UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

FEB 3 1999

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Environmental Assessment for Amendment 56 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area and Amendment 56 to the Fishery Management Plan for Groundfish of the Gulf of Alaska

LOCATION: The Exclusive Economic Zone off Alaska

SUMMARY: This environmental assessment addresses a revision to the definition of overfishing for groundfish in these two fishery management plans. To comply with section 303(a) of the Sustainable Fisheries Act, maximum sustainable yield is treated as a limit, rather than a target. Overfishing is defined as any amount of fishing in access of prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers, which are listed in descending order of preference, corresponding to whether a given item of information is reliable for the purpose of this definition.

RESPONSIBLE OFFICIAL: Steven Pennoyer
Administrator
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The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information. Also please send one copy of your comment to me in Room 5805, PAP, U.S. Department of Commerce, Washington, D.C. 20230.

Sincerely,

Susan Fruchter

Susan B. Fruchter
Director of the Office of
Policy and Strategic Planning

ENVIRONMENTAL ASSESSMENT
FOR
AMENDMENT 56 TO THE FISHERY MANAGEMENT PLAN FOR THE GROUNDFISH FISHERY OF THE BERING SEA AND ALEUTIAN ISLANDS AREA
AND
AMENDMENT 56 TO THE FISHERY MANAGEMENT PLAN FOR THE GROUNDFISH FISHERY OF THE GULF OF ALASKA

TO REDEFINE ACCEPTABLE BIOLOGICAL CATCH AND OVERFISHING

Prepared by

Staff
National Marine Fisheries Service
Alaska Fisheries Science Center

January 21, 1999

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Executive Summary

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) contains a number of provisions pertaining to the content of fishery management plans (FMPs) and a requirement that all FMPs be updated so as to be consistent with those provisions by October 11, 1998. In addition, the Magnuson-Stevens Act requires the Secretary of Commerce to establish advisory guidelines, based on the Magnuson-Stevens Act's "National Standards," to assist in this process. A draft of these National Standard Guidelines (NSGs) was published as a proposed rule on August 4, 1997 and the final rule was published on May 1, 1998. Because the NSGs were written for a general audience, the National Marine Fisheries Service (NMFS) decided to supplement them with a more technically oriented report containing examples of methods that might be used to satisfy the NSGs (Restrepo et al. *in press*).

With regard to the definitions of the overfishing level (OFL) and acceptable biological catch (ABC) presently contained in the FMPs for the groundfish fisheries of the Bering Sea and Aleutian Islands Region (BSAI) and the Gulf of Alaska (GOA), the following are areas in which changes are suggested by the Magnuson-Stevens Act, the NSGs, or the Restrepo report:

1) Maximum sustainable yield (MSY) should be treated as a limit rather than a target. This means that "limit" harvest strategies (such as the rules used to specify OFL) should result in a long-term average catch that approximates MSY, and that "target" harvest strategies (such as the rules used to specify ABC) should result in catches that are substantially more conservative than the limit. Tiers 2-4 of the current ABC/OFL definitions could be interpreted as treating MSY as a target rather than a limit.

2) A minimum stock size threshold should be identified for each stock so as to provide a means to determine whether the stock is overfished. The current ABC/OFL definitions do not identify such a threshold.

3) The procedures used to specify both limit and target harvest levels should address uncertainty in stock status as well as reference points. Tier 1 of the current ABC/OFL definitions considers uncertainty in the target fishing mortality rate, but does not address uncertainty in projected or reference stock size.

4) The procedures used to specify both limit harvest levels (e.g., OFL) and target harvest levels (e.g., ABC) should be consistent across stocks within an FMP, even when the levels of information available for those stocks vary considerably. This means that a specification procedure which prescribes a reduction in the fishing mortality rate when relative abundance is low should not be abandoned whenever absolute abundance is uncertain. Tiers 4 and 5 of the current ABC/OFL definitions do not adjust the fishing mortality rate when stock size is low, and Tier 6 of the current definitions implicitly increases the fishing mortality rate when stock size is low.

This plan amendment proposal considers four alternatives:

> Alternative 1: No change. MSY is treated as a target rather than a limit under certain circumstances, no minimum stock size threshold is identified, specification procedures can be inconsistent depending on information level, and uncertainty in projected and reference stock sizes is not addressed.
>
> Alternative 2: (preferred) MSY is consistently treated as a limit rather than a target.

Alternative 3: Modest change. MSY is consistently treated as a limit rather than a target, a minimum stock size threshold is identified, uncertainty in projected and reference stock sizes is addressed, and specification procedures are consistent *given a sufficient* information level.

Alternative 4: Substantial change. MSY is consistently treated as a limit rather than a target, a minimum stock size threshold is identified, uncertainty in projected and reference stock sizes is addressed, and specification procedures are consistent *regardless of* information level.

The impacts of the alternatives were analyzed by calculating what changes, if any, would have been required in the 1998 total allowable catch (TAC) levels had either Alternative 2, Alternative 3, or Alternative 4 been in place at the end of 1997. In the case of Alternative 3, no changes in TAC would have been required. In the case of Alternative 4, the possible impacts would have depended on the relative abundance levels determined by the Scientific and Statistical Committee (SSC) for stocks managed under Tiers 4, 5, or 6 of the current ABC/OFL definitions. Because no such determinations were actually made in 1997, the analysis proceeds by applying a default "rule of thumb" to judge relative sizes of these stocks. If the SSC were to have determined that all such stocks were at a moderate or high level of abundance (as would have been the case for the 1998 fishery had the default rule been followed), no changes in TAC would have been required under Alternative 4. At the other extreme, if the SSC were to have determined that all such stocks were currently overfished (i.e., if the SSC were to have judged that the default rule drastically over-estimated stock size in all cases), individual TAC reductions under Alternative 4 would have summed to 37,800 t in the GOA and 105,000 t in the BSAI, or 12% and 5% of the sum of the actual 1998 TACs, respectively. However, some or all of these reductions could potentially have been offset by increasing TACs on stocks for which TAC was below ABC. None of the alternatives is likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

1.0 INTRODUCTION

The groundfish fisheries in the Exclusive Economic Zone (3 to 200 miles offshore) off Alaska are managed under the Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska (GOA) and the Fishery Management Plan for the Groundfish Fisheries of the Bering Sea and Aleutian Islands Area (BSAI). Both of these fishery management plans (FMPs) were developed by the North Pacific Fishery Management Council (Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The GOA Groundfish FMP was approved by the Secretary of Commerce and became effective in 1978 and the BSAI Groundfish FMP became effective in 1982.

Actions taken to amend the FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson-Stevens Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NEPA, E.O. 12866, and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1 of this document. Section 2 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 3 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered.

This Environmental Assessment/Regulatory Impact Review (EA/RIR) addresses plan amendments to redefine "acceptable biological catch" (ABC) and "overfishing" in the BSAI and GOA Groundfish FMPs. In April 1998, the Council and its advisory bodies (the Advisory Panel and Scientific and Statistical Committee) reviewed a draft EA/RIR and recommended several changes to the alternatives. A revised analysis was released for public review on May 6. In June 1998, the Council adopted Alternative 2, as detailed in this document, as its preferred alternative.

1.1 Purpose of and Need for the Action

On October 11, 1996, the President signed into law the Sustainable Fisheries Act (Public Law 104-297). The Sustainable Fisheries Act made numerous amendments to the Magnuson Fishery Conservation and Management Act, resulting in what is now known as the Magnuson-Stevens Act. In particular, Section 108(a) of the Sustainable Fisheries Act amended Section 303(a) of the old Magnuson Act, resulting in Section 303(a) of the new Magnuson-Stevens Act. Section 303(a) describes required provisions of fishery management plans, including the following new requirement (paragraph (10)):

> Specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery.

This language supersedes the requirement in the 1989 version of the National Standard Guidelines (NSGs), which read,

> Each FMP must specify, to the maximum extent possible, an objective and measurable definition of overfishing for each stock or stock complex covered by that FMP, and provide an analysis of how the definition was determined and how it relates to reproductive potential.

In addition to replacing the above regulatory requirement with a new statutory requirement, the Sustainable Fisheries Act also instituted the following definition of "overfishing," a term which had previously lacked a statutory definition (paragraph (29) of Section 3):

> The terms "overfishing" and "overfished" 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.

This language supersedes the definition in the 1989 version of the NSGs, which read,

> "Overfishing" is a level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis,

where "MSY" denotes "maximum sustainable yield."

Responsibility for complying with the language in the new Section 303(a) of the Magnuson-Stevens Act is given in Section 108(b) of the Sustainable Fisheries Act as follows:

> Not later than 24 months after the date of enactment of this Act, each Regional Fishery Management Council shall submit to the Secretary of Commerce amendments to each fishery management plan under its authority to comply with the amendments made in subsection (a) of this section.

Thus, the Council must submit amendments bringing the FMPs for the BSAI and GOA groundfish fisheries into compliance with the above by October 11, 1998. To aid in the development of such amendments, the National Marine Fisheries Service (NMFS) is required by Section 301(b) of the Magnuson-Stevens Act to revise the NSGs. A draft of the revised NSGs was published as a proposed rule on August 4, 1997 and the final rule was published on May 1, 1998.

Because the specification of overfishing currently contained in the BSAI and GOA Groundfish FMPs is formally linked to the specification of ABC, overfishing and ABC specifications are considered jointly in this amendment package.

1.2 Alternatives Considered

1.2.1 Alternative 1. No change. The following language would remain in the groundfish FMPs (where "OFL" denotes the "overfishing level" and "SSC" denotes the "Scientific and Statistical Committee"):

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a "pdf" refers to a probability density function. For tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

1) *Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*
   - *1a) Stock status:* $B/B_{MSY} > 1$
     $F_{OFL} = \mu_A$, the arithmetic mean of the pdf
     $F_{ABC} \le \mu_H$, the harmonic mean of the pdf
   - *1b) Stock status:* $\alpha < B/B_{MSY} \le 1$
     $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     $F_{ABC} \le \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - *1c) Stock status:* $B/B_{MSY} \le \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
2) *Information available: Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{30\%}$, and $F_{40\%}$.*
   - *2a) Stock status:* $B/B_{MSY} > 1$
     $F_{OFL} = F_{MSY} \times (F_{30\%}/F_{40\%})$

$F_{ABC} \leq F_{MSY}$

2b) *Stock status:* $\alpha < B/B_{MSY} \leq 1$

$F_{OFL} = F_{MSY} \times (F_{30\%}/F_{40\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

$F_{ABC} \leq F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

2c) *Stock status:* $B/B_{MSY} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

3) *Information available: Reliable point estimates of B,* $B_{40\%}$, $F_{30\%}$, and $F_{40\%}$.

3a) *Stock status:* $B/B_{40\%} > 1$

$F_{OFL} = F_{30\%}$

$F_{ABC} \leq F_{40\%}$

3b) *Stock status:* $\alpha < B/B_{40\%} \leq 1$

$F_{OFL} = F_{30\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) *Stock status:* $B/B_{40\%} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

4) *Information available: Reliable point estimates of B,* $F_{30\%}$, and $F_{40\%}$.

$F_{OFL} = F_{30\%}$

$F_{ABC} \leq F_{40\%}$

5) *Information available: Reliable point estimates of B and natural mortality rate M.*

$F_{OFL} = M$

$F_{ABC} \leq 0.75 \times M$

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 $\leq 0.75 \times$ OFL

1.2.2 Alternative 2. (Preferred) MSY is consistently treated as a limit rather than a target. The following language would be incorporated into the groundfish FMPs, replacing the existing definition of overfishing:

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a "pdf" refers to a probability density function. For tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to

view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

1) *Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*

1a) Stock status: $B/B_{MSY} > 1$

$F_{OFL} = \mu_A$, the arithmetic mean of the pdf

$F_{ABC} \le \mu_H$, the harmonic mean of the pdf

1b) Stock status: $\alpha < B/B_{MSY} \le 1$

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

$F_{ABC} \le \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

1c) Stock status: $B/B_{MSY} \le \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

2) *Information available: Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.*

2a) Stock status: $B/B_{MSY} > 1$

$F_{OFL} = F_{MSY}$

$F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%})$

2b) Stock status: $\alpha < B/B_{MSY} \le 1$

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

$F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

2c) Stock status: $B/B_{MSY} \le \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

3) *Information available: Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.*

3a) Stock status: $B/B_{40\%} > 1$

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

$F_{ABC} \le F_{40\%}$

3b) Stock status: $\alpha < B/B_{40\%} \le 1$

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

$F_{ABC} \le F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) Stock status: $B/B_{40\%} \le \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

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

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

$F_{ABC} \le F_{40\%}$

5) *Information available: Reliable point estimates of B and natural mortality rate M.*

$F_{OFL} = M$

$F_{ABC} \le 0.75 \times M$

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 $\le 0.75 \times$ OFL

1.2.3 Summary of Similarities and Differences Between Alternatives 1 and 2. The alternatives are compared in terms of their textual similarities and differences below, where plain text indicates language common to both alternatives, "strikeout" indicates language unique to Alternative 1, and shading indicates language unique to Alternative 2.

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a "pdf" refers to a probability density function. For tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

1) *Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*

   1a) *Stock status:* $B/B_{MSY} > 1$

   $F_{OFL} = \mu_A$, the arithmetic mean of the pdf

   $F_{ABC} \le \mu_H$, the harmonic mean of the pdf

   1b) *Stock status:* $\alpha < B/B_{MSY} \le 1$

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

   $F_{ABC} \le \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

   1c) *Stock status:* $B/B_{MSY} \le \alpha$

   $F_{OFL} = 0$

   $F_{ABC} = 0$

2) *Information available: Reliable point estimates of B, B_{MSY}, F_{MSY}, ~~$F_{30\%}$~~ $F_{35\%}$, and $F_{40\%}$.*

   2a) *Stock status:* $B/B_{MSY} > 1$

   ~~$F_{OFL} = F_{MSY} \times (F_{30\%}/F_{40\%})$~~

   $F_{OFL} = F_{MSY}$

   ~~$F_{ABC} \le F_{MSY}$~~

   $F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%})$

   2b) *Stock status:* $\alpha < B/B_{MSY} \le 1$

   ~~$F_{OFL} = F_{MSY} \times (F_{30\%}/F_{40\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$~~

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

   ~~$F_{ABC} \le F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$~~

   $F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

   2c) *Stock status:* $B/B_{MSY} \le \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

3) *Information available: Reliable point estimates of B, $B_{40\%}$, ~~$F_{30\%}$~~ $F_{35\%}$, and $F_{40\%}$.*

3a) Stock status: $B/B_{40\%} > 1$

~~$F_{OFL} = F_{30\%}$~~

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

$F_{ABC} \leq F_{40\%}$

3b) Stock status: $\alpha < B/B_{40\%} \leq 1$

~~$F_{OFL} = F_{30\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$~~

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

$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) Stock status: $B/B_{40\%} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

4) *Information available: Reliable point estimates of B, ~~$F_{30\%}$~~ $F_{35\%}$, and $F_{40\%}$.*

~~$F_{OFL} = F_{30\%}$~~

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

$F_{ABC} \leq F_{40\%}$

5) *Information available: Reliable point estimates of B and natural mortality rate M.*

$F_{OFL} = M$

$F_{ABC} \leq 0.75 \times M$

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 $\leq 0.75 \times$ OFL

1.2.4 Alternatives 3 and 4: Modest and Substantial Change, Respectively. Under Alternatives 2 and 3, MSY is consistently treated as a limit rather than a target, a minimum stock size threshold is identified, and uncertainty in projected and reference stock sizes is addressed. Under Alternative 3, specification procedures are consistent given a sufficient information level, while under Alternative 4, specification procedures are consistent regardless of information level. The following language would be incorporated into the groundfish FMPs, replacing existing definitions of "acceptable biological catch," "overfishing," and "maximum sustainable yield" and adding definitions of "harvest control rules" and "proxies" (language is identical under Alternatives 3 and 4 except as indicated in bold type):

Harvest Control Rules (see Figure) are mathematical formulae used to relate fishing mortality to projected spawning biomass, where spawning biomass is defined in terms of the combined sexes (either the sum of female spawning biomass and male spawning biomass, or female spawning biomass divided by the proportion of females in the spawning population). These formulae involve quantities which are estimated with some degree of uncertainty. For each such quantity, this uncertainty is described by a probability density function (pdf). In particular, for a stock that is fished at a constant per-capita rate, let the fishing mortality rate that would maximize equilibrium yield be designated F_{MSY}, and let the corresponding level of equilibrium spawning biomass be designated B_{MSY}. Because the true values of F_{MSY} and B_{MSY} cannot be known with certainty, the control rules are parametrized not in terms of F_{MSY} and B_{MSY} directly, but in terms of statistics pertaining to their respective pdfs. Likewise, because future spawning biomass cannot be known with certainty, the independent variable in the control rules is defined in terms of the pdf of projected spawning biomass. Specifically, the control rules use the following quantities:

Quantity	Definition
B	the geometric mean of the pdf of projected spawning biomass
α	a fraction, set at a value of 0.05 except where specified otherwise by the SSC
β	the geometric mean of the pdf of B_{MSY}
ϕ	the arithmetic mean of the pdf of F_{MSY}
γ	the harmonic mean of the pdf of F_{MSY}

Two control rules are defined: a target control rule and a limit control rule. The target control rule places a cap on the intended harvest rate. Because the intended harvest rate is seldom achieved exactly, the limit control rule serves to cap the acceptable amount of error involved in implementing the intended harvest rate. The limit control rule is comprised of three sections, given by the three right-hand columns below:

Stock Status:	$B/\beta \le \alpha$	$\alpha \le B/\beta \le 1$	$1 \le B/\beta$
F_{lim}:	0	$\phi(B/\beta-\alpha)/(1-\alpha)$	ϕ

The target control rule is proportional to the limit control rule, specifically, $F_{tar} = (\gamma/\phi)F_{lim}$.

Proxies are used to estimate B, β, ϕ, and γ in the harvest control rules when direct estimates are unavailable. The following quantities are used to define various proxies:

- C_{ave}, the average catch since 1978;
- M, the instantaneous natural mortality rate;
- $F_{35\%}$, the fishing mortality rate associated with an equilibrium level of spawning per recruit (SPR) equal to 35% of the equilibrium level of spawning per recruit in the absence of any fishing;
- $F_{40\%}$, the fishing mortality rate associated with an equilibrium level of SPR equal to 40% of the equilibrium level of spawning per recruit in the absence of any fishing; and
- $B_{35\%}$, the long-term average biomass that would be expected under average recruitment and $F=F_{35\%}$;

The proxies shown in the table below are listed in order of preference, where "n/a" means that a particular proxy level is not applicable to the quantity in question:

Quantity	Proxy 1	Proxy 2	Proxy 3	Proxy 4
B	point estimate of spawning biomass	depends on alternative [a]	n/a	n/a
β	point estimate of B_{MSY}	point estimate of $B_{35\%}$	depends on alternative [b]	n/a
ϕ	point estimate of F_{MSY}	point estimate of $F_{35\%}$	point estimate of M	point estimate of C_{ave}/β
γ	point estimate of $(F_{MSY} \times F_{40\%}/F_{35\%})$	point estimate of $F_{40\%}$	point estimate of $M \times 0.75$	point estimate of $C_{ave}/\beta \times 0.75$

Footnotes

a) **Under Alternative 3, Proxy 2 for B consists of β.**
Under Alternative 4, Proxy 2 for B consists of the SSC's best subjective estimate.

b) **Under Alternative 3, Proxy 3 for β consists of B.**
Under Alternative 4, Proxy 3 for β consists of the SSC's best subjective estimate.

The following rules will govern the computation and use of the above proxies:

1) A particular proxy will be used only if it is based on reliable estimates. The SSC will have final authority for determining whether a given estimate is "reliable" and may use either objective or subjective criteria in making such determinations.

2) If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to base calculations of spawning biomass or SPR on a knife-edge maturity assumption.

3) "Average" means arithmetic mean except as specified otherwise by the SSC. In computing C_{ave}, the average will be computed with respect to those years for which catch was greater than zero. In computing average recruitment, the average will be computed with respect to those years for which recruitment is reliably estimated.

4) If Proxy 4 is used to estimate ϕ or γ, then the catch corresponding to the limit or target control rule will be computed as $F_{lim} \times B$ or $F_{tar} \times B$, respectively.

The following additional rule would apply under Alternative 4 only:

5) A subjective estimate of β will be expressed as a multiple of C_{ave}, for example C_{ave}/M. A subjective estimate of B will consist of one of four qualitative abundance levels: overfished, low, moderate, and high. To map these qualitative levels into the control rules, they will be interpreted quantitatively as shown in the two left-most columns of the table below, which in turn imply the limit and target fishing mortality rates shown in the middle two columns. The two right-most columns of the table will apply in the special case where Proxy 4 is used to estimate both ϕ and γ.

Biomass Level	B/β	F_{lim}/ϕ	F_{tar}/ϕ	C_{lim}/C_{ave}	C_{tar}/C_{ave}
Overfished	0.24	0.2	0.15	0.048	0.036
Low	0.62	0.6	0.45	0.372	0.279
Moderate	1	1	0.75	1	0.75
High	1.6	1	0.75	1.6	1.2

Acceptable Biological Catch (ABC) is a preliminary description of the target 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 fishing mortality rate used to calculate ABC is capped by the relationship $F_{ABC} \leq F_{tar}$.

Overfishing is any amount of fishing in excess of the maximum fishing mortality threshold, which in turn is defined as F_{lim}. The catch corresponding to F_{lim} is the "overfishing level" (OFL). In addition to constituting the maximum fishing mortality threshold, F_{lim} also plays a role in defining the minimum stock size threshold (MSST). The MSST is estimated formally by whichever of the following is greater: $\beta/2$, or the minimum stock size at which rebuilding to β would be expected to occur within 10 years if the stock were exploited consistently at F_{lim}. For stocks lacking formal estimates, the MSST is estimated provisionally as $\max(1/2, 1-M)\beta$. Should a stock fall below its MSST, the stock will be considered "overfished" and remedial action will be undertaken to rebuild the stock in accordance with the Magnuson-Stevens Act and the National Standard Guidelines.

Maximum Sustainable Yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated formally as the long-term average catch that would be obtained if the stock were exploited consistently at F_{lim}. For stocks lacking formal estimates, MSY is estimated provisionally as $\phi \times \beta$.

Alternatives 3 and 4 would both have specified a minimum stock size threshold to be used in determining whether a stock is considered "overfished" in the sense of the Magnuson-Stevens Act. If a stock is "overfished" in this sense, remedial actions of the type prescribed in Section 304(e) of the Magnuson-Stevens Act (see also §600.310(e) of the NSGs) are required. The two alternatives would also have increased the extent to which the definitions of ABC and OFL are consistent across various possible levels of information (e.g., across the six tiers of the current definitions). This consistency would have been achieved in two ways: First, instead of specifying a different pair of harvest control rules (the equations specifying F_{OFL} and F_{ABC}) for each level of information, a single pair of harvest control rules would have been established, with variation in information availability addressed through a tiered series of proxy values for the parameters of those control rules. The second means of achieving consistency pertained to the more poorly understood stocks (i.e., those managed under tiers (4-6) of the current ABC/OFL definitions). In one of these alternatives, each stock managed under tiers (4-6) of the current ABC/OFL definitions would have been assumed to be at a moderate level of abundance (e.g., at a level corresponding to B_{MSY} in tiers (1-2)). In the other alternative, the SSC would have been required to use its best judgment to make a qualitative determination as to the relative abundance of each stock managed under tiers (4-6) of the current ABC/OFL definitions.

The Council and SSC reviewed Alternatives 3 and 4 (designated as Alternatives 2 and 3, respectively, in the April 1998 draft of this analysis) at the April 1998 Council meeting; the SSC discussed these alternatives and recommended for further analysis and final action the former Alternative 2 but without the MSST criterion. The alternative recommended by the SSC is brought forward in this analysis as Alternative 2, which the Council subsequently recommended for Secretarial approval.

2.0 ENVIRONMENTAL ASSESSMENT

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in significant impact on the human environment. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact statement (EIS) must be prepared for major Federal actions significantly affecting the human environment.

An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers. The purpose and alternatives were discussed in Sections 1.1 and 1.2, and the list of preparers is in Section 6. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

2.1 Environmental Impacts of the Alternatives

The environmental impacts generally associated with fishery management actions are effects resulting from (1) harvest of fish stocks which may result in changes in food availability to predators and scavengers, changes in the population structure of target fish stocks, and changes in the marine ecosystem community structure; (2) changes in the physical and biological structure of the marine environment as a result of fishing practices, e.g., effects of gear use and fish processing discards; and (3) entanglement/entrapment of non-target organisms in active or inactive fishing gear. A summary of the effects of the annual groundfish harvests on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the final environmental assessment for the annual groundfish total allowable catch specifications.

2.1.1 Alternative 2: Methods. This assessment focuses on impacts that would be expected under Alternative 2, and measures these impacts relative to those that would be expected under Alternative 1. The impacts of features contained in Alternative 1 were analyzed previously in the EA/RIR for Amendments 44 and 44 to the BSAI and GOA Groundfish FMPs (adopted in June, 1996) and are not re-analyzed here.

Alternatives 1 and 2 would establish policies for setting ABC and OFL levels in each future year based on estimates of stock size available at the time. However, it is difficult to evaluate the long-term impacts of these alternatives quantitatively, because there is no way to tell at present what the estimated size of any given stock will be in the future. Instead, this assessment focuses on short-term impacts, which were evaluated by considering how OFL, ABC, and total allowable catch (TAC) would likely have changed in 1998 had a particular alternative been in place at the end of 1997. Assumptions made in conducting this assessment are listed below (assumptions #6 and #8 are included for logical completeness, but were never actually used in the analysis because no such cases arose):

1) Only information published or distributed prior to 1998 could be used in specifying 1998 OFL, ABC, and TAC under any of the alternatives. Such information includes the 1997 SAFE reports (BSAI Groundfish Plan Team 1997, GOA Groundfish Plan Team 1997).

2) Following the procedures used by the GOA and BSAI Groundfish Plan Teams in 1997, the following proxy values were used: Dusky rockfish SPR values were used as proxies for the other members of the GOA pelagic shelf rockfish complex, yelloweye rockfish SPR values were used as proxies for the other members of the GOA demersal shelf rockfish complex, flathead sole SPR values were used as proxies for all members of the BSAI "other flatfish" complex except for Alaska plaice, and the shortspine thornyhead natural mortality rate was used as a proxy for the other members of the eastern Bering Sea (EBS) and AI "other rockfish" complexes.

3) In cases where estimates of $F_{40\%}$ and M are given in the relevant SAFE report but an estimate of $F_{35\%}$ is lacking, $F_{35\%}$ was estimated as described in Appendix A. This method is based on an equation presented by Thompson (1993).

4) In cases where Alternative 2 gave an F_{OFL} value equal to the F_{OFL} value given under Alternative 1, the OFL under Alternative 2 was set equal to the OFL under Alternative 1.

5) In cases where Alternative 2 gave an F_{OFL} value *different from* the F_{OFL} value given under Alternative 1, the OFL under Alternative 2 was set equal to the product of the OFL under Alternative 1 and the ratio of F_{OFL} under Alternative 2 to F_{OFL} under Alternative 1.

6) In cases where Alternative 2 gave an F_{ABC} value less than the F_{ABC} value given under Alternative 1, the ABC under Alternative 2 was set equal to the product of the ABC under Alternative 1 and the ratio of F_{ABC} under Alternative 2 to F_{ABC} under Alternative 1.

7) In cases where Alternative 2 gave an F_{ABC} value greater than or equal to the F_{ABC} value given under Alternative 1, the ABC under Alternative 2 was set equal to the ABC under Alternative 1.

8) In cases where Alternative 2 gave an ABC less than the TAC given under Alternative 1 (i.e., the actual 1998 TAC), the TAC under Alternative 2 was set equal to the ABC under Alternative 2.

9) In cases where Alternative 2 gave an ABC greater than or equal to the TAC given under Alternative 1 (i.e., the actual 1998 TAC), the TAC under Alternative 2 was set equal to the TAC under Alternative 1.

2.1.2 Alternative 2: Results. Likely impacts associated with each of the alternatives are detailed in Tables 1-4. Tables 1-2 focus on parameter values used, while Tables 3-4 focus on fishing mortality rates and catch specifications that result from those parameter values. Tables 1 and 3 pertain to the GOA, while Tables 2 and 4 pertain to the BSAI. According to Tables 3-4, no changes in 1998 ABCs or TACs would have been required under Alternative 2. Although 1998 ABCs and TACs would not necessarily have been affected under Alternative 2, in most cases OFL would have been reduced. Of the 38 stocks or stock complexes for which TACs are set under the groundfish FMPs (not counting "other species" in the GOA), OFL would have been lower in 26 cases under Alternative 2 (12 out of 16 cases in the GOA and 14 out of 22 cases in the BSAI). According to Tables 3-4, the aggregate OFL in the GOA would have been reduced from about 818,000 t under Alternative 1 to about 701,000 t under Alternative 2, while the aggregate OFL in the BSAI would have been reduced from about 4,200,000 t under Alternative 1 to about 2,940,000 t under

Alternative 2. The table below compares aggregate ABC and aggregate TAC to aggregate OFL under Alternatives 1 and 2 in the GOA and BSAI.

	Sum(ABC)/Sum(OFL)		Sum(TAC)/Sum(OFL)	
Area	Alt. 1	Alt. 2	Alt. 1	Alt. 2
GOA	0.67	0.78	0.40	0.46
BSAI	0.58	0.84	0.48	0.68

In the above table, it is important to note that the numerator does not change between alternatives (i.e., all of the change between alternatives is attributable to change in the aggregate OFL).

2.1.3 Alternative 2: Discussion. As the above results indicate, the alternatives appear to be indistinguishable in terms of their short-term impacts on TACs, with the major difference being a general decrease in OFL under Alternative 2. According to Tables 3-4, the aggregate OFL in the GOA would have been reduced by about 14%, while the aggregate OFL in the BSAI would have been reduced by about 30%. Nearly all of the changes in individual OFLs occur in cases where stocks are managed under tiers (3-4) of the current ABC/OFL definitions, because tiers (3-4) are based on $F_{35\%}$ under Alternative 2 rather than $F_{30\%}$ under Alternative 1. The reason for switching to $F_{35\%}$ in Alternative 2 is that it is nearer to the mid-point of the ranges of F_{MSY} proxies listed in the NSGs and in the report by Restrepo et al. (in press), and was derived as a robust estimate of F_{MSY} by Clark (1991). This change would be consistent with treating MSY as a limit rather than a target, so that fishing at $F=F_{OFL}$ would tend to achieve a long-term average catch close to MSY, while fishing at $F=F_{ABC}$ would tend to result in a somewhat lower long-term average catch but a somewhat higher long-term average stock size.

The one case where a change in OFL occurs outside of tiers (3-4) is EBS pollock, which is currently managed under tier (2), and for which OFL would be significantly lower under Alternative 2. However, it should be noted that the OFL shown for EBS pollock under Alternative 2 in Table 4 is most likely underestimated, because the approximation implied by assumption #5 in Section 2.1.1 tends to break down as the ratio of F_{OFL} under Alternative 1 to F_{OFL} under Alternative 2 increases. This ratio is much greater for EBS pollock than for any other stock, due largely to the fact that EBS pollock is the only stock managed under tier (2) of the current ABC/OFL definitions (i.e., it is the only stock for which a reliable estimate of F_{MSY} is available). In fact, 72% of the decrease in aggregate OFL in the BSAI is due to EBS pollock. If EBS pollock is removed from the calculation, aggregate OFL in the BSAI decreases by only 17% under Alternative 2, roughly in line with the 14% reduction calculated for the GOA.

Tier (2) is also significant in that it is the only place where the two alternatives differ with respect to F_{ABC}. Under tier (2) of Alternative 1, F_{ABC} is based on F_{MSY}, whereas under tier (2) of Alternative 2, F_{ABC} is based on F_{MSY} deflated by the factor $F_{40\%}/F_{35\%}$. As with the switch from $F_{30\%}$ to $F_{35\%}$ discussed above, inclusion of this deflation factor under tier (2) would be consistent with treating MSY as a target rather than a limit. As noted above, the only stock currently managed under tier (2) is EBS pollock. The reason that 1998 ABC for this stock would not have been reduced under Alternative 2 is that the value of F_{ABC} used to set the actual 1998 ABC was 0.30, well below the maximum permissible value of 0.37 under the current ABC/OFL definitions (see Figure). By coincidence, an F_{ABC} of 0.30 would have been the maximum permissible value under Alternative 2. Thus, the 1998 ABC for EBS pollock would not have been affected by switching to Alternative 2, but only because the Council had already chosen to set ABC conservatively under Alternative

1. One way to characterize the impact of Alternative 2 in this context is to note that it would have limited the Council's ability to set a higher ABC.

Section 304(e) of the Magnuson-Stevens Act contains specific requirements for remedial action to be taken whenever a stock is determined to be "overfished." One of the changes between the new statutory definition of "overfishing" and the former regulatory definition (see Section 1.1) is that "overfishing" and "overfished" are now synonymous (formerly, "overfished" was not defined). Under a strict interpretation of the statutory definition, then, any stock subjected to a fishing mortality rate greater than F_{OFL} would be considered overfished. Other interpretations are possible, though. For example, the NSGs complement the statutory definition of "overfished" by determining a stock to be overfished whenever it falls below its "minimum stock size threshold" (MSST). The MSST is defined, in part, on the basis of the stock's ability to rebuild within 10 years if fished at the maximum allowable level (i.e., if catch were to equal OFL in each of the next 10 years). It could be argued that this approach provides additional protection for the environment by assuring that remedial action is taken when stock size falls below the MSY level. However, the SSC has found that specification of an MSST is not warranted in the case of GOA and BSAI groundfish. Specifically, the SSC stated the following in the minutes of its April, 1998 meeting:

> "The Council policy of using a biomass-based policy that reduces fishing mortality as stocks decrease in size was deliberately selected to provide for automatic rebuilding.... The added complexity of a threshold policy on top of a biomass-based policy serves no useful purpose, is harder to implement, and will be harder for the public to understand. The current stock assessment approach is sufficient to assure that harvest levels provide for sufficient rebuilding within the specified period of 10 years...."

Given that the principal requirement pertaining to a stock which falls below its MSST is that it be harvested according to a strategy that is expected to rebuild it within the statutory time frame (not to exceed 10 years except under very limited circumstances), it seems superfluous to specify an MSST if such a harvest strategy is already in place. Thus, assuming that the SSC is correct in its finding that the current approach automatically assures sufficient rebuilding within 10 years, specification of an MSST in the BSAI and GOA Groundfish FMPs should not be necessary.

In terms of the alternatives' compliance with other provisions of the Magnuson-Stevens Act, some guidance may be taken from Restrepo et al. (in press), who provide a set of "default" harvest control rules which they consider to be consistent with a precautionary approach to fisheries management in general, and with the Magnuson-Stevens Act and NMFS' draft revision of the NSGs in particular. Both of the alternatives considered here are at least as conservative as the default rules of Restrepo et al. in some respects. However, there are exceptions. For example, values of OFL prescribed under tiers (2-4) of Alternative 1 and values of ABC allowed under tier (2) of Alternative 1 are less conservative than would be the case under the default rules when stock abundance is high. Also, values of OFL prescribed and values of ABC allowed under tiers (4-6) of both alternatives are less conservative than would be the case under the default rules when stock abundance is low.

2.1.4 Alternatives 3 and 4: Methods. The alternatives considered here would establish policies for setting ABC and OFL levels in each future year based on estimates of stock size available at the time. It is difficult to evaluate the long-term impacts of these alternatives quantitatively, because there is no way to tell at present what the estimated size of any given stock will be in the future. Instead, this assessment focuses on short-term impacts, which were evaluated by considering how OFL, ABC, and total allowable catch

(TAC) would likely have changed in 1998 had a particular alternative been in place at the end of 1997. Even with this simplifying restriction, a special set of problems remains for stocks managed under Tiers 4, 5, and 6 of the current ABC/OFL definitions, because the impacts of Alternative 4 on catch specifications for such stocks depend upon subjective estimates (i.e., Proxy 2 for B and Proxy 3 for β) which have not yet been made. One way to establish these subjective estimates would be for the SSC to adopt a "rule of thumb" that could be applied in all situations, then deviate from that rule as appropriate on a case-by-case basis, using its best scientific judgment developed from whatever other information is available. The procedure described in Appendix A represents one possible form for such a rule of thumb, and is the basis upon which likely impacts of Alternative 4 are determined in this assessment. Other assumptions made in conducting this assessment include the following:

1) Only information published or distributed prior to 1998 could be used in specifying 1998 OFL, ABC, and TAC under any of the alternatives. Such information includes the 1997 SAFE reports (BSAI Groundfish Plan Team 1997, GOA Groundfish Plan Team 1997).

2) In cases where an estimate of $B_{40\%}$ is given in the relevant SAFE report but an estimate of $B_{35\%}$ is lacking, $B_{35\%}$ was estimated as $B_{40\%} \times 7/8$.

3) In cases where estimates of $F_{40\%}$ and M are given in the relevant SAFE report but an estimate of $F_{35\%}$ is lacking, $F_{35\%}$ was estimated as described in Appendix B. This method is based on an equation presented by Thompson (1993).

4) In cases where a species occurs in both the BSAI and the GOA but an estimate of M is given in only one of the two SAFE reports, it was assumed that the given estimate applies to both the BSAI and the GOA stocks.

5) In cases where estimates of M are given for some members (the "first sub-group") of a species group for which a single TAC is specified but estimates of M are not given for the other members (the "second sub-group"), M was estimated for the members of the second sub-group as the biomass-weighted average of the estimates for the members of the first sub-group.

6) In the case of BSAI squid, M was estimated at a value of 0.8. An M of 0.8 implies a cumulative survival rate of about 0.1 through age 3, approximating the observation of Trumble (1973) that few squid survive beyond this age.

7) In cases where Alternative 3 or 4 gave an F_{lim} value equal to the F_{OFL} value given under Alternative 1, the OFL under Alternative 3 or 4 was set equal to the OFL under Alternative 1.

8) In cases where Alternative 3 or 4 gave an F_{lim} value different from the F_{OFL} value given under Alternative 1, the OFL under Alternative 3 or 4 was set equal to the product of the OFL under Alternative 1 and the ratio F_{lim}/F_{OFL}.

9) In cases where Alternative 3 or 4 gave an F_{tar} value less than the F_{ABC} value given under Alternative 1, the ABC under Alternative 3 or 4 was set equal to the product of the ABC under Alternative 1 and the ratio F_{tar}/F_{ABC}.

10) In cases where Alternative 3 or 4 gave an F_{tar} value greater than or equal to the F_{ABC} value given under Alternative 1, the ABC under Alternative 3 or 4 was set equal to the ABC under Alternative 1.

11) In cases where Alternative 3 or 4 gave an ABC less than the TAC given under Alternative 1 (i.e., the actual 1998 TAC), the TAC under Alternative 3 or 4 was set equal to the ABC under the respective alternative.

12) In cases where Alternative 3 or 4 gave an ABC greater than or equal to the TAC given under Alternative 1 (i.e., the actual 1998 TAC), the TAC under Alternative 3 or 4 was set equal to the TAC under Alternative 1.

2.1.5 Alternatives 3 and 4: Results. Based on the rule of thumb described in Appendix A, stocks in the GOA are generally at a high level of abundance, while stocks in the BSAI are generally at a moderate level of abundance.

Possible impacts associated with alternatives 3 and 4 are detailed in Tables 5-8. The organization of these tables is outlined below. Tables 5-6 correspond to the GOA and Tables 7-8 correspond to the BSAI. Odd-numbered tables focus on fishing mortality rates and even-numbered tables focus on catch specifications. Tables are further subdivided according to different possible assumptions regarding the relative abundance of certain stocks managed under Alternative 4. For stocks managed using Proxy 2 for B, the following possibilities were considered: a) all such stocks are at a high level of abundance, b) all such stocks are at a moderate level of abundance, c) all such stocks are at a low level of abundance, and d) all such stocks are overfished. Locations of results corresponding to the rule of thumb described in Appendix A are shaded below.

Focus:	Fishing Mortality Rates				Catch Specifications			
Stocks:	High	Moderate	Low	Overfished	High	Moderate	Low	Overfished
GOA:	Table 5a	Table 5b	Table 5c	Table 5d	Table 6a	Table 6b	Table 6c	Table 6d
BSAI:	Table 7a	Table 7b	Table 7c	Table 7d	Table 8a	Table 8b	Table 8c	Table 8d

If all stocks managed by using Proxy 2 for B or Proxy 3 for β under Alternative 3 were judged to be at the same level of relative abundance, the likely impacts of Alternative 3 on 1998 TACs are as follow:

	Sum of GOA TAC Reductions		Sum of BSAI TAC Reductions	
Stock Status	Absolute (t)	As % of Total	Absolute (t)	As % of Total
High	0 t	0%	0 t	0%
Moderate	0 t	0%	0 t	0%
Low	10,000 t	3%	33,800 t	2%
Overfished	37,800 t	12%	105,000 t	5%

In those cases where Alternative 4 would have resulted in individual TAC reductions, it should be noted that some or all of these reductions could potentially have been offset by increasing TACs on stocks for which TAC was below ABC.

The following table summarizes the use of proxies under Alternatives 3 and 4. For each quantity used in the control rules (B, β, ϕ, and γ) and each FMP (GOA and BSAI), the table describes the total number of stocks or stock complexes that would have been managed in 1998 using the definition of the quantity itself and each proxy thereof. For example, the shaded cells in the table should be read as follows: "In the BSAI, no stock would have been managed using β itself, 1 stock would have been managed using Proxy 1 for β, 9 stocks would have been managed using Proxy 2 for β, and 12 stocks would have been managed using Proxy 3 for β." If a stock complex includes stocks which would be managed under different proxy levels for the same quantity, the stock was counted under the least-preferred proxy.

Quantity:	B			β				ϕ					γ				
Proxy Used:	None	1	2	None	1	2	3	None	1	2	3	4	None	1	2	3	4
GOA:	0	13	4	0	0	6	11	0	0	9	7	1	0	0	9	7	1
BSAI:	0	21	1	0	1	9	12	0	1	13	8	0	0	1	13	8	0
Total:	0	34	5	0	1	15	23	0	1	22	15	1	0	1	22	15	1

Had Alternative 2 or Alternative 3 been in place for the 1998 season, the above table indicates that the majority of stocks would have been managed using Proxy 1 for B, Proxy 3 for β, and Proxy 2 for both ϕ and γ. All stocks required resorting to some proxy for each of the quantities used in the control rules.

2.1.6 Alternatives 3 and 4: Discussion. The above results indicate that the four alternatives may be indistinguishable in terms of their short-term impacts on TACs (e.g., if the more poorly understood stocks are all judged to be at high or moderate levels of abundance, as in tables 5a, 6a, 7b, and 8b). However, the impacts of Alternatives 3 and 4 can be distinguished in other ways. Two of the most important are discussed below.

1) OFLs for stocks managed under Tiers 3 and 4 of the current ABC/OFL definitions would be lower under Alternatives 3 or 4, because Proxy 2 for ϕ consists of $F_{35\%}$ in Alternatives 3 and 4 whereas Tiers 3 and 4 of Alternative 1 are based on $F_{30\%}$. In addition, the OFL for EBS pollock, which is currently calculated under Tier 2, would be significantly lower under Alternatives 3 or 4. However, it should be noted that the OFL shown for EBS pollock under Alternatives 3 and 4 in Tables 8a-8d is most likely under-estimated, because the approximation implied by assumption #8 in Section 2.1.1 tends to break down as the ratio of F_{OFL} to F_{lim} increases. This ratio is much greater for EBS pollock than for any other stock, due largely to the fact that EBS pollock is the only stock managed under Tier 2 of the current ABC/OFL definitions (i.e., it is the only stock for which a reliable estimate of F_{MSY} is available).

2) The degree of future protection that would be afforded to the more poorly understood stocks is greater under Alternative 4 than under Alternatives 1 or 3, because Alternative 4 requires that fishing mortality be reduced when it appears that a stock has fallen to a low level, even if it is not possible to estimate the size of the stock statistically. Thus, even though there is presently no evidence to suggest that any of the more poorly understood stocks is at risk, should qualitative evidence of such risk arise in the future, Alternative 4 would provide a mechanism for reducing fishing mortality.

In terms of the alternatives' compliance with the Magnuson-Stevens Act, some guidance may be taken from Restrepo et al. (in press), who provide a set of "default" harvest control rules (both limit and target) which they consider to be consistent with a precautionary approach to fisheries management in general, and with the Magnuson-Stevens Act and NMFS' draft revision of the NSGs in particular. All four of the alternatives considered here are at least as conservative as the default rules of Restrepo et al. in some respects. However, there are exceptions. Values of OFL prescribed under Tiers 2-4 of Alternative 1 and values of ABC prescribed under Tier 2 of Alternative 1 are less conservative than those prescribed under the default rules when stock abundance is high. Values of both OFL and ABC prescribed under Tiers 4-6 of Alternative 1 are less conservative than those prescribed under the default rules when stock abundance is low. Likewise, values of both OFL and ABC prescribed by using Proxy 2 for B and Proxy 3 for β under Alternative 3 are less conservative than those prescribed under the default rules when stock abundance is low. Values of OFL

and ABC prescribed under Alternative 4, on the other hand, are at least as conservative as those prescribed under the default rules in all cases.

2.2 Impacts on Endangered or Threatened Species

Background. The ESA provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by the Department of Commerce (NMFS) for most marine species, and the U.S. Fish and Wildlife Service (FWS) for terrestrial and freshwater species.

The ESA procedure for identifying or listing imperiled species involves a two-tiered process, classifying species as either threatened or endangered, based on the biological health of a species. Threatened species are those likely to become endangered in the foreseeable future [16 U.S.C. ' 1532(20)]. Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range [16 U.S.C. ' 1532(20)]. The Secretary, acting through NMFS, is authorized to list marine mammal and fish species. The Secretary of Interior, acting through the FWS, is authorized to list all other organisms.

In addition to listing species under the ESA, the critical habitat of a newly listed species must be designated concurrent with its listing to the "maximum extent prudent and determinable" [16 U.S.C. ' 1533(b)(1)(A)]. The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. The primary benefit of critical habitat designation is that it informs Federal agencies that listed species are dependent upon these areas for their continued existence, and that consultation with NMFS on any Federal action that may affect these areas is required. Some species, primarily the cetaceans, listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Listed Species. The following species are currently listed as endangered or threatened under the ESA and occur in the GOA and/or BSAI:

Endangered

Northern Right Whale	*Balaena glacialis*
Bowhead Whale[1]	*Balaena mysticetus*
Sei Whale	*Balaenoptera borealis*
Blue Whale	*Balaenoptera musculus*
Fin Whale	*Balaenoptera physalus*
Humpback Whale	*Megaptera novaeangliae*
Sperm Whale	*Physeter macrocephalus*
Snake River Sockeye Salmon	*Oncorhynchus nerka*
Short-tailed Albatross	*Diomedia albatrus*
Steller Sea Lion[1]	*Eumetopias jubatus*

[1]listed as endangered in waters west of Cape Suckling.

Threatened

Snake River Fall Chinook Salmon	*Oncorhynchus tshawytscha*
Snake River Spring/Summer Chinook Salmon	*Oncorhynchus tshawytscha*
Steller Sea Lion[2]	*Eumetopias jubatus*
Spectacled Eider	*Somateria fishcheri*

Section 7 Consultations. Because both groundfish fisheries are federally regulated activities, any negative affects of the fisheries on listed species or critical habitat and any takings[3] that may occur are subject to ESA section 7 consultation. NMFS initiates the consultation and the resulting biological opinions are issued to NMFS. The Council may be invited to participate in the compilation, review, and analysis of data used in the consultations. The determination of whether the action "is likely to jeopardize the continued existence of" endangered or threatened species or to result in the destruction or modification of critical habitat, however, is the responsibility of the appropriate agency (NMFS or FWS). If the action is determined to result in jeopardy, the opinion includes reasonable and prudent measures that are necessary to alter the action so that jeopardy is avoided. If an incidental take of a listed species is expected to occur under normal promulgation of the action, an incidental take statement is appended to the biological opinion.

Section 7 consultations have been done for all the above listed species, some individually and some as groups. Below are summaries of the consultations.

Endangered Cetaceans. NMFS concluded a formal section 7 consultation on the effects of the BSAI and GOA groundfish fisheries on endangered cetaceans within the BSAI and GOA on December 14, 1979, and April 19, 1991, respectively. These opinions concluded that the fisheries are unlikely to jeopardize the continued existence or recovery of endangered whales. Consideration of the bowhead whale as one of the listed species present within the area of the Bering Sea fishery was not recognized in the 1979 opinion, however, its range and status are not known to have changed. No new information exists that would cause NMFS to alter the conclusion of the 1979 or 1991 opinions. NMFS has no plan to reopen Section 7 consultations on the listed cetaceans for this action. Of note, however, are observations of Northern Right Whales during Bering Sea stock assessment cruises in the summer of 1997 (NMFS pers. commun.). Prior to these sightings, and one observation of a group of two whales in 1996, confirmed sightings had not occurred.

Steller Sea Lion. The Steller sea lion range extends from California and associated waters to Alaska, including the Gulf of Alaska and Aleutian Islands, and into the Bering Sea and North Pacific and into Russian waters and territory. In 1997, based on biological information collected since the species was listed as threatened in 1990 (60 FR 51968), NMFS reclassified Steller sea lions as two distinct population segments under the ESA (62 FR 24345). The Steller sea lion population segment west of 144°W. longitude (a line near Cape Suckling, Alaska) is listed as endangered; the remainder of the U.S. Steller sea lion population maintains the threatened listing.

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[2]listed as threatened in waters east of Cape Suckling.

[3]the term "take" under the ESA means "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct" (16 U.S.C. ' 1538(a)(1)(B)).

NMFS designated critical habitat in 1993 (58 FR 45278) for the Steller sea lion based on the Recovery Team's determination of habitat sites essential to reproduction, rest, refuge, and feeding. Listed critical habitats in Alaska include all rookeries, major haul-outs, and specific aquatic foraging habitats of the BSAI and GOA. The designation does not place any additional restrictions on human activities within designated areas. No changes in critical habitat designation were made as result of the 1997 re-listing.

Beginning in 1990 when Steller sea lions were first listed under the ESA, NMFS determined that both groundfish fisheries may adversely affect Steller sea lions, and therefore conducted Section 7 consultation on the overall fisheries (NMFS 1991), and subsequent changes in the fisheries (NMFS 1992). The most recent biological opinion on the BSAI and GOA fisheries effects on Steller sea lions was issued by NMFS January 26, 1996. It concluded that these fisheries and harvest levels are unlikely to jeopardize the continued existence and recovery of the Steller sea lion or adversely modify critical habitat. NMFS has no plan to reopen Section 7 consultations on Steller sea lions for this action.

Pacific Salmon. No species of Pacific salmon originating from freshwater habitat in Alaska are listed under the ESA. These listed species originate in freshwater habitat in the headwaters of the Columbia (Snake) River. During ocean migration to the Pacific marine waters a small (undetermined) portion of the stock go into the Gulf of Alaska as far east as the AI. In that habitat they are mixed with hundreds to thousands of other stocks originating from the Columbia River, British Columbia, Alaska, and Asia. The listed fish are not visually distinguishable from the other, unlisted, stocks. Mortal take of them in the chinook salmon bycatch portion of the fisheries is assumed based on sketchy abundance, timing, and migration pattern information.

NMFS designated critical habitat in 1992 (57 FR 57051) for the for the Snake River sockeye, Snake River spring/summer chinook, and Snake River fall chinook salmon. The designations did not include any marine waters, therefore, does not include any of the habitat where the groundfish fisheries are promulgated.

NMFS has issued two biological opinions and no-jeopardy determinations for listed Pacific salmon in the Alaska groundfish fisheries (NMFS 1994, NMFS 1995). Conservation measures were recommended to reduce salmon bycatch and improve the level of information about the salmon bycatch. The no jeopardy determination was based on the assumption that if total salmon bycatch is controlled, the impacts to listed salmon are also controlled. The incidental take statement appended to the second biological opinion allowed for take of one Snake River fall chinook and zero take of either Snake River spring/summer chinook or Snake River sockeye, per year. As explained above, it is not technically possible to know if any have been taken. Compliance with the biological opinion is stated in terms of limiting salmon bycatch per year to under 55,000 and 40,000 for chinook salmon, and 200 and 100 sockeye salmon in the BSAI and GOA fisheries, respectively.

Short-Tailed Albatross. The entire world population in 1995 was estimated as 800 birds; 350 adults breed on two small islands near Japan. The population is growing but is still critically endangered because of its small size and restricted breeding range. Past observations indicate that older short-tailed albatrosses are present in Alaska primarily during the summer and fall months along the shelf break from the Alaska Peninsula to the Gulf of Alaska, although 1- and 2-year old juveniles may be present at other times of the year (FWS 1993). Consequently, these albatrosses generally would be exposed to fishery interactions most often during the summer and fall--during the latter part of the second and the whole of the third fishing quarters.

Short-tailed albatrosses reported caught in the longline fishery include two in 1995, one in October 1996, and none so far in 1997. Both 1995 birds were caught in the vicinity of Unimak Pass and were taken outside the observers' statistical samples.

Formal consultation on the effects of the groundfish fisheries on the short-tailed albatross under the jurisdiction of the FWS concluded that BSAI and GOA groundfish fisheries would adversely affect the short-tailed albatross and would result in the incidental take of up to two birds per year, but would not jeopardize the continued existence of that species (FWS 1989). Subsequent consultations for changes to the fishery that might affect the short-tailed albatross also concluded no jeopardy (FWS 1995, FWS 1997). The US Fish and Wildlife Service does not intend to renew consultation for the 1998 groundfish fisheries.

Spectacled Eider. These sea ducks feed on benthic mollusks and crustaceans taken in shallow marine waters or on pelagic crustaceans. The marine range for spectacled eider is not known, although Dau and Kitchinski (1977) review evidence that they winter near the pack ice in the northern Bering Sea. Spectacled eider are rarely seen in U.S. waters except in August through September when they molt in northeast Norton Sound and in migration near St. Lawrence Island. The lack of observations in U.S. waters suggests that, if not confined to sea ice polyneas, they likely winter near the Russian coast (FWS 1993). Although the species is noted as occurring in the GOA and BSAI management areas no evidence that they interact with these groundfish fisheries exists.

Conditions for Reinitiation of Consultation. For all ESA listed species, consultation must be reinitiated if: the amount or extent of taking specified in the Incidental Take Statement is exceeded, new information reveals effects of the action that may affect listed species in a way not previously considered, the action is subsequently modified in a manner that causes an effect to listed species that was not considered in the biological opinion, or a new species is listed or critical habitat is designated that may be affected by the action.

Impacts of the Alternatives on Endangered or Threatened Species. Neither of the alternatives under consideration would affect the prosecution of the groundfish fisheries of the BSAI or GOA in a way not previously considered in the above consultations. Neither of the alternatives are expected to increase overall TAC amounts, PSC limits, or takes of listed species. Therefore, neither of the alternatives is expected to have a significant impact on endangered, threatened, or candidate species.

2.3 Impacts on Marine Mammals

Marine mammals not listed under the ESA that may be present in the BSAI include cetaceans, [minke whale (*Balaenoptera acutorostrata*), killer whale (*Orcinus orca*), Dall's porpoise *(Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and the beaked whales (e.g., *Berardius bairdii* and *Mesoplodon spp.*)] as well as pinnipeds [northern fur seals (*Callorhinus ursinus*), and Pacific harbor seals (*Phoca vitulina*)] and the sea otter (*Enhydra lutris*).

Neither of the alternatives is expected to increase overall TAC amounts, PSC limits, or takes of marine mammals. Therefore, neither of the alternatives is expected to have a significant impact on marine mammals.

2.4 Coastal Zone Management Act

Implementation of each of the alternatives would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

2.5 Conclusions or Finding of No Significant Impact

Neither of the alternatives is likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

Gary C. Matlock — 1-27-99

for Assistant Administrator for Fisheries, NOAA — Date

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Tables

Gulf of Alaska

Species	Tier	B	B_{MSY}	F_{MSY}	$B_{40\%}$	$F_{35\%}$	$F_{40\%}$	M	C_{ave}
Walleye pollock	3	258,000	n/a	n/a	268,000	0.43	0.36	n/a	n/a
Pacific cod	3	146,000	n/a	n/a	107,000	0.41	0.34	n/a	n/a
Arrowtooth flounder	3	1,010,000	n/a	n/a	272,000	0.23	0.19	n/a	n/a
Sablefish	3	153,000	n/a	n/a	181,000	0.14	0.12	n/a	n/a
Pacific ocean perch	3	107,000	n/a	n/a	145,000	0.094	0.076	n/a	n/a
Thornyhead rockfish	3	22,800	n/a	n/a	16,400	0.098	0.080	n/a	n/a
Northern rockfish	4	83,400	n/a	n/a	n/a	0.093	0.075	n/a	n/a
Pelagic shelf rockfish	4	55,600	n/a	n/a	n/a	0.12	0.10	n/a	n/a
Demersal shelf rockfish	4	27,800	n/a	n/a	n/a	0.031	0.025	n/a	n/a
Shallow water flatfish	4,5	316,000	n/a	n/a	n/a	0.21	0.17	0.20	n/a
Shortraker/rougheye	4,5	65,400	n/a	n/a	n/a	0.040	0.032	0.030	n/a
Other slope rockfish	4,5	104,000	n/a	n/a	n/a	0.068	0.055	0.068	n/a
Rex sole	5	72,300	n/a	n/a	n/a	n/a	n/a	0.20	n/a
Flathead sole	5	206,000	n/a	n/a	n/a	n/a	n/a	0.20	n/a
Deep water flatfish	5,6	101,000	n/a	n/a	n/a	n/a	n/a	0.10	2,210
Atka mackerel	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6,200
Other species									

Table 1. Tiers and parameters used in calculating OFL, ABC, and TAC in the GOA. Stocks and stock complexes are grouped according to the tiers of the current ABC/OFL definitions under which they are managed. The symbol "n/a" means that a particular parameter is not applicable to a given tier. The symbol "C_{ave}" represents average catch. Other symbols are defined in the text. In the case of stock complexes, parameter values may be those of a single stock in the complex used as a proxy for the complex as a whole, or a weighted average of all stocks in the complex. When a stock complex is managed under two tiers, the parameter values listed are generally not applicable to all stocks in the complex. In the case of shallow water flatfish, rock sole are managed under tier (4) and the other members of the complex are managed under tier (5); in the case of shortraker/rougheye rockfish, rougheye are managed under tier (4) and shortraker are managed under tier (5); in the case of "other slope rockfish," sharpchin are managed under tier (4) and the other members of the complex are managed under tier (5); and in the case of deep water flatfish, dover sole are managed under tier (5) and the other members of the complex are managed under tier (6).

Species	Tier	B	B_{MSY}	F_{MSY}	$B_{40\%}$	$F_{35\%}$	$F_{40\%}$	M	C_{ave}
Walleye pollock (EBS)	2	5,820,000	6,000,000	0.38	n/a	0.44	0.36	n/a	n/a
Walleye pollock (Bog.)	3	280,000	n/a	n/a	2,000,000	0.33	0.27	n/a	n/a
Pacific cod	3	383,000	n/a	n/a	352,000	0.35	0.29	n/a	n/a
Yellowfin sole	3	757,000	n/a	n/a	593,000	0.13	0.11	n/a	n/a
Greenland turbot	3	95,000	n/a	n/a	138,000	0.32	0.26	n/a	n/a
Rock sole	3	650,000	n/a	n/a	267,000	0.19	0.16	n/a	n/a
Sablefish (EBS)	3	16,800	n/a	n/a	19,800	0.14	0.12	n/a	n/a
Sablefish (AI)	3	19,300	n/a	n/a	22,800	0.14	0.12	n/a	n/a
True POP (EBS)	3	23,900	n/a	n/a	34,400	0.072	0.058	n/a	n/a
True POP (AI)	3	129,000	n/a	n/a	127,000	0.084	0.068	n/a	n/a
Atka mackerel	3	152,000	n/a	n/a	145,000	0.42	0.34	n/a	n/a
Arrowtooth flounder	4	531,000	n/a	n/a	n/a	0.28	0.23	n/a	n/a
Flathead sole	4	824,000	n/a	n/a	n/a	0.19	0.16	n/a	n/a
Other flatfish	4	313,000	n/a	n/a	n/a	0.32	0.26	n/a	n/a
Walleye pollock (AI)	5	106,000	n/a	n/a	n/a	n/a	n/a	0.30	n/a
Other red rockfish (EBS)	5	11,600	n/a	n/a	n/a	n/a	n/a	0.031	n/a
Sharpchin/northern (AI)	5	94,000	n/a	n/a	n/a	n/a	n/a	0.060	n/a
Shortraker/rougheye (AI)	5	46,500	n/a	n/a	n/a	n/a	n/a	0.028	n/a
Other rockfish (EBS)	5	7,030	n/a	n/a	n/a	n/a	n/a	0.070	n/a
Other rockfish (AI)	5	13,000	n/a	n/a	n/a	n/a	n/a	0.070	n/a
Other species	5	669,000	n/a	n/a	n/a	n/a	n/a	0.20	n/a
Squid	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,620

Table 2. Tiers and parameters used in calculating OFL, ABC, and TAC in the BSAI. Stocks and stock complexes are grouped according to the tiers of the current ABC/OFL definitions under which they are managed. The symbol "n/a" means that a particular parameter is not applicable to a given tier. The symbol "C_{ave}" represents average catch. Other symbols are defined in the text. In the case of stock complexes, parameter values may be those of a single stock used as a proxy for the complex as a whole, or a weighted average of all stocks in the complex.

Gulf of Alaska

	1998 Fishing Mortality				1998 Catch Specifications					
	Alternative 1		Alternative 2		Alternative 1			Alternative 2		
Species	OFL	ABC	OFL	ABC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock	0.50	0.34	0.41	0.34	186,100	130,000	124,730	154,000	130,000	124,730
Pacific cod	0.45	0.18	0.41	0.34	141,000	77,900	63,470	128,000	77,900	63,470
Arrowtooth flounder	0.28	0.19	0.23	0.19	295,970	208,340	35,000	243,000	208,340	35,000
Sablefish	0.15	0.085	0.12	0.10	23,450	14,120	14,120	18,300	14,120	14,120
Pacific ocean perch	0.079	0.055	0.068	0.055	18,090	12,820	10,776	15,600	12,820	10,776
Thornyhead rockfish	0.12	0.080	0.098	0.080	2,840	2,000	2,000	2,320	2,000	2,000
Northern rockfish	0.11	0.060	0.093	0.075	9,420	5,000	5,000	7,960	5,000	5,000
Pelagic shelf rockfish	0.15	0.090	0.12	0.10	8,390	5,260	5,260	6,710	5,260	5,260
Demersal shelf rockfish	0.038	0.020	0.031	0.025	950	560	560	775	560	560
Shallow water flatfish	0.23	0.15	0.21	0.16	59,540	43,150	18,630	53,500	43,150	18,630
Shortraker/rougheye	0.042	0.024	0.037	0.030	2,740	1,590	1,590	2,440	1,590	1,590
Other slope rockfish	0.073	0.053	0.068	0.053	7,560	5,260	2,170	7,060	5,230	2,170
Rex sole	0.20	0.15	0.20	0.15	11,920	9,150	9,150	11,920	9,150	9,150
Flathead sole	0.20	0.15	0.20	0.15	34,010	26,110	9,040	34,010	26,110	9,040
Deep water flatfish	n/a	n/a	n/a	n/a	9,440	7,170	7,170	9,440	7,170	7,170
Atka mackerel	n/a	n/a	n/a	n/a	6,200	600	600	6,200	600	600
Other species							15,460			15,460
Total					817,620	549,030	324,726	701,235	549,000	324,726

Table 3. Fishing mortality rates and catch specifications in the GOA under Alternatives 1 and 2. Under Alternative 1, all values correspond to those actually used in the specification process for the 1998 season. Under Alternative 2, ABC fishing mortality rates are those corresponding to the upper limit of the definition. Rules used to estimate OFL, ABC, and TAC under Alternative 2 are given in the text. In the case of stock complexes, fishing mortality rates may be those of a single stock in the complex used as a proxy for the complex as a whole, or a weighted average of all stocks in the complex.

Bering Sea and Aleutian Islands

	1998 Fishing Mortality				1998 Catch Specifications					
	Alternative 1		Alternative 2		Alternative 1			Alternative 2		
Species	OFL	ABC	OFL	ABC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock (EBS)	0.66	0.30	0.37	0.30	2,060,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000
Walleye pollock (Bog.)	0.035	0.026	0.031	0.026	8,750	6,410	1,000	7,820	6,410	1,000
Pacific cod	0.42	0.25	0.35	0.29	336,000	210,000	210,000	280,000	210,000	210,000
Yellowfin sole	0.16	0.11	0.13	0.11	314,000	220,000	220,000	255,000	220,000	220,000
Greenland turbot	0.27	0.17	0.22	0.17	22,300	15,000	15,000	17,800	15,000	15,000
Rock sole	0.23	0.16	0.19	0.16	449,000	312,000	100,000	371,000	312,000	100,000
Sablefish (EBS)	0.15	0.085	0.12	0.10	2,160	1,300	1,300	1,690	1,300	1,300
Sablefish (AI)	0.15	0.085	0.12	0.10	2,230	1,380	1,380	1,750	1,380	1,380
True POP (EBS)	0.056	0.031	0.049	0.039	3,300	1,400	1,400	2,880	1,400	1,400
True POP (AI)	0.096	0.055	0.084	0.068	20,700	12,100	12,100	18,100	12,100	12,100
Atka mackerel	0.50	0.23	0.42	0.34	134,000	64,300	64,300	113,000	64,300	64,300
Arrowtooth flounder	0.36	0.23	0.28	0.23	230,000	147,000	16,000	179,000	147,000	16,000
Flathead sole	0.23	0.16	0.19	0.16	190,000	132,000	100,000	157,000	132,000	100,000
Other flatfish	0.39	0.26	0.32	0.26	253,000	164,000	89,434	203,000	164,000	89,434
Walleye pollock (AI)	0.30	0.23	0.30	0.23	31,700	23,800	23,800	31,700	23,800	23,800
Other red rockfish (EBS)	0.031	0.023	0.031	0.023	356	267	267	356	267	267
Sharpchin/northern (AI)	0.060	0.045	0.060	0.045	5,640	4,230	4,230	5,640	4,230	4,230
Shortraker/rougheye (AI)	0.028	0.021	0.028	0.021	1,290	965	965	1,290	965	965
Other rockfish (EBS)	0.070	0.053	0.070	0.053	492	369	369	492	369	369
Other rockfish (AI)	0.070	0.053	0.070	0.053	913	685	685	913	685	685
Other species	0.20	0.04	0.20	0.15	134,000	25,800	25,800	134,000	25,800	25,800
Squid	0.8	0.6	n/a	n/a	2,620	1,970	1,970	2,620	1,970	1,970
Total					4,202,451	2,454,976	2,000,000	2,935,051	2,454,976	2,000,000

Table 4. Fishing mortality rates and catch specifications in the BSAI under Alternatives 1 and 2. Under Alternative 1, all values correspond to those actually used in the specification process for the 1998 season. Under Alternative 2, ABC fishing mortality rates are those corresponding to the upper limit of the definition. Rules used to estimate OFL, ABC, and TAC under Alternative 2 are given in the text. In the case of stock complexes, fishing mortality rates may be those of a single stock used as a proxy for the complex as a whole, or a weighted average of all stocks in the complex.

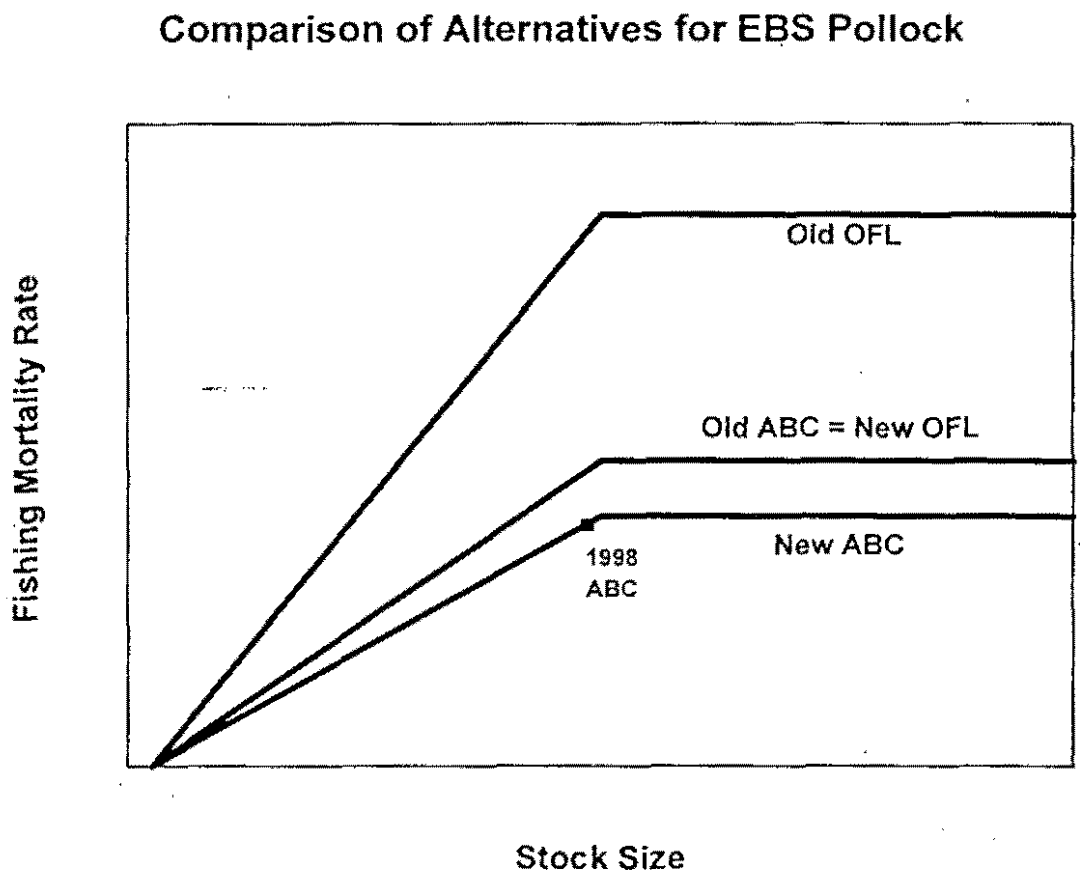

Figure 1. Summary of differences between the alternatives as applied to EBS pollock. "Old OFL," the top line in the figure, corresponds to the F_{OFL} definition under Alternative 1. "Old ABC = New OFL," the middle line in the figure, corresponds to both the F_{ABC} definition under Alternative 1 and the F_{OFL} definition under Alternative 2. "New ABC," the bottom line in the figure, corresponds to the F_{ABC} definition under Alternative 2. The point labeled "1998 ABC" corresponds to the stock size of EBS pollock projected for 1998 and the 1998 F_{ABC} value actually specified for EBS pollock.

Gulf of Alaska

	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock	1	2	2	2	258,000	234,000	0.43	0.36	0.50	0.34	0.43	0.36	0.43	0.36
Pacific cod	1	2	2	2	146,000	93,600	0.41	0.34	0.45	0.18	0.41	0.34	0.41	0.34
Arrowtooth flounder	1	2	2	2	1,010,000	238,000	0.23	0.19	0.28	0.19	0.23	0.19	0.23	0.19
Sablefish	1	2	2	2	153,000	158,000	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Pacific ocean perch	1	2	2	2	107,000	127,000	0.094	0.076	0.079	0.055	0.078	0.063	0.078	0.063
Thornyhead rockfish	1	2	2	2	22,800	14,400	0.098	0.080	0.12	0.080	0.098	0.080	0.098	0.080
Rex sole	1	3	3	3	72,300	45,200	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15
Flathead sole	1	3	3	3	206,000	129,000	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15
Shallow water flatfish	1	3	2,3	2,3	316,000	197,000	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15
Shortraker/rougheye	1	3	2,3	2,3	65,400	40,900	0.042	0.030	0.042	0.030	0.042	0.030	0.042	0.030
Other slope rockfish	1	3	2,3	2,3	104,000	64,800	0.073	0.053	0.073	0.053	0.073	0.053	0.073	0.053
Northern rockfish	1	3	2	2	83,400	52,100	0.11	0.075	0.11	0.060	0.11	0.075	0.11	0.075
Pelagic shelf rockfish	1	3	2	2	55,600	34,800	0.15	0.10	0.15	0.090	0.15	0.10	0.15	0.10
Demersal shelf rockfish	1,2	3	2	2	27,500	17,200	0.038	0.025	0.038	0.020	0.038	0.025	0.038	0.025
Deep water flatfish	1,2	3	3	3	103,000	64,400	0.10	0.076			0.10	0.076	0.10	0.076
Atka mackerel	2	3	3	3	23,100	14,500	0.30	0.23			0.30	0.23	0.30	0.23
Other species	2	3	4	4										

Table 5a. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the GOA, assuming that poorly understood stocks are all judged to be at a **high** level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

Gulf of Alaska

	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock	1	2	2	2	258,000	234,000	0.43	0.36	0.50	0.34	0.43	0.36	0.43	0.36
Pacific cod	1	2	2	2	146,000	93,600	0.41	0.34	0.45	0.18	0.41	0.34	0.41	0.34
Arrowtooth flounder	1	2	2	2	1,010,000	238,000	0.23	0.19	0.28	0.19	0.23	0.19	0.23	0.19
Sablefish	1	2	2	2	153,000	158,000	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Pacific ocean perch	1	2	2	2	107,000	127,000	0.094	0.076	0.079	0.055	0.078	0.063	0.078	0.063
Thornyhead rockfish	1	2	2	2	22,800	14,400	0.098	0.080	0.12	0.080	0.098	0.080	0.098	0.080
Rex sole	1	3	3	3	72,300	72,300	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15
Flathead sole	1	3	3	3	206,000	206,000	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15
Shallow water flatfish	1	3	2,3	2,3	316,000	316,000	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15
Shortraker/rougheye	1	3	2,3	2,3	65,400	65,400	0.042	0.030	0.042	0.030	0.042	0.030	0.042	0.030
Other slope rockfish	1	3	2,3	2,3	104,000	104,000	0.073	0.053	0.073	0.053	0.073	0.053	0.073	0.053
Northern rockfish	1	3	2	2	83,400	83,400	0.11	0.075	0.11	0.060	0.11	0.075	0.11	0.075
Pelagic shelf rockfish	1	3	2	2	55,600	55,600	0.15	0.10	0.15	0.090	0.15	0.10	0.15	0.10
Demersal shelf rockfish	1,2	3	2	2	27,500	27,500	0.038	0.025	0.038	0.020	0.038	0.025	0.038	0.025
Deep water flatfish	1,2	3	3	3	102,000	102,000	0.10	0.076			0.10	0.076	0.10	0.076
Atka mackerel	2	3	3	3	14,500	14,500	0.30	0.23			0.30	0.23	0.30	0.23
Other species	2	3	4	4										

Table 5b. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the GOA, assuming that poorly understood stocks are all judged to be at a **moderate** level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

Gulf of Alaska

	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock	1	2	2	2	258,000	234,000	0.43	0.36	0.50	0.34	0.43	0.36	0.43	0.36
Pacific cod	1	2	2	2	146,000	93,600	0.41	0.34	0.45	0.18	0.41	0.34	0.41	0.34
Arrowtooth flounder	1	2	2	2	1,010,000	238,000	0.23	0.19	0.28	0.19	0.23	0.19	0.23	0.19
Sablefish	1	2	2	2	153,000	156,000	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Pacific ocean perch	1	2	2	2	107,000	127,000	0.094	0.076	0.079	0.055	0.078	0.063	0.078	0.063
Thornyhead rockfish	1	2	2	2	22,800	14,400	0.098	0.080	0.12	0.080	0.098	0.080	0.098	0.080
Rex sole	1	3	3	3	72,300	117,000	0.20	0.15	0.20	0.15	0.20	0.15	0.12	0.09
Flathead sole	1	3	3	3	206,000	333,000	0.20	0.15	0.20	0.15	0.20	0.15	0.12	0.09
Shallow water flatfish	1	3	2,3	2,3	316,000	509,000	0.21	0.15	0.21	0.15	0.21	0.15	0.12	0.09
Shortraker/rougheye	1	3	2,3	2,3	65,400	105,000	0.042	0.030	0.042	0.030	0.042	0.030	0.025	0.018
Other slope rockfish	1	3	2,3	2,3	104,000	167,000	0.073	0.053	0.073	0.053	0.073	0.053	0.044	0.032
Northern rockfish	1	3	2	2	83,400	134,000	0.11	0.075	0.11	0.060	0.11	0.075	0.07	0.045
Pelagic shelf rockfish	1	3	2	2	55,600	89,700	0.15	0.10	0.15	0.090	0.15	0.10	0.09	0.06
Demersal shelf rockfish	1,2	3	2	2	27,500	44,400	0.038	0.025	0.038	0.020	0.038	0.025	0.023	0.015
Deep water flatfish	1,2	3	3	3	102,000	165,000	0.10	0.075			0.10	0.075	0.06	0.045
Atka mackerel	2	3	3	3	8,960	14,500	0.30	0.23			0.30	0.23	0.18	0.13
Other species	2	3	4	4										

Table 5c. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the GOA, assuming that poorly understood stocks are all judged to be at a low level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

Gulf of Alaska

	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock	1	2	2	2	258,000	234,000	0.43	0.36	0.50	0.34	0.43	0.36	0.43	0.36
Pacific cod	1	2	2	2	146,000	93,600	0.41	0.34	0.45	0.18	0.41	0.34	0.41	0.34
Arrowtooth flounder	1	2	2	2	1,010,000	238,000	0.23	0.19	0.28	0.19	0.23	0.19	0.23	0.19
Sablefish	1	2	2	2	153,000	158,000	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Pacific ocean perch	1	2	2	2	107,000	127,000	0.094	0.076	0.079	0.055	0.078	0.063	0.078	0.063
Thornyhead rockfish	1	2	2	2	22,800	14,400	0.098	0.080	0.12	0.080	0.098	0.080	0.098	0.080
Rex sole	1	3	3	3	72,300	301,000	0.20	0.15	0.20	0.15	0.20	0.15	0.04	0.03
Flathead sole	1	3	3	3	206,000	859,000	0.20	0.15	0.20	0.15	0.20	0.15	0.04	0.03
Shallow water flatfish	1	3	2,3	2,3	316,000	1,310,000	0.21	0.15	0.21	0.15	0.21	0.15	0.04	0.03
Shortraker/rougheye	1	3	2,3	2,3	65,400	272,000	0.042	0.030	0.042	0.030	0.042	0.030	0.008	0.006
Other slope rockfish	1	3	2,3	2,3	104,000	432,000	0.073	0.053	0.073	0.053	0.073	0.053	0.015	0.011
Northern rockfish	1	3	2	2	83,400	347,000	0.11	0.075	0.11	0.060	0.11	0.075	0.02	0.015
Pelagic shelf rockfish	1	3	2	2	55,600	232,000	0.15	0.10	0.15	0.090	0.15	0.10	0.03	0.02
Demersal shelf rockfish	1,2	3	2	2	27,500	115,000	0.038	0.025	0.038	0.020	0.038	0.025	0.008	0.005
Deep water flatfish	1,2	3	3	3	102,000	424,000	0.10	0.075			0.10	0.075	0.02	0.015
Atka mackerel	2	3	3	3	3,470	14,500	0.30	0.23			0.30	0.23	0.06	0.04
Other species	2	3	4	4										

Table 5d. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the GOA, assuming that poorly understood stocks are all judged to be **overfished** under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

Gulf of Alaska

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock	186,100	130,000	124,730	160,000	130,000	124,730	160,000	130,000	124,730
Pacific cod	141,000	77,900	63,470	128,000	77,900	63,470	128,000	77,900	63,470
Arrowtooth flounder	295,970	208,340	35,000	243,000	208,340	35,000	243,000	208,340	35,000
Sablefish	23,450	14,120	14,120	21,200	14,120	14,120	21,200	14,120	14,120
Pacific ocean perch	18,090	12,820	10,776	18,000	12,820	10,776	18,000	12,820	10,776
Thornyhead rockfish	2,840	2,000	2,000	2,320	2,000	2,000	2,320	2,000	2,000
Rex sole	11,920	9,150	9,150	11,900	9,150	9,150	11,900	9,150	9,150
Flathead sole	34,010	26,110	9,040	34,000	26,110	9,040	34,000	26,110	9,040
Shallow water flatfish	59,540	43,150	18,630	59,500	43,150	18,630	59,500	43,150	18,630
Shortraker/rougheye	2,740	1,590	1,590	2,740	1,590	1,590	2,740	1,590	1,590
Other slope rockfish	7,560	5,260	2,170	7,560	5,260	2,170	7,560	5,260	2,170
Northern rockfish	9,420	5,000	5,000	9,420	5,000	5,000	9,420	5,000	5,000
Pelagic shelf rockfish	8,390	5,260	5,260	8,390	5,260	5,260	8,390	5,260	5,260
Demersal shelf rockfish	950	560	560	950	560	560	950	560	560
Deep water flatfish	9,440	7,170	7,170	10,400	7,170	7,170	10,400	7,170	7,170
Atka mackerel	6,200	600	600	6,930	600	600	6,930	600	600
Other species			15,460			15,460			15,460
Total	817,620	549,030	324,726	724,310	549,030	324,726	724,310	549,030	324,726

Table 6a. Impacts of alternatives on 1998 catch specifications in the GOA, assuming that poorly understood stocks are all judged to be at a high level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. Under the scenario shown in this table, no reductions in 1998 TACs would have been required under Alternative 3 or Alternative 4.

Gulf of Alaska

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock	186,100	130,000	124,730	160,000	130,000	124,730	160,000	130,000	124,730
Pacific cod	141,000	77,900	63,470	128,000	77,900	63,470	128,000	77,900	63,470
Arrowtooth flounder	295,970	208,340	35,000	243,000	208,340	35,000	243,000	208,340	35,000
Sablefish	23,450	14,120	14,120	21,200	14,120	14,120	21,200	14,120	14,120
Pacific ocean perch	18,090	12,820	10,776	18,000	12,820	10,776	18,000	12,820	10,776
Thornyhead rockfish	2,840	2,000	2,000	2,320	2,000	2,000	2,320	2,000	2,000
Rex sole	11,920	9,150	9,150	11,900	9,150	9,150	11,900	9,150	9,150
Flathead sole	34,010	26,110	9,040	34,000	26,110	9,040	34,000	26,110	9,040
Shallow water flatfish	59,540	43,150	18,630	59,500	43,150	18,630	59,500	43,150	18,630
Shortraker/rougheye	2,740	1,590	1,590	2,740	1,590	1,590	2,740	1,590	1,590
Other slope rockfish	7,560	5,260	2,170	7,560	5,260	2,170	7,560	5,260	2,170
Northern rockfish	9,420	5,000	5,000	9,420	5,000	5,000	9,420	5,000	5,000
Pelagic shelf rockfish	8,390	5,260	5,260	8,390	5,260	5,260	8,390	5,260	5,260
Demersal shelf rockfish	950	560	560	950	560	560	950	560	560
Deep water flatfish	9,440	7,170	7,170	10,300	7,170	7,170	10,300	7,170	7,170
Atka mackerel	6,200	600	600	4,350	600	600	4,350	600	600
Other species			15,460			15,460			15,460
Total	817,620	549,030	324,726	721,630	549,030	324,726	721,630	549,030	324,726

Table 6b. Impacts of alternatives on 1998 catch specifications in the GOA, assuming that poorly understood stocks are all judged to be at a **moderate** level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. Under the scenario shown in this table, no reductions in 1998 TACs would have been required under Alternative 3 or Alternative 4.

Gulf of Alaska

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock	186,100	130,000	124,730	160,000	130,000	124,730	160,000	130,000	124,730
Pacific cod	141,000	77,900	63,470	128,000	77,900	63,470	128,000	77,900	63,470
Arrowtooth flounder	295,970	208,340	35,000	243,000	208,340	35,000	243,000	208,340	35,000
Sablefish	23,450	14,120	14,120	21,200	14,120	14,120	21,200	14,120	14,120
Pacific ocean perch	18,090	12,820	10,776	18,000	12,820	10,776	18,000	12,820	10,776
Thornyhead rockfish	2,840	2,000	2,000	2,320	2,000	2,000	2,320	2,000	2,000
Rex sole	11,920	9,150	9,150	11,900	9,150	9,150	7,130	5,470	5,470
Flathead sole	34,010	26,110	9,040	34,000	26,110	9,040	20,400	15,600	9,040
Shallow water flatfish	59,540	43,150	18,630	59,500	43,150	18,630	35,800	25,900	18,630
Shortraker/rougheye	2,740	1,590	1,590	2,740	1,590	1,590	1,650	959	959
Other slope rockfish	7,560	5,260	2,170	7,560	5,260	2,170	4,560	3,170	2,170
Northern rockfish	9,420	5,000	5,000	9,420	5,000	5,000	5,680	3,770	3,770
Pelagic shelf rockfish	8,390	5,260	5,260	8,390	5,260	5,260	5,030	3,510	3,510
Demersal shelf rockfish	950	560	560	950	560	560	569	420	420
Deep water flatfish	9,440	7,170	7,170	10,200	7,170	7,170	6,130	4,600	4,600
Atka mackerel	6,200	600	600	2,690	600	600	1,610	600	600
Other species			15,460			15,460			15,460
Total	817,620	549,030	324,726	719,870	549,030	324,726	661,079	509,179	314,725

Table 6c. Impacts of alternatives on 1998 catch specifications in the GOA, assuming that poorly understood stocks are all judged to be at a **low** level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show instances where reductions in 1998 TACs would have been required under Alternative 4. No reductions in 1998 TACs would have been required under Alternative 3.

Gulf of Alaska

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock	186,100	130,000	124,730	160,000	130,000	124,730	160,000	130,000	124,730
Pacific cod	141,000	77,900	63,470	128,000	77,900	63,470	128,000	77,900	63,470
Arrowtooth flounder	295,970	208,340	35,000	243,000	208,340	35,000	243,000	208,340	35,000
Sablefish	23,450	14,120	14,120	21,200	14,120	14,120	21,200	14,120	14,120
Pacific ocean perch	18,090	12,820	10,776	18,000	12,820	10,776	18,000	12,820	10,776
Thornyhead rockfish	2,840	2,000	2,000	2,320	2,000	2,000	2,320	2,000	2,000
Rex sole	11,920	9,150	9,150	11,900	9,150	9,150	2,390	1,830	1,830
Flathead sole	34,010	26,110	9,040	34,000	26,110	9,040	6,800	5,220	5,220
Shallow water flatfish	59,540	43,150	18,630	59,500	43,150	18,630	12,000	8,690	8,690
Shortraker/rougheye	2,740	1,590	1,590	2,740	1,590	1,590	549	319	319
Other slope rockfish	7,560	5,260	2,170	7,560	5,260	2,170	1,520	1,060	1,060
Northern rockfish	9,420	5,000	5,000	9,420	5,000	5,000	1,890	1,250	1,250
Pelagic shelf rockfish	8,390	5,260	5,260	8,390	5,260	5,260	1,670	1,170	1,170
Demersal shelf rockfish	950	560	560	950	560	560	189	139	139
Deep water flatfish	9,440	7,170	7,170	10,200	7,170	7,170	2,050	1,540	1,540
Atka mackerel	6,200	600	600	1,040	600	600	207	156	156
Other species			15,460			15,460			15,460
Total	817,620	549,030	324,726	718,220	549,030	324,726	601,785	466,554	286,930

Table 6d. Impacts of alternatives on 1998 catch specifications in the GOA, assuming that poorly understood stocks are all judged to be **overfished** under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 4, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show instances where reductions in 1998 TACs would have been required under Alternative 4. No reductions in 1998 TACs would have been required under Alternative 3.

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	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock (EBS)	1	1	1	1	5,820,000	6,000,000	0.38	0.31	0.66	0.30	0.37	0.30	0.37	0.30
Pacific cod	1	2	2	2	383,000	308,000	0.35	0.29	0.42	0.25	0.35	0.29	0.35	0.29
Yellowfin sole	1	2	2	2	757,000	519,000	0.13	0.11	0.16	0.11	0.13	0.11	0.13	0.11
Greenland turbot	1	2	2	2	95,000	121,000	0.32	0.26	0.27	0.17	0.25	0.20	0.25	0.20
Rock sole	1	2	2	2	650,000	234,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Sablefish (EBS)	1	2	2	2	16,800	17,300	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Sablefish (AI)	1	2	2	2	19,300	20,000	0.14	0.12	0.15	0.085	0.13	0.12	0.13	0.12
True POP (EBS)	1	2	2	2	23,900	30,100	0.072	0.058	0.056	0.031	0.06	0.05	0.06	0.05
True POP (AI)	1	2	2	2	129,000	111,000	0.084	0.068	0.096	0.055	0.08	0.07	0.08	0.07
Atka mackerel	1	2	2	2	152,000	127,000	0.42	0.34	0.50	0.23	0.42	0.34	0.42	0.34
Walleye pollock (AI)	1	3	3	3	106,000	66,300	0.30	0.23	0.30	0.23	0.30	0.23	0.30	0.23
Walleye pollock (Bog.)	1	3	2	2	280,000	1,750,000	0.33	0.27	0.035	0.026	0.33	0.27	0.038	0.031
Arrowtooth flounder	1	3	2	2	531,000	332,000	0.28	0.23	0.36	0.23	0.28	0.23	0.28	0.23
Flathead sole	1	3	2	2	824,000	515,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Other flatfish	1	2,3	2	2	313,000	162,000	0.32	0.26	0.39	0.26	0.32	0.26	0.32	0.26
Other red rockfish (EBS)	1	3	3	3	11,600	7,270	0.031	0.023	0.031	0.023	0.031	0.023	0.031	0.023
Sharpchin/Northern (AI)	1	3	3	3	94,000	58,800	0.060	0.045	0.060	0.045	0.060	0.045	0.060	0.045
Shortraker/Rougheye (AI)	1	3	3	3	46,500	29,100	0.028	0.021	0.028	0.021	0.028	0.021	0.028	0.021
Other rockfish (EBS)	1	3	3	3	7,030	4,390	0.070	0.053	0.070	0.053	0.070	0.053	0.070	0.053
Other rockfish (AI)	1	3	3	3	13,000	8,130	0.070	0.053	0.070	0.053	0.070	0.053	0.070	0.053
Other Species	1	3	3	3	669,000	418,000	0.20	0.15	0.20	0.039	0.20	0.15	0.20	0.15
Squid	2	3	3	3	4,680	2,920	0.80	0.60	0.80	0.60	0.80	0.60	0.80	0.60

Table 7a. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the BSAI, assuming that poorly understood stocks are all judged to be at a high level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

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	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock (EBS)	1	1	1	1	5,820,000	6,000,000	0.38	0.31	0.66	0.30	0.37	0.30	0.37	0.30
Pacific cod	1	2	2	2	383,000	308,000	0.35	0.29	0.42	0.25	0.35	0.29	0.35	0.29
Yellowfin sole	1	2	2	2	757,000	519,000	0.13	0.11	0.16	0.11	0.13	0.11	0.13	0.11
Greenland turbot	1	2	2	2	95,000	121,000	0.32	0.26	0.27	0.17	0.25	0.20	0.25	0.20
Rock sole	1	2	2	2	650,000	234,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Sablefish (EBS)	1	2	2	2	16,800	17,300	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Sablefish (AI)	1	2	2	2	19,300	20,000	0.14	0.12	0.15	0.085	0.13	0.12	0.13	0.12
True POP (EBS)	1	2	2	2	23,900	30,100	0.072	0.058	0.056	0.031	0.06	0.05	0.06	0.05
True POP (AI)	1	2	2	2	129,000	111,000	0.084	0.068	0.096	0.055	0.08	0.07	0.08	0.07
Atka mackerel	1	2	2	2	152,000	127,000	0.42	0.34	0.50	0.23	0.42	0.34	0.42	0.34
Walleye pollock (AI)	1	3	3	3	106,000	106,000	0.30	0.23	0.30	0.23	0.30	0.23	0.30	0.23
Walleye pollock (Bog.)	1	3	2	2	280,000	1,750,000	0.33	0.27	0.035	0.026	0.33	0.27	0.038	0.031
Arrowtooth flounder	1	3	2	2	531,000	531,000	0.28	0.23	0.36	0.23	0.28	0.23	0.28	0.23
Flathead sole	1	3	2	2	824,000	824,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Other flatfish	1	2,3	2	2	313,000	192,000	0.32	0.26	0.39	0.26	0.32	0.26	0.32	0.26
Other red rockfish (EBS)	1	3	3	3	11,600	11,600	0.031	0.023	0.031	0.023	0.031	0.023	0.031	0.023
Sharpchin/Northern (AI)	1	3	3	3	94,000	94,000	0.060	0.045	0.060	0.045	0.060	0.045	0.060	0.045
Shortraker/Rougheye (AI)	1	3	3	3	46,500	46,500	0.028	0.021	0.028	0.021	0.028	0.021	0.028	0.021
Other rockfish (EBS)	1	3	3	3	7,030	7,030	0.070	0.053	0.070	0.053	0.070	0.053	0.070	0.053
Other rockfish (AI)	1	3	3	3	13,000	13,000	0.070	0.053	0.070	0.053	0.070	0.053	0.070	0.053
Other Species	1	3	3	3	669,000	669,000	0.20	0.15	0.20	0.039	0.20	0.15	0.20	0.15
Squid	2	3	3	3	2,920	2,920	0.80	0.60	0.80	0.60	0.80	0.60	0.80	0.60

Table 7b. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the BSAI, assuming that poorly understood stocks are all judged to be at a **moderate** level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

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	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock (EBS)	1	1	1	1	5,820,000	6,000,000	0.38	0.31	0.66	0.30	0.37	0.30	0.37	0.30
Pacific cod	1	2	2	2	383,000	308,000	0.35	0.29	0.42	0.25	0.35	0.29	0.35	0.29
Yellowfin sole	1	2	2	2	757,000	519,000	0.13	0.11	0.16	0.11	0.13	0.11	0.13	0.11
Greenland turbot	1	2	2	2	95,000	121,000	0.32	0.26	0.27	0.17	0.25	0.20	0.25	0.20
Rock sole	1	2	2	2	650,000	234,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Sablefish (EBS)	1	2	2	2	16,800	17,300	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Sablefish (AI)	1	2	2	2	19,300	20,000	0.14	0.12	0.15	0.085	0.13	0.12	0.13	0.12
True POP (EBS)	1	2	2	2	23,900	30,100	0.072	0.058	0.056	0.031	0.06	0.05	0.06	0.05
True POP (AI)	1	2	2	2	129,000	111,000	0.084	0.068	0.096	0.055	0.08	0.07	0.08	0.07
Atka mackerel	1	2	2	2	152,000	127,000	0.42	0.34	0.50	0.23	0.42	0.34	0.42	0.34
Walleye pollock (AI)	1	3	3	3	106,000	171,000	0.30	0.23	0.30	0.23	0.30	0.23	0.18	0.13
Walleye pollock (Bog.)	1	3	2	2	280,000	1,750,000	0.33	0.27	0.035	0.026	0.33	0.27	0.038	0.031
Arrowtooth flounder	1	3	2	2	531,000	856,000	0.28	0.23	0.36	0.23	0.28	0.23	0.17	0.14
Flathead sole	1	3	2	2	824,000	1,330,000	0.19	0.16	0.23	0.16	0.19	0.16	0.11	0.10
Other flatfish	1	2,3	2	2	313,000	241,000	0.32	0.26	0.39	0.26	0.32	0.26	0.32	0.26
Other red rockfish (EBS)	1	3	3	3	11,600	18,800	0.031	0.023	0.031	0.023	0.031	0.023	0.018	0.014
Sharpchin/Northern (AI)	1	3	3	3	94,000	152,000	0.060	0.045	0.060	0.045	0.060	0.045	0.036	0.027
Shortraker/Rougheye (AI)	1	3	3	3	46,500	75,000	0.028	0.021	0.028	0.021	0.028	0.021	0.017	0.012
Other rockfish (EBS)	1	3	3	3	7,030	11,300	0.070	0.053	0.070	0.053	0.070	0.053	0.042	0.032
Other rockfish (AI)	1	3	3	3	13,000	21,000	0.070	0.053	0.070	0.053	0.070	0.053	0.042	0.031
Other Species	1	3	3	3	669,000	1,080,000	0.20	0.15	0.20	0.039	0.20	0.15	0.12	0.09
Squid	2	3	3	3	1,810	2,920	0.80	0.60	0.80	0.60	0.80	0.60	0.48	0.36

Table 7c. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the BSAI, assuming that poorly understood stocks are all judged to be at a low level of abundance under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

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	Quantities Used in Control Rules								1998 Fishing Mortality Rates					
	Proxy Level				Value (Alternative 3 shaded)				Alternative 1		Alternative 2		Alternative 3	
Species	B	β	ϕ	γ	B	β	ϕ	γ	OFL	ABC	OFL	ABC	OFL	ABC
Walleye pollock (EBS)	1	1	1	1	5,820,000	6,000,000	0.38	0.31	0.66	0.30	0.37	0.30	0.37	0.30
Pacific cod	1	2	2	2	383,000	308,000	0.35	0.29	0.42	0.25	0.35	0.29	0.35	0.29
Yellowfin sole	1	2	2	2	757,000	519,000	0.13	0.11	0.16	0.11	0.13	0.11	0.13	0.11
Greenland turbot	1	2	2	2	95,000	121,000	0.32	0.26	0.27	0.17	0.25	0.20	0.25	0.20
Rock sole	1	2	2	2	650,000	234,000	0.19	0.16	0.23	0.16	0.19	0.16	0.19	0.16
Sablefish (EBS)	1	2	2	2	16,800	17,300	0.14	0.12	0.15	0.085	0.14	0.12	0.14	0.12
Sablefish (AI)	1	2	2	2	19,300	20,000	0.14	0.12	0.15	0.085	0.13	0.12	0.13	0.12
True POP (EBS)	1	2	2	2	23,900	30,100	0.072	0.058	0.056	0.031	0.06	0.05	0.06	0.05
True POP (AI)	1	2	2	2	129,000	111,000	0.084	0.068	0.096	0.055	0.08	0.07	0.08	0.07
Atka mackerel	1	2	2	2	152,000	127,000	0.42	0.34	0.50	0.23	0.42	0.34	0.42	0.34
Walleye pollock (AI)	1	3	3	3	106,000	442,000	0.30	0.23	0.30	0.23	0.30	0.23	0.06	0.04
Walleye pollock (Bog.)	1	3	2	2	280,000	1,750,000	0.33	0.27	0.035	0.026	0.33	0.27	0.038	0.031
Arrowtooth flounder	1	3	2	2	531,000	2,210,000	0.28	0.23	0.36	0.23	0.28	0.23	0.06	0.05
Flathead sole	1	3	2	2	824,000	3,430,000	0.19	0.16	0.23	0.16	0.19	0.16	0.04	0.03
Other flatfish	1	2,3	2	2	313,000	445,000	0.32	0.26	0.39	0.26	0.22	0.18	0.22	0.18
Other red rockfish (EBS)	1	3	3	3	11,600	48,500	0.031	0.023	0.031	0.023	0.031	0.023	0.006	0.005
Sharpchin/Northern (AI)	1	3	3	3	94,000	392,000	0.060	0.045	0.060	0.045	0.060	0.045	0.012	0.009
Shortraker/Rougheye (AI)	1	3	3	3	46,500	194,000	0.028	0.021	0.028	0.021	0.028	0.021	0.006	0.004
Other rockfish (EBS)	1	3	3	3	7,030	29,300	0.070	0.053	0.070	0.053	0.070	0.053	0.014	0.010
Other rockfish (AI)	1	3	3	3	13,000	54,200	0.070	0.053	0.070	0.053	0.070	0.053	0.014	0.010
Other Species	1	3	3	3	669,000	2,790,000	0.20	0.15	0.20	0.039	0.20	0.15	0.04	0.03
Squid	2	3	3	3	702	2,920	0.80	0.60	0.80	0.60	0.80	0.60	0.16	0.12

Table 7d. Impacts of alternatives on 1998 OFL and ABC fishing mortality rates in the BSAI, assuming that poorly understood stocks are all judged to be **overfished** under Alternative 4. The columns under the heading "Quantities Used in Control Rules" show which proxies would have been substituted for each of the four quantities used in the control rules defined by Alternatives 3 and 4, along with the values of those proxies. The columns under the heading "1998 Fishing Mortality Rates" show the fishing mortality rates corresponding to OFL and ABC. In the case of Alternative 1, these are the rates corresponding to the OFL and ABC values actually specified for 1998. In the case of Alternatives 3 and 4, these are the rates emerging from the control rules, given the estimates shown in the "Value" columns (note that the ABC rate shown is thus an upper limit; i.e., the Council could choose a lower value). Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show hypothetical examples of such estimates. For these stocks, Alternative 3 always assumes a moderate level of abundance.

Bering Sea and Aleutian Islands

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock (EBS)	2,060,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000
Pacific cod	336,000	210,000	210,000	280,000	210,000	210,000	280,000	210,000	210,000
Yellowfin sole	314,000	220,000	220,000	255,000	220,000	220,000	255,000	220,000	220,000
Greenland turbot	22,300	15,000	15,000	20,500	15,000	15,000	20,500	15,000	15,000
Rock sole	449,000	312,000	100,000	371,000	312,000	100,000	371,000	312,000	100,000
Sablefish (EBS)	2,160	1,300	1,300	1,950	1,300	1,300	1,950	1,300	1,300
Sablefish (AI)	2,230	1,380	1,380	2,000	1,380	1,380	2,000	1,380	1,380
True POP (EBS)	3,300	1,400	1,400	3,320	1,400	1,400	3,320	1,400	1,400
True POP (AI)	20,700	12,100	12,100	18,100	12,100	12,100	18,100	12,100	12,100
Atka mackerel	134,000	64,300	64,300	113,000	64,300	64,300	113,000	64,300	64,300
Walleye pollock (AI)	31,700	23,800	23,800	31,700	23,800	23,800	31,700	23,800	23,800
Walleye pollock (Bog.)	8,750	6,410	1,000	82,500	6,410	1,000	9,550	6,410	1,000
Arrowtooth flounder	230,000	147,000	16,000	179,000	147,000	16,000	179,000	147,000	16,000
Flathead sole	190,000	132,000	100,000	157,000	132,000	100,000	157,000	132,000	100,000
Other flatfish	253,000	164,000	89,434	203,000	164,000	89,434	203,000	164,000	89,434
Other red rockfish (EBS)	356	267	267	356	267	267	356	267	267
Sharpchin/Northern (AI)	5,640	4,230	4,230	5,640	4,230	4,230	5,640	4,230	4,230
Shortraker/Rougheye (AI)	1,290	965	965	1,290	965	965	1,290	965	965
Other rockfish (EBS)	492	369	369	492	369	369	492	369	369
Other rockfish (AI)	913	685	685	913	685	685	913	685	685
Other Species	134,000	25,800	25,800	134,000	25,800	25,800	134,000	25,800	25,800
Squid	2,620	1,970	1,970	2,620	1,970	1,970	2,620	1,970	1,970
Total	4,202,451	2,454,976	2,000,000	3,013,381	2,454,976	2,000,000	2,940,431	2,454,976	2,000,000

Table 8a. Impacts of alternatives on 1998 catch specifications in the BSAI, assuming that poorly understood stocks are all judged to be at a **high** level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. Under the scenario shown in this table, no reductions in 1998 TACs would have been required under Alternative 3 or Alternative 4.

Bering Sea and Aleutian Islands

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock (EBS)	2,060,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000
Pacific cod	336,000	210,000	210,000	280,000	210,000	210,000	280,000	210,000	210,000
Yellowfin sole	314,000	220,000	220,000	255,000	220,000	220,000	255,000	220,000	220,000
Greenland turbot	22,300	15,000	15,000	20,500	15,000	15,000	20,500	15,000	15,000
Rock sole	449,000	312,000	100,000	371,000	312,000	100,000	371,000	312,000	100,000
Sablefish (EBS)	2,160	1,300	1,300	1,950	1,300	1,300	1,950	1,300	1,300
Sablefish (AI)	2,230	1,380	1,380	2,000	1,380	1,380	2,000	1,380	1,380
True POP (EBS)	3,300	1,400	1,400	3,320	1,400	1,400	3,320	1,400	1,400
True POP (AI)	20,700	12,100	12,100	18,100	12,100	12,100	18,100	12,100	12,100
Atka mackerel	134,000	64,300	64,300	113,000	64,300	64,300	113,000	64,300	64,300
Walleye pollock (AI)	31,700	23,800	23,800	31,700	23,800	23,800	31,700	23,800	23,800
Walleye pollock (Bog.)	8,750	6,410	1,000	82,500	6,410	1,000	9,550	6,410	1,000
Arrowtooth flounder	230,000	147,000	16,000	179,000	147,000	16,000	179,000	147,000	16,000
Flathead sole	190,000	132,000	100,000	157,000	132,000	100,000	157,000	132,000	100,000
Other flatfish	253,000	164,000	89,434	203,000	164,000	89,434	203,000	164,000	89,434
Other red rockfish (EBS)	356	267	267	356	267	267	356	267	267
Sharpchin/Northern (AI)	5,640	4,230	4,230	5,640	4,230	4,230	5,640	4,230	4,230
Shortraker/Rougheye (AI)	1,290	965	965	1,290	965	965	1,290	965	965
Other rockfish (EBS)	492	369	369	492	369	369	492	369	369
Other rockfish (AI)	913	685	685	913	685	685	913	685	685
Other Species	134,000	25,800	25,800	134,000	25,800	25,800	134,000	25,800	25,800
Squid	2,620	1,970	1,970	2,620	1,970	1,970	2,620	1,970	1,970
Total	4,202,451	2,454,976	2,000,000	3,013,381	2,454,976	2,000,000	2,940,431	2,454,976	2,000,000

Table 8b. Impacts of alternatives on 1998 catch specifications in the BSAI, assuming that poorly understood stocks are all judged to be at a **moderate** level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. Under the scenario shown in this table, no reductions in 1998 TACs would have been required under Alternative 3 or Alternative 4.

Bering Sea and Aleutian Islands

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock (EBS)	2,060,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000
Pacific cod	336,000	210,000	210,000	280,000	210,000	210,000	280,000	210,000	210,000
Yellowfin sole	314,000	220,000	220,000	255,000	220,000	220,000	255,000	220,000	220,000
Greenland turbot	22,300	15,000	15,000	20,500	15,000	15,000	20,500	15,000	15,000
Rock sole	449,000	312,000	100,000	371,000	312,000	100,000	371,000	312,000	100,000
Sablefish (EBS)	2,160	1,300	1,300	1,950	1,300	1,300	1,950	1,300	1,300
Sablefish (AI)	2,230	1,380	1,380	2,000	1,380	1,380	2,000	1,380	1,380
True POP (EBS)	3,300	1,400	1,400	3,320	1,400	1,400	3,320	1,400	1,400
True POP (AI)	20,700	12,100	12,100	18,100	12,100	12,100	18,100	12,100	12,100
Atka mackerel	134,000	64,300	64,300	113,000	64,300	64,300	113,000	64,300	64,300
Walleye pollock (AI)	31,700	23,800	23,800	31,700	23,800	23,800	19,000	14,300	14,300
Walleye pollock (Bog.)	8,750	6,410	1,000	82,500	6,410	1,000	9,550	6,410	1,000
Arrowtooth flounder	230,000	147,000	16,000	179,000	147,000	16,000	107,000	88,300	16,000
Flathead sole	190,000	132,000	100,000	157,000	132,000	100,000	94,100	79,100	79,100
Other flatfish	253,000	164,000	89,434	203,000	164,000	89,434	203,000	164,000	89,434
Other red rockfish (EBS)	356	267	267	356	267	267	212	159	159
Sharpchin/Northern (AI)	5,640	4,230	4,230	5,640	4,230	4,230	3,370	2,530	2,530
Shortraker/Rougheye (AI)	1,290	965	965	1,290	965	965	774	579	579
Other rockfish (EBS)	492	369	369	492	369	369	296	222	222
Other rockfish (AI)	913	685	685	913	685	685	547	410	410
Other Species	134,000	25,800	25,800	134,000	25,800	25,800	80,300	25,800	25,800
Squid	2,620	1,970	1,970	2,620	1,970	1,970	1,570	1,180	1,180
Total	4,202,451	2,454,976	2,000,000	3,013,381	2,454,976	2,000,000	2,734,589	2,330,470	1,966,194

Table 8c. Impacts of alternatives on 1998 catch specifications in the BSAI, assuming that poorly understood stocks are all judged to be at a low level of abundance under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show instances where reductions in 1998 TACs would have been required under Alternative 4. No reductions in 1998 TACs would have been required under Alternative 3.

Bering Sea and Aleutian Islands

1998 Catch Specifications

Species	Alternative 1			Alternative 2			Alternative 3		
	OFL	ABC	TAC	OFL	ABC	TAC	OFL	ABC	TAC
Walleye pollock (EBS)	2,060,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000	1,150,000	1,110,000	1,110,000
Pacific cod	336,000	210,000	210,000	280,000	210,000	210,000	280,000	210,000	210,000
Yellowfin sole	314,000	220,000	220,000	255,000	220,000	220,000	255,000	220,000	220,000
Greenland turbot	22,300	15,000	15,000	20,500	15,000	15,000	20,500	15,000	15,000
Rock sole	449,000	312,000	100,000	371,000	312,000	100,000	371,000	312,000	100,000
Sablefish (EBS)	2,160	1,300	1,300	1,950	1,300	1,300	1,950	1,300	1,300
Sablefish (AI)	2,230	1,380	1,380	2,000	1,380	1,380	2,000	1,380	1,380
True POP (EBS)	3,300	1,400	1,400	3,320	1,400	1,400	3,320	1,400	1,400
True POP (AI)	20,700	12,100	12,100	18,100	12,100	12,100	18,100	12,100	12,100
Atka mackerel	134,000	64,300	64,300	113,000	64,300	64,300	113,000	64,300	64,300
Walleye pollock (AI)	31,700	23,800	23,800	31,700	23,800	23,800	6,330	4,760	4,760
Walleye pollock (Bog.)	8,750	6,410	1,000	82,500	6,410	1,000	9,550	6,410	1,000
Arrowtooth flounder	230,000	147,000	16,000	179,000	147,000	16,000	35,800	29,400	16,000
Flathead sole	190,000	132,000	100,000	157,000	132,000	100,000	31,400	26,400	26,400
Other flatfish	253,000	164,000	89,434	140,000	113,000	89,434	140,000	113,000	89,434
Other red rockfish (EBS)	356	267	267	356	267	267	71	53	53
Sharpchin/Northern (AI)	5,640	4,230	4,230	5,640	4,230	4,230	1,130	845	845
Shortraker/Rougheye (AI)	1,290	965	965	1,290	965	965	258	193	193
Other rockfish (EBS)	492	369	369	492	369	369	98	74	74
Other rockfish (AI)	913	685	685	913	685	685	182	137	137
Other Species	134,000	25,800	25,800	134,000	25,800	25,800	26,800	19,800	19,800
Squid	2,620	1,970	1,970	2,620	1,970	1,970	525	395	395
Total	4,202,451	2,454,976	2,000,000	2,950,381	2,403,976	2,000,000	2,467,014	2,148,947	1,894,571

Table 8d. Impacts of alternatives on 1998 catch specifications in the BSAI, assuming that poorly understood stocks are all judged to be **overfished** under Alternative 4. In the case of Alternative 1, the values listed under OFL, ABC, and TAC for each species are the values actually specified for 1998. In the case of Alternative 3, the value listed under OFL for each species is the value emerging from application of the limit control rule, the value listed under ABC for each species is the lesser of the ABC under Alternative 1 and the value emerging from application of the target control rule, and the value listed under TAC for each species is the lesser of the ABC under Alternative 3 and the TAC under Alternative 1. In the case of Alternative 4, the values listed under OFL, ABC, and TAC for each species are analogous to those listed under Alternative 3. Stocks for which objective estimates of both B and β are available (i.e., those for which Proxy 1 is used for B and Proxy 1 or 2 is used for β) are shown in the upper portion of the table. For the stocks in the lower portion of the table, Alternative 4 requires the SSC to use its best subjective estimate of B or β when an objective estimate is unavailable. The shaded cells in this table show instances where reductions in 1998 TACs would have been required under Alternative 4. No reductions in 1998 TACs would have been required under Alternative 3.

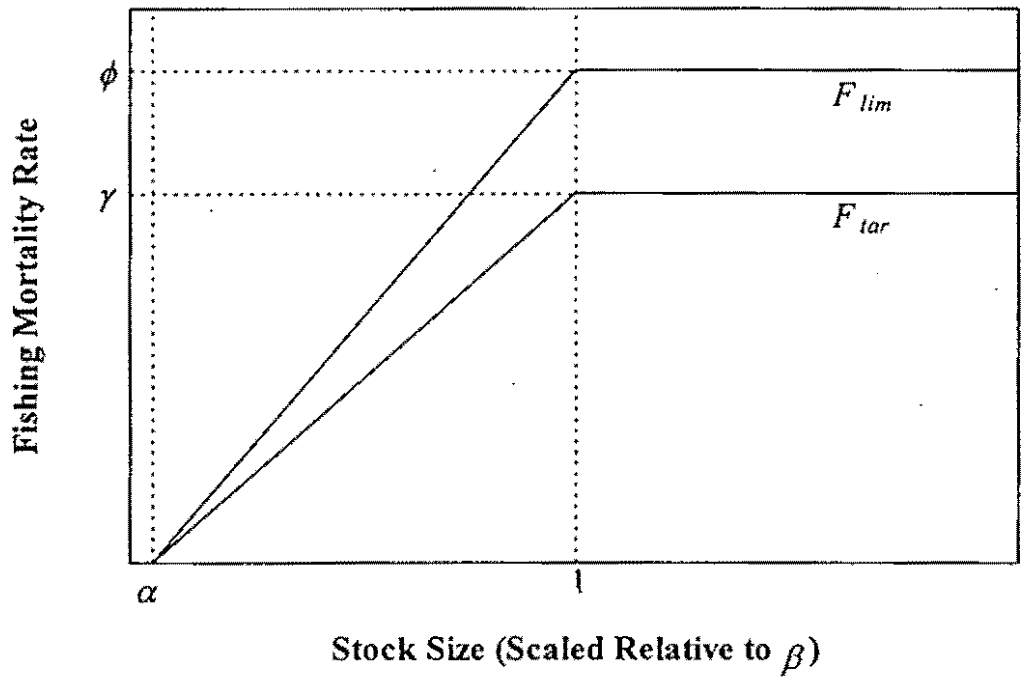

Figure 2. Limit (F_{lim}) and target (F_{tar}) control rules under Alternatives 3 and 4. Each control rule gives fishing mortality as a function of stock size. The parameters of the control rules are α, β, ϕ, and γ (see text). Although the definitions of some terms are different, these control rules are identical in form to Tier 1 of the current ABC/OFL definitions (Alternative 1).

Appendix A: A Procedure for Estimating Relative Abundance

One way to establish the "subjective" proxies called for in Alternative 4 would be for the SSC to adopt a rule of thumb that could be applied in all situations, then deviate from that rule as appropriate on a case-by-case basis, using its best scientific judgment developed from whatever other information is available. The following is an example of one such rule of thumb.

a) From the set of stocks managed under an FMP, form two groups:
Group 1: stocks for which objective estimates of B and β exist, and
Group 2: stocks for which objective estimates are lacking for either B or β.

b) For each stock in Group 1, list the following: B, β, C_{ave}, and M.

c) For the n stocks in Group 1 (indexed $i = 0, ..., n-1$), compute the following averages:

$$\theta = \left(\frac{1}{n}\right)\sum_{i=0}^{n-1}\frac{B_i}{\beta_i}, \quad q = \left(\frac{1}{n}\right)\sum_{i=0}^{n-1}\frac{C_{ave_i}}{M_i\beta_i}.$$

d) Determine relative abundance and define parameter p according to the following table:

If the value of θ is...	then assume stocks may be characterized as...	and set p equal to...
less than 0.6	overfished	0.24
between 0.6 and 1.0	low in abundance	0.62
between 1.0 and 1.6	moderate in abundance	1.00
greater than 1.6	high in abundance	1.60

e) For each stock in Group 2 that has an objective estimate of B but not β, estimate β as B/p.

f) For each stock in Group 2 that has an objective estimate of β but not B, estimate B as βp.

g) For each stock in Group 2 that lacks objective estimates of both B and β,
first estimate β as C_{ave}/Mq,
then estimate B as βp.

Based on current information, the above rule of thumb would indicate that Group 1 GOA stocks tend to be at a high level of abundance ($\theta = 1.72$, $p = 1.6$), while Group 1 BSAI stocks tend to be at a moderate level of abundance ($\theta = 1.23$, $p = 1.0$). The values shown under Alternative 4 in tables 5a, 6a, 7b, and 8b result from assuming that these levels apply to all Group 2 stocks as well. Values of q used for these tables were 1.43 and 1.12 for the GOA and BSAI, respectively.

Appendix B: A Procedure for Estimating $F_{35\%}$

Equation (17) of Thompson (1993) can be manipulated to provide an estimate of $F_{35\%}$ based on values of $F_{40\%}$ and M. First, define

$$x = \frac{F_{40\%}}{M}$$

and

$$K'' = \frac{-2x^2 + x + 3}{2x^2 + 4x - 3}.$$

Then, the following solution holds for the simple dynamic pool model in which growth (in weight) is a linear function of age:

$$F_{35\%} = \left(\frac{10 + 2\sqrt{25 + 35K''(K'' + 1)}}{7(K'' + 1)} - 1 \right) M.$$

Reference:

Thompson, G. G. 1993. A proposal for a threshold stock size and maximum fishing mortality rate. *In* S. J. Smith, J. J. Hunt, and D. Rivard (editors), Risk evaluation and biological reference points for fisheries management, p. 303-320. Can. Spec. Publ. Fish. Aquat. Sci. 120.

Appendix C: A Procedure for Estimating $F_{35\%}$

Equation (17) of Thompson (1993) can be manipulated to provide an estimate of $F_{35\%}$ based on values of $F_{40\%}$ and M. First, define

$$x = \frac{F_{40\%}}{M}$$

and

$$K'' = \frac{-2x^2 + x + 3}{2x^2 + 4x - 3}.$$

Then, the following solution holds for the simple dynamic pool model in which growth (in weight) is a linear function of age:

$$F_{35\%} = \left(\frac{10 + 2\sqrt{25 + 35K''(K'' + 1)}}{7(K'' + 1)} - 1 \right) M.$$

Reference:

Thompson, G. G. 1993. A proposal for a threshold stock size and maximum fishing mortality rate. *In* S. J. Smith, J. J. Hunt, and D. Rivard (editors), Risk evaluation and biological reference points for fisheries management, p. 303-320. Can. Spec. Publ. Fish. Aquat. Sci. 120.

Comparison of Alternatives for EBS Pollock