ENVIRONMENTAL ASSESSMENT

For Proposed Amendment 13 to the Fishery Management Plan for the Scallop Fishery Off Alaska

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Abstract: This environmental assessment analyses a range of alternatives to implement Annual Catch Limits (ACLs) in the Alaskan Scallop Fishery to meet regulatory requirements. Four alternatives are examined: Alternative 1: Status Quo; Alternative 2: Set ACL equal to the overfishing level (OFL); Alternative 3: Set ACL equal to 90% of the OFL; and Alternative 4: Set ACL equal to 75% of the OFL. For alternatives 2-4, two options are considered, establishing a statewide ACL and establishing ACLs by region. Three additional options are included for the treatment of non-target scallop stocks: option 1: remove non-target stocks from the FMP; option 2: move non-target scallop stocks to an ecosystem component category under the FMP (and do not establish ACLs for these stocks); and option 3: set ACLs for non-target scallop stocks. The Council's preferred alternative selected Alternative 3, with statewide management (option 2), a re-estimated OFL to include known discards, and option 2 for non-target stocks to move them into the ecosystem component. The impacts of the alternatives upon scallop resources, fishery participants, habitat, marine mammals, and other groundfish resources are discussed in the analysis.

Executive Summary

The Fishery Management Plan for the Scallop Fishery Off Alaska (FMP) governs scallop fisheries in the U.S. exclusive economic zone (EEZ) of the Bering Sea, Aleutian Islands, and the Gulf of Alaska, and includes weathervane scallops and other scallop species not currently exploited. Management actions for the Alaskan scallop fisheries must comply with applicable Federal laws and regulations.

The proposed action is to establish an annual catch limit (ACL) and accountability measures (AMs) to meet the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the National Standard 1 Guidelines (NS 1 Guidelines; 50 CFR 600.310). The ACL is to be established based upon acceptable biological catch (ABC) control rule which accounts for the uncertainty in the overfishing limit (OFL). To meet the ACL requirements, an ABC would be established under the such that ACL = ABC. The FMP delegates to the State of Alaska (State) the responsibility to set guideline harvest levels (GHLs) following the criteria in the FMP. Under the proposed action, the FMP would contain the additional condition that the GHLs must be set sufficiently low to prevent total catch from exceeding the ACL.

Four alternatives to implement ACLs are contained in this environmental assessment.

- Alternative 1: Status Quo
- Alternative 2: Set ACL equal to the OFL
- Alternative 3: Set ACL equal to 90% of the OFL **(Preferred)**
- Alternative 4: Set ACL equal to 75% of the OFL

Under Alternatives 2–4, the estimate of MSY would be redefined to include estimates of discard mortality in the directed scallop fishery, the groundfish fisheries, and agency surveys and the default OFL would be set equal to the MSY. Alternatives 2–4 also include two options: establish a statewide ACL and establish ACLs by region.

Three options are considered for the treatment of non-target scallop stocks.

- Option 1: Remove non-target stocks from the FMP
- Option 2: Move non-target scallop stocks to an ecosystem component category under the FMP (and do not establish ACLs for these stocks) **(Preferred)**
- Option 3: Set ACLs for non-target scallop stocks

The Council recommends (1) Alternative 3a: Statewide ACL where the ABC control rule = 90% of OFL; (2) that MSY be redefined to include total catch and that the default OFL equal the MSY (MSY = OFL = 1.284 million pounds); and (3) Option 2: Move non-target scallop species to the ecosystem component.

The impacts of the alternatives upon scallop resources, fishery participants, habitat, marine mammals, and other groundfish resources are discussed in the analysis. Based on this analysis, the alternatives will have an insignificant impact on other groundfish resources, habitat, or prohibited species.

Based on historical catch patterns, Alternatives 2 through 4 are unlikely to constrain the fishery when ACLs are applied statewide, but may constrain the fishery in some regions at times of high scallop abundance when region-specific ACLs are applied. To determine the relative risk of overfishing by each of the alternatives, a probability approach was employed to estimate the relative risk of exceeding the OFL under each of Alternatives 2-4. This approach also considers additional, unmeasured scientific uncertainty and its relative impact on the perceived risk of overfishing.

The requirement to account for all removals necessitates taking into account the scallop discard mortality in directed and non-directed fisheries. The combination of progressively more conservative ACLs (moving from Alternative 2 to Alternative 4), combined with providing a sufficient buffer to allow for incidental catch not to exceed the ACL, would provide additional conservation against overfishing for the scallop resource but has greater potential to constrain the scallop fishery. Alternatives 3 and 4 provide for additional conservatism by further buffering against the uncertainty in the estimation of the OFL.

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Chapter 1 Purpose and Need

The Fishery Management Plan for the Scallop Fishery Off Alaska (FMP) governs scallop fisheries in the U.S. exclusive economic zone (EEZ) of the Bering Sea and Aleutian Islands (BSAI), and the Gulf of Alaska (GOA), and includes weathervane scallops (*Patinopecten caurinus*) and other scallop species (family Pectinidae) not currently exploited. Management actions for the Alaskan scallop fisheries must comply with applicable Federal laws and regulations. The BSAI is defined as the U.S. EEZ south of the Bering Strait to the Alaska Peninsula and Aleutian Islands and extending south of the Aleutian Islands west of 170º 00' W longitude. The GOA is defined as the U.S. EEZ of the North Pacific Ocean, exclusive of the Bering Sea, between the eastern Aleutian Islands at 170º 00' W longitude and Dixon Entrance at 132º 40' W longitude.

The FMP establishes a State/Federal cooperative management regime that delegates scallop fisheries management to the State of Alaska (State) with Federal oversight. Management measures in the FMP fall into two categories: Category 1 measures are those delegated to the State for implementation, while Category 2 measures are limited access management measures and all Federal requirements, which are fixed in the FMP, implemented by Federal regulation, and require an FMP amendment to change. Category 1 and 2 measures are listed in Table 1-1. State regulations are subject to the provisions of the FMP, including its goals and objectives, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and other applicable Federal laws. The action described in this analysis is a federal measure and thus will fall under Category 2, although it may have implications for certain Category 1 measures.

Table 1-1 Management measures in FMP.

CATEGORY 1 (Delegated to the State)	**CATEGORY 2 (Fixed in FMP, Implemented by Federal Regulation)**
Guideline Harvest Levels	License limitation program
Registration Areas, Districts, Subdistricts and Sections	Optimum Yield specification
Gear Limitations	Overfishing specification
Crew and Efficiency Limits	EFH/HAPC designation
Fishing Seasons	
Observer Requirements	
Prohibited Species and Bycatch Limits	
Recordkeeping and Reporting Requirements	
In-season Adjustments	
Closed Areas	
Other	

Management actions for the Alaskan scallop fisheries must comply with applicable Federal laws and regulations. Although several laws and regulations guide this action, the principal laws and regulations that govern this action are the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the National Environmental Policy Act (NEPA). None of the alternatives require implementing regulations and, therefore, the Regulatory Flexibility Act does not apply and review under Executive Order 12866 is not required.

1.1 Purpose and Need

The proposed action is to establish in the FMP a mechanism for specifying an annual catch limit (ACL) at a level such that overfishing does not occur in the weathervane scallop fishery and establish measures to ensure accountability. The purpose of the proposed action is to reduce the risk of overfishing and maintain healthy scallop stocks that will provide optimum yield over the long-term, in compliance with the MSA and the national standard guidelines.

The Council approved the following problem statement for this analysis in October 2009.

On January 16, 2009, NMFS issued final guidelines for National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). They provide guidance on how to comply with new annual catch limit (ACL) and accountability measure (AM) requirements for ending overfishing of fisheries managed by federal fishery management plans. Annual catch limits are amounts of fish allowed to be caught in a year. A legal review of the Alaskan Scallop FMP found there were inadequacies in the FMP texts that need to be addressed. Several work groups (e.g., ABC/ACT Control Rules, Vulnerability Evaluations) have been created to produce reports on how to carry out the more technical components of the NS 1 guidelines. Statutory deadlines require compliance with the MSA by the start of the 2011 fisheries.

This action is necessary to facilitate compliance with requirements of the MSA to end and prevent overfishing, rebuild overfished stocks and achieve optimum yield.

1.2 Magnuson-Stevens Act and National Standard Guidelines

The Magnuson-Stevens Act sets forth ten national standards for fishery conservation and management. National Standard 1 states that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the U.S. fishing industry." The specification of OY and the conservation and management measures to achieve it must prevent overfishing. NMFS published national standard guidelines (50 CFR sections 600.310 – 600.355) to provide comprehensive guidance for the development of FMPs and FMP amendments that comply with the Magnuson-Stevens Act national standards.

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA, Public Law 109-479) includes provisions intended to prevent overfishing by requiring that: FMPs establish a mechanism for specifying ACLs in the plan (including a multiyear plan); implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery; and including measures to ensure accountability (AMs). ACLs and AMs are required by fishing year 2010 if overfishing is occurring in a fishery, and they are required for all other fisheries by fishing year 2011. The MSRA includes a requirement for the Scientific and Statistical Committee (SSC) to recommend fishing levels to the Council, and provides that ACLs may not exceed the fishing levels recommended by the SSC. NMFS's National Standard 1 Guidelines state that the ABC is the fishing level recommendation that is most relevant to ACLs.

On January 16, 2009, NMFS published a final rule to amend the National Standard 1 guidelines to provide guidance on how to comply with the new ACL and AM requirements intended to end overfishing of fisheries managed under fishery management plans (74 FR 3178; 50 CFR 600.310). The guidelines clarify the relationship between ACLs, ABCs, overfishing limits (OFLs), maximum sustainable yield (MSY), OY, and other applicable reference points.

On January 12, 2007, the President signed into law the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act, which amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Several of these amendments prompted the Council, with involvement of the Scallop Plan Team, and in consultation with NMFS Alaska Region and NOAA General Counsel, to consider amending the Council's Fishery Management Plan for the Scallop Fishery off Alaska (Scallop FMP).

At the outset of this consultative process, the Council developed an Action Plan that targeted areas where the Scallop FMP appeared non-compliant with the new requirements.[1] The alternatives currently under consideration were developed specifically in order to satisfy the new legal requirements imposed by these amendments to the Magnuson-Stevens Act while preserving the existing co-management regimes of the Scallop FMP to the extent possible.

The provisions of the Magnuson-Stevens Act, as amended in 2007, establish, either expressly or by logical extension, five basic requirements that relate to the Scallop FMP.[2] These five requirements may be paraphrased as follows:
(1) The FMP must provide for the specification of annual catch limits (ACLs) that will prevent overfishing;
(2) The FMP, must establish measures that will ensure adherence to annual catch limits, which, at a minimum, address any overages that may occur;
(3) The Council must establish an acceptable biological catch (ABC) control rule based on the scientific advice of its Scientific and Statistical Committee (SSC), and which accounts for relevant sources of scientific uncertainty, and the FMPs must describe the ABC control rule;
(4) The Council's Scientific and Statistical Committee must provide the Council with periodic recommendations for specifying the ABC for each fishery; and
(5) The FMP must describe the maximum sustainable yield (MSY) and assess and specify the optimum yield (OY) for the fishery.

These five requirements and the statutory and regulatory underpinnings for each of them are addressed below.

A provision in the Guidelines entitled, "*Flexibility in application of NS1 Guidelines*" acknowledges that there may exist "limited circumstances that may not fit the standard approaches to specification of reference points and management measures set forth in these guidelines." 50 C.F.R. § 600.310(h)(3). None of the examples cited in the provision (aquaculture operations, management of species listed under the Endangered Species Act, and species with unusual life history characteristics) appear analogous to scallop management, for which determinations of the overfishing levels and status of the stocks largely conform to the methods set forth in the Guidelines. Nonetheless, while it does not appear likely, it may be possible to articulate a rationale for why scallop management presents one of the "limited circumstances" that warrants an alternative approach.

[1] See http://www.fakr.noaa.gov/npfmc/current_issues/ACL/ACLactionsScallopFMP509.pdf.
[2] NMFS's Guidelines for National Standard 1 of the Magnuson-Stevens Act provide guidance to Councils about how to satisfy the obligations newly imposed under the 2007 amendments to the Magnuson-Stevens Act. Pursuant to the Magnuson-Stevens Act, the National Standard Guidelines are advisory. 16 U.S.C. § 1851(b). Nonetheless, the National Standard Guidelines reflect mandates imposed by the Act and present "the Secretary's interpretation of the national standards so that [the Councils] will have an understanding of the basis on which FMPs will be reviewed" for consistency with legal requirements. 50 C.F.R. § 600.305(a)(2). The Guidelines employ the word "must" "to denote an obligation to act; it is used primarily when referring to requirements of the Magnuson-Stevens Act, the logical extension thereof, or of other applicable law." 50 C.F.R. § 600.305(c)(1) (emphasis added).[2] This document identifies several of the obligations under the Magnuson-Stevens Act that are denoted in the Guidelines for National Standard 1 as steps that "must" be taken.

It is important to note that such an alternative approach, if warranted, may afford some flexibility, but only with respect to the Guidelines themselves. This provision cannot be invoked to excuse non-compliance with any of the fundamental statutory requirements; at most, it affords the Council an opportunity to explain why a particular approach meets all of the statutory requirements without necessarily conforming to the model set forth in the Guidelines. The five general requirements addressed below relate to express statutory mandates and provisions of the Guidelines that employ the term "must" to address "obligation[s] to act" based on the requirements of the Magnuson-Stevens Act and "the logical extensions thereof," as determined by NMFS, 50 C.F.R. § 600.305(c)(1).

1. The Council's FMPs must establish a mechanism for specifying Annual Catch Limits that will prevent overfishing.

As amended, the Magnuson-Stevens Act, ***at section 303(a)(15)***, provides that

> "***Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall . . . establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability***." 16 U.S.C. § 1853(a)(15).

The Scallop FMP must provide for the annual establishment of catch limits that have legal effect and that will prevent overfishing.

The Guidelines for National Standard 1, 74 Fed. Reg. 3,204 – 3,213 (Jan. 16, 2009) *codified at* 50 C.F.R. § 600.310, elaborate on how to determine, substantively, that catch limits are set at levels "***such that overfishing does not occur in the fishery***." In short, the Guidelines establish a framework which ensures that catch limits are scientifically based and, whenever possible, that the catch limit can be expected to prevent overfishing (i.e., it is likely that a total catch equal to the catch limit will not result in actual overfishing). The Guidelines state that the FMP must describe "***Mechanisms for specifying [annual catch limits (ACLs)] . . . in relationship to the [acceptable biological catch (ABC)] . . . ." 50 C.F.R. § 600.310(c)(4). The "ACL cannot exceed the ABC . . .***." 50 C.F.R. §600.310(f)(5). Where it is possible to assess the probability that a catch equal to the acceptable biological catch will result in overfishing, ***"[t]his probability that overfishing will occur cannot exceed 50 percent and should be a lower value***." 50 C.F.R. § 600.310(f)(4). Provided that there is an ABC control rule which meets the requirements identified above, establishing an annual catch limit at or below the acceptable biological catch should ensure that the limit is established at a level that can be expected to prevent overfishing from occurring in a given year, as required by ***section 303(a)(15)*** of the Magnuson-Stevens Act, 16 U.S.C. § 1853(a)(15). Thus, the Guidelines rely on a process for establishing a scientifically based acceptable biological catch amount to ensure that catch limits are scientifically based and do not lead to inadvertent overfishing. As described below, the Magnuson-Stevens Act expressly prescribes a role for the Council's SSC in recommending acceptable biological catch amounts, and by implication, mandates the specification of acceptable biological catch amounts for each stock in the fishery.

2. The Council's FMPs must establish measures to ensure adherence to annual catch limits, including, at a minimum, measures to address any overages that occur.

The Guidelines for National Standard 1 also provide further detail regarding the statutory requirement to establish "***measures to ensure accountability***" with annual catch limits, ***section 303(a)(15) of the Magnuson-Stevens Act***, 16 U.S.C. § 1853(a)(15). When an annual catch limit has been exceeded, accountability measures "***must be triggered and implemented as soon as possible to correct the operational issue that caused the ACL overage as well as any biological consequences to the stock or stock complex resulting from the overage when it is known***." 50 C.F.R. § 600.310(g)(3). This provision

of the Guidelines echoes the legislative history of the 2007 amendments to the Magnuson-Stevens Act regarding the mandate to establish "***measures to ensure accountability***" with annual catch limits. *See* S. Rep. No. 109-229 (April 4, 2006) ("the Committee determined that, to ensure compliance with the 1996 amendments, S. 2012 needed to require that: . . . (2) any catch in excess of [the annual catch] limit (overages) should be deducted from the following year's catch limit through appropriate management measures."). In sum, FMPs must establish accountability measures that address the causes and consequences of overages of annual catch limits.

3. The Council's FMPs must contain an ABC control rule for each stock in the fishery, which accounts for relevant scientific uncertainty, including the uncertainty in the estimate of the overfishing level.

The Guidelines for National Standard 1 state that the FMPs must describe an ABC control rule for each stock in the fishery and prescribes two substantive aspects of the control rule. "***For all stocks and stock complexes that are 'in the fishery' . . ., the Councils must evaluate and describe [an ABC control rule] in their FMPs and amend the FMPs, if necessary, to align their management objectives to end or prevent overfishing . . . .***" 50 C.F.R. § 600.310(c)(3); *see also* 50 C.F.R. § 600.310(f) ("***The following features (see paragraphs (f)(1) through (f)(5) of this section) of acceptable biological catch and annual catch limits apply to stocks and stock complexes in the fishery*** "); 50 C.F.R. § 600.310(f)(4) ("***For stocks and stock complexes required to have an ABC, each Council must establish an ABC control rule based on scientific advice from its SSC***.").[3] In addition, where it is possible to assess the probability that a catch equal to the ABC will result in overfishing, ***"[t]his probability that overfishing will occur cannot exceed 50 percent and should be a lower value."*** *Id.* Finally, the ABC control rule "***must articulate how the ABC will be set compared to the OFL based on . . . the scientific uncertainty in the estimate of OFL and any other scientific uncertainty***." *Id.*

4. The Council's Scientific and Statistical Committee must recommend acceptable biological catch amounts for stocks in the fishery.

Two procedural requirements introduced by the 2007 amendments to the Magnuson-Stevens Act relate to the process for establishing annual catch limits. First, the Magnuson-Stevens Act, at ***section 302(g)(1)(B)***, now expressly requires the Council's SSC to provide recommendations for acceptable biological catch for the Council's managed fisheries.

> ***"Each scientific and statistical committee shall provide its Council ongoing scientific advice for fishery management decisions, including recommendations for acceptable biological catch . . . ."*** 16 U.S.C. § 1852(g)(1)(B).

Additionally, for the annual catch limits specified for each fishery via the mechanism established in the Council's FMP, ***section 302(h)(6) of the Magnuson-Stevens Act states that***

> ***"Each Council shall, in accordance with the provisions of this Act… develop annual catch limits for each of its managed fisheries that may not exceed the fishing level recommendations of its scientific and statistical committee or the peer review process established under subsection (g) . . . ."*** 16 U.S.C. § 1852(h)(6).

While the meaning of "fishing level recommendations" is not precisely clear on its face, this provision is best construed as precluding the Council from specifying an annual catch limit that exceeds the acceptable biological catch recommended by the SSC pursuant to section 302(g)(1)(B) of the Magnuson-Stevens Act, 16 U.S.C. § 1852(g)(1)(B).

[3] The obligation to establish an ABC control rule is implicit in, and logically derives from, the express statutory requirement for the SSC to recommend an ABC to the Council, 16 U.S.C. § 1852(g)(1)(B).

NMFS has indicated that this provision's reference to a "fishing level recommendation" is best construed as the acceptable biological catch recommended by the SSC. "Of the several required SSC recommendations (Magnuson-Stevens Act 302(g)(1)(B)), the ABC is most directly applicable as the constraint on the Council's ACL." 74 Fed. Reg. at 3,189 (Jan 16, 2009); *see* 50 C.F.R. § 600.310(b)(2)(v)(D) ("***The SSC recommendation that is most relevant to ACLs is ABC, as both ACL and ABC are levels of annual catch***."); *see also* 74 Fed. Reg. at 3,189 ("the ABC is the appropriate constraint on ACL because it is the annualized result of applying that control rule"); *id*. at 3,181. The legislative history of the 2007 amendments supports NMFS's construction. *See* S. Rep. No. 109-229 at *3 ("The following major recommendations of the Commission for the reauthorization of the Magnuson-Stevens Act were a catalyst for moving the legislation forward and were incorporated into S. 2012: Require the Councils to make management decisions based on the findings of their scientific and statistical committees (SSCs). . . . Require each Council to set harvest limits at or below the allowable biological catch determined by its SSC.").

NOAA General Counsel provided the Council with a requested legal memorandum in April 2010[4], which set forth these procedural requirements and explained their application in the context of an FMP that delegates to the State of Alaska the function of setting the total allowable catch for the fishery. The legal memorandum concluded the SSC must provide acceptable biological catch recommendations to the Council, as prescribed by the Magnuson-Stevens Act, and that such recommendations would constrain the applicable annual catch limits, irrespective of whether the State of Alaska or the Council ultimately specifies such limits.

Thus, substantively, the FMPs must include a mechanism for establishing annual catch limits that will prevent overfishing, along with measures to ensure accountability. In addition, procedurally, the SSC must recommend amounts of acceptable biological catch for the stocks in the fishery on an ongoing (e.g., annual) basis, and the annual catch limits may not exceed the SSC's fishing level recommendations.
These procedural steps are set forth in mandatory terms in the Magnuson-Stevens Act. They represent a chosen means to further Congress's goal— to ensure that scientifically based catch limits are established. *See, e.g.*, S. Rep. No. 109-229 at *7 ("After numerous meetings and discussions with the Councils, industry, and conservation groups, the Committee determined that, to ensure compliance with the 1996 amendments, S. 2012 needed to require that: (1) scientifically established annual catch limits be set and adhered to in each managed fishery"); *id*. at *3 (quoted above).

5. The Council's FMPs must describe MSY and assess and specify the OY for the fishery.

The Guidelines for National Standard 1 require that each FMP include an estimate of MSY and specify the optimum yield from the fishery. "***Each FMP must include an estimate of MSY for the stocks and stock complexes in the fishery, as described in paragraph (d)(2) of this section***." 50 C.F.R. § 600.310(e)(1). "***An FMP must contain an assessment and specification of OY, including a summary of information utilized in making such specification, consistent with the requirements of section 303(a)(3) of the Magnuson-Stevens Act***." 50 C.F.R. § 600.310(e)(3)(ii).

Finally, the FMP must designate which stocks are "in the fishery", as all target stocks in the fishery must have established MSY and OY, as well as ACLs, AMs and ABC control rules. There are four species of scallop stocks under the Alaska Scallop FMP. These include weathervane scallops, pink scallops, spiny scallops and rock scallops. However, the FMP only provides an estimate of MSY and OY for weathervane scallops. If pink scallops, spiny scallops and rock scallops are to remain in the fishery, the

[4] Lisa Lindeman, Alaska Regional Counsel, Memorandum for the North Pacific Fishery Management Council re: Role of Scientific and Statistical Committee in Annual Catch Limit Determinations in Fishery Management Plans in which Total Allowable Catch Setting is deferred to the State of Alaska (April 8, 2010).

FMP will need an estimate of MSY and OY for these stocks. Furthermore ACLs and AMs will need to be established for those stocks in the fishery as described previously.

The MSA defines "fishery" broadly, and this definition did not change with the passage of the MSRA. A "fishery" is "one or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics," and "any fishing of such stocks" (see MSA section 3(13) and 50 CFR 600.10). The term "fishery" can mean different things in different contexts. For example, when dealing with biological concepts such as determining a status of overfishing or overfished, the NS1 guidelines generally apply at the "stock or stock complex" level (See, e.g., 50 CFR 600.310(c)(1) and (d) [defining maximum sustainable yield (MSY) and "overfish" with regard to "stock or stock complex"] and 50 CFR 600.305(c)(12) [explaining that "stock or stock complex" is used as a synonym for "fishery" in NS 1 guidelines]). In other instances, such as managing a fishery for optimum yield (OY), the term "fishery" may be viewed more broadly (see 50 CFR 600.310(e)(3)(v)(F) [referring to OY at the "fishery" level as a possible alternative to the "stock or stock complex" level]).

Given the broad definition of "fishery," the Regional Councils have had, and continue to have, considerable discretion in defining the "fishery" under FMPs. Some FMPs include only one or a few stocks whereas others include several or hundreds of species. The primary reasons why stocks are included in FMPs are because people seek to harvest them for sale or personal use (i.e., the fish are the target of fishing activity), or they are caught incidentally in the pursuit of harvesting one or more other stocks and could experience overfishing or become overfished without conservation and management measures. These reasons are consistent with the stated purposes of the MSA, which include the preparation and implementation of FMPs "which will achieve and maintain, on a continuing basis, the optimum yield from each fishery" (see MSA section 2(b)(4)). OY is defined with regard to "the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems" (see MSA section 3(33)).

While the focus of FMPs has been on stocks managed for OY, some FMPs have included other stocks in recent years in an effort to incorporate ecosystem approaches to management. Congress acknowledged this increased attention to ecosystem approaches in the "Findings" section of the MSA (see MSA section 2(a)(11) [acknowledging that a number of Regional Councils have demonstrated significant progress in integrating ecosystem considerations under existing authorities of the MSA]). In addition, the MSRA added a new section, section 303(b)(12), that provides that an FMP may "include management measures in the plan to conserve target and non-target species and habitats, considering the variety of ecological factors affecting fishery populations."

NMFS encourages ecosystem approaches to fishery management and recommends clarification of what constitutes the "fishery." As such, NMFS guidance pertaining to "stocks in the fishery" and "ecosystem component" (EC) species are described in detail below. The Regional Councils have the discretion to determine, on a case-by-case basis, whether changes in their stock classifications under current FMPs are needed.

Stocks in a fishery include: target stocks; nontarget stocks that are retained for sale or personal use; and non-target stocks that are not retained for sale or personal use and that are either determined to be subject to overfishing, approaching overfished, or overfished, or could become so, according to the best available information, without conservation and management measures. Stocks in a fishery may be grouped into stock complexes, as appropriate. Requirements for reference points and management measures for these stocks are described throughout the NS1 guidelines.

"Target stocks" are stocks that fishers seek to catch for sale or personal use, including "economic discards" as defined under MSA section 3(9). "Non-target species" and "nontarget stocks" are fish caught incidentally during the pursuit of target stocks in a fishery, including "regulatory discards" as defined under MSA section 3(38). They may or may not be retained for sale or personal use. Non-target species may be included in a fishery and, if so, they should be identified at the stock level. Some non-target species may be identified in an FMP as EC species or stocks. "Ecosystem component (EC) species" generally are not retained for any purpose, although *de minimis* amounts might occasionally be retained.

The proposed actions contained in this analysis were developed according to these requirements and amended guidelines.

1.3 Other Applicable Laws

Several state regulations may be pertinent to some of the options under consideration for non-target species in this analysis. In particular, regulation 5 AAC 39.210 Management Plan for High Impact Emerging Fisheries guides State actions in the event that a fishery under State management develops beyond a low sporadic level. In addition, 5 AAC 38.076 Alaska Scallop Fishery Management Plan provides fishery regulations for targeting both weathervane and other scallop species; regulations include registration areas, legal gear, and observer and reporting requirements. Finally, regulation 5 AAC 38.010 Application of Regulations clarifies that regulations which apply to a State registration area also apply to waters of the adjacent EEZ.

Chapter 2 Description of Alternatives

This section contains an overview of the four alternatives considered for analysis as well as those that were initially considered, but, for the reasons described in section 2.2, were not carried forward for analysis.

2.1 Alternatives

Four alternatives with associated options for spatial management for weathervane scallops are considered in this analysis. A comparison of the ACLs for the different alternatives is contained in Table 2-1. Consideration of the options for management of the non-target scallop stocks is contained in Section 2.1.4. One of the non-target stock options must be selected in conjunction with one of the alternatives (and spatial option) for ACLs for the weathervane scallop stock.

2.1.1 Alternative 1: Status quo (No Action alternative)

Alternative 1 is the no action alternative. This alternative would retain the current management as specified in the FMP for establishment of federal overfishing limits on a statewide basis and State guideline harvest ranges (GHRs) and guideline harvest levels (GHLs) by registration area. Note that this alternative is considered for comparative purposes against other alternatives in this analysis but, per revised federal guidelines as specified in Chapter 1, would not meet all applicable legal requirements.

Under the FMP, overfishing is defined as a level of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce MSY on a continuing basis. The MSY is defined as the largest long-term average catch that can be taken from a stock under prevailing ecological and environmental conditions. The long-term average stock size obtained by fishing year after year at this rate under average recruitment may be a reasonable proxy for the MSY stock size, and the long-term average catch so obtained may be a reasonable proxy for MSY.

Amendment 6 to the scallop FMP established MSY for weathervane scallops at 1.24 million pounds (lbs) of shucked meats based on the average catch from 1990 to 1997, excluding 1995 when the fishery was closed most of the year. The period of 1990–1997 reflects prevailing ecological conditions. The fishery was fully capitalized during this time period, and all areas of the state open to the scallop fishery were being exploited. Prior to that period, vessels moved into and out of the scallop fishery, partly due to economic opportunities in other fisheries (Shirley and Kruse 1995). However, since 1993, the fishery has been somewhat limited by crab bycatch limits, closure areas, and season length. As a consequence, a stable period during the history of this fishery does not exist. The OY is estimated statewide with an upper bound of the MSY. The OY range is defined as 0–1.24 million lbs.

The overfishing control rule is defined as a fishing rate in excess of the natural mortality rate, which has been estimated as $F_{overfishing}$ = M = 0.13 (12% per year) statewide. If an estimate of the statewide weathervane scallop spawning biomass was available, the overfishing control rule would be applied to that estimate to determine the OFL. An estimate of the statewide weathervane scallop spawning biomass is not currently available, however, which prevents application of the overfishing control rule to annually determine the OFL. The FMP does not specifically provide another mechanism for establishing an OFL that is expressed as an amount of scallops. This analysis recognizes that, in practice, the MSY functions as the OFL for weathervane scallops. Each year, the total retained catch is compared to the MSY to determine whether overfishing occurred.

No reference points are established for the non-target scallop species.

The Scallop SAFE report (NPFMC 2010b) provides an overview of information available for assessment and management of scallop stocks within the three management regions shown in **Figure 2-1**. Information on management by region is summarized below (from NPFMC 2010b):

ADF&G manages the weathervane scallop fishery by registration areas and districts for guideline harvest ranges (GHRs), which are hard caps established in State of Alaska regulations for each registration area and not to be exceeded. The sum of the GHRs equals the MSY. Guideline harvest limits (GHLs) are pre-season targets set for each fishing area (registration area, district, or statistical area) prior to each season. Total harvest for each fishing area during a given season will typically be near or below, but may exceed, the GHL. Catch data are relayed by radio from the onboard observers or the vessel operator thrice weekly, or more often as required by the ADF&G manager. Fishing may be closed in any area before the GHL is reached due to concerns about localized depletion, trends in CPUE, or bycatch rates.

Region 1 (Southeast Alaska): No regular assessment surveys are conducted in the Southeast Alaska Region. Management of the fishery relies solely on fishery-dependent data. Separate GHLs are assigned for Area D and District 16, both of which fall into Scallop Registration Area D (Yakutat). Southeast shellfish management staff meets annually with the scallop biometrician to review analysis of the most recent scallop observer data. Data considered when adjusting GHLs include: total harvest and CPUE for the entire registration area; total harvest and CPUE by scallop bed; daily CPUE versus cumulative catch in each bed where effort occurred; shell height histograms for Area D and District 16; and Tanner crab bycatch for the entire registration area. The GHLs are set prior to each fishing season based on these data. There are no crab bycatch limits in Scallop Registration Area D.

Region 2 (Central Region): ADF&G conducts biennial dredge surveys in the Kamishak District of the Cook Inlet Registration Area and near Kayak Island in the Prince William Sound Registration Area. Data from these surveys are used to set GHLs. In the Kamishak District fishery, vessels are limited to a single 6-ft dredge, and observer requirements may be waived at the discretion of ADF&G, although ADF&G staff are regularly deployed as observers when fishing occurs.

***Region 4 (Westward Region)*:** Regular scallop stock assessment surveys are not conducted in the Westward Region. GHLs are set after review of observer data collected during recent seasons. For some areas, GHLs are set by statistical area to distribute effort and reduce the likelihood of localized depletion. Management staff also set CPUE benchmarks for some areas prior to the season, and if CPUE falls below the benchmark level during fishing, management staff meet to review in-season observer data and the fishery may be closed or be allowed to continue. In all areas, crab bycatch and CPUE are closely monitored during the season, and scallop fishing in an area may be closed due to high crab bycatch or poor fishery performance.

2.1.2 Alternatives 2–4: Establish ABC control rules using fixed buffers for the scallop stocks

The intent of an ABC control rule is to account for scientific uncertainty in the calculation of the OFL. Alternatives 2-4 represent a range of buffer values from 0–25% of the OFL.

As discussed under Alternative 1, the FMP does not contain a mechanism to establish an OFL in the absence of a statewide weathervane scallop spawning biomass estimate. This analysis recognizes that, in practice, the MSY functions as the OFL for weathervane scallops. Under Alternatives 2-4, the default OFL, in the absence of an estimate of spawning biomass, would be specified in the FMP at the MSY and the MSY and OY would be adjusted to account for total catch.

Alternatives 2-4 would revise the retained catch MSY and OY range to reflect total catch by encompassing all sources of scallop fishing mortality, including discards in the directed scallop fishery,

bycatch in the groundfish fisheries, and mortality associated with research surveys. The additional fishing mortality from these other sources was estimated as 3.6 percent of the annual retained catch. The statewide weathervane scallop MSY would be revised from 1.24 million pounds (562 metric tons) to 1.284 million pounds (582 metric tons) of shucked meats. The OY is estimated statewide with an upper bound of the MSY. Under Alternatives 2-4, the weathervane scallop OY range would also be revised to be 0 to 1.284 million pounds (582 metric tons) of shucked meats.

Currently, the FMP specifies an overfishing control rule for weathervane scallops stocks as a fishing rate in excess of the natural mortality rate. If an estimate of the statewide weathervane scallop spawning biomass was available, the overfishing control rule would be applied to that estimate to determine the OFL. An estimate of the statewide weathervane scallop spawning biomass is not currently available, however, which prevents application of the overfishing control rule to annually determine the OFL. Therefore, until such an estimate of spawning biomass is available, under Alternatives 2-4, the FMP would specify a default OFL equal to the MSY of 1.284 million pounds.

There are many sources of scientific uncertainty in this OFL, some of which can be readily quantified based on the data collected from a fishery through the use of assessments and other methods of data analysis, while other sources cannot. For weathervane scallops, most sources of uncertainty are not directly quantifiable at this time. The ABC control rules for Alternatives 2–4 are formulated based on fixed buffers which would account for this unquantifiable uncertainty in the OFL.

Options beneath each alternative consider spatial management of the ACL, either statewide or regionally. Regions under each alternative and option are the State management regions as shown in **Table 2-1** and **Figure 2-1**.

For the purpose of scallop management under regional ACLs, two tiers may be considered based on the relative information available.

Tier 1: Survey information available and some estimation of biomass by region is possible. Commercial fishery-dependent data available for PWS (100% observer coverage); Observer coverage in Cook Inlet may be waived at the discretion of ADF&G.

Tier 2: Commercial fishery-dependent data only (100% observer coverage).

For reasons explained in Section 2.2, management by individual registration areas, rather than by regions, was not considered at this time.

2.1.2.1 Alternative 2: ABC = OFL

Alternative 2 would establish an ABC control rule such that the maximum ABC is established annually at equal to the OFL. ACL(s) will be set equal to the ABC(s)[5]. There are two options considered under this alternative for specifying ACLs: statewide (Alternative 2a) and by region (Alternative 2b).

Alternative 2a: Statewide ACL: One statewide ABC and ACL.

Alternative 2b: Regional ACL: An ABC and ACL would be established for each region at the sum of the upper ends of the GHRs in that region, plus estimated discard mortalities for that region.

[5] Note that NS 1 Guidelines strongly discourage an ACL = OFL without adequate justification to demonstrate that this ACL level will prevent overfishing. See relevant provisions under 50 C.F.R. § 600.310(f)(5)(i).

2.1.2.2 Alternative 3: ABC ≤ 90% of OFL [preferred]

Alternative 3 would establish an ABC control rule such that ABC is established annually at a level no greater than 90% of the OFL. This percentage deduction from the OFL accounts for additional uncertainty in the estimate of the OFL. ACL(s) will be set equal to the ABC(s). There are two options considered under this alternative for specifying ACLs: statewide (Alternative 3a) and by region (Alternative 3b).

Alternative 3a: Statewide [preferred]: One statewide ABC and ACL at or below 90% of the OFL.

Alternative 3b: Regional ACL: An ACL and ABC would be established for each region at or below 90% of the sum of the upper ends of the GHRs in that region, plus estimated discard mortalities for that region.

2.1.2.3 Alternative 4: ABC ≤ 75% of OFL

Alternative 4 would establish an ABC control rule such that ABC is established annually at a level no greater than 75% of the OFL. This percentage deduction from the OFL further accounts for additional uncertainty in the estimate of the OFL. ACL(s) will be set equal to the ABC(s). There are two options considered under this alternative for specifying ACLs: statewide (Alternative 4a) and by region (Alternative 4b).

Alternative 4a: Statewide [preferred]: One statewide ABC and ACL at or below 75% of the OFL.

Alternative 4b: An ACL and ABC would be established for each region at or below 75% of the sum of the upper ends of the GHRs in that region, plus estimated discard mortalities for that region.

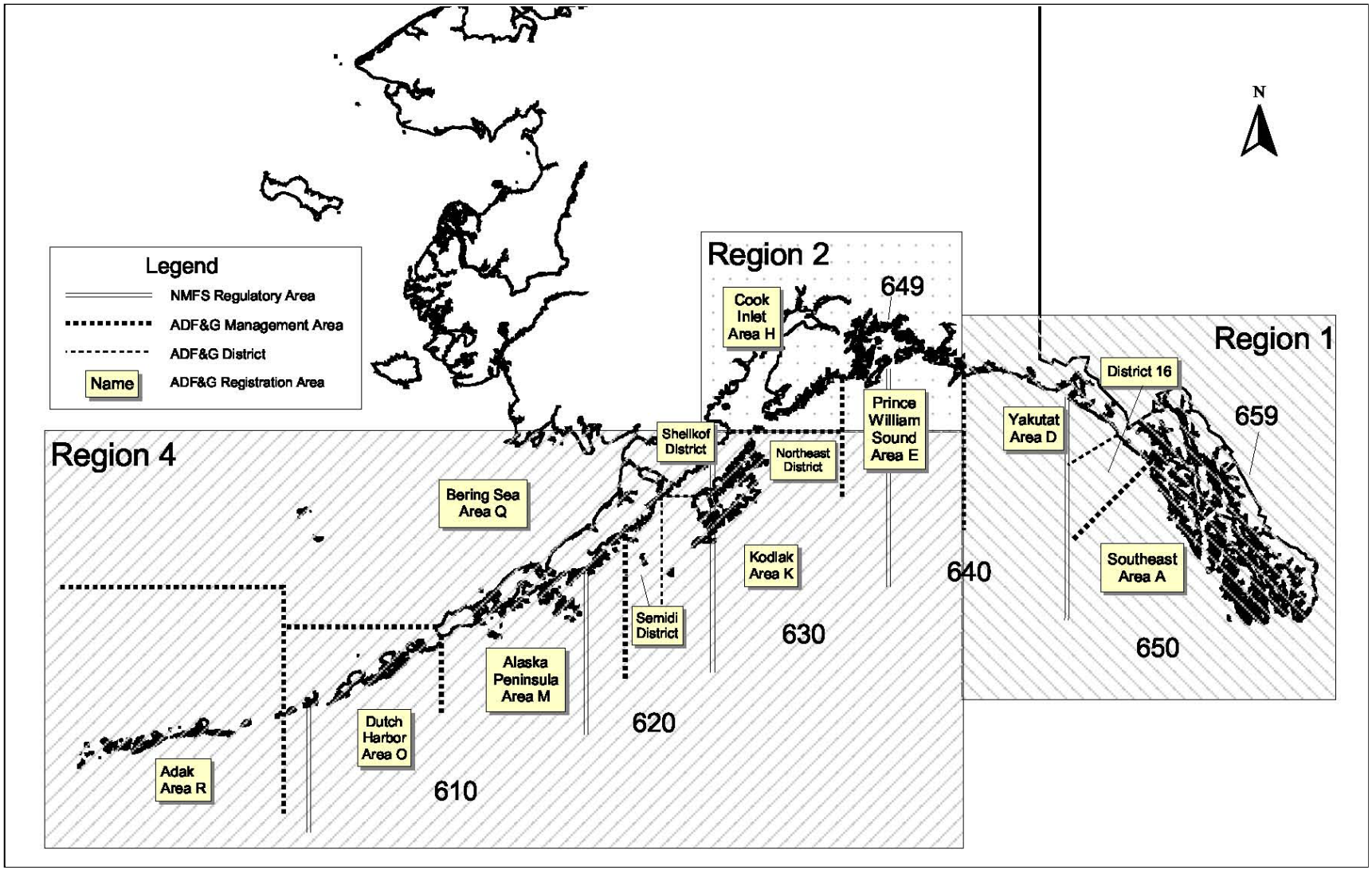

Figure 2-1 Location of ADF&G registration areas in relation to ADF&G regions (shown as patterned rectangles) and NMFS regulatory areas (shown as 3-digit numbers for the Gulf of Alaska).

Table 2-1 Alternatives 1-4 and associated ACLs statewide and by region.

	ADF&G Region	Alternative 1 Upper end of GHR (no ACL)	Alternative 2a ACL ≤100% OFL SW	Alternative 2b ACL ≤100% OFL (Region)	Alternative 3a ACL ≤ 90% OFL SW	Alternative 3b ACL ≤ 90% OFL (Region)	Alternative 4a ACL = 75% OFL SW	Alternative 4b ACL = 75% OFL (Region)
Yakutat	1	250,000		261,870		235,680		205,730
District 16	1	35,000		36,660		33,000		28,800
Region 1 Total		**285,000**		**298,530**		**268,680**		**234,530**
PWS	2	50,000		51,280		46,160		39,450
Cook Inlet	2	20,000		20,510		18,460		15,780
Region 2 Total		**70,000**		**71,790**		**64,620**		**55,230**
Kodiak	4	300,000		309,750		278,770		239,860
Alaska Pen.	4	100,000		103,250		92,920		79,950
Dutch Harbor	4	110,000		113,570		102,220		87,950
Adak	4	75,000		77,440		69,690		59,970
Bering Sea	4	300,000		309,750		278,770		239,860
Region 4 total		**885,000**		**913,760**		**822,370**		**707,590**
Statewide		**1,240,000**	**1,284,080**		**1,155,670**		**997,350**	

All alternatives are in meat weights (lbs); "GHR" = Guideline Harvest Range; "SW' = Statewide. Under Alternatives 2-4, the OFL includes estimated discards.

2.1.3 Accountability Measures

As noted in Section 1.2, AMs are also a required provision of the MSA in conjunction with provisions for ACL requirements. The intent of the AMs is to further protect a stock from overfishing by preventing the ACLs from being exceeded and providing for a transparent response mechanism in the event that the established ACLs are exceeded.

Currently ADF&G tracks total removals, although only retained catch accrues against the GHL. Discards are estimated and reported annually and would need to accrue against an ACL to account for total removals (after application of a handling mortality rate as described in Section 3.1). ADF&G has responsibility for setting the annual GHLs (Table 1-1). In the event of exceeding the ACL, ADF&G would have the appropriate information to take corrective measures, under oversight of the Council through the annual SAFE report, when setting subsequent GHLs.

First, the State would establish the annual GHL for each scallop management area at a level sufficiently below the ACL so that the sum of the directed scallop fishery removals and estimated discard mortality in directed scallop and groundfish fisheries does not exceed the ACL.

Second, the inseason management measures that prevent catch from exceeding the GHL, and have been a part of management of the weathervane scallop fishery since the inception of this FMP, would also prevent catch from exceeding the ACL. State management requires 100 percent observer coverage of all vessels in the weathervane scallop fishery. Fishery observers provide inseason data on catch and bycatch. Managers monitor inseason fisheries landings and observer data and have the authority to close a fishery inseason to prevent catch from exceeding the GHL.

Third, if total catch does exceed the ACL, State managers would account for the overage through a downward adjustment to the GHL in the following season by an amount sufficient to remedy the biological consequences of the overage.

The annual SAFE report would indicate whether an overage occurred and if so what action was taken by the State. The SSC, in annually setting the ABC, would have the opportunity to evaluate what measures the State took in correcting for exceeding an ACL. The SSC would annually review the SAFE report prior to setting the ABC and would have the flexibility to set an ABC lower than that calculated by application of the ABC control rule should they have conservation concerns regarding the corrective measures and the potential biological consequences of exceeding the ACL.

2.1.4 Options for non-target stocks (applies to all)

"Target stocks" are scallop stocks that are retained for sale or personal use, including "economic discards" as defined under Magnuson-Stevens Act section 3(9). "Non-target stocks," including "non-target species," are fish caught incidentally during the pursuit of target stocks in a fishery, including "regulatory discards" as defined under Magnuson-Stevens Act section 3(38). Non-target stocks may or may not be retained for sale or personal use. Non-target species, if included in a fishery, should be identified at the stock level.

These options deal with the treatment of non-target scallop stocks under the FMP. One of the three options below must be selected for management of the non-target stocks. Although the weathervane scallop has comprised the primary scallop fishery off Alaska, other species of scallop are contained under the FMP and sporadic efforts have been made to harvest the pink scallop (*Chlamys rubida*), arctic pink scallop (*C. pseudoislandica*), and spiny scallop (*C. hastata*) (Kruse 1994). A total of approximately

124,000 lbs of meats of *Chlamys* sp. harvested along the Aleutian Islands between 1991 and 1992 comprise the sole records of non-weathervane scallop landings in the ADF&G fish ticket database (C. Russ, ADF&G, Homer, pers. comm.). In addition, the rock scallop (*Crassadoma gigantea*) is harvested by divers for personal use in nearshore waters of Southeast Alaska, and continuing investigations have examined aquaculture techniques for rock scallop (Agosti 2001; J. Hetrick, Alutiiq Pride Shellfish Hatchery, Seward, pers. comm.).

2.1.4.1 Option 1: Remove from FMP

This option would remove the non-target scallop species from the FMP. Once removed, management authority for these removed species would default to the State. The State would regulate fishing for these species by vessels registered under State law. This action would allow the State to implement more responsive, regionally based, management of these species than is currently possible under the FMP. The intended effect of this action would be to repeal duplicative Federal regulations, provide for more responsive State management, and prevent localized overfishing of non-target scallop species occurring predominantly in nearshore waters.

2.1.4.2 Option 2: Move to Ecosystem component [preferred]

Non-target species (rock scallops and the *Chlamys* species) may be identified in an FMP as ecosystem component (EC) species through an FMP amendment (see § 600.310(d)). "EC species" generally are not retained for any purpose, although *de minimis* amounts might occasionally be retained.

This option would move non-target scallop stocks to an EC under the FMP for which ACLs are not established. Under the ecosystem component, targeting of these species would not be possible without moving them "into the fishery" and establishing ACLs for these stocks. While these stocks are currently not targeted commercially, moving them to the ecosystem component would be intended to discourage uncontrolled fishing on these species without applicable management measures in place should they become economically viable in the future. There is currently is a low-level personal use/subsistence fisheries for some of these species in State waters.

EC species could include non-target fish species that are not considered part of the fishery, but are species with which the fishery may occasionally interact (i.e., catch) (see § 600.310(d)(5)). As a default, all stocks in an FMP are considered to be "in the fishery" unless otherwise classified through an FMP amendment (see § 600.310(d)). To be considered for possible EC classification, species should, among other considerations, conform to the following criteria; conversely, failure to satisfy these criteria could eliminate some groups from further consideration as EC stocks.

- Be a non-target species or non-target stock;
- Not be determined to be subject to overfishing, approaching an overfished condition, or overfished;
- Not be likely to become subject to overfishing or overfished in the absence of conservation and management measures; and
- Not generally be retained for sale or personal use.

The EC species may be identified at the species or stock level, and may be grouped into complexes. The EC species may be included in an FMP or FMP amendment for any of the following reasons:

> "…for data collection purposes; for ecosystem considerations related to specification of OY for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem issues. While EC species are not considered to be "in the fishery," a Council should consider measures for the fishery to

minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored on a regular basis, to the extent practicable, to determine changes in their status or their vulnerability to the fishery. If necessary, they should be reclassified as in the fishery."

EC species are appropriate to consider when addressing specification of OY and conservation and management measures for the fishery (see MSA sections 3(33) (referring to taking into account the marine ecosystems in OY definition), and 3(5) (referring to avoiding irreversible or long-term effects on fishery resources and the marine environment and ensuring multiplicity of options)). Because EC species are not considered to be in the fishery, specification of reference points and ACLs are not required.

2.1.4.3 Option 3: Set ACL for those stocks

This option would set ACLs for the non-target species *Chlamys* sp. and rock scallops. Currently there is little stock assessment and fishery performance data on which to base the ACLs. Thus, determination of ACLs would rely primarily on the limited data available from ADF&G and NMFS trawl surveys. Species identification for non-target scallops can be highly uncertain (e.g., non-weathervane scallop were often recorded simply as *Chlamys*), particularly for ADF&G and older NMFS survey data. Thus, for purposes of this preliminary analysis, non-target scallop species were pooled into a non-target group rather than at the species level. Although area-swept estimates from the trawl survey data may be extrapolated to population estimates, the available data is fairly sparse and extrapolation was beyond the scope of our analysis. Therefore, available survey catch data are summarized at both the statewide and the regional levels.

In order to establish an aggregate ACL for the non-target species, it is first necessary to establish an OFL for the non-target species. An ACL could then be established as a fixed proportion of the OFL similar to the options considered under Alternatives 2-4. Three approaches could be considered for establishing an OFL for these aggregate non-target scallop stocks.

1. Extrapolate area-swept estimates from agency surveys to population estimates, and set the OFL as some fixed proportion of the average annual population estimate. This approach would require spatial analysis of the survey data to provide for some averaging approach between surveys occurring in the same geographic location (e.g., there is likely some spatial overlap between the NMFS and ADF&G surveys in Region 4). This approach is complicated because survey catchability is unknown for non-target species, but likely differs between the ADF&G and NMFS survey gears.

2. Set the OFL as fixed portion of the average annual catch. Given that the only documented harvest of non-target species was 124,000 lbs of meats in 1991 and 1992, this approach would rely on an average annual catch of 62,000 lbs of meats. However, there is high uncertainty in this estimate since it is based on only two years of data and localized catch locations.

3. Set a non-target OFL in relationship to estimated discard mortality needs. This approach relies on agency survey data and could include discard information from the groundfish fisheries. Because groundfish fishery discards are presently pooled into a "bivalve" category, this approach would overestimate historical discards. A problem with setting the OFL according to historical discard mortality is the uncertainty in how well the historical data represent the trends and spatial distribution of the non-target species. For example, the groundfish fishery data on bivalve discards exists only since 2003. An increase in stock abundance of non-target species would

likely increase discard mortality in agency surveys and various fisheries, perhaps resulting in the OFL being exceeded at a time when stock abundance is high.

2.1.5 ABC recommendation annually by SSC

Under Alternatives 2-4, the Council's SSC will annually set a statewide ABC for the weathervane scallop fishery prior to the beginning of the fishing season. The SSC may set an ABC lower than the maximum ABC, but it must provide an explanation for setting the ABC below the maximum ABC. This will not change the timing of scallop management and annual establishment of GHLs by the State. The GHLs must be established below the annual ACL, with sufficient buffer below the ACL to allow for any incidental catch of scallops in either directed or non-directed fisheries.

2.1.6 Preferred Alternative

In October 2010, the Council recommended amending the FMP to include Alternative 3a, establishing a maximum ABC control rule equal to 90% of the OFL. In specifying 'option a' the Council indicated that the ABC that will result from the application of the stated control rule will be applied statewide. The Council also indicated that, in conjunction, OFL will be set equal to a total catch MSY. As indicated in section 3.3, this results in an MSY = OFL = 1.284 million pounds. Note that the Council motion mis-specified this number as 1.29 million pounds. This was a rounding error and the Council's intent was that the OFL be calculated as identified in section 3.3, and the result of that method is 1.284 million pounds.

With respect to explicit accountability measures to be established in the case that the ACL is exceeded, the Council indicated the following in their motion:

> The annual GHL for each scallop management area will be established by the State of Alaska at a level sufficiently below the ACL so that the sum of the estimated discard mortality in directed scallop and groundfish fisheries as well as the directed scallop fishery removals does not exceed the ACL. Anytime an ACL is exceeded the overage will be accounted for through a downward adjustment to the GHL during the fishing season following the overage.

In addressing the management of non-target scallop stocks, the Council selected option 2, moving the stocks into the Ecosystem Component of the FMP as the preferred management approach.

Rationale for the preferred alternative

In selecting this preferred alternative, the Council indicated that this approach best balanced the need to meet MSA requirements while allowing the State of Alaska the flexibility to manage the fishery. State management of scallops is currently very conservative with 100% observer coverage and in-season management closures as necessary to prevent exceeding of establish harvest levels. The Council specified the default OFL at the re-estimated MSY. MSY was estimated based upon retained catch only, thus the re-estimation is necessary to account for discards occurring over that time period and for consistency with current regulation to account for all sources of mortality. The OFL is considered to be a conservative estimate due to the fact that there are areas of known scallop beds that are not included in the catch calculation as they are currently closed to fishing although they have supported historic harvests in the past.

The buffer value selected of 10% (ABC = 90% of OFL) is considered to be sufficiently conservative due to the precise management of this fishery and the fact that average harvest rates currently are approximately 45% of MSY and have never exceeded 68% of MSY. The selection of a statewide ABC control rule at 90% of the OFL provides conservation against overfishing due to uncertainty in the catch-

based OFL estimate while not overly constraining the fishery at this time. Management of an ACL at a statewide level rather than a regional level is a fundamental aspect to this recommendation. The statewide management approach was recommended by both the Scallop Plan Team and the SSC given that the registration areas and their regional groupings themselves are not biologically-based and thus a statewide ACL is more biologically meaningful and consistent with current understanding of stock structure then a regional ACL.

For non-target stocks, the Council's preferred approach is to move them to the EC category. Non-targeted scallops are managed under the scallop FMP but are not generally retained in commercial scallop fisheries off Alaska. These non-target scallop species occupy habitats at different depths than the targeted weathervane scallops; therefore incidental catch in the weathervane scallop fishery would not pose a serious risk to these stocks. The best available scientific information does not indicate that any of the non-target scallop species are overfished, subject to overfishing or approaching an overfished condition, or likely to become overfished if placed in the EC category. This approach is preferred as it eliminated the risk of over-harvesting these stocks should they be removed from the FMP, while acknowledging that information is not sufficient to establish ACLs for these stocks at this time, nor is harvest of these stocks currently occurring.

2.2 Comparison of alternatives

This section compares the primary features of the alternatives relative to the requirements detailed in section 1.2.

Table 2-2 Summary of Federal requirements and how each Alternative (1-4) addresses these requirements

Requirement: MSA or NS1 guidelines	How addressed under each alternative: Note all of the alternatives retain current Category 1 harvest level (GHL) recommendations by the State.			
	Alternative 1 Status quo	**Alternative 2**	**Alternative 3**	**Alternative 4**
Establish a mechanism for specifying ACLs	No mechanism for specifying ACLs. No ABC control rule. The FMP requires that the sum of the GHLs, not exceed MSY.	ABC control rule where ACL = ABC=OFL. Selection of this alternative would indicate that there is no uncertainty in the OFL estimate and annual catches equal to the OFL would not result in overfishing. NS1 Guidelines state that the Secretary may assume that such catch limits would not prevent overfishing, absent sufficient analysis and justification. The P* analysis contained in this document indicates that by definition ACL = OFL would lead to a 50% chance of overfishing.	ABC control rule where ACL = ABC≤90% of OFL. The 10% buffer accounts for the potential uncertainty in the OFL to avoid overfishing.	ABC control rule where ACL = ABC≤75% of OFL. The 25% buffer accounts for the potential uncertainty in the OFL to avoid overfishing.

Requirement: MSA or NS1 guidelines	How addressed under each alternative: Note all of the alternatives retain current Category 1 harvest level (GHL) recommendations by the State.	
Accountability Measures	NA: The FMP does not establish a mechanism for specifying AMs. The FMP does not specify measures that will be triggered in the event of an overage of ACL.	Overages relative to the GHL in the directed fishery are unlikely due to management precision but have occurred historically by region. This is less likely due to the formation of the voluntary cooperative but is nonetheless possible. Some accounting for discards however must be taken in setting the GHL below the levels whereby the sum of GHLs would reach the ACL (under the Statewide spatial scale) or by region (for regional option).
Defining stocks as 'in the fishery' or as an 'ecosystem component' species	All scallop species are in the fishery, but the FMP only specifies an OY and MSY for weathervane scallop stocks. No MSY or OY are contained for pink, spiny or rock scallops.	Weathervane scallops are 'in the fishery'. Three options are provided for non-target scallop stocks: Option 1-Remove from FMP; Option 2-Move to Ecosystem Component; or Option 3-Set ACLs for non-target stocks.

2.3 Alternatives considered and not carried forward for analysis

In the development of this analysis, several alternatives were considered but not carried forward due to a lack of available information upon which to base ACLs. In addition to the constant buffer approach in the alternatives for analysis, two measures were recommended during the NPFMC's ACL workshop in May 2009 (NPFMC 2009c). These were to re-estimate MSY based upon the older catch history time frame and to estimate scallop density in unfished areas using trawl survey and other scallop survey information.

The current proxy MSY is based on historical average catch by ADF&G registration area, but excluding years of fishery development, considered to over-estimate productivity, and also years when catches were extremely low, considered to under-estimate productivity (Kruse 1994; NPFMC 2006). If an older estimate of average catch were considered, it would include years when the fishery was developing, which could over-estimate productivity. Based on more recent information, including fishery performance, observer sample, and survey data, GHLs implemented by the state have resulted in catches substantially less than the MSY, suggesting that the existing MSY may be overly optimistic under current environmental conditions. Tools such as the video imaging system currently being developed to provide distribution and density data (Rosenkranz et al. 2008) or development of age-structured models (Bechtol 2000) would improve our understanding of weathervane scallop stocks and allow the MSY to be better evaluated. However, a formal re-evaluation of the current MSY is not realistic at this time due to a lack of sufficient new information.

Extrapolation of scallop density estimates into other areas based on NMFS trawl survey data would also be problematic due to two primary factors. First, because weathervane scallops tend to occur at, or slightly imbedded in, a sand, silt, and/or clay substrates (Turk 2000), survey bottom trawls tend to "ride" over most scallops, making the trawl an inefficient sampling tool. Second, the high density scallop beds exhibit patchy distributions such that coarse extrapolation of scallop densities may provide unrealistic expectations with high uncertainty in potential scallop yield. Dredge surveys are currently used in the Central Region (Region 2) to set GHLs for Kayak Island (Area E) and Cook Inlet (Area H; NPFMC 2010b). In all other areas, the scallop observer program provides the primary data for setting GHLs. These data consist of a time series of scallop harvest and fishing effort, including catch per unit effort (CPUE), fishing locations, size structure of the catch, discard of scallops, and crab bycatch. A towed imaging system to survey scallop beds is currently being developed by ADF&G with (Rosenkranz et al. 2008). At present, extension of the dredge survey to other areas is not feasible due to survey costs, and the towed imaging system is still under development. Thus, expansion of scallop density estimates into all areas was not carried forward at this time.

In addition, analysis to a finer spatial scale of resolution was considered but not carried forward for several reasons. First, fishery prosecution at the registration area scale has been highly variable over time in many of the areas in response to fluctuations in stock status, fleet dynamics, and closure of some historical fishing areas to provide greater protection to benthic species (e.g., crabs) and their habitat. This variability makes it difficult to characterize patterns for some of the registration areas. Second, the scallop fleet tends to operate as a statewide fleet, moving on relatively short notice among regions or registration areas in response to market conditions, other vessels, catch rates, and other factors. Third, preliminary genetic analysis suggests that little genetic variability exists among scallop aggregations located in areas from the Gulf of Alaska to the Bering Sea (Gaffney et al. under review.). As scallops are commonly considered to be structured as metapopulations, i.e. subpopulations interconnected through larval dispersal (Orensanz et al., 2006; Orensanz and Jamieson, 1998), management considerations at the scale of registration areas can actually bisect beds themselves in addition to bisecting areas of larval dispersal. This consideration, combined with the limited evidence of genetic variation between the GOA

and Bering Sea regions as yet (Gaffney et al. under review.), indicates that annual catch limits at scales larger than individual registration areas may be justified.

Finally, an alternative that lumps non-target scallop species into a scallop complex was considered but not carried forward. Because we currently lack sufficient data to assess non-target species (see section 4.6), management of a scallop complex would rely on the weathervane scallop abundance. Under such a scenario, a rapid increase in harvests of non-target species would not automatically trigger management controls of the "scallop complex," potentially putting the non-target species at risk.

Chapter 3 Methodology

Management of weathervane scallops by ADF&G occurs on scales ranging from registration area to individual documented beds (e.g., the east and west beds around Kayak Island). Within the spatial scale of the management unit, ADF&G applies a GHL, representing an acceptable fishery harvest removal based on fishery expectations derived from both short- and long-term fishery performance and assessment data. The GHL may not exceed the GHR; GHRs are hard caps established in State of Alaska regulation for each registration area and are not to be exceeded. The currency used for management of weathervane scallop fisheries off Alaska is lbs of shucked scallop meats. Amendment 6 to the FMP established an overfishing level for weathervane scallops as a fishing rate ($F_{overfishing}$) in excess of the natural mortality rate M = 0.13 (NPFMC 2006). An Optimum Yield range was specified as 0-1.24 million lbs of shucked scallop meats statewide. The upper bound of this range was established as the proxy MSY for weathervane scallops, and as noted previously, is based on the average catch from 1990-1997 (excluding 1995).

This analysis of proposed alternatives relies heavily on data available in NPFMC documents (NPFMC 2006, 2010b) and data provided by various staff from NMFS or ADF&G. For this analysis, we examined ACL alternatives relative to the upper ends of the GHRs as defined under Chapter 38 Miscellaneous Shellfish Fisheries in State regulation. The analysis was restricted to the ADF&G regions where commercial scallop fishing occurs: Region 1 includes the Southeast Alaska and Yakutat Areas; Region 2 includes the Prince William Sound and Cook Inlet Areas; and Region 4 includes the Westward Area (Figure 2-1). For the analysis, we evaluated harvests and discards for the years 1990–2008, particularly focusing on the years 1998–2008 as representing fishery and survey data following implementation of the 1.24 million lb MSY (Table 3-1).

Under Alternative 1, Status Quo, the practice was to assume that the OFL was set equal to the MSY, which is the upper bounds on the statewide sum of the upper ends of the Registration Area GHRs, or 1.24 million lbs (562.4 mt) of meats, applied statewide to federal waters off the coast of Alaska. In examining Alternatives 2–4, the ACL is defined as a fixed percentage (100, 90, or 75%) of the OFL. Because the OFL should ideally consider all sources of fishing mortality, the MSY under Alternatives 2–4 was redefined to be the current MSY plus estimated discard mortalities in the directed scallop fishery, the groundfish fishery, and agency surveys. Under Alternatives 2-4, in the absence of a statewide estimate of weathervane scallop spawning biomass, a default OFL was established equal to the redefined MSY of 1.284 million lbs of shucked meats.

The ACL alternatives were evaluated at both the statewide level and by ADF&G region. For evaluation at the regional level, the upper ends of the registration area GHRs and discards were pooled within ADF&G management region.

3.1 Scallop discard estimation and associated mortality

Discards of scallops and corresponding discard mortality, in the directed scallop fisheries is currently taken into consideration by ADF&G fishery managers when setting a GHL, the pre-season harvest target, but is not deducted from the GHL. Discard mortality also occurs in non-scallop fisheries and in agency surveys. To better understand the impacts of the alternatives on total scallop mortality and potential management implications, the maximum GHL was calculated as the deduction of an estimate of total discard mortality from the ACL derived under each alternative. Evaluation of the impact of Alternative 1 (status quo) includes no accounting for scallop discards in either directed scallop fisheries or non-scallop fisheries. Analyses of Alternatives 2–4 incorporate estimates of incidental scallop discard mortality; mortality sources considered included directed scallop fisheries, federal groundfish fisheries, and agency

surveys. Data on estimated scallop bycatch in other non-scallop EEZ fisheries (e.g., crab fisheries) is either not available or is believed to be negligible. For Alternatives 2–4, discard mortality was evaluated at both the statewide and regional levels.

Table 3-1. Annual weathervane scallop harvests and percentages of the upper end of the regulatory GHRs by ADF&G region for the 1998/99 to 2008/09 fishing seasons.

	Region			
Year	1	2[a]	4	Statewide
	Annual harvest (lbs of shucked meats)			
1998/99	275,831	19,650	508,117	803,598
1999/00	284,305	40,725	512,941	837,971
2000/01	226,603	50,782	473,232	750,617
2001/02	124,198	30,090	398,453	552,741
2002/03	126,403	24,232	358,820	509,455
2003/04	161,990	19,980	302,566	484,536
2004/05	111,380	55,437	264,777	431,594
2005/06	213,001	49,205	263,151	525,357
2006/07	164,395	36,990	286,088	487,473
2007/08	126,140	37,105	295,068	458,313
2008/09	171,275	20,040	151,119	342,434
Mean	180,502	34,931	346,757	562,190
CV (%)	34.0	37.7	33.2	28.8
MSY	285,000	70,000	885,000	1,240,000
	Annual harvest percentage of the upper end of the GHR			
				% of MSY
1998/99	96.8	28.1	57.4	64.8
1999/00	99.8	58.2	58.0	67.6
2000/01	79.5	72.5	53.5	60.5
2001/02	43.6	43.0	45.0	44.6
2002/03	44.4	34.6	40.5	41.1
2003/04	56.8	28.5	34.2	39.1
2004/05	39.1	79.2	29.9	34.8
2005/06	74.7	70.3	29.7	42.4
2006/07	57.7	52.8	32.3	39.3
2007/08	44.3	53.0	33.3	37.0
2008/09	60.1	28.6	17.1	27.6
Mean % of MSY	63.3	49.9	39.2	45.3
CV (%)	34.0	37.7	33.2	28.8

[a] Due to confidentiality resulting from low fishing effort, Region 2 data includes Cook Inlet catches only in the 1999/00, 2000/01, 2002/03 and 2004/05 seasons.

Sources: G. Rosenkranz, ADF&G, Kodiak, pers. comm.; NPFMC 2010b

Weathervane scallops may be discarded rather than shucked due to market considerations, such as meat color or small scallop size (the minimum dredge ring size is currently 4 inches [101.6 mm]), or due to excessive mechanical damage to the scallop from the capture process. Discarded scallops may suffer mortality on deck due to mechanical damage or physiological stress such as temperature change or desiccation, or suffer post-discard mortality due to physiological stress or increased predation from shell damage or an inability to swim. On deck mortality from mechanical damage may be less for smaller scallops (J. Stone, pers. comm.), although no formal studies have been conducted off Alaska. For Atlantic scallops (*Placopecten magellanicus*), Murawski and Serchuk (1989) estimated about 90% of tagged scallops were alive several days after being returned to the water. Total discard mortality of Atlantic scallops remains uncertain, but is estimated as 20% from the combined on-deck (10%) and post-release (10%) mortality (NEFSC 2007). In the absence of additional information, we applied a 20% mortality to discards from the directed scallop fishery off Alaska.

Scallop discards in the directed scallop fisheries off Alaska were generally estimated by scallop observer program samples during the fishing seasons 1998/1999 to 2008/2009 (Table 3-2). Due to a more limited and sporadic fishing effort among years, estimated discards in the Cook Inlet scallop fishery only included data for the 1999/2000 to 2005/06 seasons (Table 3-2). Because of harvest confidentiality due to a small number of permit holders in many fishing seasons, Cook Inlet discard data were not available as annual estimates but were obtained as an aggregate total (2,327.5 lbs of meats) among the seven seasons. No bycatch data were available for Cook Inlet fisheries following the 2005/2006 season. Thus, the average Region 2 bycatch estimates were calculated as the annual average for the Prince William Sound fishery combined with the average for the Cook Inlet fishery for years in which data were available.

Because the observer estimates were initially calculated as round weight (except data on meat weights were used in Cook Inlet), discard estimates were converted to shucked scallop meat weights to provide consistency with the currency used for management. Scallop meats represent approximately 8-12% of the round weight depending on area and season (Barnhart and Rosenkranz 2003), so a median meat recovery of 10% was used to convert scallop discard estimates to meat equivalents for this ACL analysis. Estimated scallop discards in the directed scallop fisheries were summarized by region and statewide. Annual statewide discards in the scallop fisheries ranged from 75,715 lbs of meats in 2008/09 to 123,938 lbs in 2007/08 (Table 3-2). Mean annual scallop discards in the directed scallop fisheries totalled 97,803 lbs (CV = 5%) of meats statewide for the 1998/1999 to 2008/2009 fishing seasons. Within regions, annual discards generally exhibited moderate interannual variability with CVs of 9% in Regions 1 and 4 and 21% in Region 2. The largest component of the annual discards, 50,815 lbs of meats (52% of the statewide total), occurred in Region 4, followed by 42,830 lbs (44% of total) in Region 1, and 4,158 lbs (4% of total) in Region 2. Using a 20% discard mortality rate to extrapolate to discard mortality in the directed scallop fisheries resulted in annual estimates of 8,566 lbs of meats in Region 1, 832 lbs in Region 2, and 10,163 lbs in Region 4, totalling to 19,561 lbs of meats statewide (Table 3-2).

Discard mortality also occurs in non-scallop fisheries, but estimates have even greater uncertainty due to a lack of studies in on-deck and delayed mortality in non-scallop fisheries, the lack of historical data, and limits of the current scallop identification protocol. Bycatch estimates, derived from the groundfish observer program and extrapolated to the groundfish fleet level, were obtained from the NMFS Alaska Region as summarized in Table 3-3 by discarded whole weight (mt) by NMFS regulatory area for the years 2003–2009 (J. Gasper and G. Harrington, NMFS, Juneau, pers. comm.). No data are currently available for years prior to 2003. Under the current groundfish observer reporting system, all bivalves (e.g., clams, mussels, scallops) are categorized as class Pelecypoda, with no further taxonomic break-down. In the absence of more comprehensive data, we treated the Pelecypoda estimate as total scallop bycatch. Because these bycatch values overestimate, by an undetermined amount, the true scallop bycatch in the groundfish fisheries, the estimates are assumed to be conservative. We used a meat

recovery of 10% to convert scallop bycatch estimates from the round weight reported by the groundfish observer program to the meat weights currency applied in the scallop fishery.

Table 3-2 Estimated scallop discards (lbs of meats) in directed scallop fisheries by ADF&G management region for the 1998/1999 to 2008/2009 fishing seasons.

	ADF&G Region			
	1	2[a]	4	Total
Seasons	Estimate meat weight (lbs)			
1998/99	29,680	1,279	60,743	91,701
1999/00	59,089	1,850	53,536	114,475
2000/01	64,020	1,383	34,457	99,860
2001/02	32,118	2,382	42,456	76,956
2002/03	37,309	756	71,844	109,910
2003/04	39,864	4,996	54,857	99,717
2004/05	23,781	8,279	70,194	102,255
2005/06	43,183	6,409	39,964	89,556
2006/07	40,842	3,810	43,440	88,092
2007/08	52,610	7,965	63,364	123,938
2008/09	48,636	2,966	24,112	75,715
Total	471,132	44,404	558,965	1,074,501
Average	42,830	4,158	50,815	97,803
Standard Dev.	12,396	2,713	15,232	15,020
Standard Error	3,738	818	4,593	4,529
CV (%)	8.7	19.7	9.0	4.6
	Average annual discard mortality[b]			
	8,566	832	10,163	19,561

[a] Confidential data for Cook Inlet is included in Region 2 total and average, but excluded from annual estimates.
[b] Discard mortality was assumed to be 20%.
Sources: G. Rosenkranz, ADF&G, Kodiak, pers. comm.; C. Trowbridge, ADF&G, Homer, pers. comm.

Finally, in the absence of additional information, we applied a discard mortality rate of 20%, similar to that for discards in the directed scallop fishery (see above). The 20% mortality assumption may overestimate true scallop discard mortality, but provides a reasonable approach given the available data.

In the GOA, annual scallop bycatch in the federal groundfish fisheries has ranged from 392 lbs of meats in 2004 to 1,479 lbs in 2007 (mean = 985, CV = 17%; Table 3-3). Annual bycatch has generally increased during the years 2003–2009. During these years, Regulatory Area 630 accounted for 62% (annual mean of 607 lbs of meats) of the GOA scallop bycatch. Annual scallop bycatch in the federal groundfish fisheries of the BSAI was highest in 2003 (5,776 lbs of meats), declined to a low of 1,163 lbs in 2007, and increased in 2008 and 2009 (Table 3-3). Mean bycatch among years was 2,924 lbs of meats (CV = 21%). Regulatory Area 509 accounted for 49% (annual mean of 1,439 lbs of meats) of the BSAI scallop bycatch. Statewide scallop bycatch averaged 3,909 lbs of meats annually (CV = 12%), ranging from 2,643 lbs in 2007 to 6,247 lbs in 2003. The BSAI generated the largest component of the statewide scallop bycatch (75% of statewide total) in all years except 2007. Mortality extrapolated from the groundfish fisheries under a 20% discard mortality rate averaged 782 lbs of meats annually (Table 3-3), comprised of 3 lbs from Region 1, 2 lbs from Region 2 and 777 lbs from Region 4.

Table 3-3 Bivalve bycatch (lbs of shucked meats) estimated by the groundfish observer program.

Regulatory Area	Year 2003	2004	2005	2006	2007	2008	2009	Mean	C.V. (%)
Gulf of Alaska									
610	41.8	53.8	149.8	93.8	55.4	58.4	537.8	141.5	47.7
620	135.2	140.8	155.6	441.6	191.2	203.0	204.1	210.2	19.1
630	293.6	196.9	904.4	605.1	1,232.0	503.4	514.9	607.2	22.2
640	0.1	0.0	0.0	0.3	0.2	10.7	87.8	14.1	87.5
649	0.0	0.0	0.0	0.0	0.1	0.7	22.5	3.3	96.0
650	0.3	0.1	0.0	0.0	0.0	0.0	24.4	3.5	98.4
659	0.4	0.0	0.0	0.2	0.4	7.9	23.0	4.6	71.4
Total	471.4	391.6	1,209.8	1,140.9	1,479.2	784.0	1,414.5	984.5	16.9
Bering Sea/Aleutian Islands									
508	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	98.2
509	1,495.9	2,591.5	872.4	858.3	352.5	1,960.3	1,944.7	1,439.4	20.6
512	1.4	0.0	0.0	0.0	0.0	0.4	0.0	0.3	72.7
513	274.1	221.1	178.8	44.4	37.3	145.6	32.4	133.4	27.6
514	53.9	70.5	48.1	65.9	101.5	11.8	38.8	55.8	19.0
516	2.2	3.0	1.7	1.1	0.0	0.6	4.7	1.9	31.6
517	587.9	931.3	470.4	184.4	73.8	556.2	248.8	436.1	25.4
518	1.0	1.1	1.4	1.3	0.4	3.5	3.4	1.7	26.4
519	65.4	95.9	28.8	17.7	11.6	18.2	10.7	35.5	34.7
521	69.0	75.3	19.3	25.9	70.6	24.8	146.2	61.6	27.3
523	0.7	1.4	1.1	0.1	1.9	0.0	3.4	1.2	36.3
524	1.7	25.1	102.8	30.9	24.9	62.9	20.0	38.3	33.3
541	1,364.0	282.9	36.8	486.1	461.6	159.1	99.9	412.9	41.5
542	1,858.8	57.2	84.3	97.4	23.8	10.0	6.0	305.4	84.9
543	0.3	0.0	0.0	0.0	3.5	0.2	1.3	0.8	64.0
Total	5,776.1	4,356.6	1,845.9	1,813.4	1,163.4	2,953.6	2,560.3	2,924.2	21.0
Statewide Total	6,247.4	4,748.2	3,055.7	2,954.4	2,642.6	3,737.6	3,974.8	3,908.7	12.1
	Annual average discard mortality [a]								
	1249.5	949.6	611.1	590.9	528.5	747.5	795.0	781.7	12.1

[a] Discard mortality was assumed to be 20%

Source: J. Gasper and G. Harrington, NMFS, Juneau, pers. comm.

Scallop discard mortality in several agency surveys was also examined. For example, ADF&G uses an 8-foot New Bedford style scallop dredge to conduct scallop surveys in Areas E and H of Region 2 (Bechtol 2003; Bechtol et al. 2009). In addition, ADF&G conducts multi-species surveys using a 400 Eastern bottom trawl in Region 2 (Registration areas E and H) and in Region 4 (Registration areas K, M, and O; Bechtol 2005; Spalinger 2009; M. Stichert, ADF&G, Kodiak, pers. comm.; M. Spahn, ADF&G, Homer, pers. comm..). For waters of the Gulf of Alaska and Bering Sea, NMFS conducts multi-species surveys with a standard 83-112 Eastern bottom trawl (von Szalay 2008; Lauth 2010; R. Foy, NMFS, Kodiak, pers. comm.). Because our intent was to estimate actual discard mortality, data from these surveys were obtained as unscaled survey catches, (i.e., the actual catches, before standardizing for tow length or extrapolation to area swept estimates), then summarized by both region and statewide. Similar to the above discard calculations, we applied a meat recovery rate of 10% to convert to meat weights from survey round weight, and then a discard mortality rate of 20% (Table 3-4).

Due to survey timing, the NMFS trawl survey primarily caught scallops on odd-numbered years, largely reflecting survey location, such as the NMFS biennial survey of the GOA (von Szalay 2008). Estimates of discard mortality in weathervane scallops by agency surveys was relatively minor during 1998-2008, averaging 259 lbs (CV=7.6%) of meats statewide, comprised of 0.1 lbs (<1% of total) from Region 1, 130 lbs (50.3% of total) from Region 2, and 129 lbs (49.6% of total) from Region 4 (Table 3-4). The ADF&G trawl surveys generated the largest component (148 lbs of meats) of the discard mortality, followed by the ADF&G dredge survey (110 lbs), and the NMFS trawl survey (2 lbs).

Our analysis did not examine incidental mortality incurred as a result of contact with fishing or survey gear or sediment disturbance, but in cases where scallop are not captured by the gear. Such mortality could involve mechanical damage from contact with the gear or being buried due to sediment redistribution by the gear. Calculation of incidental mortality in Atlantic scallops relies on estimation of gear efficiency, or the probability that a scallop in the path of the gear is captured, and the mortality rate for scallops in the path of the gear (NEFSC 2007). Due to the difficulty in estimating these parameters, we did not incorporate incidental mortality into this analysis.

3.2 Discard mortality allocation among regions

Although weathervane scallops are found broadly throughout the subtidal marine environment, the occurrence of beds with high densities of scallops is relatively limited. In addition, the spatial distribution of the scallop fishery is substantially less than the distribution of the groundfish fishery. Therefore, our analysis of Alternatives 2–5 applied two approaches for incorporating discard mortality. For alternatives considering ACLs at the statewide level, scallop bycatch was pooled across all NMFS regulatory areas. This approach considers that, although scallops are managed on relatively discrete scales, the FMP examines scallops across all of Alaska. Therefore, available data on scallop discard mortality in all federal groundfish fisheries and agency surveys, even in areas without active scallop fisheries or documented beds, was deducted from the statewide ACL. For alternatives considering ACLs at the regional level, scallop discard mortality in agency surveys was assigned to the corresponding ADF&G region based on tow location. However, bivalve bycatch from the federal groundfish fisheries, initially designated only to NMFS regulatory area, was apportioned to the ADF&G regional management areas based on the distribution of the primary scallop beds within the NMFS regulatory areas. In cases where the groundfish catch accounting system allocated scallop bycatch to areas where no scallop fishing occurred, the estimated bycatch was assigned to the encompassing or nearest ADF&G region. For example, although no commercial fishing for weathervane scallops occurs in NMFS Regulatory Area 659, the catch accounting system assigns scallop bycatch to NMFS Regulatory Area 659; therefore, we allocated the Area 659 bycatch to ADF&G Region 1. Allocation of bycatch among ADF&G regions

Table 3-4 Annual (A) biomass and estimated discard mortality (lbs of meats) of weathervane scallops and (B) biomass (whole lbs) of non-target scallops captured in ADF&G and NMFS surveys within ADF&G management region during 1998-2008.

	Region 1		Region 2				Region 4		
Year	NMFS Trawl	Region Total	ADF&G Dredge	ADF&G Trawl	NMFS Trawl	Region Total	ADF&G Trawl	NMFS Trawl	Region Total
A. Weathervane scallops									
	Survey catch (lbs of meats)[a]								
1998			535	39		574	533		533
1999	<1	<1	623	222	2	847	574	1	575
2000			705	60		764	517		517
2001	0	0	742	339	0	1,081	536	13	548
2002			236	87		322	407		407
2003	<1	<1	552	117	<1	669	580	11	591
2004			975	52		1,027	732		732
2005	1	1	335	102	1	437	619	3	622
2006			590	42		632	997		997
2007	1	1	411	56	<1	467	927	6	933
2008			337	13		350	610		610
Mean	0.5	0.5	549.1	102.5	0.6	651.8	639.2	6.9	642.3
CV (%)	37.4	37.4	12.4	29.2	51.3	12.5	8.7	32.7	7.6
	Estimated weathervane scallop discard mortality (lbs of meats)[b]								
Mean	0.1	0.1	109.8	20.5	0.1	130.4	127.8	1.4	128.5
B. Non-target scallop species									
	Survey Catch (whole lbs)								
1998			NA	46		46	75		75
1999	1	1		6	10	15	68	36	105
2000				33		33	109		109
2001	0	0		53	2	55	23	32	55
2002				15		15	19		19
2003	2	2		12	2	13	33	96	129
2004				38		38	11		11
2005	3	3		10	3	14	3	111	114
2006				18		18	20		20
2007	0	0		7	2	9	15	77	92
2008				<1		<1	8		8
Total	5	5		238	18	257	384	352	736
Mean	1.0	1.0		21.7	3.7	23.3	34.9	70.3	66.9
CV (%)	55.1	55.1		24.9	43.0	22.2	29.3	22.4	20.8

[a] Meat weight based on a median meat recovery of 10% statewide.
[b] Discard mortality assumes a 20% mortality on scallops that were captured, but nor retained.

during recent years is shown in Table 3-5. Based on this allocation, the bycatch within a region was assumed to have a 20% discard mortality and converted to meat equivalents by assuming a 10% meat recovery. The ratio of the meat discard mortality compared to the pounds of meats retained by the directed scallop fishery was converted to a discard mortality rate for the directed scallop fishery, the groundfish fishery, and agency surveys within each ADF&G region (Table 3-6).

3.3 Estimating the OFL

To define the OFL in terms of total scallop mortality, it was necessary to increase the MSY value of 1.24 million lbs of shucked meats by an amount equivalent to estimates of the additional fishing mortality during the 1990–1997 period (excluding 1995) on which the MSY is based. With the additional discard mortality totalling to 3.6% of the retained catch, the MSY is redefined to equal 1.284 million lbs of scallop meats, including all sources of fishing and survey mortality. In this analysis, the OFL equals this redefined MSY estimate.

Specifically, discard mortality at that time occurred in the scallop fishery, the groundfish fishery, and agency surveys, at a minimum. However, little discard data is available for the period of interest. Therefore, the mean of annual discard mortality rates was estimated for each of the above discard sources for years in which data was available (Table 3-6), and the sum of the means was used to scale and redefine the MSY. In estimating the means, we note that "year" as defined in the available data was often inconsistent. For example, scallop seasons were defined according to calendar year prior to 1994, but spanned portions of two calendar years thereafter. Groundfish fishery data and agency surveys are defined according to calendar year. For simplicity, we assigned the groundfish and survey data to the first year in a scallop season spanning portion of two calendar years. Thus, bycatch in the 1998 groundfish fisheries was allocated to the 1998/99 scallop season. Although this approach may shift some of the effect of a large scallop recruit cohort, it was assumed that any errors are approximately normally distributed, particularly given individual growth differences that result in a given recruit class becoming fully selected over a series of years by a particular fishery/survey gear.

For the scallop fishery, statewide discard mortality comprised an additional 3.6% of the annual retained catch. This mortality was derived from on-board observer data during the 1998/99 to 2008/09 fishing seasons and based on a meat recovery equivalent of 10% of the whole weight and an assumed discard mortality rate of 20%. We note that within this period, the discard mortality rate was 1.7% higher beginning with the 2002/03 season compared to the preceding years. This increase may be an effect of formation of the fishery cooperatives which allowed the fleet to be more selective in which scallops are retained compared to the pre-cooperative years (J. Stone, pers. comm.). The implication is that the scallop discard mortality rate may have been slightly lower during the years on which the proxy MSY is based, but there is insufficient data to confirm this. For the groundfish fishery, an additional discard mortality of 0.2% (CV = 12%) of the annual retained scallop catch was derived using data from the 2002/03 to 2008/09 fishing seasons. As mentioned previously, this rate applies to bivalves, used as a proxy for weathervane scallops. It is anticipated that historical groundfish discards may have been substantially greater than in recent years due to several factors. First, changes in gear technology, such as roller gear designed to keep the footrope of a bottom trawl slightly off the bottom, likely reduce scallop bycatch. Second, the spatial distribution of groundfish fishing effort has become more constrained in an effort to protect critical habitat for various species. Third, the development of various fishery rationalization or quota-share programs, particularly in the eastern Bering Sea, has generally reduced both the number of vessels fishing and the "race for fish," generally allowing greater fishing effort to be replaced by more efficient effort in targeting a particular groundfish species. Agency survey data, derived from the 1998–2008 calendar years, generated an additional discard mortality of <0.1% (CV = 12%) of the retained catch. This mean is averaged across surveys that may occur annually or biennially in different areas, but likely represents long-term annual discard mortality.

Table 3-5. The ADF&G registration area in relation to the corresponding ADF&G Region, estimated annual discard mortality (lbs of shucked meats) in the directed scallop fisheries, federal groundfish fisheries, and agency surveys, and the total estimated scallop bycatch during 1998/98–2008/09.

			Groundfish fishery discards			
ADF&G Registration Area	ADF&G Region	Directed fishery discards (lbs)	Allocated Regulatory Area [a]	Bycatch fishing mortality (lbs)	Agency survey mortality (lbs)	Total annual discard mortality (lbs)
Yakutat	1		650, 659 and half of 640	3		
District 16	1		Pooled with Yakutat	With above		
Region 1 Total	1	8,566		3	<1	8,569
PWS	2	765	Half of 640 and 649	2		
Cook Inlet	2	67	0	With above		
		832		2	130	964
Kodiak	4		630 and half of 620	142		
Alaska Pen.	4		Half of 620 and half of 610	35		
Dutch Harbor	4		Half of 610	14		
Adak	4		541	83		
Bering Sea	4		BSAI excluding 541	502		
		10,163		777	128	11,068
Total		19,561	Statewide	782	259	20,602

[a] Shows the NMFS Regulatory area to which groundfish fishery bycatch was allocated. Totals may differ due to rounding.

Table 3-6. Retained catch (lbs of meats) and estimated additional discard mortality in the scallop fishery, the groundfish fishery, and agency surveys as a percentage of the retained catch.

		Discard mortality as percentage of retained catch			
Season	Retained Catch	Scallop Fishery	Groundfish Fishery	Agency Surveys	Total
Region 1					
1998/99	275,831	2.15			
1999/00	284,305	4.16		<0.01	
2000/01	226,603	5.65			
2001/02	124,198	5.17		0.00	
2002/03	126,403	5.90	<0.01		
2003/04	161,990	4.92	<0.01	<0.01	
2004/05	111,380	4.27	<0.01		
2005/06	213,001	4.05	<0.01	<0.01	
2006/07	164,395	4.97	<0.01		
2007/08	126,140	8.34	<0.01	<0.01	
2008/09	171,275	5.68	0.01		
Mean	180,502	4.75	<0.01	<0.01	4.75
CV (%)	10.2	9.7	67.2	137.6	
Region 2					
1998/99	19,650	1.30		0.58	
1999/00	40,725	0.91		0.42	
2000/01	50,782	0.54		0.30	
2001/02	30,090	1.58		0.72	
2002/03	24,232	0.62	<0.01	0.27	
2003/04	19,980	5.00	<0.01	0.67	
2004/05	55,437	2.99	<0.01	0.37	
2005/06	49,205	2.61	<0.01	0.18	
2006/07	36,990	2.06	<0.01	0.34	
2007/08	37,105	4.29	<0.01	0.25	
2008/09	20,040	2.96	0.07	0.35	
Mean	34,931	2.19	0.01	0.37	2.57
CV (%)	11.4	20.36	156.8	14.3	
Region 4					
1998/99	508,117	2.39		0.02	
1999/00	512,941	2.09		0.02	
2000/01	473,232	1.46		0.02	
2001/02	398,453	2.13		0.03	
2002/03	358,820	4.00	0.35	0.02	
2003/04	302,566	3.63	0.31	0.04	
2004/05	264,777	5.30	0.23	0.06	
2005/06	263,151	3.04	0.22	0.05	
2006/07	286,088	3.04	0.18	0.07	
2007/08	295,068	4.29	0.25	0.06	
2008/09	151,119	3.19	0.51	0.08	
Mean	346,757	2.93	0.28	0.04	3.25
CV (%)	10.0	11.5	14.5	17.7	

A similar approach, applying the data available for the same time periods as were used above, was used to estimate discard mortality within regions (Table 3-5 and Table 3-6). Within Region 1, additional discard mortality averaged 4.75% of the annual retained catch. This additional discard mortality resulted primarily from the directed scallop fishery with <0.01% in both the groundfish fishery and agency surveys. For consideration of alternatives that establish ACLs at the regional level, the revised proxy MSY for Region 1 becomes 298,532 lbs of meats. Additional discard mortality within Region 2 averaged 2.57% of the annual retained catch, comprised of 2.19% in the scallop fishery, 0.01% in the groundfish fishery, and 0.37% in agency surveys. With the additional mortality, the revised proxy MSY for Region 2 became 71,798 lbs of meats. For Region 4, the additional discard mortality averaged 3.25% of the annual retained catch for the year examined, comprised of 2.93% in the scallop fishery, 0.28% in the groundfish fishery, and 0.04% in agency surveys. The proxy MSY for Region 4 increased to 913,759 lbs of meats.

For the purpose of this analysis, it was assumed that the ACL available under each alternative is allocated to either retained catch or discard mortality, represented by a discard mortality rate, such that:

$$ACL = C(1 + D) \tag{1}$$

where C is retained catch and D is the discard mortality rate expressed as a mean percentage of the retained catch. Although the directed fishery has been constrained in recent years to levels substantially below the upper ends of the GHRs established in ADF&G regulation, for this analysis we also assumed that the retained catch is harvested up to the amount estimated by rearranging the above to give:

$$C = \frac{ACL}{1 + D}. \tag{2}$$

However, annual determination of catch and pre-season estimates of discard mortality within the ACL will continue to be the responsibility of ADF&G management staff.

3.4 Analysis of fixed buffers

To evaluate the potential effects of adoption of the fixed buffers contained in Alternatives 2-4, we applied a potential constant buffer (multiplier) to the OFL to give the corresponding ACL using:

$$ABC = B_f OFL \tag{3}$$

where B_f is the fixed multiplier. Retained catch was then calculated from Equation 2, and discard mortality estimated as the difference between the ACL and retained catch. For the purpose of this analysis, the GHL was assumed to be the smaller of either the upper end of the GHR allowable in State regulation or the retained catch apportionment of the ACL.

For Alternative 2a, a statewide ACL was set equal to the statewide OFL of 1.28 million lbs (582.5 mt) of shucked meats (Table 2-1). The maximum allowable GHL (i.e., retained catch) was estimated based on the statewide discard mortality rate of 3.6% among the directed scallop fishery, groundfish fisheries, and agency surveys. Alternative 2b sets regional ACLs equal to the regional GHR upper bounds, plus estimated historical discard mortalities, resulting in ACLs of 298,530 lbs (135.4 mt) of shucked meats for Region 1, 71,790 lbs (32.6 mt) for Region 2, and 913,760 lbs (414.5 mt) for Region 4 (Table 2-1).

Alternatives 3a and 3b incorporate greater uncertainty into the estimate by establishing the upper bound of the harvest range at 90% of the OFL for statewide or 90% of the upper bounds of regional GHR, plus estimated historical discard mortalities. Two options were considered under this alternative (Table 2-1):

Alternative 3a estimates the scallop ACL at the statewide level and results in a statewide ACL of 1,155,670 lbs (524.2 mt) of meats; Alternative 3b estimates scallop ACLs at the ADF&G regional level and results in ACLs of 268,280 lbs (121.9 mt) lbs for Region 1, 64,620 lbs (29.3 mt) for Region 2, and 822,370 lbs (373.0 mt) for Region 4.

Alternatives 4a and 4b are similar to Alternatives 3a and 3b but incorporate even greater uncertainty into the estimate by establishing the upper bound of the harvest range at 75% of the OFL or 75% of the upper bounds of regional GHR, plus estimated historical discard mortalities. Two options were considered under this alternative (Table 2-1): Alternative 4a estimates the scallop ACL at the statewide level and results in a statewide ACL of 997,350 lbs (452.4 mt) of meats; Alternative 4b estimates scallop ACLs at the ADF&G regional level and results in ACLs of 234,530 lbs (106.4 mt) for Region 1, 55,230 lbs (25.1 mt) for Region 2, and 707,590 lbs (321.0 mt) for Region 4.

3.5 The P* method and additional uncertainty

The implications of using a fixed buffer between the OFL and the ABC were examined using the P* method (Caddy and McGarvey 1996; Prager *et al*. 2003; Shertzer *et al*. 2008; Hanselman 2009; NPFMC 2010a), in which P* represents the probability that the ABC exceeds the true OFL. Thus, a lower P* value implies a lower probability that the ABC exceeds the true OFL (i.e., the probability of the stock being overfished is less). Values of P* may be calculated from a *t*-distribution that depends on the size of the fixed buffer and the estimated scientific uncertainty associated with a stock. This analysis was done to better explicitly evaluate Alternatives 2-4 in relation to the potential for overfishing.

While the intent of the ABC control rule is to account for scientific uncertainty in the estimation of the OFL, a variety of sources can introduce scientific uncertainty. Some uncertainty may be characterized as "within" by being quantified within an assessment model. To generate a distribution for the OFL, we used the standard error of the annual total scallop mortality for 1990–1997 (excluding 1995), the years on which the proxy MSY is based. However, "additional" uncertainty exists that cannot be quantified within the existing stock assessment, such as the extent to which discard mortality rates estimated for recent years represent the true rates during the years used to define the OFL. To accommodate this unquantified uncertainty, an additional variance term, σ_a, is added to the within uncertainty. For this deterministic analysis in which the OFL for weathervane scallops is based on historical catch levels, the probability of the stock being overfish was calculated through the t-distribution as:

$$t_{(P^*, n-1\,df)} = \frac{\bar{x}\left(1 - B_f\right)}{\sqrt{s_{\bar{x}}^2 + (\sigma_a \bar{x})^2}} \qquad (4)$$

where t is the probability based on a *t*-distribution with the P* probability and 6 degrees of freedom, $\bar{x}$ is the revised proxy MSY, $s_{\bar{x}}$ is the standard error of the annual total mortality in the years producing the revised proxy MSY, and σ_a is additional uncertainty. In the case where no additional uncertainty is assumed, $\sigma_a = 0.0$. For this analysis, P* values were calculated at both the statewide and regional scales for the multiplier values of 1.0, 0.90, and 0.75, representing Alternatives 2, 3, 4, respectively, but also with values of additional uncertainty, σ_a , of 0.0 (no additional uncertainty), 0.2, 0.3, 0.4, and 0.5 (Table 3-7).

3.6 Data to evaluate non-target scallop stocks

To examine potential impacts of the non-target options, data on capture of non-target scallop species was derived from ADF&G and NMFS trawl surveys for the years 1998–2008 (M. Stichert, ADF&G, Kodiak;

M. Spahn, ADF&G, Homer; and R. Foy, NMFS, Kodiak, all pers. comm.). Trawl surveys are conducted in Region 1 only by NMFS and in Regions 2 and 4 by both ADF&G and NMFS. Among all ADF&G surveys, all non-target scallops were recorded as *Chlamys* sp. Although data extrapolated to area-swept estimates were not available for the ADF&G surveys, and these trawl surveys are not designed to assess non-target scallop species, surveys catches of non-target scallops were relatively minor (Table 3-4). Data on non-target species was summarized according to whole weight (lbs). In Region 1, catches of non-target scallops by the NMFS survey in odd-numbered years from 1999 to 2007 averaged 1 lb annually. For Region 2, ADF&G catches among either annual trawl surveys averaged 22 lbs (whole weight; CV = 84%) annually, ranging from <1 to 53 lbs, whereas NMFS surveys caught an average of 4 lbs annually. For Region 4, annual catch of *Chlamys* among ADF&G trawl surveys ranged from 3 to 109 lbs, averaging 35 lbs (CV = 97%), whereas NMFS survey catches averaged 70 lbs (CV = 50%) annually.

Table 3-7. Estimates of P* for multiplier of B_f = 1.0, 0.90, and 0.75 and additional uncertainty of σ_a = 0.0 (no additional uncertainty), 0.2, 0.3, 0.4, and 0.5 at the statewide and regional levels with the OFL of 1.28 million lbs of meats.

	σ_a=0.0	σ_a =0.2	σ_a =0.3	σ_a =0.4	σ_a =0.5
B_f	Statewide P*				
1.00	0.500	0.500	0.500	0.500	0.500
0.90	0.285	0.357	0.390	0.413	0.428
0.75	0.091	0.187	0.247	0.292	0.326
B_f	Region 1 P*				
1.00	0.500	0.500	0.500	0.500	0.500
0.90	0.345	0.380	0.401	0.419	0.431
0.75	0.168	0.226	0.269	0.305	0.334
B_f	Region 2 P*				
1.00	0.500	0.500	0.500	0.500	0.500
0.90	0.418	0.424	0.431	0.438	0.444
0.75	0.304	0.318	0.333	0.348	0.363
B_f	Region 4 P*				
1.00	0.500	0.500	0.500	0.500	0.500
0.90	0.252	0.348	0.387	0.411	0.427
0.75	0.063	0.173	0.240	0.289	0.324

Chapter 4 Impacts of Alternatives on Scallop Resource and Economics

4.1 Alternative 1 (status quo)

Under this alternative no change would be made to the current management to implement ACLs. Scallop catch would continue to be constrained by the statewide MSY and GHLs and GHRs set by ADF&G registration areas, as described below. Additionally, under Alternative 1, there would be no change to the management of non-target scallop species.

Commercial fishing for scallops under the State of Alaska Scallop Fishery Management Plan occurs in 9 scallop registration areas (Figure 4-1; NPFMC 2010b). These registration areas include Southeastern Alaska (Area A); Yakutat (Area D and District 16); Prince William Sound (Area E); Cook Inlet (Area H); Kodiak (Area K), which is subdivided into the Northeast, Shelikof and Semidi Districts; Alaska Peninsula (Area M); Dutch Harbor (Area O); Bering Sea (Area Q); and Adak (Area R). Scallop seasons have never been opened in Area A, and effort occurred in Area R only during 1995.

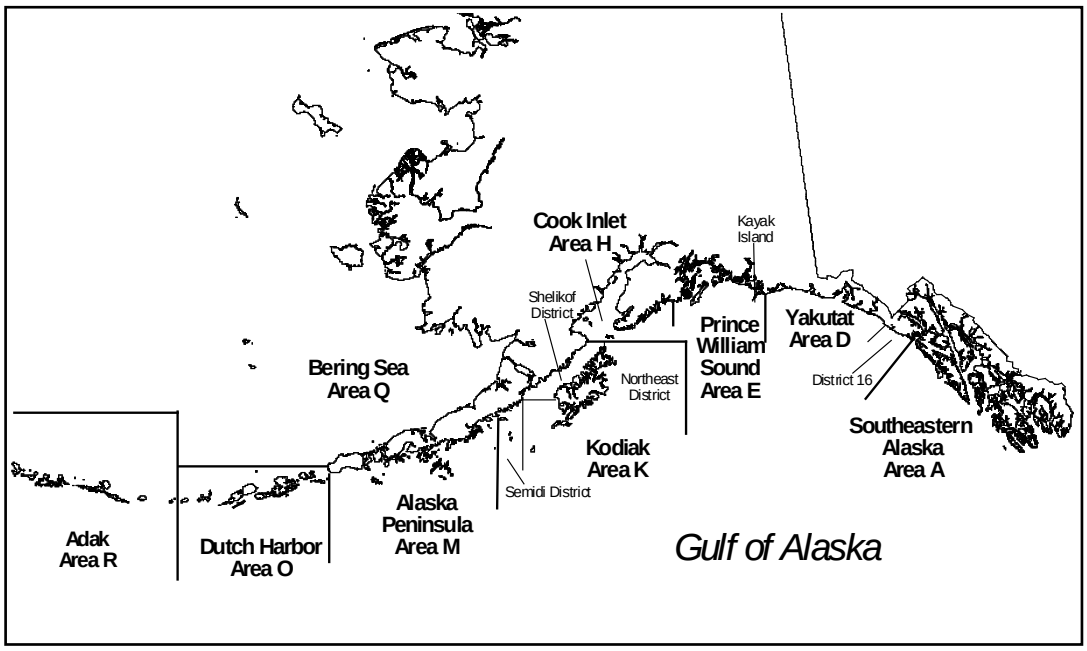

Figure 4-1 Alaska weathervane scallop fishing registration areas (from NPFMC 2010b).

The fishery is managed by ADF&G within registration areas and districts. For each registration area, State of Alaska regulations establish a GHR, the upper end which represents a hard cap that is not to be exceeded. Prior to each season, ADF&G sets GHLs as pre-season targets for each fishing area (registration area, district, or statistical area). These pre-season targets are typically based on historical fishery performance combined with recent stock status information such as survey data and/or size and age composition data (NPFMC 2010b). Specifying harvest levels in terms of ranges allows the State to make in-season management adjustments to harvest areas or allowances based on observer data and concerns about fishery performance, bycatch rates, or localized depletion (NPFMC 2006).

The State of Alaska first established regulatory GHRs for traditional scallop fishing areas in 1993 under the Interim Management Plan for Commercial Scallop Fisheries in Alaska. Regulatory GHRs (set as shucked meats) were 0–250,000 lbs for Yakutat, 0–50,000 lbs for Prince William Sound, 0–20,000 lbs for the Kamishak District of Cook Inlet, 0–400,000 lbs for Kodiak, and 0–170,000 lbs for Dutch Harbor. These GHRs were determined by averaging historic catches from 1969 to 1992 excluding years when either no fishing or a "fishing-up effect" occurred (Barnhart 2003).

Prior to the 1996 re-opening of the weathervane scallop fishery, the State of Alaska set the following GHRs for non-traditional registration areas: 0–200,000 lbs for the Alaska Peninsula, 0–600,000 lbs for the Bering Sea, 0–35,000 lbs for District 16, and 0–75,000 lbs for Adak. The upper limits from traditional and non-traditional areas totalled 1.8 million lbs, which was defined as maximum sustainable yield (MSY) in Amendment 1 to the federal FMP (Table 4-1).

In 1998, the Scallop Plan Team recommended a more conservative definition of MSY (Table 4-1). Based on average landings from 1990 to 1997, excluding 1995 when the fishery was closed most of the year, MSY was subsequently established in Amendment 6 of the FMP at 1.24 million lbs, with optimum yield (OY) defined as the range 0–1.24 million pounds. To accommodate the new definition, the State of Alaska reduced regulatory GHR ceilings to 300,000 lbs for Kodiak, 110,000 lbs for Dutch Harbor, 100,000 lbs for the Alaska Peninsula, and 300,000 lbs for the Bering Sea. Thus, MSY and the State regulatory GHR ceiling are both 1.24 million lbs.

Table 4-1 Alaska weathervane scallop harvest, Maximum Sustainable Yield, and percentage of the MSY harvested during the 1993/94–2007/08 seasons.

Season	Harvest (lbs meat)	MSY	% MSY
1993/94	984,583	1,800,000	55
1994/95	1,240,775	1,800,000	69
1995/96	410,743	1,800,000	23
1996/97	732,424	1,800,000	41
1997/98	818,913	1,800,000	45
1998/99	822,096	1,240,000	66
1999/2000	837,971	1,240,000	68
2000/01	750,617	1,240,000	61
2001/02	572,838	1,240,000	46
2002/03	509,455	1,240,000	41
2003/04	492,000	1,240,000	40
2004/05	425,477	1,240,000	34
2005/06	525,357	1,240,000	42
2006/07	487,473	1,240,000	39
2007/08	458,313	1,240,000	37
2008/09	342,434	1,240,000	28

The GHRs are specified both at the registration area and statewide (Table 4-2), with a statewide GHR of 1.24 million lbs established as the sum of the upper ends of the GHRs across registration areas. In-season management by ADF&G targets a GHL at the scale of registration area or statistical reporting area, taking into consideration aspects such as fishery performance, stock status, stock age composition, etc. The fishery is managed conservatively with harvest levels well below the MSY, and since the MSY levels were updated in 1996, annual catches have averaged from 28% to 66% of the statewide MSY (Table 4-1; NPFMC 2010b).

Prior to 1993, no formal management plan existed for scallop fishing off Alaska (Kruse 1994). Beginning with the 1993/1994 season, the statewide MSY, defined as the sum of the upper end of the registration area GHRs, was 1.8 million lbs of shucked meats (Table 4-1). This statewide total was reduced to 1.24 million lbs with the 1998/99 season. The statewide MSY has not been exceeded since being implemented in the 1993/94 season (Table 4-1). But, overages of the GHL have infrequently occurred at the spatial scale of registration area (Table 4-3). Following adoption of the 1.24 million lb statewide MSY, only 13 of the 74 GHLs (18%) were exceeded for the registration area-season combinations; in all instances the overage represented less than 5% of the GHL. Management performance improved noticeably following implementation of fishery cooperatives as the GHLs were exceeded in 29% (7 of 24 GHLs) of the cases prior to the 2001/02 season but in only 12% (6 of 50 GHLs) of the cases after the 2000/01season.

The overfishing control rule is defined as a fishing rate in excess of the natural mortality rate, which has been estimated as $F_{overfishing}$ = M = 0.13 (12% per year) statewide. If an estimate of the statewide weathervane scallop spawning biomass was available, the overfishing control rule would be applied to that estimate to determine the OFL. An estimate of the statewide weathervane scallop spawning biomass is not currently available, however, which prevents application of the overfishing control rule to annually determine the OFL. The FMP does not specifically provide another mechanism for establishing an OFL that is expressed as an amount of scallops. This analysis recognizes that, in practice, the MSY functions as the OFL for weathervane scallops. Each year, the total retained catch is compared to the MSY to determine whether overfishing occurred.

However, while the fishery is managed conservatively for harvests well below MSY, the status quo approach under Alternative 1 does not explicitly incorporate bycatch needs into the management process and, thus, fails to comply with the ACL standards. In addition, abundance is currently estimated for only two of the nine registration areas and a determination of whether the stock is above the MSST cannot be made at this time on the statewide stock.

4.2 Alternatives 2–4

As discussed in Section 2.1.2, Alternatives 2–4 all employ fixed buffer values, ranging from 0–25%, to establish the ABC control rule as a fraction of the total catch OFL. Two main aspects differentiate among the alternatives: (1) the size of the buffer under consideration (0, 10%, or 25%); and (2) the spatial scale at which the ACL is specified (statewide or by region). The appropriate size of the buffer depends primarily on the uncertainty surrounding estimating the MSY, and hence the OFL. A secondary component involves the uncertainty around two factors: (1) estimation of discard mortality from all sources; and (2) management implementation.

This analysis examines discard mortality based on an annual average of the available data on scallops captured, but not retained, by a variety of fisheries and agency surveys. Thus, years of both higher and lower discards have occurred. Directed fishery harvests in recent years have been substantially below the regulatory allowable maximum, represented by the upper end of the statewide GHR (Table 3-1). However, in the event of increased stock abundances, total scallop mortality will likely increase as the management target is increased to accommodate the increased stock abundance. Increased abundance

will also increase the discards from all other sources of discard mortality. In-season estimation of discard mortality will be a critical aspect to prevent catch from exceeding the ACL annually (and avoiding the need to implement AMs). For purposes of this analysis, ACLs were apportioned to retained catch and discard mortality according to the method laid out in Chapter 3 (Table 4-2). In order to look at relative fishery constraints, the retained catch was compared to the GHR to determine the "maximum GHL" as an estimate of the maximum retained harvest by region. However, the annual GHL would ultimately be determined by the State, within the constraints of the ACL and the GHRs listed in State regulation.

With respect to management implementation, while this is a consideration in maintaining harvests below the ACL (i.e., not necessarily in the specification of the ACL), it affects our ability to estimate impacts, particularly in conjunction with the assumptions and uncertainty in the discard estimates. The precision with which managers achieve the target harvest level may become increasingly important as harvest targets, and corresponding discard mortality, approaches the ACL. To gain perspective on management implementation, we also examined the actual harvest level as a percentage of the target GHL. Because several factors can affect a GHL not being achieved (e.g., no or reduced fleet effort due to poor weather), the more important aspect from the stock perspective is that the GHL is not exceeded. Among years and registration areas, management implementation in the scallop fishery kept harvests at or near the GHL (Table 4-3). Among registration areas, the GHL was exceeded from 0 to 56% of the time. However, in all cases of overages, the GHL was exceeded by a maximum of 5%.

The second factor differentiating the alternatives is the appropriate spatial scale for ACL management in order to best provide protection against overfishing. In-season management for the GHL is currently implemented at the registration area, or on finer scales, such as specific beds, based on pre-fishery and in-season perceptions of stock status. These perceptions often are based on historical fishery performance measures such as CPUE or size and age composition data that may suggest different production from fishing areas at different spatial scales. Although growth rates of weathervane scallops appear to increase moving from east to west in the Gulf of Alaska (Ignell and Haynes 2000; Kruse et al. 2000), it is unclear whether these differences are driven by genetics or environmental conditions. Strong genetic differences would suggest scallops are self-recruiting. However, a recent study used four classes of molecular markers to examine genetic variability in weathervane scallops from eight locations in the Gulf of Alaska and the Bering Sea (Gaffney et al. under review). Results indicate virtually no population structure across the spatial distributions sampled and high gene flow is proposed as a causative mechanism. However, the authors suggest a cautionary approach is warranted because geographically separated scallop "populations" may still be ecologically independent. The use of the State of Alaska's management regions, which roughly coincide with putative larval drift zones, is offered as a reasonable approach for sustainable harvest management.

Table 4-2 Effects of alternatives on ACLs, discard mortality, and maximum GHLs, all measured in lbs of shucked meats, for the weathervane scallop fishery, and the corresponding probability, P*, that the ACL exceeds the true OFL. The preferred alternative is indicated in bold.

Alternative	ABC Control Rule	Spatial Scale	ACL	Discard mortality[a]	Maximum GHL[b]	P*
1 – Status quo	ABC = GHR	Statewide	1,240,000	NA	1,240,000	NA
2a	ABC = OFL	Statewide	1,284,089	44,089	1,240,000	0.500
2b	ABC = upper end of GHRs +discards	Region 1	298,532	13,532	285,000	0.500
		Region 2	71,798	1,798	70,000	0.500
		Region 4	913,759	28,759	885,000	0.500
3a	**ABC = 90% of OFL**	**Statewide**	**1,155,680**	**39,680**	**1,116,000**	**0.285**
3b	ABC = 90% of upper end of GHRs +discards	Region 1	268,678	12,178	256,500	0.345
		Region 2	64,619	1,619	63,000	0.418
		Region 4	822,383	25,883	796,500	0.252
4a	ABC = 75% of OFL	Statewide	963,067	33,067	930,000	0.091
4b	ABC = 75% of upper end of GHRs +discards	Region 1	223,899	10,149	213,750	0.168
		Region 2	53,849	1,349	52,500	0.304
		Region 4	685,319	21,569	663,750	0.063

[a] Discard mortality was calculated as the sum of estimated scallop discards in the direct scallop fishery, bivalve bycatch in the federal groundfish fisheries as a proxy for weathervane scallop discards, and catch in agency surveys, and assuming a 20% discard mortality rate in (see text for description).
[b] The maximum GHL is the ACL minus the discard mortality.

4.3 Alternative 2

4.3.1 Alternative 2a: Statewide ACL = OFL

Alternative 2a would establish a statewide ACL equal to the OFL of 1.284 million lbs. Scallop GHLs are constrained by the GHR which is specified both at the registration area and statewide, with a statewide GHR of 1.24 million lbs (562.5 mt) of shucked meats. However, the GHRs do not account for discard mortality from various fisheries and surveys. Current discard mortality rates would result in discard mortality of 44,089 lbs, reducing the maximum statewide GHL to the ADF&G regulatory maximum of 1.24 million lbs (Table 4-2). Given the historical ADF&G management performance yielding annual harvests ranging from 28% to 68% of historical MSY (Table 4-1), adoption of this alternative is not expected to significantly affect ADF&G in-season management strategies. However, statewide bycatch needs as applied in this analysis are estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish fisheries and the potential for future changes in scallop bycatch among fisheries.

The use of Equation 4 to examine Alternative 2a, which specifies a multiplier of B_f=1.00, indicates P*=0.500, which means that there is an equal probability that the ABC will be above or below the true, but unknown, OFL (
Table 3-7). This result is based on available data and the assumption that uncertainty in the estimation of the OFL is adequately represented by the variability in the annual catch and discard data used to estimate the MSY, and hence the OFL. This result is expected given that the OFL is based on the annual average of estimated retained plus discard scallop mortality during 1990-1997 (excluding 1995), and the ABC is set equal to the OFL. Assumption of additional uncertainty for a fixed multiplier of B_f=1.00 for an assumed OFL of 1.284 million lbs of meats has little effect on P* (i.e., the probability of the ABC exceeding the OFL).

This alternative establishes an ACL = ABC = OFL. Therefore, it allows the possibility that the sum of the GHLs, and, in theory, the total harvest of weathervane scallops, could equal the OFL. The NS 1 Guidelines state "If a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary [of Commerce] may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach." 50 C.F.R. § 600.310(f)(5)(i).

However, comparison of actual annual catches (Table 4.1) and percentage of OFL are very low, particularly since 1998/99. This implies the potential that while the calculated P* = 0.5, the realized catches are likely to be far below the ACL (without consideration of discards noting that Table 4-1 is for retained catch only).

This alternative would benefit the weathervane scallop stock compared to status quo because: (1) an estimate of total fishing mortality would now be included in estimation of the OFL; and (2) anticipated discard mortality would need to be explicitly considered when setting the annual fishery GHL. Because the scallop fishery is currently managed for a statewide harvest that is substantially less than the OFL, the current discard mortality of 20,601 lbs of meats is substantially less than that applied in Alternative 2a, thus providing a buffer between the maximum GHL and the ACL (Table 3-4). Potential future increases in total stock abundance would likely result in increases to both the annual GHL and to the scallop discard mortality in the direct scallop fishery, non-scallop fisheries, and agency surveys. Our analysis used average estimates for the 1998/99 to 2008/09 fishing seasons to represent annual discard mortality. Given the uncertainty in preseason estimates of discard mortality, underestimation of mortality in years with harvest levels approaching the MSY could result in the statewide OFL being exceeded. To some extent, unanticipated discard mortality or catch overages in some registration areas could be remedied by in-season management adjustments to restrict the directed scallop fishery in alternative registration areas. However, the potential for management implementation error is high given the potential for time lags in data from various fisheries and agency surveys. We also note that there is currently no mechanism to address increased discard mortalities in non-

scallop fisheries other than to reduce directed scallop fishery harvests.

Table 4-3 Percentage of the annual GHL harvested in a season and ADF&G registration area during 1998/99–2007/08.[a]

Season	Yakutat	Yakutat District 16	Prince William Sound	Cook Inlet	Kodiak Northeast District	Kodiak Shelikof District	Alaska Peninsula	Bering Sea	Dutch Harbor
	Percentage of the registration area GHL that was harvested								
1998/99	97.2	97.6	98.3		100.0		31.6	24.2	42.2
1999/00	99.9	98.9	102.1	101.6	100.0	104.4	37.8	41.2	5.9
2000/01	78.3	88.3	100.9	102.6	100.0	100.0	23.2	102.8	
2001/02	51.9	58.3	100.3		100.0	98.4		70.4	
2002/03	61.4	10.5	78.2	43.0	100.0	100.3		87.8	60.0
2003/04	80.5	3.1	99.9		100.0	100.0	0.0	40.6	
2004/05	43.5	69.8	98.6	30.6	100.0	97.0	0.0	9.6	
2005/06	99.7	39.0	98.4		100.0	100.0	0.0	46.4	
2006/07	100.6	64.0	100.0		100.0	101.6	0.6	96.5	
2007/08	84.0	0.9	100.3		100.0	100.0	0.0	100.0	
Average	79.7	53.0	97.7	69.4	100.0	100.2	11.7	62.0	36.0
CV (%)	26.4	71.6	7.1	54.8	0.0	2.0	140.6	54.7	76.6
	Percentage of the years in which the GHL was exceeded								
	10.0	0.0	40.0	50.0	0.0	55.6	0.0	10.0	0.0

[a] GHL = Guideline Harvest Level. Missing data may indicate the area was closed, the registration area GHL was not established (Shelikof in 1998/99), or the data were confidential.

4.3.2 Alternative 2b: Regional ACLs = upper end of regional GHR + discards

Alternative 2b would establish regional ACLs at the sum, by region, of the upper ends of the GHRs defined in ADF&G regulation for commercial scallop fishery registration areas, plus estimated fishery and survey discard mortalities. The total sum of the upper ends of the GHRs equal the MSY of 1.24 million lbs (562.5 mt) of shucked meats (Table 4-1). The sum of the upper ends of the GHRs for each region are 285,000 lbs (129.3 mt) of meats for Region 1, 70,000 lbs (31.8 mt) for Region 2, and 885,000 lbs (401.4 mt) for Region 4. But these GHRs do not include estimated discard mortality during the 1990–1997 years (excluding 1995) on which the OFL is based. Redefining the upper ends of the regional GHRs to account for historical discard mortality increases the regional GHRs to 229,330 lbs (135.8 mt) of meats for Region 1, 71,782 lbs (32.6 mt) for Region 2, and 915,786 lbs (415.4 mt) for Region 4 (Table 4-2). Applying the discard mortality rates by region results in estimated discard mortalities of 13,532 lbs of meats for Region 1, 1,798 lbs for Region 2, and 28,759 lbs for Region 4. In contrast, current discard mortality is estimated to be 8,569 lbs of meats in Region 1, 964 lbs in Region 2, and 11,068 lbs in Region 4, although annual fishery harvests are substantially less than the maximum allowed as upper ends of the regional GHRs (Table 3-4).

Based on ADF&G management performance following the 2001 implementation of the License Limitation Program (LLP; NPFMC 2006), annual harvests have comprised a maximum of 74.7, 79.2, and 40.5% of the regional GHRs for Regions 1, 2, and 4, respectively (Table 3-1). Thus, adoption of this alternative is not expected to significantly affect ADF&G in-season management strategies. However, regional discard mortalities as applied in this analysis are estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish fisheries and the potential for future changes in scallop bycatch among fisheries. Given interregional variability in benthic species composition (e.g., mussels may predominate as bivalves in some areas and scallops predominate in other areas), uncertainty is likely exacerbated when estimating bycatch needs at the regional level.

The use of Equation 4 through Alternative 2b, which specifies a multiplier of B_f=1.00 for the regional ABCs, results in an estimated P*= 0.500 for each of Region 1, Region 2, and Region 4 (
Table 3-7). Similar to aspects of Alternative 2a, this result from setting the regional ABCs equal to revised GHRs for each region that include discard scallop mortalities. Assumption of additional uncertainty for a fixed multiplier of B_f =1.00 for an assumed OFL of 1.284 million lbs of meats had little effect on P* (i.e., the probability of the ABC exceeding the OFL).

As with Alternative 2a, this alternative would establish regional ACLs equal the regional ABCs, and the sum of the regional ACLs would equal the OFL. Therefore, it allows the possibility that the sum of the GHLs, and, in theory, the total harvest of weathervane scallops, could equal the OFL. The National Standard 1 Guidelines state "If a Council recommends an ACL which equals ABC, and the ABC is equal to OFL, the Secretary [of Commerce] may presume that the proposal would not prevent overfishing, in the absence of sufficient analysis and justification for the approach." 50 C.F.R. § 600.310(f)(5)(i).

Similar to Alternative 2a, however, comparison of actual annual catches (Table 4.1) and percentage of OFL are very low, particularly since 1998/99. This implies the potential that while the calculated P* = 0.5, the realized catches are likely to be far below this (without consideration of discards noting that Table 4-1 is for retained catch only).

Alternative 2b shares some of the benefits as Alternative 2a in providing additional protection from overfishing in comparison with status quo, in that estimated discard mortality would be explicitly considered when establishing regional GHL levels. However, the potential problem with underestimation of scallop discard mortality is increased because of the smaller spatial scale of in-season management.

For example, if ADF&G sets the GHL as the maximum allowable after deducting anticipated discard mortality, but actual discard mortality exceeds preseason estimates, the regional ACL could be exceeded if the fishery takes its full allocation. There is some potential for in-season management adjustments if other registration areas exist within the region and the directed scallop fisheries can be constrained in those alternate registration areas. Thus, the potential for management error to result in ACL overages is greater for Alternative 2b that Alternative 2a.

4.4 Alternative 3

4.4.1 Alternative 3a: Statewide ACL ≤ 90% of OFL [preferred]

Alternative 3a would establish a statewide ACL as 90% of the OFL. This is the Council's preferred alternative. Applying an ABC control rule of 90% of the OFL would result in a statewide ACL of 1,155,680 lbs (524.2 mt) of meats. Apportioning this ACL results in a discard mortality of 39,680 lbs (18.0 mt) of meats and a retained catch of 1,116,000 lbs (506.2 mt) (Table 4-2). Given the historical ADF&G management performance yielding annual harvests ranging from 28% to 68% of the statewide OFL, adoption of this alternative is not expected to significantly affect ADF&G in-season management strategies (Table 4-3). However, statewide bycatch needs as applied in this analysis are estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish fisheries and the potential for future changes in scallop bycatch among fisheries.

The use of Equation 4 to examine Alternative 3a, which specifies a multiplier of B_f=0.90, indicates a statewide P* value of 0.285, the probability that the ABC will exceed the true, but unknown, OFL given the available data and the assumption that variability is represented in the annual catch (Table 3-7). However, incorporation of additional uncertainty increases the P* value, although not to the level of assuming B_f=1.00.

Additionally, by providing a 10% buffer between the OFL and the ACL, Alternative 3a gives greater protection to the weathervane scallop resource, particularly at times when stock abundance, and the corresponding discard mortality, is high, and GHLs for the registration areas are close to the maximum allowable. Actual realized harvests compared with MSY annually have ranged from 69%-28% from 1993/94-2008/09 (retained catch).

Therefore, this alternative would prevent overfishing and prevent a level of harvest that would jeopardize the sustainability of the weathervane scallops stock.

Because this is a statewide ACL, similar to Alternative 2a, unanticipated overages in either the directed fishery harvests or discard mortality may be accommodated through in-season management adjustments which curtail directed scallop fishing in other registration areas. At this time, there is no measure which constrains fishing in non-scallop fisheries to reduce weathervane scallop discard mortality. However, actual discard mortality would need to substantially exceed preseason estimates, and all fishery harvests among all registration areas would need to be at or near the maximum GHL to exceed the ACL.

4.4.2 Alternative 3b: Regional ACLs ≤ 90% of the upper end of regional GHR + discards

Alternative 3b would establish regional ACLs based on 90% of the sum, by region, of the upper ends of the GHRs, defined in ADF&G regulation for commercial scallop fishery registration areas, plus the estimated discard mortality from the scallop and groundfish fisheries and agency surveys. The total sum of the upper ends of the GHRs equal the MSY of 1.24 million lbs (562.5 mt) of shucked meats (Table 4-1). Under an ABC control rule of 90%, Alternative 3b would establish regional ACLs of 268,678 lbs (121.8 mt) of meats for Region 1, 64,619 lbs (29.3 mt) for Region 2, and 822,383 lbs (373.0 mt) for

Region 4 (Table 4-2). Estimated discard mortalities under these ACLs would be 12,178 lbs, 1,619 lbs and 25,883 lbs of meats for ADF&G Region 1, Region 2, and Region 4, respectively, with corresponding maximum allowable retained catches of 256,500 lbs in Region 1, 63,000 lbs in Region 2, and 796,500 lbs in Region 4.

Historical fisheries harvested a much higher proportion of the regional GHRs (e.g., 99.8% of the Region 1 GHR in the 1999/00 season, but annual harvests have comprised a maximum of 74.7, 79.2, and 40.5% of the regional GHRs for Regions 1, 2, and 4, respectively, following the 2001 implementation of the LLP (Table 4-3). From a historical perspective, this alternative would have been constraining during the 1998/99 and 1999/2000 seasons in Region 1, but is less likely to be so under more recent stock abundance levels and management practices. Nonetheless, regional bycatch needs as applied in this analysis are estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish fisheries and the potential for future changes in scallop bycatch among fisheries. In addition, both annual GHLs and anticipated bycatch needs will depend on which scallop beds are targeted because a given bed may not open every year. Therefore, a more conservative approach may be needed by ADF&G managers when setting GHLs for individual registration areas.

Alternative 3b specifies a multiplier of B_f=0.90 for the ACL within each region, and results in an estimated P*= 0.345 for Region 1, 0.418 for Region 2, and 0.252 for Region 4 (
Table 3-7). The rank differences in the P* values among regions reflects the relative differences in interannual variability of average catches over the years in which the proxy MSY values are based. It is also apparent that P* values, representing the probability that the ACL will exceed the true, but unknown OFL, increase as greater uncertainty is considered in the estimation of the OFL. The relative differences in regional P* values are less pronounced with reduced (i.e., smaller σ_a values), compared to greater, uncertainty.

This alternative improves protection to the scallop resource over status quo (and Alternatives 2a and 2b) by providing a 10% buffer between the OFL and the ACL. This protection is likely to be greatest when stock abundance, and the corresponding discard mortality, is high, and GHLs for the registration areas are close to the maximum allowable. Similar to Alternative 2b, there is greater potential for unanticipated catches and/or discards to result in a regional ACL being exceeded compared to a statewide ACL, as in Alternative 3a, because there is less opportunity to make in-season management adjustments by constraining fishing in alternate registration areas within a regional management area. We also note that there is currently no mechanism to address increased discard mortalities in non-scallop fisheries other than to reduce directed scallop fishery harvests.

4.5 Alternative 4

4.5.1 Alternative 4a: Statewide ACL ≤ 75% of OFL

Alternative 4a would establish a statewide ACL as 75% of the OFL. Applying the ABC control rule of 75% of the OFL results in a statewide ACL of 963,067 lbs (436.8 mt) of meats (Table 4-2). The estimated discard mortality becomes 33,067 lbs, with a retained catch of 930,000 lbs.

Historical ADF&G management performance produced annual retained catches ranging from 28% to 68% of the statewide MSY; retained catches have comprised <50% of the MSY since the 2001 LLP implementation for weathervane scallops (Table 4-3; NPFMC 2006). Thus, this alternative is anticipated to retain a buffer of at least 20% between the ACL and the GHL, after accounting for estimated discard mortality. This alternative is not likely to significantly affect ADF&G in-season management strategies, particularly based on harvest targets in recent years, and provided that bycatch does not increase dramatically based on future analysis. However, statewide bycatch needs as applied in this analysis are

estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish fisheries and the potential for future changes in scallop bycatch among fisheries.

The use of Equation 4 to examine Alternative 4a, which specifies a multiplier of B_f=0.75, indicates a statewide P* value of 0.091, thus, a relatively low probability that the ABC will exceed the true, but unknown OFL, given the available data and the assumption that variability is represented in the annual catch (
Table 3-7). However, incorporation of additional uncertainty increases the P* value, and σ_a values of 0.4 or 0.5 result in P* values exceeding that under a fixed multiplier of B_f =0.90 with no additional uncertainty.

By increasing the buffer between the OFL and the ACL to 25%, this alternative further increases the protection from overfishing provided to the weathervane scallop resource in comparison to Alternatives 3a or 3b. Given the history of management implementation, the 25% buffer substantially exceeds the maximum GHL overage of 5% since the 1998/99 season (Table 4-3). However, in the event of unanticipated overages in either the directed fishery harvests or discard mortality, this alternative with a statewide ACL, similar to Alternative 2a, allows for in-season management adjustments which curtail fishing in other registration areas. In addition,
Table 3-7 shows that high values of assumed additional uncertainty result in P* values that exceed the P* value with a fixed multiplier of 0.90 and no additional uncertainty. But, because of the 25% buffer in this alternative, in order for total catch to exceed the OFL, the actual discard mortality would need to substantially exceed preseason estimates, and all fishery harvests in all registration areas would need to be at or near the maximum GHL. We note that there is currently no mechanism to address increased discard mortalities in non-scallop fisheries other than to reduce directed scallop fishery harvests.

4.5.2 Alternative 4b: Regional ACLs ≤ 75% of the upper end of regional GHR + discards

Alternative 4b would establish regional ACLs based on 75% of the sum, by region, of the upper ends of the GHRs, defined in ADF&G regulation for commercial scallop fishery registration areas, plus estimated discard mortalities in the directed scallop fishery, the groundfish fisheries, and agency surveys. The total sum of the upper ends of the GHRs equal the MSY of 1.24 million lbs (562.5 mt) of shucked meats (Table 4-1). The GHRs for each ADF&G registration area are 285,000 lbs (129.3 mt) of shucked meats for Region 1, 70,000 lbs (31.8 mt) for Region 2, and 885,000 lbs (401.4 mt) for Region 4 (Table 4-2). This ABC control rule would result in ACLs of 223,899 lbs (101.6 mt) of meats for Region 1, 53,849 lbs (24.4 mt) for Region 2, and 685,319 lbs (310.9 mt) for Region 4. Estimated discard mortalities under these ACLs would be 10,149 lbs of meats in Region 1, 1,349 lbs in Region 2, and 21,569 lbs in Region 4, with resulting maximum GHLs of 213,750 lbs in Region 1, 52,500 lbs in Region 2, and 663,750 lbs in Region 4. Although these maximum GHLs are smaller than the upper ends of the GHRs as specified in State regulation, ADF&G management in recent years has targeted GHLs smaller than the regulatory maximum (Table 4-3).

This alternative would have constrained the fishery if implemented in the late 1990s to early 2000s in Regions 1 and in 2004/05 in Region 2 (Table 3-1). Based on ADF&G management performance following the 2001 implementation of the LLP, annual harvests as a proportion of the regional GHRs have ranged from 39.1 to 74.7% (mean = 53.9%, CV = 22.7%) for Region 1, from 28.5 to 79.2% (mean = 49.6, CV = 40.6%) in Region 2, and from 17.1 to 40.5% (mean = 31.0, CV = 23%) in Region 4 (Table 4-3). Depending on the stock assessment and anticipated bycatch needs in any given year, adoption of this alternative has the potential to constrain directed scallop fishing in Regions 1 and 2, but would likely retain an adequate buffer between the ACL and the ADF&G management target to accommodate discard mortality needs in Region 4. However, regional bycatch needs as applied in this analysis are estimated with some uncertainty due to the current pooling of scallops into a bivalve category for the groundfish

fisheries and the potential for future changes in scallop bycatch among fisheries. Given interregional variability in benthic species composition (e.g., mussels may predominate as bivalves in some areas while scallops predominate in other areas), uncertainty is likely exacerbated when estimating bycatch needs at the regional level.

Alternative 4b specifies a multiplier of B_f =0.75; through Equation 4, estimated P* values of 0.168 for Region 1, 0.304 for Region 2, and 0.063 for Region 4 (Table 4-2). The rank differences in the P* values among regions reflects the relative differences in interannual variability of average catches. As in other alternatives with B_f <0.75, P* increases with greater assumed additional uncertainty, particularly in Region 4 for which the P* values under σ_a of 0.4 or 0.5 exceeds that under a fixed multiplier of B_f =0.90 with no additional uncertainty (
Table 3-7).

We note that the Region 2 stocks have relatively low GHR caps and relatively high variability in fishery performance compared to other regions. The reasons for these differences are unknown, but several aspects are suspected. For the Prince William Sound scallop beds, fishing in 1995 by an unregistered vessel substantially exceeded the upper end of the Registration Area GHR, possibly reducing stock productivity (Barnhart et al. 2008). In the case of the Cook Inlet scallop beds, the beds, and corresponding biomasses, are relatively small with high interannual variability (Trowbridge and Goldman 2006), possibly suggesting relatively low resilience compared to other scallop beds. Thus, a slightly more conservative approach may be warranted for these areas.

This alternative, similar to Alternative 4b, provides greater protection to the weathervane scallop population relative to Alternatives 1-3. Although fisheries in some regions and years may have been constrained had the average discard mortality been considered under a 25% Control Rule, we note that management has been relatively precise in all regions (Table 4-3). Thus, with preseason incorporation of anticipated discard mortality into the management process, it is unlikely that scallop mortality would have approached the ACL. However, the previous notes about the reduced flexibility of in-season management adjustments under regional compared to statewide ACLs still apply under this alternative. We also note that there is no measure at this time that would constrain fishing in non-scallop fisheries to reduce weathervane scallop discard mortality.

4.6 Options for non-target species

No commercial harvests have been documented for scallop species other than weathervane scallops in waters off Alaska since at least 1992 (C. Russ, ADF&G, Homer, pers. comm.). Major fishery development is not anticipated for non-weathervane scallops but market potential does exist for both "pink and rock" scallops. The spatial distribution of non-weathervane scallop species is not well defined, although these species currently compose a relatively minor component of catches in both NMFS and ADF&G surveys. The following section discusses the possible impacts of the options considered (described in Section 2.1.4) for management of non-weathervane scallop species.

4.6.1 Remove non-weathervane scallop species from FMP

This option would limit the FMP to weathervane scallops by removing non-weathervane species from the FMP through an FMP amendment. The FMP covers all scallop stocks in waters of the EEZ off the State of Alaska. Seven species of non-weathervane scallops are known to occur in Alaskan waters but three species predominate: pink (*Chalmys rubida*); spiny scallops (*Chlamys hastate)*; and rock scallops (Crassodoma *gigantean*).

ADF&G currently has management authority for all scallops in State waters and ADF&G and NMFS jointly manage fishing for all scallop species in Federal waters under State and Federal regulations. If non-weathervane species are removed from the FMP, management authority over State-registered vessels fishing for non-weathervane scallops in all waters off Alaska will default to the State of Alaska. State regulation would apply to a vessel registered under State law that opted to fish for non-weathervane scallops in State or Federal waters. Non-weathervane scallops would be removed from the current LLP required for scallops and the permit limited to weathervane scallops. Without this permit, there would be no Federal permit requirement for operating VMS and no Federal permit gear endorsement for mandatory observer coverage on a vessel fishing non-weathervane scallops. Currently, 100 percent observer coverage is provided by the State of Alaska in commercial scallop fisheries as a category one management measure under the Scallop FMP and therefore observer coverage mandated by a federal fishing permit is not necessary.

Managing these species external to the Federal council process would ease the burden of Federal oversight for what would likely be a relatively small fishery. Additionally, State management can respond quickly in the short term and provide region and area expertise to prevent localized overfishing if a fishery prosecuted by State-registered vessels developed rapidly for non-weathervane scallops. The actions that would be required for a non-weathervane scallop fishery to develop under this option are, to some extent currently implemented by ADF&G. Individuals interested in harvesting non-weathervane scallops are required to obtain an ADF&G Commissioner's Permit. As conditions of the permit, ADF&G includes various management measures such as legal gear, harvest area, harvest limits, bycatch considerations, and observer and reporting requirements. If a fishery harvest were allowed, ADF&G would implement inseason management measures as needed to achieve fishery guidelines for scallop guideline harvest ranges and crab bycatch limits. In the event that State-registered vessels rapidly developed a fishery for non-weathervane scallops, the State would implement the High Impact Emerging Fishery Policy to constrain the fishery. As understanding of the fishery potential increases, the Alaska Board of Fisheries (Board) could develop a more refined management plan for vessels registered with the State to fish non-weathervane scallops. The Board reviews Scallop management proposals on a three-year cycle, and their next regularly scheduled review is in early 2012.

Several factors merit consideration in evaluating the risks of the option to remove non-weathervane scallops from the Scallop FMP. These include the magnitude of a potential non-weathervane scallop fishery, directed fishing for non-weathervane scallops by unlicensed vessels (i.e. vessels without State of Alaska registration or a Federal LLP), and the impacts of unlicensed fishing vessels on incidental catch, EFH, and protected habitat areas.

Information on catch of non-weathervane scallops compiled for this analysis and from ADF&G managers provide data on stock distribution, the extent of existing fishing effort, and the potential for development of a directed fishery for non-weathervane scallops; this data is summarized below:

- Generally little is known on the distribution of non-weathervane species although they are encountered during the directed fishery for weathervane scallops, and in groundfish trawl fisheries.

- Combined information from ADF&G and NMFS regional trawl surveys (Table 3-4) shows that the sum of the annual average survey catch was 91 whole pounds between 1998 and 2008. Non-weathervane species are also seen in camera sled surveys in areas with and without weathervane scallops.

- Incidental harvest of non-weathervane scallops during the directed weathervane scallop fishery is low, likely due to the minimum 4" diameter ring size that must be used on weathervane scallop

dredge gear. During the 2007/08 weathervane scallop fishery less than 0.1% of the harvest in Kodiak's Northeast District was *Chlamys* sp. (see ADF&G summary of observer data report at http://www.sf.adfg.state.ak.us/FedAidPDFs/FDS10-36.pdf, Table 11).

- Section 4.6.3 of this analysis contains a report by personal communication of historical commercial harvests of non-weathervane scallops. Between 1991 and 1992, harvests along the Aleutian Islands were limited to approximately 124,000 lbs of meats . All of the harvest occurred in waters of the EEZ.

- Since the early 1990s there has been very little interest in targeting non-weathervane scallops, as demonstrated by only a few requests for Commissioner's permits. ADF&G area shellfish managers reported only one request for a Commissioner's permit in the Central region in the early 1990s (no harvest), and the Westward region received one request in 2008 for fishing Petrel Bank. This request was denied because of an established red king crab fishery in the same area.

- Limited non-commercial harvest of *Chlamys* sp. and rock scallops by divers currently occur within nearshore waters under State jurisdiction.

Recent agency surveys and records of commercial and recreational effort indicate non-weathervane scallops are dispersed in waters off Alaska but whether commercial quantities exist is unknown at this time. The lack of effort by the currently licensed weathervane scallop fleet to target non-weathervane scallops under a Commissioner's permit suggests there is insufficient economic incentive to prosecute a fishery on non-weathervane species and limited potential for a fishery to develop in the near-term. Compared to the "Mr. Big" scenario where an unlicensed vessel targeted a known stock of highly valuable weathervane scallops, there does not currently appear to be a known, productive concentration of non-weathervane scallops to prompt investment in a fishery.

The risk of unlicensed vessels developing the non-weathervane scallop fishery appears to be low based on State records that show few Commissioner's Permits have been issued and no effort to target non-weathervane scallops has been expended by the scallop LLP holders. The Scallop FMP was developed in part to limit the potential of unlicensed vessels from fishing for weathervane scallops and notes that "the objective of the Scallop FMP is to prevent localized overfishing of scallop stocks and protect the long term productivity of the resource to allow for the achievement of optimum yield on a continuing basis. This objective is based on the premise that uncontrolled fishing for scallops in Federal waters could result in irreversible damage to the resource's ability to recover in a reasonable period of time." This Scallop FMP objective recognizes risk is not just a near-term issue but that a precedent has been set for unlicensed activity of a vessel fishing for scallops in Federal waters outside the jurisdiction of State of Alaska regulations (a.k.a. "Mr. Big").

It seems unlikely that a non-weathervane scallop fishery could be prosecuted without bottom contact and incidental bycatch of FMP species such as weathervane scallops, crab, or groundfish. The impacts could be significant on these species especially in areas where scallop and crab habitat overlap. Protection of EFH and areas of habitat concern deserve high priority in assessing risk of removing non-weathervane scallops from the scallop FMP. In the event that a vessel fishing in the EEZ with a State of Alaska registration, but without a Federal fisheries permit, was found retaining more than an incidental amount of any FMP species (e.g. weathervane scallops), then prompt Federal enforcement action may be taken. Current State-mandated observer coverage serves as a deterrent to discarding incidental species catch to circumvent such enforcement action. Federal enforcement action could not intervene in suspected unrestricted fishing in the EEZ for non-weathervane scallops by a State-registered vessel unless a federal violation (e.g., impacts on EFH) was identified. To halt fishing where there is not a violation of existing federal regulation would require the adoption of an emergency rule to prohibit the activity at issue. In

making this recommendation, the Council considers the NMFS policy guidelines for the development and approval of regulations to address emergencies. Emergency rule making is intended for circumstances that are extremely urgent, where substantial harm to or disruption of the fishery would be caused in the time it would take to follow standard rulemaking procedures (62 FR 44421). An emergency rule is not immediate and requires a minimum 30-day public notice unless notice and comment are waived. During this interim period, habitat and associated resources lack protection from continued impacts of fishing. It may be possible to develop Federal regulations to minimize bycatch and protect habitat by requiring any vessel fishing mobile bottom contact gear in the EEZ off Alaska to operate VMS, carry an observer, and not enter habitat of particular concern; however, this regulatory process can take about two years to complete.

Removing non-weathervane scallops from the FMP enables the State to manage the development of a commercial fishery without going through the Federal regulatory process. It also creates a risk that a vessel not registered with the State of Alaska could enter the EEZ and conduct unregulated fishing for non-weathervane scallops. This risk is low as unregistered vessels could circumvent State regulations only if that vessel never entered State of Alaska waters. To do so, the vessel would have to: 1) be a U.S. vessel that is documented by the U.S. Coast Guard to fish in the EEZ; 2) have enough food, fuel, and other supplies so as to not enter State waters; and 3) harvest enough non-weathervane scallops to cover costs, while avoiding harvest of any FMP species including weathervane scallops. Table 4-4 provides an overview of the potential limitations on a vessel operating in Federal waters under a suite of licensing scenarios if non-weathervane scallops were removed from the FMP.

Table 4-4 Management Regime for Non-Weathervane Scallops if Removed from the Scallop FMP.

Management Regime	Vessels with a Federal weathervane scallop LLP and with a State of Alaska permit	Vessels without a Federal weathervane scallop LLP and with a State of Alaska permit	Vessels with a Federal weathervane scallop LLP and without a State permit	Vessels without a Federal weathervane scallop LLP and without a State permit
Remove Non-Weathervane Scallops from FMP. No Federal fisheries license would be required. No Federal monitoring would be required.	Could harvest non-weathervane scallops under restrictions imposed by State of Alaska (State). State could require an ADF&G Commissioner's permit, or impose other harvest restrictions. State Emergency Order authority could control known harvests if necessary.		Could harvest non-weathervane scallops in Federal waters. Would not be restricted by ADF&G Commissioner's permit in Federal waters. No rapid Federal action to curtail non-weathervane scallop harvests in Federal waters; Federal emergency rule required to manage non-weathervane scallop harvest under an FMP.	

		Federal emergency rule required to manage non-weathervane scallop harvest under an FMP. Could not land non-weathervane scallops in Alaska.	Could not land non-weathervane scallops in Alaska. Could not retain more than incidental amount of any FMP species.

Although the overall risk to stocks of non-weathervane species from unlicensed vessels by removing them from the Scallop FMP is low, that risk could be further reduced by placing non-weathervane scallops into an EC category of the FMP, instead of removing them from the FMP. Non-weathervane scallops likely could qualify as an EC species. The continued inclusion of non-weathervane scallops in the Scallop FMP would enable State and Federal fishery managers through coordinated exercise of their respective authority, to limit all vessels operating in the EEZ, whether or not they are registered with the State, from targeting or retaining non-weathervane scallops in Federal waters. It is not clear how transferring non-weathervane scallops to an EC would be executed within the FMP framework that delegates category one management measures to the State of Alaska. As has been discussed, once species are an EC, the species is not in the fishery, and therefore should not be exploited by a directed fishery until the FMP is amended to transfer them out of an EC, establish status determination criteria and an annual catch limit. The transaction as described effectively removes fishery access in the EEZ and requires Federal regulation to amend the FMP before fishing can resume. This could be addressed though addition of a category two management measure to transfer species from the ecosystem species component category into the fishery.

Retaining non-weathervane scallops as an EC species should eliminate the risk of unregulated fishing in the EEZ. However, the cost of that insurance is that some federal action will be needed before a commercial fishery in the EEZ could develop. A commercial fishery could develop in State waters while non-weathervane scallops are designated an EC species.

Assuming there is a relatively low risk of unlicensed vessels becoming active in the non-weathervane scallop fishery the difference between management by removing non-weathervane scallops from the FMP, or by managing non-weathervane scallops as an EC species, is the positioning of management authority by the State or Federal government for regulation and enforcement of fishing activity in the EEZ.

4.6.2 Move to Ecosystem Component [preferred]

This option would create an EC category in the FMP for the non-target rock scallops and the *Chlamys* species. This action would retain oversight of non-target scallops by the Council, and require monitoring, to the extent practicable, of the scallop species exclusive of weathervane scallops. Monitoring would likely include compilation of historical and future data from sources such as State and Federal surveys and incidental bycatch in other fisheries, with a periodic status report summarizing landings and biomass data provided through SAFE reports. There is currently little information available on these non-target species and their role in the ecosystem as a benthic, filter feeder is unknown, as is their potential as an ecosystem indicator. One criterion that should be met for EC classification (see section 2.1.4.2) is that non-target species "Not generally be retained for sale or personal use." At present, some non-commercial harvests of non-target species (e.g., harvests by scuba divers) occur, although the extent of these removals is not well quantified.

The following factors were considered, per the National Standard 1 Guidelines, in classifying these non-target species as an EC species:

(A) These scallop species are not the target of commercial exploitation or retention by commercial fisheries;
(B) None of the non-target scallop species are generally retained for sale or personal use;
(C) The best available scientific information indicates that none of the non-target scallop species are overfished or subject to overfishing; and
(D) The best available scientific information indicates that none of the non-target stocks are likely to become subject to overfishing or overfished in the absence of conservation and management measures.

In accordance with NS 1 Guidelines, reference points and status determination criteria are not specified for the EC species. No additional catch restrictions would be enacted (e.g. prohibited bycatch of these species in other fisheries) if non-target species are transferred to an EC classification. If there was a future interest in fishery development, these species would need to be moved "into the fishery" through an FMP amendment and ACLs would need to be established annually.

Classifying non-target scallop species as EC species would improve management under the FMP but would have nominal impacts on these species because they are currently not subject to fishing. However, these species would be monitored to ensure they are not targeted and that incidental catch does not reach a point where there are concerns for the sustainability of these stocks. Evaluation of EC species bycatch in the weathervane scallop fishery occurs annually through the existing SAFE report process. The SAFE report annually summarizes best available scientific information on EC species. The weathervane scallop fishery has an insignificant effect on the productivity and thus the sustainability of any non-target scallop species. Therefore, the proposed action and its alternatives would not change the way the fishery impacts the sustainability of any non-target species under the scallop FMP and, therefore, the proposed actions will have an insignificant effect on these species.

4.6.3 Set ACLs for non-weathervane scallops

Establishment of ACLs for non-target scallop species would potentially provide increased protection against fisheries impacts. However, the data available to establish ACLs is limited. Establishment of ACLs will require stock assessment or fishery performance data for non-target species as either a group or broken out by individual species. Reported commercial harvests for *Chlamys* sp. are limited to approximately 124,000 lbs of meats harvested along the Aleutian Islands between 1991 and 1992 (C. Russ, ADF&G, Homer, pers. comm.). The rock scallop is harvested by divers for personal use in nearshore waters of Southeast Alaska, but commercial harvests have not been recorded.

Documentation of any scallop species by federal groundfish observers has been limited, with at-sea observations pooled into a "bivalve" category that averaged 39,087 lbs (whole weight; 17.7 mt) annually across all Alaska groundfish fisheries (Table 3-3). Delineating this bivalve catch into more refined species groups, including non-target scallop species, is not possible at this time. The NMFS and ADF&G bottom trawl surveys have also produced some data on the abundance and distribution of non-target scallop species, although species identification has been inconsistent over time; most of the non-target species encountered by these survey platforms are likely *Chlamys* sp. In addition, samples sizes on which to establish ACLs for non-target species is sparse, represented by an annual average survey catch of 1 lb from Region 1, 23 lbs from Region 2, and 67 lbs from Region 4 for a statewide total of 91 lbs annually among all ADF&G and NMFS trawl survey platforms since 1998 (Table 3-4).

In the event that this option is selected by the Council, it is expected that development of ACLs in anticipation of a potential fishery will involve a concerted effort by both ADF&G and NMFS staff for data compilation, analysis, and technical review, as well as periodic updates of data and analysis. Although both state and federal waters contribute to the greater population, the species composition and spatial distribution remains largely unknown. In addition to the Council process to develop ACLS, determination of the TAC/GHL would involve virtually all of the management measures identified under Option 1 as being implemented by ADF&G. In essence, measures to be developed by the State of Alaska would include, but not limited to, legal gear, harvest area, harvest limits, bycatch considerations, and in-season management measures such as observer and reporting requirements. In the event of rapid fishery development for non-target scallop species, the State would implement the High Impact Emerging Fishery Policy to constrain fishery development until additional management measures are developed. As understanding of the fishery potential increases, the Alaska Board of Fisheries would develop a more refined management plan.

Three proposed approaches to establish an OFL for non-target stocks in aggregate are provided in Section 2.1.4.3.

4.7 Economic Impacts

4.7.1 Indirect Effects

Assessment of economic indirect effects that the analyzed ACL alternatives may have on the scallop fishery is constrained by confidentiality of data, the availability of reliable cost and operational data, and the lack of thoroughly tested models to quantify direct effects as a basis for estimating indirect effects. As a result, indirect effects of the alternatives on the scallop fishery are necessarily hypothetical in nature. In combination these constraints limit discussion of economic indirect effects. Qualitatively, fishing practices under any of the alternatives are likely unchanged from current conditions. There would be no change to the LLP or to any of the licenses under the alternatives. Therefore, no change is anticipated in relative value of the scallop fishery LLP licenses or the economic indirect effects on participants in the fishery. Under the action alternatives, restrictions would be established that formalize several existing practices of the cooperative State and Federal management of the scallop fishery. These restrictions clarify the uncertainty in estimating harvests and circumstances when management action is appropriate to prevent overfishing. These changes in process would provide fishery participants additional information about the fishing seasons and may have economic indirect effects on participant decision making.

4.7.2 Direct Effects

This section provides analysis of the potential economic direct effects that the ACL alternatives may have on the scallop fishery. This analysis compares the ACL levels, as a percent of the OFL, with the percent that harvest has represented by region and statewide from the 1998/99 season through the 2008/09 season. The information contained in this section comes from Table 3-6 as well as from economic price and revenue data contained in the 2010 Scallop SAFE report (NPFMC 2010b). This retrospective analysis shows what would have occurred, in terms of forgone revenue, had the ACL levels been in place during this time frame.

Figure 4-2 provides an historical overview that identifies seasons when the scallop harvests, statewide and by region, would have exceeded the ACL levels of 75 percent and 90 percent of the OFL. This figure makes it clear that were the ACL set at a statewide level there would historically have been no impact because the statewide harvests, since inception of the current MSY of 1.24 million pounds, have always been below both the 75 percent and 90 percent levels of MSY, the functional OFL. This figure does;

however, point out that were the ACL set regionally at 75 percent of the upper end of the regional GHR, the ACL would historically have been exceeded, or nearly so, for Region 1 in each of the seasons of 1998/99, 1999/00, 2000/01, and 2005/06 (each instance is circled). This is also true for Region 2 in 2000/01 and 2004/05. An ACL set at 90 percent of the upper end of the regional GHR would have been exceeded in 1998/99, 1999/00 in Region 1. In contrast, Region 4 harvests have not historically exceeded 60 percent of the upper end of the regional GHR and would not have been affected by ACLs set at either the 75 percent or 90 percent of the GHR.

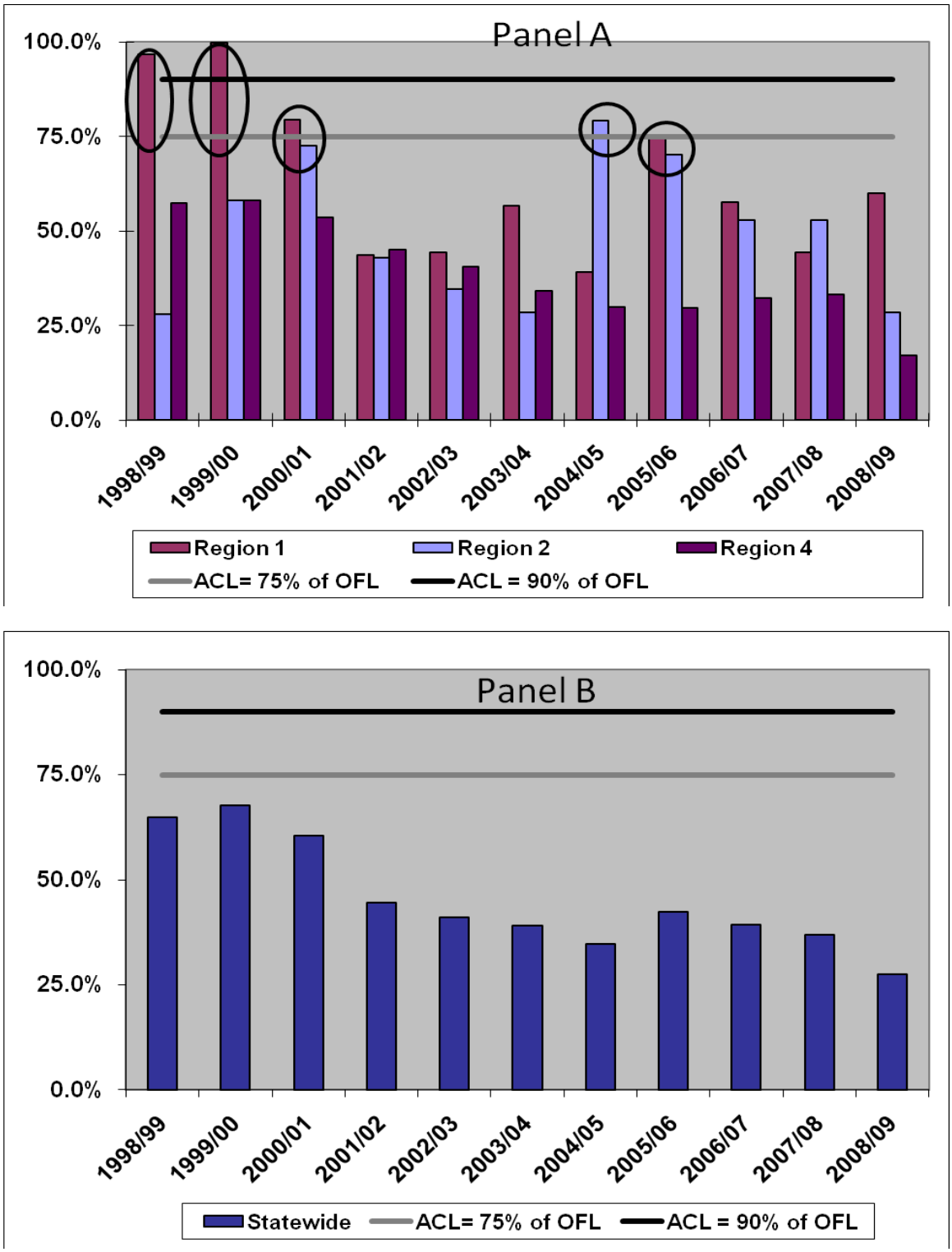

Figure 4-2 Scallop harvests by region (a) and statewide (b) as a percent of the upper end of the GHR, compared to ACL levels.

Scallop prices along with overall revenue estimates by region and statewide and are presented in Table 4-5.

Table 4-5 Alaska scallop first wholesale value per pound with total revenue (in dollars) by region and season.

Year	Real Price ($/lb.)	Value of Annual harvest			
		Region			
		1	2[a]	4	Statewide
1998/99	$7.94	$2,190,098	$156,021	$4,034,449	$6,380,568
1999/00	$7.63	$2,169,247	$310,732	$3,913,740	$6,393,719
2000/01	$6.60	$1,495,580	$335,161	$3,123,331	$4,954,072
2001/02	$6.14	$762,576	$184,753	$2,446,501	$3,393,830
2002/03	$6.04	$763,474	$146,361	$2,167,273	$3,077,108
2003/04	$5.88	$952,501	$117,482	$1,779,088	$2,849,072
2004/05	$6.00	$668,280	$332,622	$1,588,662	$2,589,564
2005/06	$8.03	$1,710,398	$395,116	$2,113,103	$4,218,617
2006/07	$8.10	$1,331,600	$299,619	$2,317,313	$3,948,531
2007/08	$5.98	$754,317	$221,888	$1,764,507	$2,740,712
2008/09	$6.34	$1,085,884	$127,054	$958,094	$2,171,032

Under Alternative 1 (the No Action alternative), scallop catch would continue to be constrained by the statewide MSY and GHLs and GHRs set by ADF&G registration areas. Assuming the ecology of the scallop resource remains relatively constant and that the harvest levels and first wholesale value per pound remain similar, the economic effect of not taking action would be insignificant.

Alternative 2a would set a statewide ACL equal to the OFL. As shown in both Figure 4-2 and in Table 4-1, this alternative would historically have had no direct effects because the statewide harvest has not exceeded 70 percent of the MSY and has been considerably lower than that percentage in recent years.

Alternative 2b would set the regional ACLs at the upper end of the GHR in each individual region. As shown in both Figure 4-2 and in Table 3-6, this alternative would historically have had no direct effects because regional harvests have not exceeded the upper range of the GHR in recent years, although Region 1 harvests were within two tenths of a percentage point of achieving the upper range of the GHR in the 1999/00 season.

Alternative 3a would establish a statewide ACL that would be 90 percent of the OFL. As shown in Table 4-6, a statewide ACL set at 90 percent of the upper end of the statewide GHR would not have resulted in forgone revenue in any of the seasons since 1998/99, when the 1.24 million pound MSY was first implemented. A review of Table 4-1 and Figure 4-2 shows that the greatest statewide harvest, as a percentage of GHR, occurred in 1999/00 at 67.6 percent of the MSY and has trended downward in recent years.

Alternative 3b would set regional ACLs at 90 percent of the upper end of the GHR in each individual region. As shown in Table 4-6, Region 1 would historically have had forgone harvest and revenue of 6.8 and 9.8 percent in 1998/99 and 1999/00 respectively. This translates into $148,927 and $212,586 of forgone revenue in 1998/99 and 1999/00 respectively. The other regions would historically not have been affected by this alternative.

Table 4-6 Percent of harvest and revenue (upper) that would historically have been forgone under ACL=90% of regional GHR along with estimated historic forgone revenue (dollars, lower)

Year	Percent of harvest forgone with ACL=90% of regional GHR			
	Region 1	Region 2	Region 4	Statewide
1998/99	6.8	0	0	0
1999/00	9.8	0	0	0
2000/01	0	0	0	0
2001/02	0	0	0	0
2002/03	0	0	0	0
2003/04	0	0	0	0
2004/05	0	0	0	0
2005/06	0	0	0	0
2006/07	0	0	0	0
2007/08	0	0	0	0
2008/09	0	0	0	0
Year	Forgone Revenue with ACL=90% of regional GHR			
1998/99	$148,927	$0	$0	$0
1999/00	$212,586	$0	$0	$0
2000/01	$0	$0	$0	$0
2001/02	$0	$0	$0	$0
2002/03	$0	$0	$0	$0
2003/04	$0	$0	$0	$0
2004/05	$0	$0	$0	$0
2005/06	$0	$0	$0	$0
2006/07	$0	$0	$0	$0
2007/08	$0	$0	$0	$0
2008/09	$0	$0	$0	$0

Alternative 4a would establish a statewide ACL that would be 75 percent of the OFL. As shown inTable 4-7, a statewide ACL set at 75 percent of the OFL would not have resulted in forgone revenue in any of the seasons since 1998/99, when the 1.24 million pound MSY was first implemented. A review of Table 4-1 and Figure 4-2, shows that the greatest statewide harvest, as a percentage of MSY, occurred in 1999/00 at 67.6 percent of MSY and has trended downward in recent years.

Alternative 4b would set regional ACLs at 75 percent of the upper end of the GHR in each individual region. As shown inTable 4-7, Region 1 would historically have had forgone harvest and revenue of 21.8 percent, 24.8 percent, and 4.5 percent in 1998/99, 199/00, and 2000/01 respectively. This translates into $477,441, $537,973, and $67,301 of forgone revenue in 1998/99, 199/00, and 2000/01 respectively. In addition, Region 2 would have had forgone harvest and revenue of 4.2 percent, or $13,970, in the 2004/05 season. Region 4 would historically not have been affected by this alternative.

The economic effects of the management alternatives on other scallop species not targeted by the weathervane scallop fishery are difficult to approximate because existence of commercial quantities is unknown. Interest in developing a fishery and extent of market potential are also unknown. Harvest of non-weathervane scallops was documented in a single landing in 1992 and minor quantities of other scallops occur as discards in the weathervane scallop fishery and as bycatch in groundfish fisheries. A directed fishery on non-weathervane scallops could result in bycatch of weathervane scallops which may

have economic implications for weathervane scallop fishermen. More detailed discussion of the alternative management options for non-weathervane scallops is provided in Section 4.6 of this analysis.

The economic effects of the management alternatives on non-weathervane scallop species not targeted by the weathervane scallop fishery likely differ between the alternatives. As noted previously, the three alternatives provided for non-weathervane scallop species are: 1) removal from the FMP; 2) placement in an EC category; and 3) set an ACL. An economic effect of removing non-weathervane scallops from the FMP could result from an unlikely but plausible loss of existing and future weathervane and non-weathervane scallop resources from overfishing by unlicensed and unregulated fishing operations and impacts to EFH and protected habitat areas. Placing non-weathervane scallops in an EC category means the species are not "in the fishery", and therefore cannot be exploited by a directed fishery until the FMP is amended. In this case the economic effect on non-weathervane scallops would be a function of lost fishing opportunity and as yet undetermined future catch and resource value. Retaining scallop species in the FMP requires a permit under State management authority to fish in State or Federal waters. Potential economic effects from permitting a fishery on non-weathervane scallops would depend on the permit conditions that can specify among multiple restrictions, which may include a harvest limit, harvest area and observer requirements.

The weathervane scallop fishery has an insignificant effect on the productivity and thus the sustainability of non-weathervane scallops. Therefore, this action and its alternatives would not change the way the weathervane scallop fishery impacts the sustainability of any non-target scallop species under the scallop FMP and thus the alternatives will have an insignificant effect on these species.

Table 4-7 Percent of harvest and revenue (upper) that would historically have been forgone under ACL=75% of regional GHR along with estimated historic forgone revenue (dollars, lower)

Year	Percent of harvest forgone with ACL=75% of regional GHR			
	Region 1	Region 2	Region 4	Statewide
1998/99	21.8	0	0	0
1999/00	24.8	0	0	0
2000/01	4.5	0	0	0
2001/02	0	0	0	0
2002/03	0	0	0	0
2003/04	0	0	0	0
2004/05	0	4.2	0	0
2005/06	0	0	0	0
2006/07	0	0	0	0
2007/08	0	0	0	0
2008/09	0	0	0	0
Year	Forgone Revenue with ACL=75% of regional GHR			
1998/99	$477,441	$0	$0	$0
1999/00	$537,973	$0	$0	$0
2000/01	$67,301	$0	$0	$0
2001/02	$0	$0	$0	$0
2002/03	$0	$0	$0	$0
2003/04	$0	$0	$0	$0
2004/05	$0	$13,970	$0	$0
2005/06	$0	$0	$0	$0
2006/07	$0	$0	$0	$0
2007/08	$0	$0	$0	$0
2008/09	$0	$0	$0	$0

4.7.3 The Economic Benefits of ACL Management

ACLs are intended to reduce the probability that overfishing could occur, and thereby improve the likelihood that OY is achieved for the fishery as a whole. The achievement of OY is a major tenet of fisheries management under the national standards prescribed in the Magnuson-Stevens Act.

For fish stocks that are not undergoing overfishing, such as weathervane scallops, ACL requirements still might require catch targets slightly less than current catch quotas if there is a demonstrated risk of overfishing. In general, management via ACLs should contribute to the conservation of stocks through more rapid rebuilding of overfished stocks and preventing overfishing, even in stocks not presently overfished.

Weathervane scallops are presently being harvested at levels that are considerably below the MSY for this fishery (Table 4-1). Historically, the fishery has not exceeded 70 percent of statewide MSY. This is largely due to conservative management by ADF&G, which sets GHLs that are below the upper end of the GHR range. Further, the fishery has 100 percent observer coverage, although coverage may be waived in the Cook Inlet area at the discretion of ADF&G staff. Thus, management of the fishery, via closures, is quite timely and results in catch that does not generally exceed the GHLs, which are set below the upper end of the GHRs (Table 4-3).

Chapter 5 Other Marine Resources and Habitat

Bycatch in the scallop fishery includes prohibited species, other commercially important species of fish and invertebrates, miscellaneous non-commercial species, and natural and man-made debris (e.g., Barnhart and Rosenkranz 2003). Prohibited species include king crab (*Paralithodes camtschaticus*), Tanner crab (*Chionoecetes bairdi*), snow crab (*C. opilio*), Dungeness crab (*Cancer magister*), and Pacific halibut (*Hippoglossus stenolepis*). Although a variety of marine vertebrates, invertebrates, and debris are caught incidentally in the scallop fishery dredges, weathervane scallops comprise the bulk of haul composition samples. During the 2000/01–2007/08 seasons, the most common items, by percent weight, have been weathervane scallops (84%), twenty-arm sea stars *Pycnopidia helianthoides* (4%), natural debris such as kelp and wood (3%), and assorted skate species (2%) (NPFMC 2010b). Gorgonian (hard) corals are infrequently encountered in observer samples; corals were observed in only 11 of 15,836 sampled tows.

For this action, the setting is all waters in and off Alaska including the Bering Sea, Aleutian Islands and Gulf of Alaska. Any effects of this action and analysed alternatives are limited to this area. The alternatives will not increase the amount of harvest, the intensity of harvest or the location of harvest, therefore, this action is not expected to increase the impacts of the scallop fishery on habitats and Essential Fish Habitat (EFH). Impacts of the scallop fishery on habitat are discussed in section 5.4 of the EA, Appendix D of the FMP (NPFMC 2006), and the Environmental Impact Statement (EIS) for Essential Habitat Identification and Conservation in Alaska (NMFS 2005). The EIS also addresses impacts of the scallop fishery on the EFH assessment and designated Habitat Areas of Particular Concern. The EIS concludes that impacts on EFH from the scallop fishery are minimal and temporary.

The effects of this action on society within this area are on individuals directly and indirectly participating in the Federal scallop fishery and on those who use the ocean resources. Because the alternatives concern the use of a present and future resource, this action may have impacts on society as a whole or regionally (NPFMC 2005). Public health and safety will not be impacted by this action. Amendment of the scallop FMP to reduce the risk of overfishing will not have substantial or adverse impacts on vessel operations, crew size, fishing practices, gear or gear usage, processing product, or the entanglement or entrapment of non-target organisms in active or inactive scallop fishing gear. The action is not expected to substantially affect any of the groundfish fisheries, therefore the scallop fishery will have no substantial impacts on public health and safety in other fisheries. Operation of the scallop fishery under the scallop FMP will not change. Therefore, the action will have an insignificant effect on public health and safety.

5.1 Impacts of Alternatives on Scallop Fishery Bycatch

Pacific cod has typically comprised <0.5% of scallop fisheries catch biomass (e.g., Rosenkranz and Burt 2009). Because a single Pacific cod weighs substantially more than a single scallop, on average, observer estimates of Pacific cod bycatch by weight represent relatively few individual Pacific cod compared to weathervane scallops. Under current scallop fishery in-season management strategies in which ADF&G targets a GHL that is typically well below any of the proposed alternative ACLs, adoption of any of the proposed alternatives is not expected to substantially affect the Pacific cod fisheries. Although the potential exists for shifts in a species spatial distribution due to aspects such as global warming or changes in inter-specific competition (e.g., Perry et al. 2005), it is still unlikely that Pacific cod would develop substantial spatial overlap with weathervane scallops given different habitat preferences.

The scallop fishery bycatch extrapolation of observer samples in the NMFS catch accounting program indicates bycatch of bivalves, including scallops, in the Pacific cod fishery (J. Gasper, NMFS, Juneau, pers. comm.). This is based on the occurrence of bivalves observed on top of retrieved pots, clamped onto retrieved longlines, or in the dump of a trawl tow. Under the current management approach and

proposed ACL alternatives, estimates of the anticipated bycatch of weathervane scallops in the Pacific cod fisheries are deducted from the scallop fishery ABC(s) under the ABC control rule applicable for the alternative considered. Although this essentially redistributes the burden for scallop bycatch in the Pacific cod fisheries to the scallop fisheries, the bycatch redistribution is not limiting to the scallop fishery based on the current approach to specifying ABC and the available data for scallop bycatch in the Pacific cod fishery.

Skates have become a species of concern due to life history characteristics and an uncertainty in the catch composition (Ormseth and Matta 2009). Skates comprise ~2% of historical catch biomass in observed scallop tows (Barnhart and Rosenkranz 2003). Flounder and sole in aggregate typically comprise < 1.5% of scallop fishery catch biomass, but may approach 5% along the Alaska Peninsula. Other groundfish species typically comprise smaller components of the scallop bycatch. Based on the proportionally smaller body size of scallops compared to most groundfish species, these bycatch values represent a relatively small number of individual groundfish.

Based on this information, the weathervane scallop fishery has an insignificant effect on the productivity and thus the sustainability of any non-target groundfish species. The proposed action and its alternatives would not change the way the fishery impacts the sustainability of any non-target species under the FMP and, therefore, the proposed actions will have an insignificant effect on these species. Under current scallop fishery in-season management in which ADF&G targets a GHL that is typically well below any of the proposed alternative ACLs and the 100% observer coverage collects complete data on bycatch in the scallop fishery.

Shifts in species distribution due to factors such as climate change or inter-specific competition may increase scallop fishery bycatch of any groundfish resource. Similarly, such shifts may increase scallop bycatch in particular groundfish fisheries. These potential changes would need to be addressed as they occur.

5.2 Impacts on Marine Mammals

Within the EEZ off Alaska, the scallop fishery is classified as a Category III fishery under the Marine Mammal Protection Act because it has annual mortality and serious injury of a marine mammal stock of less than 1% of that stock's potential biological removal. A fishery that interacts only with non-strategic stocks and whose level of take has insignificant impact on the stocks is placed in Category III. An observer program is in place for the scallop fisheries off Alaska. No takes of marine mammals in the scallop fishery off Alaska recorded in the ADF&G Observer database during 1996–2008. However, anecdotal information suggests a small pinniped was captured in a scallop dredge fished off Yakutat in 2009 (R. Burt, ADF&G, Kodiak, pers. comm.). Although the condition (i.e., alive or dead) of the pinniped prior to capture in the dredge was not determined, the likelihood of a live marine mammal being captured in a scallop dredge remains extremely low. Therefore, the mortality of the pinneped cannot be attributed with certainty to the weathervane scallop fishery. The weathervane scallop fishery has insignicant , if any, impacts on marine mammals. The proposed action and its alternative would not change the way the scallop fishery impacts endangered or threatened species, marine mammals, or critical habitat of these species under the FMP and, therefore, the proposed actions will have an insignificant effect on these species and their critical habitat.

5.3 Impacts on Other Benthic Organisms

Because the scallop fishery off Alaska has 100% observer coverage (although coverage may be reduced at the discretion of ADF&G management staff in the Cook Inlet region; Trowbridge and Goldman 2006;

NPFMC 2010b), bycatch data on non-target species in the fishery is well documented. This includes prohibited species (e.g., crab and halibut), other commercially important fish and invertebrate species, miscellaneous non-commercial species, and natural and man-made debris. Annual ADF&G reports document catch composition data from observer sampling (Rosenkranz and Burt 2009).

Crab mortality in the scallop fisheries likely varies spatially and by fishing practices and benthic substrate. Hennick (1973) estimated about 30% of Tanner crabs and 42% of the red king crabs caught in scallop dredges in the Gulf of Alaska fishery were killed or injured. Hammerstrom and Merritt (1985) estimated an 8% mortality to Tanner crab in Cook Inlet scallop fishery, whereas Kaiser (1986) estimated mortality rates of 19% for Tanner crab and 48% for red king crab bycatch off Kodiak Island. Based on observer data collected in 1993, Urban et al. (1994) reported 13–35% of the Tanner crab caught by scallop dredges were dead or moribund, with the highest mortalities for small (<40 mm carapace width, CW) and large (>120 mm CW) crabs. Delayed mortality in discarded Tanner crab has not been estimated. Compared to the Gulf of Alaska, crab mortality appears to be lower in the Bering Sea scallop fisheries with observer-documented mortalities of 10% for red king crab, 11% for Tanner crab, and 19% for snow crab (Barnhart et al. 1996). As in the Gulf of Alaska, mortality appeared to be related to size, with larger and smaller crabs having higher mortality rates (Barnhart et al. 1996). These mortality rates are substantially less than the 80% discard mortality assumed for crab species caught by bottom trawls fisheries in the Bering Sea (NPFMC 2010a).

Following the 2001 implementation of fishery cooperatives in the scallop fishery, incidental catch in the scallop fishery dropped by 39%, including catch and discard reductions of 51% for brittle stars and sea baskets, 1% for prohibited species, 12% for other commercial species, 56% for kelps and rocks, and 52% for miscellaneous starfish species (Northern Economics 2003). The decline in kelp and rocks is noteworthy in that these make up important habitat components of the ecosystem; thus, this decline may indicate reduced stress upon the habitat as a result of revised fishing practices following the formation of cooperatives.

Crab Bycatch Limits (CBLs) are used to monitor and regulate crab bycatch in the scallop fishery based on localized crab stock abundance (Table 5-1). Annual CBLs are established by ADF&G by region before the scallop season, and bycatch is monitored in-season through observer reports. Scallop fishery closures due to CBLs attainment have decreased in recent years, partly due to decreased crab abundance (Barnhart and Rosenkranz 2003), and also due to industry encouragement to avoid high bycatch areas. Bycatch may affect harvest and CPUE in the Bering Sea scallop fishery as vessel operators cease fishing when bycatch rates exceed benchmarks. Although bycatch caps, expressed as crab abundance, include all sizes of crabs caught in the scallop fishery (Barnhart 2003), prohibited species caps are based on total abundance irrespective of crab size. Thus, a juvenile crab accrues to the PSC limit the same as an adult crab. However, in areas where CBLs are linked to crab stock abundance, reduction in the abundance of a crab stock results in a corresponding reduction in the CBL, thus providing increased protection to the crab stock. The Scallop SAFE report annually reports crab bycatch in the Alaskan scallop fishery (NPFMC 2010b). Annual bycatch of crab species in the scallop fishery are shown in Table 5-2.

None of the alternatives would change the prosecution of the weathervane scallop fishery in a way that would increase its impacts on crab or other benthic organisms. Therefore, none of the alternatives are expected to jeopardize the long-term productivity of crab or other benthic organisms.

Table 5-1 Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.

Area/District	Red King Crab[a]	*C. bairdi*[a]	*C. opilio*[b]
Yakutat District 16	NE	NE	NA
Yakutat Area D	NE	NE	NA
Prince William Sound	NE	0.5%	NA
Cook Inlet Kamishak District	60 crab[c]	0.5%	NA
Kodiak Northeast District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Shelikof District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Semidi District	NE	NE	NA
Alaska Peninsula	0.5% or 1.0%	0.5% or 1.0%	NA
Bering Sea	500 crab[c]	3 tier approach	3 tier approach
Dutch Harbor	0.5% or 1.0%	0.5% or 1.0%	NA
Adak[d]	50	10,000 crab[c]	NA

[a] NE = Not established.
[b] NA = Not applicable.
[c] Fixed CBL.
[d] Bycatch limit established to provide scallop fleet opportunity for exploratory fishing while protecting crab resources.

Table 5-2 Bycatch of crabs (number crabs) by species in the Bering Sea scallop fishery, 1995–2008.

Year	Snow crab	Bristol Bay red king crab	Tanner crab
1995	0	0	0
1996	104,836	0	17,000
1997	195,345	0	28,000
1998	232,911	146	36,000
1999	150,421	1	n/a
2000	105,602	2	53,614
2001	68,458	0	48,718
2002	70,795	2	48,053
2003	16,206	0	31,316
2004	3,843	0	15,303
2005	5,211	2	15,529
2006	8,543	10	45,204
2007	19,367	1	35,288
2008	17,205	1	60,373

5.4 Impacts on Benthic Habitat

Two broad categories of habitat impacts may result from scallop dredge fisheries: habitat alteration and gear-induced damage and mortality (Grant 2000). Scallop dredging may alter habitat through unobserved mortality to marine organisms, discard mortality, and modification of benthic sediments and community structure. Dredging resuspends fine sediments, buries gravel below the surface, and overturns large rocks that are embedded in the substrate (NEFMC 1982, Caddy 1973). Dredging also dislodges buried shell material, buries gravel under resuspended sand, and overturns larger rocks with an appreciable roughening of the sediment surface (Caddy 1968).

For some scallop species, dredges have been shown to adversely affect substrate required for settlement of young to the bottom (Fonseca et al. 1984; Orensanz 1986). An investigation of sediment impacts from a New Bedford scallop dredge found that vertical redistribution of bottom sediments had greater implications than the horizontal translocation associated with scraping and plowing the bottom (Mayer et al. 1991). The scallop dredge tended to bury organic matter below the surface, causing a shift in sediment metabolism away from aerobic respiration that occurs at the sediment surface. Dredge marks on the sea floor tend to be short-lived in areas of strong bottom currents, but may persist in low energy environments (Messieh et al. 1991).

Bycatch data from the Scallop Observer Program indicates that habitat forming organisms (e.g. Gorgonian hard corals) are infrequently encountered in scallop fishery catch. Since 1996, corals have only been encountered in 11 of the 15,836 tows sampled for catch composition and bycatch (Barnhart and Rosenkranz 2003). Natural debris, such as kelp and wood, comprised approximately 5% of the total percent weight sampled for the same time period. As previously expressed, the bycatch of kelp and rocks declined 56% after scallop fishery cooperatives were implemented in 2001(Northern Economics 2003).

Although this may indicate reduced stress upon the habitat due to changes in fishing practices following the formation of cooperatives, a specific study to assess changes to fishing practices has not been conducted.

The Alaska weathervane scallop fishery occurs in continental shelf waters at 40–150 m depths in three main areas: the eastern Gulf of Alaska between Prince William Sound and Cape Spencer, around Kodiak Island, and in the eastern Bering Sea (Turk 2000; Figure 4-1). Because the fishery footprint is confined to these areas, and many areas of similar habitat are closed to scallop dredging, the effects of these alternatives on the GOA and Bering Sea ecosystems are likely to be minor (NPFMC 2010b). The habitat impacts of the scallop fishery are not anticipated to change under the proposed alternatives because the alternatives do not increase the amount of scallops harvested or change the location or timing of the fishery. In the event that discard mortality become limiting to the scallop fishery, habitat impacts may decrease.

Chapter 6 Cumulative Effects

Analysis of the potential cumulative effects of a proposed Federal action and its alternatives is a requirement of NEPA. Cumulative effects are those combined effects on the quality of the human environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such other actions (40 CFR 1508.7, 1508.25(a), and 1508.25(c)). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed by evaluating each action individually. At the same time, the CEQ guidelines recognize that it is not practical to analyze the cumulative effects of an action on the universe, but to focus on those effects that are truly meaningful.

In this EA, relevant past and present actions are identified and integrated into the impacts analysis in Chapter 4 and 5. This section provides a summary description of the reasonably foreseeable future actions identified in this analysis that may affect scallops, the biological and physical environment and that also may be affected by the alternatives in this analysis. Consideration of future actions provides the reader with an understanding of the changes in the impacts of the alternatives on each resource component when we take into account the reasonable foreseeable future actions. The "action area" for scallop management includes the federal waters of the Gulf of Alaska and Bering Sea. The time frame for future actions is ten years.

CEQ regulations require a consideration of actions, whether taken by a government or by private persons, which are reasonably foreseeable. This is interpreted as indicating actions that are more than merely possible or speculative. Actions have been considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or the publication of a proposed rule. Actions simply "under consideration" have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen.

Future actions that may affect the scallop fishery, the bycatch in that fishery, and the impacts of the scallop fishery on the resources components analyzed in this EA have been grouped in the following four categories:

- Ecosystem-sensitive management
- Traditional management tools
- Actions by other Federal, State, and international agencies

- Private actions
- Natural events

Table 6-1 summarizes the reasonably foreseeable "actions" identified in this analysis that are likely to have an impact on a resource component within the action area and timeframe. Identification of actions likely to impact a resource component, or change the impacts of any of the alternatives, within this action's area and time frame will allow decision makers and the public to make a reasoned choice among alternatives. Actions are understood to be human actions (e.g., a proposed rule to designate northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). Natural events are included in this analysis for informational purposes.

Table 6-1 Reasonably foreseeable future actions and natural events

Ecosystem-sensitive management	• Increasing habitat protection • Actions to minimize bycatch
Traditional management tools	• Continuation of License Limitation Program
Other Federal, State, and international agencies	• State management of scallop fisheries
Private actions	• Commercial scallop fishing • Increasing levels of economic activity in Alaska's waters and coastal zone
Natural events	• Ocean acidification • Climate change

While the reasonably foreseeable future actions impact the scallop resource and fishery, no actions were identified that would combine with the effects of this action to result in cumulatively significant impacts on the biological and physical environment (including scallop species, fish stocks, habitat, ESA-listed species, marine mammals, or benthic organisms), fishing safety, or consumers have been identified that would accrue from the proposed actions. None of the alternatives change the general manner, timing, or location in which the weathervane scallop fishery operates and the majority of the future actions are continuations of existing actions.

While climate warming trends are being studied and increasingly understood at a global scale (IPCC 2007), the ability for fishery managers to forecast biological responses to changing climate continues to be difficult. The Council and NMFS have taken actions that indicate a willingness to adapt fishery management to be proactive in the face of changing climate conditions. The Council currently receives an annual update on the status and trends of indicators of climate change in the Bering Sea through the presentation of the Ecosystem Assessment and Ecosystem Considerations Report (Boldt 2009). Much of the impetus for Council and NMFS actions in the northern Bering Sea, where bottom trawling is prohibited in the Northern Bering Sea Research Area, and in the Alaskan Arctic, where the Council and NMFS have prohibited all fishing until further scientific study of the impacts of fishing can be conducted, derives from the understanding that changing climate conditions may impact the spatial distribution of fish, and consequently, of fisheries. In order to be proactive, the Council has chosen to close any potential loopholes to unregulated fishing in areas that have not previously been fished. Consequently, it is likely that as other impacts of climate change become apparent, fishery management will also adapt in response. Because of the large uncertainties as to what these impacts might be, however, and our current inability to predict such change, it is not possible to estimate what form these adaptations may take.

Like climate change, ocean acidification is documented to be occurring globally, and is likely to continue and increase given current trends in anthropogenic carbon emissions and projected release of deep water methane.

And, acidification could have implications, as yet unknown, for the food web of the northeast Pacific Ocean. Consequently, it is likely that as impacts of ocean acidification become apparent, fishery management will also adapt in response. Because of the large uncertainties as to what these impacts might be, however, and our current inability to predict such change, it is not possible to estimate what form these adaptations may take.

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