries, and USFWS as interpreted by the NPFMC and implemented by NOAA Fisheries (see Section 3.1). In addition, under FMP 3.1, NOAA Fisheries would collaborate with USFWS to scientifically develop and assess fishing methods that would reduce the incidental take of all albatross species. This shift to include measures that protect other albatross besides the short-tailed would probably not yield substantial differences in the avoidance regulations, since the species all feed in similar fashion and often occur together. In fact, the effectiveness of the proposed regulations to deter short-tailed albatross is an assumption based on the measured deterrence of the non-endangered albatross (Melvin *et al.* 2001).

Overall fishing effort may be the same as under the status quo but it also may be decreased, depending on some new considerations under this alternative. As part of the goal to accelerate the incorporation of ecosystem considerations into the TAC-setting process, NOAA Fisheries would review the appropriateness of using F_{40} as the target fishing rate (Appendix B). NOAA Fisheries would also develop indices of key ecosystem processes that will be used to track ecosystem health and modify TAC if warranted. Environmental measurements involving particular species of seabirds and their food supplies may well be included in these new ecosystem indices. If fishing effort is reduced in response to ecosystem concerns, incidental take of seabirds could be reduced.

Under FMP 3.1, NOAA Fisheries would establish goals and guidelines for selecting Marine Protected Areas (MPAs) and other no-fishing zones. To the extent that these new conservation areas are established in areas important to seabirds, this program could offer important refuge areas for at least some species.

Another goal of the Alternative 3 policy will be to increase the rationalization of the fisheries. If such programs lead to changes in the size of fishing vessels, they could impact the overall effectiveness of seabird avoidance measures that vary according to vessel length. This could also affect data collection on seabird-fishery interactions, since coverage of the Observer Program is also dependent on the size of the vessel. In both cases, when vessel size increases above a certain threshold, seabird protection measures and observer coverage are both improved as far as seabirds are concerned.

Under FMP 3.1, the Observer Program would likely be strengthened to improve the scientific collection of data. This may include more extensive training for observers in seabird identification, especially from hard body parts (feet and bills), which may allow an improvement in the amount of species-specific information collected and the reduction of the “unidentified seabird” category. Improvements in sampling design and record-keeping may also help narrow the confidence intervals around estimates, especially in the trawl data, and thereby improve the usefulness of the data for impact assessment purposes. The Observer Program may also be used to expand research on the effectiveness of seabird avoidance techniques under different conditions.

The expected effects of the FMP 3.1 and 3.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

5.2 Effects of FMP 3.1 Seabird Measures on Seabirds

Since the seabird protection measures under FMP 3.1 would likely be the same as under FMP 1, the impacts on seabirds would be the same as listed in Section 3.2. The increased emphasis on developing and testing the effectiveness of new avoidance techniques may lead to future changes that would reduce incidental take even further. Any progress in reducing incidental take on longlines, especially for surface-feeding species, will reduce the likelihood of exceeding the incidental take threshold for short-tailed albatross. At this end of the Alternative 3 management framework, investigations into the extent of trawl third wire collisions would be continued and mitigation measures would be implemented for the trawl sector as they are proven effective or as required by future ESA Section 7 consultations with USFWS. The initial effects of the trawl and pot fisheries on incidental take of seabirds under FMP 3.1 would be similar to that described in Section 3.2.

5.3 Effects of FMP 3.1 Seabird Measures on Other Resources

Seabird protection measures under FMP 3.1 would be unlikely to impact the physical environment or benthic habitats. For the same reasons as stated in FMP 1, no marine mammals, target fish, or non-target fish are likely to be affected by seabird avoidance requirements on the longline fleet. The increased emphasis on seabird research under this policy, among other research topics, would certainly be expected to contribute to our understanding of predator-prey relationships and other ecosystem functions, just as research into marine mammal biology and fish biology would be expected to improve our understanding of seabirds.

From an economic standpoint, the cost to the longline fleet in new gear and vessel modifications is minimal. The USFWS has recently had a program to reimburse vessel owners for these costs but future funding for this program is uncertain. It is possible that additional deterrent devices or modifications will be instituted under FMP 3.1 as research demonstrates the effectiveness of new techniques. Any new techniques would be developed in conjunction with the longline fleet in order to address safety and fishability concerns. The cost of adding new gear and deploying it will be offset, at least in part, by the more successful delivery of baited hooks to their intended target. One potential economic benefit of these seabird protection measures is that they reduce the chance that the longline fishery will exceed the incidental take threshold of short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet.

5.4 Overview of Seabird Protection Measures Under FMP 3.2

At the end of the range of the Alternative 3 management framework represented by FMP 3.2, research into seabird protection measures is extended to all seabird species. Under FMP 3.2, seabird protection measures would be continually improved through scientific research on the effectiveness of new techniques. Protection of ESA-listed species would continue to have a high priority, but NOAA Fisheries would also initiate research and implement regulations to minimize the incidental take of all seabird species. Since different species are more likely to be taken in trawl gear than longlines, this sector would likely be subject to new gear modifications and/or fishing technique regulations. Pot fishing is by far the cleanest method of fishing in regard to incidental take of seabirds, so it may not receive high priority in mitigation research. The research necessary to develop these new seabird deterrent techniques and gear modifications would require a great deal of cooperation and coordination with USFWS, the fishing industry, and academic institutions.

Under FMP 3.2, allocations of TAC in space and time would be based on protecting living marine resources, including seabirds. Such changes in the distribution of fishing effort may have substantial impacts on the incidental take of seabirds, especially if they are correlated with areas of high seabird concentration. At this end of the Alternative 3 spectrum, up to 15 percent of the BSAI/GOA would be included in MPAs and 5 percent in no-take marine reserves. To the extent that these protected areas overlap with important seabird habitat, they could provide an experimental opportunity to study the dynamics of seabird-fishery interactions, including the impacts of fishing on colony-level survival and reproductive success. The results of such research would provide scientific justification for future fishery management decisions.

Rationalization of all fisheries would be a priority under FMP 3.2. If the economics of rationalization leads to significant changes in the sizes of vessels used (one way or the other), and seabird avoidance measures continue to be based on the size of fishing vessel, rationalization could affect the extent to which particular avoidance measures are used and therefore either increase or decrease the overall effectiveness of these mitigation measures.

The Observer Program would be expanded under FMP 3.2 so that vessels > 60 ft LOA would be required to have 100 percent coverage (up from 30 percent at present). If observers continue to collect data on seabird avoidance or deterrence techniques, this increase in quantity of data would certainly improve our understanding of seabird-fishery interactions. A substantial improvement in observer coverage would also be factored into Section 7 consultations and may affect the establishment of future incidental take thresholds for short-tailed albatross.

5.5 Effects of FMP 3.2 Seabird Measures on Seabirds

Reaching the goal of reducing incidental take for all seabirds will depend on the successful development of efficient new avoidance or deterrence techniques. Assuming that these efforts lead to significant decreases in seabird take for the longline and trawl fleets, several species may realize measurable population-level benefits. Northern fulmars are the species taken most frequently by all three gear sectors. Because their overall population levels are very difficult to census accurately, the beneficial impact of reducing incidental take may only be measurable on a colony level, especially on the Pribilof Islands. Laysan and black-footed albatross have both experienced recent population-level declines (see Section 3.7 species accounts in the Programmatic SEIS) so any reduction in take rates would help overall conservation efforts for these species. Any improvements in fishing gear or avoidance techniques that reduce the take of surface-feeders will reduce the likelihood of exceeding the incidental take threshold for short-tailed albatross.

Under FMP 3.2, NOAA Fisheries would advocate and cooperate as much as possible with USFWS to expand research into seabird population dynamics and foraging ecology. NOAA Fisheries' emphasis on collecting seabird-fishery interaction data will likely complement the work of other agencies and academic institutions, leading to an improved understanding of how seabirds respond to their environment.

5.6 Effects of FMP 3.2 Seabird Measures on Other Resources

New seabird avoidance measures would be required to address the FMP 3.2 goal of reducing incidental take of all species. It is not apparent what this might mean for gear restrictions but it would seem likely that trawl gear would be affected as well as longline gear. Since pot gear takes so few seabirds of any species (estimated average of less than 50 birds per year in the combined BSAI/GOA pot fisheries, NPFMC 2002), it is unlikely that gear modifications would be pursued in this sector. Gear modifications on bottom trawls could change the way these gear types physically modify the ocean bottom. However, given other goals of FMP 3.2 to protect benthic habitats, it is unlikely that any gear modifications designed to minimize seabird take would be approved if they had an adverse impact on benthic habitat. Similarly, reduction of incidental take of marine mammals is also a goal of FMP 3.2, so it is unlikely that changes in seabird protection measures would be approved if they had adverse impacts on marine mammals. Area/gear-type closures aimed at minimizing seabird incidental take may also benefit marine mammals, non-target fish species, and invertebrates where they occur together.

The costs of making gear modifications in the trawl fleet may be substantial, depending on the complexity of those modifications. Development of such modifications would have to be done in conjunction with the fishing fleet so that fishability and safety concerns would be addressed for any proposed solution. Maintaining reasonable catch rates of target fish would be one of the criteria used in developing successful mitigation measures, so the impact of new seabird protection measures on target fish should be minimized. However, gear modifications and area restrictions may decrease catch per unit effort and therefore have substantial economic repercussions for the trawl fleet.

Seabird avoidance measures that are currently in use or proposed for the longline fleet are less effective in protecting species that can dive on baited hooks, such as shearwaters, than they are for surface-feeding species. New gear modifications may be required for the longline fleet to protect these diving species, and perhaps the surface-feeding species too, as research demonstrates the effectiveness of new techniques and gear such as weighted groundlines. The cost of adding new gear and deploying it will be offset, at least in

part, by improved success in delivering baited hooks to their intended target. Improved seabird protection measures will reduce the chance that the fishery will exceed the incidental take threshold of short-tailed albatross.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

The seabird-related goals of the Alternative 4 management policy are incorporated into a sweeping change in the way managers approach scientific uncertainty. This management policy is based on the assumption that, until proven otherwise, fishing produces adverse impacts on the environment but, due to incomplete data and scientific uncertainty, we know little about these impacts. Alternative 4 would adopt a highly precautionary approach in which the burden of proof is shifted to the user of the resource to demonstrate that the intended use would not have a detrimental effect on the environment. For seabirds, this means that protective measures would be implemented immediately for all species. Research would be initiated to evaluate current population estimates for all seabird species that interact with the groundfish fisheries. The goal of research on seabird avoidance techniques would be to develop, in cooperation with the fishing industry, measures that reduce incidental takes to levels approaching zero for all threatened or endangered species and for USFWS's list of species of management concern (including red-legged kittiwake, marbled murrelet, and Kittlitz's murrelet). The strategy for instituting seabird protection measures would follow the general management strategy of this alternative, which would be to substantially curtail the groundfish fisheries until more information is known about the frequency and intensity of fishery impacts upon the environment. Once more is known about fishery effects on the ecosystem, scientific information would be used to modify and relax the precautionary measures initially adopted.

6.1 Overview of Seabird Protection Measures under FMP 4.1

In contrast to the other alternatives, the goal of FMP 4.1 in regard to seabirds would be to provide even stricter protection measures than are presently required or proposed by the USFWS for protection of short-tailed albatross. By adding the other two albatross species plus red-legged kittiwake to the list of species for incidental take "approaching zero," seabird protection measures at least as effective as paired streamer lines, perhaps coupled with weighted groundlines or underwater setting designs, would likely be implemented for the entire longline fleet, not just the largest vessels. In addition, the goal of reducing incidental take of marbled and Kittlitz's murrelets to levels approaching zero poses some difficulties for the trawl fleet. Observers presently have identity codes for these two species but they are difficult to distinguish from other small alcids, especially after being brought up in a trawl. Given the hundreds of "unidentified" alcids and seabirds taken in trawls every year, there is uncertainty about how many of these murrelets are presently caught in groundfish trawls. Under FMP 4.1, this uncertainty will have to be addressed before and after any mitigation measures on the trawl fleet are implemented.

While it may be desirable to develop perfect technological solutions, reducing incidental take of all albatrosses and other species of concern to levels approaching zero may also require extensive training programs to demonstrate how to deploy gear correctly, plus performance reviews or incentives to maintain the highest standards. NOAA Fisheries is currently trying to identify the longline vessels with the worst incidental take records in order to provide customized evaluations and assistance for those crews and captains (S. Fitzgerald, Observer Program, personal communication). Given the wide variety in vessel and gear configurations in use, this vessel-specific approach to training may prove very effective in reducing overall incidental take. Incentive programs may also be useful management tools. These could range from an annual prestigious award (the "bragging rights approach") to an increased allocation of TAC to the cleanest

fishermen (the “market approach”). Captains and their crews would then have incentive to monitor the birds more closely and develop their own avoidance behavior procedures. This would probably work best in conjunction with the Observer Program for independent verification of incidental take levels.

FMP 4.1 would be similar to FMP 3.2 in that NOAA Fisheries would establish seabird protection measures for all species of seabirds. Since different species are more likely to be taken in trawl gear than longlines (i.e., alcids and shearwaters), this sector would likely be subject to new gear modifications and/or fishing technique regulations. Pot fishing could also be subject to new seabird avoidance regulations even though this is currently the cleanest method of fishing. The research necessary to develop these new seabird deterrent techniques and gear modifications would require a great deal of cooperation and coordination with USFWS, the fishing industry, and academic institutions. It is hard to predict whether seabird protection measures would be based on vessel length, but if all fisheries are required to reduce incidental take for all species, potential changes in the structure of the fishery should have minimal impact on total seabird incidental take.

The TAC-setting policies of FMP 4.1 would greatly reduce fishing effort from current levels and would thus reduce seabird incidental take. In addition, MPAs would be established in 20 to 50 percent of the BSAI/GOA. To the extent that these new conservation areas overlapped with areas important to seabirds, this program could offer important refuge areas for at least some species.

The expected effects of the FMP 4.1 and 4.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

6.2 Effects of FMP 4.1 Seabird Measures on Seabirds

The species that are taken most frequently in the groundfish fisheries and that stand to benefit the most from improved avoidance or deterrence techniques include the northern fulmar, Laysan albatross, and black-footed albatross. Several species groups, including gulls, shearwaters, and alcids, are also taken in substantial numbers but the impact on particular species within these groups is not known. Continued improvements in seabird identification protocols (especially from feet and bills) and an increased priority on seabird data collection efforts in the Observer Program could reduce the proportion of unidentified birds in the data set and narrow the confidence intervals around incidental take estimates. For vessels that do not have observers, fishermen could be required to retain all seabirds for identification in port. The expansion of directed research on seabird population trends could potentially allow the direct effects of the fisheries to be monitored on the population or colony level. However, if the take reduction programs are successful, these effects should be negligible.

The large number of significant changes to the fishery contemplated in this alternative would undoubtedly trigger new Section 7 consultations with USFWS regarding incidental take thresholds for short-tailed albatross. The outcome of those complex deliberations can not be predicted at this time. However, more research and emphasis would be given to seabird-fishery interactions and mitigation efforts in this alternative than any of the others. Improved seabird avoidance or deterrence measures should greatly reduce the chance of exceeding any incidental take threshold for short-tailed albatross.

6.3 Effects of FMP 4.1 Seabird Measures on Other Resources

The broad seabird protection goals of FMP 4.1 would likely require substantial changes in at least the groundfish trawl and longline gear types and may include area/season closings to avoid seabird concentrations. Acceptable gear modifications under this alternative could not have adverse impacts on benthic habitat, marine mammals, non-target fish, or any other part of the environment. The much greater emphasis on seabird research, both in population censusing and foraging ecology, would certainly contribute to an improved understanding of other ecosystem components and dynamics.

The economic impact of seabird protection measures would include research development costs for new fishing techniques, the costs of making gear and ship modifications throughout the fleet, any change in catch per unit effort for target species, and costs associated with a more dispersed fishing effort due to closures. These economic costs would undoubtedly be very substantial.

6.4 Overview of Seabird Protection Measures Under FMP 4.2

At this end of the Alternative 4 management framework, as represented by FMP 4.2, all commercial groundfish fishing would be halted while research on environmental parameters continued. Experimental fishing permits could be granted so that the industry could work in cooperation with various agency personnel and academic institutions to conduct research. The intent of FMP 4.2 would be to close the fisheries only until specific fisheries were certified or demonstrated to have minimal effects on the environment, at which point they would be opened under a new ecosystem-based management system. Under FMP 4.2, biological monitoring of seabirds would be conducted at a much higher level than at present as part of the ongoing effort to track ecosystem health.

6.5 Effects of FMP 4.2 Seabird Measures on Seabirds

Cessation of fishing would certainly eliminate the incidental take of seabirds and benefit certain species. Whether such benefits could be measured on a population level would probably depend on the intensity of population monitoring for those species both before and after fishing was stopped. Some seabirds, notably fulmars and gull species, may derive substantial benefits from fishing activity in the form of scavenged offal and waste. Although their attraction to fishing vessels puts them in danger of incidental take, this supplemental food source would be eliminated if all the fisheries were closed, with potentially adverse effects on their survival and reproductive success rates. The cumulative net benefit or detriment of fishing activity on scavenging species has not been examined in Alaska. This would be an appropriate and likely topic of seabird research under this alternative.

6.6 Effects of FMP 4.2 Seabird Measures on Other Resources

Although many other elements of FMP 4.2 would lead to the same conclusion, the seabird protection goal of eliminating incidental take of all seabirds completely would lead to a closure of the entire groundfish fishery. The impact on all physical and biological resources in the BSAI/GOA could be considered beneficial in the sense that human influence on them would be greatly reduced. However, some species would undoubtedly suffer losses in population and distribution, even as other species gain, as the ecosystem moves to a new dynamic state.

The economic cost to the groundfish industry and the communities that rely on such fishing would be disastrous. Only those involved in supporting environmental research and perhaps ecotourism could be seen to benefit economically from this situation.

Section 7 Data Gaps and Information Needs

7.1 Information Required to Monitor and Quantify Impacts

The 2001 Draft Programmatic SEIS (NMFS 2001, pp 4.3-1 and 4.3-50) and the Ecosystem Considerations for 2003 report (NPFMC 2002, pp 192-195) has identified the major gaps in our knowledge of seabird ecology with respect to the groundfish fisheries and recommend the following:

- Compile existing data on diet, distribution, and abundance of seabirds into a common, accessible database.
- Initiate new research on seabird diets and foraging ecology, especially during the non-breeding seasons.
- Update population estimates for all seabird species.
- Improve knowledge about the distribution, abundance, and ecology of forage fish, especially with regard to management of predatory groundfish and climate change.
- Initiate studies to examine potential fishery impacts at the breeding-colony level.
- Analyze Observer Program data to identify particular areas and time periods with the most adverse seabird-fishery interactions.
- Continue to improve collection of species-specific incidental take data through the Observer Program and collaborative efforts to develop and test effective take reduction measures in the longline and trawl fleets.
- Quantitative modeling of fishery impacts on selected seabird species at the population level.
- Examine role of fishery discards and offal in seabird reproduction and survival as a function of the spatial/temporal distribution of fishing efforts.
- Employ new research techniques (i.e., satellite telemetry) to examine at-sea distributions of sensitive species like short-tailed albatross.

Many of these efforts are underway but will require long-term commitments of resources and patience on the part of administrators and the public before scientists can reach meaningful conclusions.

For the purposes of analyzing regional population trends, adequate data exists for only a few species of seabirds that breed in Alaska, notably black-legged kittiwakes, red-legged kittiwakes, common murre, and thick-billed murre. More limited population and reproductive data is available for several other species (Dragoo *et al.* 2001). Unless USFWS receives substantial increases in their future research budgets, the murre and kittiwakes will most likely continue to be the most useful species for fishery impact assessments. Population trends for the three albatross species can also be monitored fairly accurately because of their

limited number of tropical breeding colonies, although assumptions must be made regarding the number of non-breeders that do not return to the colonies every year. The albatross species in the BSAI/GOA traverse huge distances and are impacted by many different kinds of human activities across international boundaries. Their frequent interactions with the groundfish fisheries and the important management implications of the ESA necessitate ongoing cooperation with other regional and international conservation agencies and institutions.

In addition to basic reproduction and population trend data, fishery impact assessment also requires an explanation of the mechanism(s) of action. For species that are thought to be impacted primarily through direct fishery-related mortality, such as the albatross species, population modeling can be combined with measurements of incidental take in the fisheries to calculate the degree of population impact (Cousins and Cooper 2000). The accuracy and completeness of incidental take levels should continue to be monitored by independent observers and tracked over time as new seabird avoidance techniques are introduced. Several other factors that influence seabird incidental take, such as overall nutritional state of the birds and seasonal distribution of fishing effort, should be monitored as well so that the effectiveness of the new avoidance techniques can be assessed with less uncertainty. For species thought to be affected primarily through fishery-induced changes in food availability, quantitative changes in prey availability (which includes elements of prey abundance, schooling behavior, and the “patchiness” of distribution) are much more difficult to measure. The complexity of the issue may be best addressed by trying to measure and compare the physiological state of birds in areas that are fished versus areas that are not fished. While traditional studies of this nature require the collection of birds for stomach and tissue samples, newer serological methods only require live capture and drawing blood samples (Piatt *et al.* 1998, Suryan *et al.* 1998a, Suryan *et al.* 1998b, Suryan *et al.* 2000).

The key to this kind of comparative analysis is finding suitable study areas for comparison. The establishment of no-fishing reserves around selected breeding colonies would greatly facilitate such studies. Comparative studies of this nature could be conducted for both fish-eating and plankton-eating seabird species. Ideally, nutritional studies would be conducted in conjunction with reproductive and population trend studies in order to link the impact mechanism with the potential effect. While it would not eliminate all uncertainty about potential impacts, a system of research reserves offers some hope of scientifically deciphering the ecosystem complexities of marine life. It is important to note that no-fishing reserves that were within 3 nautical miles (nm) of shore would have to be established in conjunction with the State of Alaska. The effect of a federal reserve would obviously be nullified if state-managed fisheries were allowed to continue inside a no-take reserve boundary. This would be especially important if the no-fishing reserve encompassed a seabird breeding colony.

Several concerns have been raised about the Observer Program incidental take data, including the large number of birds that are reported under “unidentified” or group categories rather than individual species and the large variability in take estimates within and between reported years (public comments on NFMS 2001, Appendix G). As described in Section 3.2, the Observer Program is addressing some of these issues with improvements in field identification methods based on feet and bills, improvements in sampling design and data collection protocols, and improvements in observer seabird training programs. However, there will always be unidentifiable bird remains and there is some value in combining rarely taken species into groups for reporting and analysis purposes. The quality and quantity of seabird data coming out of the Observer Program is largely a function of how much emphasis is placed on collecting seabird data versus other kinds of fishery data. Some of the alternatives give the collection of seabird data a higher priority than others. For

some types of seabird-fishery interaction data, it may be necessary to have dedicated seabird observers on a subset of vessels that already have fishery observers. These seabird observers would not have fish sampling duties and could collect other types of data not normally collected in the Observer Program. The development of video monitoring techniques may also be useful in this effort, especially on smaller boats that did not carry observers. Of course, the potential value of this data will need to be balanced by the cost of acquiring it.

One concern is that observers were not accounting for birds that are hooked on longlines as they were deployed but fell off before they were retrieved on board. One study from Australia (Gales 1998) indicated that 30 to 95 percent of the birds coming out of the water fell off or were shaken off the gangions before being hauled aboard and were thus missed by observers. However, that study was based on an observer program that did not actively watch the groundline as it was retrieved. In the Observer Program, observers actually watch the groundline as it is retrieved and tally birds that fall off before being retrieved on board. This accounts for some of the “unidentified seabird” data. The question of how many birds are hooked as a line is deployed but fall off while the groundline is underwater is an issue that could perhaps be addressed by a series of experiments. These experiments could use birds already taken in the fishery or taken for other scientific purposes. The known numbers of seabirds placed on the line would then be compared to the number retrieved after the line soaked under normal fishing conditions. Such experiments may improve estimates of how many birds are actually taken in the fisheries. An alternative might be to use underwater video cameras to observe the longlines as they are being deployed. This technology is currently being developed to study the impacts of pelagic trawls (Kim Rivera, NOAA Fisheries seabird coordinator, personal communication) but it would probably require substantial research and development for longline applications. Again, the cost of developing this technology may be disproportionate to the value of the data, especially if new avoidance measures dramatically reduce incidental take on longlines.

7.2 New Modeling Needs

Concerns for fishery impacts range from population-level effects to local breeding-colony effects. As a practical matter, population modeling efforts have been limited to those species most frequently taken incidentally in the longline fisheries (northern fulmars) and to species of special concern (the three albatross species). Even though most other species are not monitored closely enough to determine if impacts are occurring on a population level, recent survey trends have raised interest in trying to model possible colony-level impacts on species that breed near intensive fishing efforts. Considering the proximity of major trawl and longline fishing efforts around the seabird colonies of the Pribilof Islands, it seems that this would be an appropriate region to model potential impacts on diving species such as the murres and on surface-feeding species such as the kittiwakes. While the murres are taken incidentally in trawls, a potentially larger impact may take place through fishery-induced changes in predator-prey relationships and other food web interactions with forage fish and important invertebrate prey. This localized impact model would thus be part of and integrated with a larger ecosystem modeling effort called for in some alternatives.

There are many questions that would need to be addressed regarding how seabirds would factor into an ecosystem model. Recent work by Hunt *et al.* (2000) has attempted to quantify some of the prey consumption parameters for seabirds and marine mammals in the North Pacific. While such “broad brush” analyses are valuable for overall energy and mass flow estimates, more localized measurements and assumptions about seabird numbers, seasonal distribution, and diet will be needed for a mathematical model to reflect the dynamics that are important to seabird survival and reproduction. The impact of seabird foraging on prey species, especially around breeding colonies, would also be an important element in any modeling effort.

The ecosystem model would have practical applications in the Alternative 4 policy, which requires the fishery management system to incorporate indices of “ecosystem health” in allocation decisions. The question of what these indices might be for seabirds deserves careful consideration. One candidate for a measurable index is the population densities of selected “indicator” species. There are two challenges with this approach. First, state-of-the-art seabird censusing techniques are still not very precise so there will always be a substantial amount of scientific uncertainty regarding population levels, especially over large areas. Second, populations of animals are never static, even in the absence of humans, so a certain amount of fluctuation should be seen as acceptable or even desirable in a “healthy ecosystem.”

Decisions will have to be made about how much change in an index is acceptable and at what point management should respond. One option is to develop different “levels of concern” based on the direction and amount of change over time, similar to the International Union for Conservation of Nature and Natural Resources’s “red list” ranking system for species, but for regions defined as biologically important to the fishery rather than global population. In any case, even if a set of ecosystem “warning signs” can be developed, the underlying mechanisms of change must be determined before appropriate mitigation can be taken. It must be acknowledged that there may be issues that the NPFMC or NOAA Fisheries may not be able to address with changes to the fishery management system. For example, if the population of a seabird indicator species begins to decline because of persistent pesticide pollution from agricultural runoff in Asia, the NPFMC will not be able to correct the situation by changing groundfish allocations.

Every impact analysis depends to some degree on knowledge about the distribution and abundance of seabird species in the BSAI/GOA, especially in areas away from breeding colonies and during the non-breeding season when most direct interactions with the fisheries occur. While a great deal of data has been collected over the years, much of it was collected in the 1970s and 1980s (Outer Continental Shelf Environmental Assessment Program) and is not readily accessible because it is stored in various places and formats. The U.S. Geological Survey/Biological Resource Division, in cooperation with NOAA Fisheries, USFWS, and the Minerals Management Service, has recently begun compiling this information into a standardized database format that will eventually be available to the public. Preliminary results from this North Pacific Pelagic Seabird Database have been used to analyze the degree of distributional overlap between selected species and different groundfish fisheries in the Ecosystem Considerations for 2003 report (NPFMC 2002). The Ecosystem Considerations for 2003 report contains several maps (Figures 5 to 12) that are good examples of how GIS technology can be used to facilitate understanding and analysis of seabird-fishery interactions. However, the basic abundance and distribution data for all seabird species need to be updated for these efforts to be most useful.

Section 8 **Comparative Analysis of the Policy Alternatives**

The four policy alternatives considered in this document cover a wide range of possibilities as far as seabird protection measures are concerned. Although these measures deal mostly with the direct impacts of incidental take, many other FMP components influence the indirect impacts of the fishery on seabirds. The following comparison will focus on how the different alternatives would approach the incidental take of seabirds in fishing gear.

Under the Alternative 2 policy, incidental take of seabirds would not be considered a serious enough issue to warrant any regulations or restrictions on the fishing fleet unless there was clear scientific evidence of adverse population-level impacts. Alternative 2 would do the minimum amount necessary to comply with the ESA concerning the endangered short-tailed albatross or any other listed species. The use of the Observer Program to gather seabird-fishery interaction data is also integral to this issue because this is the data presently used by USFWS to monitor the incidental take threshold on short-tailed albatross. Under the Alternative 2 policy, the Observer Program could range from having no seabird monitoring function (at the FMP 2.1 end of the management framework) to having the same coverage and seabird monitoring function as at present (under FMP 2.2). NOAA Fisheries would need to find a compromise within the range of Alternative 2 that satisfies USFWS during Section 7 consultations.

Under the Alternative 1 management policy, compliance with the short-tailed albatross BiOp (USFWS 1999) led to the scientific development of new seabird deterrent techniques and the joint recommendations of NOAA Fisheries, USFWS, and Washington Sea Grant Program for improving seabird avoidance regulations on longliners. It is expected that these measures will greatly reduce the numbers of incidental takes for several species of concern, including the three albatross species and northern fulmars. The Observer Program would be used to monitor the effectiveness of these regulations in reducing take and that information would be used to make improvements in the regulations. In contrast, the Alternative 3 management policy would place more emphasis on reducing incidental take for all species of seabirds. Scientific research would be used to develop improvements in seabird deterrent devices and avoidance techniques not only for the longline fleet but for trawl and possibly pot gear as well. The Observer Program would be expanded to improve the quantity and quality of seabird data collected and would continue to be a key component of research on seabird-fishery interactions. Under the Alternative 4 management policy, the goal would be to reduce incidental take of all seabird species to levels approaching zero. This may require strong incentive programs for fishermen as well as gear modifications in the longline and trawl fleets. The great reduction in fishing effort proposed under Alternative 4 would also result in substantial reductions in seabird take.

While the numbers of birds taken incidentally in the fisheries can be sampled and estimated quantitatively, the impact of specific take levels for the population of a particular species is subject to a substantial amount of uncertainty. The imprecise nature of most seabird population estimates, plus natural fluctuations in population levels, makes it very difficult to say for sure whether a given level of anthropogenic mortality is causing the population to decline. The different alternatives vary in how they would deal with such uncertainty in management decisions. The Alternative 1 policy acknowledges that the fishery has an impact on various parts of the environment but prioritizes management actions based on the scientific evidence of

significant impact. Mitigation efforts may be expanded beyond what is absolutely necessary in order to account for some uncertainty in the scope of a perceived problem. Research is directed toward the most pressing concerns and is oriented toward direct fishery interactions.

The Alternative 2 policy sees the fishery as one of many factors affecting ocean resources but assumes that the fishery does not do any real harm to the environment. Any restrictions on the fleet would only be enacted if there was clear scientific evidence of adverse impact, and mitigation efforts would be as limited in time and space as possible. Research into fishery interactions with the environment would not have a high priority. Alternative 3 assumes that the fishery has a greater impact on a number of environmental factors than we presently realize but that not all of it is bad. Mitigation efforts would still be prioritized by scientific evidence of adverse impact, but more uncertainty would be acceptable for a “significance” finding. The Alternative 3 policy would thus be more “precautionary” in dealing with uncertainty than the Alternative 1 policy, and mitigation efforts would be extended to more seabird species than required under the ESA. More emphasis would be placed on researching indirect fishery interactions with the ocean ecosystem. The Alternative 4 policy approach is to assume that the fisheries are having many adverse impacts on the ocean environment, including on many seabird species, but we do not know enough about fishery interactions to know what they are at present. The fishery would be greatly restricted until scientific evidence could be accumulated to make certain that there was no direct or indirect adverse impacts on a given resource. Environmental research would receive a much higher priority than in any other scenario. In the first three alternatives, various degrees of uncertainty about an impact would be used to prevent restrictions on the industry. In the Alternative 4 policy, the burden of proof is reversed and uncertainty about an impact would be used to prevent fishing.

Table 1. Summary of seabird protection measure effects.

Resource	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Seabirds	• New seabird protection measures based on Washington Sea Grant Program (WSGP) research expected to greatly reduce take of surface-feeding species on longlines and reduce chance of reaching Endangered Species Act (ESA) take threshold for short-tailed albatross. Many vessels have already adopted these measures voluntarily. • Research into trawl third wire collisions and possible mitigation. No other trawl or pot gear modifications under consideration. • Observer Program continues to improve data collection training and protocols and is integral in research efforts. • Fishing rates and allocation between gear types as at present.	• Old seabird protection measures would apply unless mandated by United States Fish and Wildlife Service (USFWS) under ESA. Present measures have no performance standards so effectiveness differs between vessels. Average overall take has not declined with existing measures. Some voluntary use of new techniques likely. • No restrictions or gear modifications on trawl or pot sectors would be considered. • Research on seabird-fishery interactions and Observer Program receive lower priority. • Fishing effort increases impact on total take.	• Old seabird protection measures would apply unless mandated by USFWS under ESA. Average overall take has not declined with existing measures except that voluntary adoption of new techniques has decreased take rate since 2001. • No restrictions or gear modifications on trawl or pot sectors would be considered unless required by ESA consultation. • Observer Program emphasis on seabird data remains stable. • Fishing effort stable so overall impact same as present.	• New seabird protection measures based on WSGP research expected to greatly reduce take of surface-feeding species on longlines and reduce chance of reaching ESA take threshold for short-tailed albatross. • Research into trawl third wire and other impacts receives greater attention. New mitigation considered as needed. • Observer Program continues to improve data collection training and protocols. • Overall take decreases with effective protection measures and stable fishing effort.	• Same protection measures as FMP 3.1 plus emphasis on further reduction. More emphasis on monitoring and mitigating species of mgmt concern, including murrelets and red-legged kittiwake. • Increased emphasis on mitigating take from trawls. New measures implemented as proven effective. • Increased cooperative research into seabird population- and colony-level effects of fishery. Expanded role of Observer Program data. • Decreased fishing effort and new mitigation greatly reduces overall take of seabirds.	• Continual development and adoption of more effective protection measures for longline and trawl fleet with goal of eliminating take of all species. Chance of exceeding ESA take threshold for short-tailed albatross greatly reduced. • Cooperative research into seabird population dynamics and foraging ecology to examine all potential fishery impacts. • Observer Program continues to expand and improve data collection. • Greatly decreased fishing effort and new mitigation essentially eliminates take of seabirds.	• Initial closure of groundfish fishery eliminates incidental take of seabirds. Specific proposed fisheries must have minimal impact on environment, including near-zero take of seabirds. • Research into seabird-fishery interactions and basic ecology increases in conjunction with experimental fisheries and directed studies.

Table 1 (cont.). Summary of seabird protection measure effects.

Resource	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Other biological resources	New seabird protection measures for longlines will not likely affect catch rates of any fish species or incidental take of marine mammals.	Existing seabird protection measures do not affect catch rates of any fish species or incidental take of marine mammals.	Same as FMP 2.1.	Same as FMP 1.	• Same as FMP 1 for longlines. Potential gear modifications for trawls may affect incidental take of other species but prevention of adverse impacts will be criteria for successful mitigation. • Increased research on seabirds improves overall understanding of marine ecology.	• Prevention of adverse effects on other animals will be key criteria of new seabird protection measures. • Increased research on seabirds improves overall understanding of marine ecology.	• No initial fishery or effects. Certified fisheries will not have adverse effects on other fish or mammals.
Physical resources	New seabird protection measures will not affect physical environment.	Old seabird protection measures do not affect physical environment.	Same as FMP 2.1.	Same as FMP 1.	Potential gear modifications for trawls may affect physical environment but prevention of adverse impacts will be criteria for successful mitigation.	Potential gear modifications for trawls may affect physical environment but prevention of adverse impacts will be criteria for successful mitigation.	No initial fishery or effects. Certified fisheries will not have adverse effects on physical environment.
Social and economic resources	• Cost of new seabird protection measures minimal and partially offset by improved deliverance of baited hooks. • Reduced chance of exceeding ESA take threshold for short-tailed albatross reduces chances of new requirements.	• No new costs for longline fleet. • Chance of exceeding ESA take threshold for short-tailed albatross remains and may lead to additional measures.	Same as FMP 2.1.	Same as FMP 1.	• Cost of potential modifications for trawls and longlines may be substantial. • Greatly reduced chance of ESA driven restrictions.	Same as FMP 3.2.	Initial shutdown of fishery will have severe consequences for industry and communities. Gear restrictions on subsequently opened fisheries may be costly.

Section 9 References

- Baduini, C.L., Hyrenbach, K.D., Coyle, K.O., Pinchuk, A., Mendenhall, V., and Hunt Jr, G.L. (2000). "Mass mortality of short-tailed shearwaters in the eastern Bering Sea during summer 1997." Fisheries Oceanography, In press.
- Cousins, K., and Cooper, J. (2000). The population biology of the black-footed albatross in relation to mortality caused by longline fishing. Honolulu, HI. 159 pp.
- Dick, M.H., and Donaldson, W. (1978). "Fishing vessel endangered by Crested Auklet landings." *Condor*, 80, pp.235-236.
- Dragoo, D.E., Byrd Jr., G.V., and Irons, D.B. (2001). Breeding status and population trends of seabirds in Alaska, 2000. U.S. Fish and Wildlife. Service Report AMNWR 01/07.
- Gales, R. (1998). "Albatross populations: status and threats." Albatross Biology and Conservation, G. Robertson and G.R., eds., Surrey Beatty & Sons, Chipping Norton, NSW, Australia, pp.20-45.
- Golet, G.H., Kuletz, K.J., Roby, D.D., and Irons, D.B. (2000). "Adult prey choice affects chick growth and reproductive success in pigeon guillemots." *Auk*, 117(1), pp.82-91.
- Hunt Jr. G.L., and Byrd Jr., G.V. (1999). "Marine bird populations and the carrying capacity of the eastern Bering Sea." The Bering Sea: Physical, Chemical and Biological Dynamics, T.R. Loughlin and K. Ohtani, eds., Alaska Sea Grant Program, 304 Eielson Building, University of Alaska Fairbanks, Fairbanks, AK 99775. pp.631-650.
- Hunt, G.L., Kato, H., and McKinnell, S.M. (eds.). (2000). Predation by marine birds and mammals in the subarctic North Pacific Ocean. PICES scientific report No. 14. North Pacific Marine Science Organization, Sidney, B.C., Canada. 168 pp.
- Melvin, E.F., Parrish, J.K., Dietrich, K.S., and Hamel, O.S. (2001). Solutions to seabird bycatch in Alaska's longline demersal fisheries. Final report to NMFS on research performed by the University of Washington Sea Grant Program (Project A/FP-7) in collaboration with the Fishing Vessel Owners Association, the North Pacific Longline Association, the NMFS, and the United States Fish and Wildlife Service, submitted August 31, 2001. 53p. Accessed from website on 13 May 2002: <http://www.wsg.washington.edu/pubs/seabirds/seabirdpaper.html>.
- National Marine Fisheries Service (NMFS). (2001). Alaska Groundfish Fisheries: Draft Programmatic Supplemental Environmental Impact Statement. NMFS, Alaska Region, NOAA, U.S. Dept. Of Commerce.
- NMFS. 2002. Revised Draft Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for a Regulatory Amendment to Revise Regulations for Seabird Avoidance Measures in the Hook-and-Line Fisheries off Alaska to Reduce the Incidental Catch of the Short-tailed Albatross and Other Seabird Species. NMFS, Alaska Regional Office, Juneau. Available online at <http://www.fakr.noaa.gov/protectedresources/seabirds/ea/draft1202/reviseddea.pdf>.

- North Pacific Fishery Management Council (NPFMC). (2002). Stock Assessment and Fishery Evaluation Report (SAFE): Ecosystem Considerations for 2003. Appendix C of the SAFE Report for the Bering Sea, Aleutian Islands and Gulf of Alaska. Compiled and reviewed by Plan Teams for the Groundfish Fisheries of the Bering Sea, Aleutian Islands, and Gulf of Alaska. Pat Livingston (ed.). Alaska Fisheries Science Center, Seattle, Washington.
- Piatt, J.F., Abookire, A.A., Drew, G., Kitaysky, A., Litzow, M., Nielsen, A., Speckmann, S., van Pelt, T., and Zador, S. (1998). "Cook Inlet seabird and forage fish studies." Exxon Valdez Oil Spill Restoration Project Annual Report, Restoration Project 97163M, U.S. Geological Survey, Biological Resource Division, Anchorage, AK.
- Piatt, J.F., and Rose, D.G. (1998). "Cook Inlet seabird and forage fish studies (CISEAFFS)." *Pacific Seabirds*, 25, pp.39.
- Suryan, R.M., Irons, D.B., and Benson, J.E. (1998a). "Foraging ecology of black-legged kittiwakes in Prince William Sound, Alaska, from radio tracking studies." *Pacific Seabirds*, 25, pp.45.
- Suryan, R.M., Irons, D.B., and Benson, J.E. (1998b). "Kittiwakes as indicators of forage fish availability." Exxon Valdez Oil Spill Restoration Project Annual Report, Restoration Project 97163E, U.S. Department of the Interior, Fish and Wildlife Service, 1211 E. Tudor Road, Anchorage, AK 99503.
- Suryan, R.M., Irons, D.B., and Benson, J.E. (2000). "Prey switching and variable foraging strategies of black-legged kittiwakes and the effect on reproductive success." *Condor*, 102, pp.373-384.
- U.S. Fish and Wildlife Service (USFWS). (1989a). "Endangered Species Act. Section 7 Consultation on the Effects of the Groundfish Fisheries Conducted under the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans of the NPFMC (Seabirds; Biological Opinion)." U.S. Department of the Interior, Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503.
- USFWS. (1989b). "Endangered Species Act. Section 7 Consultation on the Effects of the Interim Incidental Take Exemption Program on certain listed species in U.S. Waters. Letter from James W. Pulliam (USFWS) to James W. Brennan (NMFS)." U.S. Department of the Interior, Fish and Wildlife Service, 75 Spring Street, W.W. Atlanta, GA 30303. pp.34.
- USFWS. (1993). "Final Rule to List the Spectacled Eider as Threatened." *Federal Register*, 58, pp.27474-27480.
- USFWS. (1994). "Letter from Ann Rappoport, USFWS, to Steven Pennoyer, NMFS, Re: Endangered Species Act Formal Section 7 Consultation for the 1994 Groundfish Total Allowable Catch Specifications." U.S. Department of the Interior, Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503.

USFWS. (1995). "Endangered Species Act. Section 7. Reinitiation of Consultation on the Effects of the Groundfish Fisheries Conducted under the Bering Sea and Aleutian Islands and Gulf of Alaska Fishery Management Plans of the NPMC, (Seabirds; amended Biological Opinion from July 3, 1989)." U.S. Department of the Interior, Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503.

USFWS. (1997). "Letter from Ann Rappoport to Steven Pennoyer Re. Endangered Species Act Formal Section 7 Consultation and Biological Opinion on effects of the 1997 Total Allowable Catch Specifications and Environmental Assessment for groundfish fisheries in the Gulf of Alaska and Bering Sea-Aleutian Islands on short-tailed albatrosses." U.S. Department of the Interior, Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503.

USFWS. (1999). "Biological opinion on the effects of the BSAI and GOA 1999-2000 groundfish fisheries on the short-tailed albatross." pp. 36.

USFWS. (2000a). Beringian Seabird Colony Catalog. Published in conjunction with the Alaska Department of Fish and Game. Anchorage, Alaska. Available on-line at <[URL:http://164.159.151.5/seabird/index.html](http://164.159.151.5/seabird/index.html)>

USFWS. (2000b). Final rule extending the endangered status of th short-tailed albatross (*Phoebastria albatrus*) to include the species' range within the United States. Federal Register, 65 (July 31, 2000), pp. 46643-46654.

Personal Communications

S. Fitzgerald, Observer Program, NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.

K. Laing, Migratory Bird Management, USFWS, Anchorage, AK.

K. Rivera NOAA Fisheries Seabird Coordinator, Auke Bay Fisheries Science Center, Juneau, AK.

APPENDIX F

Gear Restrictions and Allocations

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Gear Restrictions and Allocations	F-7-1
	1.1 Definition of Allocation and the Need for Allocation Measures	F-7-1
	1.2 Types of Management Tools for Allocating Fishing Privileges	F-7-1
	1.3 Trends in Allocations Among Gear Types in Alaska Groundfish Fisheries	F-7-1
Section 2	Analysis of Alternatives	F-7-5
Section 3	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-7-6
	3.1 Overview of Gear Restrictions and Allocations of Alternative 1	F-7-6
	3.2 Effects of Gear Restrictions and Allocations of Alternative 1	F-7-8
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-7-14
	4.1 Overview of Gear Restrictions and Allocations of FMP 2.1	F-7-14
	4.2 Effects of Gear Restrictions and Allocations of FMP 2.1	F-7-14
	4.3 Overview and Effects of Gear Restrictions and Allocations of FMP 2.2	F-7-15
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-7-16
	5.1 Overview and Effects of Gear Restrictions and Allocations of FMP 3.1	F-7-16
	5.2 Overview of Gear Restrictions and Allocations of FMP 3.2	F-7-16
	5.3 Effects of Gear Restrictions and Allocations of FMP 3.2	F-7-16
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-7-19
	6.1 Overview of Gear Restrictions and Allocations of FMP 4.1	F-7-19
	6.2 Effects of Gear Restrictions and Allocations of FMP 4.1	F-7-19
	6.3 Overview and Effects of Gear Restrictions and Allocations of FMP 4.2	F-7-21
Section 7	Data Gaps and Information Needs	F-7-22
Section 8	Comparative Analysis of Alternatives	F-7-23
Section 9	References	F-7-27

ACRONYMS AND ABBREVIATIONS

AFA	American Fisheries Act
BSAI	Bering Sea and Aleutian Islands
CDQ	community development quota
CVOA	Catcher Vessel Operational Area
EBS	eastern Bering Sea
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
ESA	Endangered Species Act
FMP	Fishery Management Plan
GOA	Gulf of Alaska
m	meter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
N	North
nm	nautical miles
nm ²	square nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service or NMFS
NPFMC	North Pacific Fishery Management Council
PFMP	Preliminary Fishery Management Plan
PSC	prohibited species catch
TAC	total allowable catch
U.S.	United States
W	West

Section 1 Gear Restrictions and Allocations

This qualitative impact assessment discusses current and proposed gear restrictions and allocations in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) groundfish fisheries. The introductory section is divided into three parts. First, we define the term "allocation" in the context of fishery management and describe the need for and rationale behind allocation measures. Second, we identify various types of management tools used to address allocation issues or implement allocation decisions. The tools of particular interest here are those measures that allocate fishing privileges among users of different gear types. Third, we describe recent trends in the application of such allocation measures in the Alaska groundfish fisheries.

1.1 Definition of Allocation and the Need for Allocation Measures

The National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) defines an "allocation" or "assignment" of fishing privileges as a direct and deliberate distribution of the opportunity to participate in a fishery among identifiable, discrete user groups or individuals (61 Federal Register [FR] 32552, June 24, 1996). Allocation measures have normally been implemented by fishery managers for one or more of the following reasons: 1) to maintain healthy fish stocks or rebuild depressed stocks; 2) to protect resources that are not directly associated with fishing; or 3) to protect the economic position of certain groups engaged in a fishery or in related fisheries.

If it becomes necessary to allocate fishing privileges among various United States (U.S.) fishermen, National Standard 4 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires that the allocation be 1) fair and equitable to all such fishermen; 2) reasonably calculated to promote conservation; and 3) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges (Sec. 301(a)(4)).

1.2 Types of Management Tools for Allocating Fishing Privileges

A fishery management plan (FMP) that merely perpetuates existing fishing practices may result in an allocation if those practices directly distribute the opportunity to participate in a fishery (61 FR 32552, June 24, 1996). Alternatively, an FMP may contain management measures specifically intended to allocate fishing privileges. A wide array of management tools can be used to intentionally allocate fishing privileges, and these privileges can be allocated among many different types of user groups. This analysis focuses on those management tools that allocate fishing privileges among users of various kinds of fishing gear. Such tools include quotas by gear type, different fishing seasons for gear types, prohibitions on the use of certain gear, and the assignment of ocean areas to different gear users.

1.3 Trends in Allocations Among Gear Types in Alaska Groundfish Fisheries

U.S. foreign bilateral agreements were the main mechanism for managing groundfish fisheries off Alaska before 1976. Allocations among users of different gear types included time-area closures to protect domestic fishermen from fishing grounds preemption and gear conflicts caused by mobile foreign trawl gear.

Following the implementation of the MSA in 1976, foreign fishing could be conducted in the new 200-nautical mile (nm) U.S. Fishery Conservation Zone (later changed to the Exclusive Economic Zone [EEZ]) only pursuant to an international treaty or a governing international fishery agreement. The BSAI groundfish preliminary fishery management plan (PFMP) prohibited foreign fishing within 12 nm, except at certain times of the year in parts of the Aleutian Islands. Specifically to protect juvenile halibut, no trawling was allowed from December 1 through May 31 in a large area north of the Aleutian Islands and east of 170° West (W) longitude, which later would be called the Winter Halibut Savings Area, and in an area just south of the Pribilof Islands known as the Misty Moon Grounds. Further, the Bristol Bay Pot Sanctuary, north of the Alaska Peninsula running from the eastern boundary of the Winter Halibut Savings Area east to 160° W, was closed to trawling all year to prevent conflicts between foreign trawl gear and U.S. crab pots.

The GOA groundfish PFMP prohibited trawling within 12 nm (except at 169°-170° W) to prevent gear conflicts and catch of inshore species. Six Kodiak Island Gear Areas were closed to foreign fishing from August 10 through May 31 to prevent conflicts with U.S. crab pots and halibut setlines. To protect emergent domestic fisheries in Dutch Harbor and Sand Point, no trawling at all was allowed in the Davidson Bank area. Three additional areas were closed around Kodiak Island within five days of the halibut fishery so the grounds would be undisturbed and gear conflicts with U.S. fishermen would be reduced. A rule change to the FMP in April 1978 further restricted foreign fishing by limiting the cod fishery west of 157° W and inside the 500-meter (m) isobath to longlines to reduce bycatch of other species and to prevent gear conflicts during the halibut season.

Under the sablefish PFMP there were no time area restrictions in the Bering Sea, but there were various year-round and temporary closures in the Aleutian Islands. In the GOA, the foreign setline fishery had to stay outside the 500-m depth contour to reduce gear conflicts with domestic fishermen.

A major task of the North Pacific Fishery Management Council (NPFMC), which first convened in October 1976, was to develop FMPs for the groundfish fisheries to replace the PFMPs (which applied only to foreign fisheries). The first FMP developed was for the GOA groundfish fisheries, implemented in January 1979; the BSAI groundfish FMP was implemented in 1982. Both plans carried forward most of the PFMP management measures. Some time-area closures were expanded, and depth restrictions were set on foreign longline fishing for Pacific cod in the Winter Halibut Savings Area in the eastern Bering Sea (EBS).

By the end of 1985, only minor foreign fisheries, directed on pollock and Pacific cod, were being allowed in the GOA. Foreign harvesting continued in the Bering Sea. Even there, foreign trawling had ended within 20 nm of the Aleutian Islands, and foreign longlining for cod was restricted to north of 55° North (N) and west of 170° W, depending on ice conditions. To protect halibut, southeast Alaska, east of 140° W, was closed to all foreign fishing in 1982. The Kodiak Island Gear Areas were expanded into one large area, bounded by the “Lechner Line,” and its closure to all foreign trawling was designed to prevent gear conflicts between foreign trawlers and U.S. crab fishermen and to prevent preemption of crab grounds during the crab season by foreign trawlers. This closure remained in place while foreign trawlers still worked the grounds off Kodiak. Foreign trawling ceased in the GOA after 1985.

During the five years between 1986 and 1991, the groundfish fisheries became totally domestic. During this period, bycatch control in the domestic fisheries was a major policy emphasis. Extensive closures were imposed on domestic trawlers around Kodiak Island and in the EBS to protect red king crab. Some closures were complete and year-round; others were for parts of the year and applied just to bottom trawling. By 1990, prohibited species catch (PSC) restrictions were widely applied to the entire domestic fleet through a complex allocation of PSC limits by area, season, gear, and fishery sector, including both trawl and fixed gear. This PSC framework was first established for the GOA and later applied to the BSAI, although differences exist between the two areas in terms of prohibited species, method for setting the catch restrictions, and the fisheries/gear types to which the restrictions apply.

By 1992, a separate statistical subarea was created around Bogoslof Island to allow for the establishment of a separate total allowable catch (TAC) for pollock in this subarea, thereby providing regulatory protection of Aleutian Basin pollock during spawning to help rebuild the Aleutian Basin pollock stock. This stock was heavily fished in central Bering Sea international waters by foreign fleets displaced from the U.S. EEZ. Additionally, the Aleutian Islands management area was partitioned into three separate areas to manage Atka mackerel, and later, pollock.

By 1995, a large area (referred to as the Pribilof Islands Habitat Conservation Area) around the Pribilof Islands was closed to trawling to protect halibut and blue king crab and for other purposes. The Pribilof Islands trawling closure conferred benefits on local residents and also reduced the potential for disturbance and incidental mortality of marine mammals and seabirds that live in the area. In addition, more areas in Bristol Bay were closed to non-pelagic trawling to protect red king crab and their habitat, and the Chinook Salmon Savings Area was established to reduce bycatch of chinook salmon in the Bering Sea groundfish trawl fisheries. All trawling was prohibited in the area.

The rapid expansion of the domestic fleet during the 1980s also led to increased interactions among gear types. In the early 1980s, for example, domestic longliners had increased their harvests of sablefish rapidly as markets for this species developed. Two new gear types, pots and sunken gillnets, entered the sablefish fishery in 1984. In addition, trawling by foreign joint ventures in the central and western GOA also took sablefish. All these gears created an overcapacity problem in the domestic sablefish fishery, as well as gear conflicts between longline fishermen and pot fishermen. In 1985, in the first allocation of an Alaska groundfish species among domestic fishermen, 80 percent of the sablefish TAC in the western and central GOA was allocated to longline gear while trawl gear was allocated the remaining 20 percent, but only to cover incidental catches. In the eastern GOA, 95 percent of the sablefish was allocated to longline gear and 5 percent to trawl gear to cover incidental catches. The use of pots in the sablefish fishery was phased out in the GOA. In the BSAI, gear allocations in the sablefish fishery were implemented in 1990. In the Aleutian Islands subarea, 25 percent was allocated to trawl gear and the remainder to fixed gear, while in the Bering Sea subarea 50 percent of the TAC was allocated to trawl gear.

In 1992, allocations of BSAI pollock were made between inshore and offshore sectors. In addition, a catcher vessel operational area (CVOA) was established in the Bering Sea in which catcher processors and motherships were prohibited from engaging in directed fishing for pollock during the B Season (September 1 to November 1). Inshore-offshore allocation of GOA pollock and Pacific cod were also approved in 1992—the inshore sector was allocated 90 percent of the pollock and 80 percent of the Pacific cod. The inshore-offshore allocations in the GOA remain in place as approved in 1992; however, the BSAI allocations were altered in 1995 and finally replaced with the American Fisheries Act (AFA) of 1998. The AFA

modified the allocations of the BSAI pollock quota as follows: 10 percent to the western Alaska Community Development Quota (CDQ) program, with 50 percent of the remainder allocated to the inshore sector, 40 percent to the offshore sector, and 10 percent to the mothership sector.

In the early 1990s, there were also concerns within the fishing industry regarding the need for stability in the trawl gear and fixed gear (longline, pot, and jig) fleets that targeted Pacific cod. In 1994, an allocation of the BSAI Pacific cod harvests among vessels using trawl, hook-and-line or pot gear, and jig gear was implemented. While the fixed and trawl gear fleet were allocated about their average catch, the 2 percent allocation to jig gear was larger than historical catches. This allocation to jig gear was intended to encourage participation of small, shore-based vessels. The BSAI Pacific Cod "gear split" was re-authorized in 1996 with changes in the allocation and an additional split between trawl catcher vessels and trawl catcher processors. In 2000, the fixed gear portion of the BSAI Pacific cod fishery was further subdivided between longline catcher processors, longline catcher vessels, and pot gear vessels. In 2001, a further split was deemed necessary between pot catcher processors and pot catcher vessels.

The 1990s also saw an increase in concern about fishery interactions with protected species. In 1990, NOAA Fisheries-listed Steller sea lions as threatened under the Endangered Species Act (ESA). Subsequently, NOAA Fisheries closed areas year-round to trawling within 10 miles of 37 Steller sea lion rookeries, and to within 20 miles during the pollock A season (January 20 to April 15) around five rookeries in the BSAI. There were comparable closures in the GOA. To reduce competition for prey and avoid localized depletion in sea lion foraging areas, the pollock TAC was spread over three areas, and the amount of excess pollock that could be taken in a quarter was limited.

Section 2 Analysis of Alternatives

The following four policy alternatives are under consideration by the NPFMC:

Alternative 1 – Continue Under the Current Risk-Averse Management Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented.

Alternative 2 – Adopt a More Aggressive Management Policy: A less precautionary management policy (i.e., a more aggressive harvest strategy) would be implemented based upon the concept that the present strategy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This strategy assumes that fishing at the recommended levels would have no adverse impact on the environment except in specific cases that are generally known.

Alternative 3 – Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community- or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species.

Alternative 4 – Adopt a Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy and its associated FMP framework would be to impose very restrictive conservation and management measures at minimum, which would only be modified or relaxed when additional reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve, and be responsive to, the public but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but, due to a lack of information and uncertainty, we know little about these impacts. A goal of this alternative, as expressed through its FMP framework, is to include the use of explicit allocative or cooperative programs to reduce excess capacity and allocate fish to particular gear types and fisheries.

Each of the policy alternatives outlined above, with the exception of Alternative 1, contains two bookends to a range of management measures that illustrate how the framework of each policy could be implemented. These bookends provide a level of detail that allows the effects of the alternatives on the environment to be compared. They also provide a basis for the NPFMC to commit to the goals and principles of a particular policy alternative, while allowing it, under the MSA, to adaptively manage the fishery through FMP amendments using the best scientific information available.

Section 3 Alternative 1: Continue Under the Current Risk-Averse Management Policy

3.1 Overview of Gear Restrictions and Allocations of Alternative 1

Alternative 1 would maintain current gear restrictions and allocations in the Alaska groundfish fisheries. Many of the management measures in the groundfish FMPs could be considered allocative and restrict gear in one way or another. This analysis focuses on the measures listed below.

No-Trawl Zones

The no-trawl zones in effect at this time and their implementing FMP amendments are as follows:

GOA

- Amendment 15 - Kodiak bottom trawl closures (renewed by Amendment 18 and made permanent by Amendment 26).
- Amendment 41 - Southeast trawl closure (implemented as part of the Groundfish License Limitation Program in 1996).
- Amendment 59 - Sitka Pinnacles Marine Reserve.
- Amendment 60 - Cook Inlet closed area.

BSAI

- Amendment 10 - Trawl closure north of Alaska Peninsula.
- Amendment 16a - Herring Savings Areas.
- Amendment 18 - Catcher Vessel Operational Area (boundaries modified by Amendment 38).
- Amendment 21a - Pribilof Islands Habitat Conservation Area.
- Amendment 21b - Chinook Salmon Savings Areas (revised by Amendment 58).
- Amendment 35 - Chum Salmon Savings Area.
- Amendment 37
 - Bristol Bay Red King Crab Savings Area
 - Nearshore waters of Bristol Bay trawl closure
- Amendment 40 - C. opilio Bycatch Limitation Zone.

Pollock bottom trawl gear prohibition in the BSAI

Pollock bottom trawling is banned in the BSAI under Amendment 57 to the BSAI FMP.

Sablefish pot gear prohibition in the GOA

The harvest of sablefish with pot gear is banned under Amendment 14 to the GOA FMP.

Sablefish and Pacific cod allocation

Sablefish TACs are allocated among gear types under Amendment 14 to the GOA FMP and Amendment 13 to the BSAI FMP. The BSAI Pacific cod TAC is allocated among gear types under Amendment 46 and Amendment 64 to the BSAI FMP. Amendment 24 to the BSAI FMP seasonally apportions the amount of Pacific cod TAC allocated to vessels using longline or pot gear.

Atka mackerel allocation

Amendment 34 allocates up to 2 percent of the Atka mackerel TAC specified for the eastern BSAI to vessels using jig gear.

Shortraker/rougheye rockfish allocation

After subtraction of reserves, Amendment 53 allocates 30 percent of the remaining shortraker/rougheye TAC to non-trawl gear and 70 percent of the remaining TAC to trawl gear.

While this analysis focuses on the measures listed above, it is recognized that other management measures may indirectly restrict gear or allocate harvest amounts among gear types. For example, the PSC management measures of Alternative 1 have the indirect effect of allocating between gear types and fishing sectors. Some of the management measures that may indirectly restrict gear or allocate harvest amounts among gear types are listed below.

GOA

- Amendment 18 - Halibut PSC allocations and Shelikof Strait management area.
- Amendment 19 - Prohibit pollock roe stripping.
- Amendment 21 - Apportion PSC limits by fishery and gear.
- Amendment 22 - Experimental fishing permits.
- Amendment 23 - Inshore/offshore allocation of pollock and Pacific cod (extended and/or modified by Amendments 40, 51, and 61).
- Amendment 24 - PSC control measures.

- Amendment 25 - Steller sea lion buffer zones.
- Amendment 27 - Trawl test areas.

BSAI

- Amendment 9 - Directed fishing definition.
- Amendment 12a - Revised halibut and crab PSC limits.
- Amendment 14 - Prohibit pollock roe stripping.
- Amendment 16 - Gear restrictions related to interim harvest levels and PSC management.
- Amendment 17 - Experimental fishing permits.
- Amendment 18 - Inshore/offshore allocation of pollock (extended and/or modified by Amendments 38, 51, and 61).
- Amendment 19 - Adjusted PSC categories.
- Amendment 20 - Steller sea lion buffer zones.
- Amendment 21 - Halibut bycatch mortality limits.
- Amendment 41 - Reduced *C. bairdi* PSC limit.
- Amendment 46 - Adjust halibut PSC for Pacific cod.

3.2 Effects of Gear Restrictions and Allocations of Alternative 1

Effects on Marine Mammals

Three marine mammal species are of particular importance relative to both direct and indirect fishery interactions: Steller sea lions, Northern fur seals, and harbor seals. Interactions between the groundfish fisheries and other marine mammals are relatively low.

The incidental take of Steller sea lions under Alternative 1 is low. Based on NOAA Fisheries observer records from the BSAI and GOA trawl, longline, and pot fisheries during 1990 to 1999, the mean annual mortality rate was 9.6 animals per year from the western stock of Steller sea lions. The last recorded mortality of a Northern fur seal in any Alaskan groundfish fishery occurred in 1996. Observer records from 1990 to 1998 indicate that direct interactions of Northern fur seals with groundfish vessels occurred only in the BSAI trawl fishery, despite observer placement in pot, longline, and trawl fisheries in both the BSAI and GOA. Incidental direct take of harbor seals by the groundfish fisheries operating in the GOA and BSAI are uncommon and collectively amounted to less than 0.2 percent of the GOA and southeast Alaska harbor seal management unit potential biological removals.

Sperm and killer whales are known to interact directly with longline gear. However, interactions that result in harm to any of the toothed whales, other than occasional incidental takes, have not been documented. Sperm whales in the GOA have been observed feeding off longline gear targeting sablefish and halibut. While sperm whales appear to be attracted to these vessels, the interactions with boats employing commercial longline gear do not appear to have an adverse impact on sperm whales. Much to the contrary, the whales appear to have become more attracted to these vessels in recent years. (NMFS 2001).

Most information regarding killer whale consumption of commercially important groundfish results from observations of whales removing catch from longlines that are retrieved in locations ranging from the south EBS to Prince William Sound. In the waters between Unimak Pass and the Pribilof Islands, killer whales regularly strip sablefish and Greenland turbot from longlines (NMFS 2001). Fishermen have testified at the NPFMC that increased interactions with killer whales have made the use of longline gear in areas of the BSAI difficult.

Steller sea lions may compete with groundfish fisheries for prey. Some toothed-whale species prey on the same species caught in groundfish fisheries. This is especially the case for killer whales and sperm whales. The impact of prey competition on these marine mammals is a function of both the amount of fishing activity and its concentration in space and time. In general, it does not appear that under Alternative 1 prey competition represents a concern for other marine mammals at current population levels (NMFS 2001). There may be localized effects based on spatial and temporal patterns of fishing (NMFS 2001). To the extent that no-trawl zones impose limits on fishing activity inside the critical habitat of marine mammals, it can be assumed that at least some protection is currently provided from these effects.

Effects on Seabirds

Several effects on seabirds related to gear restrictions and allocations can be summarized. Hook-and-line gear catches almost 90 percent of the seabirds taken in groundfish fisheries. This gear type, therefore, will dominate any direct effects of Alternative 1 on the incidental catch of most seabirds. The species most impacted by hook-and-line gear are northern fulmars, gulls, albatrosses (including endangered short-tailed albatross), and shearwaters in the BSAI and northern fulmars, albatrosses, and gulls in the GOA. Trawl gear is responsible for the remaining 10 percent of seabird incidental catch. Trawl gear takes mainly alacids, northern fulmars, and gulls.

Several factors are likely to affect the risk of seabird incidental catch including fishing effort (number of hooks set or trawl-hours per year), the distribution of effort by subarea and season, the abundance and distribution of seabirds in the vicinity of fishing vessels, and the use of seabird deterrents in longline fisheries. The relative importance of these factors has not been fully studied.

In both the BSAI and GOA, northern fulmars are more likely to be taken with increased fishing effort than any of the other three seabird groups that are taken by longline gear. Differences in species-specific foraging behavior and behavior while around fishing vessels could be a factor in the different catch rates. The impact of hook-and-line fishing effort cannot be predicted in detail because of unknown factors such as the seasons and locations of fishing as it relates to the abundance and distribution of seabirds and the effectiveness of the deterrent measures being used.

To the extent that measures under Alternative 1 allocate more Pacific cod and sablefish to hook-and-line gear, there is an increased probability that more seabirds will be taken. Data indicate that allocations for hook-and-line gear in some fisheries have increased. In the BSAI, direct allocations of Pacific cod to hook-and-line and pots increased from 44 percent in 1994 to 51 percent in 1997. A specific allocation of 40.953 percent was made to hook-and-line gear in 2000. Sablefish allocations in the GOA have favored users of hook-and-line gear since 1985, when they received 95 percent of the sablefish in the eastern GOA and 80 percent of the sablefish in the central and western GOA. In the BSAI, beginning in 1990, they received a 50 percent allocation in the Bering Sea and a 75 percent allocation in the Aleutian Islands.

The establishment of the Pribilof Islands Habitat Conservation Area has had a positive effect on seabirds (NMFS 2001). Red-legged kittiwakes and black-legged kittiwakes, seabird species of special concern, appear to have remained at stable population numbers since 1989. Other seabird species, such as northern fulmars and common murrelets are increasing on the Pribilof Islands (NMFS 2001).

Effects on Target Species

The directed pollock fishery is conducted exclusively by pelagic trawl gear in the BSAI and primarily by this gear type in the GOA. Historically, large fractions of the total pollock harvest occurred in a relatively short time and in a fairly concentrated area. More recently, management measures have served to disperse the fishing effort over broader areas. Regional TACs are further allocated by season and there are limits to the amount of pollock catch that can be taken inside Steller sea lion critical habitat. The level of habitat disturbance and the temporal and spatial concentration of the catch under Alternative 1 does not appear to affect the stock's sustainability either through changes in the population's genetic structure or changes in reproductive success, as measured by the ability of the stock to maintain itself above its minimum stock size threshold.

The trawl fisheries targeting sablefish are often limited by PSC limits. Therefore, to the extent that more sablefish is allocated to trawl gear, the overall harvest of sablefish by trawl and fixed gear combined is expected to be lower. In 2001, the central GOA trawl and longline gear fully harvested their sablefish allocations. However, in the western GOA, trawl gear only caught 35 percent of its allocation and longline gear caught 90 percent. Longliners harvested 78 percent of their sablefish allocation in the Bering Sea, while trawlers harvested only 53 percent. In the Aleutian Islands longliners harvested 64 percent of their allocation and trawlers harvested only 7 percent.

Under Alternative 1 and the existing FMP, trawl fishing is not permitted in the southeast/east Yakutat area, and the Pacific ocean perch acceptable biological catch or TAC normally allocated to that area is typically not caught. Pacific ocean perch stocks in all areas are fished at less than the overfishing level. The other slope rockfish category in the GOA includes sharpchin, harlequin, redstripe, silvergray, redbanded, and yellowmouth rockfish. Historically, almost all catch for these species has been as bycatch in other fisheries, although there was a small amount of directed fishing for silvergray and yellowmouth rockfish in the early 1990s. Trawl surveys show the biomass for all species of other slope rockfish is concentrated in the eastern GOA area (Heifetz *et al.* 1999). Since 1998, the prohibition on trawling in the eastern GOA east of 140°W has afforded a high level of protection to all species in the other slope rockfish group since most of these species are only taken in trawls.

Yellowfin sole catch rates have been lowered by the no-trawl zones along the northern side of the Alaska Peninsula. These area closures have forced vessels to shift their effort to areas in which PSC bycatch levels are higher. Consequently, the yellowfin sole TAC is not fully harvested due to PSC limits.

Effects on Non-Target (Forage, Other, and Non-Specified) Species

In deep water longline fisheries the catch of non-specified species in terms of volume or weight may nearly equal target species catch. This phenomenon is attributed to the bycatch of grenadiers, a large-size fish. Also, the longline fishery for Pacific cod catches a higher rate of skates than does the trawl fishery. Included in this longline bycatch is a disproportionately large amount of rarer skate species. To the extent that current allocations among gear types have favored users of longline gear, Alternative 1 has had a negative effect on these non-target species.

Effects on Prohibited Species

PSC limits and time and area closures have been specified for some prohibited species in the current FMP. The requirement that fisheries be closed (or moved) when PSC limits are attained has constrained some groundfish fisheries in recent years. Pacific halibut bycatch limits have affected bottom trawl fisheries, in particular; consequently, portions of fishing quotas annually specified for most flatfish species have remained unharvested (Witherell 1995). The majority of halibut bycatch in the BSAI is taken in trawl fisheries, specifically those targeting Pacific cod, yellowfin sole, and rock sole. Longline fisheries targeting Pacific cod take the next largest proportion of halibut bycatch. Overall, 80 percent of BSAI halibut bycatch is predicted in bottom trawl fisheries, 16 percent in longline fisheries, 4 percent in pelagic trawl fisheries, and less than 1 percent in all other gear types. The proportions are similar in the GOA, with 86 percent in bottom trawl fisheries, 12 percent in longline fisheries, and less than 2 percent in all other gear types.

The bycatch of halibut is mostly juveniles and this juvenile mortality is taken into account within the halibut stock assessments and the International Pacific Halibut Commission quota-setting process (NMFS 2001). While no significant impacts to halibut populations are predicted under Alternative 1, the bycatch mortality of juvenile halibut will continue to reduce yields in the directed halibut fishery.

PSC limits have led to technological innovation on the part of harvesters. For instance, careful release requirements in longline fisheries have been implemented to improve survival of halibut discards. Likewise, several trawlers voluntarily use bycatch reduction devices in their nets to release incidentally caught halibut with minimal harm.

Numerous areas are closed to non-pelagic trawling to protect king and Tanner crab stocks. These include the Bristol Bay Red King Crab Savings Area, the nearshore Bristol Bay no-trawl zone, the Pribilof Islands Habitat Conservation Area, and areas around Kodiak Island. Since the Bristol Bay measures were implemented, bycatch of red king crab has been greatly reduced, and the Bristol Bay red king crab stock has rebuilt to levels that supported directed crab fisheries in 1996-2001, but the stock is again declining due to a lack of recruitment. Since the establishment of the Pribilof Islands Habitat Conservation Area, the blue king crab population has continued to decline and is now considered overfished. With regard to the effects of the Kodiak Island area closures, surveys have detected signs of rebuilding for some crab stocks. In 2001, the *C. bairdi* Tanner crab fishery at Kodiak Island reopened after a seven-year closure. However, king crab stocks in the vicinity of Kodiak Island remain depressed.

About 94 percent of all BSAI herring catch occurs in the Bering Sea pelagic trawl fishery for pollock. Recently, bycatch of herring in groundfish fisheries has been very low compared to both herring biomass (1 percent or less in the BSAI and 0.05 percent in the GOA) and herring catch in directed fisheries (ADF&G 2000). Thus, bycatch of herring under Alternative 1 is unlikely to have significant impacts on herring populations.

Chinook salmon in the BSAI are taken primarily in pollock fisheries (about 92 percent of the total) and the Pacific cod bottom trawl fishery (7 percent). Amendment 58 to the BSAI FMP revised the boundaries of the chinook salmon savings areas and instituted bycatch levels that will trigger trawl closures in those areas. Amendment 35 to the BSAI FMP set chum salmon bycatch limits and a chum salmon savings area that prohibits all trawling.

Effects on Habitat, Including Essential Fish Habitat, and Ecosystems

A number of the no-trawl zones are designed, at least in part, to protect habitat and/or essential fish habitat. In addition, the prohibition on bottom trawling for pollock in the BSAI affords greater protection to habitat, including essential fish habitat (EFH). Under Alternative 1, year-round closures to bottom trawling are 16 percent, 18 percent, and 21 percent of the benthic EFH in the Bering Sea, Aleutian Islands, and GOA, respectively. Although these percentages are near the 20 percent recommendation for marine reserves (Agardy 1994, Lauck *et al.* 1998, Allison *et al.* 1998), the primary focus of these area closures is to protect crab habitat. Because this habitat is generally relatively shallow and does not encompass a wide range of habitat types and depths, the closures do not protect a wide range of EFH for other species. The exception is the bottom trawl closure area in southeast Alaska, which encompasses a wide range of habitat types and depths. There are generally no area restrictions in the deeper waters that encompass the outer continental shelf and upper slope of the central and western GOA and BSAI. Within the areas currently open to bottom trawl fishing, specific areas or "hotspots" are repeatedly fished each year, while other areas are undisturbed or fished very lightly (Coon *et al.* 1999, Fritz *et al.* 1998). Presumably, an area is repeatedly trawled because there are high catches of target species and the bottom topography is suitable.

Fixed gear may also adversely impact benthic biota and habitat. Longline and pot gear can damage benthic biota by hooking, crushing, and plowing. In some cases, fixed gear may have a greater impact than trawl gear due to its ability to be more easily fished on a wider range of habitat types. Geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed gear impacts. The Sitka Pinnacles Marine Reserve and nearshore areas of some marine mammal protection zones are the only areas closed to fixed gear fisheries.

The existing no-trawl zones are likely to have ecosystem benefits in the EBS, as they comprise a relatively large portion of the continental shelf. The three Bering Sea area closures (Pribilof Islands Habitat Conservation Area, Bristol Bay and Red King Crab Savings Area) total about 30,000 square nautical miles (nm²), which encompasses about 25 percent of the Bering Sea shelf. The GOA closures encompass about 47,000 nm², but a vast majority (about 80 percent) of this area is off the continental shelf (greater than 200 nm). Additional no-trawl zones include the Steller sea lion rookeries and haulouts. The 2.5 nm² Sitka Pinnacles Marine Reserve established in 2000 prohibits all groundfish and halibut fishing but allows recreational and commercial fishing for salmon.

Economic and Social Effects

Trawl closure areas were established with the expressed purpose of reducing bycatch of species valuable to certain non-groundfish commercial, recreational, or subsistence fisheries. Similarly, allocations of groundfish TACs among gear types were intended, at least in part, to protect the economic interests of participants in certain fisheries. There is insufficient economic data to determine the magnitude of the costs and benefits of these measures or how these costs and benefits are distributed across fishery participants.

The costs of prohibited species discards under Alternative 1 include 1) the cost imposed on participants in the groundfish fisheries by having to stay within the PSC limits; 2) the cost of prohibited species discards imposed on crab, halibut, herring, and salmon fishermen (including commercial, recreational, and subsistence fishermen) in terms of reduced catch and value; 3) the cost of any net adverse ecological effects associated with discarding prohibited species at sea; and 4) the management and enforcement costs associated with controlling this bycatch. The second type of costs is the opportunity costs of catching and discarding prohibited species. In the case of a PSC limit that is not utilized fully, this opportunity cost may be low. All but the first type of cost are external costs from the perspective of groundfish fishermen.

The imposition of compliance costs on the fishery participants reduces their potential profitability. This provides them economic incentives, at least in part, to comply in a less costly manner. Fishery participants have responded by developing gear modifications that selectively reduce bycatch of unwanted species (e.g., larger mesh in trawls, excluder devices) or increase survivability after being caught (e.g., grates on sorting decks). To the extent that these modifications are successful at reducing unwanted bycatch or PSC mortality, fishermen are able to catch more of their target species.

Effects on Management and Enforcement

NOAA Fisheries manages the fisheries off Alaska based on TAC amounts for target species and PSC limits for species that may not be retained. The TAC and PSC amounts are further subdivided by gear type, area, and season. The complexity of the management regime has increased substantially over the years. In 1995, for example, there were 40 TAC allocations and 38 PSC allocations in the BSAI. By 1999, there were 79 TAC allocations and 54 PSC allocations. Each allocation may require NOAA Fisheries to take a management action, such as close a fishery, reallocate bycatch amounts, or investigate an overage. When a directed fishery in one area is closed, the boats that participated in the fishery often move to another area or change to another target. This shift, in turn, often leads to the need for additional management actions. Though the number of allocations has increased, the quantity of fish available for these allocations has not, and NOAA Fisheries is required to manage increasingly small blocks of fish. To do this adequately requires the use of increasingly sophisticated catch-monitoring tools, such as observer coverage, electronic reporting, vessel monitoring systems, and the use of at-sea scales. Though these tools increase the quantity, quality, and timeliness of the data available to NOAA Fisheries, they also increase the demands on staff to effectively make use of a larger and more complex data system.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

4.1 Overview of Gear Restrictions and Allocations of FMP 2.1

FMP 2.1 would eliminate all trawl closure areas and trawl and fixed gear restrictions. The only closed areas that will remain in effect are those specifically implemented to protect Steller sea lions.

4.2 Effects of Gear Restrictions and Allocations of FMP 2.1

Effects on Marine Mammals

Eliminating all trawl closure areas could increase the effects of fishing on marine mammals. The effects of fishing on marine mammals could occur as vessels harvest schools of fish that marine mammals also feed on. However, the scope and magnitude of such effects are unknown because little is known about interactions between fishing activities and marine mammal foraging. Steller sea lions would continue to receive some level of protection due to separate and continued findings of jeopardy. Protective measures instituted for Steller sea lions would also provide some protection for other species, although the measures would not necessarily address these other marine mammals' specific habitat and activity patterns.

Effects on Seabirds

Some of the trawl closure areas that would be eliminated under FMP 2.1 are close to shore and adjacent to seabird rookeries such as the Pribilof Islands Habitat Conservation Area. To the extent that seabirds feed in proximity to their rookeries, opening fisheries near the rookeries could interfere with seabird foraging behavior. Localized depletion of prey species around seabird colonies could be particularly detrimental during the chick-rearing period for the breeding seabirds. For instance, the recent reductions in the populations of kittiwakes in the Pribilof Islands suggest that a decline in the abundance of prey (e.g., capelin) near these islands has had a negative impact on these seabirds. The cause of this decline in the abundance of prey is unknown.

Effects on Target Species

The elimination of trawl closure areas under FMP 2.1 would have little, if any, effect on target species, as the harvest of these species would continue to be governed by TACs.

Effects on Non-Target (Forage, Other, and Non-Specified) Species

The elimination of trawl closure areas under FMP 2.1 is expected to have little, if any, effect on non-target species.

Effects on Prohibited Species

Many of the areas closed to trawling under Alternative 1 were done so specifically to reduce the catch of prohibited species. This is the case in the Pribilof Islands Habitat Conservation Area, the Kodiak Island area closures, the Halibut Savings Area, and the Salmon and Herring Savings Areas. Reopening these areas under FMP 2.1 is expected to result in an overall increase in the catch of prohibited species. In some cases, however, the PSC associated with a target fishery may decrease by opening a closed area. For example, when the Bristol Bay area was closed to trawling the trawl fleet shifted its effort to other areas to harvest yellowfin sole. This shift resulted in a significant increase in PSC per metric ton of yellowfin sole harvested. A reopening of the Bristol Bay area to yellowfin sole trawling, therefore, may result in a decrease in the PSC associated with this target fishery.

Effects on Habitat, Including Essential Fish Habitat, and Ecosystems

If non-pelagic trawling resumes in the areas reopened under FMP 2.1, disturbance of benthic biota and habitat will occur. The extent of the disturbance will depend on the specific type of trawls used and the amount of fishing effort. The impact also varies with the habitat type. Because most of the areas have been closed to trawling for some time, the extent of change induced by a resumption of trawling will probably be substantial.

Economic and Social Effects

Trawl closure areas were established with the expressed purpose of reducing bycatch of species valuable to certain non-groundfish commercial, recreational, and subsistence fisheries, including those fisheries targeting crab, salmon, and herring. Therefore, reopening these areas under FMP 2.1 can be expected to have a negative economic impact on the participants in these fisheries. For instance, to the extent that the Kodiak Island area closures were successful in protecting *C. bairdi* Tanner crab stocks, opening those areas to trawling will have adverse economic effects on crabbers. These effects are associated with the taking of crab as bycatch (direct costs) or negatively affecting crab habitat or crab prey (indirect costs). On the other hand, reopening areas may reduce the operating costs of trawlers. Similar effects would be expected for subsistence and commercial salmon fisheries if the BSAI salmon savings areas were reopened. There is insufficient economic data to determine the magnitude of these costs and benefits.

Effects on Management and Enforcement

FMP 2.1 will result in decreased enforcement costs due to the elimination of closed areas. With fewer closed areas to monitor, enforcement agencies will have fewer obligations for resource deployment such as overflights and vessel patrols. However, these savings may not be substantial, as many of the patrols that monitor closed areas also monitor compliance with other management measures.

4.3 Overview and Effects of Gear Restrictions and Allocations of FMP 2.2

FMP 2.2 is identical to Alternative 1 in terms of gear restrictions and allocations. Consequently, the predicted effects on the environment are the same.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

5.1 Overview and Effects of Gear Restrictions and Allocations of FMP 3.1

FMP 3.1 is identical to Alternative 1 in terms of gear restrictions and allocations. Consequently, the predicted effects on the human environment are the same.

5.2 Overview of Gear Restrictions and Allocations of FMP 3.2

This FMP would prohibit the use of bottom (non-pelagic) trawl gear to harvest pollock in the GOA and would restrict fishing to areas where fishing has previously been concentrated.

5.3 Effects of Gear Restrictions and Allocations of FMP 3.2

Effects on Marine Mammals

Prohibiting bottom trawling for pollock in the GOA will likely have little direct effect on marine mammals. The prohibition will lead to an increase in the use of pelagic trawls for pollock and an associated change in the size distribution of the catch and amount and type of bycatch species. Fisheries data suggest that switching to the use of pelagic trawls would result in a decrease in bycatch. The composition of the bycatch is uncertain. Some of the bycatch species of pelagic trawls may also be marine mammal prey.

Because FMP 3.2 would spatially concentrate fishing effort, there will be more area available to marine mammals without direct fishing disturbance. However, the particular areas where fishing is open will determine if this concentration leads to fewer interactions. To the extent that the open areas are also used by marine mammals, interactions may increase, since fishing effort will be redirected to those areas.

Effects on Seabirds

The effects of the gear restrictions and allocations of FMP 3.2 on seabirds are likely similar to those described for marine mammals. In particular, the effects depend on what fishing areas remain open (NMFS 2001).

Effects on Target Species

The gear restrictions and allocations of FMP 3.2 would have little, if any, impact on target species, as the harvest of these species would continue to be restricted by TACs.

Effects on Non-Target (Forage, Other, and Non-Specified) Species

The prohibition on bottom trawling for pollock in the GOA will lead to an increase in the use of pelagic trawls and an associated change in the amount and type of bycatch species. Fisheries data suggest that switching to pelagic trawling would result in a decrease in bycatch. The composition of the bycatch is uncertain. The effects of spatially concentrating fishing effort on non-target species are also uncertain, as the areas that will remain open have not yet been specified.

Effects on Prohibited Species

The prohibition on bottom trawling for pollock in the GOA will result in a decrease in the catch of some prohibited species in that fishery. Pelagic trawling for pollock has a lower mortality rate for halibut and takes fewer *C. bairdi* Tanner crab and chinook salmon. However, there could be a higher bycatch of other species of salmon, as pelagic trawling exhibits a higher bycatch rate for these salmon species.

Effects on Habitat, Including Essential Fish Habitat, and Ecosystems

The prohibition on bottom trawling for pollock in the GOA could lead to a substantial decrease in fishing impacts to benthic biota and habitat. The bycatch rate of benthic organisms in the GOA pollock fishery is considerably higher for bottom trawl gear than for pelagic trawl gear. For example, it is estimated that the catch rate is 1,000 times higher for coral, 20 times higher for anemones, and at least 900 times higher for sponges (NMFS 2001).

By limiting the groundfish fisheries to grounds where fishing has traditionally been concentrated, benthic biota and habitat in other areas would be protected from continuing impacts and be allowed to recover from past habitat disturbances. The potential benefits of such closures include protection of ecosystem structure and function and improved scientific understanding of the role of marine habitat (Murray *et al.* 1999). The effectiveness of these area closures is increased if the boundaries and locations of a network of closures is appropriately designed (Dugan and Davis 1993, Murray *et al.* 1999). Intuitively, concentrating even more fishing effort in areas already impacted by fishing gear would lead to increased disturbance of benthic ecosystems and substrates. These impacts would be less than on areas not already being impacted, although it would no doubt vary by habitat and substrate type. The overall tradeoff between continued degradation of some areas and recovery of others is not determinable at this time.

A possible shortcoming of closing only those areas where fishing has previously been concentrated is that traditional fishing grounds would likely coincide with the preferred habitat for adult stages of many groundfish species. Consequently, this approach may not provide adequate protection or opportunity for restoration of affected habitat.

Economic and Social Effects

The prohibition on bottom trawling for pollock in the GOA would result in increased costs for those fishing vessels that switch to pelagic trawling. These vessels would have to purchase new gear and learn to use it.

Restricting fishing to areas where fishing has previously been concentrated could lead to increased operating costs and decreased revenues for some vessels if they have to travel farther to harvest fish or fish in less productive areas. Catch rates for the fleet as a whole are likely to fall as vessels are forced into areas of greater fishing concentration.

Effects on Management and Enforcement

Restricting fishing to areas where fishing has previously been concentrated is expected to increase monitoring and enforcement costs. Closing areas to certain fisheries or to certain gear types may be more difficult to enforce than closing areas to all fishing by, say, establishing no-take marine reserves. For example, the only means of determining if a vessel is towing a pelagic rather than a non-pelagic trawl or targeting flatfish instead of Pacific cod is by directly observing the gear and/or catch on deck. Therefore, the regulations specific to a restricted area will determine the level of monitoring and enforcement costs for this FMP component.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

6.1 Overview of Gear Restrictions and Allocations of FMP 4.1

FMP 4.1 would prohibit trawling in all fisheries that can be prosecuted with other gear types (e.g., fisheries with greater than 25 percent incidental catch and bycatch). In effect, this measure represents an allocation of groundfish TAC to users of fixed gear. In addition, FMP 4.1 restricts bottom trawling for flatfish to specific areas and prohibits fishing in areas identified as no-take marine reserves.

Based on a preliminary review of fisheries data, the trawl fisheries that can be prosecuted with other gear types are Pacific cod in the BSAI; Greenland turbot and sablefish in the BSAI; and, partially, rockfish fisheries in the GOA harvesting shortraker/rougheye and thornyhead. All of these fisheries can be prosecuted with fixed gear, primarily hook-and-line (i.e., longline) gear.

6.2 Effects of Gear Restrictions and Allocations of FMP 4.1

Effects on Marine Mammals

To the extent that trawling in BSAI Pacific cod fisheries has an adverse effect on the foraging success of marine mammals, there will be a positive impact on marine mammals from the elimination of such trawling. Closing nearshore portions of the GOA to bottom trawling could have a positive effect on harbor seals.

An increase in the use of longline gear may result in an increase in fishery interactions with killer whales and sperm whales. Killer whale takes of sablefish and turbot off of longlines in the BSAI and as far east as Prince William Sound is well documented. Sperm whales in the GOA have been observed feeding off longline gear targeting sablefish.

Effects on Seabirds

An increase in the use of longline gear would result in an increase in fishery interactions with seabirds. Longline gear accounts for 90 percent of the seabird catch in the groundfish fisheries (NMFS 2001). The primary types of seabirds affected will be northern fulmars, gulls, albatrosses, and shearwaters.

Effects on Target Species

The elimination of trawling in some groundfish fisheries would have little, if any, effect on target species, as the harvest of these species would continue to be restricted by TACs. The overall amount of target species caught would not change provided the fixed gear fleet has sufficient fishing capacity to harvest the quota.

The elimination of trawling for Pacific cod in the BSAI would result in a decrease in the harvest of non-target species caught in the trawl Pacific cod fishery. These species include flatfish, rockfish and pollock. The elimination of trawling for turbot and sablefish in the BSAI would also result in a decrease in the harvest of flatfish. Also, the size of Pacific cod caught with trawl and fixed gear is different, so there will be a change in age-class removals due to gear selectivity (NMFS 2001).

Thornyhead rockfish caught with longline gear tend to be older than those taken by trawl gear. Consequently, an increase in the harvest of thornyhead with longlines will cause a shift in size and age composition.

Effects on Non-Target (Forage, Other, and Non-Specified) Species

A decrease in the use of trawl gear is expected to result in decreased harvests of jellyfish and spiny dogfish in the GOA and forage fish in the BSAI (NMFS 2001). An accompanying increase in the use of longline gear will result in higher catches of grenadiers and skates. In addition, increased harvests are expected for forage fish, sculpin, octopus, and sleeper sharks in the GOA and octopus and spiny dogfish in the BSAI.

Effects on Prohibited Species

A shift from trawl to fixed gear in the BSAI Pacific cod fishery would result in a significant decrease in bycatch mortality of *C. bairdi* Tanner crab, red king crab, halibut, and chinook salmon (NPFMC 1996). A similar shift in the BSAI turbot-sablefish fishery would result in a slight increase in halibut and other salmon mortality and a decrease in *C. bairdi* crab mortality. The overall catch of prohibited species would not change if reductions in prohibited species bycatch are transferred to other fisheries and/or gears.

There will be a positive effect on the age structure of halibut as a result of shifting to fixed gear. Halibut caught as prohibited species by longline gear are typically older and larger than those taken by trawl gear.

Effects on Habitat, Including Essential Fish Habitat, and Ecosystems

A decrease in the use of trawl gear is expected to result in a net positive effect on benthic biota and habitat. Coral catch would be substantially reduced, and decreases in the catch of anemones, sponges, sea pens, and sea whips would also occur. Restricting bottom trawling for flatfish to specific areas is also likely to have a positive effect on benthic biota and habitat.

Economic and Social Effects

Redistributing fishing effort to fixed gear (pots and hook-and-line) may lead to grounds congestion, increased gear conflicts, increased fishing costs, and reduced revenues. For example, grounds crowding with pots and longline gear occurred in the halibut and sablefish fisheries prior to the implementation of the Individual Fishing Quota program. The result was increased gear loss, vessels racing to fish on the more productive grounds, and higher injury rates among crew.

Owners of vessels displaced from the affected trawl fisheries will have the choice of switching gears, switching fisheries, or tying up their boats. Given the entry constraints to the more lucrative fisheries such as pollock, sablefish, and crab, it is likely that many displaced vessels will have no viable economic options in the North Pacific fisheries.

The overall amount of target species delivered to processors would not change provided the fixed gear fleet has sufficient fishing capacity to harvest the quota. In some fisheries (e.g., sablefish longline fishery) this capacity may not be available, at least in the short-term.

A shift from trawl to fixed gear will change the availability of certain processed products in U.S. markets. For instance, Pacific cod are typically processed into fillets by trawl catcher processors, while longline catcher processors are generally restricted to producing headed and gutted products. To the extent that the production of fillets in the Alaska groundfish fisheries is reduced significantly, the price of fillet products to U.S. consumers may increase.

Effects on Management and Enforcement

The gear restrictions and allocations implemented under FMP 4.1 are not expected to result in a significant change in management and enforcement costs.

6.3 Overview and Effects of Gear Restrictions and Allocations of FMP 4.2

Under FMP 4.2, the allocation of fishing privileges among gear types is not a possible management measure, as the FMP prohibits all fishing for groundfish in the EEZ off Alaska. These effects would prevail until each Alaska groundfish fishery was subjected to an environmental review and, based on the results of that review, permitted to operate under strict regulations. Only fisheries certified by NOAA Fisheries to have no significant adverse effects on the environment would be authorized to operate in the EEZ off Alaska. Such a review and certification process would likely take up to two years, based on the length of a recent environmental review of the Alaska pollock fishery conducted by an international organization. Regulations accompanying each certified fishery may include specific gear restrictions, gear allocations, and closed areas.

Section 7 Data Gaps and Information Needs

The following numerical data would support the analysis of the effects of the alternatives as they relate to gear restrictions and allocations in the Alaska groundfish fisheries:

- PSC estimates prior to implementation of current no-trawl zones.
- Current stock status of prohibited species in current no-trawl zones.
- Previous fishing activity in current no-trawl zones by season and target species.
- PSCs in yellowfin sole fishery before and after implementation of current no-trawl zones.
- Historical comparison of pollock fishing in the GOA with pelagic and non-pelagic trawls in terms of pollock catch, bycatch amount and composition, fishing areas, number and size of vessels, and ports of origin/landing.
- Incidental catch and bycatch by gear group, area, and target species.

Section 8 Comparative Analysis of Alternatives

The following summarizes the effects of each policy alternative in terms of gear restrictions and allocations in the Alaska groundfish fisheries as determined by analyses of each alternative's associated FMP framework.

Alternative 1: This alternative would maintain current gear restrictions and allocations in the Alaska groundfish fisheries.

Alternative 2: FMP 2.1 would eliminate all trawl closure areas and trawl and fixed gear restrictions. The only closed areas that will remain in effect are those specifically implemented to protect Steller sea lions. FMP 2.2 is identical to Alternative 1 in terms of gear restrictions and allocations.

Alternative 3: FMP 3.1 is identical to Alternative 1 in terms of gear restrictions and allocations. FMP 3.2 would prohibit the use of bottom (non-pelagic) trawl gear to harvest pollock in the GOA and would restrict fishing to areas where fishing has previously been concentrated.

Alternative 4: FMP 4.1 would prohibit trawling in all fisheries that can be prosecuted with other gear types (e.g., fisheries with greater than 25 percent incidental catch and bycatch). In effect, this measure represents an allocation to users of fixed gear. In addition, FMP 4.1 restricts bottom trawling for flatfish to specific areas and prohibits trawling in areas identified as marine protected areas. FMP 4.2 prohibits all fishing for groundfish in the EEZ off Alaska

The following table summarizes the anticipated effects of different approaches toward implementing gear restrictions and allocations in the Alaska groundfish fisheries as described in the associated FMP bookends.

Table 1. Summary of anticipated effects of gear restrictions and allocations of Fishery Management Plan bookends in the Alaska groundfish fisheries.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Physical environment						
No effect Fishing activities currently managed under the existing FMPs are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	Potentially adverse effect Since areas presently closed to bottom trawling would be opened, there could be localized areas of disturbance as a result of concentrated fishing effort.	No effect Fishing activities currently managed under the existing FMPs are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	No effect Fishing activities currently managed under the existing FMPs are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	Beneficial effect Since more area will be closed to bottom trawling and a greater percentage of the fishable area will be designated as no-take marine reserves, fewer impacts on the substrate will be realized as compared to the current FMPs.	Beneficial effect This FMP closes additional deeper areas to trawling, and provides for a higher percentage of no-take marine reserves. Therefore, there should be less impact on the physical environment across a wider range of depths and habitats.	Potentially adverse/ beneficial effect There would be no negative effects from fisheries on the physical environment while fishing is suspended. Only those fisheries that have no adverse effects on the environment will be allowed to resume. Displaced fishing effort could have indirect adverse effects.

Table 1 (cont.). Summary of anticipated effects of gear restrictions and allocations of Fishery Management Plan bookends in the Alaska groundfish fisheries.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Biological environment						
Beneficial effect No-trawl zones would continue to impose limits on fishing activity inside the critical habitat of marine mammals. Measures that allocate more Pacific cod and sablefish to longline gear may increase the probability that certain seabird species are taken and certain non-target species are caught. The Pribilof Islands Habitat Conservation Area will continue to have a positive effect on seabirds. Some no-trawl zones are designed to protect habitat and will contribute to the protection of certain target species and prohibited species.	Adverse effect Eliminating all trawl closure areas would likely impact marine mammals through the disruption of prey behavior. Opening fisheries near rookeries could interfere with seabird foraging behavior. If non-pelagic trawling resumes in reopened areas, disturbance of benthic biota and habitat will occur.	Same effects as FMP 1.	Same effects as FMP 1.	Beneficial effect The prohibition on bottom trawling for pollock in the Gulf of Alaska (GOA) would lead to a substantial decrease in fishing impacts to benthic biota and habitat.	Beneficial effect Elimination of trawling in Bering Sea and Aleutian Islands (BSAI) Pacific cod fisheries may have a positive effect on foraging success of marine mammals. Closing nearshore portions of the GOA to bottom trawling may have a positive effect on harbor seals. An increase in the use of longline gear may result in an increase in seabird takes and interactions with killer whales and sperm whales. A shift from trawl gear to longline gear will decrease the catch of some non-target species and increase the catch of others. A decrease in use of trawl gear will have a positive effect on benthic biota and habitat.	Potentially adverse/beneficial effect There would be no negative effects from fisheries on the biological environment while fishing is suspended. Only those fisheries that have no adverse effects on the environment will be allowed to resume. Displaced fishing effort could have indirect adverse effects.

Table 1 (cont.). Summary of anticipated effects of gear restrictions and allocations of Fishery Management Plan bookends in the Alaska groundfish fisheries.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Economic and social effects						
Beneficial effect Trawl closure areas will continue to reduce bycatch of species valuable to certain non-groundfish commercial, recreational, or subsistence fisheries. Similarly, allocations of groundfish total allowable catches (TACs) among gear types will continue, at least in part, to protect economic interests of participants in certain fisheries.	Adverse/ beneficial effect A reopening of no-trawl zones will have a positive economic effect on trawling operations but a negative economic effect on participants in fisheries that target prohibited species.	Same effects as FMP 1.	Same effects as FMP 1.	Potentially adverse effect The prohibition on bottom trawling for pollock in the GOA would result in increased costs for those fishing vessels that switch to pelagic trawling. Restricting fishing to areas where fishing has previously been concentrated could lead to increased operating costs or decreased revenues for some vessels. Catch rates for the fleet as a whole are likely to fall as vessels are forced into areas of greater fishing concentration and congestion.	Potentially adverse effect Shifting from trawl to fixed gear will concentrate fishing effort in some fixed gear fisheries. Concentration of fishing effort may lead to grounds congestion, increased gear conflicts, increased fishing costs, and reduced revenues. Owners of vessels displaced from affected trawl fisheries will have the choice of switching gears, switching fisheries, or tying up their boats. A shift from trawl to fixed gear will change the availability of certain processed products in United States markets.	Adverse effect If the people and equipment that are displaced shift to some underutilized fishery, or into an entirely different segment of the economy, society will not lose part of its productive capacity. However, some of the displaced effort may be transferred into a fishery already suffering from overexploitation or overcapacity.

Section 9 References

- Agardy, M. T., 1994. Advances in marine conservation: The role of marine protected areas. *Trends in Ecology and Evolution* 9:267-270.
- Alaska Department of Fish and Game (ADF&G), 2000.
<http://www.cf.adfg.state.ak.us/geninfo/finfish/herring/catchval/2kFBcatc.htm>.
- Allison, G., Lubchenko, J., and Carr, M. H., 1998. Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applications* 8(1):S79- S92.
- Coon, C., Shirley, T. C., and Heifetz, J., 1999. Spatial and temporal patterns of bottom trawling in the Gulf of Alaska and Aleutian Islands. NOAA Technical Report.
- Dugan, J. E., and Davis, G. E., 1993. Applications of marine refugia to coastal fisheries management. *Canadian Journal of Fisheries and Aquatic Science* 50:2029-2042.
- Fritz, L. W., Greig, A., and Reuter, R. F., 1998. Catch-per-unit-effort, length, and depth distributions of major groundfish and bycatch species in the Bering Sea, Aleutian Islands, and Gulf of Alaska regions based on groundfish fishery observer data. NOAA Technical Memorandum, NMFS-AFSC-88.
- Heifetz, J., Ianelli, J. N., Clausen, D. M., and Fujioka, J. T., 1999. Slope rockfish. Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska as projected for 2000. North Pacific Fishery Management Council, Anchorage.
- Lauck, T., Clark, C. W., Mangel, M., and Munro, G. R., 1998. Implementing the precautionary principle in fisheries management through marine reserves. *Ecological Applications* 8(1):S72-S78.
- Murray, S. N., Ambrose, R. F., Bohnsack, J. A., Botsford, L. W., Carr, M. H., Davis, G. E., Dayton, P. K., Gotshall, D., Gunderson, D. R., Hixon, M. A., Lubchenko, J., Mangel, M., MacCall, A., McArdle, D. A., Ogden, J. C., Roughgarden, J., Starr, R. M., Tegner, M. J., and Yoklavitch, M. M., 1999. No-take reserve networks: Sustaining fishery populations and marine ecosystems. *Fisheries* 24:11-25.
- National Marine Fisheries Service (NMFS), 2001. Alaska Groundfish Fisheries Draft Programmatic Supplemental Environmental Impact Statement. NMFS, Alaska Region, Juneau.
- North Pacific Fishery Management Council (NPFMC), 1996. Environmental Assessment/Regulatory Impact Review for Amendment 46, Pacific Cod Allocations, to the Bering Sea and Aleutian Islands Fishery Management Plan. NPFMC, Anchorage.
- Witherell, D., 1995. Management of flatfish fisheries in the North Pacific. Alaska Sea Grant College Program Report AK-SG-95-04.

This page intentionally left blank

APPENDIX F

Overcapacity

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Overcapacity	F-8-1
1.1	Definition of Overcapacity and an Overview of the Issue	F-8-1
1.2	Management Measures Used to Address Overcapacity	F-8-3
1.3	Trends in Overcapacity in Alaska Groundfish Fisheries and Applications of Management Tools	F-8-6
Section 2	Analysis of Alternatives	F-8-12
Section 3	Alternative 1: Continue under the Current Risk-Averse Management Policy	F-8-14
3.1	Overview of Overcapacity Management Measures of Alternative 1	F-8-14
3.2	Effects of Overcapacity Management Measures of Alternative 1	F-8-17
3.2.1	Effects on Marine Mammals	F-8-17
3.2.2	Effects on Seabirds	F-8-18
3.2.3	Effects on Target Groundfish Species	F-8-18
3.2.4	Effects on Non-Target (Forage, Other, and Non-Specified) Species	F-8-19
3.2.5	Effects on Prohibited Species	F-8-20
3.2.6	Economic and Social Effects	F-8-21
3.2.7	Effects on Ecosystem	F-8-28
3.2.8	Effects on Management and Enforcement	F-8-28
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-8-31
4.1	Overview of Overcapacity Management Measures of FMP 2.1	F-8-31
4.2	Effects of Overcapacity Management Measures of FMP 2.1	F-8-32
4.2.1	Effects on Marine Mammals	F-8-32
4.2.2	Effects on Seabirds	F-8-32
4.2.3	Effects on Target Groundfish Species	F-8-33
4.2.4	Effects on Non-Target (Forage, Other, and Non-Specified) Species	F-8-33
4.2.5	Effects on Prohibited Species	F-8-33
4.2.6	Economic and Social Effects	F-8-33
4.2.7	Effects on Ecosystem	F-8-35
4.2.8	Effects on Management and Enforcement	F-8-35
4.3	Overview and Effects of Overcapacity Management Measures of FMP 2.2	F-8-35
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-8-36
5.1	Overview of Overcapacity Management Measures of FMP 3.1	F-8-36
5.2	Effects of Overcapacity Management Measures of FMP 3.1	F-8-36
5.2.1	Effects on Marine Mammals	F-8-36
5.2.2	Effects on Seabirds	F-8-37
5.2.3	Effects on Target Groundfish Species	F-8-37
5.2.4	Effects on Non-Target (Forage, Other, and Non-Specified) Species	F-8-38
5.2.5	Effects on Prohibited Species	F-8-39
5.2.6	Economic and Social Effects	F-8-39

TABLE OF CONTENTS (continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
	5.2.7 Effects on Ecosystem	F-8-45
	5.2.8 Effects on Management and Enforcement	F-8-46
5.3	Overview and Effects of Overcapacity Management Measures of FMP 3.2	F-8-48
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-8-49
6.1	Overview of Overcapacity Management Measures of FMP 4.1	F-8-49
6.2	Effects of Overcapacity Management Measures of FMP 4.1	F-8-49
	6.2.1 Biological and Physical Effects	F-8-49
	6.2.2 Economic and Social Effects	F-8-50
6.3	Overview and Effects of Overcapacity Management Measures of FMP 4.2	F-8-50
Section 7	Opportunities for Quantification	F-8-52
Section 8	Data Gaps and Information Needs	F-8-54
Section 9	Comparative Analysis of Alternatives	F-8-55
Section 10	References	F-8-60

TABLES

Table 1.	Summary of the effects of the alternatives on overcapacity.	F-8-57

ACRONYMS AND ABBREVIATIONS

AFA	American Fisheries Act
BSAI	Bering Sea/Aleutian Islands
CDQs	Community Development Quotas
CFEC	Commercial Fisheries Entry Commission
CFQs	Community or Group-Based Fishing Quotas
CRP	Comprehensive Rationalization Program
DAP	Domestic Annual Processing
EEZ	Exclusive Economic Zone
FAO	Food and Agricultural Organization
FMP	Fishery Management Plan
ft	Feet
GAO	Government Accounting Office
GOA	Gulf of Alaska
IFQ	Individual Fishing Quotas
IPOA	International Plan of Action
ITQs	Individual Transferable Quotas
kg	Kilograms
LLP	License Limitation Program
MFC	Management of Fishing Capacity
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
mt	Metric Tons
NRC	National Research Council
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
PCC	Pollock Conservation Cooperative
PSC	Prohibited Species Catch
TAC	Total Allowable Catch
TALFF	Total Allowable Level of Foreign Fishing
U.S.	United States

This page intentionally left blank

Section 1 Overcapacity

This introductory section is divided into three parts. First, overcapacity is defined and an overview of how this problem develops in fisheries and its effects is presented. Second, the ability of various management tools to reduce excess capacity in fisheries is examined. Third, trends in overcapacity in the Alaska groundfish fisheries are described as well as and the management tools that have been applied to address overcapacity in these fisheries.

1.1 Definition of Overcapacity and an Overview of the Issue

Fishing capacity is defined as the ability of a vessel or fleet of vessels to catch fish (NMFS 1999).¹ This ability is a function of such factors as the number of fishing vessels in the fleet; the size of each vessel; the technical efficiency of each vessel (determined by factors such as on-board gear and equipment, fishermen's knowledge and techniques, and the size of the crew); and the time spent fishing (NFCC undated). Loosely speaking, overcapacity in a fishery occurs when the ability to catch fish exceeds what is needed to harvest sustainable yields.

Overcapacity is a consequence of the perverse incentive system confronting fishermen in an open access or regulated open access condition (Gréboval and Munro 1999).² Under this condition, the so-called "race for fish" induces fishermen to apply an excessive level of operating inputs (e.g., labor, fuel, time) and capital inputs (e.g., vessel and gear improvements) as they compete with each other for shares of the total allowable catch (TAC). If these additional inputs are not applied, the individual fisherman may find that he or she is unable to increase, or even maintain, their share of the TAC over a number of fishing seasons.

The many problems created by overcapacity have been summarized by Kirkley and Squires (1999):

[Overcapacity] generates intense pressure to continue harvesting past the point of sustainability in order to keep as much of the fleet working as possible. With revenues spread among many vessels operating under little or no profits, reductions in fleet size become politically and socially more difficult. Vessels are more vulnerable to changes in the resource base and regulations when they are only marginally viable because of excess capacity. Excess capacity encourages inefficient allocation and constitutes a major waste of economic resources. Overcapitalization and excessive use of variable inputs follow. Excess capacity also complicates the fishery management process, particularly in open access, frequently leading to detailed and comprehensive regulation. Excess capacity substantially reinforces the increasing tendency for management decisions to become primarily allocation decisions, i.e., decisions about the gainers and losers of wealth and profits (or losses) from alternative management choices over an overfished or even declining resource stock.

¹ Accurately measuring and monitoring capacity and capacity utilization in a particular fishery can be exceedingly complex (see, for example, Kirkley *et al.* 2002).

² Open access refers to a situation in which access to a fishery is unrestricted. In a regulated open access, fishery authorities restrict the total harvest without attempting to control the total fleet size (Gréboval and Munro 1999). In this paper, open access means regulated open access.

It is important to realize that the development of overcapacity is the result of rational investment by fishermen given the economic and other incentives that they face under open access conditions to increase capacity beyond levels which may be optimal for society as a whole (Cunningham and Gréboval 2001). It is equally important to note that, although the origin of excess fishing capacity stems from the widespread tendency of harvesters or processors to overinvest under open access conditions, government subsidies and other economic incentives can substantially contribute, directly or indirectly, to the build-up of excessive fishing capacity. In the United States, for example, government policies and programs have fostered growth in harvesting capacity in many ways (Hogarth 2001; see also Federal Fisheries Investment Task Force 1999). Domestic fishermen were encouraged to engage in fisheries that had previously been dominated by foreign vessels, including fisheries for species that were considered “underutilized” in the United States (U.S.) market. Investment tax credit provisions in the Internal Revenue Service code until 1986 stimulated spending on new vessel construction. Federal loans, loan guarantees, and tax deferral programs stimulated the purchase, repair, and refitting of fishing vessels. Direct grant programs, such as the Saltonstall-Kennedy Fishery Development Grants program, provided seed money for new product development and other projects. Foreign allocations and trade policies were linked through the so-called “Fish-and-Chips” initiative to promote foreign market opportunities for U.S. producers.

Overcapacity affects many fisheries throughout the world and has become an issue of international concern. In 1995, Articles 6 and 7 of the United Nations Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries directly addressed the issue of overcapacity, calling on nations “to take measures to prevent or eliminate excess fishing capacity” and to “reduce capacity to levels commensurate with the sustainable use of fishery resources” (FAO 1995). To this end, the FAO Committee on Fisheries adopted an International Plan of Action (IPOA) for the Management of Fishing Capacity (MFC) in 1999. The objective of the IPOA/MFC is for nations and regional fisheries organizations to achieve worldwide an efficient, equitable and transparent management of fishing capacity, preferably by 2003, but not later than 2005. The IPOA/MFC is not a binding agreement, but it is a strong sign that the economic and biological problems associated with overcapacity are receiving increasing attention in the international arena.

The United States was an active participant in the technical consultations and negotiations leading to the IPOA/MFC. Concerns about excessive fishing capacity in certain domestic fisheries began to emerge in the 1980s (Hogarth 2001). The National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) and Councils began to explore various forms of limited entry in many federally managed fisheries; direct grants for research and development declined; and various other domestic and international market promotion activities were curtailed or terminated. Congress passed the Commercial Fishing Vessel Anti-Reflagging Act of 1987 that placed more restrictive limits on foreign investments in U.S. documented and flagged fishing vessels.

Despite these initial efforts to constrain fishing capacity, the problem of overcapacity intensified in a number of major U.S. fisheries in the late 1980s and early 1990s (Hogarth 2001). Starting in 1994, the federal government began to purchase redundant vessels and/or permits in selected fisheries. Over the next six years the federal government provided \$140 million to purchase fishing permits, fishing vessels and related gear from fishermen, thereby reducing the capacity of U.S. fishermen to harvest fish (Government Accounting Office [GAO] 2000). In 1996, the Sustainable Fisheries Act (Section 312 (b)-(e)) established the Fishing Capacity Reduction Program, the objective of which is to obtain the maximum sustained reduction in fishing capacity at the least cost and in a minimum period of time. To achieve this objective the program authorizes the use of both public and private resources to fund the removal of redundant vessels.

1.2 Management Measures Used to Address Overcapacity

As discussed previously, investment in increasingly higher levels of fishing inputs is an entirely rational response from the point of view of the individual fisherman given the set of economic incentives they face under open access conditions. However, the economic waste resulting from redundant capital and labor in the fishery and the dissipation of the net economic returns that fish harvesting might generate is "irrational" from society's point of view as well as from the perspective of the fishermen as a group. Management systems designed to end the "race for fish" and reduce overcapacity are said by economists to lead to "rationalization" of fisheries, i.e., toward an allocation of labor and capital between fishing and other industries that maximizes the net value of production from the economy as a whole (Anderson 1977). Fisheries management methods used to address the problem of overcapacity may be classified into two groups: input-based methods (also referred to as effort-based methods), which are those measures that attempt manage capacity by regulating input use; and incentive adjusting methods, which are those measures aimed at changing the incentive system itself (Cunningham and Gréboval 2000; Gréboval and Munro 1999).

Input-based methods include license limitation programs, gear and vessel restrictions, time and area closures and trip limits. The purpose of limited license programs is to impose a maximum on the number of fishing units operating in a fishery (Gréboval and Munro 1999). The licenses, which may be transferable or non-transferable, are issued (given or sold) to either the fishing unit or to the fisherman (or company).³ Gear and vessel restrictions are designed to reduce and constrain the capacity of individual fishing units by limiting the type and amount of inputs employed. Area and time closures prohibit fishing at specified times and in specified areas, thereby restricting the way inputs can be used (Anderson 1986). Trip limits restrict the extent to which inputs can be used by imposing a catch ceiling for an individual fishing trip.

One major shortcoming of input-based methods is that they do not remove the incentives that lead to overcapacity in the first place (Cunningham and Gréboval 2001). In a continuing attempt to outdo their competition in the race for fish, fishermen will increase their ability to catch fish by substituting inputs that are not restricted. This problem is called input substitution or more colloquially "capital stuffing." Even if the potential for input substitution is currently limited, the incentives will exist to increase input substitutability in the medium to long-term (Cunningham and Gréboval 2001). Even apparently simple management measures will be subject to input substitution. For instance, restrictions on fishing time in the form of closed seasons or days at sea restrictions will quickly lead fishermen to use the fact that there are different kinds of time (Cunningham and Gréboval 2001). They are likely to attempt to reduce travel time (using faster vessels, re-designed propellers, etc.) and gear manipulation time (switchover to mechanized gear handling, etc.) so as to be able to increase fishing time within the constraint imposed by the closed season.

Perhaps, an even more fundamental problem with input-based measures relates to the way they reduce capacity. Essentially, they are designed to increase the costs of fishing for individual fishing units by prohibiting certain cost-effective ways of operating (Anderson 1986). Yet, one approach to measuring excess capacity in an open access situation is in terms of cost. That is to say, excess capacity is measured by comparing the actual cost of harvesting with the costs that would prevail if the amount of capital employed was optimal. If this approach is taken, it is difficult to see how measures designed to increase costs artificially will improve a perceived excess capacity problem (Gréboval and Munro 1999).

³ As of October 1999, there were 15 vessel moratoria and 11 license/vessel limitation programs in place in federally managed U.S. marine fisheries (Darcy and Matlock 2000).

Notwithstanding these problems with input-based measures, experience indicates that a license limitation program used in combination with restrictions imposed on a few key characteristics can severely constrain fishing capacity (Cunningham and Gréboval 2001). The introduction of such a system at an early stage of fisheries development makes it considerably easier to achieve this end. Typically, however, such schemes are introduced with rather unrestrictive conditions for initial license allocation in fisheries that already manifest evidence of excessive capacity. If overcapacity already exists in a fishery, a buyback of surplus vessels and/or permits is often required, as attrition of participating fishermen generally involves too slow a process of capacity reduction (Cunningham and Gréboval 2001).

As noted earlier, a number of buyback programs have been implemented in U.S. fisheries.⁴ After assessing the three largest buyback programs (for the New England groundfish, Alaska pollock, and Washington State salmon fisheries), the (GAO 2000) concluded that the effectiveness of buybacks in fisheries can be hampered by the entry of buyback participants into other fisheries; the activation of latent fishing permits in buyback fisheries;⁵ and the flow of capacity back into buyback fisheries as the fishermen who remain in the buyback fisheries increase their investments in gear, technology and other fishing inputs.

In contrast to input-based methods, incentive adjusting methods create an environment which removes incentives that lead to the creation of excess capacity and encourage industry-based capacity adjustments that tend to be more efficient and easier to implement (Cunningham and Gréboval 2001). The two incentive adjusting methods that will be discussed here are individual fishing quotas (IFQs) and community or group-based fishing quotas (CFQs).

IFQs allocate a certain portion of the annual TAC to individual vessels, fishermen or other eligible recipients based on initial qualifying criteria. Individual transferable quotas (ITQs) are transferable IFQs, i.e., quota shares that can be bought, sold or, in some cases, leased. CFQs allocate quota to communities, cooperatives or other groups, as distinct from vessel owners or fishermen. These two types of incentive adjusting methods are also referred to as “rights-based” methods, as the allocation of shares of the TAC to specific individuals or groups conveys an important form of property right.⁶ Where property rights exist, there is no incentive for fishermen to invest in ever more elaborate vessels or equipment — or, to be more precise, to select anything but the lowest cost combination and deployment of fishing inputs (Crutchfield 1979; Scott 2000). In other words, rights-based management systems (in which rights are freely transferable) are “self-rationalizing” systems. Redundant capital is removed from the fishery as more efficient operations purchase the rights of less efficient operations. In economic theory, the less efficient operations, having sold their rights to participate, will exit the fishery and shift their labor and capital to some underutilized fishery or into an

⁴ Holland et al. (1999) present a comprehensive analysis of buyback programs around the world.

⁵ Latent fishing permits are those held by potential participants who are currently inactive or active only at low levels, but who could suddenly actively participate if the resource stock, market conditions or regulations change. A large number of underutilized or inactive permits is often the result of generous initial allocations during the implementation of license limitation programs and attests to the socially or politically sensitive aspects of such programs (Gréboval and Munro 1999; see also Ginter and Muse 2002).

⁶ The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) refers to an IFQ as an exclusive “fishing privilege,” rather than a right. In specific reference to authorizing IFQs or other limited access systems, MSA states that such an authorization, “(A) shall be considered a permit for the purposes of sections 307, 308 and 309; (B) may be revoked or limited at any time in accordance with this Act; (C) shall not confer any right of compensation to the holder of such individual fishing quota or other such limited access system authorization if it is revoked or limited; and (D) shall not create, or be construed to create, any right, title, or interest in or to any fish before the fish is harvested” (Sec. 303(d)(3)).

entirely different segment of the economy. The result is a net gain to society in the form of a reduction in costs and an increase in production.

IFQs have been used worldwide since the late 1970s and have been adopted in the following U.S. fisheries — halibut and sablefish (North Pacific), wreckfish (South Atlantic), surf clam/ocean quahog (Mid-Atlantic) and bluefin tuna (North Atlantic) (Wertheimer and Swanson 2000).⁷ It is possible that IFQs would have been applied to other domestic fisheries had not Congress intervened through enactment of the Sustainable Fisheries Act of 1996, which established a moratorium on the implementations of new IFQ programs. With that legislation Congress also requested the National Academy of Sciences to study the social, economic, and biologic effects of IFQs and other limited entry systems and to make recommendations about existing and future IFQ programs. The National Academy of Sciences convened a Committee to Review Individual Fishing Quotas, which in its report to Congress (National Research Council [NRC] 1999a) identified the following advantages and concerns from the range of IFQ programs implemented in U.S. fisheries:

Advantages — IFQ programs are widely identified as being a highly effective way of dealing with overcapitalization in the fishing industry. Removing the race for fish has reduced the incentive to buy ever-larger vessels and more equipment and to fish during unsafe conditions. Consumers have been able to purchase fresh fish during longer periods of the year. Many fishermen testified that IFQs provided the opportunity to utilize better fishing and handling methods, reducing bycatch of nontargeted species and maintaining higher product quality. Gear conflicts may also be reduced by IFQs.

Concerns — A number of problems were identified in operative IFQ programs during the committee's work. Prominent among them are concerns about the fairness of the initial allocations, effects of IFQs on processors, increased costs for new fishermen to gain entry, consolidation of quota shares (and thus economic power), effects of leasing, confusion about the nature of the privilege involved, elimination of vessels and reductions in crew, and the equity of gifting a public trust resource.

The Committee concluded that, “IFQs should be allowed as an option in fisheries management if a regional council finds them to be warranted by conditions within a particular fishery and appropriate measures are imposed to avoid potential adverse effects. The issues of initial allocation, transferability, and accumulation of shares should be given careful consideration when IFQ programs are considered and developed by regional councils and reviewed by the Secretary of Commerce.”

On September 30, 2002, Congress lifted the moratorium on the development and implementation of IFQ programs established by the Sustainable Fisheries Act. It is currently considering legislation to establish National Standards for the design and conduct of IFQ programs.

There has been somewhat less experience in implementing CFQs in U.S. fisheries. The community development quotas (CDQs) established in the 1990s for western Alaska communities are one form of such a system. Fisheries cooperatives may also function like CFQs. The 1998 American Fisheries Act allowed the creation of various cooperatives of Alaska pollock producers. Each cooperative is provided access to a fixed

⁷ Shotton (2001a) provides a series of case studies of IFQ programs that have been implemented in various fisheries around the world, while Shotton (2001b) presents case studies of the effects of IFQs on fleet capacity and concentration of quota ownership.

portion of the pollock resource and, in turn, sub-allocates quota shares within the group. In 1997, a similar cooperative system was developed voluntarily by catcher processors participating in the Pacific whiting fishery in the Pacific Northwest (NRC 1999a).⁸ Another way to implement CFQs is to modify existing legislation to allow communities or other groups to enter into the market for IFQs where they have been established. An example of such an approach is the measure the North Pacific Fishery Management Council (NPFMC) approved in 2002 that would allow eligible fishing villages in the Gulf of Alaska (GOA) to acquire IFQs for sablefish and halibut.

Input-based methods and incentive adjusting methods of reducing excess capacity in fisheries have been discussed separately here in order to compare the two methods. In reality, fishery management regimes can comprise both types of measures. For instance, license limitation programs may be a first step toward implementation of IFQs. Similarly, buybacks under a licensing scheme are unlikely to be very effective at reducing capacity, whereas under IFQs they may be a very helpful way of quickly decreasing it to the desired level (Gréboval and Munro 1999).

1.3 Trends in Overcapacity in Alaska Groundfish Fisheries and Applications of Management Tools

From 1976 until the late 1980s, a variety of federal laws and programs were developed to promote the “Americanization” of fisheries inside the U.S. Exclusive Economic Zone (EEZ), especially the rich groundfish resources of the Bering Sea (NMFS 2002a). A start towards this was made in the late 1970s and early 1980s with the advent of the “Fish-and-Chips” policy and enactment of the American Fisheries Promotion Act. These strategies increased the number of criteria upon which foreign fishing privileges in the U.S. EEZ were based to include the removal of trade barriers, the commitment to purchase the products of the U.S. seafood industry, the minimization of gear conflicts and the transfer of fishing and processing technology. A parallel program sponsored by NOAA Fisheries, the Fisheries Obligation Guarantee Program, guaranteed over \$150 million worth of loans between 1977 and 1996 for the construction of U.S. catcher processors and inshore floating processors (NMFS 2002a).⁹ This program lowered capital investment costs relative to competitive market rates, thereby encouraging capital investment in the North Pacific groundfish fisheries and other U.S. fisheries. The financial assistance offered under the program was extended to U.S. processing plants in 1983.

Furthermore, management measures promulgated under the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) were designed to promote the development of a U.S. offshore fleet through an allocation system that favored domestic vessels over foreign vessels and joint venture operations. Domestic processors were surveyed annually in the fall, prior to the setting of total allowable level of foreign

⁸ While license limitation programs do not generally provide an incentive to fishermen to avoid overcapacity, the establishment of a cooperative in the Pacific whiting fishery is an example of how these programs can provide such an incentive (NRC 1999a). When the number of license holders in a particular fishery is restricted to a relatively small number and there is sufficient interaction between them, cooperative patterns of behavior may emerge. In particular, the license holders may agree to adopt their own management measures which remove the need to race for capacity.

⁹ The Fisheries Obligation Guarantee Program has been known by many names over the years (Federal Fisheries Investment Task Force 1999). It grew out of the Fisheries Loan Fund in the Fish and Wildlife Act of 1956, became a mortgage insurance program, and then grew into the Fishing Vessel Obligation Guarantee Program. Later the program was expanded beyond fishing vessels and became the Fisheries Obligation Guarantee Program. The Sustainable Fisheries Act of 1996 renamed the program the Fisheries Financing Program and transformed it into a direct loan program that no longer financed new harvesting capacity additions.

fishing (TALFF), to estimate the amount of domestic annual processing (DAP) for the year. Domestic processors were generally allocated the DAP from survey results if it was less than the TAC, whether or not domestic processors had a track record proving they could process that level of the TAC. The DAP directly reduced the TALFF. In addition to domestic processing priority, a domestic annual harvesting priority was created. If U.S. fishing vessels wished to participate in groundfish fisheries, they were also given a priority over TALFF, regardless of whether domestic processors were involved.

The period of rapid expansion of the domestic groundfish fisheries was accompanied by a flood of foreign capital into new vessels and processors (NMFS 2002a). Taking advantage of Norwegian lending and shipbuilding programs, and positioning aggressively within evolving management structures, one Norwegian-financed firm, American Seafoods, came to dominate the offshore sector (Federal Fisheries Investment Task Force 1999). After the passage of the Commercial Fishing Vessel Anti-Reflagging Act of 1987 fishing and processing vessels were required to have at least 50 percent U.S. ownership, but no similar ownership requirements were imposed on shoreside processors—all shoreside processors in Alaska were considered domestic regardless of the actual ownership of the facility. Most of the shoreside pollock processing capacity was built and owned by Japanese seafood companies.

Foremost within the overall rapid development of the pollock fishery was the at-sea processing sector (NMFS 2002a). Other sectors, including inshore processing plants and harvesting vessels, existed prior to the development of the domestic pollock fishery, but they were involved in other fisheries. By 1990, there were more than 50 catcher processors participating in the Bering Sea/Aleutian Islands (BSAI) pollock fishery, along with several motherships and four major shoreside plants. The new domestic catcher processor fleet alone brought enough capacity to the BSAI pollock fishery to catch and process considerably more pollock than allowed under the TAC. Estimates of harvesting capacity in the pollock fishery suggested that perhaps two or three times more capacity existed in the fishery than would be required to “efficiently” harvest the TAC (NMFS 2002a). Nearly a year round fishery in the early to mid-1980s, the pollock fishery opening shrank to less than 60 days by 1992, despite a steady, or slightly increasing, quota. It is estimated that half of the catcher processors operating between 1994–98 experienced financial difficulties resulting in bankruptcy or forced the sale of the vessel (NPFMC 2001).

Another groundfish fishery in which overcapacity quickly developed was the sablefish fishery. During the 1980s, the domestic fleet harvesting sablefish grew in number, size, and sophistication in vessels (Pautzke and Oliver 1997). From 1981 to 1988, the number of vessels longer than 50 feet (ft) grew tenfold and the number of smaller vessels grew by a factor of fourteen. Approximately 1,000 vessels were fishing for sablefish by 1992. There are several reasons for the large and rapid expansion of harvesting capacity within the sablefish fishery — sablefish was a relatively high-priced species, the larger vessels in the halibut fleet could enter the sablefish fishery at a relatively low cost, decreases in the length of the halibut fishing season provided an added incentive for those vessels to become more active in the sablefish fishery, and in addition to the hook and line gear similar to that used in the halibut fishery, pot gear could be used to harvest sablefish very effectively (NMFS 1996). As the fleet grew, the fishing season in the Gulf of Alaska, the area responsible for the majority of the catches, became progressively shorter (Sigler and Lunsford 2001). By the late 1980s, the race for fish caused season length to decrease to 1 or 2 months. In some areas, this open access fishery was as short as 9 days. For example, from 1984 to 1987, the season length decreased from 8 months to less than 2 weeks as the number of vessels increased fivefold in the West Yakutat region.

The race for fish resulted in a symmetrical race to process. Local markets for fresh fish are limited in Alaska and most fish must be processed and shipped to other markets. The concentration of harvest in short periods led to large investments by processors competing to process a greater share of the catch. Processing costs increased with the excessive capital investment. In addition, decisions about product mix and quality control tended to be dominated by a need to maximize profits per operating day rather than maximizing profit per unit of fish. In the pollock fishery, for example, replacing some surimi production with production of higher-valued fillets would have required sacrificing overall production to rival processors. For the same reason, maximizing recovery rates was uneconomical, particularly for the offshore processors that would then lose additional time steaming in to unload the low-grade product made with protein recovered from surimi wash water.

By 1992, the NPFMC came to realize that the rapid Americanization of the groundfish fisheries had created overcapitalized fisheries that generated all manner of management issues. In response, the NPFMC initiated a comprehensive rationalization program (CRP) and published the problem statement shown in the box below.

NPFMC Comprehensive Rationalization Program Problem Statement

Expansion of the domestic fleet harvesting fish in the EEZ off Alaska, in excess of that needed to harvest the optimum yield efficiently, has made compliance with the Magnuson Act's National Standards and achievement of the Council's comprehensive goals, adopted December 7, 1984, more difficult under current management regimes. In striving to achieve its comprehensive goals, the Council is committed to: (1) assure the long-term health and productivity of fish stocks, and other living marine resources of the North Pacific and Bering Sea ecosystem, (2) support the stability, economic well-being and diversity of the seafood industry, and provide for the economic and social needs of the communities dependent on that industry, and (3) efficiently manage the resources in its jurisdiction to reduce bycatch, minimize waste, and improve utilization of fish resources to provide the maximum benefit to the present and future generations of fishers, associated fishing industry sectors, communities, consumers, and the nation as a whole.

The Council's overriding concern is to maintain the health of the marine ecosystem to ensure the long-term conservation and abundance of the groundfish and crab resources. In addition, the Council must address the competing and oftentimes conflicting needs of the domestic fisheries that have developed rapidly under open access, fisheries which have become over-capitalized and mismatched, to the finite fishery resources available. Symptomatic of the intense pressures in the over-capitalized groundfish and crab fisheries under the Council jurisdiction off Alaska are the following problems:

1. Harvesting capacity in excess of that required to harvest the available resource.
2. Allocation and preemption conflicts between and in industry sectors, such as with inshore and offshore components.
3. Preemption conflicts between gear types.

4. Gear conflicts in fisheries where there is overcrowding of fishing gear due to excessive participation and surplus fishing effort on limited grounds.
5. Dead-loss such as with ghost fishing by lost or discarded gear.
6. Bycatch loss of groundfish, crab, herring, salmon, and other non-target species, including bycatch, which is not landed for regulatory reasons.
7. Economic loss and waste associated with discard mortality of target species harvested but not retained for economic reasons.
8. Concerns regarding vessel and crew safety, which are often compromised in the race for fish.
9. Economic instability in various sectors of the fishing industry, and in fishing communities caused by short and unpredictable fishing seasons, or preemption which denies access to fisheries resources.
10. Inability to provide for long-term, stable fisheries-based economy in small economically disadvantaged adjacent coastal communities.
11. Reduction in ability to provide a quality product to consumers at a competitive price, and thus maintain the competitiveness of seafood products from the EEZ off Alaska on the world market.

NPFMC Comprehensive Rationalization Program Problem Statement (cont.)

12. Possible impacts on marine mammals and seabirds, and marine habitat.
13. Inability to achieve long-term sustainable economic benefits to the Nation.
14. A complex enforcement regimen for fishers and management alike, which inhibits the achievement of the Council's comprehensive goals.

In the years following the initiation of the CRP, the NPFMC and NOAA Fisheries, whether intentionally or unintentionally, progressively limited the number of participants in the Alaska groundfish fisheries and the types of activities in which they can engage. Major regulatory actions that affected capacity in the groundfish fisheries included the following:

Sablefish and Halibut Longline Fishery IFQ Program

This IFQ program was approved by the NPFMC in 1991 and implemented by NOAA Fisheries in 1995 (GOA Fishery Management Plan [FMP] Amendment 20 and BSAI FMP Amendment 15). IFQs were allocated to vessel owners and lessors who landed fish in 1988, 1989, or 1990, and based on total landings in their best 5 of the 7 years from 1984 through 1990 (halibut) or best 5 of the 6 years from 1985 through

1990 (sablefish). Shares were allocated within separate management areas and for specific vessel size classes. In addition, quota shares issued in amounts less than 20,000 pounds of IFQ in the implementation years were issued as “blocks,” which are indivisible upon transfer. No such transfer restrictions exist for quota shares initially issued in amounts greater than 20,000 pounds of IFQ. Halibut and sablefish IFQs are marketable, but can be sold or traded only within each management area, within the same vessel size category, and with restrictions on the total amount and type of quota held. Although most original IFQ recipients can use hired skippers to fish their shares, new entrants must be onboard the vessel when their shares are caught.

Western Alaska Community Development Quota Program

The western Alaska CDQ program was created by the NPFMC in the context of allocations between the inshore and offshore sectors of the groundfish fisheries. As stated in the NPFMC’s FMP for BSAI groundfish, the purpose of the western Alaska CDQ program is “to provide fishermen who reside in western Alaska communities a fair and reasonable opportunity to participate in the BSAI groundfish fisheries, to expand their participation in salmon, herring, and other nearshore fisheries, and to help alleviate the growing social economic crisis within these communities.” Initially, the western Alaska CDQ program relied on an allocation of 7.5 percent of the annual pollock TAC in the Bering Sea. This allocation, known as the CDQ reserve, was allocated among eligible western Alaska communities. Fishing under this CDQ program began in 1992. In 1993, the NPFMC extended the community development quota to halibut and sablefish. Western Alaskan communities were allocated 20 percent of the BSAI sablefish and various percentages of the halibut in Bering Sea management areas 4A through 4E. The multi-species CDQ allocations, adding all remaining BSAI groundfish, prohibited species and crab, were implemented in 1998. Bering Sea opilio, bairdi, and king crab were phased in at 3.5 percent in 1998, 5 percent in 1999, and 7.5 percent in 2000. The American Fisheries Act of 1998 (AFA) increased the pollock allocation for the western Alaska CDQ program to 10 percent.

Harvesting Vessel Moratorium

A moratorium on new harvesting vessels entering the groundfish fisheries was implemented in 1995 through GOA Amendment 28 and BSAI Amendment 23. The moratorium reduced the possibility of significant increases in the number of large-capacity harvesting vessels actively participating in the groundfish fisheries. Generally, a vessel qualified for a moratorium permit if it made a legal landing of any moratorium species during the qualifying period of January 1, 1988, through February 9, 1992.

North Pacific License Limitation Program

Final implementing rules for the NPFMC’s groundfish License Limitation Program (LLP) were published in 1998, and the first licenses were issued in 2000. The LLP also added the remaining groundfish species in the BSAI to the western Alaska CDQ program. The CDQ portion of the LLP was implemented in 1998. The LLP superceded the moratorium and further reduced the number of vessels eligible to participate in the groundfish fisheries. For general licenses, the base qualifying period established was January 1, 1988, through June 27, 1992, approximately four months longer than the moratorium qualification period, in order to be consistent with the NPFMC’s published cutoff date for qualification under the CRP. The LLP also established groundfish area and gear endorsements. Licenses under the LLP are generally transferable, but endorsements are not severable from the license. Licensed vessels can be replaced, but increases in the length of licensed vessels are limited in vessels under 125 ft and prohibited in larger vessels.

American Fisheries Act

In 1998, Congress passed the AFA which, among other things, limited the number of harvesting and processing vessels that would be allowed to participate in the BSAI pollock fishery.¹⁰ Only harvesting and processing vessels that met specific requirements, based on their participation in the 1995 to 1997 fisheries are eligible to harvest BSAI pollock. At inception of the AFA, 21 catcher processors and 112 catcher vessels qualified, or were specifically identified as being eligible, to participate under the AFA guidelines. Nine other catcher processors were bought out through a combination of \$15.2 million in federally appropriated funds and a \$75 million federal loan to the fishing industry. The AFA also established the authority and mechanisms by which the remaining pollock fleet can form fishing cooperatives. Within each cooperative, each member company is contractually allocated a percentage share of the total cooperative allocation based on its historical catch (or processing) levels. In practice, the cooperative system is similar to an IFQ system. However, the distribution of fishing privileges and the system for trading, selling or enforcing them is decided by the members of the separate cooperatives. Both leasing and sale of harvesting privileges among members of the cooperative are allowed. The leasing and sale of harvesting privileges to an outside party are allowed only if the buyer agrees to abide by the rules set forth in the cooperative's contract. The buyer must also harvest and process the quota with one of the vessels already permitted or a replacement vessel that meets specified criteria. Finally, it should be noted that the AFA also restricts AFA-eligible vessels from shifting their fishing effort into other fisheries. "Sideboard" measures, as they have become known, prevent AFA-listed vessels from increasing their catch in other fisheries beyond their average 1995 to 1997 levels.

Sablefish and Halibut IFQ Shares for Communities

In 2002, the NPFMC approved a measure that would allow fishing villages in the GOA with fewer than 1,500 residents to acquire IFQs for sablefish and halibut. The measure allows 42 villages to buy IFQs and then lease them to resident fishermen. Combined village purchases can not exceed 21 percent of the GOA TACs for the two fish species. There is a limit of 50,000 pounds per user from a community, and leasing is restricted to residents of the community owning the quota shares.

¹⁰ The MSA also revised U.S. ownership requirements for fishing vessels (increasing the required level of American ownership from 50 to 75 percent) and modified specific allocations of the BSAI pollock quota as follows - 10 percent to the western Alaska CDQ program, with the remainder allocated 50 percent to the inshore sector, 40 percent to the offshore sector, and 10 percent to the mothership sector.

Section 2 Analysis of Alternatives

The following four policy alternatives are under consideration by the NPFMC:

Alternative 1 — Continue Under the Current Risk-Averse Management Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. With respect to overcapacity in the groundfish fisheries, an objective of this alternative is to continue to reduce excess fishing capacity, overcapitalization, and the adverse effects of the race for fish.

Alternative 2 — Adopt a More Aggressive Management Policy: A less precautionary management policy (more aggressive harvest strategy) would be implemented based upon the concept that the present strategy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This strategy assumes that fishing at the recommended levels would have no adverse impact on the environment except in specific cases that are generally known. This alternative and its associated FMP framework would maintain the statutorily mandated programs to reduce excess capacity and the race for fish.

Alternative 3 — Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this FMP framework, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment, not just a population of a given species. Regarding the issue of overcapacity, this FMP framework would maintain the LLP program and further decrease excess fishing capacity and other adverse effects of the race for fish by eliminating latent licences and extending programs such as community or rights-based management to some or all groundfish fisheries; provide for adaptive management by periodically evaluating the effectiveness of rationalization programs and the allocation of property rights based on performance; and, to support fishery management, extend the cost recovery program to all rationalized groundfish fisheries.

Alternative 4 — Adopt a Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy and its associated FMP framework would be to impose very restrictive conservation and management measures at minimum that would only be modified or relaxed when additional reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve, and be responsive to, the public but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but, due to a lack of information and uncertainty, we know little about these impacts. A goal

of this alternative, as expressed through its FMP framework, is to include the use of explicit allocative or cooperative programs to reduce excess capacity and allocate fish to particular gear types and fisheries.

Each of the policy alternatives outlined above, with the exception of Alternative 1, contains two bookends to a range of management measures that illustrate how the framework of each policy could be implemented. These bookends, referred to hereafter as FMP bookends, provide a level of detail that allows the effects of the alternatives on the environment to be compared. They also provide a basis for the NPFMC to commit to the goals and principles of a particular policy alternative, while allowing it, under the MSA, to adaptively manage the fishery through FMP amendments using the best scientific information available.

Section 3 Alternative 1: Continue under the Current Risk-Averse Management Policy

3.1 Overview of Overcapacity Management Measures of Alternative 1

This alternative would maintain current measures to reduce excess capacity and the race for fish in the Alaska groundfish fisheries. Current measures that address overcapacity include the LLP; the sablefish longline fishery IFQ program; the cooperatives established in the BSAI pollock fishery under the AFA; the western Alaska CDQ program; and the sablefish IFQ shares for communities. Descriptions of these measures are provided in the preceding section (Section 1.3). In this section we provide an overview of the success of these measures in attaining the goal of this alternative as it relates to the issue of overcapacity. The section that follows this one examines how the measures have affected relevant physical, biological, and socioeconomic environmental resources.

The 1995 moratorium allowed 4,144 unique vessels in the crab and groundfish fisheries, about 1,800 more than the current fleet but significantly less than the 15,709 unique vessels that participated in the fisheries since 1978 that had the potential to re-enter if no action was taken. The LLP, which superseded the moratorium, also did not provide significant limits on fishing capacity in Alaska groundfish fisheries, but that was not its intent (Ginter and Muse 2002). The allocation criteria were easily met, and the criteria allowed vessels to upgrade and were not combined with restrictive limits on gear or vessel characteristics other than length and processor status. The LLP does not set limits on the amount of harvest by an individual vessel. Nor does it limit the harvesting sectors to a small enough number of participants with a sufficient community of interest that negotiation of a voluntary rights-based management system is possible (NMFS 2002a). As a consequence, the intense competition, potential economic instability, and other adverse effects associated with excess capacity and the race for fish continue to occur in many Alaska groundfish fisheries. Nevertheless, the LLP has been successful in partially stabilizing the groundfish fisheries and defining the potential classes of persons eligible for individual or group-based fishing privileges under future rationalization programs.

The sablefish longline fishery IFQ program has been partially successful in reducing excess capacity in the fishery. The number of active vessels has declined every year since program implementation. In 2000, 416 vessels had landings of sablefish compared to 822 vessels in 1990. More than 400 transfers occurred in the first year of the program, which suggests that the market was relatively efficient with low transaction costs. Many of the fishermen who exited the fishery had not received sufficient quota shares during the initial allocation to fish economically (Hartley and Fina 2001a). On the other hand, overall capacity is still high in terms of how much fish the participating vessels could harvest if they were not constrained by their IFQs and by the TAC (Hartley and Fina 2001b). The number of quota share transfers has shown a declining trend, with 346 transfers in 2000.

There are a number of reasons why capacity in the sablefish fishery has not declined further, the primary reason being that the majority of participants view the sablefish fishery as a means of supplementing income from other major fisheries such as the halibut, salmon and crab fisheries (Hartley and Fina 2001b). Allowing fishers to choose when to harvest their IFQs has further established the halibut and sablefish fisheries as part-time fisheries. Fishermen now have greater choice of when to harvest their shares to avoid conflicts with

other seasons. It is also likely that the speed of fleet adjustment has been influenced by the lack of earning opportunities for vessels outside of the fisheries in which they normally participate. Alternative uses for the excess vessels and labor in the sablefish longline fishery appear to be limited.

A second major reason that a large-scale reduction in the sablefish longline fleet has not occurred is that the IFQ program includes restrictions on the use, transfer, and accumulation of quota shares that were specifically designed to limit the degree of consolidation in the fishery (Hartley and Fina 2001a; Ginter and Muse 2002). However, by eliminating the race for fish, the IFQ program eliminated the perverse incentive to increase fishing capacity, it allowed the fisheries to operate much more efficiently given the remaining level of excess capacity and it eliminated the need for further direct actions to control fishing capacity in the sablefish longline fishery.

The AFA was implemented in phases beginning in 1999 and continuing into 2000. As noted earlier, the MSA allowed for the formation of cooperatives among catcher processors, among the catcher vessels that deliver to the catcher processors, among eligible motherships and catcher vessels in the mothership sector, and among eligible catcher vessels delivering fish to shoreside processors in the inshore sector of the BSAI pollock fishery. Cooperatives in the catcher processor sector began in 1999, while cooperatives for the inshore and mothership sectors were established in 2000. Since the AFA was enacted, all sectors of the BSAI pollock fleet have grown smaller as marginal vessels have been removed from the fishery through fishery cooperatives (NMFS 2002a). The buyout of the nine catcher processors resulted in nearly a one-third reduction in the size of the catcher processor fleet, although overall capacity in the catcher processor sector was reduced by a somewhat lesser amount because these nine vessels were among the smallest and least efficient vessels in the catcher processor fleet (NMFS 2002a). In 1999, five of the 21 catcher processors authorized to fish under the AFA chose not to fish during the A/B season and six chose not to fish during the C/D season. This pattern continued in 2000 and 2001 when four and three catcher processors were idle in the A/B season, respectively. Five of the catcher processors were idle in both 2000 and 2001 for the C/D season.¹¹ In addition, one catcher processor sold its catch history to the cooperative and left the fishery completely. The seven catcher vessels authorized to deliver to catcher processors have leased much of their TAC allocation for pollock to catcher processors (receiving as much or more per pound for leased quota as they had for delivered fish the previous year). Since 1999, none of the seven vessels have engaged in directed fishing for pollock. Other improvements in economic efficiency within the catcher processor sector have resulted from in-season transfers of allocations from one vessel to another within a company and between companies (e.g., small amounts of quota that did not warrant another trip are transferred to another vessel making a trip) (NMFS 2002a).

The AFA also authorizes three motherships to participate in the BSAI pollock fishery and 20 catcher vessels to deliver pollock to these motherships. In the year prior to implementation of the AFA the number of vessels delivering more than 10 metric tons (mt) of pollock to motherships was 31. In 2000, the first year in which a cooperative was operating in the mothership sector, the number of vessels delivering to motherships was 19, and the same number delivered fish in 2001. A reduction in fleet size has also occurred in the inshore harvesting sector. In 1998, 107 inshore catcher vessels delivered greater than 10 mt of pollock to inshore processors. That number decreased in 1999 to 100 vessels, decreased again in the 2000 roe fishery to 91 vessels and remained at 91 vessels in 2001. The boats that dropped out were probably less efficient due to

¹¹ Some of the vessels idled in the pollock fishery continued to participate in the whiting fishery off Oregon and Washington (Felthoven 2002).

either high fuel costs or high maintenance costs (e.g., converted oil rig supply vessels or “mud” boats). Other vessels that may have been eliminated from this sector include those for whom a few trips would not be sufficiently supported by the limited quota available due to their port location (e.g., Washington, Oregon, Kodiak) (NMFS 2002a). Industry sources suggest that additional catcher vessels are likely to retire from active participation in the BSAI pollock fishery. The catcher boats that are expected to exit the fishery are the smaller vessels with smaller horsepower and hold size and less capacity to fish offshore in adverse winter weather (NMFS 2002a).

The consolidation of harvesting capacity in the BSAI pollock fishery that has occurred since passage of the AFA seems to indicate that less efficient fishing and processing vessels were removed from the fishery so that costs could be reduced or a better/higher valued product could be produced (NMFS 2002a). It is notable that many of the vessels involved in the pollock fishery were voluntarily removed from the fishery despite the lack of alternative uses.

The western Alaska CDQ program was developed as a means of extending the economic opportunities of productive fisheries in the BSAI area to small, rural communities. Although the program was not designed to address overcapacity, it has had a number of important implications for efforts to control capacity in the Alaska groundfish fisheries. First, the CDQ program removed a portion of the groundfish harvest from the open access fishery and further restricted the possibility that additional harvesting capacity could erode the expected returns of currently participating vessels. Secondly, the CDQ program served to demonstrate how a TAC allocation to a sector of the fishery could rationalize that sector and lead to benefits of increased value of the harvest (Ginter and Muse 2002). Thirdly, the implementation of the CDQ program led to the development of many of the enforcement and monitoring procedures that would be applied to other measures to reduce excess fishing capacity in the groundfish fisheries. For example, data collection needs for the AFA are nearly identical to those of the CDQ pollock fishery (NMFS 2002a). Lastly, the CDQ program showed how a rights-based approach could be used for positive redistributive purposes, in this case the economic development of isolated communities in western Alaska with high levels of unemployment. Studies suggest that the CDQ recipients have been successful in using their quota allocations to meet the community development goals of the program (NRC 1999b; Northern Economics, Inc. 2002).

The program that established community quota shares for sablefish was also not intended as a means of reducing excess capacity in the Alaska groundfish fisheries. Rather, this measure was implemented solely to provide for the sustained participation of small, fishery-dependent, rural communities in the Gulf of Alaska in the IFQ sablefish and halibut fisheries. However, because eligible Gulf communities will be leasing their IFQs to local residents who will likely fish on smaller vessels or as a part-time operation, the program will help to reduce capacity in these fisheries. In addition, the allocation of sablefish IFQ shares to communities is similar to the western Alaska CDQ program in that it demonstrates how a rights-based approach can be used to protect the economic interests of certain groups.

In conclusion, the current management regime includes a variety of measures that have, at least in part, limited excess harvesting and processing capacity in Alaska groundfish fisheries. Yet, as indicated by recent problem statements prepared by the NPFMC, the measures have not been successful in eliminating excess capacity as one of the major management problems for the BSAI and GOA groundfish fisheries. A recent report by Felthoven et al. (2002) supports the Council's position that significant excess capacity remains in several Alaska groundfish fisheries. The study estimated the difference between the maximum amount of fish that could and would be caught by fishermen, given existing technological and economic constraints, if the

limitations imposed by TACs were removed and the amounts of fish harvested in 2001. The study found that, conservatively, there was about 17 percent excess capacity in the Atka mackerel fleet, about 26 percent for flatfish, 35 percent for Pacific cod, 39 percent for pollock, 21 percent for rockfish, 24 percent for sablefish, and 30 percent for other groundfish. These estimates apply to the catcher vessel and catcher processor components of the fleet. Excess capacity for pollock may have declined since the study was completed as fishing operations take advantage of cooperative fishing arrangements under the AFA.

Under the current management regime Alaska groundfish fisheries are expected to continue to generate an important share of the total ex-vessel value of all domestic commercial fisheries. However, the use of the race for fish to allocate TACs and prohibited species catch (PSC) limits and the high levels of excess harvesting and processing capacity in many of the groundfish fisheries are expected to significantly decrease the net benefits to the Nation from these fisheries.

3.2 Effects of Overcapacity Management Measures of Alternative 1

3.2.1 Effects on Marine Mammals

Concentrated removal of key prey species of marine mammals has been a concern, especially with respect to effects of the pollock fishery on Steller sea lions. The fishery cooperatives established under the American Fisheries Act have increased the temporal dispersion of the pollock fishery and decreased the likelihood of localized depletion of Steller sea lion and northern fur seal prey (NMFS 2001a). This does not mean, however, that the catch has been spread throughout the year. Rather, when the fishery operates, there is no race among individual vessels or sectors, but seasonal peaks in fishing effort, such as during the roe season, still occur. While the pace of the pollock fishery is slower, the degree to which the change has reduced competition with Steller sea lions and northern fur seals is uncertain.

The establishment of cooperatives has also resulted in greater spatial dispersion of fishing effort to the extent that fishermen choosing to fish at different times of the year have located migrating schools of pollock in different locations. However, the overall spatial and temporal distribution of the pollock fishery is much more likely to be governed by the imposition of Steller sea lion protection measures. Nevertheless, to the extent to which the formation of fishery cooperatives has facilitated efforts to reduce the spatial and temporal concentration of fishing effort, Steller sea lion protection efforts have been enhanced (NMFS 2002a).

In addition, the emergence of fishery cooperatives provides managers and industry greater ability to manage fishing effort at the individual vessel level relative to the previous open access fishery (NMFS 2002a). For example, fishery cooperatives have demonstrated the ability to internally regulate the fishing activities of individual vessels in both the BSAI directed pollock fishery and in non-pollock sideboard fisheries. Under the open access regime in effect prior to 1999, pollock fishery management measures were bluntly applied in the aggregate to the inshore and offshore fleets, with no attempt or ability to regulate the individual fishing patterns of individual vessels. The increased management capacity since the establishment of cooperatives can only increase the ability of managers and industry to successfully implement Steller sea lion protection measures.

Implementation of the IFQ program in the sablefish longline fishery has contributed to a decline in interactions between this fishery and resident killer whale populations. Sablefish longline fishermen face depredation of hooked sablefish by killer whales. As fishermen retrieve their gear when fishing for sablefish, killer whales frequently pick sablefish off the hooks. The IFQ program has allowed fishermen to reduce the depredation of harvests by setting smaller amounts of gear that can be more quickly retrieved and moved when killer whales appear.

3.2.2 Effects on Seabirds

The incidental catch of seabirds is a potential problem in longline fisheries for sablefish and Pacific cod. Several factors are likely to affect the risk of seabird incidental catch, including fishing effort (e.g., number of hooks deployed), the distribution of effort by sub-area and season, the abundance and distribution of seabirds in the vicinity of fishing vessels and the use of seabird deterrents in longline fisheries (NMFS 2001a). The relative importance of these factors has not been fully studied. However, it is reasonable to assume that risk increases or decreases partly as a consequence of changes in fishing effort. Research suggests that the relationship between fishing effort and the number of birds hooked in the BSAI and GOA varies for different species groups. In both the BSAI and GOA northern fulmars are more likely to be taken with increased fishing effort than any of the other three seabird groups that are taken by longline gear. That is, as the number of hooks increases, so do the number of fulmars hooked. However, it appears that the amount of fishing effort does not play a key role in whether albatrosses, gulls, or shearwaters are taken (NMFS 2001a).

In the sablefish longline fishery, improved catching efficiency during IFQ management has reduced the number of hooks and days at sea necessary to catch the quota (Sigler and Lunsford 2001). During the period 1995 to 1998, IFQ management reduced the total number of hooks fished by 38 percent, from 263 million to 164 million, or about 25 million hooks per year. Based on this information, the number of fulmars taken is predicted to decrease under Alternative 1. The incidental take of other seabird species is not expected to change as a result of changing fishing effort. The impact of hook-and-line fishing effort cannot be predicted in detail because of unknown factors such as the seasons and locations of fishing as it relates to the abundance and distribution of seabirds and the effectiveness of the deterrent measures being used.

3.2.3 Effects on Target Groundfish Species

Compared to previous open access management, IFQ management increased sablefish longline fishery catch rates and decreased harvest of immature fish (Sigler and Lunsford 2001). Localized depletion and fishing in marginal areas also occurred less often. Fishery selectivity of the longline fleet favored larger, older fish with the transition from the open access to the IFQ fishery. The mature fraction improved by nine percentage points for female sablefish and one percentage point for males. Decreased harvest of immature fish improved the chance that individual fish will reproduce at least once. The analysis of spawning biomass per recruit showed that spawning potential was higher for the IFQ fishery compared with the open access fishery. Spawning biomass per recruit was 9.29 kilograms (kg) per recruit for the open access fishery and 10.0 kg per recruit for the IFQ fishery, a 9 percent increase.

Predicting when to close the open access sablefish fishery was difficult because of the speed and brevity of the fishery (Sigler and Lunsford 2001). The sablefish TAC frequently was exceeded in the GOA during open access management, but it has not been exceeded during IFQ management. It is also likely that the reduction of lost gear and sablefish mortality resulting from lost gear (deadloss) has allowed the sablefish TAC to remain higher than it would have been under the previous management regime (Hartley and Fina 2001b).

Cooperatives established under the AFA may result in a shift in the age distribution of the pollock catch. As the race for fish is lessened, fishermen may search longer for fish of a desirable marketing size. This could result in reduced catch of undersized pollock. Also, to the extent that fishing under AFA cooperatives has slowed the pace of the BSAI pollock fishery and distributed fishing effort over a wider area, the likelihood that the fishery could result in depletion of relatively distinct spawning populations not presently recognized under the current management system could be reduced (NMFS 2002a). Catch of non-pollock groundfish in the directed pollock fishery is negligible and sideboard measures restrict the participation of AFA vessels in other groundfish fisheries to some level of historic participation. Therefore, the effects on non-pollock target species are considered to be insignificant.

One potential negative effect of an IFQ system is that fisherman may have an incentive to “high-grade” the catch by discarding lower quality fish that count against the quota. High-grading can result in incorrect inferences from landed catch (NRC 1999a). Not only would actual mortality rates be higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards).

High-grading is generally less likely to occur in open access fisheries because the race for fish usually provides a substantial incentive for fishermen to deliver as much as they can catch as quickly as possible. However, a 1995 report from Fisheries Information Systems noted that, after IFQ implementation, groundfish discards in the sablefish longline fishery actually declined from 24 percent to less than 10 percent (Buck 1995). The discard rate in the fishery in 1999 was only 8 percent. Furthermore, preliminary comparison of the size distribution of sablefish in the commercial landings and catches in the NOAA Fisheries sablefish longline survey do not suggest widespread high-grading (NRC 1999a). The presence of NOAA Fisheries observers on larger vessels in the IFQ program undoubtedly restricts the opportunity to high-grade (Buck 1995). In addition, the relative rate of catch of low-value fish is thought to be high enough, and the price difference between low- and high-value fish is thought to be small enough, that the expense of replacing discarded low-value fish would result in little or no increase in net revenues to the fishermen. Fisheries in which high-grading is not a serious concern seem to be characterized by minimal price differentials among fish sizes and/or relatively high costs of catching replacement fish (NRC 1999a). The price differential for small sablefish is minimal, no more than 12.5 percent in 2000 (Sigler and Lunsford 2001).

3.2.4 Effects on Non-Target (Forage, Other, and Non-Specified) Species

Rights-based management systems such as the sablefish longline fishery IFQ program and the cooperatives established in the BSAI pollock fishery are designed to increase economic gains in fisheries by allowing reasonably paced and well-planned fisheries in areas where fishermen get more target species catch with less bycatch. Although there would be economic benefits to the fishery if bycatch of all undesired species were reduced across the board (more efficient processing, less handling time of nonmarketable animals, etc.), the reality of fishing is that bycatch of some kind is unavoidable; therefore, fishermen avoid the bycatch that is most detrimental and accept that which is least harmful to them economically. While there is considerable

motivation to avoid catching non-target species, such as halibut or salmon, that can potentially constrain groundfish fisheries through PSC limits, there may be little incentive to avoid bycatch of non-constraining species. This point is underscored by the fact that the sablefish longline fishery has been managed under an IFQ system for the past several years, and yet this fishery still has very high grenadier (non-specified) bycatch (NMFS 2001a). In some years the catch of grenadiers may approach that of target species in this fishery.

3.2.5 Effects on Prohibited Species

The tools necessary to prevent bycatch from adversely affecting the stocks of the prohibited species themselves are in place. Therefore, the prohibited species catch in the groundfish fishery is principally not a conservation problem. Because prohibited species have catch limits that can constrain groundfish fisheries, there is considerable incentive to avoid catching these species. Experience with the cooperatives in the BSAI pollock fishery indicates that eliminating the race for fish under a rights-based management system may facilitate fishermen's efforts to reduce the catch of prohibited species. When the race for fish is eliminated, fishermen are able to fish more cleanly (i.e., minimize their bycatch), as they can fish in a less hurried fashion and avoid areas where prohibited species catch is high. Bycatch rates of all prohibited species are very low in the directed Bering Sea pollock fisheries, with the species of greatest interest being salmon and herring. Since the implementation of the AFA, both herring and other salmon bycatch rates have decreased while chinook salmon bycatch rates have increased but remain below historic levels (NMFS 2002a).

The AFA also facilitates collective efforts by industry to reduce prohibited species bycatch. In 2001, for example, the pollock intercooperative group composed of representatives of all catcher vessel and catcher processor cooperatives (co-ops) announced the development of an "other salmon" (primarily chum salmon) bycatch management program for the Bering Sea pollock fishery (NMFS 2002a). The goal is to implement a rate-based program for reducing chum salmon bycatch by restricting pollock harvest in areas of chum bycatch to vessels with low bycatch rates as an incentive to promote cleaner fishing practices. The pollock cooperatives are the key component of this program. By promoting bycatch reduction on a co-op by co-op basis, co-ops are given incentives to develop clean fishing practices.

In the sablefish longline fishery, prohibited species bycatch reduction was inherent in the IFQ program due to the close interaction between sablefish and halibut fisheries. Much of the longline bycatch of halibut occurred in the sablefish fisheries, and many fishermen fish for both species (and receive IFQ for both). To the extent sablefish fishermen have halibut IFQ, this halibut is now retained and counted against the target quotas, as opposed to being discarded (by regulation prohibited species bycatch has to be discarded unless donated to a food relief agency). This resulted in an immediate reduction of the annual GOA halibut prohibited species limit from 750 mt to around 150 mt (Pautzke and Oliver 1997).

The bycatch of many prohibited species has not been significantly affected by current measures related to overcapacity because the measures have not had an appreciable effect on the groundfish fisheries in which those species are caught (NMFS 2001a). The majority of halibut bycatch in the BSAI and GOA is taken in non-pollock trawl fisheries, specifically those targeting Pacific cod and flatfish. Longline fisheries targeting Pacific cod take the next largest proportion of halibut bycatch. Most of the bycatch of crab in the BSAI comes from the yellowfin sole, rock sole and other flatfish, and Pacific cod fisheries. Most of the bycatch of Tanner crab in the GOA comes from the Pacific cod pot fishery and the flathead sole trawl fishery.

3.2.6 Economic and Social Effects

Economic Impacts on Vessel Owners Including Owners of Catcher Processors

There is insufficient information to calculate the change in the overall profitability of the sablefish longline fishery that has resulted from implementation of the IFQ program. However, an increase in the profitability of this fishery is suggested by the fact that quota prices have increased substantially since 1995 (Hartley and Fina 2001a). In addition, some preliminary quantitative information on the costs and benefits to fishermen is available. Sigler and Lunsford (2001) estimated that IFQ management increased fishery catch rates in the GOA even though sablefish abundance was decreasing. Fishery catch rates by region and year averaged 0.24 kg per hook during the open access fishery and 0.39 kg per hook during the IFQ fishery (during summer). The improved catch rates are likely the result of less crowding on the most productive fishing grounds with longer seasons and a slower paced fishery. Since the IFQ program was implemented, the season length has changed, from as short as 10 days during open access to 8 months under IFQ management, with landings distributed broadly throughout the year. Because the catch now occurs over several months, vessels no longer are forced to fish side by side. In addition to higher catch rates, some fishermen have received a higher price for their fish because they are able to time their fishing to obtain the best price for their harvests (Hartley and Fina 2001b). In a survey of sablefish fishermen, 50 percent reported a price increase for their harvests (Knapp and Hull 1996).

Sigler and Lunsford (2001) also found that catching efficiency increased 1.8 times with the change from an open access to an IFQ fishery. IFQ management reduced the total number of hooks fished by 38 percent, from 263 million to 164 million, or about 25 million hooks per year. Moreover, the IFQ fishery required 3,000 fewer days at sea to catch the quota. Fewer days at sea reduce variable costs such as fuel, bait, and gear. The researchers estimated that for the 1995–1998 fisheries, fuel, gear, and bait costs decreased from \$33 million to \$20 million, or about \$3.1 million per year. Compared with landed value, these fuel, gear, and bait costs decreased from 8 to 5 percent of landed value.

Private banks and government agencies have come to treat quota shares allocated under the IFQ program as having financial value that may allow them to serve as collateral for loans, for instance (Iudicello *et al.* 1999). By the end of 1997, banks had placed liens on 388 quota shares; private lenders, on 116 shares; the IRS, on 79 shares; and Alaska's child support program, on 26 shares.

The economic impacts of the AFA on the various types of vessels that comprise the BSAI pollock fleet have been discussed by government and industry reports (also see Felthoven 2002). According to NMFS (2002a), members of industry indicate that both the catcher processors and catcher vessels were more profitable under the cooperative structure in 1999 than they were under the old system that required them to race for fish. A GAO study of the catcher processor co-ops in operation in 1999 stated that the end of the race for fish has given catcher processors more time to search for the size of fish most conducive to the products processors want to produce (NMFS 2002a). The average haul size for catcher processors dropped by roughly 30 percent between the A seasons in 1998 and 1999. The daily catch rate for the group of catcher processors that fished in 1998 and 1999 declined by over 60 percent. Peak weekly catch rates declined substantially in 1999 and further yet in 2000. Whereas in 1998 the vast majority of the winter season catch was taken in 4 weeks, in 2000, the same percentage of the catch was spread out over 10 weeks.

With smaller haul sizes, more careful processing and the ability to search out fish of optimal size and roe content, the pollock catcher processor fleet was able to improve product quality, increase product utilization rate, and optimize product mix to market conditions. In particular, the quality and yields of roe increased and the fleet was able to produce more high-valued products in place of less valuable products. For example, catcher processors were able to respond to increased demand and rising fillet prices by increasing deep skin fillet production while decreasing surimi and mince production. In addition, the quality of single-freeze fillets coming from catcher processors is said to be higher than that of a few years ago because the vessels have sufficient time to handle catch more carefully (NMFS 2001b). Also attributable to the end of the race for fish is an increased product utilization rate, leading to more product per unit of fish caught (NMFS 2001b). Processors that are able to generate more product from a given amount of pollock are likely to increase their revenues. This also translates to increased profits for the firm if they are able to produce that product for less than the cost of production. The Pollock Conservation Cooperative (PCC) catcher processors estimated that their utilization rate increased 35 percent in 2000 over a 1998 (pre-AFA) baseline (NMFS 2002a). Their overall utilization rate in 2000 was just over 27 percent.

With regard to the effects of AFA on the mothership sector, Halvorsen *et al.* (2000) conclude that, while that sector's share of the TAC was decreased by approximately one-sixth and it did not receive any direct compensation for this decrease, it is expected to benefit from rationalization, but not by as much as the catcher processors. The offshore mothership sector slowed and smoothed out weekly production significantly in the 2000 winter season, prolonging the season by several weeks. This sector did not have fillet production capacity; therefore, there were no major shifts in production mix.

Halvorsen *et al.* (2000) could not rule out the possibility that the rules for inshore pollock cooperatives have actually hurt independent catcher vessel owners financially. While these rules give fishermen opportunities to move between processors, they cannot do so without costs (Ginter and Muse 2002). Fisherman who want to avoid an open access fishery must deliver to the same processor they delivered to last year, thus the position of processors with the fishermen is strengthened.¹² Due to these restrictions, it is unclear whether the efficiency gains from inshore cooperatives will be as great as those in the offshore sector. However, the pace of production and product mix in the winter season of 2000 suggest some immediate gains. For example, weekly processed catch was spread out as production was deliberately slowed down. In addition, the inshore sector increased their utilization rate of BSAI pollock after cooperatives were implemented. Members of the inshore sector increased their utilization rate about 2.3 percent from 1999 to 2000 (NMFS 2002a). Their overall utilization rate in 2000 was 36.6 percent. While their increase was not as great as that seen in the catcher processor sector, it still indicates they were able to produce about 4,000 mt more product in 2000 relative to what they would have produced had their utilization rate remained at the 1999 levels.

Unless vessels are scrapped, capacity reduction schemes may induce transfer of fishing effort to other fisheries which themselves exhibit overcapacity.¹³ For example, the increased flexibility afforded to pollock catcher vessels by the creation of co-ops leads to increased opportunity for these vessels in other fisheries; a shift in fishing effort could create benefits for the catcher vessels, but could also indirectly create economic

¹² The AFA requires members of a cooperative as a group to deliver 90 percent of their TAC to the processing firm associated with that cooperative. Catcher vessels that want to switch cooperatives must spend at least one year in the open access fishery.

¹³ Under the provisions of the AFA, eight of the nine catcher processors that were bought out were required to be scrapped and the ninth vessel was permanently stripped of its U.S. fisheries endorsement and prohibited from fishing in the U.S. EEZ, or in foreign or international waters on any stock of fish that occurs within the U.S. EEZ.

hardship in the form of reduced profitability for the fishermen already engaged in those fisheries. If the catcher vessels were to shift their effort to other fisheries, catch per unit effort and individual harvest for existing fishermen could decline substantially due to crowding and intensified fishing pressure on stocks. In anticipation of these potential problems, the AFA included provisions for the NPFMC to enact measures to protect non-AFA fisheries from adverse impacts resulting from the AFA and pollock fishery cooperatives. BSAI Amendment 61 contains various specific protective measures developed by the Council which limit the pollock industry's participation in other fisheries — these measures are referred to as “sideboards.” AFA catcher vessels have been operating under groundfish sideboards since 2000. The management of sideboard fishing at an individual cooperative (and by extension, individual vessel) level has eliminated the potential for an increased race for fish in major sideboard fisheries (NMFS 2002a).

Impacts on Owners of Inshore Processing Plants

After implementation of the sablefish longline fishery IFQ program, existing processors found themselves burdened with excess capacity and a loss of bargaining power (Hartley and Fina 2001b). The processors operating prior to IFQs developed their businesses to accommodate the huge rush of fish that occurred with the short intense seasons. With IFQs, new niche processors catering to the fresh-market entered the fishery, and a number of the larger traditional processors found themselves with excess capacity. Moreover, with the additional competition to buy fish and disappearance of market gluts, some processors lost bargaining power as vessel owners were more able to search out buyers willing to pay the highest price (Hartley and Fina 2001b; Iudicello *et al.* 1999).

By the time the AFA was being drafted, traditional inshore processors in Alaska recognized the consequences of IFQs and exercised their political power to prevent new IFQ systems that did not include provisions that protected the interests of processors (Hartley and Fina 2001b). The AFA and implementing rules require each catcher vessel that joins a cooperative and delivers inshore to bring a share of the TAC to that cooperative proportional to its historical catch. The vessels, in aggregate, have to agree to deliver 90 percent of their TAC to the processing firm associated with that cooperative. These inshore catcher vessel cooperatives were controversial (Ginter and Muse 2002). They appeared to give inshore processors control over rights to a part of the TAC, over and above the rights that accrued to them as vessel owners.

Inshore processors have also benefitted from the slower-paced pollock fishery under cooperatives. With the more moderate and regular landings by catcher vessels, processors have been able to increase their production of higher-value products. For example, the inshore processing sector increased production of higher valued fillets by over 50 percent and decreased surimi as a percentage of total production. However, total fillet production is still less than one-third of surimi production.

Impacts on Vessel and Processing Crews and Other Employees

A disadvantage of IFQ programs is that they can lead to a smaller fishing workforce and potentially increase unemployment (Buck 1995). Some crewmembers may be unable to find employment elsewhere, but those who find jobs may earn less. The most significant loss is likely to be part-time fishermen and deck hands. Under IFQ management, vessels will not need the high number of deck hands to participate in labor-intensive “derby”-style openings.

A survey of sablefish fishermen in the year following implementation of the IFQ program suggested that a slight decline in the number of crew occurred under the program (Knapp and Hull 1996). With IFQs and the resulting change from a race for fish, the number of crewmembers on a typical trip is believed to have fallen from a range of 3 to 6 to a range of 2 to 4 (including the skipper).

On the other hand, an anticipated advantage of a fishery managed under an IFQ program is that jobs for crewmembers who remain in the fishery may become more stable and permanent, replacing the short, temporary or seasonal jobs characteristic of many open access fisheries (Buck 1995). In turn, the longer fishing seasons and more stable employment can translate into higher income. Believing that crewing jobs would be better paid under an IFQ system, the Deep Sea Fisherman's Union of Seattle supported the creation of the sablefish IFQ program. It is in fact estimated that payments per individual crewmember have increased under the program. The decline in the number of active sablefish vessels and reductions in crew size after IFQ implementation is estimated to have increased average payments per individual crewmember from \$3,165 in the pre-IFQ fishery to \$8,342 in the IFQ fishery (Hartley and Fina 2001b).

As a form of compensation for the loss of employment opportunities, the NPFMC made the provision that the only persons who could purchase sablefish IFQ shares that were not initial recipients had to be “legitimate” crewmembers with at least 150 days of fishing experience. With this provision, crewmembers who might otherwise lose their jobs can establish themselves in the fishery, and because the owner of the quota shares is required to be onboard when the IFQs are fished, these crewmembers can guarantee themselves a position (Hartley and Fina 2001b). Moreover, crewmembers who purchase quota shares increase their value as crew, as their quota shares add to the overall harvest limit of the vessel on which they work (Ginter and Muse 2002). Approximately 850 crewmembers have invested in sablefish quota shares since the IFQ program was initiated (Gulf of Alaska Coastal Communities Coalition 2000).

Both crewmembers and vessel owners have been assisted in purchasing sablefish and halibut IFQ shares by the North Pacific IFQ loan program, a financing mechanism authorized by the MSA in 1996. The MSA specifies that 25 percent of the fees collected by NOAA Fisheries to manage the sablefish and halibut IFQ program must be deposited in a U.S. Treasury Department account and made available for appropriation to support the loan program. To date, however, the program has largely been supported by a Congressional appropriation. The MSA specifies that the loan program is to provide aid in financing the 1) purchase of individual fishing quotas in that fishery by fishermen who fish from small vessels; and 2) first-time purchase of individual fishing quotas in that fishery by entry-level fishermen. Currently, the program has approximately \$5 million available for financing quota share purchases. In Fiscal Year (FY) 2002, 39 loans were issued, mostly to vessel owners and crewmembers who fish from small (< 60 ft length over-all) vessels.

Impacts on Communities

The harvesting and processing sectors of the fishing industry in Alaska and elsewhere are labor-intensive and often located in relatively isolated communities. IFQs could harm such communities, should a reduction in fleet size and fewer employees following IFQ implementation reduce the number of processors and demand for associated shoreside services (Buck 1995). These effects can disrupt economies of small communities that depend on commercial fishing, especially during the transition from open access to an IFQ program. These changes are one facet of the wealth distribution issue that typically accompanies the reduction of capacity under a rights-based management system (Gréboval and Munro 1999). Market forces are likely to

lead to a certain degree of concentration and may also lead to the elimination of financially less efficient small-scale or community operations.

From the onset of implementing measures to control capacity in the groundfish fisheries, the NPFMC has included provisions that constrain individuals or entities from acquiring an excessive share of these fisheries. The LLP limits the number of groundfish licenses that any one person can hold to 10 licenses. A person is defined in Section 679.2 as, “any individual (whether or not a citizen of the United States), any corporation, partnership, association, or other entity (whether or not organized, or existing under the laws of any state).” In the development of the sablefish longline fishery IFQ program several restrictions on the use, transfer, and accumulation of quota were imposed to avoid excessive consolidation and maintain the pre-existing characteristics of the longline fleet as being comprised of relatively small-scale, owner-operator vessels (Hartley and Fina 2001b; Ginter and Muse 2002). The NPFMC recognized that maintaining the social and economic fabric of the fishery is important to the many coastal communities in which fishing vessels in the fishery are home ported (Ginter and Muse 2002).

There is a lack of consensus on whether the IFQ program has had an overall positive or negative impact on coastal Alaska communities and the fishermen residing in those communities (Pautzke and Oliver 1997). The Alaska Commercial Fisheries Entry Commission (CFEC) (1999) provides a detailed breakdown of changes in quota holdings and deliveries by census area, rural versus urban, state of residence, type of entity, etc. There has been some consolidation of quota within communities and some movement of quota between communities, but trends in geographical consolidation of quota or deliveries are not clear.

While a lack of detailed socioeconomic data makes it difficult to characterize exactly how communities were affected by the implementation of the IFQ program, it appears that some Alaska communities have seen reductions in quota holdings by their residents and in local landings, whereas others have had increases. However, because overall sablefish landings declined, deliveries to many areas declined dramatically. For example, sablefish deliveries to Ketchikan/Prince of Wales, the Wrangell-Petersburg census area and the Skagway-Yakutat-Angoon census area fell by 70 to 75 percent between 1994 and 1998 (CFEC 1999). In 2000, the Gulf of Alaska Coastal Communities Coalition (2000) submitted a proposal to the NPFMC citing the disproportionate amount of quota share transfers out of smaller, rural communities as a symptom of the continuing erosion of their participation in the sablefish and halibut fisheries. Anecdotal evidence cited in the proposal suggests that the fishermen in these communities were not awarded sufficient quota shares during initial issuance to make it economically viable to continue fishing. In contrast, fishermen who received larger initial allocations were able to finance additional quota share purchases with the capital provided from their new asset base.

The Restricted Access Management office, which is the entity established by NOAA Fisheries to manage the IFQ program, and the CFEC have confirmed that: 1) the rate of decline of the amount of quota shares in the smaller communities is higher than that of the larger communities; 2) the bulk of the quota share consolidation has taken place in the smaller holdings; and 3) very few initial large quota share recipients reside in smaller coastal communities. A combination of several possible factors may explain the relatively low amount of initially issued quota shares and the subsequent transfer of quota shares out of the target communities. These factors include the lack of general infrastructure to support fisheries; the lack of financial wherewithal among community residents to buy vessels, equipment and quota shares; and the higher transportation costs associated with fishing in small, remote communities that are located further from the major markets.

To help ensure sustained participation of smaller, rural GOA communities in the sablefish and halibut fisheries, the IFQ program was amended to allow eligible communities to hold quota shares. Communities can create or identify an existing entity to purchase and manage halibut and sablefish quota shares, for lease to and use by qualified individual community members. Rural villages will likely use federal and state grants to purchase quota shares. By providing communities with an opportunity to increase participation in the IFQ fisheries, this modification of the IFQ program is expected to further overall economic development in participating communities, the majority of which have limited economic alternatives. Because this measure was only recently approved by the NPFMC in 2002, there is insufficient information to determine the direction or magnitude of these effects.

The western Alaska CDQ program has benefitted the small communities in the Aleutian Islands and on the Bering Sea that have traditionally been unable to participate in fisheries (Northern Economics, Inc. 2002). Communities granted quota shares have handled their shares in different ways. Some quota shares have been transferred annually to industry partners (CDQ shares can not be permanently transferred) in exchange for royalties and employment benefits while other shares have been used to directly develop fishing sectors within the communities. Since the inception of the program in 1992, the program has provided approximately 1,000 jobs annually for western Alaska residents and has created an excess of \$8 million in wages annually since 1998. Over the duration of the CDQ program annual pollock CDQ royalties have consistently exceeded \$13 million. In 2000, the CDQ communities received nearly \$33 million in pollock CDQ royalties, while royalties from the multi-species program provided the communities an additional \$7.4 million. The value of CDQ community assets in aggregate, including equity ownership in fishing vessels, on-shore development projects, loan portfolios and IFQ holdings, increased from nearly \$15 million in 1992 to over \$152 million in 2000.

In conclusion, constraints on the restrictions of the use, transfer, and accumulation of IFQs may prevent preemption of communities or fishery sectors. However, the social benefits of these measures should be weighed against the efficiency losses. The greatest increase in profits for the overall industry is likely to come from a system with a minimum of constraints on transferability and use of quota shares. For the industry as a whole, increases in profitability can be achieved by shifting harvesting and processing from less efficient operations to more efficient ones. Gains in economic efficiency may be made by concentrating production in fewer operations, especially if there are firms with excess harvesting or processing capacity as continues to be the case in most sectors of the Alaska groundfish fishery. Furthermore, it is possible, but by no means certain, that there are economies of scale that would favor larger firms and lead to greater concentration of the industry. At the same time, however, one must recognize that it is this potential for increasing profits by shifting and concentrating harvest and processing operations that poses the threat of preemption of sectors and communities.

Impacts on Consumers of Groundfish Products

Seafood consumers can benefit from a rights-based management system because fishermen are able to fish at different times and thus supply markets with a more continuous flow of high-quality product (Buck 1995). Prior to the implementation of the IFQ program in the sablefish and halibut longline fisheries, the abbreviated seasons limited the availability of fresh halibut to a very short period each year.¹⁴ Under the IFQ program,

¹⁴ Sablefish is usually frozen at sea.

fishermen have distributed their catch throughout the year. A survey of registered buyers in the first year of the program found that fresh halibut production rose 18 to 38 percent under the program, benefitting consumers and marketers of fresh fish. Furthermore, the slower pace of fishing in the halibut longline fishery resulted in better fish handling, and the overall quality of the catch has improved (Hartley and Fina 2001b).

On the other hand, IFQs can increase seafood costs because consumers will miss the low prices that occur during, and because of, the race for fish (Buck 1995). In the Alaska sablefish fishery, for example, prices have increased since IFQ implementation (Hartley and Fina 2001b).

Impacts on Fishing Vessel Safety

Because IFQs guarantee that one's allocated catch will be available later, they provide fishermen increased flexibility in choosing when to fish (Buck 1995). The option of choosing when to fish improves vessel safety, as fishermen can fish at a more leisurely pace and avoid fishing in dangerous weather or locations. In the sablefish longline fishery, the fishing season was converted to an eight-month season from March 15 to November 15. Fishermen have distributed their harvests across the entire season. The lowest harvests occur in the first few and last few months of the season, when the weather is the most threatening (Buck 1995). Nevertheless, market forces can reduce potential safety benefits if processors offer premium prices during inconvenient or less safe times. However, some fishermen may still choose to fish in bad weather if, for example, the best price for catch is offered during and immediately after storm periods.

Although some incentive may remain to fish in less than optimum conditions under an IFQ program, fewer personal injuries and fatalities and less gear destruction should occur than under comparable open access conditions. A 1995 report from Marine Safety Reserve, a liability pool, noted a substantial decline in the longline vessel accident rate (injuries per fishing day) following implementation of the sablefish IFQ program (Buck 1995). Safety statistics compiled by the U.S. Coast Guard show that, as the IFQ program progressed, a substantial drop in search and rescue missions for the sablefish and halibut fisheries occurred (Hartley and Fina 2001b; Woodley 2002). Furthermore, a survey of sablefish fishermen revealed that more than 90 percent reported weather as an important factor in determining when to fish quota (Knapp and Hull 1996).

Similar benefits in vessel safety have resulted from the operation of the AFA pollock cooperatives. While the slowing down of the BSAI pollock fishery and the flexibility offered by the quota systems has not had an impact upon fatality rates (the fatality rate has remained at zero since 1995), vessel owners from several of the Pollock Conservation Cooperative companies have reported an approximately 50 percent reduction in processing crew injuries (Woodley 2002). In addition, safety-enhancing features such as less competitive and slower paced operations are also found among vessels participating in some CDQ fisheries (Woodley 2002).

The risk to fishermen is expected to remain high in other groundfish fisheries under the current management regime. This is due, in part, to the continued use of the race for fish to allocate TACs and PSC limits among competing fishermen.

3.2.7 Effects on Ecosystem

Elimination of the race for fish may reduce local and temporal depletions that can be disruptive to ecosystems. Reduction in the number of hooks being used is also likely to reduce habitat effects of fishing longline gear (Sigler and Lunsford 2001). IFQ management of the sablefish longline fishery has shown to improve catching efficiency compared with open access management, to the point that the number of hooks necessary to catch the TAC was reduced. Invertebrates such as coral, anemones, and sea stars are often snagged and brought to the surface with longline gear; however, documentation of how longline gear affects the seafloor and associated species is limited, and these effects have not been quantified.

The AFA cooperatives have reduced effort in the BSAI pollock fishery and allowed the fishery to spread out in time and space. However, because pelagic trawl gear does not significantly impact the substrate and benthic habitat, the effects of this dispersal of fishing effort on the physical environment are expected to be insignificant (NMFS 2002a).

The amendment that allows eligible communities to purchase sablefish IFQs could have an effect on the location of the fishery if quota shares are purchased by remote communities from residents located in larger ports and fished in close proximity to the remote communities. That could result in a shift of some of the harvest from the areas surrounding the larger ports to more remote areas. This may be a positive effect in the context of local depletion concerns, but the level of effect is highly dependent on the amount of quota shares communities purchase and where residents of those communities choose to fish. At present, there is insufficient information to determine the direction or magnitude of these effects.

The effects on the substrate, water column, and benthic biota caused by fisheries that use bottom trawl gear have not been mitigated by current measures that address overcapacity. Bottom trawls are used to fish Pacific cod and various species of flatfish. Trawling on sea floor habitat and benthic communities in the GOA generally disturb sea floor habitats by displacing boulders, removing epifauna, decreasing the density of sponges and anthozoans, and damaging echinoderms (NMFS 2001a). However, the effects of this disturbance on fish and other living marine resources are not known.

3.2.8 Effects on Management and Enforcement

A rights-based management program can lead to increased costs for administration, monitoring, and enforcement. Both buyers and fishermen have stated that the sablefish longline fishery IFQ program imposes extra administrative burdens and costs on their operations (Hartley and Fina 2001b). To ensure that catch is monitored, fishermen are required to communicate to NOAA Fisheries by radio their approximate catch at least 6 hours before landing. The requirement is particularly troublesome for small vessels that make short day trips, as it forces some to approximate their catch before leaving the port. However, the requirement provides monitoring agents with the opportunity to be onsite at the time of landing. Dockside monitoring has also been simplified by requiring that all buyers be registered with NOAA Fisheries. Buyers are required to report all purchases to NOAA Fisheries through an automated system that records prices and weights of deliveries.

Substantial public funding was required at the outset of the IFQ program. Implementation and management costs for the Restricted Access Management office—the entity established by NOAA Fisheries to manage the program—and NOAA Fisheries enforcement costs were \$4.6 million in the year of implementation (NRC 1999a). The MSA provides for cost recovery measures that can impose a fee on quota holders of up to 3 percent of the ex-vessel value of IFQ landings. Total fee collections cannot exceed the annual cost of management and enforcement. Such measures were implemented for the sablefish and halibut IFQ program in 2001. Seventy-five percent of fee payments are deposited in the Limited Access System Administrative Fund and made available to NOAA Fisheries to offset costs of management and enforcement of the halibut and sablefish IFQ program. Direct program costs remained almost the same for FY 2001 (\$3,430,357) as for 2000 (\$3,474,111) (NMFS 2002b). More pounds of halibut, and almost the same amount of sablefish, were landed in 2001 as compared with 2000. The FY 2001 fee percentage increased to 2.0 percent from 1.8 percent in the prior year due to a decreased ex-vessel value of fish in 2001.

The MSA also authorizes NOAA Fisheries to collect a fee to recover the costs directly related to the management and enforcement of a CDQ program. To date, no fees have been collected by NOAA Fisheries to administer the western Alaska CDQ program. However, the State of Alaska collects fees to defray the costs of administering this program.

IFQ programs have been criticized for increasing the incentive for fishermen to operate illegally (Buck 1995). For example, with an IFQ program, each fisherman personally benefits from quota busting (i.e., under-reporting the quantity of fish landed). While some reports of unreported catch have been received by enforcement agents for the sablefish IFQ program, the problem is believed to be minor (Matthews 1997). In addition, the program is thought to have increased fishermen's interest in fishery enforcement by NOAA Fisheries personnel who monitor IFQ landings and created some self-monitoring. Quota shareholders have an incentive to report on each other, since cheating directly harms individual quota holders. Fishermen now consider violations by other fishers as devaluing their interest in the fishery by reducing the TAC in future years (Matthews 1997). U.S. Coast Guard enforcement costs for vessels and aircraft for the IFQ program increased from \$7.3 million in 1994 to \$25.5 million in 1995 but declined to \$10 million by 1997 (NRC 1999a). However, Coast Guard search and rescue operations for the halibut and sablefish fisheries decreased dramatically to about one-third the level prior to IFQ management (Hartley and Fina 2001b).

New catch accounting requirements established for the western Alaska CDQ program and AFA pollock cooperatives required an increase in observer coverage. At least two observers are required aboard each vessel. The cost of having two observers on board at all times probably exceeds \$710 per day (2 x \$355 per deployment day, not including food costs) for each vessel.

In addition to the additional observer coverage, flow scales and observer sampling stations equipped with motion-compensated platform scales are required of catcher processors participating in CDQ fisheries and AFA-eligible catcher processors. Recently, NOAA Fisheries estimated the purchase price of a flow scale to be about \$45,000; a motion-compensated platform scale is about \$4,000 (Alan Kinsolving, NOAA Fisheries, personal communication, January 2003). Annual service costs were estimated to be \$2,000. If modification of the vessel is not necessary or minimal, the costs of installation would be around \$4,000, with most or all of the work being done by crewmembers. If extensive reconfiguration of the vessel is necessary (e.g., shifting RSW tanks), installation costs could be up to \$250,000, although NOAA fisheries indicates that costs should not exceed \$30,000 in most cases. NOAA Fisheries also noted that the installation of scales might reduce

vessel production, particularly if processing equipment has to be relocated, and that there is the potential for lost fishing time should the scales stop working.

Finally, during the implementation of a rights-based management program, public and private costs may be incurred adjudicating evidentiary and fairness issues to make the initial determination of who will be included. In the sablefish IFQ program, the importance of the initial allocation was increased because of restrictions on transferability of quota shares (Hartley and Fina 2001a). Yet, only 179 applicants—fewer than 3 percent of the total—appealed the decision made in the technical review. More than half of the appeals challenged determinations of eligibility for quota shares or challenged vessel ownership or lease interest conflicts. Only 10 of the appeals heard by NOAA have been subsequently appealed to the federal court system (Hartley and Fina 2001a).

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

4.1 Overview of Overcapacity Management Measures of FMP 2.1

FMP 2.1 would eliminate the LLP and moratorium, maintain the AFA pollock cooperatives, repeal the CDQ except for pollock and crab, eliminate the sablefish longline fishery IFQ program, eliminate the sablefish IFQ shares for communities, and cease further work on rationalization in the groundfish fisheries. The AFA pollock cooperatives and CDQ for pollock and crab would be maintained because they are statutorily mandated.

Because FMP 2.1 eliminates some of the current management measures designed specifically to control overcapacity, it is expected to substantially increase the level of excess harvesting and processing capacity in certain groundfish fisheries. The only groundfish fishery in which measures to control excess capacity are retained under this FMP is the BSAI pollock fishery. The fishery most likely to experience a dramatic increase in fishing capacity is the sablefish longline fishery. With elimination of the IFQ program, the fishery would revert to an open access condition and catch would be allocated by the race for fish. Given the relatively strong market for sablefish, it is likely that many new vessels will enter the fishery. The increased competition, in turn, will cause harvesters to expand their capacity in an effort to maintain or increase their share of the catch.

The changes in fishing capacity that will occur as a result of elimination of the LLP are less certain. The considerable latent capacity in the groundfish fisheries since implementation of the LLP indicates that resource stocks, market conditions, the regulatory environment or other factors have discouraged some holders of LLP groundfish licenses from becoming active participants in the fisheries. On the other hand, some fishermen who are not license holders would likely find the fisheries an attractive proposition if the LLP program was eliminated and the cost of obtaining a license was removed. In particular, a significant number of vessels currently restricted to fishing in state waters because they do not hold an LLP license would likely be tempted to enter federally-managed Pacific cod trawl and pot fisheries in the GOA. These fisheries could represent an attractive alternative to these vessels given the high ex-vessel price for Pacific cod and the poor market for salmon. Similarly, a number of vessels currently restricted to fishing for crab may be tempted to enter Pacific cod fisheries due to the decline of crab resources. Other groundfish fisheries could also experience an increase in fishing effort. For example, current participants in non-trawl Pacific cod fisheries, as well as any new entrants in those fisheries, may decide to upgrade their vessels in order to participate in the GOA pollock trawl fishery. In addition, some of the larger trawl vessels with area endorsements to harvest Pacific cod in the GOA are likely to shift part of their fishing effort to the BSAI fishery. Finally, elimination of the BSAI cod endorsement for fixed gear vessels is likely to result in an increase in effort in the relatively lucrative BSAI Pacific cod fishery. Owners of head-and-gut trawlers, for example, may be tempted to refit their vessels and enter the fishery during periods when trawling activity is slow. In summary, elimination of the LLP would probably result in an overall net increase in fishing effort in the groundfish fisheries, but it is difficult to quantify the likely increase in capacity.

4.2 Effects of Overcapacity Management Measures of FMP 2.1

4.2.1 Effects on Marine Mammals

FMP 2.1 would increase the total fishing effort in the Bering Sea and GOA groundfish fisheries, with incidental take of marine mammals expected to rise accordingly. However, the entanglement of marine mammals in derelict fishing gear does not have significant population level effects (NMFS 2001a), and this conclusion is not expected to change as a result of increases in fishing effort of the magnitude resulting from this FMP bookend.

Elimination of the IFQ program in the sablefish longline fishery is likely to increase interactions between this fishery and resident killer whale populations. Sablefish longline fishermen face depredation of hooked sablefish by killer whales. As fishermen retrieve their gear when fishing for sablefish, killer whales frequently pick sablefish off the hooks. A resumption of the race for fish is expected to restrict the ability of fishermen to adopt fishing practices (e.g., setting smaller amounts of gear) that reduce the depredation of harvests by killer whales.

An increased level of marine mammal prey disturbance is likely to occur under this FMP bookend. The impact on those marine mammals that utilize groundfish as prey species is a function of the target species, the amount of fishing activity, and the concentration of fishing activity in space and time (NMFS 2001a). Most notably, the race for fish that ensues under this FMP would decrease the temporal distribution of certain groundfish fisheries relative to FMP 1. A temporal concentration could, in turn, result in the local depletion of certain groundfish species. However, the species most likely to be affected (e.g., sablefish and Pacific cod) are of less consequence to marine mammals, as they comprise a small percent of their diet.

Other forms of disturbance to marine mammals that could result from increased fishing effort are largely unknown. Vessel traffic, nets moving through the water column or underwater sound production may all represent perturbations that could affect foraging behavior (NMFS 2001a). Data do not exist to determine the severity of any potential effects. Anecdotal evidence suggests that fisheries disturbance-related events are unlikely to be of consequence to the Steller sea lion population as a whole. For instance, vessel traffic and underwater sound production have long been features of the Bering Sea and GOA, at least over much of the twentieth century. Such circumstances prevailed before and after the decline of Steller sea lions, suggesting no obvious causal link (NMFS 2001a). Steller sea lions also appear to be tolerant of at least some anthropogenic effects, as noted by their attraction to fish processing facilities and gillnets, as well as their distributions in proximity to ports. Further, the eastern stock of Steller sea lions is increasing, despite anthropogenic activities throughout its range on the west coast of north America and particularly in southeast Alaska (NMFS 2001a).

4.2.2 Effects on Seabirds

Under FMP 2.1, longline effort is predicted to increase in the GOA. Consequently, an increase in the incidental take of northern fulmars in the GOA is predicted. However, this increase is likely to be small given the effectiveness of current measures to reduce the mortality of seabirds in longline fisheries. The incidental take of albatrosses, shearwaters, and gulls is not likely to change under this FMP bookend, as it appears that the amount of longline fishing effort does not play a key role in whether these species are taken (NMFS 2001a).

Annual trawl effort in the BSAI and GOA is predicted to increase under this FMP bookend. Consequently, it is anticipated that trawl incidental catch of alcids, gulls, and northern fulmars would increase relative to FMP 1.

The overlap of trawl and pot gear fisheries and Steller's eider critical habitat is relatively small and in limited geographic areas (NMFS 2001a). The effects of these gear types on the benthic habitat in these areas are not known, but an increase in fishing effort would not be expected to affect the Steller's eider at a population level.

4.2.3 Effects on Target Groundfish Species

In principle, FMP 2.1 could increase the degree of spatial and temporal concentration of groundfish catches because it expands the race for fish. For example, the removal of selected measures constraining capacity, as prescribed in FMP 2.1, could lead to excessive local harvest rates within a region. This is most likely to occur in the GOA, where the groundfish fisheries are primarily shore-based and the fleets are less likely to venture to distant regions to explore for alternative fishing locations. With the constant increase of new entrants in the sablefish longline fishery, fishing seasons will degenerate to several short seasons each year. Localized depletion and fishing in marginal areas will occur more often. In addition, the speed and brevity of the fishery will make it more difficult to predict when to close the fishery. In the eastern Bering Sea, the large shelf area, coupled with the AFA pollock cooperatives, would reduce the race to maximize shares of the seasonal TAC allocations, and incidences of localized depletion are less likely to occur.

4.2.4 Effects on Non-Target (Forage, Other, and Non-Specified) Species

An increase in fishing effort in the Pacific cod longline fishery in the BSAI would be expected to result in increases in skate and sculpin bycatch. Economic incentives to reduce the catch of these species would not change under this alternative.

4.2.5 Effects on Prohibited Species

Under this FMP bookend, the race for fish is expected to accelerate in some fisheries and be reinstated as the method of allocation in others. Consequently, prohibited species catch would be expected to increase, since fishermen will fish less cleanly if they are forced to fish in a hurried fashion and in areas where prohibited species catch is high. Catches of halibut, in particular, are expected to increase as effort increases in the Pacific cod and sablefish longline fisheries.

4.2.6 Economic and Social Effects

Impacts on the Fishing Industry

Under FMP 2.1, the BSAI and GOA groundfish fisheries are expected to continue to provide high and relatively stable levels of seafood products to domestic and foreign markets. However, FMP 2.1 will reimpose the use of the race for fish to allocate the annual TAC among competing fishermen in the sablefish fishery and possibly accelerate the race for fish in other groundfish fisheries by removing the LLP. The expected result is lower ex-vessel values due to a decrease in: 1) retention rates; 2) product utilization rates; 3) product quality; and 4) the ability of fishermen to take fuller advantage of seasonal demand for some

seafood products to prevent seasonal market gluts or to take advantage of seasonal differences in product quality. In addition, the race for fish is expected to increase both fixed and variable harvesting costs substantially by compelling fishermen to compete for the fish through applications of additional effort.

The overall impact of FMP 2.1 on the level of excess fishing and processing capacity will vary by fishery. The fishery most likely to be negatively affected is the sablefish longline fishery. FMP 2.1 will eliminate incentives to reduce excess capacity in the sablefish fishery. Therefore, we expect an increase in capacity in the long-term and a return to the former level of excess capacity (or beyond). The end result will be a sablefish longline fishery exhibiting numerous overcapitalization problems such as multiple, compressed fishing seasons, gear conflicts, market gluts, declining revenues, increasing fixed and variable costs, and an overall reduction in benefits to fishery participants. Other groundfish fisheries will experience these negative economic effects to the extent that FMP 2.1 creates or exacerbates overcapacity in those fisheries.

The economic impacts of FMP 2.1 may vary over time and across fishery participants. The first new entrants in the fisheries affected are likely to experience an increase in income (otherwise they would not enter the fisheries), while the fishermen already engaged in those fisheries will experience an income reduction due to the increased competition. As additional fishermen enter the fisheries, the race for fish will force fishermen to apply additional effort and costs will increase accordingly. In addition, competition for productive fishing locations would increase and catch rates will likely fall, translating into less harvesting revenue for any given effort level. Enterprises with high operating costs would be the first to feel the cost-revenue squeeze. Over the longer run, operations with high fixed costs would be disadvantaged by the reduced contribution margin of each fishing trip made. These negative economic effects are likely to cause some fishermen to exit the affected fisheries.

Impacts on Consumers

By expanding the race for fish, FMP 2.1 would impede the continuous flow of high-quality groundfish products, which, in turn, would prevent some potential consumer benefits from being attained.

Impacts on Communities

The impacts on communities from eliminating the sablefish longline fishery IFQ program are unclear because there is a lack of consensus on whether this rights-based system has had an overall positive or negative impact on coastal Alaska communities and the fishermen residing in those communities (Pautzke and Oliver 1997). However, the potential economic instability created in the affected fisheries will likely have an adverse effect on some fishing communities.

The repeal of the CDQ for species except for pollock and crab will clearly have a negative effect on the western Alaska communities participating in the CDQ program. The CDQ shares that would be lost represent about 25 percent of the total shares that were allocated to these communities in 2001. In 2000, the percentage of the total royalties generated by non-pollock and non-crab species was about 10 percent, or about \$4 million.

Impacts on Fishing Vessel Safety

The safety risk to fishermen is expected to increase under this FMP 2.1. The expanded use of the race for fish to allocate TACs among competing fishermen will contribute to the pressure on fishermen to operate farther from shore or in areas and seasons with more hazardous weather conditions.

4.2.7 Effects on Ecosystem

The effects of FMP 2.1 on the ecosystem are uncertain. The increase in fishing effort expected under this FMP and the consequent acceleration of the race for fish may increase the risk of local and temporal depletions that can be disruptive to ecosystems. However, specifying the increased level of risk or the impacts on the ecosystem is not possible with the information currently available.

4.2.8 Effects on Management and Enforcement

The elimination of the sablefish longline fishery IFQ program and LLP will lead to reduced costs for administration, monitoring, and enforcement. In addition, buyers and fishermen will experience a decrease in administrative burdens and costs on their operations.

4.3 Overview and Effects of Overcapacity Management Measures of FMP 2.2

FMP 2.2 is identical to FMP 1 in terms of measures to reduce overcapacity. Consequently, the predicted effects on the human environment are the same.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

5.1 Overview of Overcapacity Management Measures of FMP 3.1

FMP 3.1 expands the use of rights-based management for groundfish fisheries through programs such as individual or group-based (e.g., community or cooperative) quota systems. This expansion occurs on a fishery-by-fishery basis as needed. The sablefish longline and BSAI pollock fisheries currently operate under rights-based management in the form of the IFQ program and the AFA cooperatives. Thus, the effects of FMP 3.1 in terms of managing capacity in those fisheries would be the same as the effects of FMP 1.

One of the primary reasons for expanding the use of rights-based management is to prevent the build-up of excess harvesting and processing capacity or reduce excess capacity that already exists (NMFS 2001a). Excess capacity both contributes to and is the result of the race for fish, with its associated potential negative impacts on profitability, product quality, and safety. Rights-based systems, whether they allocate shares of the catch to individuals or groups, are incentive adjusting methods, in that they attempt to control capacity by creating economic incentives for owners of vessels to decrease their use of labor and capital rather than by directly regulating the level of fishing effort.

The implementation of additional IFQ programs that end the race for fish and allow transfer of quota shares would be expected to lead to some consolidation of quota to fewer vessels. The degree of consolidation would vary depending on the level of excess capacity, economies of scale and scope in harvesting, and rules that restrict transfer and accumulation of quota shares (NMFS 2001a)¹⁵. Similar consolidation could occur with expanded use of cooperatives or community quota programs. Some excess capacity (in the sense of an ability of vessels and processors to catch and harvest TACs in less time than a maximum season length would allow) could be expected to persist regardless of what type of additional rights-based measures are put in place. This is generally the case for a number of reasons: it is often not economically efficient to operate at maximum possible production levels; there are typically certain times of the year when it is more efficient and profitable to harvest and process fish; and alternative uses for fishing and processing capital are limited (NMFS 2001a).

5.2 Effects of Overcapacity Management Measures of FMP 3.1

5.2.1 Effects on Marine Mammals

FMP 3.1 focuses on enhancing the decision-making power of fishermen through expanded use of rights-based management systems, which inherently means they will modify their actions according to the prevailing circumstances (e.g., the abundance and distributions of fish in space and time). The experience with AFA cooperatives in the pollock fishery and IFQs in the sablefish longline fishery shows that fishing may be spread out temporally as a result of rights-based systems (NMFS 2001a). This can be expected to

¹⁵It is also important to note National Standard 4 of the MSA addresses the issue of concentration of quota by requiring that Councils allocate fishing privileges “in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.”

reduce the potential for local depletions of fish stocks and the associated negative impacts on marine mammals and other species.

Changes in the spatial pattern of fishing effort under an expanded rights-based management system could also be positive from the standpoint of protecting marine mammals if those changes disperse the fleets or move them away from important foraging areas (NMFS 2001a). Conversely, the changes could result in adverse impacts if they concentrate effort in space, coincident with foraging marine mammals. Overall, the degree of spatial concentration is expected to decrease because the opportunity costs associated with exploring alternative fishing grounds would be reduced relative to FMP 1.

5.2.2 Effects on Seabirds

To the extent that an expanded rights-based management system decreases fishing effort (e.g., reduction in number of hooks or trawl-hours per year) in the BSAI and GOA, a decrease in the incidental take of seabirds is predicted relative to FMP 1.

5.2.3 Effects on Target Groundfish Species

Experience with the AFA pollock cooperatives, sablefish IFQ program, and western Alaska CDQ program has demonstrated the benefits of such programs in preventing catch from exceeding annual TACs, particularly when a TAC is subdivided into smaller allowances by time and area (NMFS 2001a).

An expansion of rights-based management will likely disperse the groundfish fisheries over space and time. This could increase protection to target species by reducing the potential for localized depletion. Under IFQs or group-based quota systems, less fishing would occur in marginal areas and during less-than-optimal times, thus increasing protection to target species if less fishing results in lower catches of small fish. Exceeding the quota would be less likely with a cooperative or IFQ program than in the fast-paced, open access fishery. This would reduce the risk of overfishing target species. However, the way in which fisheries might be distributed in time and space under a cooperative or IFQ program is unknown (NMFS 2001a).

A potential negative effect of an IFQ system is that fisherman may have a heightened incentive to high-grade — by throwing less valuable fish overboard they can save their quota for more valuable fish. High-grading can result in incorrect inferences from landed catch (NRC 1999a). Not only would actual mortality rates be higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards). The occurrence of high-grading will depend on the conditions in each fishery. Fisheries in which high-grading is a concern seem to be characterized by substantial price differentials among fish sizes and/or relatively low costs of catching replacement fish (NRC 1999a).

Implementing rights-based systems, whether IFQs or group-based quota systems, presents special difficulties for fisheries in which multiple species are often caught together (NMFS 2001a). However, it also offers an opportunity to address the problem of target species discards in those fisheries provided individual quotas on bycatch are established (see discussion below on effects on prohibited species). If the ability of vessels to determine the species make-up of their catch is limited or costly, it will be necessary to have a flexible system in place that will prevent discard of fish for which the individual does not have sufficient quota or hold the individual accountable for the total catch. One option is to allow individuals to fish only when they

hold sufficient quota for all of the species that might possibly be taken on a given trip. This, however, may be needlessly restrictive and might make it impossible for the fleets to take the entire TAC of some jointly caught species unless there are provisions for transfer of quota shares with minimum transactions costs (NMFS 2001a).

Several options have been used in multi-species fisheries elsewhere with varying success (NMFS 2001a). The primary method used in New Zealand is to allow vessels to land catch for which they do not hold quota and forfeit it for a price set high enough to make it worthwhile for them to bring it in to port but low enough that they make no profit on it. This system is referred to as a deemed value system. One of the main objectives of this program in New Zealand is to assure fuller accounting of catch, but it also prevents waste of potentially valuable fish that might otherwise be discarded.

A second option would be for the authorities to set aside or purchase some share of the overall quotas of various species at the beginning of the season and allow individuals to lease quota shares at the time of landing for fish they land in excess of their quota landings. Still another option would be to allow individuals to buy or lease quota on the open market after landing fish. This should work well if the market for quota shares is flexible with minimum transaction costs. However, trades or leases of quota shares in small blocks would have to be allowed, which would complicate administration of the system (NMFS 2001a).

5.2.4 Effects on Non-Target (Forage, Other, and Non-Specified) Species

Experience with the cooperatives in the pollock fishery shows that reductions in bycatch can be achieved more easily than in a competitive TAC fishery because vessels are more willing to accept the reductions in target species catch rates that they may incur by moving to areas with lower bycatch rates or by using fishing techniques that reduce bycatch (NMFS 2001a). The penalty for reduced catch rates is lessened in two ways. First, reduced catch rates will no longer equate with a smaller share of total catch as they did under the race for fish since the vessel is assured of its “right” to catch a given quantity of fish. Second, vessels are likely to fish slower and catch less fish per tow in some fisheries in order to optimize the rate of flow of raw fish for the processing plant and/or to improve the quality of the fish.

However, the implementation of rights-based management systems may not necessarily result in a reduction in the bycatch of non-target species. If net returns can be increased by fishing in areas where catches of non-target species are high there is little economic incentive for fishermen to alter their fishing behavior. The individual fishermen reaps the full benefits of such fishing practices, while the environmental costs are spread across all members of society. These environmental costs are external to fishermen’s account of costs in the sense that they do not appear in their ledgers and, therefore, are not considered when fishermen calculate whether a particular fishing strategy is profitable.

On the other hand, rights-based management systems that include individual quotas on bycatch provide strong economic incentives to reduce bycatch because they “internalize” the external costs of that bycatch in the private returns of individual fishermen. Consequently, it would be worthwhile for each fisherman to take steps to reduce bycatch rates. There remains, however, the problem of estimating the annual TAC for a given non-target species. The population structure, reproductive rate, and other biological characteristics of a non-target species may be insufficiently known to determine what level of fishing mortality that species can tolerate without harm. To further complicate matters, this threshold may not be uniform from region to

region or over time, depending on the species in question. The effects of individual quotas on bycatch are discussed in more detail in the following prohibited species section.

5.2.5 Effects on Prohibited Species

Rights-based management systems could allow for more slowly paced fisheries, which could reduce the temporal concentration of prohibited species bycatch relative to FMP 1. In addition, incentives to avoid prohibited species bycatch might encourage fishermen to leave areas of high bycatch, thus potentially reducing spatial concentration relative to FMP 1.

However, because these are indirect effects of a rights-based management regime, it is difficult to predict the magnitude of change relative to FMP 1. Changes in the temporal or spatial concentration of the fisheries may do little to reduce prohibited species bycatch if prohibited species are widespread. Individual or group-based quotas for the target species may change the nature of the fishery little unless a rights-based management system to take specific amounts of prohibited species is also implemented. The structure of these bycatch rights would most probably mirror the structure of target species rights. They would be granted to individuals (or possibly cooperatives or community groups) in proportion to the quota shares they held and the expected relative bycatch rates associated with various species.¹⁶ With individual bycatch quotas, the costs to society of bycatch would be internalized by the individuals responsible for those costs and, therefore, it would be worthwhile for those individuals to take steps to reduce bycatch rates. The end result is an increased proportion of catch taken in the respective target fishery and correspondingly lower discard rates (NRC 1999a).

If bycatch of prohibited species could be reduced, total catches, and consequently revenues, would increase for some species where take of prohibited species had constrained fisheries. As with quotas in a multi-species fishery, there would likely have to be some contingency system for cases where quota holders still held target species quota but insufficient bycatch quota to match it. Vessels might be prohibited from fishing unless they held sufficient bycatch quota or they might be allowed to purchase bycatch quota after the fact or pay a fee in relation to the level of bycatch (NMFS 2001a).

5.2.6 Economic and Social Effects

Overview of Impacts on the Fishing Industry

The level and distribution of the benefits and costs of expanded rights-based management will vary by fishery and sector (NMFS 2001a). The extent of the gains will depend on the degree to which the race for fish had been leading harvesters and processors to sacrifice quality, produce lower value products, use more costly production processes, endure higher bycatch rates, or maintain excess capital and labor in order to increase production. Experience with rights-based programs in some Alaska groundfish fisheries and the continuing

¹⁶Individual bycatch quotas are expressly permitted in Alaska groundfish fisheries under Sec. 313(2)(A) of the MSA, which states, "Notwithstanding Section 303(d), and in addition to the authority provided in Section 303(b)(10), the North Pacific Council may submit, and the Secretary may approve, conservation and management measures which provide allocations of regulatory discards to individual fishing vessels as an incentive to reduce per vessel bycatch and bycatch rates in fishery, provided that (i) such allocations may not be transferred for monetary consideration and are made only on an annual basis; and (ii) any such conservation and management measures will meet the requirements of subsection (h) and will result in an actual reduction in regulatory discards in the fishery."

presence of a profit-dissipating race for fish in other fisheries suggest that improvements in the economic performance of the groundfish fisheries due to increased value and reduced costs may be substantial.

An extension of rights-based management to other groundfish fisheries is expected to increase the value of production for a variety of reasons (NMFS 2001a). Some increases in value can be expected as a result of the improved quality that can be achieved by more careful harvesting and handling practices (in a race for fish these time-consuming practices may be neglected because the opportunity costs are too high). For example, vessels may choose to make shorter tows to reduce the crushing of fish in the codend or may spend more time searching for larger, more valuable fish. Quality can be increased and costs reduced by better organization of deliveries of fish to plants to reduce delays in unloading. The value of production will also increase because processors have the time and incentive to make products of higher value, where previously they had focused on products that could be produced quickly or with lower quality fish. For instance, fillet production could replace round or headed and gutted product. Further increases in the value of production will be achieved as the harvest volume increases in fisheries (e.g., flatfish fisheries) that were previously constrained by PSC limits. Increases in harvest volume will be most notable if individual quotas on bycatch are established.

The costs of harvesting and processing are also expected to fall for a variety of reasons (NMFS 2001a). Individual vessels and processing facilities will have the opportunity to select the lowest cost combination of fishing and processing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost effective harvesting and processing operations. Fixed costs will be reduced by consolidating harvesting and processing operations and retiring or selling off vessels and processing equipment. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting and processing rights and on the level of excess capacity prior to implementation of remedial measures.

Impacts on Vessel Owners Including Owners of Catcher Processors

While either of the two (individual or group-based) categories of rights-based systems may benefit vessel owners, current vessel owners as a group are likely to benefit most from an IFQ program that allocates freely transferable and leaseable quota shares to vessel owners on the basis of catch histories. The overall increases in profitability for vessel owners will vary from fishery to fishery but are expected to be substantial in most cases.

Not all vessel owners will benefit equally and the relative benefits will depend on the formula that relates catch history to allocations (NMFS 2001a). If a substantial portion of the initial quota shares in an IFQ program is allocated to other groups (e.g., crew, processors, or community groups), vessel owners could potentially suffer an initial financial loss since they would have to purchase quota to undertake their historical level of fishing. Whether or not other gains in cost reduction or increased prices might offset the costs of acquiring quota could only be determined after the structure of the IFQ program and the allocation formula were determined, and even then it would be difficult to assess.

Cooperatives can also be expected to provide net benefits to vessel owners as a group. It appears that the AFA catcher processor cooperative has generated benefits similar to those of an IFQ program. However, the rules governing cooperatives will be very important in determining the distribution of benefits between catcher vessels and processors. It has been argued by catcher vessel owners in the BSAI pollock fishery that

the rules for AFA inshore cooperatives have actually hurt independent vessel owners financially. A report by Halvorsen *et al.* (2000) could not rule out this possibility. As this report explains, variations on the current rules of cooperatives that would allow smaller groups of catcher vessels to form cooperatives and easier movement between plants would tend to shift the balance of market power to catcher vessel owners. This shift, in turn, would increase their share of any net benefits resulting from increased efficiency and product value that might occur as a result of cooperative-driven rationalization. The overall gains to vessel owners that might be expected in terms of increasing the value of catch and decreasing harvesting costs are likely to be smaller with cooperatives than with IFQs if the ability of vessel owners to form and transfer between cooperatives, to sell or lease catch rights, and to freely choose their point of delivery is limited. Such limitations would inhibit consolidation and transfer of harvest and processing activities to the most efficient operations.

The impacts of community quota programs on vessel owners are even less clear. Some vessel owners might gain if communities, in turn, grant them catch rights that enable them to slow down and choose fishing times; however, there is the potential that others might be harmed financially if their current ability to harvest resources is curtailed and they need to buy or lease catch rights from communities. Even if a community grants catch rights at no charge, the profitability of the vessel owners could still be undermined if their freedom to choose which buyers they sell their fish to is limited by the community.

Impacts on Owners of Inshore Processing Plants

Owners of processing plants other than catcher processors have not been granted allocations of shares in prior rights-based fishery management programs in the United States, although such allocations may be granted under the Alaska crab fisheries rationalization program. Arguments have been made (e.g., Matulich and Sever 1999) that IFQ programs may lead to expropriation of quasi-rents from processors.¹⁷ This could result if excess processing capacity exists and there are no alternative uses for processing equipment. It is also possible that plant owners would share in the overall economic gains that could be made through fishery rationalization. The degree to which that would be true would depend on the level of excess capacity and the degree to which plant owners are engaged in competition with each other to gain market share. If processors are somehow guaranteed shares, they would naturally be more likely to benefit or less likely to suffer harm from implementation of an IFQ program (NMFS 2001a).

The structure of cooperatives can also affect the benefits that accrue to owners of processors from rights-based management (NMFS 2001a). Rules for cooperatives in the inshore BSAI pollock fishery currently restrict the ability of vessels to transfer between cooperatives and require members of a cooperative as a group to deliver 90 percent of their catch to one processor. Compared with cooperative rules that would allow for free movement of vessels between cooperatives, the present inshore cooperatives shift the balance of power in price negotiations toward the processors. In general, processors can be expected to benefit more from this type of cooperative structure, though the absolute distribution of profits created by the move to cooperatives in any particular fishery is not clear.

¹⁷ Quasi-rent is the difference between the selling price and the variable costs of a product.

Community fishery quotas might also provide protection to processors in small communities if the communities restrict the landing locations of their quotas (NMFS 2001a). However, if the program worked similarly to the current western Alaska CDQ program, communities could lease out quota to operations that processed elsewhere and local processors might be preempted.

In summary, rights-based systems have the potential to reduce the competitiveness of markets and shift the balance of market power between harvesters and processors (NMFS 2001a). Care must be taken to minimize threats to competitive markets and to avoid, or at least be aware of, shifts in market power that may result in income transfers between sectors. Ex-vessel markets for fish are already quite thin in most Alaska groundfish fisheries. Consolidation of harvest and processing sectors will make these markets thinner yet. The number of buyers competing for fish may be reduced to a few or a sole buyer in some cases if restrictions were to be placed on where fish can be delivered. The possible result would be a shift in income from harvesters to processors.

On the other hand, without restrictions on where or to what plants fish can be delivered, income transfers may move in the other direction (NMFS 2001a). The temporal spreading of fishing may cause processors to bid up prices in attempt to lower average costs by increasing the amount and duration of their processing. As Matulich and Sever (1999) points out, there is the potential under certain conditions that the quasi rents of processors may be expropriated by harvesters in this process. The possibility also exists that harvesters with sufficient shares of a given TAC might have enough market power to make monopoly profits by reducing output below the TAC. However, the danger of monopolistic practices is low, as groundfish are sold largely in international markets.

Impacts on Vessel and Processing Crews and Other Employees

Prior rights-based systems in Alaska and elsewhere in the United States have not allocated initial quota shares to vessel crews or other employees of fishing or processing companies. If any of these individuals were allocated shares under an IFQ program, they would be expected to make financial gains similar to those made by vessel owners receiving shares (NMFS 2001a).

If crewmembers are not allocated shares, it is uncertain whether they could expect their long-term earnings to rise or fall with an IFQ program (NMFS 2001a). In the halibut and sablefish IFQ fisheries, crewmembers have sometimes been expected to contribute toward the cost of quota shares used, but increases in the value of production have led to higher crew incomes. Whether crewmembers and other seafood industry employees are likely to share in the net gains in profitability that result from an IFQ program or other rights-based system will depend on the supply and demand for labor, and this is likely to vary by fishery and area.

One impact that is likely in any type of rights-based system is a decrease in the number of crewmembers and processing workers employed and an increase in the term of employment of the individuals who remain in the fishery. This is a natural consequence of the consolidation of fishing and processing activities to fewer vessels and plants that operate over a longer period of time.

Impacts on Communities

Rights-based systems can be expected to have some positive impacts on fishing communities, particularly those in Alaska (NMFS 2001a). Ending the race for fish should increase the economic stability of the fishing industry. If fishing is spread out more evenly over the year, short-term seasonal jobs that were often filled by out-of-state workers are likely to be replaced with more steady, sometimes year-round, employment opportunities that can provide a living for individuals and families that wish to live in Alaska year-round.

On the other hand, rights-based systems could lead to the preemption or reduction of fishing, processing, and shoreside support activities in some traditional fishing communities unless restrictions are implemented to inhibit or prohibit a geographic redistribution of landings (NMFS 2001a). This would be a natural consequence of consolidation in the industry as excess capital is scrapped or allowed to degenerate without replacement and production is shifted to more efficient operations. Even if reductions in harvesting and processing capacity were uniform across communities, one would expect a decrease in economic activities in fishery support sectors due to reductions in harvesting and processing capital. IFQ programs and cooperative programs can be designed to reduce or prevent this. Doing so could entail some sacrifice in overall efficiency gains, but this must be weighed against the social benefits of preserving traditional fishing communities.

Granting quota shares to community groups would be an alternative and more transparent way to assist traditional fishing communities in remaining involved in the fisheries or in providing them financial resources to develop new industries. Moreover, group-based systems may lead to a more optimal concentration and reallocation of quota shares in the sense that broader social considerations could be internalized (Gréboval and Munro 1999).

Impacts on Consumers of Groundfish Products

Rights-based systems can be expected to lead to increases in the average quality of a variety of fishery products originating from the Alaska groundfish fisheries (NMFS 2001a). The total catch of some species and the catch taken in target fisheries where discards rates are lower is also likely to increase as a result of decreased bycatch rates. There may be increases in fresh products relative to frozen products in some fisheries but probably to a much smaller degree than occurred in the halibut fishery under the IFQ program. Assuming that demand is not perfectly elastic, increasing the value of production leads to gains in consumer surplus that will accrue to seafood consumers in the United States. Changes in consumer surplus will also depend on the demand for different product forms if there are changes in product mixes. Consumers could be negatively affected if a rights-based system leads to a decrease in the competitiveness of markets. Such a decrease could result in higher seafood prices without accompanying increases in quality which, in turn, would reduce consumer surplus. The likelihood of this occurring depends both on the level of consolidation that might occur and the elasticity of demand for the particular species (NMFS 2001a).

Impacts on Fishing Vessel Safety

Rights-based systems of any kind are expected to improve safety by reducing the pressure to fish under dangerous conditions (NMFS 2001a). The race for fish creates incentives to fish farther from shore or in areas and seasons with more hazardous weather conditions and requires crewmembers to work for long stretches with little rest or sleep. Rights-based systems should slow down the rate of fishing and reduce the

financial penalty incurred by opting to stop fishing under unsafe conditions. The most important benefit of improved safety will be a decrease in fishery related injuries and loss of life. Other benefits include savings from not having to replace lost vessels and gear. Finally, significant improvements in safety, if they occur, should result in decreased insurance costs for industry (NMFS 2001a).

At the same time, it is important to recognize that rationalized fisheries do not necessarily guarantee improvements in safety for fishermen. Under an IFQ program, for example, market opportunities may still encourage fishermen to fish at times or in places that are unsafe.

Distribution Issues with Expanded Rights-Based Management

The economic and social impacts of expanded use of rights-based management in the groundfish fisheries will be largely determined by the initial allocation of quota shares. Whether shares of TACs are allocated to individuals, cooperatives, or communities, the basis for determining the allocation will undoubtedly be controversial (NMFS 2001a). The allocation mechanisms are likely to vary significantly, depending on the type of rights-based system or systems implemented.

If IFQ programs are expanded to additional fisheries, a wide variety of allocation mechanisms and formulas should be considered. Although past IFQ programs in the United States have allocated quota shares to vessel owners based on catch histories, other options should also be examined, such as those that attempt to incorporate objectives that maximize net benefits to society. For example, the criteria for initial allocation of quota shares could include a vessel's acceptance of conservation goals (NRC 1999a). Further, retention of shares could be contingent on the vessel's ability to pass a regular performance review. When allocating quota shares it is important to bear in mind that granting shares to individuals free of charge is likely to result in those individuals receiving substantial windfall gains (NMFS 2001a). These windfall gains may be construed as a transfer of wealth from the public to certain individuals since exclusive withdrawal rights to publicly owned resources are being gifted. Whether and to whom this wealth should be gifted is an important question that should be carefully considered.

It has been argued that vessel owners have invested their labor and risked their capital (and often their lives) to develop fisheries, and in return they should be given preferential access to those resources (NMFS 2001a). The problem with this position is that vessel owners as a group are only one element of a diverse collection of stakeholders who might be viewed as possessing a "right" to benefit from resources harvested in federally-managed fisheries (or from other resources directly or indirectly affected by those fisheries). Possible other stakeholders include, but are not limited to, skippers who are not vessel owners, vessel crew (on-board processing crew as well as fishing crew), processors, and individuals in communities that support fishing and processing operations. The NPFMC should consider whether and how these other stakeholders might be included in initial allocations of IFQ shares. Furthermore, the MSA requires the Council to consider the allocation of a portion of the annual harvest in a fishery for entry-level fishermen, small vessel owners, and crewmembers who do not hold or qualify for individual fishing quotas.

While recognizing that the MSA may currently restrict such actions, the NPFMC should also consider whether some or all of the IFQ shares should be sold or auctioned to allow the public to capture all or a share of the windfall gains created by the IFQ system (Macinko and Bromley 2002). A variety of tax mechanisms could also be used to capture a portion of the net economic returns that fish harvesting might generate and place them in the public coffer.

If cooperatives are expanded to other groundfish fisheries, the cooperatives themselves would likely be responsible for allocating quota shares among their individual members. However, a method of allocating among cooperatives is still required. The model used for AFA inshore cooperatives is to allocate catch shares based on the combined catch histories of the cooperative's members.

If quota shares are granted to communities, allocations might be based on the historic landings made in those communities and/or the pooled catch histories of the communities' residents. A variety of other formulas might be developed to meet particular social and economic objectives. Under the western Alaska CDQ program, allocations to CDQ groups are not fixed in order to allow flexibility in directing benefits and achieving community development goals. In such an arrangement, it is of paramount importance that the process for allocating community quotas be stable and transparent (NRC 1999b).

Whether quota shares are allocated to individuals, cooperatives or communities, it may be prudent to put in place mechanisms that will allow the nature of the fishing privileges to be altered (NMFS 2001a). A stable set of privileges and responsibilities with an extended timeframe is important to promote the efficiency and stability of the fishery, but it is also important to maintain administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of quota shares. One such mechanism discussed by the NRC (1999b) is referred to as the Australian drop-through system. In this system initial entitlements are defined and fixed for a long but finite period—30 years in certain Australia fisheries. Periodically, perhaps every ten years, a comprehensive review of these entitlements takes place and changes can be made to the set of rights and obligations. Shareholders can switch to this new set of entitlements (whatever is currently on offer) any time before the term of their old entitlements expired, at which time they would automatically exchange entitlements for the current set on offer. Switching to the new entitlement package locks in the right to guard those entitlements for the remaining life of that entitlement. Other systems of balancing stability with flexibility are possible—what is important is to strike the proper balance to protect the health and prosperity of the fishery and the authority of regulators to make appropriate management decisions in the best interest of the public (NMFS 2001a).

5.2.7 Effects on Ecosystem

The main predator/prey-related effects of FMP 3.1 would be to spread out the removal of either predators or prey over space and time due to the elimination of the race for fish. Fishing practices, such as the use of larger mesh sizes, might also be used to decrease the catch of less desirable (smaller) sizes of fish. This would tend to increase the removal of larger, more predatory fish from the system relative to FMP 1, potentially reducing any possible competition for prey with other predators (NMFS 2001a). Presumably, species that prey on adult groundfish would have a more stable population from which to draw food, potentially resulting in less extreme predator/prey population cycles. Lower catches of small fish would impact the amount of juvenile fish available to the ecosystem. Under FMP 3.1, more juvenile fish could interact in the predator/prey cycle. Shifts in these interactions are difficult to predict given the complex nature of food webs (NMFS 2001a).

Large changes in species composition would not be expected in the ecosystem because variability in affected groundfish species appear to be more driven by recruitment variability (NMFS 2001a). Reduced energy flow at higher trophic levels, which would shorten the food chain and decrease the lifespan of organisms (both of which may occur from fishery selectivity toward older fish), would be indicators of a more stressed, less mature ecosystem according to Odum (1985). No quantitative measures are available of the extent to which

these processes would be affected. However, the magnitude of this change relative to environmentally driven recruitment changes suggests that there would not likely be a large ecosystem impact in this regard.

FMP 3.1 might reduce the number of vessels participating in groundfish fisheries, but it could also spread the fishing effort over space and time. Consequently, FMP 3.1 may not provide any additional protection from the introduction of non-indigenous species relative to FMP 1.

It is also important to note that rights-based management systems can be structured in a variety of ways to achieve ecological objectives. Under these systems, individual users can be held accountable for resources they use and the costs, including some ecological costs, they impose. For example, individual bycatch quotas might be established in selected groundfish fisheries to reduce the catch of benthic invertebrates such as corals and sponges. Thus, FMP 3.1 could potentially internalize certain ecosystem costs that are not fully borne by fishermen. By holding fishermen accountable for ecosystem effects and imposing monitoring mechanisms to ensure that accountability, FMP 3.1 could also improve the response time to observed ecosystem changes relative to the current management system, which relies on the time-consuming process of regulatory amendments. The effects of individual quotas on bycatch are discussed in more detail in the previous section, which describes effects on prohibited species.

5.2.8 Effects on Management and Enforcement

Experience with the IFQ and western Alaska CDQ programs and AFA pollock cooperatives suggests that expansion of rights-based systems to other fisheries is likely to result in substantial increases in the costs of monitoring, enforcement, and administration. As rights-based systems are extended to other fisheries, NOAA Fisheries will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches of individual vessels. To do this adequately requires the use of increasingly sophisticated catch-monitoring tools, such as observer coverage, electronic reporting, vessel monitoring systems, and at-sea scales. Though these tools increase the quantity, quality, and timeliness of the data available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system.

For vessels delivering unprocessed fish to shore plants, monitoring catches poses potentially fewer but different problems than for catcher processors. The monitoring program for halibut provides a model for how this might be done. Vessels could be required to notify monitoring authorities several hours in advance of landing so that unloading could be observed, quantities measured and quota shares debited appropriately. This would require substantial increases in monitoring infrastructure and personnel, but it is difficult to quantify the levels without first deciding on both the specific structure of the rights-based program itself and also the monitoring scheme.

Enforcement of bycatch quotas is likely to be more difficult than target species quotas, especially if they are at the individual level, because there is no incentive for the catch to be brought to port unless discarding is difficult and costly. It seems likely that higher observer coverage would be required to monitor or discourage discarding, and current sampling procedures would have to be improved to provide more accurate and reliable estimates of bycatch. In addition to the added cost of paying observers (expected to be about \$355 per deployment day, not including food costs), some smaller vessels may have difficulty in providing berths for observers.

Vessels that process fish at sea pose additional problems since the product landed does not correlate exactly with the amount of raw fish caught. One way to accurately monitor catches of these vessels is to increase observer coverage so that accurate, officially sanctioned catch levels are recorded for each tow made by each entity. This requires having at least two observers aboard each vessel as is done with the western Alaska CDQ program and the AFA pollock cooperatives. The cost of having two observers on board at all times probably exceeds \$710 per day (2 x \$355) for each vessel.

In addition to the additional observer coverage under a rights-based management system, vessels would probably be required to install flow scales and observer sampling stations equipped with motion-compensated platform scales. Recently, NOAA Fisheries estimated the purchase price of a flow scale to be about \$45,000; a motion-compensated platform scale is about \$4,000 (Alan Kinsolving, NOAA Fisheries, personal communication, January 2003). Annual service costs were estimated to be \$2,000. If modification of the vessel is not necessary or minimal, the costs of installation would be around \$4,000, with most or all of the work being done by crewmembers. If extensive reconfiguration of the vessel is necessary (e.g., shifting RSW tanks), installation costs could be up to \$250,000, although NOAA Fisheries indicates that costs should not exceed \$30,000 in most cases. NOAA Fisheries also noted that the installation of scales might reduce vessel production, particularly if processing equipment has to be relocated, and that there is the potential for lost fishing time should the scales stop working.

An expansion of rights-based management systems would require additional agency resources to develop the process through which fishing rights are assigned; to adjudicate appeals about the assignment of fishing rights to individuals or groups; to administer the annual assignment of catch amounts and transfers of fishing rights; and to penalize people violating regulations. Efforts to develop individual quotas for non-target species face the problem of estimating an annual TAC. The development of TACs for additional species would require specific information about stocks that can be difficult and costly to obtain.

Cost recovery fees imposed on industry could partly offset management costs that would otherwise be publicly funded. While the MSA contains strict limitations on fees that can be levied on the fishing industry, Section 304(d) of the MSA authorizes NOAA Fisheries to collect a fee to recover the costs directly related to the management and enforcement of an IFQ or CDQ program. The fee can not exceed 3 percent of the ex-vessel value of fish harvested under any such program.

Cost recovery fees have been applied in the sablefish longline fishery IFQ program and may be developed for the western Alaska CDQ program. In addition, the AFA authorized a \$75 million loan to reduce fishing capacity in the BSAI pollock fishery, and NOAA Fisheries established an inshore fee system as the means of repaying the loan.¹⁸ The proceeds of the loan partly paid the cost of removing nine catcher processors (which the AFA specified) from all commercial fishing in the U.S. EEZ. Presumably, similar methods of implementing cost recovery fees could be applied to new rights-based systems whether quotas were given to individuals or groups.

A key issue to resolve under an expanded rights-based management system will be the management of State of Alaska parallel fisheries – fisheries within state jurisdiction that are opened concurrent with the federal season to allow vessels to harvest federal quota within state waters. For many of the groundfish fisheries this

¹⁸ In exchange for an increased share of the pollock quota, the inshore sector agreed to help pay the costs of decommissioning the vessels, with the inshore sector paying 6 cents for each pound of pollock it harvested (Felthoven 2002).

concurrent opening is necessary for their effective prosecution. A potential problem is that the state constitution may prohibit the enforcement of federal regulations within state waters. Furthermore, the state may be unable to delegate management authority over fisheries within state jurisdiction to NOAA Fisheries. Legal clarification of these potential constraints has been requested from the state.

5.3 Overview and Effects of Overcapacity Management Measures of FMP 3.2

FMP 3.2 closely resembles FMP 3.1 in terms of overcapacity measures, except the timing of implementing rights-based management systems is accelerated. The timing of implementation is an extremely important issue in expanding rights-based programs to other fisheries; whether to implement rights-based system for all groundfish species and TAC groupings at once or in an incremental fashion. Huppert *et al.* (1992) recommended setting allocations for all stocks at once to avoid cascading spillovers of effort and capacity into fisheries that are not subject to rights-based management. If this is not done, a complex system of sideboards will likely be required as it was for the AFA. The accelerated approach to implementing rights-based management systems adopted by FMP 3.2 is likely to mitigate these spillover effects and reduce the need for sideboard measures.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

6.1 Overview of Overcapacity Management Measures of FMP 4.1

FMP 4.1 includes all of the capacity reduction measures of FMP 1 plus effort-based measures (also referred to as input-based methods) to further reduce fishing capacity. These effort-based measures may include limits on trips, gear size, vessel size or vessel horsepower, or seasonal exclusive area registration. All of the effort-based measures attempt to control capacity by directly regulating the character, amount, or usage of various fishing inputs. Gear and vessel restrictions limit the type or quantity of those particular inputs. Seasonal exclusive area registration prohibits individual fishing units from operating outside a specified area each season, thereby restricting where inputs can be used. Trip limits restrict the extent to which inputs can be used by imposing a catch ceiling for an individual fishing trip. Trip limits are often accompanied by a limit on the frequency of landings, which restricts the duration of use of inputs.

Obviously, such measures would have to be associated with a restriction on the number of fishermen; otherwise, it is clear that no control is placed on total potential effort. The number of participants in the Alaska groundfish fisheries is currently capped by the License Limitation Program. But even if the number of fishermen is restricted, effort-based measures do little towards mitigating the race for fish, and fishermen will continue to have an incentive to fish harder in order to maintain or increase their share of the TAC. Moreover, while the measures considered here can severely restrict the type, amount or use of fishing inputs, experience in fisheries worldwide shows that, given time to adjust, fishermen will often find ways of increasing their fishing effort by substituting inputs that are not controlled. Consequently, FMP 4.1 may have little effect on the long-term dynamics of over-investment.

6.2 Effects of Overcapacity Management Measures of FMP 4.1

A wide array of possible measures may be implemented under FMP 4.1. Consequently, it is difficult to provide details on the types or magnitude of effects on the human environment. Given the uncertainty about what combination of measures might be implemented, illustrative examples of possible measures and their expected effects are provided.

6.2.1 Biological and Physical Effects

Seasonal exclusive area registration may increase the risk of local depletion of target species by requiring vessels to expend their entire fishing effort in a single defined area. On the other hand, trip limits may decrease the risk of local depletion of target species by spacing out catches over time. However, trip limits can also lead to an increase in discards of target species. As with IFQs, trip limits heighten the incentive to high-grade catches since fishermen want to ensure that only the highest-priced portion of the catch is landed and counted against the limit. Furthermore, fishermen will be required to discard target species when their catch exceeds the trip limit (NRC 1999a). The level of discards can exceed those under an IFQ program, as discarding of excess catch would occur during every trip rather than once per year.

6.2.2 Economic and Social Effects

Fishermen can expect to face increased costs under FMP 4.1, as effort-based methods are designed to increase the cost of producing effort for individual fishing units by prohibiting certain cost-effective ways of operating (Anderson 1989). To adjust to these imposed inefficiencies, fishermen will continue to increase their outlays on doing whatever is permitted to maintain or increase their share of the catch. These permitted adjustment costs may include expenditures not only on vessel and gear improvements or storing fish on board longer, but also on re-equipping their vessels to make them usable in other fisheries (Scott 1979).

While it is difficult to generalize about the impacts of effort-based measures on other sectors of the fishing industry, the predicted effects of some measures can be easily identified. A trip limit, for example, would be expected to extend the supply of fish to processing plants (and consumers) through a greater part of the year like an IFQ fishery (NRC 1999a).

Effort-based measures are often redistributive, that is, they tend to be protective of certain groups (Scott 1979). Vessel and gear restrictions may, in fact, be designed to protect the economic position of the small-boat fleet by reducing gear conflict and catch competition between small, owner-operator fishing enterprises and those that are highly capitalized. Other measures may have unintentional distribution effects. For example, if trip limits are uniform across the fishery, they may have negative distributional consequences for larger vessels (NRC 1999a).

Because effort-based measures require fishermen to use inefficient fishing methods and do little to reduce their impulse to intensify their fishing operations by, for example, operating farther from shore or in areas and seasons with more hazardous weather conditions, the safety risk to fishermen is expected to remain high under FMP 4.1.

Effort-based measures can be relatively simple to design and enforce (NRC 1999a). The problem is that they must be made progressively restrictive over time in an attempt to counter the effects of intensified fishing. Given time to adjust, fishermen can often make technological improvements or modify fishing methods to get around the input restrictions. Therefore, to keep effort at specified levels, further restrictions will be necessary. Fishery management can thereby become a race between the fishermen to circumvent induced inefficiencies and the managers to impose further inefficiencies (Anderson 1986).

6.3 Overview and Effects of Overcapacity Management Measures of FMP 4.2

By setting the TAC for all groundfish species initially at zero, FMP 4.2 would effectively cause current industry participants to reach the most extreme point of overcapacity. Obviously, if no fish are available for harvest, any labor or capital allocated to the groundfish fisheries would result in excess capacity.

If the people and equipment that are displaced under FMP 4.2 shift to some underutilized fishery, or into an entirely different segment of the economy, society will not lose part of its productive capacity (Anderson 1986). However, some of the displaced effort may be transferred into a fishery already suffering from overexploitation or overcapacity. Furthermore, while mobility among fisheries can be high, alternative uses for fishing vessels are quite limited (Cunningham and Gréboval 2001). These effects would prevail until each Alaska groundfish fishery was subjected to an environmental review and, based on the results of that review, permitted to operate under strict guidelines. Only fisheries certified by NOAA Fisheries to have no

significant adverse effects on the environment would be authorized to operate in the EEZ off Alaska. Such a review and certification process would likely take up to two years based on the length of a recent environmental review of the Alaska pollock fishery conducted by an international organization.

Section 7 Opportunities for Quantification

The following numerical data would support the analysis of the effects of the alternatives as they relate to overcapacity in the Alaska groundfish fisheries. Historical data are needed to compare the status of various fisheries before and after implementation of existing overcapacity reduction measures. This data would also provide a benchmark that would allow before-and-after comparisons if alternative measures are implemented. The five programs and their currently available data are outlined below.

License Limitation Program

- Number of participants in groundfish fisheries by vessel and processor class, 1992-2001.
- Estimate of current excess capacity in groundfish fisheries by vessel class and target species.
- Estimate of current latent capacity of inactive vessels by vessel designation, length category, gear type and area endorsement.
- Average sale price of groundfish license by vessel designation, length category, gear type and area endorsement, 1995-2001.

Sablefish Longline Fishery IFQ Program

- Number of holders of sablefish IFQs by size of holding in pounds (less than 5,000; 5,001 - 10,000; 10,001-25,000; greater than 25,000) by FMP area, 1995-2001.
- Number of sablefish IFQs sold/leased, 1995-2001.
- Number of crewmembers who have qualified and number who have obtained sablefish IFQs, 1995-2001.
- Number of unique longline vessels that have reported landings of sablefish by FMP area, 1995-2001.
- Average sale price of sablefish IFQs and average lease rate of sablefish IFQs, 1995-2001.
- Ex-vessel price of sablefish, 1992-2001.
- Groundfish discard rate and non-target discard rate.
- Quantitative measure of spatial and temporal distribution of fishing effort (or catch), 1992-2001.

AFA Cooperatives

- Average lease rate of catcher vessel co-op IFQs, 1999-2001.
- Average lease rate of catcher processor vessel co-op IFQs, 1999-2001.
- Product utilization rate for catcher processors, 1992-2001.
- Quantitative measure of spatial and temporal distribution of fishing effort (or catch), 1992-2001.

Western Alaska CDQ Program

- CDQ allocation percentages by species and CDQ group, 2001-2002.
- CDQ allocation amounts by species and CDQ group, 2001.
- CDQ group revenues, expenses and net income, 1992-2000.
- CDQ group royalty income, 1992-2000.
- CDQ employment and wages for all CDQ groups, 1992-2000.

Sablefish Longline Fishery Community Quota Shares

Comparison of quota share holdings in eligible Gulf communities and larger Gulf communities at initial issuance and year-end 2000.

Section 8 Data Gaps and Information Needs

Accurately measuring and monitoring harvesting and processing capacity in a particular fishery can be complex. Additional information is needed on the quantities of capital equipment purchased and maintained by plants and vessels, their activity levels in various fisheries, and variable input use (for items such as labor, fuel fishing gear, and other essential inputs).

There is insufficient data to comprehensively assess the economic consequences of existing or expanded measures to control excess harvesting and processing capacity. While detailed data on the distribution of catch and processing are available, baseline information on the current economic performance of the fisheries is lacking. The types of economic data that would be necessary include disaggregate cost and employment information from harvesting and processing firms. No data on the costs of production and very little data on employment levels are routinely collected. Without information about costs, it is not possible to determine whether the industry is making a profit or a loss, much less the magnitude of the profit or how it has been, or might be, affected by management measures related to overcapacity. The absence of employment data means that it is not possible to state the number of individuals who are employed in the fishery, their earnings, or how they are affected by management measures.

Mandatory reporting of cost and employment information is important whether measures to control overcapacity are expanded or not. However, implementation of additional measures, is likely to result in substantial changes in the overall profitability of Alaska fisheries and in the distribution of benefits. Observing those changes is important in judging the success of overcapacity reduction measures and in identifying, and potentially ameliorating, undesirable outcomes. Moreover, simply monitoring capacity in a given fishery requires cost data that is not currently being collected. Typically, the analysis of harvesting or processing capacity and capacity utilization is based on the cost structure of vessels or shoreside processing plants and examines whether the observed level of fish caught or processed coincides with the lowest-cost level given the capital stock (NMFS 2002c).

Also directly linked to the issue of capacity reduction is the level of industry consolidation that may occur after a rationalization program is implemented. At present, insufficient vessel and processing facility ownership data are being collected to monitor structural changes not reflected directly in performance- or profit-based measures, such as changes in concentration of domestic and foreign ownership in the harvesting and processing sectors, the structure of ownership (including proprietorships, publicly traded corporations and privately held corporations) and the relationships both within firms (i.e., the amount and nature of vertical and horizontal integration) and among firms (NMFS 2002c).

Section 9 Comparative Analysis of Alternatives

Table 1 summarizes the anticipated effects of different approaches toward managing harvesting and processing capacity in the Alaska groundfish fisheries as described in the associated FMP bookends.

The following table summarizes the effects of each policy alternative in terms of managing harvesting and processing capacity in the Alaska groundfish fisheries as determined by analyses of each alternative's associated FMP framework.

Alternative 1: With respect to overcapacity in the groundfish fisheries, an objective of this alternative is to continue to reduce excess fishing capacity, overcapitalization, and the adverse effects of the race for fish. Under this alternative, a Licence Limitation Program for groundfish vessels over 32 ft length over-all (with certain jig gear exceptions) and a moratorium on entry into the groundfish fisheries is in place for the BSAI and the GOA. An IFQ program is in place for sablefish in the BSAI and GOA, which includes provisions for community purchase of quota share. In the BSAI, the directed fishery for pollock is organized into cooperatives as authorized under the American Fisheries Act. A multi-species CDQ program apportions 7.5-10 percent of all BSAI groundfish quota to 65 eligible western Alaska communities. However, considerable excess capacity is expected to remain in some groundfish fisheries under this alternative

Alternative 2: This alternative and its associated FMP framework would maintain the statutorily mandated programs to reduce excess capacity and the race for fish. Under FMP 2.1, the federally-mandated effort limitation program enacted under the American Fisheries Act would remain in place, with its adjunct CDQ allocation, but all other effort limitation programs (such as the sablefish longline fishery IFQ program and the Licence Limitation Program) would be repealed. Elimination of the sablefish IFQ program under FMP 2.1 is expected to result in a return to pre-program levels of fishing capacity or higher. Elimination of the LLP is predicted to result in a significant increase in fishing effort in some groundfish fisheries, but the increase in capacity is uncertain. The effects of FMP 2.2. on overcapacity are identical to those of Alternative 1.

Alternative 3: Regarding the issue of overcapacity, this FMP framework would maintain the LLP program and further decrease excess fishing capacity and other adverse effects of the race for fish by eliminating latent licences and extending programs such as community or rights-based management to some or all groundfish fisheries; provide for adaptive management by periodically evaluating the effectiveness of rationalization programs and the allocation of property rights based on performance; and, to support fishery management, extend the cost recovery program to all rationalized groundfish fisheries. FMP 3.1 would effectively reduce excess harvesting and processing capacity in selected fisheries through programs such as individual or group-based quota systems. By setting individual or group allocations for all stocks at once, FMP 3.2 would avoid spillovers of effort into fisheries not subject to rights-based management.

Alternative 4: A goal of this alternative, as expressed through its FMP framework, is to include the use of explicit allocative or cooperative programs to reduce excess capacity and allocate fish to particular gear types and fisheries. FMP 4.1 would supplement current measures to control capacity with effort-based regulations. However, the effectiveness of such regulations in further reducing excess capacity may be limited because they do not remove the incentives that lead to overcapacity in the first place. By setting the TAC for all groundfish species at zero until such time that fisheries are certified as having no significant adverse effects on the environment, FMP 4.2 would effectively cause current industry participants to reach the most extreme point of overcapacity. Some of the displaced effort may be transferred into a fishery already suffering from overexploitation or overcapacity.

Table 1. Summary of the effects of the alternatives on overcapacity.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Ecosystem						
No effect Fishing activities currently managed under the existing Fishery Management Plans (FMP) are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	Potentially adverse effect Since areas presently closed to bottom trawling would be opened, there could be localized areas of disturbance as a result of concentrated fishing effort.	No effect Fishing activities currently managed under the existing FMPs are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	No effect Fishing activities currently managed under the existing FMPs are not expected to greatly reduce the structural integrity and complexity of the benthic habitat.	Beneficial effect Since more area will be closed to bottom trawling and a greater percentage of the fishable area will be designated as no-take marine reserves, fewer impacts on the substrate will be realized as compared to the current FMPs.	Beneficial effect This FMP closes additional deeper areas to trawling, and provides for a higher percentage of no-take marine reserves. Therefore, there should be less impact on the physical environment across a wider range of depths and habitats.	Potentially adverse/ beneficial effect There would be no negative effects from fisheries on the physical environment while fishing is suspended. Only those fisheries that have no adverse effects on the environment will be allowed to resume. Displaced fishing effort could have indirect adverse effects.

Table 1 (cont.). Summary of the effects of the alternatives on overcapacity.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Biological Environment						
Beneficial effect Decreased fishing effort in sablefish longline fishery will continue to decrease interactions with marine mammals and seabirds. Increased dispersal of fishing effort in sablefish longline fishery and Bering Sea and Aleutian Islands (BSAI) pollock fishery may decrease marine mammal prey disturbance. The decreased risk of total allowable catch (TAC) overruns and localized depletion of target species in sablefish longline fishery is expected to continue.	Adverse effect Increased fishing effort in sablefish longline fishery may result in increased interactions with marine mammals and seabirds. An increased level of marine mammal prey disturbance is likely due to concentration of fishing effort. There may be increased risk of TAC overruns and localized depletion of target species in some fisheries.	Same effects as FMP 1.	Beneficial effect Decreased fishing effort in rationalized fisheries is expected to result in decreased interactions with marine mammals and seabirds. Increased dispersal of fishing effort may decrease marine mammal prey disturbance. Decreased risk of TAC overruns and localized depletion of target species is expected. Discards can be decreased if all target species catch is counted against individual quotas and individual bycatch quotas for non-target species are implemented. Positive ecosystem effects could result if fishing effort becomes more dispersed over time and space.	Same effects as FMP 3.1 but implementation of comprehensive rights-based management system is accelerated.	Potentially adverse/beneficial effect Effort-based measures to further reduce fishing capacity will not eliminate incentives to maintain excess capacity. Seasonal exclusive area registration may increase risk of local depletion of target species by requiring vessels to expend their entire fishing effort in a single defined area. However, trip limits may decrease risk of local depletion of target species by spacing out catches over time. Trip limits can heighten the incentive to high-grade catches since fishermen want to ensure that only the highest-priced portion of catch is counted against the limit.	Potentially adverse/beneficial effect There would be no negative effects from fisheries on the physical environment while fishing is suspended. Only those fisheries that have no adverse effects on the environment will be allowed to resume. Displaced fishing effort could have indirect adverse effects.

Table 1 (cont.). **Summary of the effects of the alternatives on overcapacity.**

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Economic and Social Effects						
Beneficial/ adverse effect The relatively efficient allocation of capital and labor is expected to continue in the sablefish longline fishery and BSAI pollock fishery but some groundfish fisheries will remain overcapitalized . Increased profitability in the sablefish longline fishery and BSAI pollock fishery is expected to continue due to decreased costs and/or increased revenues. There may be fewer crew jobs in the sablefish longline fishery, but remaining jobs are likely to be more stable. Reductions in sablefish QS and landings may occur in some Alaska communities, but increases may occur in others. The improved vessel safety in the sablefish longline fishery is expected to continue.	Beneficial/ adverse effect The profitability of some groundfish fisheries is expected to increase (at least in the short run) but the profitability of the sablefish longline fishery and possibly other groundfish fisheries will decrease. Consumers may experience a decrease in the availability of some fresh groundfish products. Safety risk to fishermen is expected to increase.	Same effects as FMP 1.	Beneficial/ adverse effect A more efficient allocation of capital and labor between fishing and other industries is expected. The profitability of rationalized fisheries is expected to increase due to decreased costs and/or increased revenues. Consolidation of fishing and processing activities may result in fewer jobs, but remaining jobs are likely to be more stable. Possible changes in market power between harvesters and processors may result in income transfers. Possible reductions or increases in landings may occur in some Alaska communities. Increases in the quality and availability of some groundfish products are expected, along with improvements in vessel safety.	Same effects as FMP 3.1 but implementation of comprehensive rights-based management system is accelerated.	Beneficial/ adverse effect Fishing costs are expected to increase, as effort-based methods prohibit certain cost-effective ways of operating. A trip limit would be expected to extend the supply of fish to processing plants (and consumers) through a greater part of the year. Effort-based measures tend to be protective of certain groups. For example, vessel and gear restrictions may be designed to protect the economic position of the small-boat fleet.	Adverse effect If the people and equipment that are displaced by the closure shift to some underutilized fishery, or into an entirely different segment of the economy, society will not lose part of its productive capacity. However, some of the displaced effort may be transferred into a fishery already suffering from overcapacity. All revenues, employment and income generated by the groundfish fisheries will be lost until such time that certified fisheries begin operating.

Section 10 References

- Anderson, L. 1977. *The Economics of Fisheries Management*. The John Hopkins University Press, Baltimore.
- Anderson, L. 1986. *The Economics of Fisheries Management (Revised)*. The John Hopkins University Press, Baltimore.
- Buck, E. 1995. Individual transferable quotas in fishery management. CRS Report to Congress 95-849.
- Alaska Commercial Fisheries Entry Commission (CFEC). 1999. Changes under Alaska's sablefish IFQ program 1995 to 1998. Alaska Commercial Fisheries Entry Commission, Juneau.
- Crutchfield, J. 1979. Economic and social implications of the main policy alternatives for controlling fishing effort. *Journal of the Fisheries Research Board of Canada* 36:742-752.
- Cunningham, S. and D. Gréboval. 2001. Managing Fishing Capacity: A Review of Policy and Technical Issues. FAO Fisheries Technical Paper 409, Food and Agriculture Organization, Rome.
- Darcy, G. and G. Matlock. 2000. Development and implementation of access limitation programs in marine fisheries of the United States. In R. Shotton (ed.), *Use of Property Rights in Fisheries Management*. FAO Fisheries Technical Paper 404/2, Food and Agriculture Organization, Rome.
- United Nations Food and Agricultural Organization (FAO). 1995. *Code of Conduct for Responsible Fisheries*. Food and Agriculture Organization, Rome.
- Federal Fisheries Investment Task Force. 1999. Report to Congress. Department of Commerce, Washington, D.C.
- Felthoven, R. 2002. Effects of the American Fisheries Act on capacity, utilization and technical efficiency. *Marine Resource Economics* 17:181-205.
- Felthoven, R., Hiatt, T. and J. Terry. 2002. Quantitative estimates of fishing capacity, capacity utilization, and fishery utilization for Alaskan commercial fisheries, 2001. NMFS Alaska Fisheries Science Center, Seattle.
- Ginter, J. and B. Muse. 2002. Rights-based fishery management systems in marine fisheries off Alaska. Paper presented at the 2002 IIFET meeting, Wellington, New Zealand.
- Government Accounting Office (GAO). 2000. *Commercial Fisheries: Entry of Fishermen Limits Benefits of Buyback Programs*. RCED-00-120, Government Accounting Office, Washington, D.C.

- Gréboval, D. and G. Munro. 1999. Overcapitalization and Excess Capacity in World Fisheries: Underlying Economics and Methods of Control. In *Managing Fishing Capacity: Selected Papers on Underlying Concepts and Issues*. FAO Fisheries Technical Paper. No. 386. Food and Agriculture Organization, Rome.
- Gulf of Alaska Coastal Communities Coalition. 2000. Community purchase of halibut and sablefish individual fishing quota shares discussion paper. Gulf of Alaska Coastal Communities Coalition, Anchorage.
- Halvorsen, R., Khalil, F. and J. Lawarrée. 2000. Discussion paper on inshore sector catcher vessel cooperatives in the Bering Sea/Aleutian Islands pollock fisheries. Paper prepared for the North Pacific Fishery Management Council.
- Hartley, M. and M. Fina. 2001a. Allocation of individual fishing quota in the Alaska Pacific halibut and sablefish fisheries. In Shotton, R. (ed.), *Case Studies on the Effects of Transferable Fishing Rights on Fleet Capacity and Concentration of Quota Ownership*. FAO Fisheries Technical Paper 411, Food and Agriculture Organization, Rome.
- Hartley, M. and M. Fina. 2001b. Changes in fleet capacity following the introduction of individual fishing quotas in the Alaskan Pacific halibut and sablefish fishery. In Shotton, R. (ed.), *Case Studies on the Effects of Transferable Fishing Rights on Fleet Capacity and Concentration of Quota Ownership*. FAO Fisheries Technical Paper 412, Food and Agriculture Organization, Rome.
- Hogarth, W. 2001. Testimony of William T. Hogarth, Ph.D., Acting Assistant Administrator for Fisheries, National Marine Fisheries Service, U.S. Department of Commerce, on capacity reduction programs and subsidies in fisheries before members of the Subcommittee on Fisheries Conservation, Wildlife and Oceans, Committee on Resources, U.S. House of Representatives, Washington, D.C., May 10, 2001.
- Holland, D., Gudmundsson, E. and J. Gates. 1999. Do fishing vessel buyback programs work: A survey of the evidence. *Marine Policy* 23 (1): 47-69.
- Huppert, D., Anderson, L. and R. Harding. 1992. Consideration of the potential use of individual transferable quotas in the North Pacific groundfish trawl fishery. Volume 2. Paper prepared for NOAA.
- Iudicello, S., Weber, M. and R. Wieland. 1999. *Fish, Markets, and Fishermen: The Economics of Overfishing*. Island Press, Covelo, Ca.
- Kinsolving, A., NOAA Fisheries, personal communication, January 2003.
- Kirkley, J., and D. Squires. 1999. Capacity and capacity utilization in fishing industries. UC San Diego Discussion Paper 99-16.

- Kirkley, J., C. Morrison Paul and D. Squires. 2002. Capacity and capacity utilization in fishing industries: Definition, measurement, and a comparison of approaches. *Environmental and Resource Economics*, forthcoming.
- Knapp, G. and D. Hull. 1996. The first year of the Alaska IFQ program: A survey of sablefish quota share holders. University of Alaska Anchorage, Institute for Social and Economic Research, Anchorage.
- Macinko, S. and D., Bromley. 2002. Who Own's America's Fisheries? Island Publications Services, Washington, D.C..
- Matthews, D. 1997. Beyond IFQ implementation: A study of enforcement issues in the Alaska Individual Fishing Quota Program. Silver Spring, Maryland.
- Matulich, S. and M. Sever. 1999. Reconsidering the initial allocation of ITQs: The search for a Pareto-safe allocation between fishing and processing sectors. *Land Economics* 75(2):203-219.
- National Fisheries Conservation Center (NFCC). undated. Industry restructuring overview: Fishing capacity. <http://nfcc-fisheries.org>.
- National Marine Fisheries Service (NMFS). 1996. Our Living Oceans: The Economic Status of the Fisheries, 1996. NMFS, Washington, D.C.
- NMFS. 1999. Report of the national task force for defining and measuring fishing capacity. NMFS, Washington, D.C.
- NMFS. 2001a. Alaska Groundfish Fisheries Draft Programmatic Supplemental Environmental Impact Statement. NMFS, Alaska Region, Juneau.
- NMFS. 2001b. Steller Sea Lion Protection Measures Final Supplemental Environmental Impact Statement. Appendix D: Market analysis. NMFS, Alaska Region, Juneau.
- NMFS. 2002a. Final Environmental Impact Statement for American Fisheries Act Amendments 61/61/13/8. NMFS, Alaska Region, Juneau.
- NMFS. 2002b. Annual report IFQ fee (cost recovery) program, Pacific halibut and sablefish individual fishing quota (IFQ) program. NMFS, Restricted Access Management Program, Alaska Region, Juneau.
- NMFS. 2002c. Objective measures, models, and necessary data: Discussion paper prepared for the Crab Data Group, August 19, 2002. NMFS, Alaska Fisheries Science Center, Seattle.
- National Research Council (NRC). 1999a. Sharing the Fish: Toward a National Policy on Individual Fishing Quotas. National Academy Press, Washington, D.C.
- NRC. 1999b. The Community Development Quota Program in Alaska. National Academy Press, Washington, D.C.

- North Pacific Fishery Management Council (NPFMC). 2001. Impacts of the American Fisheries Act. Report to Congress and the Secretary of Commerce. North Pacific Fishery Management Council, Anchorage.
- Northern Economics, Inc. 2002. An assessment of the socioeconomic impacts of the western Alaska Community Development Program. Report prepared for the Alaska Department of Community and Economic Development, Anchorage.
- Odum, E. 1985. Trends expected in stressed ecosystems. *Science* 35:419-422.
- Pautzke, C. and C. Oliver. 1997. Development of the individual fishing quota program for sablefish and halibut longliner fisheries off Alaska. North Pacific Fishery Management Council, Anchorage.
- Scott, A. 1979. Development of economic theory on fisheries regulation. *Journal of the Fisheries Research Board of Canada* 36:725-741.
- Scott, A. 2000. Introducing property in fishery management. In R. Shotton (ed.), *Use of Property Rights in Fisheries Management*. FAO Fisheries Technical Paper 404/1, Food and Agriculture Organization, Rome.
- Shotton, R. (ed.). 2001a. Case Studies on the Allocation of Transferable Quota Rights in Fisheries. FAO Fisheries Technical Paper 411, Food and Agriculture Organization, Rome.
- Shotton, R. (ed.). 2001b. Case Studies on the Effects of Transferable Fishing Rights on Fleet Capacity and Concentration of Quota Ownership. FAO Fisheries Technical Paper 412, Food and Agriculture Organization, Rome.
- Sigler, M. and C. Lunsford. 2001. Effects of individual quotas on catching efficiency and spawning potential in the Alaska sablefish longline fishery. *Canadian Journal of Fisheries and Aquatic Sciences* 58(7):1300-1312.
- Wertheimer, A. and D. Swanson. 2000. The use of individual fishing quotas in the United States' EEZ. In R. Shotton (ed.), *Use of Property Rights in Fisheries Management*. FAO Fisheries Technical Paper 404/2, Food and Agriculture Organization, Rome.
- Woodley, C. 2002. Quota-based fishery management regimes. In J. Lincoln, D. Hudson, G. Conway, and R. Pescatore (eds.), *Proceedings of the International Fishing Industry Safety and Health Conference*, DHHS (NIOSH) Publication No. 2003-102, National Institute for Occupational Safety and Health, Cincinnati.

This page intentionally left blank

APPENDIX F

Alaska Native Issues

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Alaska Natives Issues	F-9-1
1.1	Summary of Current Alaska Native Issues/Groundfish Management	F-9-2
1.2	How Management of Fisheries Has Evolved to Address Alaska Native Issues	F-9-4
1.3	Management Measures Used to Address Alaska Natives Issues	F-9-6
Section 2	Overview of Policy Alternatives	F-9-8
Section 3	Alternative 1: Continue Under the Current Risk-Averse Management Policy	F-9-10
3.1	Alaska Native Participation and Consultation in Fisheries Management	F-9-10
3.1.1	Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel	F-9-10
3.1.2	Public Involvement	F-9-10
3.1.3	Co-Management	F-9-12
3.1.4	Consultation and Coordination with Indian Tribal Governments	F-9-13
3.2	Traditional Knowledge	F-9-14
3.2.1	Definition of Traditional Knowledge and Collection Methods	F-9-14
3.2.2	Applicability of Traditional Knowledge to Fisheries Management	F-9-15
3.3	Alaska Native Participation in Groundfish Fisheries by Regional Setting	F-9-15
3.3.1	Community Development Quota Participation in Groundfish Fisheries ..	F-9-15
3.3.2	Non-Community Development Quota Regional Issues	F-9-16
3.4	Subsistence Issues	F-9-19
3.4.1	Effects on Groundfish Subsistence	F-9-19
3.4.2	Effects on Subsistence Use of Steller Sea Lions	F-9-19
3.4.3	Effects on Subsistence Salmon Fisheries	F-9-20
3.4.4	Indirect Impacts on Other Subsistence Activities	F-9-25
3.5	Alaska Native Environmental Justice Issues	F-9-29
3.5.1	Community Development Quota Region as Low-Income and Minority Population and Environmental Justice Related Impacts	F-9-29
3.5.2	Non-Community Development Quota Alaska Native Environmental Justice Issues	F-9-31
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-9-36
4.1	Alaska Native Participation and Consultation in Fish Management	F-9-36
4.1.1	Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel	F-9-36
4.1.2	Public Involvement	F-9-36
4.1.3	Public Review and Comment on Fishery Management Plans, Fishery Management Plan Amendments, and Environmental Impact Statement Documents	F-9-36
4.1.4	Co-Management	F-9-36
4.1.5	Government-to-Government Consultation Requirements	F-9-36
4.2	Traditional Knowledge	F-9-36

TABLE OF CONTENTS (cont.)

<u>Section</u>	<u>Title</u>	<u>Page</u>
4.3	Alaska Native Participation in Regional Fisheries by Regional Setting	F-9-37
4.3.1	Community Development Quota Regional Issues	F-9-37
4.3.2	Non-Community Development Quota Regional Issues	F-9-37
4.4	Subsistence Issues	F-9-37
4.4.1	Steller Sea Lion Subsistence	F-9-37
4.4.2	Salmon Subsistence and Bycatch Related Issues	F-9-37
4.4.3	General Ecosystem Concerns about Volume of Fishery Removals	F-9-38
4.4.4	Other Indirect Subsistence Impacts	F-9-38
4.5	Alaska Native Environmental Justice Issues	F-9-38
4.5.1	Community Development Quota as Low-Income and Minority Population	F-9-38
4.5.2	Non-Community Development Quota Alaska Native Environmental Justice Issues	F-9-38
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-9-40
5.1	Alaska Native Participation and Consultation in Fisheries Management	F-9-40
5.1.1	Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel	F-9-40
5.1.2	Opportunity for Public Comment	F-9-40
5.1.3	Co-Management	F-9-41
5.1.4	Consultation and Coordination with Indian Tribal Governments	F-9-41
5.2	Traditional Knowledge	F-9-41
5.3	Alaska Native Participation in Regional Fisheries by Regional Setting	F-9-42
5.3.1	Community Development Quota Regional Issues	F-9-42
5.3.2	Non-Community Development Quota Regional Issues	F-9-42
5.4	Subsistence Issues	F-9-43
5.4.1	Groundfish Subsistence	F-9-43
5.4.2	Steller Sea Lion Subsistence	F-9-43
5.4.3	Salmon Subsistence and Bycatch Related Issues	F-9-43
5.4.4	Other Indirect Subsistence Impacts	F-9-43
5.5	Alaska Native Environmental Justice Issues	F-9-44
5.5.1	Community Development Quota as Low-Income and Minority Population	F-9-44
5.5.2	Non-Community Development Quota Alaska Native Environmental Justice Issues	F-9-44
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-9-45
6.1	Alaska Natives and the Magnuson-Stevens Act	F-9-45
6.1.1	Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel	F-9-45
6.1.2	Public Involvement	F-9-45
6.1.3	Co-Management	F-9-45
6.1.4	Government-to-Government Consultation Requirements	F-9-46

TABLE OF CONTENTS (cont.)

<u>Section</u>	<u>Title</u>	<u>Page</u>
6.2	Traditional Knowledge	F-9-46
6.3	Alaska Native Participation in Regional Fisheries by Regional Setting	F-9-46
6.3.1	Community Development Quota Regional Issues	F-9-46
6.3.2	Non-Community Development Quota Regional Issues	F-9-47
6.4	Subsistence Issues	F-9-47
6.4.1	Groundfish Subsistence	F-9-47
6.4.2	Steller Sea Lion Subsistence	F-9-47
6.4.3	Salmon Subsistence and Bycatch Related Issues	F-9-47
6.4.4	General Ecosystem Concerns About Volume of Fishery Removals	F-9-48
6.4.5	Other Indirect Subsistence Impacts	F-9-48
6.5	Alaska Native Environmental Justice Issues	F-9-48
6.5.1	Community Development Quota as Low-Income and Minority Population	F-9-48
6.5.2	Non-Community Development Quota Alaska Native Environmental Justice Issues	F-9-48
Section 7	Summary Comparison of All Alternatives	F-9-50
Section 8	References	F-9-52

TABLES

Table 1.	Ethnic composition of population, selected Alaska Peninsula/Aleutian Island Region communities, 2000.	F-9-17
Table 2	1999 subsistence salmon household/permit totals by community, Yukon management area	F-9-22
Table 3	Historic subsistence salmon harvests: Yukon management area	F-9-22
Table 4	1999 subsistence salmon harvests by community Kuskokwim area	F-9-23
Table 5	Historic subsistence salmon harvest Kuskokwim area	F-9-23
Table 6	Alaska Native percentage of total community population, Alaska community development quota communities, 2000	F-9-30
Table 7	Community development quota group populations (2000)	F-9-31
Table 8	Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives	F-9-54

ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
AEB	Aleutians East Borough
ANILCA	Alaska Native Interest Lands Conservation Act
AP	Advisory Panel
BSAI	Bering Sea/Aleutian Islands
CDQ	Community Development Quota
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EIS	Environmental Impact Statement
EO	Executive Order
FMP	Fishery Management Plan
ft	feet/foot
GOA	Gulf of Alaska
IFQ	Individual Fishing Quota
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPS	National Park Service
PSC	prohibited species catch
Secretary	Secretary of Commerce
SEIS	Supplemental Environmental Impact Statement
TK	Traditional Knowledge or Traditional Ecological Knowledge
USFWS	United States Fish and Wildlife Service

Section 1 Alaska Natives Issues

Indigenous people of Alaska (Alaska Natives) have long utilized fishery resources, both for subsistence and commercial purposes. The groundfish and other commercial fisheries may interact with Alaska Native subsistence activities in a number of ways, and Alaska Natives are also directly engaged in the commercial groundfish fishery in other ways.

The subsistence harvest and distribution of fish that spend part or all of their time in the ocean has occurred since people have been present in Alaska. Of the more than 200 communities with federally recognized tribal governments in Alaska, a significant majority are located in coastal areas or along river systems that support anadromous fish that, in turn, form an important part of the subsistence base of those communities. Other important subsistence resources, such as marine mammals and seabirds, depend on marine and anadromous fish to some degree. Several groundfish species are utilized for subsistence purposes but, in general, their use is overshadowed in terms of relative importance by other fish (and non-fish) species.

In particular, salmon is an important anadromous subsistence resource for Alaska Natives. However, the continuing interception (incidental bycatch) of salmon originating in western Alaska river systems by domestic salmon fisheries targeting other salmon stocks continues to be an issue today. The Native issue of the direct interception of Pacific salmon that originate in western Alaska river systems by foreign fleets on the high seas was addressed at the highest levels of government and resulted in multi-level agreements and treaties with foreign nations. Such bycatch is a concern due to recent poor returns of maturing salmon to the western Alaska river systems. This has resulted in severe economic disaster declarations and severe restrictions on subsistence harvests. The impact of the salmon bycatch within the groundfish fishery itself on Native subsistence harvest is thought to be minimal, but remains an issue. It is being addressed by the Alaska Board of Fisheries, rather than the North Pacific Fishery Management Council (NPFMC), since National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) has little direct involvement in management of the salmon fisheries in Alaska, with the exception being in southeast Alaska.

Marine mammals, and Steller sea lions specifically, are also an important subsistence resource in a number of Alaska Native communities. The impact of commercial fishing activities on Steller sea lions is an issue of particular concern to Alaska Native communities in some areas but, as discussed at length in the main body of this Programmatic Supplemental Environmental Impact Statement (SEIS), the relationship between Steller sea lion population dynamics and commercial fishing activities is not entirely clear given existing data.

Alaska Native engagement in commercial fishing activities began soon after contact with the Russians, and deepened over the course of later interactions with Euro-Americans. This engagement includes owning fishing vessels and harvesting and processing fish. Alaska Native participation in commercial fishing in general, and the groundfish fisheries in particular, was further influenced by the establishment of the NPFMC Community Development Quota (CDQ) program for commercial offshore fisheries in the Bering Sea. The CDQ program established six regional non-profit Alaska Native corporations, representing 65 coastal area villages. These CDQ corporations were initially given a share of the commercial pollock harvest quota, and in later years the program was expanded to include other groundfish and non-groundfish species. Thus creating the opportunity for western Alaska communities to enter the fisheries in a number of different ways and reap the social and economic benefits of those fisheries. Direct engagement in commercial fisheries also

creates “joint production” subsistence opportunities for Alaska Natives, where the same vessels and gear utilized for commercial production may also be utilized for subsistence production.

The NPFMC recognizes the importance of fishery resources to Alaska Natives and has specifically included Alaska Native representation on both its Advisory Panel (AP) and the NPFMC itself. Through these representatives (and others), the concerns of CDQ groups, other Native fishermen, Native communities, and subsistence harvesters are raised during the fishery management decision-making process. Fishery management measures or fishery management plans (FMP) adopted by the NPFMC, as guided by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) (Public Law 94-256), directly or indirectly address issues of Alaska Native concern, such as use of CDQ revenue, salmon bycatch, and protection of Steller sea lions, which are subject to subsistence harvest.

Fishery management must comply with the National Environmental Policy Act (NEPA) of 1969. NEPA requires that potential effects of fishery management actions on the human environment including Alaska Natives be analyzed and, to the extent practicable, mitigated. This includes effects on subsistence, CDQ groups, non-CDQ Native fishermen, and fishing communities with Native populations. Executive Order (EO) 12898 (1994) on Environmental Justice requires that the potential for disproportionately high and adverse effects on minority populations (which include Alaska Natives) be analyzed. While not a part of NEPA, this analysis typically is undertaken during the NEPA process. In addition, EO 13175 (2000) on Consultation and Coordination with Indian and Tribal Governments requires that when there is a potential for federal action to significantly or uniquely affect Indian tribal governments, federal agencies must engage in timely and meaningful consultation with federally recognized tribal governments. This consultation requirement is addressed through the MSA and NEPA compliance process. The majority of the more than 200 federally recognized tribes in Alaska are located along the coast or river systems and can potentially be affected by fishery management decisions. Further, Alaska Native communities, like other communities, that are engaged in and dependent upon the fishery, are subject to the provisions of MSA National Standard 8, which guides fishery management toward fostering the sustained participation of traditional fishing communities.

Finally, Alaska Natives have observed changes in the environment and in the distribution and populations of fish and wildlife over many generations. The value of these observations has been increasingly recognized by western scientists and fishery managers as Traditional Ecological Knowledge (Traditional Knowledge or TK). Federal agencies responsible for managing lands, waters, fish, and wildlife are collecting Traditional Knowledge and incorporating it into NEPA compliance documents and management activities to varying degrees.

1.1 Summary of Current Alaska Native Issues/Groundfish Management

Subsistence

Steller Sea Lion

Steller sea lions are harvested by some Alaska Natives, primarily Aleut, communities. The decline in sea lion populations has affected subsistence harvest practices, and Alaska Natives have expressed concern about potential cause and effect between commercial groundfish fishing and the sea lion population decline.

Salmon Bycatch

Concerns continue to be raised by Alaska Natives on the effects of salmon bycatch in the Alaska groundfish fisheries on subsistence salmon harvests, particularly in the Yukon-Kuskokwim area.

General Ecosystem Health

Concerns have been expressed by Alaska Natives on the effects of commercial fishing and associated bycatch discards on the health of the marine ecosystem, particularly with regard to discards attracting fish and wildlife and causing disease in animals that eat discards.

Joint Production

Commercial fishing often provides overhead in terms of equipment and trip costs for subsistence harvest of fish or other resources. Changes in the location of commercial fishing infrastructure through closures and changes in allocation and other changes in fishery management that affect the viability of commercial fishing (through regulatory action) operations can have an indirect adverse affect on associated subsistence activities.

Alaska Native Participation in Commercial Fisheries

CDQ Fisheries

Approximately 65 western Alaskan Native communities participate in commercial fishing through six CDQ corporations. These corporations are allocated quotas for specific fisheries, which generate employment and revenue opportunities, and provide funds for economic investment in participating communities. Changes in allocation can create beneficial or adverse effects, depending on their nature.

Non-CDQ Fisheries

Alaska Native fishermen from several communities in the Aleutian Islands/Alaska Peninsula, Kodiak, southcentral Alaska, and southeast Alaska regions participate in groundfish fisheries as boat owners, crew, or fish processors. Commercial fishing is a major component of the economy in most coastal Native communities, and changes in management measures such as allocation, seasonal and spatial closures, and gear restrictions, would create beneficial or adverse effects, depending on their nature.

Economic Viability of Traditional Alaska Communities

The MSA and the NPFMC list maintaining community benefits from fishing as an objective. Many of the Alaska communities that participate in groundfish fisheries and derive municipal revenue from fishing-related activities are predominantly Native. Fishery management actions have a direct and indirect effect on the economic viability of many coastal Alaska Native communities.

Alaska Native Participation in Fishery Management

Level of Representation within the NPFMC

Although Alaska Natives currently have some representation on the AP and NPFMC, the limited number presents some difficulty in representing potentially competing interests between CDQs, non-CDQ Native fishermen, and subsistence users.

Co-management

Other federal and state agencies, notably the U.S. Fish and Wildlife Service (USFWS) and Alaska Department of Fish & Game (ADF&G), have instituted measures to increase Alaska Native participation in management of fish and wildlife. Some Alaska Natives have indicated an interest in some form of co-management of the Alaska groundfish fisheries.

Consultation and Coordination with Indian Tribal Governments

Opportunities for consultation have been provided to potentially affected tribal governments throughout the Programmatic SEIS preparation process. However, some commentors on the Draft Programmatic SEIS have asked for greater outreach.

Public Involvement

Like other members of the public, Alaska Natives have rights and opportunities to review and comment on preparation of an Environmental Impact Statement (EIS), as part of the NEPA process.

Other Issues

Environmental Justice

Actions taken in the management of groundfish fisheries could have disproportionately adverse effects on CDQ groups and other Alaska Natives participating in fish harvesting and processing.

Incorporation of Traditional Knowledge into Fishery Management

Alaska Natives have interacted with the natural environment for many generations, and have a body of knowledge based on their observations and those passed down from ancestors. Scientists and resource managers are recognizing the value of Traditional Knowledge in supplementing other sources of information. Efforts to collect Traditional Knowledge can range from a review of existing literature to key informant interviews in the field. Incorporation of Traditional Knowledge should provide appropriate citation of the source, and Traditional Knowledge should be presented with respect.

1.2 How Management of Fisheries Has Evolved to Address Alaska Native Issues

Since the Americanization of the fisheries during the 1980s, Alaska Native issues have become increasingly important in fisheries management. This trend reflects increased Native participation in groundfish fisheries and developments of EOs and MSA/NEPA compliance. Both NOAA Fisheries and the NPFMC have made

management decisions concerning the economic viability of Alaska communities relating to bycatch, protection of subsistence resources, and allocation to CDQ groups and other fishing/processing sectors where Alaska Natives are participants.

North Pacific Fishery Management Council

The NPFMC members from western Alaska have functionally, if unofficially, represented Alaska Native interests since approximately 1987. As Alaska Native participation in the fisheries has grown, the seat has represented a broader group of interests, such as CDQ corporations, and has made the unofficial Alaska Native representation role more complex for the incumbents. Alaska Native interests represented on the AP have also become more diverse during this time period, and are addressed through regional, community, CDQ, and conservation group members appointed by the NPFMC to sit on its AP.

NEPA Compliance and Related Regulatory Requirements

Amendments to the Alaska groundfish FMPs must comply with NEPA. In the late 1970s and 1980s, NEPA compliance documents such as Environmental Assessments and EIS addressed but did not expand upon Alaska Native issues. Alaska Native groups were given the same opportunities to comment on documents as other stakeholder groups, but were not targeted for additional outreach.

The enactment of Executive Orders on Environmental Justice and Consultation and Coordination with Indian Tribal Governments in the mid-1990s increased the focus on Alaska Native issues. These issues are often addressed as part of NEPA analysis. Greater attention has since been given to potential disproportionate adverse effects on Alaska Natives. Outreach efforts have increased to meet consultation requirements. Compliance with the NEPA process and related EOs provides a mechanism for encouraging participation in fishery management decision-making.

Analytical Emphasis on Socioeconomic Issues by NPFMC and NOAA Fisheries

Staff responsibilities have evolved to include oversight of issues associated with fishing communities and social impact assessments, which have Alaska Native components. NOAA Fisheries is also adding staff with responsibilities for addressing basic research in non-economic social sciences, and this may assist in addressing the concerns of Alaska Natives. This includes a cultural anthropologist position at the Alaska Fisheries Science Center.

CDQ Program and Community Protection in Fisheries Management

The CDQ program in the Bering Sea/Aleutian Islands (BSAI) was established in 1991. The intent of the CDQ program is to promote fisheries-related economic development in the coastal communities that participate in the CDQ program. CDQ corporations can lease out their shares of the quota, or harvest and process the share themselves. In addition to generating employment for Alaska Natives, revenue generated from use of quota shares must be used for economic development under specific guidelines established by the NPFMC. The first individual fishing quota (IFQ) allocations that occurred for sablefish and halibut were established by the NPFMC. The six CDQ corporations formed and as directed by NPFMC, developed plans for how quotas would be fished and revenue distributed. Quota for additional fisheries was allocated to CDQ groups as a part of the Inshore/Offshore 1 FMP amendments and subsequent amendments. The CDQ program now applies to multiple groundfish fisheries including pollock, Pacific cod, flatfish, Atka mackerel, rockfish, and

sablefish, as well as halibut and crab. Currently, the CDQ program is allocated 10 percent of the total allowable quota for pollock and 7.5 percent for most other species. Gulf of Alaska (GOA) FMP Amendment 66 has recently been approved by NPFMC and is designed to allow 42 eligible GOA coastal communities to participate in the fixed gear halibut and sablefish IFQ Programs.

Subsistence

Establishing the prohibited species catch (PSC) for salmon and herring and associated bycatch limits has been important to Alaska Natives for both commercial and subsistence fishing. Prior to the mid-1980s, bycatch limits were primarily aimed at foreign fleets; since the mid-1980s bycatch restrictions have focused on the domestic fisheries, with bycatch limits established for chum salmon, chinook salmon, various crab species, halibut, and herring. Since 1995, conservation efforts to reduce bycatch and waste in the groundfish fishery have continued, and retention and utilization programs have been revised and improved.

1.3 Management Measures Used to Address Alaska Natives Issues

Historically, federal management measures that address Alaska Native issues relating to fishery management of the Alaska groundfish fisheries have focused on representation on the NPFMC and its committees, consideration of issues and testimony by the NPFMC, and dedication of staff resources to address Alaska Native and community concerns. The number of seats on the NPFMC from Alaska is defined in the MSA, but representation has been based on informal factors such as geographic representation and interest group affiliation. In recent years, one seat has been filled by a western Alaska representative who functionally if informally served as a representative of Alaska Native interests, with a recent focus on CDQ interests. Other Native interests, such as Native-owned catcher vessels and subsistence users have also found a voice through at least limited representation by this seat on the NPFMC. Seats on the AP change every year. The NPFMC is charged with representing a variety of interests, including subsistence fishermen. There is generally at least one CDQ representative on the AP, who has also informally functioned at times as a representative for broader based Alaska Native related interests.

Other federal and state agencies have established regional and statewide advisory councils to provide Alaska Native input to resource managers. These agencies include the USFWS (national wildlife refuges, subsistence on federal lands), NPS, (use and access of parklands) and ADF&G (harvest regulations for fish and wildlife). In general, these advisory councils and commission members provide input on subsistence, take regulations, and general fish and wildlife management issues for terrestrial and anadromous resources, and in a few cases are decision-makers. With the exception of specific marine mammals and migratory waterfowl, there is little Alaska Native involvement in federal management of offshore fish and wildlife because there is very little subsistence in federal waters.

Both NOAA Fisheries and the NPFMC have recognized the importance of addressing socioeconomic issues, including the importance of community protection. In support of this endeavor the Alaska Fisheries Science Center has recently hired a cultural anthropologist who will focus on socioeconomic and community issues. The NPFMC also addresses CDQ and community issues in their staff analysis.

Alaska Native issues related to fishery management are addressed through the NPFMC public decision process. Both the MSA and NEPA compliance process requires that potential effects on Alaska Natives be adequately assessed during the federal decision-making process. The NEPA process requires that any potential management action analyze potential impacts on socioeconomic characteristics (employment, income, municipal revenue) and subsistence use of fish and wildlife resources as a part of the human environment. This analysis will generally also include a discussion of EO 12898 on Environmental Justice (1994) and EO 13175 on Consultation and Coordination with Indian Tribal Governments (2000). Through the public involvement process Alaska Natives, communities, or individuals can voice their concerns on the potential impacts of the proposed management changes.

The CDQ program provides another indirect tool for addressing Alaska Native issues. The CDQ program was established to provide benefits to predominantly Native western Alaska communities along the Bering Sea. Allocation of groundfish quota to CDQ groups provides benefits to Alaska Natives, through their participation in the fisheries and by generating revenue that can be used in communities for fishery related economic development. The NPFMC can influence these processes when adjusting quotas and ruling on types of eligible community economic development investments in Native communities.

Section 2 Overview of Policy Alternatives

The Programmatic SEIS evaluates the environmental consequences of four different policy alternatives. Each policy alternative contains a framework comprised of a management approach and a suite of policy goals and objectives. To assess the environmental consequences and highlight for the decision-makers and the public the tradeoffs of each policy alternative, we analyzed a range of management measures that illustrate how the framework could be implemented. Ultimately, the two example FMPs under each of the alternatives to the status quo illustrate the range of actions possible under each alternative and show the flexibility each alternative will allow the NPFMC to manage the fisheries adaptively.

The four policy alternatives under consideration by the NPFMC are chosen to serve as bookends to a management framework. They will serve as a means for the NPFMC to commit to a management decision.

Alternative 1 Continue Under the Current Risk-Averse Management Policy: Under this policy alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented.

This policy approach would continue Alaska Native involvement through MSA and NEPA mechanisms. Additionally, some effort will be placed on incorporating Traditional Knowledge on fisheries management.

Alternative 2 Adopt a More Aggressive Management Policy: This alternative represents a less precautionary management policy (i.e. more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known.

This policy approach would continue existing levels of Alaska Native consultation, and incorporation of Traditional Knowledge.

Alternative 3 Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management approach through community or rights-based management, incorporation of ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic or conservation needs and to address concerns over uncertainty. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species.

This policy alternative increased consultation with, and participation of Alaska Natives in fisheries management. While this policy continues to recognize the importance of Traditional Knowledge additional efforts would be initiated to increase collection and research.

Alternative 4 Adopt a Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, shifts the burden of proof from the resource to the user when faced with uncertainty and would impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns. More emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing does produce adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts.

With regards to Alaska Native issues, this policy alternative would initiate cooperative research programs and co-management in order to enhance use of Traditional Knowledge in fishery management, including monitoring and data gathering capabilities. Consultation with Alaska Natives would increase with a particular focus on subsistence users.

Section 3 Alternative 1: Continue Under the Current Risk-Averse Management Policy

3.1 Alaska Native Participation and Consultation in Fisheries Management

3.1.1 Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel

The NPFMC was established through guidelines set by the MSA of 1976 (Public Law 94-265). The MSA outlines the number of members and how they are chosen for the NPFMC. Section 302 of the MSA states “The NPFMC shall have 11 voting members, including seven appointed by the Secretary of Commerce (Secretary) in accordance with subsection (b)(2) (five of whom shall be appointed from the State of Alaska and two of whom shall be appointed from the State of Washington). These voting members must represent the principal state official with marine fishery responsibility, the regional director of National Marine Fisheries Service (NMFS).” Appointments are based on recommendations from the state governor or other individuals who, by reason of their occupational or other experience, scientific expertise, or training, are knowledgeable regarding the conservation and management, or the commercial or recreational harvest, of the fishery resources of the geographical area concerned. Four nonvoting members include the regional director of the USFWS, the commander of the Coast Guard, the Executive Director of the Marine Fisheries Commission for the geographical area, and one representative of the Department of State. Since the late 1980s, of the 11 voting members on the current NPFMC, one member is from a western Alaska community.

Under section 101-627(4), the MSA states “The Secretary shall establish APs to assist in collection and evaluation of information relevant to the development of any fishery management plan or plan amendment for a fishery to which subsection (a)(3) applies. Each AP shall participate in all aspects of the development of the plan or amendment; be balanced in its representation of commercial, recreational, and other interests; and consist of not less than seven individuals who are knowledgeable about the fishery for which the plan or amendment is developed...” The North Pacific AP is a voluntary advisory group with no decision-making power. It currently consists of 23 members, representing various geographical regions and interests as suggested in the MSA. Of the 23 members, one individual represents CDQ constituents on behalf of the Bristol Bay Economic Development Corporation, also a CDQ group and one individual represents Aleut Enterprise Corporation. Western Alaska Native groups have traditionally been very active on the AP.

3.1.2 Public Involvement

Public involvement is a fundamental principle of both MSA and NEPA. The unique status of Alaska Natives is acknowledged by NOAA Fisheries in a number of ways when complying with the MSA and NEPA. The regulations on implementing the MSA and NEPA require that agencies make diligent efforts to involve the public including Alaska Natives, in preparing and implementing fisheries management procedures. The MSA stresses public involvement in participation of stakeholders in the NPFMC process. The procedures defined by the MSA provide opportunities for public comment at various stages during the development of fishery management actions (Section 302 Regional Fishery Management Councils 16 USC 1852). This process and the NEPA process are intertwined so that the public has formal opportunities to provide input on proposed actions on proposed FMPs or amendments through the scoping process, and during public review of Draft

and Final EIS documents. Public input and comments received must be considered in the project analysis, documentation, and decision-making.

The first formal step in EIS preparation is a Notice of Intent to prepare an EIS must be published in the Federal Register as required by NEPA 40 Code of Federal Regulations (CFR) 1501.7 and NOAA 216-6. The Notice of Intent serves as the official legal notice that a federal agency is commencing preparation of an EIS. By providing the Notice of Intent to federally recognized tribes within the project area, consultation and the opportunity to become involved is initiated.

Federal agencies recognize the importance of Alaska Native involvement through established statutes, EOs, regulations, and policies. NEPA requires formal actions to address the EOs. See Section 3.6 for a discussion of Environmental Justice.

The Council on Environmental Quality (CEQ) NEPA regulations require the lead agency's scoping process to "Invite affected federal, state, and local agencies, Indian tribes, project proponents, and other interested persons" to participate in the EIS process as required by 40 CFR 1501.7 (1). During the scoping process, NOAA Fisheries contacts tribal organizations and solicits input on the nature and extent of issues and impacts to be addressed in the EIS and the methods by which they will be evaluated. NOAA Fisheries recognizes the importance of inviting tribal involvement in the NEPA process. For example, in the Programmatic SEIS formal letters and newsletters were mailed to Alaska Native organizations informing them of the scoping process and comment period. Scoping meetings were held with the intent to prepare the Programmatic SEIS, to define the federal action under review and to offer consultation and coordination with tribal governments. This process would continue under the Alternative 1 policy.

Community outreach efforts are implemented through letters, newsletters, special meetings, and comment response. Letters and newsletters supply notification of project commencement and completion and supply project information throughout the process.

Notices of NPFMC meetings and public hearings are to be published in local newspapers distributed in major fishing ports having a direct interest in the affected fishery and areas that will result in wide publicity. Every meeting, or emergency meeting held by the NPFMC or the AP is open to the public unless notification that it is closed has been published in regional newspapers. Timely notices of meetings are required. There are usually five meetings a year. Interested persons are encouraged to present oral or written statements regarding the issues on the meeting agenda. Written comments received up to approximately one week prior to the meeting are included in meeting packets for NPFMC members, or the individual may submit their comments by giving oral or written testimony at the meeting. Minutes and all analysis action memos of each NPFMC meeting, except closed sessions, are filed and contain a record of the attendees, a description of matters discussed, and conclusions reached. The minutes are available to the public (posted on the NPFMC website, by request). Newsletters are provided following each NPFMC meeting and are distributed to mailing lists and posted on the NPFMC website.

As a matter of policy, the NPFMC routinely schedules its meetings in Anchorage, Alaska (a central geographical location), and less frequently (but on a regular basis) in the major Alaska fishing ports of Sitka, Kodiak, and Unalaska/Dutch Harbor, along with Seattle, Washington (a center of effort for the North Pacific fisheries).

Under Alternative 1, the current opportunities available for public comment on proposed and existing fishery management plans, EIS documents, regulations, and agenda items during NPFMC meetings, provide many avenues for Alaska Natives to provide input regarding groundfish fishery management.

Public Review and Comment on FMPs, Amendments, and EIS Documents

After a FMP or amendment is transmitted to the Secretary a notice stating that it is available must be immediately published in the Federal Register to inform the public that written information, views, or comments of interested persons may be submitted to the Secretary during a 60-day period. The 60-day comment period begins on the date the notice is published.

In accordance with CEQ NEPA guidelines, NOAA Fisheries must provide public notice of the availability of NEPA documents to interested persons and agencies (40 CFR 1506 (a) and (b)) notice must be published in the Federal Register and sent by mail to national organizations reasonably expected to be interested (40 CFR 1506.6 (b) (2)). This includes Alaska Natives within the project area. NOAA Fisheries will also conduct a public hearing to provide the opportunity for oral testimony, if necessary.

NOAA Fisheries provided a public comment period on the Draft 2001 Programmatic SEIS that lasted approximately six months. The comment period was announced and details were explained in a series of newsletters. Public meetings were held in five locales in and outside of Alaska to acquire oral and written comments on the Draft 2001 Programmatic SEIS. During this time, the option to contribute comments by mail was also provided. Letters were sent to tribal governments soliciting their participation and input on project-specific issues in a special state-wide teleconference between NOAA Fisheries with Alaska tribal governments. Upon the completed preliminary review of public comments, NOAA Fisheries recognized the need for increased efforts to include Western Alaska communities in the agency's decision-making process, and additional meetings were conducted.

Solicitation of public comment on proposed FMPs, their amendments, and proposed rule-making by NOAA Fisheries is required under the MSA and NEPA. Such comments are viewed by NPFMC and NOAA Fisheries as critical in helping managers shape responsible plans for our nation's fishery resources that best meet the NPFMC's and NOAA Fisheries' mission, the ten MSA National Standards, the goals of NEPA, and the interests of the American public. During the formal comment period, the public can review and comment on draft plans. The process described in this document for soliciting and analyzing public comments is part of a broader effort of public involvement and agency consultation described in this Programmatic SEIS. The comments received are analyzed and the results considered by the NPFMC and NOAA Fisheries.

3.1.3 Co-Management

Co-management is a relatively new approach to fisheries management and can be defined in many ways. In general, co-management refers to "joint decision-making by the government and communities (or other interest groups) about one or more aspects of natural resource access or use" (Castro and Nielsen 2001). According to Brown (1999), the term is often used for partnerships formed by stakeholders but does not guarantee that stakeholders share power with the management agency. The level of co-management can vary depending on the resource, management function, degree of formality of the arrangement, and the number of interests involved.

There are various arrangements for the amount of participation within co-management that range from activities as simple as consultation and coordination or as complex as the allocation of equal power among stakeholders during decision-making. Fisheries are often suited for co-management because they are a mobile resource and encompass a large area. Sharing authority and decision-making in resource management brings diverse groups together, regardless of their different interests (McCay and Jentoft 1998). Where decision-making is not able to be shared, advisory groups, review committees, and other open forums allow resource managers to consult with the public. This approach allows interested parties to express themselves to resource managers who are then exposed to a wide range of knowledge, ideas, concerns, and needs.

Co-management has many challenges. In some cases, local participants may be asked to bear the work and costs of resource management without adequate funding to support such responsibilities. For managers, it may be difficult to lead a group of diverse stakeholders who may have conflicting interests, or there may be regulatory limits on the authority to share decision-making. These challenges may make stakeholder groups or agencies reluctant to enter into a co-management agreement. However, there are benefits to such an agreement if the participants are willing and able to overcome the difficulties. Co-management efforts can provide avenues to share information and raise awareness about fisheries management. For the NPFMC and NOAA Fisheries, it may be advantageous to collaborate as it may increase their enforcement, monitoring, and research capabilities as well as enhance the communication between the agencies and interested parties.

The existing types of co-management under the Alternative 1 framework are on a primary level and include informing, consultation, and cooperation, as provided through solicitation of public comments. This form of co-management may be considered less participatory than other approaches where stakeholders have equal voting power with resource managers. Under the current Alternative 1 framework, managers are able to seek meaningful advice from the members of the AP who represent various interests, including Alaska Native interests, as well as from the public.

3.1.4 Consultation and Coordination with Indian Tribal Governments

NOAA Fisheries recognizes their special obligations to consult and coordinate with tribal governments on a government-to-government basis pursuant to Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, signed by President Clinton and published in the Federal Register on November 9, 2000. Executive Order 13175 requires executive agencies “to establish regular and meaningful consultation and collaboration with tribal officials in development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.” Further, As part of CEQ regulations regarding the scoping process, the lead agency shall: “Invite the participation of affected federal, state, and local agencies, any affected Indian tribe, the proponent of the action, and any other interested persons” Section 1501.7(a)(1).

Under Alternative 1 policy, NOAA Fisheries will continue to consult with Alaska tribal governments through the NPFMC and the MSA/NEPA decision-making process.

NOAA Fisheries complies with EO 13175, by initiating public outreach to potentially interested tribal governments. For example the agency started a government-to-government consultation effort on the Alaska Groundfish Fisheries Draft 2001 Programmatic SEIS. Letters were sent to approximately 250 federally recognized tribes within 50 miles of the Alaska coast, encouraging them to begin correspondence with NOAA Fisheries. Letters were initially sent out to introduce the project and begin the scoping period, to introduce the completed Draft 2001 Programmatic SEIS, and to indicate the closing of the preliminary review of public

comment. In these letters communities and villages were invited to scoping/public meetings or teleconferences and to submit written comment. NOAA Fisheries has made substantial effort to comply with EO 13175 and to involve and respond diligently to all communities that correspond and hold a vested interest in the future management of the groundfish fisheries.

3.2 Traditional Knowledge

3.2.1 Definition of Traditional Knowledge and Collection Methods

Traditional environmental knowledge, or TK, can generally be defined as a body of knowledge built up by a group of people through generations of living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. The quantity and quality of traditional environmental knowledge varies among community members, depending upon gender, age, social status, intellectual capability, and profession (hunter, spiritual leader, healer, etc.). With its roots firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present (Johnson 1992).

Biologists have begun to work more with indigenous peoples to integrate Traditional Knowledge into their research (Freeman and Carbyn 1988, Freeman 1992, Hobson 1992, Albert 1992). This interest in Traditional Knowledge recognizes the fact that biological field studies typically are conducted as intensive, short-term efforts during the summer. In contrast, Traditional Knowledge represents the cumulative observations of people who have lived in the environment their entire lives.

Traditional Knowledge can be passed along relatively unchanged from generation to generation, but also adapts to and reflects changes in technology and socioeconomic conditions. The term Traditional Knowledge as used in this Programmatic SEIS also includes contemporary indigenous knowledge. This knowledge includes, but is not limited to, expertise on weather, sea ice, currents, fish and wildlife, historic and current uses of the land and water for subsistence activities and other traditional uses, and impacts of human activities on fish and wildlife and the environment.

Traditional Knowledge can be obtained in a number of ways:

- Literature available from local libraries, universities, and Internet-based search engines.
- Existing information gathered from third parties such as Alaska Native organizations.
- Key informant interviews with elders and other knowledgeable individuals in Alaska Native communities.

NOAA Fisheries intends to evaluate existing sources of Traditional Knowledge for use in its fishery management analysis. It is hoped that Traditional Knowledge may be useful by providing observations on past trends and cumulative effects. In the Draft 2001 Programmatic SEIS, efforts were initiated to evaluate potential sources of Traditional Knowledge from existing literature available from state agencies, local libraries and universities, and Internet-based search engines.

3.2.2 Applicability of Traditional Knowledge to Fisheries Management

Traditional Knowledge can provide a historical perspective regarding trends and cumulative effects for specific fish and wildlife species, and for large scale environmental changes. It can also provide observations from specific geographic areas in the GOA and BSAI that can supplement scientific information or fill in data gaps. Public comments received on the initial Draft 2001 Programmatic SEIS, assist with the evaluation of Traditional Knowledge and the assessment of potentially disproportionate adverse effects on Alaska Native populations as required by EO 12898 on Environmental Justice.

The NPFMC annually adopts a set of research ideas presented by the AP and the Scientific and Statistical Committee that prioritize activities or areas in fishery management that need attention. Included in the list of research priorities are issues that may pertain to Alaska Natives such as Traditional Knowledge, bycatch research, or impacts of fishery management measures on social and economic conditions. These research priorities are then provided to NOAA Fisheries who will use the information to determine, along with their own set of priorities, where to allocate funding for research. This provides another avenue for incorporating Alaska Native Traditional Knowledge not just in fisheries management but in research as well.

Under Alternative 1, NOAA Fisheries is currently using existing literature available at libraries, universities, and the Internet to identify sources of Traditional Knowledge relevant to the GOA and BSAI groundfish fisheries. A Traditional Knowledge database has been developed, and Traditional Knowledge has been entered into the database. NOAA Fisheries intends to use relevant Traditional Knowledge excerpts in preparing the comparative baseline and reaching conclusions on the significance of potential environmental consequences. Under this framework, Traditional Knowledge is not collected from third party sources or key informant interviews.

Case Study - Development of the Traditional Knowledge Database

For the Draft 2001 Programmatic SEIS, a Microsoft Access 2000 relational database was developed for entering and querying Traditional Knowledge. The intent of the database design is to provide a tool that can be used for future Traditional Knowledge collection efforts, not only by the Alaska region, but other regions of NOAA Fisheries as well. Queries can be conducted for a number of topics, content, key words, citations, and speaker variables. This database is useful for incorporating Traditional Knowledge into fisheries management and the Programmatic SEIS.

3.3 Alaska Native Participation in Groundfish Fisheries by Regional Setting

Alaska Native issues regarding participation in the groundfish fishery and potential impacts of the management alternatives are many and complex. This section discusses regional differences in Alaska Native engagement in and dependence upon the groundfish fishery in overview. This discussion is split into CDQ and non-CDQ regions. Within the non-CDQ regions a further split is made among communities with issues related to direct participation in the fishery and those without direct participation.

3.3.1 Community Development Quota Participation in Groundfish Fisheries

The CDQ program for western Alaska was created by the NPFMC to foster regional participation in and benefit from the groundfish fisheries. At its inception during the inshore/offshore allocative decision process (in the early 1990s), the program was limited to the pollock fishery. In subsequent years it has expanded to

include a variety of other groundfish and non-groundfish species. Groundfish, in general, and the pollock fishery, in particular, provide a strong economic foundation for the CDQ program. The CDQ region includes predominately Alaska Native communities within 50 nautical miles of the Bering Sea coast. This program was intended “to provide fishermen who reside in western Alaska communities a fair and reasonable opportunity to participate in the BSAI groundfish fisheries, to expand their participation in salmon, herring, and other nearshore fisheries, and to help alleviate the growing social economic crisis within these communities” (BSAI Groundfish FMP). In order for a community to qualify as a CDQ community, it not only needed to be an Alaska Native Claims Settlement Act community within the designated geographic area, it also could not have previously developed harvesting or processing capability sufficient to support substantial participation in the groundfish fisheries in the Bering Sea (although there was some leeway for exceptions to this criteria, as illustrated by the case of Akutan, described below).

Initially, the pollock allocation to CDQs was 7.5 percent of the Bering Sea total allowable catch (TAC), but this was increased to 10 percent under provisions of the American Fisheries Act of 1998. Bering Sea opilio, bairdi, and king crab, more recent additions to the CDQ program, are currently at allocations of 7.5 percent following a phase-in period. Other allocations include halibut, sablefish, remaining BSAI groundfish, along with prohibited species, with some variability in allocations by management area as detailed elsewhere in the Draft 2001 Programmatic SEIS.

Different CDQ groups have taken different approaches to the opportunities provided by the program. Some groups have chosen to become direct participants in the fishery through ownership interest in groundfish harvest and catcher processor vessels, while others have chosen to have their quota shares harvested by industry partners in exchange for royalties and employment opportunities, preferring to invest the benefits from the groundfish fishery in developing other direct participation in local (non-groundfish) fisheries. According to Northern Economics, Inc. (2002):

Since the inception of the program in 1992, the program has provided approximately 1,000 jobs annually for western Alaska residents and has created an excess of \$8 million in wages annually since 1998. Over the duration of the CDQ program, annual pollock CDQ royalties have consistently exceeded \$13 million. In 2000, the CDQ communities received nearly \$33 million in pollock CDQ royalties, while royalties from the multi-species program provided the communities an additional \$7.4 million. The value of CDQ community assets in aggregate, including equity ownership in fishing vessels, on-shore development projects, loan portfolios and IFQ holdings, increased from nearly \$15 million in 1992 to over \$152 million in 2000.

Under Alternative 1, CDQ participation would remain the same as under existing conditions. The nature of engagement with the fishery would not change, and that no significant changes to CDQ communities would be likely to occur, at least through the mechanism of the CDQ program itself. Potential subsistence related impacts to these communities are at least partially independent of CDQ status, as developed below, but no significant new impacts to subsistence are likely to occur under Alternative 1.

3.3.2 Non-Community Development Quota Regional Issues

Alaska Native issues affect communities outside the CDQ region as well as those inside the region. The “non-CDQ region” may usefully be divided into two separate parts for discussion purposes. First are those Alaska Native communities that directly participate in the groundfish fisheries. The second set are those

communities outside of the CDQ region that do not participate directly in the groundfish fisheries, but nevertheless may experience a range of impacts from various groundfish fishery management decisions.

Impacts to Non-CDQ Alaska Native Communities with Direct Participation

A number of non-CDQ communities with significant Alaska Native populations participate directly in the BSAI groundfish fishery. These communities face potential impacts that could result from BSAI groundfish management decisions. These impacts may include non-commercial economic affects related to subsistence and Environmental Justice. These same communities also face potential impacts or issues common to all communities, Alaska Native or non-Native, that are substantially engaged in or dependent upon the fishery. These impacts may include displacement or consolidation of harvesting and processing sectors.

Table 1 displays the population information for the Alaska Peninsula/Aleutian Islands major groundfish ports in 2000. While King Cove and Sand Point are clearly the Alaska Native non-CDQ communities most engaged on a day-to-day basis in the BSAI groundfish fishery, there are Alaska Native population centers in the other Alaska communities most heavily engaged in the groundfish fishery. For example, as shown in Table 1, Unalaska's Alaska Native population is almost as large as that of King Cove, but accounts for less than 10 percent of the overall community population. Akutan is in the unique position of being both a CDQ community and to a substantial degree being directly engaged in the groundfish fishery. This overlap means that the community may be buffered from some types of impacts due to this form of diversification. However, impacts to Akutan may be amplified compared to other communities if both direct participation and CDQ engagement experience adverse outcomes under a given management alternative.

Table 1. Ethnic composition of population, selected Alaska Peninsula/Aleutian Island Region communities, 2000.

Race/Ethnicity	Unalaska		Akutan		King Cove		Sand Point	
	Number	%	Number	%	Number	%	Number	%
White	1,893	44.2%	168	23.6%	119	15.0%	264	27.7%
African American	157	3.7%	15	2.2%	13	1.6%	14	1.5%
Alaska Native/Native American	330	7.7%	112	15.7%	370	46.7%	403	42.3%
Native Hawaiian/ other Pacific islander	24	0.6%	2	0.3%	1	0.1%	3	0.3%
Asian	1,312	30.6%	275	38.6%	212	26.8%	221	23.2%
Some other race	399	9.3%	130	18.2%	47	5.9%	21	2.2%
Two or more races	168	3.9%	11	1.5%	30	3.8%	26	2.7%
Total	4,283	100%	713	100%	792	100%	952	100%
Hispanic*	551	12.9%	148	20.8%	59	7.4%	129	13.6%

Source: U.S. Census Bureau 2000.

*'Hispanic' is an ethnic category and may include individuals of any race (and therefore is not included in the total as this would result in double counting).

Akutan is also unique with respect to the degree of separation of the industrial enclave that comprises local commercial processing development from the remaining portion of the community. As discussed in Section 3.9.3 of the Programmatic SEIS, among all of the communities engaged in fishing, the residential portion of the community is in some ways most like a traditional Aleut community due to its relative distinctness from

the local industrial development. This distinction may serve to shape localized impacts somewhat differently than what would be the case in more spatially integrated communities.

Support services are present in King Cove and Sand Point and are of key importance to local private sector economies. King Cove and Sand Point have very different types of engagement with the groundfish fishery than do communities in the CDQ program. Both communities have a significant local commercial harvest fleet, and both are home to major shore processors. Akutan does not have a local fleet but does have a major processor. All three communities derive a significant portion of municipal revenues from fish landings in the community, and groundfish make up a substantial portion of the overall landings. The local public sector also derives revenue by providing a variety of services to fishing industry participants.

In general, the communities of King Cove, Sand Point, and to a lesser extent Akutan may be impacted by the various groundfish management actions quite differently than CDQ communities. For example, King Cove, Sand Point, and Akutan are economically sensitive to impacts resulting from changes to harvesting, processing, or support service sectors, and all three communities depend on municipal revenues derived from active engagement in the fishery. None of these types of impacts is likely under Alternative 1.

It is also important to note that the participation of King Cove and Sand Point in groundfish fisheries does have direct and indirect benefits for some other CDQ communities. King Cove and Sand Point are part of the Aleutians East Borough (AEB), and revenue that derives from landings in these communities (along with landings in Akutan) substantially benefits smaller Alaska Native (and CDQ) communities in the AEB, such as False Pass and Nelson Lagoon.

Impacts to Non-CDQ Alaska Native Communities Without Direct Participation

There are a significant number of Alaska Native communities that are neither CDQ communities nor directly participating non-CDQ communities that may still experience impacts resulting from the various proposed groundfish fishery management approaches. The CDQ regions encompass a coastal area extending “50 nautical miles from the baseline from which the breadth of the territorial sea is measured along the Bering Sea coast from the Bering Strait to the western most of the Aleutian Islands, or on an island within the Bering Sea.” It excludes communities “located on the GOA coast of the North Pacific Ocean” and Alaska Native (and other) communities located in Alaska’s “Interior.”

There are no anticipated impacts relating to subsistence and Environmental Justice for the GOA communities not directly engaged in the fishery. Data developed to date suggest no concerns over these types of impacts, and none has been raised during the public involvement process. The situation is, however, different for the communities of the Interior. A central concern of relevant Alaska Native communities in the Interior is the impact of the groundfish fishery on the subsistence and commercial salmon fishery. A number of comments on the Draft 2001 Programmatic SEIS related to this issue have been received from the Yukon-Kuskokwim area. Two specific regional groups that have been active in the public involvement process associated with the compilation of this Draft 2001 Programmatic SEIS have been the Association of Village Council Presidents and the Tanana Chiefs Conference, Inc., regional non-profit corporations that provide health, social, education, and community services to Alaska Native villages within Western Alaska and the Interior regions. Most of the communities served by these organizations are located along the Kuskokwim and Yukon Rivers and their tributaries. Because potential impacts to these regions focus on subsistence issues, impacts to these regions are discussed in the following section.

3.4 Subsistence Issues

The discussion of subsistence has been expanded from what appeared in the Draft 2001 Programmatic SEIS, which drew public comment for its general nature.¹ A new section has been added and subsistence issues are now treated at some length in the revised Programmatic SEIS.

Potential effects of the proposed alternative on subsistence use of natural resources may be usefully split into five main sections, each of which is summarized below:

- Potential effects on groundfish subsistence use.
- Potential effects of commercial groundfish fisheries on subsistence use of Steller sea lions.
- Salmon bycatch in the groundfish fishery and associated impacts to subsistence salmon fishing.
- General ecosystem concerns about volume of fishery removals.
- Indirect impacts on other subsistence activities, including joint production and income-related impacts.

3.4.1 Effects on Groundfish Subsistence

There is a relatively low level of subsistence activity associated with groundfish species targeted for commercial harvest. For the communities profiled, the best available information indicates that groundfish made up less than 10 percent of total subsistence take, and ranged far behind salmon and other non-salmon fish. There are no indications that ongoing commercial harvest is adversely affecting groundfish-specific subsistence activities. Further, Alternative 1 policy and current FMP do not restrict subsistence fishing directly. As a result, no significant impacts to groundfish subsistence are anticipated under any of the Alternatives. Therefore, effects of the Alternatives on groundfish subsistence will not be discussed further in this document.

3.4.2 Effects on Subsistence Use of Steller Sea Lions

The effects of Alternative 1 on Steller sea lion subsistence use are less straightforward than is the case for groundfish subsistence use. The subsistence harvest of Steller sea lions has declined substantially since 1992, over the same time period that the overall population of Steller sea lions was declining, as discussed in Section 3.9.5.3 of the Draft 2001 Programmatic SEIS. However, the relationship between the two is not clear. Furthermore, the complex connections between commercial groundfish fisheries and the decline in Steller sea lion population, discussed at length in the body of the Draft 2001 Programmatic SEIS, render the analysis of impacts of commercial fishing on Steller sea lion based subsistence problematic. It is evident though, that

¹“AKN 06: The Draft Programmatic SEIS erroneously indicates that Alaska Native communities do not have a stake in the management of the groundfish fisheries. The Draft Programmatic SEIS suggests that because the fisheries occur in the Exclusive Economic Zone, impacts to Alaska Native subsistence are few. This is not the case and should be revised.” A second general category of comment “AKN 11: NMFS should establish marine protected areas which include provision for traditional Alaska Native subsistence uses.” is not addressed in this section, but rather is encompassed in the marine protected areas discussion, and will be added to this section after consultation with authors of the broader Marine Protected Areas and Essential Fish Habitat analyses.

both of these relationships are important for assessing the potential effects of Alternative 1 on the subsistence use of Steller sea lions. This effect will be true for each of the four policy alternatives.

To the extent that Alternative 1 does not indirectly result in restrictions on existing opportunities or abilities to take Steller sea lions for subsistence purposes, it will have no direct adverse effects upon subsistence uses of Steller sea lions. If current levels of groundfish fishing are causing a decline in the Steller sea lion population, the fisheries could be indirectly contributing to the declining trend in subsistence harvest and use of the Steller sea lion that has occurred in recent years. Thus, to the extent that the design or mitigation strategies contained in Alternative 1 achieve the intended protection of Steller sea lion populations, the alternative will have neutral to positive effects on the subsistence use of that resource. More precise assessments are not possible, given the quality and quantity of information available, although it is probable that subsistence harvest levels will not be significantly changed by the projected potential changes in the Steller sea lion population resulting from Alternative 1. This is due to the complex dynamics involved in the existing conditions surrounding contemporary subsistence harvest of these animals, as developed in detail in Section 3.9.5.3 of the Draft 2001 Programmatic SEIS.

Even relatively large changes in Steller sea lion populations may not be accompanied by changes in the rate of subsistence use. Although subsistence harvest is to some degree related to the total population (and density) of animals to be taken, other factors also affect the rate of harvest, especially at low population levels. Unfortunately, little is known about these relationships, so the threshold at which the population is no longer perceived as “low” is not clear. Further, while anecdotal information suggests that there are long-term, intergenerational changes occurring, no detailed information exists on changes in cultural preferences for, and uses of, traditional marine-mammal-based foods. A number of other variables, such as negotiated agreements, may also influence long-term trends.

When examining impacts on a community level, it is important to note that of all the communities identified in the text of the Draft 2001 Programmatic SEIS as having a documented Steller sea lion harvest, only Akutan and Unalaska are identified as “regionally important groundfish communities” with substantial direct participation in the fishery. In other words, where use of Steller sea lions is identified as important to the community subsistence base, the commercial groundfish fishery is generally not, and vice versa.

3.4.3 Effects on Subsistence Salmon Fisheries

Salmon bycatch in Alaska groundfish fisheries has been an ongoing management issue for the Alaska groundfish fisheries and has been a concern repeatedly noted in the public comment process for this Programmatic SEIS.² This concern focuses on the recent status of the western Alaska stocks and the contribution of salmon bycatch to decreasing subsistence harvests. The following sections on historic and current subsistence salmon harvest are summarized from the most recent data from this area supplied by the ADF&G (2001).

² **AKN 10: The Draft Programmatic SEIS fails to analyze the issue of salmon bycatch, which is seriously impacting Alaska Native subsistence.** The salmon discarded in the groundfish fisheries are jeopardizing subsistence harvests. This issue must be addressed in the revised document.

In 1999, fisheries in four management areas accounted for 77 percent of the total subsistence salmon harvest statewide. These were Yukon (232,070 salmon; 25 percent of the statewide total); Kuskokwim (202,413 salmon; 21 percent); Northwest Alaska (154,294 salmon; 16 percent); and Bristol Bay (143,756 salmon; 15 percent). The total estimated salmon subsistence harvest in Alaska in 1999 was 975,617 fish based on annual harvest assessment programs.

The bycatch species of most concern in the groundfish fishery are chinook and chum, and of these two, chinook is considered a much larger potential problem. In 1999, the largest subsistence harvests of chinook salmon occurred in the Kuskokwim Area (77,660 salmon; 50 percent of the statewide total), followed by Yukon (50,515 salmon; 33 percent), Bristol Bay (13,009 salmon; 8 percent); and Northwest (6,242 salmon; 4 percent). Three areas dominated the subsistence chum salmon harvest in 1999: Yukon (162,670 salmon; 48 percent of the statewide harvest), Northwest (115,676 salmon; 34 percent), and Kuskokwim (47,612 salmon; 14 percent). Given that the majority of salmon subsistence harvest occurs in the Yukon and Kuskokwim areas, the following discussion will focus on these areas.

Yukon Area

As in the past, today's residents of the Yukon River area rely heavily on fish for food. While non-salmon species provide an important component of the overall fish harvest, salmon comprises the bulk of the total subsistence fish harvested. Although four salmon species are harvested in the Yukon drainage subsistence fishery, chinook, chum, and coho salmon comprise the majority of the subsistence harvests. In portions of the drainage, subsistence harvests of some species, especially chum and chinook salmon, are substantial. Often subsistence harvests far exceed commercial harvests.

Depending on the drainage area, subsistence fishing occurs from late May through early October. Fishing activities are either based from a fish camp or from the home village. Fishing patterns and preferred sites vary from community to community. Extended family groups, typically representing several households, often undertake subsistence salmon fishing and typically cooperate to harvest, process, preserve, and store salmon for subsistence use.

In 1999, it is estimated that 2,888 households participated in the fishery, and as shown in Table 2 these households were distributed over a large number of communities that are in turn spread across a wide geographic region. The estimated 1999 total subsistence salmon harvest for the Yukon area broken down by species included 50,515 chinook (22 percent), 79,250 summer chum (34 percent), 83,420 fall chum (35 percent), 19,984 coho (9 percent), and 681 pink salmon (0.3 percent). There has been considerable variation from year-to-year, however, as shown in Table 3. However, these numbers show that chum and coho salmon were significantly down for 1998 and 1999.

Kuskokwim Area

The harvest of fish and wildlife for subsistence use is an important component of the mixed subsistence-cash economy throughout the Kuskokwim area. The subsistence salmon fishery in the region is one of the largest and most important in the state. Many other households, which are not directly involved in catching salmon, participate by assisting family and friends with cutting, drying, smoking, and associated preservation activities (salting, canning and freezing). ADF&G Subsistence Division studies in the region indicate that fish contribute as much as 85 percent of the total pounds of fish and wildlife harvested in a community annually, and salmon as much as 53 percent of the total annual harvest (Coffing 1991).

Table 2. 1999 subsistence salmon household/permit totals by community, Yukon management area.

Community	Households/ permits total	Community	Households/ permits total	Community	Households/ permits total
Alakanuk	128	Grayling	51	Nunam Iqua (Sheldon's Point)	35
Alatna	12	Healy	8	Pilot Station	95
Allakaket	54	Holy Cross	66	Pitka's Point	26
Anvik	40	Hooper Bay	194	Rampart	29
Beaver	32	Hughes	24	Ruby	73
Bettles	20	Huslia	84	Russian Mission	57
Birch Creek	14	Kaltag	57	Saint Mary's	118
Central	12	Kotlik	90	Scammon Bay	76
Chalkyitsik	35	Koyukuk	38	Shageluk	32
Circle	21	Manley Hot Springs	16	Stevens Village	31
Eagle	65	Marshall	68	Tanana	122
Emmonak	157	Minto	65	Venetie	54
Fairbanks	95	Mountain Village	151	Other Alaska Communities	54
Fort Yukon	173	Nenana	33	Totals	2,888
Galena	183	Nulato	100		

Table 3. Historic subsistence salmon harvests: Yukon management area.

Year	Estimated salmon harvest				
	Chinook	Summer chum	Fall chum	Coho	Total
1990	48,587	115,609	167,900	43,460	375,556
1991	46,773	118,540	145,524	37,388	348,225
1992	47,077	142,192	107,808	51,980	349,057
1993	63,915	125,574	76,882	15,812	282,183
1994	53,902	124,807	123,565	41,775	344,049
1995	50,620	136,083	130,860	28,377	345,940
1996	45,671	124,738	129,258	30,404	330,071
1997	57,117	112,820	95,141	23,945	289,023
1998	54,124	87,366	62,901	18,121	222,512
1999	50,515	79,250	83,420	19,984	233,169
1995-1999 Average	51,609	108,051	100,316	24,166	284,143
1990-1999 Average	51,830	116,698	112,326	31,125	311,978
1975-1999 Average	42,113	184,387	136,889	29,713	365,499

There were 37 communities consisting of approximately 4,200 households with permits within the Kuskokwim area for the 1999 salmon subsistence fishery, as shown in Table 3. The 1999 total subsistence salmon harvest estimates for the Kuskokwim area were 77,660 chinook, 47,612 chum, 49,388 sockeye, and 27,753 coho salmon. As was the case in the Yukon area, considerable variation is seen from year to year, as shown in Table 4, and the 1998-1999 harvest levels were significantly below the ten-year average. The historic salmon harvest for the Kuskokwim area is presented in Table 5.

Table 4. 1999 subsistence salmon harvests by community Kuskokwim area.

Community	Households/ permits total	Community	Households/ permits total	Community	Households/ permits total
Akiachak	119	Kongiganak	71	Oscarville	15
Akiak	58	Kwethluk	142	Platinum	19
Aniak	163	Kwigillingok	95	Quinhagak	132
Atmautluak	53	Lime Village	17	Red Devil	18
Bethel	1,508	Lower Kalskag	63	Sleetmute	35
Chefornak	94	McGrath	100	Stony River	16
Chuathbaluk	28	Mekoryuk	92	Takotna	14
Crooked Creek	30	Napakiak	73	Telida	2
Eek	67	Napaskiak	74	Toksook Bay	133
Goodnews Bay	53	Newtok	80	Tuluksak	72
Kalskag (Upper)	53	Nightmute	67	Tuntutuliak	74
Kasigluk	136	Nikolai	29	Tununak	109
Kipnuk	176	Nunapitchuk	100	Totals	4,180

Table 5. Historic subsistence salmon harvest Kuskokwim area.

Year	Estimated salmon harvest					
	Chinook	Sockeye	Chum	Coho	"Small salmon"	Total salmon
1990	92,678	39,662	131,469	50,713	221,844	314,522
1991	90,224	56,404	96,308	55,581	208,293	298,517
1992	68,665	34,159	99,576	44,496	178,231	246,896
1993	91,721	51,363	61,726	35,295	148,384	240,105
1994	98,378	39,279	76,951	36,504	152,734	251,112
1995	100,159	28,622	68,942	39,165	136,729	236,888
1996	81,598	35,036	90,238	34,698	159,972	241,570
1997	85,506	41,270	40,976	30,714	112,960	198,466
1998	86,115	37,578	67,665	27,239	132,482	218,597
1999	77,660	49,388	47,612	27,753	124,753	202,413
1960-1999 Average	57,887	NA	NA	NA	186,232	244,118
1995-1999 Average	86,208	38,379	63,087	31,914	133,379	219,587
1990-1999 Average	87,270	41,276	78,146	38,216	157,638	244,909

Salmon Bycatch under Groundfish Fishery Existing Conditions

The issue of salmon bycatch is presented in more detail in the bycatch qualitative analysis paper. The five species of Pacific salmon are divided into two FMP bycatch management groups: chinook salmon, and “other” salmon (chum, sockeye, coho, pink). (Steelhead trout have not been observed recently in either the BSAI or GOA and were not considered in that assessment). All groundfish fisheries in the BSAI and GOA are prohibited from retaining any species of salmon except for those retained under the Voluntary Salmon Donation Program that authorizes their retention for local food banks (BSAI FMP Amendment 26, GOA FMP Amendment 29). In 1999, over 3 million pounds of salmon were donated.

Of the five salmon species, only the bycatch of chinook and chum salmon is of any serious concern in the BSAI and GOA. Pink, coho, and sockeye salmon populations in Alaska are considered healthy, and bycatch in the groundfish fisheries represents only a minuscule portion of state harvests and overall population size. These three species also are small components of bycatch in the groundfish fishery relative to chinook and chum salmon.

While the overall bycatch of chinook and chum salmon is also very small relative to state harvests, bycatch take could pose a threat to specific stocks (rivers of origin). A recent paper by Witherell *et al.* (2002) provides a compilation of the latest data on Alaska groundfish fisheries salmon bycatch under existing conditions:

Bycatch is primarily juvenile salmon that are one or two years away from returning to the river of origin as adults. The origin of salmon taken as bycatch includes rivers in western Alaska, southcentral and southeast Alaska, Asia, British Columbia, and Washington. Analysis indicates that an incidental catch of 30,000 chinook salmon in the Bering Sea and Aleutian Islands groundfish trawl fisheries equates to about 14,581 adult chinook salmon from western Alaska. Similarly, a bycatch of 60,000 chum salmon in the Bering Sea and Aleutian Islands groundfish trawl fisheries equates to about 13,120 adult chum salmon from western Alaska. We estimated that, on average, salmon bycatch in the Bering Sea and Aleutian Islands groundfish trawl fisheries reduced the western Alaska chum salmon run by less than 0.2%, and reduced the western Alaska chinook salmon run by less than 2.7%. Impacts of salmon bycatch from the Gulf of Alaska groundfish trawl fisheries cannot be estimated at this time (Witherell, et al. 2002).

Some western stocks of chinook and chum salmon are currently depressed. In 2000, there were fishing closures in the Yukon and Kuskokwim River systems, and it is possible that ADF&G escapement goals may not be realized over the immediate future. If individual stocks become so depressed that full closure of direct fisheries is insufficient to enable a rebound in the population, then any additional mortality, including bycatch, could negatively impact the stock. It is estimated that 58-70 percent of chinook salmon bycatch in the BSAI groundfish fisheries may originate from western Alaska stocks, but it is unknown what proportion of these salmon are specifically from depressed stocks. Analysts contend that there is insufficient information to determine the effects of BSAI bycatch and PSC limits on specific at-risk stocks within this western group.

Under BSAI FMP Amendment 21b, the PSC limit represents about 19.2 to 36.9 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. This is a substantial portion of the domestic harvest. In 1999, the NPFMC adopted BSAI FMP Amendment 58 to (1) further reduce the chinook salmon bycatch limit from 48,000 to 29,000 fish over a four-year period, (2) implement year-round accounting of chinook salmon bycatch in the pollock fishery, (3) revise the

boundaries of the chinook Salmon Savings Areas, and (4) set more restrictive closure dates. This reduced PSC limit represents about 11.6 to 22.3 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. PSC limits have not been established for salmon in the GOA, nor is bycatch considered a potential problem for GOA subsistence fisheries under existing conditions. Some western Alaska stocks of chum salmon are also depressed, but analysts estimate that only about 19 percent of chum salmon bycatch in the BSAI is from western stocks. Because this is equivalent to only 1.3 to 1.5 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chum salmon landings reported between 1997 and 1999, bycatch represents a tiny fraction of landings even for depressed stocks. The quantitative assessment of bycatch and the relationship of bycatch to individual salmon stocks are discussed in detail in the Bycatch Qualitative Analysis Paper, as well as in the Draft Programmatic SEIS. It is apparent that this analysis conflicts with views held by a significant number of Alaska Native entities and individuals participating in the public involvement process. The degree to which this divergence of opinion is based in the different approaches of scientific analysis and Traditional Knowledge is unknown. Whatever the specific origin of this divergence, it is acknowledged that this conflict in viewpoint exists.

Under Alternative 1, the amount of salmon bycatch and associated impacts to western Alaska stocks would appear relatively low, and adverse impacts on subsistence would therefore not be significant. However, salmon bycatch is nonetheless a contentious issue given the current state of some of the salmon fisheries. For example, in 2000, "salmon returns throughout the Yukon and Kuskokwim River drainages and the entirety of Norton Sound were less than 50 percent of the 20-year average" (D. Eggers, ADF&G Juneau, personal communication, cited in Witherell *et al.* 2002). These and correspondingly adverse conditions in the Bristol Bay sockeye fishery have led the state to constrain commercial, recreational, and subsistence harvests, and in 1998, 1999, and 2000, economic disaster was formally declared for western Alaska based on collapsed salmon runs (Witherell *et al.* 2002). While year-to-year fluctuations are common (more so in the GOA than in BSAI fisheries), in recent years chum salmon bycatch in the BSAI has remained fairly stable. However, BSAI chinook bycatch increased in 2001 to about 7 percent above the 1990-2001 annual average (Witherell *et al.* 2002). Given the existing conditions in the salmon fisheries and the specific importance of salmon to overall subsistence take, the cause of public concern voiced by Alaska Natives over salmon bycatch in the Alaska groundfish fisheries is readily apparent. However, this concern does not appear to be supported by existing quantitative data and analysis.

It is also important to note that adverse subsistence salmon conditions in western Alaska are having a regulatory impact on commercial salmon fisheries in Alaska Native groundfish communities elsewhere. Specifically, Area M, which includes both the north and south sides of the western end of the Alaska Peninsula as well as the eastern part of the Aleutian Islands, has faced commercial restrictions designed to decrease the interception of western Alaska salmon while targeting Bristol Bay and Alaska Peninsula salmon stocks. These restrictions have had a marked negative impact on the communities of King Cove and Sand Point, two Alaska Native communities directly involved groundfish communities, as discussed in Section 3.9.3 of the Programmatic SEIS.

3.4.4 Indirect Impacts on Other Subsistence Activities

Beyond direct use of groundfish and Steller sea lions as subsistence resources and potential bycatch-related impacts to subsistence salmon fisheries, the Alternative 1 policy or FMP could have indirect impacts on other subsistence pursuits. These types of impacts fall into two main categories:

- Impacts to other subsistence pursuits as a result of loss of income from the commercial groundfish fishery. This income could be used to purchase fuel, vehicles, other subsistence related gear, or otherwise offset expenses required to engage in a range of subsistence pursuits.
- Impacts to other subsistence pursuits as a result of the loss of opportunity to use commercial fishing gear and vessels for subsistence pursuits, where these assets are used in such a manner that commercial and subsistence catches are jointly produced, based on shared use of fixed and variable inputs.

The variables that influence these indirect impacts are numerous and complex. Although some impacts are likely to accrue to a limited number of communities that participate directly in the fishery, quantification of these impacts is problematic. Impacts to subsistence in communities that participate in the fishery primarily through investment and control of quota (the CDQ communities) could occur through loss of income that would be directed toward subsistence pursuits, but quantification of these impacts is also problematic.

It is also important to note that the geographic distribution of these potential impacts varies widely. Joint production impacts are confined to those individuals who own or have immediate access to vessels participating in the groundfish fisheries. The impacts of a potential loss of income would fall on a larger group of individuals, many of whom may live significant distances away from the coastal communities where commercial vessels are home ported. It should also be noted that these are both still relatively constrained areas compared to the potential subsistence salmon impacts discussed above. Though their geographic base may be narrow, the impacts on families may be much more immediate and of greater magnitude.

Income-Related Indirect Subsistence Impacts

The potential loss of income resulting in funds not being available for subsistence pursuits is a very complex issue. Below are some facets of the various issues involved.

- Loss of income can impact everyone associated with the fishery, and people associated with the fishery live in communities ranging across Alaska and the Pacific Northwest.
- Income specifically contributed by groundfish pursuits may be a larger or smaller proportion of funds used for subsistence by individuals or families.
- The relationship between loss of income and specific subsistence outcomes is not entirely straightforward.
- Field experience would indicate that subsistence strategies are, at least in part, flexible in nature and are readily adapted to the level of cash flow available.
- Income associated with the groundfish fishery can be derive from direct participation through employment, investment in vessels or processors, and/or through control of quota, such as through CDQ related revenues.
- CDQ communities represent a special case by being the only communities where fisheries subsistence is heavily practiced and where benefits from the fishery are primarily derived through investment and control of quota.

- Different CDQ groups have chosen different organizational structures and strategies for using funds derived from the program and have had varying degrees of success with their investments. As a result, there are different levels of individual and family income in different CDQ communities.
- CDQ programs focused on employment and training may, in turn, indirectly influence individual subsistence spending and participation decisions.

No loss of income related to subsistence impacts is anticipated under the Alternative 1 policy or the current FMP.

Joint Production Related Subsistence Impacts

The second type of potential impact, loss of opportunity for joint production, applies to groundfish communities with direct participation in the fishery (i.e., only vessels that currently participate in the commercial fishery can be used for joint production). This type of impact was noted in public comment on the Draft 2001 Programmatic SEIS.³

In general, there is little information on joint production within the groundfish fishery. Below are some general points about the vessels involved, followed by points about the communities involved.

- Not all vessels in the commercial groundfish fishery are also used for subsistence.
- Depending on the community involved, a greater or lesser proportion of the commercial fleet engaged in the local commercial groundfish fishery is owned and operated by non-residents.
- Joint production can occur in at least two fundamentally different ways. Subsistence fish can be retained during commercial trips, or separate trips using the commercial vessel and gear may be made for subsistence harvests.
- As a general rule, trips specifically dedicated to subsistence are not economical for the larger vessels engaged in the groundfish fishery. However, for the large vessels based in subsistence communities, dedicated trips for subsistence fishing may be unusual, but it is known from field interviews that some other subsistence use may occur.
- Smaller vessels are most likely to be involved in joint production. Though the number of joint production vessels is unknown, nearly all of the smaller class vessels that engage in the groundfish fishery are also involved in some combination of (or all of) the salmon, halibut, sablefish, and herring subsistence fisheries.
- For those small vessels engaging in other fisheries in addition to the groundfish fishery, the time of the year that the vessel is available for joint production may decrease if the reduction of the commercial groundfish fishery were of a sufficient magnitude.

³ **AKN 09: Commercial fishing provides a platform that supports subsistence activities.** The commercial fisheries form the basis of continuing cultural health in many Alaska Native communities. The economic infrastructure of the commercial fisheries provides the requisite foundation for a subsistence lifestyle. The Draft 2001 Programmatic SEIS should acknowledge this and revise its analysis accordingly.

- In practical terms, joint production opportunities also vary by gear type. Although quantitative data are slim, knowledge of the industry suggests that little subsistence takes place using trawl vessels compared to other gear types. Among the fixed gear classes, much more time is directed toward sablefish, salmon, and herring than is devoted to groundfish; therefore, the joint production opportunities in this class would remain relatively high independent of the groundfish management alternative chosen.
- Field observations indicate that different individuals look at the balance between commercial and subsistence catches during times of scarcity or forced decision-making in very different ways.
- CDQ-owned vessels that participate in the groundfish fishery usually do not participate in subsistence activities.

In terms of communities, the potential for significant social or community level impacts resulting from indirect effects of any of the alternatives on subsistence through loss of direct income (exclusive of CDQ considerations) or joint production opportunities is only anticipated in Unalaska, Akutan, King Cove, Sand Point, and Kodiak. As outlined below, joint production impacts are only considered likely for a subset of these communities.

- In the case of Unalaska, none of the large commercial vessels that deliver groundfish to the local processing plants are owned or crewed by residents of the community. There is a small boat fleet from the community that does jig for cod, and the opportunity would continue to exist for joint commercial/subsistence production. In terms of the number of participants, this fleet has seen growth and decline in recent years. There was also some longline groundfish activity by small boats, but the level of effort in federal waters is difficult to assess with current data.
- In Akutan, like Unalaska, the fleet delivering to the local processing facility is a non-resident fleet and the resident fleet from the traditional community is essentially not engaged in the commercial groundfish fishery. Therefore, there would be no joint production impacts from any of the alternatives.
- In the case of Sand Point and King Cove, local vessels less than 68 feet (ft) in length are likely to engage in subsistence. Although data are not available to quantify potential impacts of this nature, it would appear likely that if income of larger vessels (i.e., those in the Trawl Catcher Vessel non-American Fisheries Act/Trawl Catcher Vessel 60/Pot Catcher Vessel classes and some in the Fixed Gear Catcher Vessel 33-59 ft vessel class) goes down significantly because of any particular alternative, it will be more difficult for vessel owners and operators to justify using their large vessel for certain types of subsistence activities.
- Given the concentration of the fleet in Kodiak, and the inherent tendency of smaller vessels (such as those in the smaller villages as well as that portion of the Kodiak fleet) to be less specialized (and therefore have more joint production opportunities), whatever indirect subsistence impacts that do occur in this region as a result of the alternative frameworks are likely to be concentrated in the City of Kodiak itself.

In summary, the indirect impact of Alternative 1 policy or the current FMP on subsistence is difficult to assess for the reasons discussed in this section. Impacts associated with lost joint production opportunities are likely

to be concentrated among small vessel owners in a relatively small number of communities. Indirect impacts associated with loss of income may affect subsistence pursuits in a wider range of communities, including the CDQ communities. Significant adverse impacts are not anticipated under Alternative 1 or its FMPs.

3.5 Alaska Native Environmental Justice Issues

Concerns regarding environmental equity are generally termed “environmental justice.” Environmental Justice can also be defined as “the determination of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, and/or socioeconomic status” (Bryant, 2001). Environmental Justice issues encompass a broad range of impacts including those on the natural and physical environment and related social, cultural, and economic effects. EO 12898 (1994) requires each federal agency to achieve Environmental Justice by addressing “disproportionately high and adverse human health and environmental effects on minority and low-income populations.” Environmental Justice impacts are not highlighted as an objective of any of the four policy alternatives that are being analyzed in this Programmatic SEIS. However, as Alaska Native populations may be affected by future policy objectives, it is important to consider these effects. Environmental Justice impacts were not highlighted in the Draft 2001 Programmatic SEIS, either for minority populations and low-income populations in general, or for Alaska Native populations in particular. This omission was a focus of public comment.

To address this shortcoming, a description of existing conditions concerning Environmental Justice was added to the Programmatic SEIS. The following sections provide an overview of differing Environmental Justice impacts by CDQ and non-CDQ regions.

3.5.1 Community Development Quota Region as Low-Income and Minority Population and Environmental Justice Related Impacts

The purpose of the CDQ program is to facilitate the participation of BSAI community residents in the BSAI fishery, as a means to develop local community infrastructure and increase general community and individual economic and social well-being. CDQ communities are by definition predominantly Alaska Native villages, as shown in Table 6. Alaska Native residents comprise 86.8 percent of the combined total population of all CDQ communities. They are remote, isolated settlements with few natural assets with which to develop and sustain a viable diversified economic base. As a result, economic opportunities have been few, unemployment rates have been chronically high, and communities (and the region) have been economically depressed.

While these communities border some of the richest fishing grounds in the world, they have largely been unable to take advantage of these opportunities. The full domestication of the BSAI fisheries occurred relatively quickly. However, the very high capital investment required to compete in these fisheries precluded small communities from participating in their development. The CDQ program serves to ameliorate some of these circumstances by extending an opportunity to qualifying communities to directly benefit from the productive harvest and use of these publicly owned resources.

The sixty-five coastal communities currently eligible to participate in the CDQ program are organized into six CDQ groups, with between one and 21 communities in each group. The CDQ communities are geographically dispersed, extending westward to Atka, on the Aleutian Island chain, and northward along the Bering coast to the village of Wales, near the Arctic Circle. Table 6 summarizes the six CDQ groups in terms of their approximate populations. The total population of the 65 CDQ communities in 2000 was estimated

Table 6. Alaska Native percentage of total community population, Alaska community development quota communities, 2000.

Community	% of Population
Aleutian Pribilof Island Community Development Association	
Akutan	16.4%
Atka	91.3%
False Pass	65.6%
Nelson Lagoon	81.9%
Nikolski	69.2%
Saint George	92.1%
Bristol Bay Economic Development Corporation	
Aleknagik	84.6%
Clark's Point	92.0%
Dillingham	60.9%
Egegik	76.7%
Ekuk	0.0%
Ekwok	93.8%
King Salmon	30.1%
Levelock	95.1%
Manokotak	94.7%
Naknek	47.1%
Pilot Point	86.0%
Port Heiden	78.2%
Portage Creek	86.1%
South Naknek	83.9%
Togiak	92.7%
Twin Hills	94.2%
Ugashik	81.8%
Central Bering Sea Fishermen's Association	
St. Paul	86.5%
Coastal Villages Fishing Cooperative	
Chefornek	98.0%
Chevak	95.9%
Eek	96.8%
Goodnews Bay	93.9%
Hooper Bay	95.8%
Kipnuk	98.0%
Kongiganak	97.2%
Kwigillingok	97.9%
Coastal Villages Fishing Cooperative (Continued)	
Mekoryuk	96.7%
Napakiak	96.6%
Napaskiak	98.2%
Newtok	96.9%
Nightmute	94.7%
Oscarville	100.0%
Platinum	92.7%
Quinhagak	97.3%
Scammon Bay	97.4%
Toksook Bay	97.6%
Tuntutuliak	98.9%
Tununak	96.9%
Norton Sound Economic Development Corporation	
Brevig Mission	92.0%
Diomedes	93.8%
Elim	94.9%
Gambell	95.8%
Golovin	92.4%
Koyuk	94.3%
Nome	58.7%
Saint Michael	93.2%
Savoonga	95.5%
Shaktolik	94.8%
Stebbins	94.7%
Teller	92.5%
Unalakleet	87.7%
Wales	90.1%
White Mountain	86.2%
Yukon Delta Fisheries Development Association	
Alakanuk	97.9%
Emmonak	93.9%
Grayling	91.8%
Kotlik	96.1%
Mountain Village	93.5%
Nunam Iqua	93.9%
Total All Villages	86.8%

Source: U.S. Census Bureau Census 2000

to be just over 27,000. However, this population figure may include a substantial number of individuals who are not year-round residents (Table 7). The administrative offices of CDQ groups tend to be located in regional hub communities, near government or industry partner offices, and/or near community or other ongoing projects.

To the extent that subsistence in the CDQ region experiences other adverse impacts, however, no significant adverse Environmental Justice impacts associated with income or joint production loss are anticipated under Alternative 1. These impacts could occur as a result of loss of income that would otherwise be applied to subsistence pursuits or as a result of the loss of subsistence opportunities through loss of joint production opportunities or through adverse impacts to subsistence resources themselves (as in the case of salmon bycatch). These would be considered Environmental Justice impacts to the Alaska Native CDQ communities independent of (or at least not directly related to) impacts to the CDQ program itself.

Table 7. Community development quota group populations (2000).

Community Development Quota (CDQ) Group	2000 Population*
Aleutian Pribilof Island Community Development Association	1,143
Bristol Bay Economic Development Corporation	5,932
Central Bering Sea Fisherman's Association	532
Coastal Villages Region Fund	7,855
Norton Sound Economic Development Corporation	8,488
Yukon Delta Fisherman's Development Association	3,123
Total	27,073

*The population estimate may include individuals who are not year-round residents.

Source: ADCED 2001, U.S. Census, 2000

3.5.2 Non-Community Development Quota Alaska Native Environmental Justice Issues

Groundfish Communities

The discussion in this section is organized into six different topical areas as outlined below. This organization reflects the complexity of the Environmental Justice issue for the Alaska groundfish fishery, the range of regions and communities that may experience impacts, and the complex nature of ties of specific regions and communities to different sectors of the fishery, all of which have implications for Environmental Justice outcomes. Each topic is discussed in turn, and includes conclusions by region and alternative, consistent with the organization of the social impact analysis sections in the main body of the Programmatic SEIS. The individual topics are:

- Community level Environmental Justice impacts.
- Catcher vessel fleet related Environmental Justice impacts.
- Catcher processor fleet related Environmental Justice impacts.

- Shore processor related Environmental Justice impacts.
- CDQ related Environmental Justice impacts.
- Subsistence related Environmental Justice impacts.

Groundfish Community Level Environmental Justice Impacts

For the Alaska Peninsula/Aleutian Islands region, alternatives projected to significantly reduce participation in pollock and Pacific cod fisheries would result in significant and profound impacts to those communities in the region most engaged in the fishery: Unalaska, Akutan, King Cove, and Sand Point. Beyond impacts to the fisheries-related sector of the economy, impacts would ripple through other sectors of the local economy. The degree to which other sectors would decline depends upon the relative level of integration of the processing and harvesting sectors with the rest of the community economy and the diversity within the fisheries-specific portion of the economy. Unalaska, with its substantial support service sector, would experience additional impacts, but this would not necessarily disproportionately impact Alaska Natives (outside of, perhaps, local Alaska Native corporation enterprises).

Fisheries-related local government revenues would also decline significantly, with the specific amount depending on the local tax structure. Given that King Cove and Sand Point are communities where Alaska Natives constitute a plurality, these potential adverse impacts are an Environmental Justice issue, as they would disproportionately accrue to a minority population. Akutan, with its unique dual traditional community/large groundfish plant industrial enclave structure, plus its CDQ engagement would also likely experience Environmental Justice impacts, but the local fishery support sectors are relatively undeveloped compared to the other regional groundfish communities. Other predominately Alaska Native communities of the AEB would experience a substantial decline in groundfish-related tax revenue with a groundfish fishery decline, and economic opportunities are generally limited in these communities. None of these types of impacts is anticipated under the Alternative 1 policy or the current FMP.

For the Kodiak region, commercial groundfish activity is highly concentrated in the City of Kodiak itself, a largely non-Native community. All regional groundfish processors, except one, are located there, as are 87 percent of the regionally owned catcher vessels that, in turn, account for fully 95 percent of the total ex-vessel value of the regionally owned fleet over the period from 1992 to 2000. As the Alternative 1 policy does not cause a reduction in Kodiak production and Alaska Native participation in the groundfish fishery, no Alaska Native Environmental Justice impacts are anticipated to result from Alternative 1 policy of the current FMPs.

For the southcentral and southeast Alaska regions, the Washington inland waters region, and the Oregon coast region, none of the alternatives is anticipated to result in adverse impacts at the community level. Therefore, Alternative 1 is not considered likely to produce Environmental Justice concerns in these regions for any low-income or minority population, including Alaska Natives.

Catcher Vessel Fleet Related Environmental Justice Impacts

Resident owners and crews of the catcher vessel fleet in the Alaska Peninsula/Aleutian Islands region are assumed to be representative of the overall population of their communities. Given that assumption, alternatives resulting in adverse impacts to regional catcher vessels would create Environmental Justice impacts and disproportionately accrue to a minority (Alaska Native) population in the region, as would be

the case in the communities of King Cove and Sand Point. These communities together accounted for 72 percent of all regionally owned groundfish vessels and 83 percent of the total regionally owned ex-vessel groundfish value over the 1992-2000 period (Table 2).

Some disproportionate impacts would also be likely in Unalaska/Dutch Harbor, where the local fleet accounted for 21 percent of all regionally owned groundfish vessels and 14 percent of the total regionally owned ex-vessel value during this same time span. It is not as clear, however, that this would be an Environmental Justice issue, given the overall demography of the community (less than 8 percent Alaska Native in 2000), despite the fact that Alaska Native residents may be more likely to be engaged in the catcher vessel sector of the fishery than is the general population due to length of residence and historical engagement in fishery activity in general, among other factors. (Catcher vessels from the Chignik/Peninsula area communities of Chignik Bay, Chignik Lagoon, Chignik Lake, Ivanof Bay, and/or Perryville have participated in the commercial groundfish fishery at higher levels since 1997 than by earlier years, and impacts to this fleet may be Environmental Justice issues, but data on the fleet are sparse.) Significant adverse impacts are not foreseen under the Alternative 1 policy or the current FMP.

With diminishing vessel participation, owners and crew in the Kodiak region will experience significant impacts similar to the Alaska Peninsula/Aleutian Islands region, but this is not likely to be an Environmental Justice issue, given the relatively small proportion of Alaska Natives in the overall community population. However, as would be the case in Unalaska/Dutch Harbor, Alaska Native residents in the Kodiak region may be more likely to be engaged in the catcher vessel sector of the fishery than the general population, due to length of residence and historical engagement in fishery activity, among other factors.

For catcher vessel owners and crews in the southcentral and southeast Alaska regions, there are no indications that the impacts to Alaska Natives would be adverse. No adverse Environmental Justice impacts to Alaska Native-owned catcher vessels are anticipated under the Alternative 1 or the current FMPs.

Catcher Processor Related Environmental Justice Impacts

Workforce populations associated with the catcher processor sector are largely associated with the Washington inland waters region in general, and the greater Seattle area in particular, where majority ownership of this sector is concentrated. It is important to note, however, that while individuals recruited from Washington dominate employment in this overall sector, some of the smaller entities within this sector are based in the Kodiak region. Alaskan crews and Alaska Native crews specifically, have been the focus of targeted hiring efforts in the sector for a number of years. This sector's workforce is significantly different demographically from the overall population of the greater Seattle area, based on 2000 U.S. Census data for the community and on industry-reported information for the same year. While the greater Seattle area is 23 percent minority, this workforce is 63 percent minority, according to industry data. The minority component of the various workforces within this sector was largely comprised of individuals of Hispanic or Asian ancestry.

Industry data indicate that in 2000, individual reporting entities were anywhere from about 36 percent to about 86 percent minority (Table 2). Therefore, any job losses experienced under the various alternatives would largely be jobs lost by minority workers. This would indicate a disproportionate adverse impact to a minority population, and therefore is an Environmental Justice impact. However, there is no indication that, on the sector level, these impacts would cause disproportionate impacts to Alaska Natives, so it is not

considered an Alaska Native Environmental Justice issue. However, employment associated with the catcher processor sector is important to a number of CDQ entities.

Shore Processor Related Environmental Justice Impacts

The workforce populations associated with the shore-based processing plants in the Alaska Peninsula/Aleutian Islands region are significantly different demographically from the overall populations of these communities, based on interpretation of U.S. Census data and on more recent industry-reported information. These workforces are largely comprised of minority workers, of primarily either Asian or Hispanic ancestry. Industry data indicates that, in 2000, 79 percent of the workers at the plants are minority individuals, and that individual reporting plants were anywhere from about three-quarters to over 90 percent minority (Table 3). While a complete sample of processors was not obtained, it is assumed for the purposes of this analysis (and, in part, on previous knowledge of the industry) that the large processors in the region are at least roughly equivalent in their workforce composition with respect to the general proportion of minority hires, if not in the specific combination of minority groups represented at each processor.

Significant employment losses at these plants would cause a disproportionately high, adverse impact on a minority population, and therefore would be considered an Environmental Justice impact. These impacts would be further accentuated by the fact that at least some of these workers have limited English language skills. This, combined with limited opportunities to acquire job skills in other economic sectors, would indicate that these minority workers would be less able than average American workers to easily gain employment outside of the seafood industry. This is not, however, an Alaska Native issue as even plants in predominately Alaska Native communities have extremely low Alaska Native employment in their workforces. This effect is not anticipated under the Alternative 1 policy.

A similar pattern is seen in the Kodiak region, where industry data, though incomplete, suggest that these jobs are overwhelmingly held by minority workers. If this pattern holds true, significant processor job losses would cause a disproportionately high, adverse impact on a minority population, and be considered an Environmental Justice issue. Again, however, this would not be an Alaska Native issue and is not an anticipated adverse impact on Alaska Natives resulting from the Alternative 1 policy.

For the southcentral and southeast Alaska regions, the Alternative 1 policy is not anticipated to result in adverse employment impacts to shore-based processors including Alaska Natives that may work for processors. Additionally, no Alaska groundfish shore-based processors are located in the Washington inland waters or Oregon coast regions. Therefore, Environmental Justice is not considered an issue for this sector in these regions.

Subsistence Related Environmental Justice Impacts

Subsistence impacts, in general, are an Environmental Justice issue due to the disproportionate involvement of Alaska Natives in subsistence pursuits (and the exclusive engagement of Alaska Natives in subsistence activities involving taking of marine mammals). As noted above, no direct negative impacts on groundfish subsistence use or Steller sea lion subsistence use are anticipated under Alternative 1. Indirect impacts, as a result of lost opportunities for joint commercial and subsistence production, are possible under some alternatives, however, and would most likely be experienced in King Cove, Sand Point, and Kodiak. Given the assumption that the King Cove and Sand Point catcher vessel fleets reflect the overall demographic structures of those communities, and given that those communities have many Alaska Native residents, to

the degree that joint production impacts are felt, they would likely be Environmental Justice impacts. For Kodiak, the white or non-minority residents are the majority, while the Alaska Native component of the population only accounts for 10 percent of the total population. Therefore, subsistence impacts in this community are not likely to result in an adverse Environmental Justice issue. Indirect significant adverse subsistence impacts resulting from a loss of commercial fisheries income are not likely under Alternative 1, but these impacts may be felt in a much wider range of communities, and are not possible to quantify with existing data.

Disproportionately high, adverse impacts to subsistence are not considered likely for the southcentral or southeast Alaska regions under Alternative 1. Subsistence impacts are not applicable to the Washington inland waters region or the Oregon coast region.

Non-Groundfish Communities

Under the Alternative 1 policy and the current FMPs subsistence impacts could affect non-CDQ communities and communities that are not directly participating in the groundfish fishery to some degree. The potentially affected regions span a large area, such as the Yukon and Kuskokwim regions, and include many communities. However, the effects of salmon bycatch on subsistence under the Alternative 1 policy or the current FMPs do not appear to be significantly adverse.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

4.1 Alaska Native Participation and Consultation in Fish Management

4.1.1 Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel

Under the Alternative 2 policy as illustrated by FMP 2.1 and 2.2, Alaska Native representation on the NPFMC and the AP would not change. It is assumed that one member would be appointed for each group to represent Alaska Native interests.

4.1.2 Public Involvement

Public involvement under the Alternative 2 policy would remain the same as described under the Alternative 1 policy, as it is a federal requirement.

4.1.3 Public Review and Comment on Fishery Management Plans, Fishery Management Plan Amendments, and Environmental Impact Statement Documents

Under FMP bookends 2.1 and 2.2, community outreach in relation to public review and comment and scoping on FMPs, amendments, EIS, comment analysis and response, and government-to-government consultation would not change.

4.1.4 Co-Management

The level of co-management under Alternative 2 policy would likely not change from Alternative 1.

4.1.5 Government-to-Government Consultation Requirements

Under the Alternative 2 policy framework as illustrated by FMPs 2.1 and 2.2, government-to-government would not change.

4.2 Traditional Knowledge

Under the Alternative 2 policy there would be no change from Alternative 1. Traditional Knowledge obtained from existing literature and public comments would be used as a source of information for fisheries management. Under Alternative 2, there is no formal consideration of Traditional Knowledge in the management of fisheries. A formal system for collecting and evaluation of Traditional Knowledge information would not be established by NOAA Fisheries.

4.3 Alaska Native Participation in Regional Fisheries by Regional Setting

4.3.1 Community Development Quota Regional Issues

Under the Alternative 2 policy as illustrated by FMP 2.1, as noted in the main body of this Programmatic SEIS and in Appendix F-8, the Overcapacity discussion paper, CDQ for all groundfish species except for pollock would be repealed. The multi-species groundfish CDQ program has steadily grown in relative importance since its inception, and in 2000 it accounted for approximately one-tenth of all CDQ royalties. Due to the loss of revenue and other economic and employment opportunities under this bookend alternative, repeal of the multi-species program would generate adverse impacts to CDQ groups. However, under FMP 2.1, the pollock fishery would expand substantially over baseline conditions, so it is assumed that the pollock CDQ program would proportionally expand with the rest of that fishery. In terms of net change, this expansion is of sufficient magnitude that it would offset the losses incurred as a result of the discontinuation of the multi-species program on an overall or general level, but it is the case that losses and gains would not be evenly distributed among CDQ groups due to differential reliance on the various species under the overall CDQ program (and within the multi-species program in particular). As a result, the significance of direct/indirect effects to individual CDQ groups are unknown. Under FMP 2.2, CDQ would not change from Alternative 1; thus, no adverse impacts are anticipated.

4.3.2 Non-Community Development Quota Regional Issues

Non-CDQ Alaska Native Community Issues/Direct Participation

No Alaska Native issue-related negative impacts are foreseen for these communities under this alternative.

Non-CDQ Alaska Native Community Issues/no Direct Participation

Impacts to these communities are summarized in Section 4.5 below.

4.4 Subsistence Issues

4.4.1 Steller Sea Lion Subsistence

FMP 2.1 is not anticipated to have any demonstrable impact on Steller sea lion subsistence, for reasons detailed in the Alternative 1 discussion. Communities experiencing direct adverse fishery impacts due to groundfish fishing restrictions under FMP 2.2 would not benefit from improved Steller sea lion subsistence opportunities.

4.4.2 Salmon Subsistence and Bycatch Related Issues

As discussed in Appendix F-5 (Bycatch Qualitative Analysis Paper) under Alternative 1, it is possible that current PSC restrictions in the BSAI management region may not provide adequate protection to some depleted western chinook salmon stocks. If this is the case, the removal of PSC limits could exacerbate the situation and more at-risk chinook salmon might be taken. Further, the status quo PSC limit of 48,000 fish represents about 19.2 to 36.9 percent of the combined Arctic-Yukon-Kuskokwim and Bristol Bay chinook salmon landings reported between 1997 and 1999. This is a substantial portion of the domestic harvest.

Elimination of PSC limits would increase these proportions even further. This could potentially result in impacts to Alaska Native communities with substantial subsistence salmon fisheries dependent on these stocks, but further analysis is needed to confirm this possibility.

4.4.3 General Ecosystem Concerns about Volume of Fishery Removals

A more aggressive harvest strategy under this alternative would not impact Alaska Native concerns regarding this issue.

4.4.4 Other Indirect Subsistence Impacts

Joint Production Subsistence Impacts

More intense fishing efforts under the Alternative 2 policy may increase the opportunity for joint production opportunities for those continuing to participate in the fishery, but whether or not this impact would provide a significant benefit is not clear from available data.

Income-Related Subsistence Impacts

As noted in the Alternative 1 discussion, it would not appear to be possible to quantify impacts from changes of the magnitude anticipated under this alternative.

4.5 Alaska Native Environmental Justice Issues

4.5.1 Community Development Quota as Low-Income and Minority Population

Repeal of the multi-species groundfish CDQ allocations under FMP 2.1 (as noted in Section 4.4.1) could result in Environmental Justice impacts. These impacts, if they were to occur, would result from declines in employment and income and in revenues through royalties from CDQ participation and direct participation in the relevant fisheries. The direct participation impacts, if relevant, would result from the type of investments made by CDQ entities as described in detail in Section 3.9.4 of the Draft 2001 Programmatic SEIS. However, as noted above, losses in the multi-species CDQ program may be largely or entirely offset by increases in returns from the pollock CDQ program under FMP 2.1, but this will likely vary among individual CDQ groups. Although specific direct/indirect impacts are unknown at this time, any adverse impacts that do occur would disproportionately accrue to the minority and low-income populations that the CDQ program was explicitly designed to benefit and would qualify as Environmental Justice impacts. As the CDQ program does not change under FMP 2.2, similar Environmental Justice concerns do not apply.

4.5.2 Non-Community Development Quota Alaska Native Environmental Justice Issues

Groundfish Communities

Community Level

No community level impacts specific to Alaska Native communities are anticipated under Alternative 2 policy as illustrated by FMPs 2.1 and 2.2.

Sub-Community Level

No sub-community level impacts specific to Alaska Natives are anticipated under Alternative 2 policy as illustrated by FMPs 2.1 and 2.2.

Non-Groundfish Communities

If potential impacts to Western and Interior Alaska Native communities noted in Section 4.5.3, such as depletion of salmon stocks, come to fruition, these would be considered Environmental Justice impacts.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

5.1 Alaska Native Participation and Consultation in Fisheries Management

5.1.1 Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel

The Alternative 3 policy framework seeks to accelerate the existing precautionary management approach through community or rights-based management, incorporation of ecosystem-based management principles and, where appropriate and practicable, increased habitat protection and additional bycatch constraints. Therefore this alternative requires a more precautionary approach to fisheries management than the current Alternative 1 policy. Alaska Native representation on the NPFMC and the AP under the Alternative 3 policy framework would increase. Currently, Alaska Natives are represented on both the NPFMC and AP. FMP 3.2 could provide the mechanism to incorporate an Alaska Native seat on NPFMC and a voluntary position for non-CDQ Natives in the AP to represent other stakeholders. The MSA defines a position for Native American representation on the Pacific Fishery Management Council. Section 302 Regional Fishery Management Councils (16 USC 1852, Voting Members (b)(5)(A)), states “The Secretary shall appoint to the Pacific Council, a group with management authority for fisheries in California, Oregon, Washington, and Idaho, one representative of an Indian tribe with Federally recognized fishing rights from a list of not less than 3 individuals submitted by the tribal governments. The Secretary, in consultation with the Secretary of the Interior and tribal governments, shall establish by regulation the procedure for submitting a list under this subparagraph.” This regulation only applies to the Pacific Fishery Management Council, and is not a requirement for the NPFMC managing the Alaska groundfish fisheries.

5.1.2 Opportunity for Public Comment

Under the Alternative 3 policy as illustrated by the FMP bookends 3.1 and 3.2, Alaska Native consultation would increase. Possible ways to increase public involvement and Alaska Native participation could include separate meetings with Alaska Native communities and corporations for input on FMPs and amendments. Currently, the USFWS Federal Subsistence Program incorporates Alaska Natives in management through ten Regional Advisory Councils established under Title VIII of Alaska Native Interest Lands Conservation Act (ANILCA). These Advisory Councils provide recommendations and information to the Federal Subsistence Board related to policies and plans for managing subsistence. Regional Advisory Councils hold their own public meetings to discuss regulations and allow for local public input. The Regional Councils serve as liaisons between communities and the Subsistence Board.

Under the Alternative 3 policy, NOAA Fisheries and the NPFMC could take advantage of the existing Regional Councils to begin incorporating more Alaska Native input on fisheries management. Regional Advisory Councils could hold public meetings for FMPs and amendments. NPFMC and AP representatives could arrange meetings with these communities and corporations to gather input prior to any NPFMC decisions on fisheries management. Exploration of various methods such as increased personal contact with Alaska Natives by the NOAA Fisheries/NPFMC by telephone or in-person; creation or revision of official NOAA Fisheries/NPFMC Alaska Native policy; and creation of Alaska Native liaison positions in NMFS/NPFMC could be incorporated. The NPFMC could also solicit input from Alaska Native corporations

and regional non-profit groups. Exploration of various methods such as internships for Alaska Native students at NOAA Fisheries/NPFMC (including science centers), funding for travel to NPFMC meetings, video conferencing, addition of an Alaska Native seat on the AP could be incorporated. These approaches are often used by other federal agencies for projects that may impact Alaska Native interests and has proven to be an effective way to enhance Alaska Native participation.

5.1.3 Co-Management

Co-management under the Alternative 3 policy would increase Alaska Native participation in fisheries management. Alaska Native participation in the NPFMC Observer Program could increase their involvement in gathering fisheries information. Regional Advisory Councils described above could be charged with providing the NPFMC with regular updates on local needs, concerns, and ideas about how to collaborate on managing the fishery. Providing communities with more responsibility could create a stronger sense of involvement and potentially reduce conflict among stakeholders and the NPFMC.

There are other federal agencies who have increased Alaska Native participation in co-management. The Federal Subsistence Program is a multi-agency effort made up of five federal agencies that emphasize cooperation and consensus building with rural Alaskans with regard to subsistence issues. As part of this effort, 10 Regional Advisory Councils have been created to review policies and management measures and provide recommendations and information to the Federal Subsistence Board. Each Regional Council has 10 or 13 members and meets at least twice each year. Regional Councils may develop and review proposals regarding subsistence use. Public meetings are also held by the Regional Councils to involve local people in establishing regulations. An Annual Report must be prepared by each Regional Council every year containing recommendations to the Federal Subsistence Board on subsistence regulations and management policies.

5.1.4 Consultation and Coordination with Indian Tribal Governments

Under the Alternative 3 policy framework as illustrated by FMPs 3.1 and 3.2, community outreach and government-to-government representation, consultation requirements, and increased participation, would include efforts to promote increased personal contact with Alaska Natives. This may include more teleconferences and scheduled meetings with Alaska Natives as well as an increased effort to include a wider array of Alaska Native groups. Under this Alternative scoping, comment analysis and response, and public review and comment on the NEPA documents would not change.

5.2 Traditional Knowledge

The Alternative 3 policy is similar to the Alternative 1 policy, but would increase incorporation of Traditional Knowledge into fisheries management and NEPA compliance. Under the FMP 3.1, formal procedures would be developed and implemented to incorporate Traditional Knowledge into fishery management. The FMP 3.2 requires incorporation of Traditional Knowledge through additional research such as key informant interviews. Implementation of this type of FMP would require working with Alaska Native organizations to develop research programs and protocols, and would need to be coordinated with community outreach and government-to-government consultation efforts.

Increasing the level of co-management provides an avenue to incorporate more Alaska Natives in fisheries research. Exploration of various methods such as making available a research database of published Traditional Knowledge for incorporation into NOAA Fisheries documents and implementing guidelines to obligate decision-makers to address issues could be incorporated. This research would be defined as field research on specific topics of importance as intended under the Alternative 3 management policy. Again, using the Regional Advisory Councils established for subsistence management under ANILCA would offer ways of including more traditional knowledge, skills, and fisheries practices into the Alaska groundfish fisheries. Regional Advisory Councils could provide recommendations to the NPFMC on research priorities. Advisory Councils could also appoint small research groups throughout the state to help gather data on water quality, marine mammals, seabirds, fish, and general ecology. These widely distributed research groups would supplement federal and state research efforts and increase the amount of information on the North Pacific ecosystem as well as very localized areas where data may be lacking.

5.3 Alaska Native Participation in Regional Fisheries by Regional Setting

5.3.1 Community Development Quota Regional Issues

It is unclear to what extent increased rationalization would result in increased CDQ allocation. Assuming that additional fisheries are rationalized and CDQ allocation increased, there would be beneficial effects on CDQ groups.

5.3.2 Non-Community Development Quota Regional Issues

As noted in the Overcapacity qualitative analysis paper, the harvesting and processing sectors of the fishing industry in Alaska and elsewhere are labor-intensive and often located in relatively isolated communities. King Cove and Sand Point, two communities with Alaska Native populations, are examples of such communities. Based on experience with earlier rationalization programs, IFQs in groundfish fisheries could lead to a reduction in the number of vessels in the harvest sector and a decline in overall employment. Similarly, some processing consolidation may be expected to occur, but the extent to which this is likely to impact King Cove and Sand Point is difficult to assess, given the changes that occurred in the recent past under American Fisheries Act conditions. In general, rationalization effects under the Alternative 3 policy can be expected to disrupt the local economies of King Cove and Sand Point to some degree, especially during the transition from open access to an IFQ program, but the magnitude of this disruption remains to be assessed.

Non-CDQ Alaska Native Community Issues/Direct Participation

Under the Alternative 3 policy illustrated by FMPs 3.1 and 3.2, consolidation of sectors could lead to community level impacts in the Alaska Native communities of King Cove and Sand Point. As noted earlier, the degree to which consolidation takes place is a function of both individual enterprise decision-making (e.g. the efficient operation of a multi-species plant in an isolated community may require groundfish inputs where otherwise consolidation away from a community would make economic sense) and direct restrictions of movement (community protection clauses) or consolidation caps to prevent such movement.

5.4 Subsistence Issues

5.4.1 Groundfish Subsistence

Alternative 3 is not anticipated to have any demonstrable direct impact on groundfish subsistence. This is primarily due to relatively low groundfish subsistence dependency, the assumption that groundfish stocks would not be overfished, and the lack of restrictions on groundfish subsistence under this alternative.

5.4.2 Steller Sea Lion Subsistence

Given the lack of availability of information, it is not possible to measure or predict effects of Alternative 3 on subsistence in order to determine whether or not such theoretically positive effects would be significant as a result of decreased commercial harvests. Logically, management policies that reduce commercial groundfish harvest the most could have the most potential benefit for the subsistence use of Steller sea lions, but operationally such differences will likely be slight. In general, somewhat positive effects could result if reductions in groundfish harvest lead to increased sea lion populations, and if higher sea lion populations result in benefits to subsistence users of sea lions. Such benefits could include higher harvest levels and lower harvest costs for sea lions; the degree to which subsistence reliance on Steller sea lions could be affected by the proposed alternatives cannot be quantified given the lack of data, but it is not likely to be great.

5.4.3 Salmon Subsistence and Bycatch Related Issues

Under the Alternative 3 policy, PSC limits in the BSAI would be lowered to the extent practical from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2). Any benefit conferred by lower bycatch would eventually allow for higher harvests in the state's commercial, subsistence, and recreational fisheries. Because salmon stocks in Alaska are rigorously managed by ADF&G and are generally considered healthy, with the exception of some western stocks, any additional protection afforded salmon populations under Alternative 3 would, therefore, have no long-term effect on stock status. The possible exceptions are at-risk western stocks of chinook salmon that may be taken as bycatch in the BSAI (see Alternative 1 discussion 3.5.3). It would be difficult to quantitatively determine if increased protection offered under Alternative 3 would be sufficient to protect these stocks from further depletion. Qualitatively, reduced PSC limits ranging from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2) should offer proportionate protection to at-risk chinook salmon stocks. In general, however, this alternative would result in neutral or positive effects with respect to Alaska Native subsistence use of these stocks.

5.4.4 Other Indirect Subsistence Impacts

Joint Production Subsistence Impacts

Rights-based fishing efforts under Alternative 3 would increase the opportunity for joint production opportunities for those continuing to participate in the fishery, but anticipated consolidation of the fleet may offset this potential gain.

Income-Related Subsistence Impacts

Income to commercial fishermen may be expected to rise under Alternative 3, but this may be offset by an overall reduction in the number of participants in the fishery as consolidation occurs. As noted in the Alternative 1 discussion, it would not appear to be possible to quantify subsistence-income-related impacts from changes anticipated under this alternative.

5.5 Alaska Native Environmental Justice Issues

5.5.1 Community Development Quota as Low-Income and Minority Population

It is unclear to what extent increased rationalization under Alternative 3 would result in an increased CDQ allocation. Assuming that additional fisheries are rationalized and CDQ allocation increased, there would be beneficial effects on CDQ groups.

5.5.2 Non-Community Development Quota Alaska Native Environmental Justice Issues

Groundfish Communities

Community Level

Under Alternative 3, the type of community level impacts as noted for King Cove and Sand Point would be Environmental Justice impacts, and the ripple effects within the AEB could also result in Environmental Justice impacts in other AEB communities, as described under Alternative 1. If Kodiak's participation in the groundfish fishery is reduced under Alternative 3, the alternative would have significant socioeconomic effects upon the region, and especially the community of Kodiak, given the local engagement in and dependency on the groundfish fishery. The City of Kodiak's population is a non-majority plurality, and the Alaska Native population component is relatively small (less than 11 percent). It is not considered likely that these would be Environmental Justice impacts, at least on the community level.

For the southcentral and southeast Alaska regions, the Washington inland waters region, and the Oregon coast region, none of the alternatives is anticipated to result in adverse impacts at the community level. Therefore, Alternative 3 is not considered likely to cause Environmental Justice concerns in these regions for any low-income minority population, including Alaska Natives.

Sub-Community Level

The only sector within the fishery subject to potential impacts under this alternative that would involve Alaska Native Environmental Justice issues is the harvest fleet. Presumably, vessel owners would be compensated for lack of continued participation under different consolidation scenarios, but skipper and crew job losses could cause disproportionate effects on Alaska Native populations in some communities. Although crew demographic information is sparse, it is assumed that King Cove and Sand Point would be among the set of potential communities involved.

Non-Groundfish Communities

No negative impacts are anticipated for these communities, described in Section 5.5.3, and therefore there are no Environmental Justice implications for this region under the Alternative 3 policy.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

6.1 Alaska Natives and the Magnuson-Stevens Act

6.1.1 Alaska Native Representation on the North Pacific Fishery Management Council and the Advisory Panel

The Alternative 4 policy framework, a highly precautionary approach to fisheries management, would increase Alaska Native involvement in the NPFMC and the AP. One way to ensure Alaska Native participation in these groups would be to amend the MSA to guarantee two positions for Alaska Natives in both the NPFMC and the AP. Native American representation is currently part of the MSA for the Pacific Council, which has authority over Washington, Oregon, California, and Idaho. Although this has always been the traditional practice of the NPFMC, making it a written part of the MSA would not only give Alaska Natives a sense of their importance in fisheries management but such action would increase the ratio of Alaska Native representation in the decision-making process.

6.1.2 Public Involvement

The Alternative 4 policy as illustrated by the FMPs 4.1 and 4.2 would increase the opportunity for public involvement and public comment through ways suggested under the Alternative 3 policy. This may include enlisting the Regional Advisory Councils established under ANILCA to solicit Alaska Native community input. Additional efforts would encourage subsistence users to provide more input on fisheries management and their concerns on the relationship of management policies with subsistence management. Under this policy, the NPFMC and NOAA Fisheries may increase the level of cooperation with the Federal Subsistence Board and ADF&G to broaden their outreach on fisheries management.

Under the Alternative 4 FMP bookends, scoping, public review and comment on the NEPA documents, and comment analysis and response would not change. However, community outreach may need to develop and incorporate procedures whereby traditional knowledge is obtained during community outreach efforts. Community outreach should include increased consultation efforts to encourage participation and to address the needs of subsistence users through increased participation.

6.1.3 Co-Management

Under the Alternative 4 policy, the NPFMC, NOAA Fisheries, and Alaska Native communities would seek to enter into a collaborative management agreement in which Alaska Natives are given an increased level of authority greater than currently exists under the updated Alternative 1 policy. A series of Management Boards could be created throughout the region under this effort. Not only would the NPFMC seek Alaska Native input on FMPs and amendments from these Alaska Native Management Boards, but also such groups could come up with action plans for particular issues. These plans may help address issues such as localized depletion and provide a means of incorporating traditional knowledge into fisheries management. A Fisheries Joint Management Committee was established in Canada as part of the Inuvialuit Final Agreement of 1984. Joint management by this Committee is accomplished through a 50 percent Native representation. This type

of consensus-based, non-adversarial method of management has proved successful according to industry and academic perspectives (Campbell 1996).

6.1.4 Government-to-Government Consultation Requirements

Under the Alternative 4 policy framework and as illustrated by FMP bookends 4.1 and 4.2, government-to-government representation, consultation requirements, and participation would likely increase as a result of additional Alaska Native involvement and community outreach.

6.2 Traditional Knowledge

The Alternative 4 policy includes the Traditional Knowledge elements of the Alternative 3 policy, and would initiate cooperative programs for research and monitoring based on Traditional Knowledge. FMP 4.1 would require that fishery managers initiate cooperative research programs for data gathering and monitoring in order to enhance the use of Traditional Knowledge in fishery management. As with Alternative 3, this alternative would require working with Alaska Native organizations to develop research and monitoring programs and protocols, and would need to be coordinated with community outreach and government-to-government consultation efforts. This outreach may include subsistence user groups such as the United Fishing Association.

Alaska Native Management Boards established under this management policy could develop research plans outlining goals and objectives for the NPFMC. This Alaska Native perspective would increase the use of Traditional Knowledge in fisheries research, giving it more emphasis in the scientific community. This approach may also provide fisheries scientists with access to a broader, historical understanding of the ecosystem. Not only could Alaska Natives participate in collecting important scientific data, as suggested under the Alternative 3 policy, but they could create an endowment for local high school students who are thinking of going into fisheries management. The endowment could provide funding for perhaps two to four students a year to assist the Alaska Native Management Boards in collecting Traditional Knowledge and subsistence use in their communities. The Alaska Native Management Boards could then provide this information to the NPFMC and NOAA Fisheries to augment their understanding of the fisheries to include in their database.

6.3 Alaska Native Participation in Regional Fisheries by Regional Setting

6.3.1 Community Development Quota Regional Issues

Under the Alternative 4 policy commercial fishing reductions or elimination would result in significant negative impacts to the CDQ region. As noted in the discussion of the Alternative 1 policy and its effects, this region derives substantial benefit from this program, groundfish plays a dominant role in generating income within this program, and alternative opportunities for income and revenue are generally limited in this region.

6.3.2 Non-Community Development Quota Regional Issues

Non-CDQ Alaska Native Community Issues/Direct Participation

Impacts to communities directly participating in the groundfish fishery would be significant under the Alternative 4 policy. While this would encompass many Alaska coastal communities, the Alaska Native communities that would be hardest hit would be King Cove and Sand Point. These communities each have a local harvest fleet, a significant shore processing presence, and a number of support service businesses that would all experience substantial economic losses under this alternative. Further, municipal and borough revenue losses would be felt in these and other AEB communities.

Non-CDQ Alaska Native Community Issues/No Direct Participation

Issues in this region are largely tied to salmon subsistence fishing, and these are summarized in Section 6.5.3.

6.4 Subsistence Issues

6.4.1 Groundfish Subsistence

The Alternative 4 policy as illustrated by FMP bookends 4.1 and 4.2 is not anticipated to have any demonstrable direct impact on groundfish subsistence. This is primarily due to relatively low groundfish subsistence dependency and the assumption that groundfish stocks would not be overfished. Although FMP 4.2 has the potential to restrict subsistence harvest until information demonstrates that it has no significant impact on the environment, the level of groundfish subsistence harvest is so minimal it is assumed that subsistence fishing in the Exclusive Economic Zone (EEZ) would not be permanently restricted under the FMP bookend. It is also assumed that most subsistence groundfish fishing takes place in nearshore waters minimizing whatever potential impacts, however slight, that would result from this alternative policy. Lowering or virtually eliminating commercial fishing effort under this alternative would theoretically make more groundfish available for subsistence use, but there is no indication of current unmet demands that would be accommodated under Alternative 4 conditions.

6.4.2 Steller Sea Lion Subsistence

Potential impacts noted under the Alternative 3 policy would apply to the Alternative 4 policy.

6.4.3 Salmon Subsistence and Bycatch Related Issues

Under the Alternative 4 policy, PSC limits in the BSAI would be lowered to the extent practical to 30-50 percent (FMP 4.1) or to PSC = 0, the closure of the fishery (FMP 4.2). In the GOA, PSC limits would be established at 25,000 fish for chinook and 20,500 fish for other salmon (FMP 4.1) and would remain in effect until complete closure of the fishery (FMP 4.2). As noted under Alternative 3, however, because salmon stocks in Alaska are rigorously managed by ADF&G and are generally considered healthy (with the possible exception of some western stocks), any benefit conferred by lower bycatch would eventually be offset by higher harvests in the state's commercial, subsistence, and recreational fisheries. The possible exceptions are at-risk western stocks of chinook salmon that may be taken as bycatch in the BSAI. As noted in the Alternative 1 discussion, there is insufficient information to determine if these at-risk stocks are being

seriously impacted by bycatch in the BSAI under the existing conditions. In general, however, Alternative 4 would have neutral or positive effects on Alaska Native salmon subsistence uses.

6.4.4 General Ecosystem Concerns About Volume of Fishery Removals

The Alternative 4 policy would address concerns expressed by Alaska Natives about the volume of fishery removals and general ecosystem health as it is a highly precautionary approach to fisheries management.

6.4.5 Other Indirect Subsistence Impacts

Joint Production Subsistence Impacts

The drastic reduction of fishing effort under Alternative 4 would sharply reduce, if not eliminate, the joint production subsistence opportunities until more information was obtained about the frequency and intensity of fishing impacts on the environment, potentially re-opening the fishery. These impacts would effect all communities where there are Alaska Native-owned vessels participating in the fishery.

Income Related Subsistence Impacts

Loss of income under Alternative 4 would be significant, but forecasting this to engagement in subsistence pursuits is problematic, as discussed under Alternative 1. In general, however, it can be anticipated that these types of impacts would be felt in many rural Alaska communities.

6.5 Alaska Native Environmental Justice Issues

6.5.1 Community Development Quota as Low-Income and Minority Population

Significant adverse impacts to CDQ regions are anticipated under the Alternative 4 policy and would constitute Environmental Justice impacts.

6.5.2 Non-Community Development Quota Alaska Native Environmental Justice Issues

Groundfish Communities

Community Level

Direct adverse community level impacts to Alaska Native communities can be expected for King Cove and Sand Point, as well as smaller Alaska Native communities in the AEB. These would, in turn, be considered Environmental Justice impacts. Akutan and Unalaska, communities with more or less distinct Alaska Native population components, would experience significant impacts as well. If Kodiak participation in the groundfish fishery is reduced under Alternative 4, it would have significant socioeconomic effects upon the region, and especially the community of Kodiak, given the local engagement in and dependency on the groundfish fishery. The City of Kodiak's population is a non-majority plurality, and the Alaska Native population component is relatively small (less than 11 percent). It is not considered likely, therefore, that these would be Environmental Justice impacts, at least on the community level.

For the southcentral and southeast Alaska regions, the Washington inland waters region, and the Oregon coast region, none of the alternatives is anticipated to result in adverse impacts at the community level. Therefore, Alternative 4 is not considered likely to cause Environmental Justice concerns in these regions for any low-income minority population, including Alaska Natives.

Sub-Community Level

Displacement of all fishery sectors could occur under this alternative. This would be considered an Alaska Native Environmental Justice issue, specifically for the harvest vessel sector, for reasons presented in the Alternative 1 discussion.

Non-Groundfish Communities

Impacts to these communities would largely be driven by salmon subsistence issues as described above.

Section 7 Summary Comparison of All Alternatives

The following summarizes the effects of each policy alternative with regard to Alaska Native issues and the Alaska groundfish fisheries, as determined by analyses of each alternative's associated FMP framework presented in this paper. Table 8 shows a summary of the effects of the FMPs on Alaska Native issues.

Alternative 1: Under this policy alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy approach would continue Alaska Native involvement by maintaining Alaska Native representation on the NPFMC and the AP and by incorporating Traditional Knowledge presented in existing literature in fisheries management. Alaska Native participation in accordance with MSA and NEPA would continue under this alternative. CDQ participation would also remain the same as under existing conditions. The nature of engagement with the fishery would not change, meaning that no significant changes to CDQ communities would be likely to occur, at least through the mechanism of the CDQ program itself. Subsistence fishing and Steller sea lion harvest is not anticipated to be adversely affected by the Alternative 1 policy, though Alaska Natives have voiced concern over salmon bycatch from the groundfish fisheries. Under Alternative 1, there would be minimal impacts from the loss of income from the groundfish fisheries, that may indirectly impact subsistence pursuits in many communities, including CDQ communities. No Environmental Justice impacts are anticipated under the Alternative 1 policy, with the potential exception of salmon bycatch, where effects are not known.

Alternative 2: A more aggressive harvest policy would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. Although no impacts are anticipated for non-CDQ communities, the CDQ program for all groundfish species except pollock would be repealed (under FMP 2.1 only). Therefore, CDQ communities with investments in these fisheries would be significantly impacted, but these impacts may be offset in whole or in part by the increase in revenues from the pollock CDQ program. No groundfish subsistence impacts are anticipated under this policy alternative; however, the elimination of PSC limits would increase the proportion of salmon bycatch. This could potentially result in impacts to Alaska Native communities with substantial dependency on salmon subsistence. Reductions in the CDQ program and potential effects on salmon subsistence would result in Environmental Justice impacts under Alternative 2.

Alternative 3: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic or conservation needs and to address uncertainty in management information. Elements of this policy alternative that pertain to Alaska Natives include developing and implementing procedures to incorporate traditional knowledge into fisheries management through additional research. Consultation with and representation of Alaska Natives in fisheries management would increase under this policy and additional opportunities for co-management of the fisheries would be provided. Alaska Native participation in accordance with NEPA would continue under this alternative.

Increased rationalization of fisheries could benefit CDQ groups. No impacts to subsistence are anticipated under Alternative 3 other than the potential for reduced salmon bycatch. Potential Environmental Justice impacts on non-CDQ Alaska Native communities that harvest groundfish commercially may result from this alternative. However, communities that do not harvest groundfish commercially will likely not be impacted.

Alternative 4: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. It would involve a strict interpretation of the precautionary principle. The overall premise is that fishing does produce adverse impacts on the environment, but due to a lack of information and uncertainty, little is known about these impacts. With regards to Alaska Native issues, this policy alternative would require the initiation of cooperative research programs for data gathering and monitoring in order to enhance use of Traditional Knowledge in fishery management. Alaska Native participation in decision-making in accordance with MSA and NEPA would continue under all alternatives. Consultation with Alaska Natives would increase and participation of subsistence users (Native and non-Native) in fisheries management would be strongly encouraged. Traditional Alaska Native subsistence uses of fish and wildlife within protected areas would be permitted under FMP 4.1. Reductions in or elimination of commercial fishing under FMP 4.2, however, would result in significant adverse impacts to the CDQ region and to non-CDQ Alaska Native communities participating in the fishery (as well as individual Alaska Native vessel owners and others who participate in the fishery). This may result in Environmental Justice impacts to these communities. Under FMP 4.2, no fishing, including subsistence, would be permitted in the Exclusive Economic Zone without a determination that subsistence fishing is having no significantly adverse effect on the environment. This strategy could greatly affect subsistence use until more information determined otherwise.

Groundfish management alternatives that involve substantial CDQ reductions will result in disproportionate high and adverse impacts to the predominately Alaska Native CDQ region communities. As noted in above, Alaska Native population component represents 87 percent of the total population of the communities of this region. Further, as recognized by the very initiation of the CDQ program, the region is economically underdeveloped and employment and income alternatives are few. CDQ impacts would be felt in a number of different ways, including employment, income, revenues, royalties, and return on fishery investments.

Section 8 References

- Alaska Department of Community and Economic Development (ADCED). (2001). "Alaska Economic Information System" Department of Community and Economic Development. <http://www.dced.state.ak.us/home.htm>.
- Alaska Department of Fish and Game (ADF&G). (2001). "Alaska Subsistence Fisheries 1999 Annual Report." Division of Subsistence, ADF&G, Juneau, AK. Available on-line: <http://www.subsistence.adfg.state.ak.us/download/asf1999.pdf>.
- Brown, D. (1999). "Principles and Practice of Forest Co-Management: Evidence from West Central Africa." London, Overseas Development Institute: 31.
- Bryant, Ph.D., B. (2001). "What is Environmental Justice? A Broad based Definition." Environmental Justice Archive attached to Personal Home page of Dr. Bryant. <http://www.personal.umich.edu/~bbryant/envjustice.html>
- Campbell, T. (1996). "Aboriginal Co-Management of Non-Renewable Resources on Treaty or Traditional Territory." Master thesis submitted to the Committee on Resources and the Environment: University of Calgary.
- Castro, A.H.P. and E. Nielsen. (2001). Indigenous People and Co-Management: Implications for Conflict Management. *Environmental Science and Policy* 4(4/5): 229-239.
- Coffing, M.W. (1991). "Kwethluk Subsistence: Contemporary Land Use Patterns, Wild Resource Harvest and Use and the Subsistence Economy of a Lower Kuskokwim River Area Community. ADF&G Technical Paper 157. Alaska Department of Fish and Game, Division of Subsistence, Juneau, AK.
- Freeman, M.M.R. (1992). The Nature and Utility of Traditional Ecological Knowledge. *Northern Perspectives* 20:1.
- Freeman, M.M.R. and L.N. Carbyn, (eds.). (1988). "Traditional Knowledge and Renewable Resources Management in Northern Regions." Occasional Paper No. 20, Boreal Institute for Northern Studies, Edmonton.
- Hobson, G. (1992). "Traditional knowledge is science." *Northern Perspectives* 20(1): 2
- Johnson, M. (1992). "Lore: Capturing Traditional Environmental Knowledge." Ottawa: Dene Cultural Institute/IDRC.
- McCay, B.J. and S. Jentoft. (1998). Market or Community Failure? Critical Perspectives on Common Property Research. *Human Organization* 57(1): 21-29.
- Northern Economics, Inc. (2002). "An assessment of the socioeconomic impacts of the western Alaska Community Development Program." Report prepared for the Alaska Department of Community and Economic Development, Anchorage.

U.S. Census Bureau. (2000). Downloadable information available on-line at: www.census.gov

Witherell, D., D. Ackley, and C. Coon. (2002). An Overview of Salmon Bycatch in Alaska Groundfish Fisheries. *Alaska Fishery Research Bulletin* 9(1):53-64.

Table 8. Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Subsistence							
Steller sea lion	No effect To the extent that Alternative 1 does not effect Steller sea lions population levels and indirectly restrict availability for subsistence purposes, it will have no direct adverse effects upon subsistence uses of Steller sea lions.	Potentially adverse effect An increase in total allowable catch (TAC) increases competition for prey with Steller sea lion and could have a possible adverse effect on sea lion populations, and could affect the availability for subsistence harvest. demonstrable impact on Steller sea lion subsistence.	No effect Similar to Alternative 1, Steller sea lions population levels are not affected by fishing for groundfish, and FMP 2.2 will have no direct adverse effects upon subsistence uses of Steller sea lions.	Potentially beneficial effect Management policies that reduce TAC and bycatch levels potentially benefit the availability of Steller sea lions for subsistence purposes. The relative contribution of effects of fishing on Steller sea lion abundance compared to other natural environmental factors is considered small.		Potentially beneficial effect Management policies that reduce TAC and bycatch levels potentially benefit the availability of Steller sea lions for subsistence purposes. FMP. The relative contribution of effects of fishing on Steller sea lion abundance compared to other natural environmental factors is considered small.	
Salmon bycatch	No effect The amount of salmon bycatch and contribution to potential effects on western Alaska stocks would appear relatively low, although Alaska Natives have voiced concern over salmon bycatch from the groundfish fisheries.	Potentially adverse effect Elimination of prohibited species catch (PSC) restrictions in the Bering Sea and Aleutian Islands (BSAI) management region is likely to adversely affect populations of some eliminate western Alaska salmon stocks and their availability for subsistence harvest by Alaska Native communities, which heavily rely on these resources.	No effect The amount of salmon bycatch and contribution to potential effects on western Alaska stocks would appear relatively low, although Alaska Natives have voiced concern over salmon bycatch from the groundfish fisheries.	Potentially beneficial effect Alternative 3 would be sufficient to protect these stocks from further depletion. Qualitatively, reduced PSC limits ranging from 0-10 percent (FMP 3.1) to 10-30 percent (FMP 3.2) should offer proportionate protection to at-risk chinook salmon stocks. In general, however, this alternative would result in neutral or positive effects with respect to Alaska Native subsistence use of these stocks.		Potentially beneficial effect PSC limits in the BSAI would be lowered to the extent practical to 30-50 percent (FMP 4.1) or to PSC = 0, the closure of the fishery (FMP 4.2). In the GOA, PSC limits would be established at 25,000 fish for chinook and 20,500 fish for other salmon (FMP 4.1) and would remain in effect until complete closure of the fishery (FMP 4.2). This would have neutral or positive effects on Alaska Native salmon subsistence uses.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Subsistence (cont.)							
General ecosystem health	Potentially adverse effect Concerns have been expressed by Alaska Natives on the effects of commercial fishing and associated bycatch discards on the health of the marine ecosystem, particularly with regard to discards attracting fish and wildlife, and causing disease in animals that eat discards.	Potentially adverse effect A more aggressive harvest strategy under FMP 2.1 with reductions in bycatch limits under this alternative would likely increase Alaska Native concerns regarding the ecosystem. Effects under FMP 2.2 would be similar to FMP 1.		Potentially beneficial effect The Alternative 3 policy framework seeks to accelerate the existing precautionary management approach through incorporation of ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraint and therefore requires a more precautionary approach to fisheries management.		Beneficial effect The Alternative 4 policy would address concerns expressed by Alaska Natives about the volume of fishery removals and general ecosystem health as it is a highly precautionary approach to fisheries management.	
Joint production	No effect FMP 1 does not increase or decrease opportunities for joint production.	Potentially beneficial effect More intense fishing efforts under the Alternative 2 policy may increase the opportunity for joint production opportunities for those continuing to participate in the fishery, but whether or not this impact would provide a significant benefit is not clear from available data.	No effect FMP 2.2 does not increase or decrease opportunities for joint production.	No effect Rights-based fishing efforts under Alternative 3 increase the opportunity for joint production opportunities for those continuing to participate in the fishery, but anticipated consolidation of the fleet may offset this potential gain.		Adverse effect The drastic reduction of fishing effort under Alternative 4 would sharply reduce, if not eliminate, the joint production subsistence opportunities until more information was obtained about the frequency and intensity of fishing impacts on the environment, potentially re-opening the fishery. These impacts would effect all communities where there are Native-owned vessels participating in the fishery.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Alaska Native participation in commercial fisheries							
Community development quota (CDQ) fisheries	No effect CDQ participation would remain the same.	Potentially adverse effect CDQ for groundfish species except for pollock will be repealed. Alone this would be a significant negative impact to Alaska Native communities in the CDQ region, but likely will be offset at least in part by the increase in pollock TAC, which would increase overall returns. Impacts to individual CDQ groups are unknown, but may be adverse.	No effect Under FMP 2.2, CDQ would not change from Alternative 1.	Beneficial effect It is unclear to what extent that increased rationalization would result in increased CDQ allocation. Assuming that additional fisheries are rationalized and CDQ allocation increased, there would be beneficial effects on CDQ groups.		Adverse effect Commercial fishing reductions or elimination would result in significant negative impacts to the CDQ region.	
Non-CDQ fisheries	No effect Alaska Natives who own or crew on catcher vessels outside of the CDQ region participate directly in the groundfish fisheries. Opportunities for their participation do not increase or decrease under Alternative 1.	No effect No community, sub-community level, western and interior Alaska Native communities impacts.		No effect Opportunities for their participation do not increase or decrease.	Potentially adverse effect In general, rationalization effects under the Alternative 3 policy can be expected to adversely effect Alaska Native communities to some degree, especially during the transition from open access to an individual fishing quota (IFQ) program, however, the magnitude of this disruption remains to be assessed.	Adverse effect Impacts to communities directly participating in the groundfish fishery would be significant. While this would encompass many Alaska coastal communities, the Alaska Native communities that would be hardest hit would be King Cove and Sand Point. These communities each have a local harvest fleet, a significant shore processing presence, and have a number of support service businesses that would all experience substantial economic losses. Further, municipal and borough revenue losses would be felt in these and other AEB communities.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Alaska Native participation in fishery management							
Native representation	Potentially adverse effect Alaska Natives currently have some representation on the NPFMC and its AP, but the limited number presents some difficulty in representing potentially competing interests between CDQ's, non-CDQ Native fishermen, and subsistence users.	Potentially adverse effect Alaska Natives currently have some representation on the AP and NPFMC, the limited number presents some difficulty in representing potentially competing interests between CDQ's, non-CDQ Native fishermen, and subsistence users.		Potentially beneficial effect Native representation on the NPFMC and the AP under the Alternative 3 policy framework would increase Native participation in the fisheries management. FMP 3.2 could provide the mechanism to incorporate an Alaska Native seat on the Council and a voluntary position for non-CDQ Natives in the AP to represent other stakeholders.		Beneficial effect Alternative 4 policy framework would increase Native involvement in the NPFMC and the AP and process.	
Co-management	No effect Co-management suggestions are currently provided through solicitation of public comments and through Alaska Native representation on the AP and NPFMC.	No effect The level of co-management under Alternative 2 policy would not likely change from Alternative 1.		Potentially beneficial effect Co-management under the Alternative 3 policy would increase Native participation in fisheries management, and indirectly opportunities for co-management.		Potentially beneficial effect NPFMC, NOAA Fisheries, and Native communities would seek to enter into a collaborative management agreement in which Natives were given an increased level of authority (objective is in terms of Traditional Knowledge and research/monitoring) efforts than currently exists under the updated Alternative 1 policy.	
Consultation and coordination with Indian tribal government	No effect NOAA Fisheries will continue to consult with Alaska tribal governments through the NPFMC and the MSA/NEPA decision-making process.	No effect The level of consultation and coordination under Alternative 2 policy would likely not change from Alternative 1.		Potentially beneficial effect Scoping, comment analysis and response, and public review and comment during the NEPA process would continue. Community outreach and government-to-government representation, consultation requirements, and increased effort to include a wider array of Native groups would increase.		Potentially beneficial effect Government-to-government representation, consultation requirements, and participation, would likely increase as a result of additional Alaska Native involvement and community outreach.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Alaska Native participation in fishery management (Cont.)							
Public involvement	No effect Current opportunities available for public comment on proposed and existing FMPs, EIS documents regulations, and agenda items during NPFMC meetings; provide many avenues for Alaska Natives to provide input regarding groundfish fishery management.	No effect Public involvement under the Alternative 2 policy would remain the same as described under the Alternative 1 policy, because it is a federal requirement.		Potentially beneficial effect While direct mechanisms for public involvement would not change, efforts to increase Native consultation would result in additional public involvement benefits.		Beneficial effect The opportunity for public involvement and public comment would increase in the NPFMC process. Scoping, public review and comment, and comment analysis and response in the NEPA process would not change.	
Environmental justice							
CDQ region as low-income and minority population and environmental justice related impacts	No effect No significant adverse CDQ allocation-related Environmental Justice impacts or impacts associated with income or joint production loss are anticipated.	Potentially adverse effect Elimination of multi-species groundfish CDQ allocations under this alternative could result in Environmental Justice impacts if not offset by pollock CDQ gains.	No effect No significant adverse CDQ allocation-related Environmental Justice impacts or impacts associated with income or joint production loss are anticipated.	Potentially beneficial effect It is unclear to what extent that increased rationalization would result in increased CDQ allocation. Assuming that additional fisheries are rationalized and CDQ allocation increased, there would be beneficial effects on CDQ groups.		Adverse effect Significant adverse impacts to CDQ regions are anticipated. This may result in Environmental Justice impacts to communities.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Non-CDQ Alaska Native environmental justice issues							
Groundfish community level Environmental Justice impacts	No effect No community or sub-community impacts specific to Alaska Native communities are anticipated.	No effect No community or sub-community level impacts specific to Alaska Native communities are anticipated.		Potentially adverse effect It is not considered likely to cause Environmental Justice concerns in these regions for any low-income minority population, including Alaska Natives, however the harvest fleet is subject to potential impacts. Skipper and crew job losses could cause disproportionate effects on Alaska Native populations in some communities. Although crew demographic information is sparse, it is assumed that King Cove and Sand Point would be among the set of potential communities affected.		Adverse effect Direct adverse community level impacts to Alaska Native communities can be expected for King Cove and Sand Point, as well as smaller Alaska Native communities in the AEB. Akutan and Unalaska, communities with more or less distinct Alaska Native population components would experience significant impacts. Displacement of all fishery sectors could occur under FMP 4.2 specifically for the harvest vessel sector.	
Non-groundfish communities	No effect The amount of salmon bycatch and contribution to potential effects on western Alaska stocks would appear relatively low, although Alaska Natives have voiced concern over salmon bycatch from the groundfish fisheries.	Potentially adverse effect Potential adverse impacts of increased salmon bycatch to western and interior Alaska Native communities, these would be considered Environmental Justice impacts.	No effect The amount of salmon bycatch and contribution to potential effects on western Alaska stocks would appear relatively low, although Alaska Natives have voiced concern over salmon bycatch from the groundfish fisheries.	No effect No adverse impacts are anticipated for non-groundfish communities.		Potentially beneficial effect Impacts to these communities would largely be driven by salmon subsistence issues and reductions or elimination of salmon bycatch.	

Table 8 (cont.). Summary of potential effects of the policy alternatives and Fishery Management Plan bookends on Alaska Natives.

Effect Indicator	Alternative 1	Alternative 2.0		Alternative 3.0		Alternative 4.0	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Other Alaska Native issues							
Traditional knowledge	No effect NOAA Fisheries is currently using existing literature available. Under this framework, traditional knowledge is not collected from third party sources or key informant interviews.	No effect Under the Alternative 2 policy there would be no change from Alternative 1.		Beneficial effect Under the FMP 3.1, formal procedures will be developed and implemented to incorporate traditional knowledge into fishery management.	Beneficial effect The FMP 3.2 requires incorporation of traditional knowledge through additional research such as key informant interviews.	Beneficial effect Alternative 4 would require that fishery managers initiate cooperative research programs for data gathering and monitoring in order to enhance use of traditional knowledge in fishery management.	

This page intentionally left blank

APPENDIX F

Observer Program

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Observer Program	F-10-1
1.1	Observer Program Background	F-10-1
1.2	Observer Program Mission and Goal	F-10-5
1.3	Program Objectives	F-10-6
1.4	Policy Alternatives and Rationale	F-10-7
Section 2	Alternative 1: Continue Under Current Risk-Averse Management Policy	F-10-9
Section 3	Alternative 2: Adopt a More Aggressive Management Policy	F-10-15
Section 4	Alternative 3: Adopt a More Precautionary Management Policy	F-10-16
4.1	FMP 3.1	F-10-16
4.2	FMP 3.2	F-10-20
Section 5	Alternative 4: Adopt a Highly Precautionary Management Policy	F-10-21
Section 6	References	F-10-22

ACRONYMS AND ABBREVIATIONS

AED	Alaska Enforcement Division
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center's
BSAI	Bering Sea/Aleutian Islands
CDQ	Community Development Quota
CFR	Code of Federal Regulations
Council	North Pacific Fishery Management Council or NPFMC
EEZ	Exclusive Economic Zone
FFOP	Foreign Fisheries Observer Program
FMP	Fishery Management Plan
FR	Federal Register
ft	Feet
GOA	Gulf of Alaska
IFQ	Individual Fishing Quota
JPA	Joint Partnership Agreement
LOA	Length Overall
Magnuson Act	Magnuson Fisheries Conservation and Management Act of 1976
MCP	Motion-Compensated Platform
MMPA	Marine Mammal Protection Act
MRAG	Marine Resources Assessment Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	Metric Tons
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPGOP	North Pacific Groundfish Observer Program
NWAFRC	Northwest and Alaska Fisheries Center
OAC	Observer Advisory Committee
OPO	Observer Program Office
PSC	Prohibited species catch
Research Plan	North Pacific Conservation Research Plan
SDM	Service Delivery Model
TAC	Total Allowable Catch
USCG	United States Coast Guard

Section 1 Observer Program

The North Pacific Groundfish Observer Program (NPGOP) collects, maintains and distributes data for scientific, management, and regulatory compliance purposes for fisheries in the 900,000 square mile Exclusive Economic Zone (EEZ) off the coast of Alaska. The responsibilities of the NPGOP are shared among the three key components of the Program. These components are: (1) the Alaska Fisheries Science Center's (AFSC) Observer Program Office (OPO), (2) private observer provider companies permitted by the National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries), and (3) fishing companies participating in fisheries requiring observer coverage. Each entity's roles are stipulated by federal regulation in 50 Code of Federal Regulations (CFR) 679¹ and are briefly described below.

The OPO is responsible for the overall administration of the Program. The OPO permits new observer provider companies, develops observer sampling protocols, supplies observer sampling equipment, oversees observer training, certification and decertification, debriefs returning observers, and manages all observer data. Currently, the OPO maintains offices in Seattle, Washington and Anchorage, Kodiak, and Dutch Harbor, Alaska.

Observer provider companies are responsible for recruiting qualified observer candidates, deploying observers, providing logistical support to observers, and providing all employer-related services to observers (including salaries, insurance, and benefits). There are currently five permitted observer companies providing observer coverage for the Alaska groundfish fisheries.

The fishing industry is responsible for contracting with an observer provider company to supply observer coverage. They are also responsible for obtaining the required amount of observer coverage for their vessel type or processing facility and fishery. The fishing industry bears the direct cost for their observer coverage requirements as well as costs associated with carrying an additional person(s) aboard their vessel or at their processing plant. The direct annual cost to the industry for observer coverage is estimated to be approximately \$12 million. In 2002, 340 individual observers were deployed aboard 312 vessels and 20 processing facilities for nearly 35,000 observer-days.²

1.1 Observer Program Background

The NPGOP originated in 1973 with the Foreign Fisheries Observer Program (FFOP), administered by the Northwest and Alaska Fisheries Center (NWAFC)³. Observers in the FFOP were deployed on foreign vessels operating off northwest and Alaskan coasts. The primary objectives of FFOP observers were to obtain daily and/or haul bycatch catch rates (depending on vessel type), gather data on species, size, and age composition

¹ Regulations extending the applicability of the NPGOP were published in the Federal Register (FR)/ Vol. 67, No. 235 on Friday December 6, 2002.

² An observer-day is a count of each day that an individual observer is assigned to a vessel or processing plant.

³ The NWAFC divided into two separate Centers- the Northwest Fisheries Science Center and the Alaska Fisheries Science Center (AFSC) in 1984.

and, determine the incidence of Pacific halibut, salmon, and crab in landings. Additional tasks included recording data on incidentally caught marine mammals, reporting on possible violations of U.S. fishing regulations, completing net diagrams, and testing and recording product recovery rates.

The FFOP greatly expanded with the passage of the Magnuson Fisheries Conservation and Management Act⁴ of 1976 (the Magnuson Act). This act established U.S. jurisdiction over fishery resources out to 200 nautical miles from shore, the EEZ⁵, and established a program for their management. The management program specified three goals: 1) to stop the decline in abundance of overfished stocks to assure development of new U.S. fisheries, 2) to protect Pacific halibut resources and rebuild this stock and 3) to permit (through the Secretary of Commerce) foreign fishing vessels and set catch limitations for each nation. In order to ensure that these plans were implemented, the Act stipulated that foreign vessels must accept observers. The U.S. was dependent upon observers to assess impact of foreign fisheries upon stocks.

Foreign vessels had differing amounts of observer coverage throughout the years and coverage levels were based on fishing days. From 1977 to 1982, U.S. observers monitored 10 to 29 percent of active foreign fishing days. Coverage levels rose to just over 44 percent in 1983 and finally increased to 90 percent in 1984. This highest level of coverage was maintained through 1990.

Funding for the FFOP was obtained from two different sources. Foreign nations paid for expected observer costs in advance for each calendar quarter. These funds were deposited into the Foreign Fisheries Observer Fund⁶ and could only be used for costs directly related to placing observers on foreign vessels. When the monies from this advance billing system did not provide for sufficient observer coverage, a supplemental program allowed for foreign nations to pay for observer costs directly to observer contractors. Under the rules of the supplementary observer program, only companies certified by the NOAA Fisheries could provide observers. Under both funding systems, observers were provided by contractors and were not hired as federal employees.

Under the FFOP, the roles of NOAA Fisheries and the contractors (observer provider companies) were similar to those under the NPGOP, with several critical differences. First, the contractors were accountable to the NWAFC and the NWAFC was the client under this contract. This direct contractual relationship between the NWAFC and the contractor ensured an arms-length relationship from industry, a high level of integrity, and that the government's data needs were met. Additionally, the federal contracting process ensured that a statement of work existed between the NWAFC and the contractors and that each party's responsibilities were clear and documented. Finally, the contracting process allowed for a competitive bid process on an annual or biannual basis, rather than for day-to-day competition. These contractual aspects of the FFOP served to protect the observers, ensure enough income for the contractors and provide the government with appropriate oversight.

⁴ This Act was renamed the Magnuson-Stevens Fishery Conservation and Management Act (MSA) when amended in 1996 by Public Law 94-265.

⁵ This was formerly termed the "Fisheries Conservation Zone" and was changed to the EEZ by Presidential Proclamation in 1983.

⁶ This fund was created by a 1980 amendment to the Magnuson Act.

Another goal of the Magnuson Act was to Americanize fisheries. As foreign fishing diminished, so did the biological data which FFOP observers collected. In order to replace these data, and to gauge the amount of cooperation domestic fishermen would show toward observers, a voluntary, pilot, domestic observer program began in September of 1987.

Observers for the voluntary domestic observer program were hired based on foreign fishery experience and the data collected were similar to that in the FFOP, with some additional data requests. Observers recorded: (1) total catch information for each haul/set (including independent catch estimation), (2) retained catch weight, (3) an increased amount of information on gear type and performance, and (4) factory production information.

A further development in the domestic observer program occurred in 1988 when the Marine Mammal Protection Act (MMPA) was amended to require vessels that have frequent interactions with marine mammals (Category I fisheries) to carry observers for 20 to 35 percent of their fishing days. The trawl fisheries in the BSAI and GOA were classified as such fisheries. In August 1989, the AFSC began placing observers aboard these vessels using MMPA funds.

In November 1989, the North Pacific Fishery Management Council (NPFMC) passed Amendments 13 and 18 to the Fishery Management Plans (FMPs) for the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA), respectively. Within these amendments, the *Domestic* Groundfish Observer Program was called for and coverage levels were set.

In January 1990, the mandatory NPGOP⁷ was established. At the time, the NOAA Fisheries lacked authority to collect user fees. The domestic NPGOP therefore could not be funded in a manner similar to the FFOP, nor could the federal contracting process be used to obtain observers. To temporarily solve these problems, NPFMC created a third-party, pay-as-you-go system under which the fishing industry paid private observer provider companies for observer services. This Program is still in existence today.

From the Observer Program's onset, NPFMC began planning for an improved fee-based system to fund the NPGOP. Under this system, NOAA Fisheries would contract directly for observer services. This would eliminate the contractual agreement between private observer provider companies and the fishing industry, a relationship with the potential for a conflict of interest problem. A direct contractual relationship between NOAA Fisheries and observer provider companies would also allow NOAA Fisheries to more easily place observers where they were deemed necessary, providing more flexible observer coverage levels. Finally, a fee-based system could address cost inequities created by the pay-as-you-go system. In 1990, the Magnuson Act was amended to allow NPFMC to develop the North Pacific Conservation Research Plan (Research Plan) and collect fees to fund the program.⁸

⁷ The Program was also referred to as the "Domestic Groundfish Observer Program" through the early 1990's.

⁸ The Magnuson Act was again amended in 1992 to allow for a fee "not to exceed" two percent of the value of fish and crab harvested under NPFMC jurisdiction. This was an increase from the one percent allowed for in the 1990 amendment.

In 1994, final action was taken to implement the Research Plan (Department of Commerce 1994). The pay-as-you-go system was to continue through December 1995 and the fee-based Program was to begin on January 1, 1996. Fees were collected in 1995 so that funds were available for NOAA Fisheries to initiate contracts with observer provider companies under the Department of Commerce competitive bid contracting process, regulated under the Federal Acquisition Regulations.

Throughout 1995, members of the fishing industry expressed growing concerns with the design and implementation of the Research Plan. The fundamental issues were cost-related, including: 1) cost equity issues, 2) the ability of NOAA Fisheries to require appropriate observer coverage levels for special management programs (e.g., Community Development Quotas [CDQ]) while operating within the fee structure provided in the Magnuson Act, and (3) potential reductions in observer coverage due to observer cost increases. Because fees were based on the value of landed catch rather than on an observer-day, cost distribution resulted in increased observer costs for some industry sectors, and generally reduced costs for catcher vessels and small processors. Some fishery participants asserted that this distribution encumbered them with an inequitably high share of the cost of the program.

These concerns proved insurmountable and in December 1995, NPFMC repealed the Research Plan and extended the third-party, pay-as-you-go program as the Interim Groundfish Observer Program. As a result, NPFMC began considering a Joint Partnership Agreement (JPA). Under this program, a “primary contractor” would collect all industry payments for observer coverage. The government would have a joint partnership agreement with this primary contractor. Industry members would contact and pay the primary contractor directly for observer services. The primary contractor would then contract with observer provider companies for the actual provision of observer services. While the JPA eliminated the potential for a conflict of interest, it did not resolve the cost and coverage concerns identified as problematic under the Research Plan. In 1997, the potential primary contractor (Pacific States Marine Fisheries Commission) withdrew from the JPA after determining that their exposure to potential lawsuits would be too high. With this, NPFMC abandoned the JPA approach and called on NOAA Fisheries to develop a fee-based program that could be implemented under MSA authority. The Interim Program was further extended through December 31, 2000.

Yet another attempt to restructure the NPGOP began in 2000 in response to an independent review of the NPGOP by Marine Resources Assessment Group (MRAG), Americas, Inc. One recommendation made by MRAG, Americas, Inc. was that NOAA Fisheries develop a contract between NOAA Fisheries and the observer provider companies. NOAA Fisheries attempted to approach this in a stepwise fashion, with a pilot contract with companies providing observers to the American Fisheries Act (AFA) catcher processor and mothership fleet.

Under this arrangement, vessels in this fleet would be required to obtain observer coverage from observer companies that had a contract with NOAA Fisheries. In an attempt to avoid the problems associated with cost issues, this contract was envisioned to be a “no-cost” arrangement between the government and the observer provider. Payment for observer coverage would still be made directly to the observer company by the fishing company. The contract between NOAA Fisheries and the observer company would stipulate performance standards which would need to be met in order for the company to retain its rights to provide observers to this fleet. The contractual relationship between NOAA Fisheries and the observer provider company would give NOAA Fisheries more control and make the government a client of the company.

There were problems with this plan which prevented its implementation. The contract between the government and the observer company could mean that observer wages would be regulated under the Service Contract Act, meaning higher wages for observers and higher costs to the industry. Additionally, other sectors of the fishing fleet expressed concerns about using the AFA fleet for the pilot. AFA vessels are considered desirable for observer provider companies and observers alike, with their high coverage levels and regulated observer sampling stations. Concern arose among other fleet members that this “no-cost” model may not work for them, because they were a less desirable component of the fleet. Finally, the higher wages and larger vessels could draw experienced observers away from the rest of the fleet, leaving new observers to cover smaller vessels which are often more difficult to sample aboard. In late 2001, it was decided that NOAA Fisheries staff time would be better spent on regulatory changes to improve the existing NPGOP, and the “no-cost” pilot was abandoned. On December 6, 2002, the Interim Program was again extended through December 31, 2007.

In 2003, the current model used by the NPGOP to provide observers to the fishing industry looks much as it did when it was developed. This model is frequently referred to as the service delivery model (SDM). While the SDM has stayed virtually static, the fishery, the demands on the Observer Program, and the uses of observer data have greatly changed. Fishery management policies have increasingly moved toward rationalizing groundfish fisheries to improve efficiency and utilization of the resource. A specific definition of “rationalization” has not yet been adopted by NPFMC. However, the term is generally used to refer to management measures taken to improve the economic efficiency of a fishery. These measures include those taken to balance capital investment, address specific economic, social, or conservation concerns, or prevent competition between fishery participants.⁹

With an increase in management measures to rationalize fisheries, the Observer Program has experienced an increased demand for accurate, vessel specific, inseason catch data. The NPGOP was not originally designed for this purpose. Therefore, some observer coverage requirements and data collection procedures may not suit this need. For example, species composition sampling protocols were designed to reflect catch rates over time. However, under some management regimes, they are used on a haul-by-haul basis. When estimating catch of rare, but important, species, these haul specific estimates vary widely from known catch¹⁰. These catch rates stabilize with time, but management regimes may require management action based on an individual haul.

1.2 Observer Program Mission and Goal

The NPGOP’s mission is to “provide the highest quality data to promote stewardship of North Pacific living marine resources for the benefit of the nation.” The goal of the Observer Program is to “provide information essential for the management of sustainable fisheries, associated protected resources, and marine habitat in the North Pacific.”

⁹ Definition adopted from the GOA Rationalization. Proposed Amendment to the FMP for the Groundfish of the GOA. Scoping Guide to the GOA Rationalization SEIS. NOAA Fisheries Alaska Regional Staff. July 19, 2002.

¹⁰ Sarah Gaichas. Unpublished work from evaluation of basket sampling aboard a factory bottom trawler (F/T American No. 1) in association with Groundfish Forum, and analysis of observer data from three longline vessels testing seabird deterrents in summer 1999 as part of a Washington Sea Grant project.

1.3 Program Objectives

The OPO has a suite of objectives to meet its mission and goal. The Observer Program provides observers with a detailed sampling manual each year which includes a list of priorities for observers¹¹. The data observers collect directly relate to the following Observer Program objectives.

Objective 1: Provide accurate and precise catch, bycatch, and biological information for conservation and management of groundfish resources and the protection of marine mammals, seabirds, and other protected species.

To meet this objective, an observer's first priority aboard a vessel is to collect biological data on marine mammals and endangered seabirds and to notify NOAA Fisheries as soon as possible of these catches. The incidental catch of these species is a rare event, so most of an observer's time is spent on their next two priorities: the collection and transmittal of fishing effort information and species composition data.

Catch and species composition data are used extensively for establishing and monitoring quotas during the inseason management of the fishery. Observers aboard most catcher processors are able to collect these data and transmit them to the NPGOP's Seattle office on a daily basis using NOAA Fisheries-supplied custom software and the vessel's communication system. These data are then available to vessel owners and operators through a password-protected website. This immediate feedback allows the industry to view the same data that is used to manage their fishery and make their own inseason operational adjustments.

Observers assigned to processing plants collect information on each delivery, such as area fished, round weight delivered, and fishing start date. Plant observers spend most of their time during the pollock fisheries assisting vessel observers with a census of prohibited species delivered.

Additional biological data such as age structures, sex-length frequencies, Pacific halibut injury or viability assessment, and information on recovered tagged fish and crab are collected by observers. These data are primarily used only after the fishery is closed for stock assessment analyses. However, some industry members use data such as the sex ratio collected to determine their progress in roe fisheries.

Objective 2: Provide information to monitor and promote compliance with NOAA Fisheries regulations and other applicable programs.

The observers in the NPGOP have both science and compliance responsibilities. While the Observer Program strives to ensure that observers are not portrayed as "fish cops," both NOAA Fisheries and observers recognize that compliance infractions can impact an observer's sampling and data collection, thus jeopardizing data quality. Observers document fishing regulation infractions while at sea and work with OPO and NOAA Fisheries Alaska Enforcement Division (AED) personnel when necessary. Observers are instructed to inform vessel personnel when they witness a possible violation, giving the crew the opportunity to correct the problem.

¹¹ For details on each data type, and how it is collected, please refer to "The North Pacific Groundfish Observer Manual, 2003." It is available from the OPO at the AFSC or online at <http://www.afsc.noaa.gov/refm/observers/Document.htm>

Observers also document incidences of marine pollution and possible safety hazards. This information is reported either inseason or at the end of the observer's deployment, depending on severity. These data are then available to the United States Coast Guard (USCG).

Objective 3: Foster and maintain effective communications.

NPGOP observers have more contact with members of the fishing industry than any NOAA Fisheries employee. They rely on the support and cooperation of the crew in order to keep them safe at sea and accomplish their sampling tasks. The OPO trains observers in effective communication and conflict resolution skills. An effective observer can not only resolve conflicts that may arise, but communicate how vital their data are to the continued longevity of the resource. The OPO tries to ensure that the data observers collect aboard vessels and processing plants are available to the public while still protecting the fishing industry's right to privacy.

1.4 Policy Alternatives and Rationale

Four policy alternatives are under consideration by NPFMC. Each policy alternative contains a range of management measures that illustrate how the framework could be implemented, called "bookends." These bookends provide a level of detail that allows analysis and provides contrasting policies. They also provide a means to commit NPFMC to action in implementing an alternative, while allowing NPFMC, under the MSA, the flexibility to adaptively manage the fishery through FMP amendments.

Alternative 1 Continue Management Under Existing (Updated) Policy: Under this alternative, NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-adverse policy. This policy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The approach would be to continue with a plan to restructure the SDM for the provision of observer services to address issues with data quality and disproportionate cost issues.

Alternative 2 Less Precautionary Management Policy: A less precautionary management policy (e.g.: more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. Observers would be deployed in some fisheries, but mandatory coverage could be eliminated in open access fisheries. If deemed necessary, observers could be deployed at current levels under the current SDM.

Alternative 3 More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific

evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species. The main elements of this FMP would include: modifying observer coverage based on data or compliance needs; reevaluating coverage requirements to incorporate flexibility, random placement of observers or variable coverage rates depending on data needs; and changing the funding source to address cost inequity and potential conflict of interest concerns. This FMP would also include improvements to observer sampling stations on vessels and at processing facilities and finer scale identification and recording of non-target species. Finally, this FMP would call for the development of uncertainty estimates for observer catch data.

Alternative 4 Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable, scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles. The overall premise is that fishing does produce adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. With regards to the NPGOP, this alternative would increase both observer coverage levels and hauls sampled on those vessels participating in the groundfish fisheries. The funding mechanism for the Observer Program would change to one with greater distance between the observer provider and the fishing industry. NOAA Fisheries would work to expand uncertainty estimates to all possible stocks.

Section 2 **Alternative 1: Continue Under Current Risk-Averse Management Policy**

This alternative would maintain current measures of observer coverage and data collection protocols. Although this alternative may be referred to as the “status quo,” it should again be noted that the NPGOP currently in existence is meant to be an interim Program. Although the SDM of the NPGOP looks much as it did when it was developed in 1990, virtually all other aspects of the fishery, and aspects of the Observer Program, have changed. Recognizing this, staff from the OPO, the Alaska Regional Office, the NPFMC and its associated Observer Advisory Committee (OAC) have been working on improving the existing Observer Program.

In October 2002, staff from NOAA Fisheries and NPFMC met to discuss a variety of ideas for restructuring the NPGOP. NOAA Fisheries and NPFMC staff agreed that the restructuring should be limited in scope in order to be sufficiently funded and to be as non-disruptive to observer provider companies and the fishing industry as possible. The following problem statement was drafted by the OAC in January 2003.

“The North Pacific Groundfish Observer Program is widely recognized as a successful and essential program for management of the North Pacific groundfish fisheries. However, the NPGOP faces a number of longstanding problems that result primarily from its current structure. The existing program design is driven by coverage levels based on vessel size that, for the most part, have been established in regulation since 1990. The quality and utility of observer data suffer because coverage levels and deployment patterns cannot be effectively tailored to respond to current and future management needs and circumstances of individual fisheries. In addition, the existing program does not allow fishery managers to control when and where observers are deployed. This results in potential sources of bias that could jeopardize the statistical reliability of catch and bycatch data. The current program is also one in which many smaller vessels face observer costs that are disproportionately high relative to their gross earnings. Furthermore, the complicated and rigid coverage rules have lead to observer availability and coverage compliance problems. The current funding mechanism and program structure do not provide the flexibility to solve many of these problems, nor do they allow the program to effectively respond to evolving and dynamic fisheries management objectives.”

The OAC recommended that NPFMC and NOAA Fisheries proceed with an analysis to consider restructuring the NPGOP to address these issues. The analysis would propose changing the current SDM to one in which NMFS has a contract with observer provider companies and costs are covered by a combination of Federal funding and industry-paid fees. The OAC also recommended that the scope of this redesign be focused on vessels and processors in the GOA, with an option to extend the redesign to vessels operating in the BSAI which currently require less than 100 percent observer coverage. It is expected that this work will continue under this alternative.

Service Delivery Model

The current SDM is often referred to as a third-party, pay-as-you-go system. In 1998, the AFSC initiated a comprehensive review of the NPGOP, including the SDM. The review was done by an independent consulting firm, MRAG, Americas, Inc.¹². The review began in August 1999 and the final report was issued in May 2000. The MRAG, Americas, Inc. review highlighted problems with the SDMs organizational structure, coverage levels, cost distribution, and observer support system. In 2000, the OPO in Seattle conducted an internal management control review as part of a National management control review on observer programs. Similar problems with the NPGOP's SDM were discussed in both reports.¹³

The third-party pay-as-you-go SDM is designed such that industry members pay private observer companies directly for observer services. This direct financial relationship between the observer's employer and industry creates, at a minimum, the appearance of a conflict of interest. The OPO has no documented cases of an observer being asked by their company to alter data to benefit a business partner. Nevertheless, this possibility exists and OPO staff have seen less egregious cases where the company's need to provide the service to their customer outweighs the government's need for quality data. These examples include behavior such as deploying an observer with no sampling gear, no personal gear, or while the observer was ill and unable to sample.

The NPGOP currently operates with five permitted observer companies. These companies compete for industry clients. This competition may also put observers under unnecessary pressure which can be detrimental to data quality and the observer's work environment. For example, observers have reported not being allowed to board vessels because they had completed an affidavit against the vessel. In this circumstance, the observer company may choose to deploy another observer rather than lose a client. A diligent observer could lose work if the observer company does not have another vessel on which to deploy him or her.

Funding Mechanisms

The vast majority of funds supporting the NPGOP come from the fishing industry. It is estimated that their costs associated with obtaining observer coverage is approximately \$12 million. These funds are paid directly to private observer provider companies to cover the costs of observer recruitment, travel, insurance, company overhead, and employee salaries and benefits. NOAA Fisheries further contributes approximately \$3 million. NOAA Fisheries funds cover the costs associated with the operation of the Observer Program. These services include observer certification training and briefing, observer field support, observer debriefing, and management of observer data.

¹² Marine Resources Assessment Group Americas Inc. is affiliated with Marine Resources Assessment Group Ltd.

¹³ Both the Marine Resources Assessment Group report and the management control review report are available from the North Pacific Groundfish Observer Program Office at the Alaska Fisheries Science Center.

Observer Coverage Levels

The NMFS Regional Administrator can alter observer coverage levels at any time to improve accuracy, reliability, and availability of observer data if there has been a change in the bycatch composition of a specific component of the fleet or if additional observer coverage is needed to meet specific fishery management objectives. In the past, NOAA Fisheries has only pursued a change to observer coverage requirements through a change to the CFR and with the approval of NPFMC. This process can be lengthy, but allows the public to comment on the proposed change.

The Groundfish FMPs for the BSAI and GOA set observer coverage levels for different sectors of the fishery. Although observer coverage requirements are dependent upon vessel or processor type, target fishery, gear type and time of year, they are set at one of four levels: 200 percent coverage (with two observers aboard the vessel simultaneously), 100 percent coverage, 30 percent coverage, or no coverage. All coverage levels are based on days fished in a calendar quarter. Exact regulatory language dictating observer coverage levels can be found in the Title 50 of CFR §679.50 Subpart E – Groundfish Observer Program.¹⁴

Processing Plants

Processing plants include both shoreside and stationary floating processors. These facilities receive potentially sorted groundfish deliveries from catcher vessels using all types of gear. Observer coverage levels for processing plants are determined by the amount of groundfish processed each calendar month.

Processing plants processing 1,000 metric tons (mt) or more of groundfish in a calendar month are required to have an observer present each day it receives or processes groundfish during that month. Plants processing between 500 mt to 1,000 mt of groundfish are required to have observer coverage for 30 percent of the days it receives or processes groundfish during the month. Plants which process less than 500 mt of groundfish in a month are not required to obtain observer coverage. In 2002, there were 4196 observer-days spent at 20 individual processing plants.

In early 2003, coverage requirements for plants receiving pollock or Pacific cod were changed to reduce coverage during months when a directed fishery for these species closes. During these months, plants receiving less than 250 mt of groundfish per week may reduce their coverage to 30 percent of the days in which fish is received or processed. If the 250 mt limit is exceeded during a week, the plant must return to normal coverage requirements until all fish are processed. The plant can then return to the reduced coverage for the remainder of the month.

Mothership Vessels

A “mothership” vessel is a processing vessel which routinely receives unsorted catch from other vessels by way of a codend transfer. Motherships which process 1,000 mt or more of groundfish in a calendar month are required to have an observer aboard each day it receives or processes groundfish during that month. Motherships which process between 500 mt and 1,000 mt of groundfish in a month must carry an observer

¹⁴ The coverage level descriptions in this paper are given as generalities only. Special coverage requirements exist for many directed fisheries.

at least 30 percent of the days it receives or processes groundfish during that month. Motherships processing less than 500 mt of groundfish in a month are not required to carry an observer.¹⁵

In 2002, all observed motherships were participating in the pollock fishery regulated under the AFA and therefore carried additional observer coverage to meet AFA requirements. On these vessels, the lead observer aboard must have an additional certification specific to AFA and CDQ fisheries. This specialized training, called level 2 certification, is discussed in detail in the CDQ section that follows.

Observers aboard motherships treat the codends received as if they were caught by the mothership. Their data collection duties are the same as for any trawl catcher processor in the fishery in which the vessel is participating. Because the observers aboard the mothership collect all necessary data, most vessels delivering unsorted codends to motherships do not carry observers.

Trawl and Longline Vessels

In open access and Individual Fishing Quota (IFQ) groundfish fisheries, observer coverage requirements for trawl and longline vessels are determined by vessel length. Vessels greater or equal to 125 feet (ft) in length overall (LOA) are required to carry an observer for all of its fishing days. Vessels greater or equal to 60 ft LOA but less than 125 ft LOA that participate in a directed fishery for more than three fishing days in a calendar quarter are required to carry an observer for at least 30 percent of its fishing days in that quarter. Additionally, at least one fishing trip in each calendar quarter for each fishery these vessels participate in must be covered. Vessels less than 60 ft LOA are not required to carry an observer.

Pot (Trap) Vessels

In early 2003, coverage requirements for vessels fishing with pot gear were changed to base their coverage needs on pot retrievals rather than vessel length. Starting with this regulatory change, pot vessels 60 ft or greater LOA that fish for more than three days in a calendar quarter must carry an observer for at least 30 percent of the total number of pot retrievals for that calendar quarter. Additionally, at least one fishing trip in each calendar quarter for each fishery these vessels participate in must be covered. Vessels less than 60 ft LOA are not required to carry an observer.

Previous pot vessel coverage regulations required pot vessels of any length to carry an observer for 30 percent of their fishing days. The change was a regulatory response to the problem of pot vessels picking up an observer in port, traveling just out of the harbor, and retrieving one pot in order to receive observer coverage for that day. The new requirements, based on pot lifts, were made to ensure that observer data was more representative of actual fishing effort.

¹⁵ There are additional observer coverage requirements for motherships fishing in the chum salmon savings area between September 1 and October 15.

Multi-Species Community Development Quota Fishery

The CDQ Program began in December of 1992 with the goal of promoting fisheries related economic development in western Alaska. The advent and expansion of this program has greatly affected the NPGOP and its priorities.

Unlike in open-access fisheries, at-sea observer data are used exclusively to manage groundfish and halibut CDQs aboard catcher-processor vessels. Therefore, these vessels are required to have every CDQ haul sampled by an observer.

Longline and pot catcher vessels harvesting CDQ deliver all catch, with the exception of prohibited species, to processing plants. At the plant, the catch is sorted and weighed. Since there are two locations for data collection, both at-sea observer data and delivery weights from the processing plant are used to manage the CDQ. Observer data are used to determine prohibited species catch (PSC) and delivery information is used to determine retained catch weights.

In order to meet the data needs required to manage CDQ, OPO staff worked with the Alaska Regional Office to develop CDQ-specific observer experience and training, vessel equipment, and observer coverage requirements.

While these requirements were originally developed for the CDQ fisheries, they are now also used to ensure quality data collection aboard vessels operating under the AFA. Since this change was made, much of the language regarding specialized “CDQ observers” has been changed to “level 2 observers” to reflect both fisheries.

Observer Experience and Training Requirements

Since 1998, NOAA Fisheries has required that all observers deployed in CDQ fisheries have prior observing experience and each must complete a level 2 training course. The amount and type of experience each observer has determines whether the observer is qualified to serve as a lead level 2 observer. Lead observers serve as the primary point of contact for observer issues aboard the vessel for both crew and NOAA Fisheries personnel. Lead observers are also responsible for returning the data to NOAA Fisheries and carrying it through the debriefing and editing process.

To qualify as a level 2 observer, an observer must have at least 60 days of data collection for which they received an acceptable evaluation from staff at the OPO. They must also successfully complete the level 2 training class. A lead level 2 observer must have additionally completed two observer cruises and sampled a defined number of hauls aboard a particular vessel type.

Staff at the OPO and the North Pacific Observer Training Center have designed the level 2 training course to build upon an observer’s existing skills. Much of the training consists of ensuring observers know and understand the additional regulations in place to manage the CDQ and AFA fisheries.

Equipment and Operational Requirements

While the NPGOP made changes in training and certification requirements for CDQ observers, the fishing industry also responded to the need for increased data accuracy aboard these vessels. Catcher processors and motherships are required to provide additional equipment to assist observers in collecting data. These vessels must have a NOAA Fisheries-certified observer sampling station with an electronic, motion-compensated platform (MCP) scale. Additionally, trawl and mothership vessels are required to have electronic, motion-compensated flow scales that are capable of weighing all landed catch. Both scales must be certified by NOAA Fisheries.

OPO staff are responsible for the certification of sampling stations and the Alaska Region administers the scale certification program. Sampling stations and scales are inspected and certified annually prior to participating in a CDQ fishery. These stations must include the MCP scale, accessible sample collection points, adequate lighting, slip-resistant flooring, a table and hose. Additionally, the station must meet minimum space requirements.

Observer Coverage Requirements

The required amount of observer coverage aboard CDQ vessels is determined by the vessel type and the amount of work an observer can be expected to do. Regulations require that every CDQ haul be sampled aboard catcher processor and mothership vessels. Longline and trawl catcher processors and motherships generally operate 24 hours per day, making it impossible for a single observer to complete all sampling duties. These vessels are, therefore, required to carry two level 2 observers, one of whom must be lead qualified for that gear type. Catcher processors using pot gear must carry one lead level 2 observer. Catcher vessels delivering unsorted catch to a processing plant are required to carry one level 2 observer. The processing plant receiving CDQ catch must also have a level 2 observer present.

American Fishery Act Fishery

The AFA fishery has specific catch monitoring needs that require equipment and observer coverage similar to the CDQ fisheries, especially in the offshore sector. The inshore fishery is relatively unchanged from the open access fisheries, for both catcher vessels and processing plants.

Catcher processors and motherships regulated by the AFA are required to have motion-compensated flow scales and observer sampling stations. These vessels must carry at least two observers, one of which must qualify as a lead level 2 observer aboard this vessel type. Although a level 2 observer is not required at processing plants receiving AFA fishery deliveries, the plant is required to have an observer available for each consecutive 12 hour period in which the processor takes delivery of, or processes, BSAI pollock. Additionally, processors must designate a plant liaison who must be available whenever pollock is offloaded or processed to assist the plant and catcher vessel observers.

Section 3 Alternative 2: Adopt a More Aggressive Management Policy

The FMP 2.1 would eliminate observer coverage with the exception of those fisheries regulated under the AFA or CDQ. The FMP 2.2 leaves the NPGOP identical to Alternative 1.

FMP 2.1 would essentially eliminate most of the NPGOP and its data collection activities. This FMP would also reduce CDQs to only pollock and crab species. This change would mean groundfish observer data would come only from vessels and processing facilities harvesting pollock. NOAA Fisheries could expect to see a drastic reduction in inseason management data and stock assessment data collected by observers, such as age structures and stomach samples. Additionally, fishery scientists would lose a critical platform from which to complete special projects.

Observer data plays a critical role in the management of the North Pacific groundfish fisheries. Observers provide accurate information on commercial fishing harvests that may not be otherwise captured by survey vessels or vessel logbook information. Of the nearly 35,000 observer-days spent at sea in 2002, less than 20 percent of these were spent on AFA pollock catcher processor vessels. A reduction in observer data this severe would leave NOAA Fisheries without substantial information to make inseason management decisions.

Section 4 Alternative 3: Adopt a More Precautionary Management Policy

This alternative has two distinct FMP bookends, each which would make different changes to the NPGOP. FMP 3.1 would modify observer coverage requirements based on data or compliance needs, address the conflict of interest potential under the current SDM, improve observer sampling stations, increase non-target species identification training for observers and develop uncertainty estimates for target species data. FMP 3.2 is very similar to 3.1 with the exception of calling for and increase in observer coverage for vessels greater than or equal to 60 ft LOA and expanding uncertainty estimates to all possible stocks.

4.1 FMP 3.1

Observer Coverage Levels

Under this management policy, observer coverage could either stay the same as that in Alternative 1 or be modified depending upon compliance or science-based data needs. Implementation of this FMP would allow for much more flexibility for NOAA Fisheries to deploy observers where needs dictated coverage. This was a clear goal of the Research Plan as well, and in order to accomplish this task, the SDM would need to be changed. Under the current SDM, NOAA Fisheries regulates each component of the fishery to carry observers. The Agency cannot, therefore, respond immediately to increase or decrease coverage to meet a data or compliance monitoring need. Additionally, there is no mechanism in place for NOAA Fisheries to pay for observer coverage if additional coverage on a segment of the fleet was deemed necessary.

Funding Mechanisms

FMP 3.1 changes the funding mechanism for the NPGOP in order to alleviate the direct business relationship between the observer provider companies and the fishing industry. This relationship has long been a concern because it could provide a means for a fishing operation to reward or penalize their observer provider company and thus influence the work performance of the observers and the quality of the data collected. This appearance of a conflict of interest could reduce the credibility of observer data. The bookend provides three examples of restructured funding mechanisms that would eliminate this problem: (1) full Federal funding, (2) industry fee-based funding, and (3) setting aside a portion of the Total Allowable Catch (TAC). Any of these three funding mechanisms would put NOAA Fisheries more in control of the Observer Program.

Federal Funding

The NPGOP is the most expensive observer program in the Nation, due in most part to its size. In addition, the Observer Program is expected to be needed in perpetuity. These factors do not eliminate the possibility of obtaining full Federal funding, but do make it more difficult to obtain. The AFSC put forward a budget initiative to NOAA Fisheries for full Federal funding for the NPGOP for the 2004 fiscal year, but the request was not forwarded past the NOAA Fisheries Headquarters level.

Fee-based Funding

Industry fee-based funding is the mechanism that has been most explored in the North Pacific, because the Research Plan was to use this source. The issues that were problematic under the Research Plan (see page 4) all still exist today and will need to be adequately addressed before a fee-based plan will be successful. Additionally, the MSA may need to be amended again if the allowable 2 percent of ex-vessel value is inadequate to fund the Observer Program.

In its July 2002 meeting, the OAC supported full Federal funding, but NOAA Fisheries agreed that an Observer Program design that included both Federal and fee-based funding should be developed for analysis. It may be this blended system that gets the most support. A single funding source may support basic observer coverage needs, but could be strained by the component of the fleet that needs additional coverage to support specialized management plans, such as AFA and CDQ. One source could provide for basic coverage needs, and another could be used to pay for additional coverage needs called for by specialized management plans. Regardless of which funding source is used to pay for which type of observer coverage, industry representatives on the OAC clearly expressed the need for the industry portion to be capped at a specific amount. This design would require NOAA Fisheries to determine fishery specific coverage levels and to differentiate between “standard” and “specialized” management plans and their coverage needs.

Resource Funding

The TAC set aside system of funding has also been investigated by NOAA Fisheries. Currently, only the Northeast’s sea scallop dredge observer program uses this type of funding¹⁶. The OAC has discussed the feasibility of this funding source in the North Pacific and concluded that this model works best in single species fisheries which are closed primarily by reaching the TAC. This model would be difficult to implement in the multi-species fisheries in the North Pacific, which may be closed due to PSC. However, if multiple funding sources could be used under a plan similar to the Research Plan, this funding model may be useful for the crab and Pacific halibut fisheries, both of which were included in the Research Plan.

Data Collection Protocols

This FMP calls for improving sampling stations, improving observer identification skills for non-target species, and the development of uncertainty estimates for target species data.

Sampling Stations

By far the largest improvement in sampling stations came with the multi-species CDQ observer regulations described earlier. However, the OPO has not relied solely on regulations to improve observer working conditions and has taken several steps to accomplish this task. NOAA Fisheries issues basic sampling equipment to observers, but specialized gear such as flatbed scales, collapsible totes, and pulleys are also available. This additional gear allows observers to set-up effective sampling stations where space is constraining. On vessels with less than 100 percent observer coverage, the observer sampling station is

¹⁶ The scallop program is the only NMFS observer program that is resource funded. However, the Alaska Department of Fish and Game has a portion of their crab observer program funded by test-fishery cost recovery funds.

usually temporary, and having portable gear allows the observer to create a sampling space when they board different vessels.

The OPO maintains a database of vessel surveys in which observers describe where and how they sampled, and suggestions for future observers. Additionally, the OPO has many vessel diagrams available for observers before they board vessels. Finally, the OPO has permanent and rotating staff in the field offices in Dutch Harbor and Kodiak. These staff are available for vessel visits and can often make suggestions to vessel crew and observers to design the best sampling station possible. Commercial fishing vessels are not designed for research, however, and often even the best station can be crowded and difficult to work in.

If an FMP similar to this bookend was adopted, the OPO would continue to work with the fishing industry to improve sampling conditions aboard vessels. The Observer Program could also draft new regulations specifying sampling station design on certain vessel classes if it was deemed necessary. The Observer Program would need the cooperation and agreement of the OAC and NPFMC if this was to be done.

Identification of Non-target Species

Observers are currently required to identify, account for, and record everything that occurs in their sample. NOAA Fisheries has observers record some organisms under generalized group accounting codes, such as “sculpin,” “eelpout,” or “snailfish”. Many species may be included in these groups, and observers are not required to identify them all to the species level. The decision as to which species observers are required to identify is made by the OPO, in consultation with the Alaska Regional Office and NOAA Fisheries stock assessment scientists. Historically, fish that are managed were identified to species, while non-target species were not. Non-target fish that were easily identified, such as shark species, have been identified for many years by observers. In the past few years, the OPO has received requests to have observers identify more non-target species, such as skates, sculpins, members of the Osmeridae family, and some coral species. Additionally, the OPO receives requests to identify some target species further than their management group, such as Northern and Southern rock sole, and light and dark dusky rockfish.

The OPO has to balance the additional time taken to teach non-target species identification and observer time in the field keying and recording these species with all the other tasks required of observers. The Observer Program has to be especially careful not to sacrifice target species data for the collection of non-target information. In 2002, the OPO issued a special project for skate and sculpin identification and trained only experienced observers with these additional keys. Along with identifying and recording these species, the observers were asked to record how much time they spent on these tasks. This project is ongoing in 2003 and will help the Program understand the cost-benefit relationship of this additional task and set the priority on identification of these species. Under this alternative, similar work on expanding species identification would continue.

Uncertainty Estimates

Currently, observer catch and composition data are used as point estimates for fishery management purposes. There are no established confidence intervals associated with these numbers, and the mean of observer samples is used as equal to the mean of the overall population.

NOAA Fisheries uses the observer estimates of total catch, the total weight of catch reported by industry and the difference between these two numbers in the blend system for estimating total weekly removals in the open-access fisheries. This current system of inseason management requires a fixed number from both observer and industry sources. The blend system is an algorithm for selecting either observer or industry data as the source for estimation of total groundfish catch. When both data are available, the blend selects one of them to include. When a vessel is unobserved, the catch estimates are based only on industry information. The blend system is not applied to the CDQ fishery, so vessels in these fisheries must carry additional observers sufficient to sample every haul.

In 1997, NOAA Fisheries contracted Versar, Inc. to do an analysis comparing several estimators of catch and catch composition. They developed two statistical estimators of fleetwide total catch using observer data from the 1994 BSAI pollock and yellowfin sole fisheries and compared these estimates to three other estimators representative of those currently used in these fisheries (industry supplied weekly production reports, observer data and the blend system). The Versar analysis showed that the use of statistical estimation for the management of these fisheries would have resulted in attainment of the TACs earlier than would have been case when using the blend system. Additionally, Versar's simulations showed that variability is high when either only a fraction of the vessels in the fleet are sampled or when the fraction of hauls sampled on a particular vessel is low. The current levels of observer coverage in these fisheries, and the amount of hauls sampled, provided for adequate statistical precision for the most abundant species in the catch¹⁷. The statistical precision decreased for rarer species. Complete observer coverage of the CDQ fishery was supported by Versar's results¹⁸.

The Versar report concluded that statistical procedures could be used for catch estimation, instead of the blend system. However, they also recommended that fishery managers evaluate whether observer coverage was sufficiently high to yield levels that satisfy management objectives. It would be appropriate to review the use of statistical estimators in tandem with setting new observer coverage levels, to ensure that the number of measurements made will result in the desired confidence interval.

The Versar report looked only at two large fisheries, both of which had high observer coverage rates because of the size of the vessels involved in the fisheries. The NPGOP and the Alaska Regional Office will need more data on the impact of statistical estimators on fishery management of smaller fisheries, ones with less observer coverage, and fisheries in which rarer species may be a limiting factor. A change in funding and the SDM may allow more vessels and more hauls to be sampled in these fisheries, giving NOAA Fisheries some of the data required.

¹⁷ The Versar report was written prior to the enactment of the AFA and observer coverage requirements for the open-access pollock fishery was based only on vessel length.

¹⁸ At the time of the Versar report, the only observed groundfish CDQ fishery was for walleye pollock.

4.2 FMP 3.2

Observer Coverage Levels

Under this management policy, observer coverage would continue to be fixed in regulation and based on vessel length. The only change from Alternative 1 would be that all vessels greater than or equal to 60 ft LOA would be required to carry an observer each day that they participate in an open-access groundfish fishery (100 percent coverage). This coverage requirement would provide increased data in fisheries prosecuted by smaller vessels, but would still leave a component of the fleet entirely uncovered and would not allow for any flexibility for NOAA Fisheries to change coverage levels in response to data needs.

Funding Mechanisms

The change in coverage levels under this FMP would almost assuredly require a change to the NPGOPs funding mechanism as well. The options and discussions for the different funding mechanisms under FMP 3.2 are the same as those discussed under FMP 3.1.

Data Collection Protocols

This bookend also calls for the improvements in observer sampling stations and improved species identification for non-target species that are discussed under FMP 3.1. FMP 3.2 would require NOAA Fisheries to expand uncertainty estimates to all possible stocks, rather than for just target species as in 3.1.

Section 5 Alternative 4: Adopt a Highly Precautionary Management Policy

There are no differences between the FMPs 4.1 and 4.2 in regards to the NPGOP, so the alternative will be discussed as one FMP.

Observer Coverage Levels

Under this management policy, observer coverage would be increased as would the actual percent of hauls sampled. Observer coverage levels would be set by vessel size, with vessels greater than 60 ft LOA requiring 100 percent coverage with all hauls sampled for species composition. Vessels less than 60 ft LOA would be required to carry an observer for 30 percent of their fishing days and all hauls retrieved while the observer was aboard would be sampled for species composition. Vessel size greatly impacts an observer's ability to complete sampling tasks. The requirement for all hauls to be sampled may require a change in the fisher's harvest strategy or a vessel to carry more than one observer.

Funding Mechanisms

Funding mechanisms for the NPGOP would also change under this management alternative and would be the same options as those presented in Alternative 3. Funding would be either through Federal annual appropriations, industry funded through a fee, or resource funded through a TAC set aside program. As described in Alternative 3, the Program's SDM would also change to reflect the funding source.

Data Collection Protocols

Although the percentage of observer coverage across the fleet would increase, the amount of observer data may decrease due to other changes in the fishery. With the change in emphasis from industry and community concerns toward ecosystem-oriented management, observer data collection protocols and emphasis may also change. For example, new PSC limits for salmon, crab, and herring in the GOA may shift sampling emphasis toward more accurate accounting of these species and away from other duties. The emphasis on ecological relationships among species may increase the need for trophic interaction data, such as stomach collections. These shifts in data collection priorities could cause a reduction in other critical observer data, such as otolith collections, bycatch accounting or total catch estimates. The OPO will need to continue to work closely with inseason managers and stock assessment scientists to respond to the changing data needs required for implementing this management alternative.

If all fisheries are shown to have some detrimental effect on the environment, there would be no fisheries and consequently, no observer coverage. Although the current emphasis of observer data collection is for inseason management purposes, other data are collected. Observers contribute to the knowledge of the species and the environment off the North Pacific. Among other tasks, observers contribute data on new species, report on geographic or depth range extensions of species, collect data on marine mammal and endangered seabird species sightings and record information and collect samples from tagged organisms. With the closure of the fisheries, the observer's unique opportunity for collecting information also ends.

Section 6 References

- Alaska Fisheries Science Center (AFSC). 2000. Resource Ecology and Fisheries Management Quarterly Report. July-September 2000 Report. Observer Program update prepared by B. Maier.
- AFSC. 2001. Resource Ecology and Fisheries Management Quarterly Report. April-June 2001 Report. Observer Program update prepared by B. Maier.
- AFSC. 2003. North Pacific groundfish observer manual. North Pacific Groundfish Observer Program. AFSC, Seattle.
- Department of Commerce. 1994. Final rule to implement the North Pacific Fisheries Research Plan in the GOA groundfish fishery, BSAI management area groundfish fishery, BSAI area king and Tanner crab fisheries, and Pacific halibut fishery in convention waters off Alaska. Federal Register. September 6, 1994.
- Department of Commerce. 1996. The North Pacific Fisheries Management Council has submitted for review by NMFS the repeal of the North Pacific Fisheries Research Plan, Amendment 47 to the FMP for Groundfish of the GOA, Amendment 47 to the FMP for the Groundfish fishery of the BSAI and Amendment 6 to the FMP for the Commercial King and Tanner Crab fisheries in the BSAI Area. Federal Register. July 12, 1996.
- Department of Commerce. 1998. Proposed rule to extend the current groundfish observer coverage requirements and implementing regulations for the North Pacific Groundfish Observer Program (Observer Program) that will expire December 31, 1998. Federal Register. September 8, 1998.
- Department of Commerce. 2002. NOAA Fisheries issues a final rule to extend the applicability date of the existing regulations for the interim North Pacific Groundfish Observer Program, which otherwise expire on December 31, 2002, through 2007. Federal Register. December 6, 2002.
- Department of Commerce. 2003. NOAA Fisheries issues a final rule to amend regulations governing the North Pacific Groundfish Observer Program. Federal Register. January 7, 2003.
- French, R., Nelson, R. and J. Wall. 1982. Role of the United States observer program in management of foreign fisheries in the northeast Pacific Ocean and eastern Bering Sea. *North American Journal of Fisheries Management* 2:122-131.
- Gaichas, S., C. Rose, J. Gauvin, J. Henderschedt, K. Dietrich and G. Stoker. 2000. Evaluation of catch sampling methods used in Alaska fisheries. Unpublished presentation for the North Pacific Fishery Management Council. April 2000.
- Marine Resources Assessment Group (MRAG), Americas, Inc. 2000. Independent review of the North Pacific groundfish observer program. Prepared for NOAA Fisheries.

- Megrey, B. and V. Wespestad. 1990. Alaskan groundfish resources: 10 years of management under the Magnuson Fishery Conservation and Management Act. *North American Journal of Fisheries Management* 10:125-143.
- National Marine Fisheries Service (NMFS). 2000. Management control review of National Marine Fisheries Service observer programs / service delivery models. NMFS, Silver Spring, Maryland.
- NMFS. 2001. North Pacific Groundfish Observer Program (NPGOP) service delivery model: long and near term changes. Meeting Summary. Prepared by the Alaska Regional Office. May 29, 2001.
- NMFS. 2001. Discussion paper: Three complementary regulatory actions to improve the North Pacific groundfish observer program, dated September 21, 2001. Prepared by NMFS.
- NMFS. 2002. Gulf of Alaska Rationalization. Proposed Amendment to the Fishery Management Plan for the Groundfish of the Gulf of Alaska. Scoping Guide to the Gulf of Alaska Rationalization Supplemental Environmental Impact Statement. Prepared by the Alaska Regional Office. July 19, 2002.
- National Research Council. 2000. Improving the collection, management, and use of marine fisheries data. National Academy Press, Washington, D.C.
- Nelson, R. 1987. Description of NWAFC foreign fisheries observer program. Overview prepared as part of the Western Administrative Support Center's Statement of Work for the provision of observer services. WASC, Seattle.
- North Pacific Fishery Management Council (NPFMC). 2003. Draft Observer Advisory Committee Report. January 23-24, 2003.
- Volstad, J. H., W. Rickus, S. Gaurin and R. Easton. 1997. Analytical and statistical review of procedures for collection and analysis of commercial fishery data used for management and assessment of groundfish stocks in the U.S. Exclusive Economic Zone off Alaska. Versar, Inc., Columbia, Maryland. Report prepared for the AFSC, Seattle.

This page intentionally left blank

APPENDIX F

Data and Reporting Requirements

This page intentionally left blank

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
Section 1	Data and Reporting Requirements	F-11-1
1.1	Trends in Data Collection Measures in Alaska Groundfish Fisheries	F-11-1
Section 2	Analysis of Alternatives	F-11-4
Section 3	Alternative 1: Continue with the Current Risk-Averse Management Policy	F-11-5
3.1	Management Approach with Specific Reference to Industry Reporting Requirements	F-11-5
3.2	Summary of Current Industry Reporting Requirements	F-11-5
3.2.1	Overview of Current Recordkeeping and Reporting System	F-11-5
3.2.2	AFA Requirement that All Catcher Processors and Motherships Weigh Pollock Catch on NOAA Fisheries-approved Scales	F-11-13
3.2.3	Requirement that all Community Development Quota Groundfish Catch be Weighed on NOAA Fisheries-approved Scales	F-11-14
3.2.4	Mandatory Vessel Monitoring System in Atka Mackerel, Pollock, and Pacific Cod Directed Fisheries	F-11-14
3.3	Effects of Current Industry Reporting Requirements	F-11-14
3.3.1	Recordkeeping and Reporting	F-11-14
3.3.2	Vessel Monitoring System	F-11-17
Section 4	Alternative 2: Adopt a More Aggressive Management Policy	F-11-18
4.1	Management Approach with Specific Reference to Industry Reporting Requirements	F-11-18
4.2	Overview of Industry Reporting Requirements of FMP 2.1	F-11-18
4.3	Effects of Industry Reporting Requirements of FMP 2.1	F-11-18
4.4.	Overview and Effects of Industry Reporting Requirements of FMP 2.2	F-11-19
Section 5	Alternative 3: Adopt a More Precautionary Management Policy	F-11-20
5.1	Management Approach with Specific Reference to Industry Reporting Requirements	F-11-20
5.2	Overview of Industry Reporting Requirements of FMP 3.1	F-11-20
5.3	Effects of Industry Reporting Requirements of FMP 3.1	F-11-20
5.4	Overview of Industry Reporting Requirements of FMP 3.2	F-11-21
5.5	Effects of Industry Reporting Requirements of FMP 3.2	F-11-21
Section 6	Alternative 4: Adopt a Highly Precautionary Management Policy	F-11-22
6.1	Management Approach with Specific Reference to Industry Reporting Requirements	F-11-22
6.2	Overview of Industry Reporting Requirements of FMP 4.1	F-11-22
6.3	Effects of Management Measures of Industry Reporting Requirements of FMP 4.1	F-11-22
6.4	Overview and Effects of Industry Reporting Requirements of FMP 4.2	F-11-23

Section 7	Opportunities for Quantification	F-11-24
Section 8	Comparative Analysis of Alternatives	F-11-25
Section 9	References	F-11-28

TABLES

Table 1.	Required logbooks, reports, forms, and electronic logbook and reports from participants in the Alaska groundfish fisheries	F-11-6
Table 2.	Public reporting burden for recordkeeping and reporting requirements.	F-11-16
Table 3.	Summary of the effects of the alternatives on data and reporting requirements. .	F-11-26

FIGURES

Figure 1.	The blend data processing system developed for the Alaska groundfish fisheries.	F-11-10

ACRONYMS AND ABBREVIATIONS

ABC	Acceptable Biological Catch
ADF&G	Alaska Department of Fish & Game
AFA	American Fisheries Act
APA	At-Sea Processors Association
BSAI	Bering Sea/Aleutian Islands
BSR	Buying Station Report
CDQ	Community Development Quota
COAR	Commercial Operator's Annual Report
Council	North Pacific Fishery Management Council
DCPL	Daily Cumulative Production Logbook
DFL	Daily Fishing Logbook
DPR	Daily Production Report
EEZ	Exclusive Economic Zone
ft	feet/foot
FFP	Federal Fisheries Permit
FPP	Federal Processor Permit
FMPs	Fishery Management Plans
FR	Federal Register
GOA	Gulf of Alaska
GPS	Global Positioning System
IFQ	Individual Fishing Quota
LLP	License Limitation Program
LOA	Length Overall
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	Metric Tons
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fisheries Management Council
NPGOP	North Pacific Groundfish Observer Program
PRR	Product Recovery Rates
PSD	Prohibited Species Designation
PSMFC	Pacific States Marine Fisheries Commission
PSQ	Prohibited Species Quota
PTR	Product Transfer Report
QS	Sablefish Quota Share
SPELR	Shoreside Processor Electronic Logbook Report
TACs	Total Allowable Catches
U.S.	United States
VAR	U.S. Vessel Activity Report
VMS	Vessel Monitoring System
WPR	Weekly Production Reports

This page intentionally left blank

Section 1 Data and Reporting Requirements

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) states that the collection of reliable data is essential to the effective conservation, management, and scientific understanding of the fishery resources of the United States (U.S.). This qualitative impact assessment examines the effects of alternative approaches to data collection in the Alaska groundfish fisheries. Managers of these fisheries recognize that the best available biological and socioeconomic information is necessary in order to promote successful management of groundfish resources, as well as fishery resources such as crab, halibut, and salmon that are incidentally caught in the groundfish fisheries. Data collected are used for making in-season and inter-season management decisions that affect the groundfish resources and the fishing industry that utilizes them.

This qualitative impact assessment focuses on the information collected from industry reporting requirements and vessel monitoring system (VMS) requirements for the groundfish fisheries. The North Pacific Groundfish Observer Program (NPGOP) is mentioned but not discussed at length, as this program is the subject of a separate qualitative impact analysis. Nor does this qualitative assessment discuss the information collected from fishery-independent research programs conducted by National Marine Fishery Service (NMFS) or National Oceanic and Atmospheric Administration [NOAA] Fisheries) and other agencies.

The first part of this analysis provides a historical overview of requirements for industry data reporting and VMS used to monitor the groundfish fisheries. The second part of the analysis describes the alternative approaches to data collection considered by the North Pacific Fisheries Management Council (NPFMC) and their impacts.

1.1 Trends in Data Collection Measures in Alaska Groundfish Fisheries

This section briefly describes the development of requirements for recordkeeping and reporting, at-sea weighing, and VMS in the Alaska groundfish fisheries. A more complete description of current requirements is included in the discussion of Alternative 1.

Industry Recordkeeping and Reporting Requirements

The fishing industry's input into the fishery data collection system is mandated through NOAA Fisheries recordkeeping and reporting requirements. When the MSA was implemented in 1976, the groundfish fisheries were dominated by foreign catcher processors and motherships. To monitor fishing activity, NOAA Fisheries required vessel operators to record activities in logbooks. U.S. observers placed on the vessels reported catch estimates and logbook entries weekly. This system of reporting continued into the mid-1980s, when much of the groundfish catch was harvested by domestic catcher vessels and delivered to foreign processing vessels in joint venture operations. Deliveries by domestic catcher vessels to inshore processors were reported by means of the Alaska Department of Fish and Game's (ADF&G) fish tickets.¹ Catcher

¹ Fish tickets record landed weight and value by species. A fish ticket is considered a legal document and requires the signature of the permit holder (captain or operator) and the receiver (buyer).

processors were also required to submit fish ticket reports of groundfish catches to the ADF&G, but these vessels could stay at sea for long periods, and thus did not report as frequently as catcher vessels.

With the rapid expansion of the domestic catcher processor fleet, it became apparent that a mechanism for timely reporting of catches by this fleet was needed to reduce the chance of exceeding the total allowable catch (TAC). In 1985, NOAA Fisheries required operators of catcher processors and motherships that retained fish at sea for 14 days or more to provide a weekly report of the amounts of groundfish caught or received by species and by fishing area. In addition, the operators of these vessels were required to check-in and check-out of regulatory areas. By 1987, NOAA Fisheries required weekly reports of groundfish caught in the U.S. Exclusive Economic Zone (EEZ) and processed at sea from all domestic catcher processors and motherships regardless of how long their catch was retained before landing. In 1988, the reporting requirements of these vessels were augmented with at-sea transfer information. In 1989, the NPFMC closed a regulatory loophole that allowed vessels outside the EEZ to receive and process fish caught in the EEZ without reporting them to NOAA Fisheries. All vessels of the U.S. receiving EEZ-caught fish were required to hold a federal permit and thus had to comply with the weekly reporting requirements. Beginning in 2002, all motherships and any catcher processors taking deliveries from catcher vessels were required to submit ADF&G fish tickets.

At-Sea Weighing Requirements

Estimates of catch by catcher processors are based on observer data and the weekly reports submitted by vessel captains. Until recently, observers estimated catch using certified bins to make volumetric estimates of catch weight or product recovery rates were used to convert product weights back to whole fish. The captains' estimates of catch relied on an ad hoc "eyeball" method that may vary significantly across captains.

As scale technology advanced (including the refinement of motion-compensated weighing equipment), NOAA Fisheries began to require the use of at-sea scales to estimate catch weight in certain fisheries.² For example, the new catch accounting requirements established for the western Alaska Community Development Quota (CDQ) program in 1998 included the use of NOAA Fisheries-approved scales to weigh catch at sea. These requirements arose out of a need for an accurate accounting of harvests of halibut, groundfish TAC species, and prohibited species in CDQ fisheries. Catcher processors (trawl and longline) and motherships have two primary requirements. These vessel types are required to have a NOAA Fisheries-certified observer sampling station and a motion-compensated platform scale. In addition, trawl and mothership vessels are required to have certified motion-compensated flow scales.

The American Fisheries Act (AFA) also mandated the use of onboard scales to more accurately weigh fish in the BSAI at-sea pollock fisheries. This technology was necessary to verify that the sideboard caps and directed pollock harvests are not being exceeded by the AFA fleet.

² Shoreside and inshore floating processors have generally always used scales for determining delivery volumes.

VMS Requirements

In recent years, NOAA Fisheries has employed a VMS to enhance the effectiveness of monitoring and enforcement activities in the Alaska groundfish fisheries. VMS automatically determines a vessel's location several times per hour using Global Positioning System (GPS) satellites. A VMS transmitter installed on a vessel sends the position information to NOAA Fisheries via a mobile communication service provider. Each vessel is assigned a unique number, and tracking software at NOAA Fisheries provides vessel name, position, speed, and heading. The VMS transmitters are designed to be tamper-resistant and automatic. The vessel owner is unaware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission.

The first VMS requirement in the Alaska groundfish fisheries was implemented in 2000, when NOAA Fisheries required that all trawl vessels engaged in directed fishing for Atka mackerel in the Aleutian Islands subarea be equipped with a VMS transmitter. This action was necessary to enhance monitoring of fishery activities within the critical habitat of the Steller sea lion. In 2002, an emergency interim rule (67 Federal Register [FR] 956) issued by NOAA Fisheries to implement additional Steller sea lion protection measures expanded the use of VMS. The rule required all vessels using pot, hook-and-line or trawl gear that are permitted to directly fish for Pacific cod, Atka mackerel or pollock to have an operable VMS by June 10, 2002. The VMS must be operable when any of these three fisheries (Atka mackerel, pollock or Pacific cod) for which the vessel is endorsed are open, regardless of the target species. NOAA Fisheries have implemented computer programming systems that integrate VMS data with observer haul data and with the spatial (Geographic Information System) data defining critical habitat. This system automatically identifies observer-reported catch that is from critical habitat, for use in catch accounting for critical habitat limits.

Section 2 Analysis of Alternatives

The following four policy alternatives are under consideration by the NPFMC:

Alternative 1: Continue with the Current Risk-Averse Management Policy – Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing may result in some adverse impacts to the environment and that, if or when these impacts become known, mitigation measures will be developed and appropriate fishery management plans (FMPs) amendments will be implemented.

Alternative 2: Adopt a More Aggressive Management Policy – A less precautionary management policy (more aggressive harvest strategy) would be implemented based upon the concept that the present strategy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This strategy assumes that fishing at the recommended levels would have no adverse impact on the environment except in specific cases that are generally known.

Alternative 3: Adopt a More Precautionary Harvest Strategy – This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the “environment,” not just a population of a given species.

Alternative 4: Adopt a Highly Precautionary Harvest Strategy – This policy would require that managers or users of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy and its associated FMP framework would be to impose very restrictive conservation and management measures at minimum that would only be modified or relaxed when additional reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve, and be responsive to, the public but decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing does produce adverse impacts on the environment, but, due to a lack of information and uncertainty, we know little about these impacts. A goal of this alternative, as expressed through its FMP framework, is to include the use of explicit allocative or cooperative programs to reduce excess capacity and allocate fish to particular gear types and fisheries.

Each of the policy alternatives outlined above, with the exception of Alternative 1, contains two example FMPs that serve as bookends to a range of management measures that illustrate how the framework of each policy could be implemented. These bookends provide a level of detail that allows the effects of the alternatives on the environment to be compared. They also provide a basis for the NPFMC to commit to the goals and principles of a particular policy alternative, while allowing it, under the MSA, to adaptively manage the fishery through FMP amendments using the best scientific information available.

Section 3 Alternative 1: Continue with the Current Risk-Averse Management Policy

3.1 Management Approach with Specific Reference to Industry Reporting Requirements

Under this policy alternative, the NPFMC and NOAA Fisheries will continue the existing reporting requirements and observer program to provide catch estimates and biological information; continue on-going efforts to improve community and regional economic impact assessments; and increase the quality of monitoring data through improved technological means.

3.2 Summary of Current Industry Reporting Requirements

3.2.1 Overview of Current Recordkeeping and Reporting System

Data Collection

Current federal and State of Alaska recordkeeping and reporting requirements in the Alaska groundfish fisheries are summarized in Table 1. A summary of the information collected by each of the logbooks, reports, and forms follows the table.

Daily Fishing Logbook (DFL)

A DFL is required of all catcher vessels equal to greater than 60 feet (ft) LOA. Data reported include the gear type, Federal reporting area code where gear retrieval was completed, number of observers aboard, crew size, target species, time, position, and estimated total catch weight of groundfish for each haul or set, discard/disposition information, and delivery information. For trawl gear, the estimated total round catch weight of the groundfish must be reported in pounds or to the nearest metric ton (mt). For longline and pot gear, the estimated catch weight of Individual Fishing Quota (IFQ) and CDQ halibut must be reported to the nearest pound; the estimated weight of IFQ sablefish must be reported to the nearest pound and the number of sablefish must be reported; and the estimated total round catch weight of all other species must be reported to the nearest pound or to at least the nearest 0.001 mt. For each groundfish species or species group and Pacific herring, operators must record the species code, product code, and the total estimated discard/disposition amounts in whole fish weight in pounds or to at least the nearest 0.001 mt. For Pacific salmon, steelhead trout, Pacific halibut, king crab, and Tanner crab, operators must record the species code, and discard/disposition amounts in number of animals. If fish are discarded (bled) from an unsorted codend, operators must estimate and record the amount of each species discarded.

Table 1. Required logbooks, reports, forms, and electronic logbook and reports from participants in the Alaska groundfish fisheries.

Requirement name	Catcher vessel	Catcher processor	Mothership	Shoreside processor ^c	Buying station
Daily fishing logbook (DFL)	YES	NO	NO	NO	NO
Daily cumulative production logbook (DCPL) ^a	NO	YES	YES	YES	NO
Weekly production report (WPR)	NO	YES	YES	YES	NO
Optional: Electronic WPR	NO	YES	YES	YES	NO
Shoreside processor electronic logbook report (SPELR) instead of DCPL and WPR when receiving American Fisheries Act (AFA) pollock or pollock harvested in a directed pollock fishery	NO	NO	NO	YES	NO
Optional: SPELR instead of DCPL and WPR	NO	NO	NO	YES	NO
Check-in/check-out report	NO	YES	YES	YES	NO
Optional: Electronic check-in/check-out report	NO	YES	YES	YES	NO
Buying station report (BSR)	NO	NO	NO	NO	YES
United States (U.S.) vessel activity report (VAR)	YES	YES	YES	NO	NO
Daily production report (DPR) ^b	NO	YES	YES	YES	NO
Product transfer report (PTR)	NO	YES	YES	YES	NO
Commercial operator's annual report (COAR)	NO	YES	YES	YES	YES
Alaska Department of Fish and Game (ADF&G) groundfish fish ticket	NO	NO	YES	YES	YES
Required use of AFA and community development quota (CDQ) at-sea scales, including daily scale test, printed scale output, request for inspection of scales, observer station, and scale approval sticker	NO	YES	YES	NO	NO
Vessel monitoring system (VMS) when fishing for Atka mackerel, pollock, or Pacific cod	YES	YES	NO	NO	NO

^a Two formats of the DFL and catcher processor DCPL exist: one for trawl gear and one for longline and pot gear.

^b DPR is submitted only when specifically requested by the NOAA Fisheries Regional Administrator.

^c Includes stationary floating processors

Source: Adapted from NOAA Fisheries Alaska Regional Office.

Daily Cumulative Production Logbook (DCPL)

The DCPL required of all catcher processors includes data on the gear type, Federal reporting area code where gear retrieval was completed, number of observers aboard, crew size, target species, time, position, and estimated total catch weight of groundfish for each haul or set, discard/disposition information, and product information (total weight of product – by species codes, product codes, and product designation – that was produced each day). For trawl gear, the estimated round catch weight of groundfish must be reported to the nearest pound or mt. The round catch weight of pollock and the round catch weight of Pacific cod must be reported separately to the nearest pound or metric ton. For longline and pot gear, the round catch weight of pollock must be reported to the nearest pound or mt; the round catch weight of Pacific cod must be reported to the nearest pound or mt; the estimated catch weight of IFQ halibut and CDQ halibut must be reported to the nearest pound; the estimated weight of IFQ sablefish must be reported to the nearest pound and the number of sablefish must be reported; and the estimated total round catch weight of all other species must be reported to the nearest pound or to at least the nearest 0.001 mt. For each groundfish species or species group and Pacific herring, operators must record the species code, product code, and the total estimated discard/disposition amounts in whole fish weight in pounds or to at least the nearest 0.001 mt. For Pacific salmon, steelhead trout, Pacific halibut, king crab, and Tanner crab, operators must record the species code and discard/disposition amounts in number of animals. If fish are discarded (bled) from an unsorted codend, operators must estimate and record the amount of each species discarded.

The DCPL required of all motherships includes data on the gear type, Federal reporting area code where groundfish were harvested, number of observers aboard, crew size, estimated total catch weight of groundfish for each delivery, discard/disposition information, and product information (total weight of product—by species codes, product codes, and product designation—that was produced each day). The estimated round catch weight of groundfish must be reported to the nearest pound or mt. The round catch weight of pollock and the round catch weight of Pacific cod must be reported separately to the nearest pound or mt. For each groundfish species or species group and Pacific herring, operators must record the species code, product code, and the total estimated discard/disposition amounts in whole fish weight in pounds or to at least the nearest 0.001 mt. For Pacific salmon, steelhead trout, Pacific halibut, king crab, and Tanner crab, operators must record the species code and discard/disposition amounts in number of animals.

The DCPL required of all shoreside processors or stationary floating processors includes data on the gear type, Federal reporting area code where groundfish were harvested, estimated total catch weight of groundfish for each delivery, landings information, discard/disposition information, and product information (total weight of product – by species codes, product codes, and product designation – that was produced each day). The estimated round catch weight of groundfish must be reported to the nearest pound or mt. The daily total scale weight of landings must be reported, by species and product codes, in pounds or to the nearest 0.001 mt. For each groundfish species or species group and Pacific herring (a prohibited species), managers must record the species code, product code, and the total estimated discard/disposition amounts in whole fish weight in pounds or to at least the nearest 0.001 mt. For Pacific salmon, steelhead trout, Pacific halibut, king crab, and Tanner crab, operators must record the species code and discard/disposition amounts in number of animals.

Weekly Production Report (WPR)

The operator of a catcher processor or mothership or the manager of a shoreside processor must submit a WPR for any week the mothership, catcher processor, or shoreside processor is checked in (see Check-In/Check-Out Report). The WPR summarizes the DCPL on a weekly basis.

Shoreside Processor Electronic Logbook Report (SPELR)

A SPELR is required instead of a DCPL and WPR for shoreside processors or stationary floating processors receiving groundfish from AFA catcher vessels or receiving pollock harvested in a directed pollock fishery.

Check-in/Check-out Report

These reports are required of all catcher processors, motherships, and shoreside processors. Operators of catcher processors and motherships and managers of shoreside processors must notify NOAA Fisheries before and after certain activities. For example, catcher processors, motherships, and shoreside processors must check-in to and check-out of each Federal reporting area where groundfish were harvested.

Buying Station Report (BSR)

The operator or manager of a buying station must submit a BSR when receiving groundfish from a catcher vessel and delivering or shipping that groundfish to a mothership, shoreside processor, or stationary floating processor. Information reported includes the gear type, Federal reporting area code where groundfish were harvested, estimated total groundfish delivery weight (optionally, in addition to the total estimated delivery weight or actual scale weight, species codes and weights), the total discard/disposition amount by species and product codes for each associated processor, reporting area, gear type, and management program. For each buying station delivery to an associated processor, the total estimated discard and disposition amounts in whole fish weight for each groundfish species or species group and Pacific herring must be reported in pounds or to at least the nearest 0.001 mt. For each buying station delivery to an associated processor, the total estimated numbers of discard/disposition of Pacific salmon, steelhead trout, Pacific halibut, king crab, and Tanner crab must be reported in number of animals.

U.S. Vessel Activity Report (VAR)

The operator of a catcher vessel, catcher processor, or of a mothership must submit a VAR before the vessel crosses the seaward boundary of the EEZ off Alaska or crosses the U.S.-Canadian international boundary between Alaska and British Columbia. If a vessel is carrying only IFQ halibut and/or IFQ sablefish onboard, and the operator has received a Vessel Clearance or has submitted a Vessel Departure Report, the operator is not required to submit a VAR.

Daily Production Report (DPR)

If the NOAA Fisheries Regional Administrator determines that DPRs are necessary to avoid exceeding a groundfish TAC or prohibited species bycatch allowance, NOAA Fisheries may require submission of DPRs

from motherships, catcher processors, and shoreside processors for reporting one or more specified species, in addition to a WPR.

Groundfish Product Transfer Report (PTR)

The operator of a catcher processor or mothership or the manager of a shoreside processor or stationary floating processor must record each transfer of groundfish product (including unprocessed fish) or donated prohibited species on a PTR.

Commercial Operator's Annual Report (COAR)

The manager of a shoreside processor and owner of a mothership or catcher processor must annually complete and submit a COAR to ADF&G. Data reported should include the total weight (to the nearest pound) purchased from fishermen, total amount paid to fishermen, including all post-season adjustments and/or bonuses and any credit received by fishermen for gas expenses, ice, delivery premiums, and other miscellaneous expenses, price paid per pound for the recorded weight, total weight (in pounds) of the finished product, total wholesale value of the finished product, and price per pound of the finished product.

ADF&G Groundfish Fish Ticket

Required of all shoreside processors, stationary floating processors, motherships, and all harvest in connection with a CDQ program fishery. Data reported include date fishing began, date landed, gear type, ADF&G groundfish statistical area where groundfish were harvested, landed weight (in pounds) and condition of the catch by species, weight (in pounds) of discards at sea and at the dock, number and type of prohibited species discarded at sea, price paid/received per pound for the recorded weight, and monetary amount paid/received.

Data Transmission and Management

NOAA Fisheries currently operates an electronic reporting system for catch information from the groundfish fisheries. The electronic reporting system replaces a paper-based system of recordkeeping and reporting that was implemented in the late 1980's. This system required vessels and processors to maintain paper logbooks detailing fishing activity and catch. Processors were required to summarize the logbook on a weekly basis and fax the WPR to NOAA Fisheries for entry into the database. The electronic reporting system allows catcher processors, motherships, and shoreside processors to submit both WPRs and check-in/check-out reports via e-mail or direct from a modem from their computer on board. The benefits of the electronic reporting system include improved data quality, automated processing of data, improved process for correcting or updating information, and more timely data available to fishery managers.

Data Processing

The blend data processing system developed by NOAA Fisheries combines data from industry and observer reports to estimate groundfish harvest in North Pacific groundfish fisheries. The system blends the best available data from different sectors of the fishery to generate what, NOAA Fisheries believes, is the most accurate estimate of total groundfish harvest possible with the existing data. This data processing system is illustrated in Figure 1.

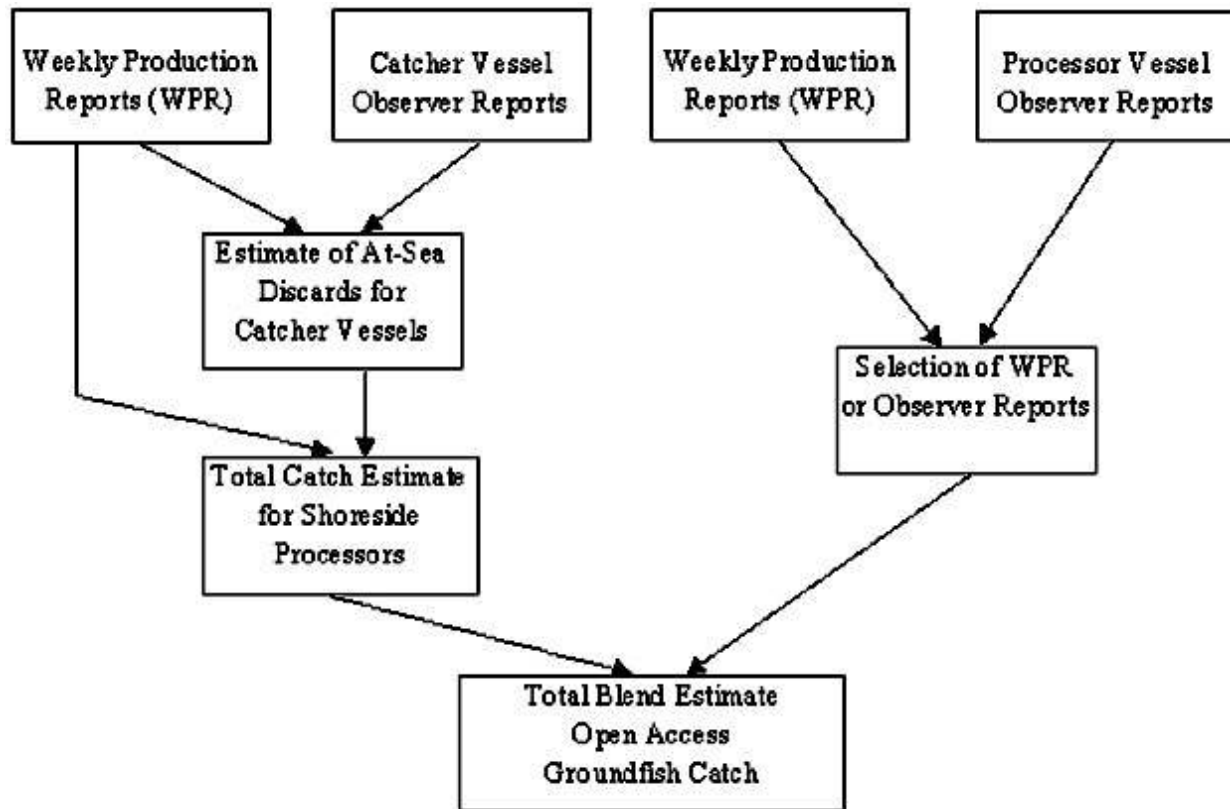


Figure 1. The blend data processing system developed for the Alaska groundfish fisheries.
Source: NOAA Fisheries Alaska Regional Office.

WPRs for shoreside processors report landed weight of catch. These WPRs are the best source of data for retained groundfish landings. All fish delivered to shoreside processors are weighed on scales, and these weights are used to account for retained catch. Observers on catcher vessels report groundfish species composition, total catch, and estimates of retention and discard on a weekly basis. Observer information on groundfish discards is used in conjunction with total retained groundfish catch from shoreside WPRs to estimate total at-sea discards from all catcher vessels, including observed and unobserved vessels. All observer data for a month, gear, and target fishery are combined to compute discard rates for each groundfish species observed to be discarded. The discard rates are expressed as a ratio of the weight of the discarded species to the total retained groundfish weight. The discard rates are multiplied by the retained landings for each shoreside processor to estimate total at-sea discards of groundfish associated with the groundfish landed to the processor.

Total catch for shoreside processors is obtained by adding the landed catch weights reported on shoreside processor WPRs to the estimates of at-sea discards. As noted earlier, WPRs for catcher processors and motherships report weights of processed products and round weights of discards. Product weights are converted to equivalent round weights using product recovery rates (PRRs). Observers on processor vessels report groundfish species composition, total catch, and estimates of retention and discards on a weekly basis for each separate reporting area and gear type. Total catch may be estimated using cod-end or bin volumetrics, scales, or conversion from production data. Species composition of the total catch is determined through taking a catch sample, and apportioning the catch by species based on that sample.

Total groundfish catch for all species combined is computed each week for each processor vessel from the WPR and from the observer report. If either report is missing, the report present is selected. If both reports are present, the blend compares the two numbers: if the WPR and observer total catch numbers are within 5 percent, the WPR is selected as the source; if the WPR is more than 30 percent higher than the observer total catch (for pollock target fisheries)³ or more than 20 percent higher (all other targets), the WPR is selected as the source. In all other cases, the observer report is selected as the source. The blend program then returns to the source data (WPR or observer) and copies the detailed records, showing gear type, area and species, to the blend. Records from WPRs are identified in the blend by a source field value of “W”, observer records are identified by a source field value of “O.”

The blend process combines data from industry production reports and observer reports to make the best, comprehensive accounting of groundfish catch. These data are used to manage quotas for groundfish in the Gulf of Alaska (GOA), Bering Sea and Aleutian Islands (BSAI). The blend data are also used as the basis for computing estimates of prohibited species bycatch. Prohibited species include Pacific halibut, salmon, herring, and crabs. Blend data are used for numerous regional and national reports, fishery stock assessments, and analysis of FMPs.

Permits and Licenses

An array of federal and State of Alaska permits and licenses is used to regulate and monitor the level of participation in the Alaska groundfish fisheries. These permitting and licensing requirements are an integral component of the data collection system as they provide the unique vessel and plant identifiers recorded in the required logbooks, reports, and forms described above. In addition, the permit and license applications record extensive information about the characteristics of the individual vessels and processing plants participating in the groundfish fisheries. The major permits and licenses are described below.

AFA Permits

All vessels and processors wishing to participate in the non-CDQ BSAI pollock fishery are required to have valid AFA permits on board the vessel or at the processing plant. AFA permits may limit the take of non-pollock groundfish, crab, and prohibited species as governed by AFA "sideboard" provisions.

Federal Fisheries Permit (FFP)

This permit is required for U.S. vessels used to fish for groundfish in the GOA or BSAI. This permit is also required for vessels used to fish for any non-groundfish species and that are required to retain any bycatch of groundfish under 50 Code of Federal Regulations (CFR) Part 679. Non-groundfish species includes but is not limited to halibut, crab, salmon, scallops, and herring. "Fishing" is a broad term and includes, for example: harvesting, processing, tendering, support, etc.

³ Pollock is processed into several products with highly variable recovery rates, including surimi and deep-skin fillets. The wider selection range is needed to ensure that WPR records are not inappropriately selected in cases where a processor achieves high recovery rates.

Federal Processor Permit (FPP)

This permit is required for stationary floating processors (processing vessels that operate solely within Alaska state waters). The permit is also required for shoreside processors that receive and/or process groundfish harvested from federal waters (or from any federally-permitted vessels).

IFQ Permits

An IFQ permit authorizes participation in fixed-gear harvests of Pacific halibut off Alaska, and most sablefish fisheries off Alaska. The permits are not specific to vessels. Permits are issued to persons holding fishable Pacific halibut and sablefish quota share (QS); or to those who are recipients of IFQ-only transfers from QS holders.

North Pacific License Limitation Program (LLP)

Any person who wishes to deploy a harvesting vessel in the groundfish fisheries in the GOA or the BSAI must hold a valid groundfish license issued under the LLP. Beginning January 1, 2003, persons who wish to participate in the directed fishery for Pacific cod in the BS and/or AI with pot or hook-and-line gear must have the appropriate gear-specific Pacific cod endorsement on the LLP license that names their vessel. Pacific cod endorsements are not required for trawl gear or jig gear; for these gears, licenses only need a trawl, or non-trawl gear endorsement, respectively. Groundfish licenses are issued with gear endorsements (trawl or non-trawl) and area endorsements. In the BSAI there are two LLP endorsement areas: BSAI. In the GOA, there are three LLP endorsement areas: West Gulf, Central Gulf, and Southeast Gulf. There are four exceptions to the LLP license requirement, including: 1) vessels that do not exceed 26 ft in length overall (LOA) in the GOA; 2) vessels that do not exceed 32 ft LOA in the BSAI; 3) vessels that do not exceed 60 ft LOA, and that are using jig gear (but no more than 5 jig machines, one line per machine, and 15 hooks per line) in the BSAI; and, 4) certain vessels constructed for, and used exclusively in, CDQ fisheries.

Prohibited Species Donation (PSD) Program Permits

These permits authorize tax-exempt organizations to distribute salmon and/or halibut (delivered by catcher vessels using trawl gear to shoreside processors) to hunger relief agencies, food bank networks, or food bank distributors.

U.S. Coast Guard Vessel Documentation

Vessels of five net tons or more used in fishing activities on navigable waters of the U.S. or in the EEZ must be documented.

Alaska Seafood Processor and Exporter License and Permit

Any person (including corporations, partnerships, limited liability companies, and joint ventures) who receives, prepares, processes or transports a seafood or fishery product including roe recovery to sell for human consumption or a person who custom processes a seafood or fishery product must have a Seafood

Processor and Exporter License and Permit. A person who transports an unprocessed seafood or fishery product outside of Alaska must also have a Seafood Processor and Exporter License and Permit.

Commercial Fishing Vessel License

Any vessel, boat, ship, or other craft which is used for commercial fishing or for aiding or assisting in the performance of any activity related to commercial fishing (including refrigeration, transportation and processing) must have a valid commercial fishing vessel license issued by the Alaska Commercial Fisheries Entry Commission.

Economic Data Collection

Economic and social analyses of federal management actions and policies are required by the MSA, the National Environmental Policy Act, the Endangered Species Act, the Regulatory Flexibility Act, Executive Order 12866, Executive Order 12898 and other federal laws. However, existing data reporting mechanisms compile very limited economic data. Currently, revenue and price data are the only economic data being systematically collected under mandatory programs. Two examples of these are ADF&G groundfish fish tickets, which contain a field to report ex-vessel prices paid/received for delivered fish, and ADF&G COAR, which contain data on both ex-vessel and wholesale values for shoreside processors. In 2000 at the request of the NPFMC, NOAA Fisheries promulgated regulations that extended to at-sea processors the requirement to submit COAR data to the State.

NOAA Fisheries and the NPFMC have recognized the increasing need to collect economic data on a regular basis. To help meet this need, the Fisheries Economics Data Program was established as a cooperative data collection program by NOAA Fisheries and the Pacific States Marine Fisheries Commission (PSMFC) with the assistance of the NPMFC and Pacific Fishery Management Council. On-going economic data collection efforts by the program include a monthly survey of fuel docks at selected ports on the West Coast and in Alaska to create a marine fuel price index. Data are currently available for the period 1999-2001. In 2000, the Fisheries Economics Data Program implemented a voluntary survey to provide data that can be used to track the economic performance of the groundfish fisheries over time. Catcher vessels, catcher processors, motherships and shoreside plants involved in the BSAI pollock fishery were surveyed first. By 2002, however, only one firm had completed a survey form and that was ultimately returned to the company when no other industry members responded.

3.2.2 AFA Requirement that All Catcher Processors and Motherships Weigh Pollock Catch on NOAA Fisheries-approved Scales

All groundfish landed by unrestricted AFA catcher processors or received by AFA motherships must be weighed on a NOAA Fisheries-approved scale and made available for sampling by a NOAA Fisheries-certified observer. These vessels are required to have an observer sampling station that includes a motion-compensated scale to improve the accuracy of sample weights. The owner and operator of an unrestricted AFA catcher processor or an AFA mothership must ensure that the vessel is in compliance with published scale requirements, that each groundfish haul is weighed separately, and that no sorting of catch takes place prior to weighing. All groundfish landed by AFA catcher vessels engaged in directed fishing for pollock in

the BSAI must be sorted and weighed on a scale approved by the State of Alaska and be made available for sampling by a NOAA Fisheries-certified observer.⁴

The scales requirements in AFA and CDQ fisheries have greatly enhanced the accuracy of data collected by observers in these fisheries.

3.2.3 Requirement that all Community Development Quota Groundfish Catch be Weighed on NOAA Fisheries-approved Scales

All catcher vessels in the groundfish and halibut CDQ fisheries that are 60 ft and greater LOA are required to have at least one certified CDQ observer for all groundfish and halibut CDQ fishing. Operators of unobserved vessels and observed catcher vessels using trawl gear are required to retain all groundfish CDQ and salmon and herring prohibited species quota (PSQ) and deliver it to a processor where it can be sorted and weighed on a certified scale. Observed catcher vessels using longline, pot, and jig gear (non-trawl gear) must either retain all groundfish and halibut CDQ and deliver it to a processor with a certified scale or provide sufficient observer coverage to sample all CDQ sets for species composition and average weight and have an observer sampling station with a motion-compensated sampling scale.

Regardless of their length, all catcher processors and motherships are required to have at least two certified CDQ observers and provide special equipment for estimating CDQ and PSQ catch. Catcher processors using trawl gear and motherships are required to weigh all catch in the CDQ fisheries on a scale certified by NOAA Fisheries and to have an observer sampling station, including a motion-compensated platform scale. Catcher processors using longline, pot, or jig gear are required to have an observer sampling station, including a motion-compensated platform scale.

Shoreside processors are required to sort all CDQ deliveries by species or species group and weigh them on a scale certified by the State. PSQ species monitored by number are required to be counted. The sorting and weighing of all CDQ and PSQ are required to be monitored by a CDQ observer.

3.2.4 Mandatory Vessel Monitoring System in Atka Mackerel, Pollock, and Pacific Cod Directed Fisheries

It is unlawful for any person to operate a vessel which is authorized to participate in the Atka mackerel, Pacific cod or pollock directed fisheries in any BSAI or GOA reporting areas, unless the vessel carries an operable NOAA Fisheries-approved VMS transmitter. The only exemption is for vessels using jig gear.

3.3 Effects of Current Industry Reporting Requirements

3.3.1 Recordkeeping and Reporting

The current industry recordkeeping and reporting requirements in the Alaska groundfish fisheries, together with the NPGOP and fishery-independent surveys conducted by NOAA Fisheries, create what is widely regarded as one of the most comprehensive fishery data collection systems in the world. NOAA fisheries

⁴ The Alaska Division of Measurement Standards is responsible for approving scales inside state boundaries and has developed an effective program for their inspection and approval.

believes that, while improvements are possible in some areas, the existing system provides sufficient data to assess the current stock condition of target species and accurately estimate the biomass levels used to set acceptable biological catch (ABC) and TACs. The result is that the threat of overfishing in target fisheries is low.

The costs to industry of complying with the current recordkeeping and reporting requirements is minimal. The public reporting burden for the recordkeeping and reporting requirements described in this analysis are summarized in Table 2 and include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The federal government incurs costs in collating, analyzing, and disseminating the fisheries data collected. Estimating these costs is difficult, but they are believed to be significant. In addition, the federal government incurs costs in disseminating information about reporting requirements to industry participants. For example, NOAA Fisheries, Alaska Region, the U.S. Coast Guard, and North Pacific Regional Fisheries Training Center, periodically conduct workshops on Federal recordkeeping and reporting requirements (e.g., 64 FR 70199, December 16, 1999). The purpose of these workshops is to explain provisions of the recordkeeping and reporting requirements for the Alaska groundfish fisheries, to provide detailed instructions on completion and submittal of the required forms and logsheets, and to answer questions on recordkeeping and reporting from members of the fishing industry and other interested parties.

There are four primary weaknesses of the existing data collection and reporting system: 1) the lack of observer coverage on smaller fishing vessels; 2) a low level of precision in catch estimates over small subsets of various fisheries; 3) a low precision level in estimates of discarded fish; and 4) insufficient collection of socioeconomic data. These four areas of weakness are discussed below.

Observer Coverage

The NPGOP is discussed in detail in a separate qualitative impact assessment. Here, it is sufficient to indicate that vessels greater than 125 ft must carry an observer 100 percent of the time, while vessels 60-124 ft long are required to carry an observer during 30 percent of their fishing days in each calendar quarter of the year in which they fish more than 10 days. Because fishing operations may occur 24 hours per day, some portion of catch, even on vessels with an observer, is not observed. NOAA Fisheries has conducted studies (e.g., Vølstad *et al.* 1996) to ascertain the effectiveness of their catch sample regimes and has concluded that the lack of more complete observer coverage does not significantly compromise total catch estimates. Nevertheless, it is clear that additional observer coverage would improve the precision of total catch and discard estimates on a vessel-by-vessel basis, particularly in target fisheries, such as the GOA Pacific cod fishery, in which smaller vessels harvest a significant portion of the TAC. While additional observer coverage would benefit the fishery with improved catch estimates, additional observer coverage would impose additional costs on the industry. Currently, NOAA Fisheries believes that the improved catch estimates would not sufficiently offset the costs of additional observers under the current management regulations.

Table 2. Public reporting burden for recordkeeping and reporting requirements.

United States (U.S.) vessel activity report	14 min./report	Catcher vessel Daily fishing logbook (DFL) longline, pot gear trawl gear	28 min./day 18 min./day
Check-in/check-out report catcher processor, mothership, shoreside processor	7 min./report 8 min./report	Mothership daily cumulative production logbook (DCPL)	31 min./day
Weekly production report	17 min./report	Shoreside processor DCPL	31 min./day
Daily production report	11 min./report	Catcher processor DCPL longline, pot gear trawl gear	41 min./day 30 min./day
Product transfer report	20 min./report	Weekly cumulative mothership Alaska Department of Fish and Game (ADF&G) fish ticket	35 min/ticket
Buying station report	23 min./report	Commercial operator's annual report	6 hr./report

Source: Adopted from NOAA Fisheries Alaska Regional Office

Precision of Estimates

The current data collection and reporting system, including the observer program, places limits on the precision of catch estimates over a sub-set of the fisheries. This lack of precision is a result of the statistical properties of the catch sampling system employed in the observer program. The system relies on the statistical “rule of large numbers” that states that the sample estimate will be closer to the true number the larger the number of observations in the sample. Total catch estimates in a fishery depend on reports by many observers who individually make many separate estimates of catch during a particular week or month. While any one of these estimates might be high or low over the entire fleet because of the large number of estimates in the sample, the overestimates will offset the underestimates. Consequently, on average the estimates of total catch will be relatively accurate.

However, because the number of samples is not large enough, NOAA Fisheries does not believe that estimates of total catch for an individual vessel are accurate enough to be defensible in a regulatory action. Similarly, NOAA Fisheries does not believe the current system provides accurate enough estimates of catch to regulate groups of vessels within a particular fleet (e.g., vessel cooperatives).

Discard Estimates

The MSA requires that, to the extent practicable, bycatch (meaning discards) must be reduced. The accuracy and precision of estimates of discarded fish are lower than optimal because by definition discards are not kept on the vessel and therefore must be counted and estimated during the fishing operation. In the absence of observers there is no way to track discards. Further, observers cannot be present at all times that fishing operations occur. As indicated above, NOAA Fisheries estimates discard amounts for fishing operations that

are observed and applies those estimates to unobserved operations. While this is a practical and relatively efficient solution, it appears likely that a better method of estimating discards will need to be developed.

Socioeconomic Data

The socioeconomic data currently collected on a routine basis are insufficient for a comprehensive analysis of the cost and benefits of proposed regulations. Intra-annual prices and prices by product grade are not supplied, and product prices reported by industry are not independently checked or verified. This may leave the revenue picture incomplete or inaccurate. No data on the costs of production and very little data on employment levels are routinely collected. Without information on harvesting and processing costs it is not possible to determine whether firms are profitable, much less the magnitude of the profit or how it has been or might be affected by regulatory changes. The absence of employment data means that it is not possible to state the number of employees affected by management decisions.

3.3.2 Vessel Monitoring System

VMS has had a positive effect on Steller sea lions, as it is an essential component of measures to protect these sea mammals. In the absence of VMS, enforcement of compliance with closed areas would be limited to random sightings by enforcement vessels or aircraft. To monitor Steller sea lion critical habitat harvest limits, managers need to know which vessels fished in the area and how much fish they caught. VMS data provide real-time information on vessel location and indicate fishing activity. These VMS data can be matched with observer data or landing data for the trip to determine if the catch is counted against the catch limit.

By allowing fishing to continue, the VMS requirement has a positive economic effect on fishery participants and fishing communities. Many important fishing grounds are included in the Steller sea lion critical habitat. The protection measures, including VMS, were developed to afford vessels an opportunity for continued access to those grounds. Allowing that access, with addition of the VMS requirement, is preferred by the fishing industry to closing the areas entirely.

The VMS requirement has imposed minimal costs on the fishing industry. The cost for the purchase and installation of a VMS unit is estimated to be \$1,926. Annual maintenance and transmission costs for a small entity are estimated to be \$220. The VMS costs have been substantially mitigated for small vessels since the PSMFC has obtained a grant of \$1.8 million from NOAA Fisheries for the purpose of reimbursing vessel owners for VMS purchases that are required. The PSMFC will reimburse up to \$2,000 of the purchase price of each unit. The grants will not cover the costs of installation, maintenance, and operation of the units.

The current costs to the federal government of maintaining the VMS program include the staffing costs associated with running the program. These staffing costs are approximately \$115,000 per year (A. Kinsolving, NOAA-Fisheries, personal communication, 20 February 2003).

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

4.1 Management Approach with Specific Reference to Industry Reporting Requirements

Under this policy alternative, the NPFMC and NOAA Fisheries will continue the existing reporting requirements to provide catch estimates and biological information. There will also be a continuation of the on-going effort to improve community and regional economic impact assessments. However, the NPFMC and NOAA Fisheries will consider repealing the Observer Program.⁵ The effects of the elimination of the Observer Program are discussed in depth in a separate qualitative impact analysis, but some of the potential spillover effects of this action on the overall data collection and monitoring program are discussed here.

4.2 Overview of Industry Reporting Requirements of FMP 2.1

This FMP would retain current reporting requirements as described in Table 1. However, no at-sea weighing of catch would be required except for AFA-eligible catcher processors. In addition, all measures requiring the use of VMS in the groundfish fisheries would be eliminated, and as mentioned above the Observer Program would be eliminated in all but the AFA pollock fishery in the BSAI.

4.3 Effects of Industry Reporting Requirements of FMP 2.1

Elimination of the Observer Program will increase the reliance of fishery managers on the data collected through current industry recordkeeping and reporting requirements, such as the estimates of total catch made by skippers as the catch is brought on board. According to NOAA Fisheries (W. Karp, NOAA Fisheries Alaska Fisheries Science Center, personal communication, December 2002), these data are not very precise, and it is certain that the accuracy of total catch estimates will decline. Data on discarded fish collected by vessel captains may be even less accurate than total catch, as there is little incentive to report discarded fish, especially prohibited species. The result will be underestimates of fishing mortality of species for which there are limited markets, e.g., skates, sculpins, arrowtooth, and many flatfish species.

Because logbook data are generally not as precise as observer data in terms of species reporting and catch estimation, stock assessments using logbook data will likely be less precise than they would be if the observer program was retained. Less precise stock assessments could lead to reduced TACs as fishery scientists adapt to the lack of precision by generating more conservative biomass estimates. In addition, increased reliance on logbook data will significantly decrease the precision of total catch data available for fishery managers. With less precise data, fishery managers are likely to adopt a conservative approach and close fisheries before actual catches reach the TAC. Closing a fishery early could result in considerable foregone industry revenues.

⁵ FMP 2.1 calls for the elimination of the Observer Program for all but the AFA pollock fishery in the BSAI. FMP 2.2 maintains the existing Observer Program.

Increased reliance on logbook data is also likely to generate additional costs for NOAA Fisheries in terms of data entry and data analysis. Currently the observer data is considered more reliable than haul by haul entries in logbooks and therefore logbook data are not routinely entered into computerized data systems, nor are they regularly used by fishery scientists in stock assessment. Entering these data into computerized data systems and preparing the data for use in stock assessment are likely to be costly, although these costs may be offset by elimination of the Observer Program.

Elimination of the current VMS requirement may have a negative impact on the fishing industry, as it could lead to the closure of all Steller sea lion critical habitat to fishing. By allowing NOAA Fisheries to effectively monitor compliance with a large number of complex area-based fishing restrictions, VMS affords vessels an opportunity for continued access to some historic fishing grounds within critical habitat. In the absence of VMS, it is possible that all critical habitat would have to be closed to fishing in order to ensure that the fisheries do not jeopardize the continued existence of Steller sea lions or adversely modify their critical habitat.

4.4. Overview and Effects of Industry Reporting Requirements of FMP 2.2

FMP 2.2 is identical to FMP 1 in terms of reporting and VMS requirements. Consequently, the predicted effects on the human environment are the same.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

5.1 Management Approach with Specific Reference to Industry Reporting Requirements

Under this policy alternative, the NPFMC and NOAA Fisheries will seek to achieve the following management objectives: increase the utility of groundfish fishery observer data for the conservation and management of living marine resources and address the equity problems of the current funding mechanism; improve the groundfish observer program; improve community and regional economic impact assessments through increased data reporting requirements; increase the quality of monitoring data through improved technological means; establish a coordinated, long-term ecosystem monitoring program to collect baseline information and compile existing information from a variety of ongoing research initiatives; adopt the recommended research plan included in this document; and cooperate with research institutions such as the North Pacific Research Board in identifying research priorities to address pressing fishery issues.

5.2 Overview of Industry Reporting Requirements of FMP 3.1

This FMP would retain current reporting requirements as described in Table 1. Economic data would be collected and verified by an independent third party, such as an accounting firm. Current requirements for at-sea weighing of catch would be retained. The VMS would be modified to incorporate new technology and system providers.

5.3 Effects of Industry Reporting Requirements of FMP 3.1

The increase in the number of VMS system providers that occurs under FMP 3.1 would increase competition among providers and possibly lead to a reduction in system costs and/or improvements in system technology.

Under FMP 3.1, collection of socioeconomic data would be conducted through independent third parties, such as accounting firms. New information would include data on employment, variable harvesting and processing costs, and fixed/annual costs. In addition, third party data collectors would be able to verify revenue data that are currently submitted to ADF&G on fish tickets and the COARs. This additional information will enhance the ability of analysts to provide accurate estimates of costs and benefits of proposed regulatory actions.

The additional administrative cost of data collection using independent firms is uncertain. However, a rough estimate can be derived from the experience of the At-Sea Processors Association (APA). In 1998, the APA contracted an independent firm to supply employment data to the NPFMC for use in an assessment of the impacts of reauthorization of inshore-offshore regulations for the BSAI pollock fishery. According to a representative of APA (P. MacGregor, Mundt MacGregor LLP, personal communication, January 2003), the information collected cost \$25,000 and covered approximately 30 pollock catcher processors. The current offshore pollock catcher processor fleet is smaller than in 1998 due to the enactment of the AFA. Consequently, it is expected that collection of employment data for this sector would be less expensive now than it was in 1998. On the other hand, verification of employment data is considerably less complex than

verification of revenue and cost information. Therefore, it is likely that the overall costs of collecting comprehensive economic data from the pollock catcher processor fleet will be significantly greater than \$25,000.

Some of the problems associated with the use of unauthenticated cost data were demonstrated in the early 1990s during the assessment of the initial allocation of pollock and Pacific cod between inshore and offshore processors. In that analysis, NOAA Fisheries surveyed fishery participants to collect data on the costs of harvesting and processing pollock and Pacific cod. The information generated as a result of the survey was used by analysts to estimate the costs and benefits of the allocation and the direct, indirect, and induced effects on employment and income. Although the inshore-offshore allocation was eventually approved by the Secretary of Commerce, the analysis of the economic effects was highly controversial. It is probable that the controversy could have been lessened if the cost and employment information collected in the survey of fishery participants had been verified by independent auditors.

5.4 Overview of Industry Reporting Requirements of FMP 3.2

This FMP would retain current reporting requirements as described in Table 1. In addition, the reporting of earnings, expenditure, and employment data would be required of all vessels and processors authorized to participate in the groundfish fisheries; these data would be reported directly to NOAA Fisheries by participants, and presumably would not be independently verified. Current requirements for at-sea weighing of catch would be retained. The VMS would be modified to incorporate new technology and system providers.

5.5 Effects of Industry Reporting Requirements of FMP 3.2

In general, the effects of this bookend are similar to the effects of FMP 3.1 in terms of data collection. The primary difference between the two bookends is the greater reporting burden imposed on industry by FMP 3.2.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

6.1 Management Approach with Specific Reference to Industry Reporting Requirements

Under this policy alternative, the NPFMC and NOAA Fisheries would increase the precision of observer data through increased observer coverage and enhanced sampling protocols, and address the shortcomings of the current funding mechanism by implementing either a federally funded or equitable fee-based system for a revamped Observer Program research plan; improve community and regional economic impact assessments through increased data reporting requirements; improve enforcement and in-season management through improved technological means; establish a coordinated, long-term monitoring program to collect baseline information and better utilize existing research information to improve implementation of the fishery ecosystem plan; and adopt the recommended research plan.

6.2 Overview of Industry Reporting Requirements of FMP 4.1

This FMP would retain current reporting requirements as described in Table 1. The use of motion-compensated scales would be required to weigh all catches made by or delivered to at sea processors or at shoreside processing plants. All vessels engaged in fishing for groundfish would be required to carry an operable NOAA Fisheries-approved VMS transmitter.

6.3 Effects of Management Measures of Industry Reporting Requirements of FMP 4.1

The data collection measures contained in FMP 4.1 are likely to have a positive impact on the natural and physical environment. Increasing scale requirements for vessels is likely to increase the quantity and quality of catch data. These data are used for assessing the condition of groundfish stocks and monitoring the potential effects of fishing on Steller sea lions. Use of scales on all catcher processors is likely to enhance the ability of NOAA Fisheries to implement and enforce regulations applying to individual vessels or sub-fleets. These measures might include the establishment of individual quotas or cooperatives (S. Salveson, NOAA Fisheries, Alaska Region, personal communication, January 2003).

The scale and VMS requirements would impose costs on the fishing industry. A motion-compensated platform scale would cost between \$6,000 and \$12,000. In addition, smaller (<200 ft LOA) at-sea processors may have insufficient space in which to install scales without considerable reconfiguration or removal of existing processing equipment (J. Gauvin, Groundfish Forum, personal communication, December 2003.). The current list price of a VMS unit is about \$2,000. The transmission cost per day is about \$5 when a vessel is active. After approximately 11.5 hours of inactivity, the unit will go into sleep mode, incurring only \$5 per week in transmission costs until activity (movement) resumes.

6.4 Overview and Effects of Industry Reporting Requirements of FMP 4.2

By suspending the harvest of groundfish until more information is known on the impacts of fishing on the environment, this FMP would effectively eliminate the need for industry requirement measures in the short-term. These effects would prevail until each Alaska groundfish fishery was subjected to an environmental review. If the results of the review determine a fishery is “eco-friendly” that fishery would be permitted to operate under specific regulations and mitigation measures. Only fisheries certified by NOAA Fisheries to have no significant adverse effects on the environment would be authorized to operate in the EEZ off Alaska. Such a review and certification process would likely take up to two years based on the length of a recent environmental review of the Alaska pollock fishery conducted by an international organization.

Section 7 Opportunities for Quantification

There are several opportunities for quantification that would support the analysis of the effects of data collection requirements. These are listed below:

1. Estimated minimum, maximum, and average number of days fished by each vessel class in 2001, and the estimated daily VMS transmission costs per vessel.
2. Physical space requirements of scales and the amount of processing capacity that might be reduced if scales were required on small catcher processors (less than 200 ft LOA).
3. The estimated costs of collecting verified socioeconomic data from the fishing industry using independent third parties.
4. The estimated costs of collecting unverified socioeconomic data directly from the fishing industry.
5. The potential improvement in the precision of cost-benefit analyses and economic impact analyses that might be gained by the collection of various types of socioeconomic information.

Section 8 Comparative Analysis of Alternatives

The following summarizes the effects of each policy alternative in terms of industry reporting requirements in the Alaska groundfish fisheries as determined by analyses of each alternative's associated FMP framework.

Alternative 1: This policy alternative would retain current reporting requirements. The economic data currently collected on a routine basis are insufficient for a comprehensive regulatory analysis.

Alternative 2: FMP 2.1 would retain current reporting requirements. However, no at-sea weighing of catch would be required except for AFA-eligible catcher processors. In addition, all measures requiring the use of VMS in the groundfish fisheries would be eliminated.

FMP 2.2 is identical to Alternative 1 in terms of reporting and VMS requirements.

Alternative 3: FMP 3.1 would retain current reporting requirements. Economic data would be collected and verified by an independent third party, such as an accounting firm. Current requirements for at-sea weighing of catch would be retained. The VMS would be modified to incorporate new technology and system providers.

FMP 3.2 would retain current reporting requirements. In addition, the reporting of earnings, expenditure, and employment data would be required of all vessels and processors authorized to participate in the groundfish fisheries. Current requirements for at-sea weighing of catch would be retained. The VMS would be modified to incorporate new technology and system providers.

Alternative 4: FMP 4.1 would retain current reporting requirements. The use of motion-compensated scales would be required to weigh all catches at sea or at shoreside processing plants. All vessels engaged in fishing for groundfish would be required to carry an operable NOAA Fisheries-approved VMS transmitter.

By suspending the harvest of groundfish, FMP 4.2 would effectively eliminate the need for industry requirement measures until fisheries have been certified that they have no significant adverse effects on the environment. Fisheries authorized to occur would be issued fishery-specific regulations that would include data collection measures.

The following table summarizes the anticipated effects of different approaches toward data reporting in the Alaska groundfish fisheries as described in the associated FMP bookends.

Table 3. Summary of the effects of the alternatives on data and reporting requirements.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Physical environment						
No effect	No effect	No effect	No effect	No effect	No effect	No effect
Biological environment						
Beneficial effect Sufficient data would continue to be collected to assess the current stock condition of target species and accurately estimate the biomass levels used to set acceptable biological catch (ABC) and total allowable catches (TACs). However, estimates of discards may be imprecise. Vessel monitoring system (VMS) has had a positive effect on Steller sea lions, as it is an essential component of measures to protect these sea mammals.	Potentially adverse effect The accuracy of total catch estimates will decline.	Same effects as FMP 1.	Same effects as FMP 1.	Same effects as FMP 1.	Beneficial effect Increasing scale requirements for vessels is likely to increase the quantity and quality of catch data. These data are used for assessing the condition of groundfish stocks and monitoring the potential effects of fishing on Steller sea lions.	No effect By suspending the harvest of groundfish until more information is known on the impacts of fishing on the environment this FMP would effectively eliminate the need for reporting and VMS requirements in the short-term.

Table 3 (cont.).

Summary of the effects of the alternatives on data and reporting requirements.

Alternative 1	Alternative 2		Alternative 3		Alternative 4	
Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Economic and social effects						
Potentially adverse/beneficial effect The costs to industry of complying with reporting and VMS requirements are minimal. However, the socioeconomic data currently collected on a routine basis are insufficient for a comprehensive analysis of the cost and benefits of proposed regulations. By allowing fishing to continue in Steller sea lion critical habitat, the VMS requirement is expected to have a positive economic effect on fishery participants and fishing communities.	Potentially adverse effect Less precise stock assessments could lead to reduced TACs and early fishery closures. Elimination of the current VMS requirement may have a negative impact on the fishing industry, as it could lead to the closure of all Steller sea lion critical habitat to fishing.	Same effects as FMP 1.	Potentially beneficial effect The additional economic information collected will enhance the ability of analysts to provide accurate estimates of costs and benefits of proposed regulatory actions. The increase in the number of VMS system providers would increase competition among providers and possibly lead to a reduction in system costs and/or improvements in system technology.	Potentially adverse/beneficial effect The reporting burden for industry participants will increase. However, the additional economic information collected will enhance the ability of analysts to provide accurate estimates of costs and benefits of proposed regulatory actions. The increase in the number of VMS system providers would increase competition among providers and possibly lead to a reduction in system costs and/or improvements in system technology.	Potentially adverse/beneficial effect The scale and VMS requirements would impose costs on the fishing industry. However, use of scales on all catcher processors is likely to enhance the ability of NOAA Fisheries to implement and enforce regulations applying to individual vessels or sub-fleets. These measures might include the establishment of individual quotas or cooperatives.	No effect By suspending the harvest of groundfish until more information is known on the impacts of fishing on the environment this FMP would effectively eliminate the need for reporting and VMS requirements in the short-term.

Section 9 References

Vølstad, Jon Helge, William Richkus, Steve Gaurin. “Analytical and Statistical Review of Procedures for Collection and Statistical Review of Procedures for Collection and Analysis of Commercial Data Used for In-Season Management in the U.S. Exclusive Economic Zone Off Alaska.” Versar, Inc. Columbia, MD 21045. September 8, 1996.

Personal Communications

J. Gauvin, Director, The Groundfish Forum, Inc., December 2003

W. Karp, NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, December 2002

A. Kinsolving, Resource Management Specialist, NOAA Fisheries, Juneau, AK, February 2003

P. MacGregor, Mundt MacGregor LLP, January 2003