FINAL ENVIRONMENTAL ASSESSMENT

for proposed amendment 43 to the

Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs

and proposed amendment 103 to the

Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands

To prevent overfishing and rebuild Pribilof Islands blue king crab

September 2014

For further information contact:

Diana L. Stram
North Pacific Fishery Management Council
605 West 4th Avenue
Anchorage, AK 99501
(907) 271-2809

Abstract

This environmental assessment evaluates six proposed alternative measures for the Pribilof Islands blue king crab (*Paralithodes platypus*) stock to minimize bycatch to the extent practicable and prevent overfishing. The Pribilof Islands blue king crab stock remains overfished and the current rebuilding plan has not achieved adequate progress towards rebuilding the stock by 2014. Four of the alternatives are different closure configurations to restrict groundfish fisheries in the areas of the stock distribution. The fifth alternative considers trigger caps and associated area closures in specific groundfish fisheries, while the sixth alternative consists of a combination of a triggered closure for groundfish fisheries combined with a year-round closure to Pacific cod pot fishing. This analysis considers the impacts of these alternatives on the bycatch of Pribilof Islands blue king crab and the potential for preventing overfishing and rebuilding the stock, as well as the environmental and social/economic impacts of these measures.

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Executive Summary

The king and Tanner crab fisheries in the Exclusive Economic Zone (3 to 200 miles offshore) of the Bering Sea/Aleutian Islands management area off Alaska are managed under the Fishery Management Plan for Bering Sea and Aleutian Islands King and Tanner Crabs (Crab FMP). The groundfish fisheries of the BSAI are managed under the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI groundfish FMP).

The Crab FMP establishes a State/Federal cooperative management regime that defers crab fisheries management to the State of Alaska (State) with Federal oversight. State regulations are subject to the provisions of the Crab FMP including its goals and objectives, the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act), and other applicable Federal laws.

On September 23, 2002, National Marine Fisheries Service (NMFS) notified the Council that the Pribilof Islands blue king crab (PIBKC) stock was overfished. The Council developed and NMFS implemented a rebuilding plan in 2003 that included a prohibition on directed fishing until the stock was rebuilt. The PIBKC fishery has been closed since 1999. On September 29, 2009, NMFS notified the Council that the current rebuilding plan has not achieved adequate progress to rebuild the stock by 2014. The PIBKC stock remains overfished.

While the directed fishery for this stock has been closed since 1999, and bycatch in the crab fisheries has been minimized, PIBKC are currently caught as bycatch in the groundfish fisheries. To comply with section 304(e)(7) of the Magnuson-Stevens Act, the Council is assessing measures to address bycatch in groundfish fisheries, the primary source of fishing mortality. The purpose of this proposed action is to prevent overfishing the PIBKC stock by minimizing bycatch of blue king crab in the federally managed groundfish fisheries, in compliance with the Magnuson-Stevens Act and the national standard guidelines. In minimizing PIBKC bycatch to the extent practicable, the North Pacific Fishery Management Council (Council) intends to provide the maximum potential for rebuilding this very depressed stock.

Six alternatives are considered in this analysis to minimize blue king crab bycatch in the federally managed groundfish fisheries. Four of the alternatives consider year-round area closures to better protect the PIBKC stock. The fifth and sixth alternatives consider trigger caps and associated time and area closures in groundfish fisheries that have contributed historically to bycatch of this stock. Alternatives 2 through 6 retain all of the current protection measures in place for the PIBKC stock and apply additional measures as described in the specific alternatives and options. For each of Alternatives 2 through 6, there is the option of increasing observer coverage, either to all fisheries to which a limit or closure applies (Option 1), or to specific fisheries (Option 2).

- **Alternative 1** retains the current Pribilof Islands Habitat Conservation Zone (PIHCZ) trawl closure around the Pribilof Islands.
- **Alternative 2** applies the PIHCZ closure additionally to those groundfish fisheries contributing to PIBKC bycatch above a threshold criteria (Option 2a) or to fishing for Pacific cod (*Gadus macrocephalus*) with pot gear (**Option 2b: Preferred Alternative**) or to fishing for Pacific cod with pot gear when triggered (Option 2c). Alternative 2b, a closure of the PIHCZ is the preliminary preferred alternative.
- **Alternative 3** proposes to apply the existing State of Alaska crab closure areas to those groundfish fisheries contributing to PIBKC bycatch above a threshold criteria (Option 3a) or to fishing for Pacific cod with pot gear (Option 3b).
- **Alternative 4** proposes two closure configurations to cover the distribution of the PIBKC stock. These closures are then proposed to apply to either those groundfish fisheries contributing to

PIBKC bycatch above a threshold criteria (Option 4a) or to fishing for Pacific cod with pot gear (Option 4b).

- **Alternative 5** proposes a range of trigger caps on those groundfish fisheries contributing to PIBKC bycatch above a threshold criteria that, if reached, would close that area to fishing (Options 5a–5d). An additional option would allocate the trigger cap amongst gear types for applicable fisheries.
- **Alternative 6** combines elements of Alternative 2b (Component 1, year-round closure of PIHCZ to pot gear) with a triggered closure of Area 5d to Pacific cod pot gear, hook-and-line gear, as well as non-pelagic trawl fishing for yellowfin sole (Component 2). An option to establish the limit in number of crabs based on the average weight in the previous season (Option a) or based on a 5-year rolling average weight (Option b). Options are also included for the allocation of the prohibited species catch limit to gear types (Option 1) or for all fisheries by seasonal allocations (Option 2).

The Council took final action on this analysis in June 2012 and selected Alternative 2, Option 2b as the preferred alternative for Amendment 103. The preferred alternative would close the PIHCZ, the area known to have key habitat components important to PIBKC, to fishing for Pacific cod pot gear, the gear type with the highest observed bycatch of bule king crab. In selecting this alternative, the Council noted that the best scientific information from survey data on PIBKC based on location of crab, observed catch rates, and habitat type indicate that this area represents the highest concentration of PIBKC. Observer data from the Pacific cod pot fishery show the highest average rate of PIBKC bycatch inside the PIHCZ; therefore, a prohibition of Pacific cod pot fishing in the PIHCZ is highly likely to reduce PIBKC bycatch in an area where the stock is concentrated. This would decrease the mortality on this stock and prevent overfishing due to bycatch.

With the proposed implementation of Amendment 103, all fishery management measures practicable have been taken to greatly eliminate PIBKC catch and protect PIBKC habitat. These measures are intended to ensure that the rebuilding time period is as short as possible in compliance with section 304(e)(4)(A) of the Magnuson-Stevens Act. Amendment 43 to the Crab FMP would amend the current rebuilding incorporate the new information available on the rebuilding time period that takes into account the status and biology of PIBKC and environmental conditions.

Based on the best available information on the biology of the stock and environmental conditions, NMFS estimates that the time period to rebuild the stock will exceed 10 years, as allowed under section 304(e)(4)(A)(ii) of the Magnuson-Stevens Act. The causes of the stock decline are thought to be predominantly due to environmental changes that inhibit blue king crab reproduction. For this stock to rebuild, the stock would likely require multiple years of above average recruitment and/or a change in environmental conditions to increase larval productivity around the Pribilof Islands. It is not possible to predict future recruitment success; however, changes in stock abundance are assessed annually in the Stock Assessment and Fishery Evaluation report.

NMFS developed a draft stock assessment model that predicted that the PIBKC stock may be rebuilt in 50 years. However, the low numbers of PIBKC encountered in biomass surveys and the poor ability to predict recruitment results in high imprecision in the projected biomass. The model imprecision, coupled with poorly understood environmental influences on the blue king crab stock, did not lead to high confidence in biomass projections during the 50 year period. As a result, NMFS is unable to predict whether the PIBKC stock can be rebuilt in the foreseeable future. Therefore, NMFS and the Council are taking action to reduce the fishing mortality on this stock and increase the likelihood that this stock will rebuild.

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1 Introduction

The king and Tanner crab fisheries in the Exclusive Economic Zone (3 to 200 miles offshore) of the Bering Sea and Aleutian Islands management area (BSAI) off Alaska are managed under the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (Crab FMP). The groundfish fisheries of the BSAI are managed under the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI groundfish FMP). These FMPs were developed by the North Pacific Fishery Management Council (NPFMC, or Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

The Crab FMP establishes a State/Federal cooperative management regime that defers crab fisheries management to the State of Alaska (State) with Federal oversight. State regulations are subject to the provisions of the Crab FMP, including its goals and objectives, the Magnuson-Stevens Act, and other applicable Federal laws. The Crab FMP defers much of the management of the BSAI crab fisheries to the State using the following three categories of management measures:

1. Those that are fixed in the FMP and require an FMP amendment to change;
2. Those that are framework-type measures the State can change following criteria set out in the FMP; and
3. Those measures that are neither rigidly specified nor frameworked in the FMP and are at the discretion of the State.

This proposed action is a revised rebuilding plan for the Pribilof Islands blue king crab (*Paralithodes platypus*) (PIBKC) stock. Management actions proposed under this analysis would amend both the Crab FMP and the BSAI groundfish FMP. Management actions for the BSAI groundfish and BSAI crab 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 Act and the National Environmental Policy Act (NEPA). These alternatives require implementing regulations and, therefore, the Regulatory Flexibility Act applies, and review under Executive Order 12866 is required. A Regulatory Impact Review/Initial Regulatory Flexibility Analysis was also prepared to analyze the social and economic effects of this action and its alternatives.

1.1 Purpose and Need

The PIBKC stock remains overfished. On September 23, 2002, the Secretary of Commerce notified the Council that the PIBKC stock biomass was below the minimum stock size threshold (MSST)[1] and was overfished. A rebuilding plan was implemented in 2003 that included a provision prohibiting directed fishing until the stock was rebuilt. The PIBKC fishery has been closed since 1999 and bycatch in 2010/2011 was below the overfishing level.

The National Marine Fisheries Service (NMFS) notified the Council on September 29, 2009, that the current rebuilding plan has not achieved adequate progress to rebuild the stock by 2014. To comply with section 304(e)(7) of the Magnuson-Stevens Act, the Council is amending the PIBKC rebuilding plan to add measures to address bycatch in groundfish fisheries, the primary source of fishing mortality.

Under the Magnuson-Stevens Act, the Council has two years from notification to develop and implement a revised rebuilding plan for the PIBKC stock. However, development of additional rebuilding measures

[1] Under the Crab FMP, MSST is defined as ½ the biomass of maximum sustained yield (B_{MSY}) (NPFMC 2011a).

required more time due to a number of difficulties and data limitations, including defining appropriate stock boundaries, identifying which groundfish fisheries to restrict, and determining the appropriate way to analyze the existing data on PIBKC bycatch in the groundfish fisheries. Therefore, the Council has taken the time necessary to address these issues and develop appropriate alternatives, recognizing that the current PIBKC protections remain in place.

Pursuant to the Magnuson-Stevens Act section 304(e)(4)(A) and the National Standard Guidelines, the purpose of this proposed action is to develop an amended rebuilding plan to prevent overfishing and to rebuild the PIBKC stock in as short a time as possible with the understanding that the biology of this stock and environmental conditions dictate that rebuilding is not expected to occur within 10 years.

The Council's problem statement for this analysis is the following:

> *The Pribilof Islands blue king crab stock remains overfished and the current rebuilding plan has not achieved adequate progress to rebuild the stock by 2014. In order to comply with provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) an amended rebuilding plan must be implemented prior to the start of the 2011/2012 fishing season.*
>
> *The directed blue king crab fishery has been closed since 1999 and action has been taken to limit bycatch mortality in other crab fisheries occurring near the Pribilof Islands. Action to limit bycatch in the groundfish fisheries may also be necessary. Recent trends in crab bycatch suggest that groundfish fisheries occurring near the Pribilof Islands have the potential to exceed the annual overfishing level and acceptable biological catch for this stock.*
>
> *This action is necessary to facilitate compliance with requirements of the MSA to end and prevent overfishing, rebuild overfished stocks and achieve optimum yield.*

In crafting this problem statement, the Council further noted that this problem statement reflects not only the Council's obligation under Magnuson-Stevens Act to rebuild this stock, but also the Council's desire to prevent overfishing on an annual basis and ensure that all fisheries contributing to PIBKC bycatch mortality share in the rebuilding effort. In their final action in June 2012, the Council decided to focus on the fishery with the highest observed bycatch (Pacific cod pot) in an area where the stock is concentrated [the Pribilof Islands Habitat Conservation Zone (PIHCZ)] to rebuild the PIBKC stock in as short a time as possible taking into account the needs of the fishing communities. The rationale for the preferred alterative is discussed in Section 2.8.

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, "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 600.310 through 600.355) to provide comprehensive guidance for the development of FMPs and FMP amendments that comply with the Magnuson-Stevens Act National Standards. The Guidelines provide guidance for status determination criteria and rebuilding overfished stocks, including specifying the time period for rebuilding.

The Magnuson-Stevens Act, in section 303(a)(10), requires that each FMP specify objective and measurable criteria (status determination criteria) for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfil the intent of the Magnuson-Stevens Act, such status determination criteria are comprised of two components: A maximum fishing mortality threshold (MFMT) and a minimum stock size threshold (MSST) (see 50 CFR 600.310(e)(2)).

This environmental assessment (EA) addresses alternatives for rebuilding the PIBKC stock as required under the Magnuson-Stevens Act. This action must be consistent with the ten National Standards of the Magnuson-Stevens Act section section 301(a)(1); fishery management plan provisions 303(a)(10) and 303(a)(14); rebuilding overfished fisheries 304(e); and national standard guidelines 50 CFR 600.310. The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (Public Law 109-479) amended section 304(e)(3) of the Magnuson-Stevens Act, which now requires the Council and Secretary of Commerce (Secretary) to develop and implement a rebuilding plan within two years of receiving notification from the Secretary that a stock is overfished, approaching an overfished condition, or has not made adequate progress towards rebuilding.

Rebuilding of overfished stocks is required by the Magnuson-Stevens Act, section 304. The applicable section of the Act is provided below.

(e) REBUILDING OVERFISHED FISHERIES.--

(1) The Secretary shall report annually to the Congress and the Councils on the status of fisheries within each Council's geographical area of authority and identify those fisheries that are overfished or are approaching a condition of being overfished. For those fisheries managed under a fishery management plan or international agreement, the status shall be determined using the criteria for overfishing specified in such plan or agreement. A fishery shall be classified as approaching a condition of being overfished if, based on trends in fishing effort, fishery resource size, and other appropriate factors, the Secretary estimates that the fishery will become overfished within two years.

(2) If the Secretary determines at any time that a fishery is overfished, the Secretary shall immediately notify the appropriate Council and request that action be taken to end overfishing in the fishery and to implement conservation and management measures to rebuild affected stocks of fish. The Secretary shall publish each notice under this paragraph in the Federal Register.

(3) Within two years of an identification under paragraph (1) or notification under paragraphs (2) or (7), the appropriate Council (or the Secretary, for fisheries under section 302(a)(3)) shall prepare a fishery management plan, plan amendment, or proposed regulations for the fishery to which the identification or notice applies--

(A) to end overfishing in the fishery and to rebuild affected stocks of fish; or

(B) to prevent overfishing from occurring in the fishery whenever such fishery is identified as approaching an overfished condition.

(4) For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations prepared pursuant to paragraph (3) or paragraph (5) for such fishery shall--

(A) specify a time period for ending overfishing and rebuilding the fishery that shall--

(I) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and

(ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;

(B) allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery; and

(C) for fisheries managed under an international agreement, reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(5) If, within the 2-year period beginning on the date of identification or notification that a fishery is overfished, the Council does not submit to the Secretary a fishery management plan, plan amendment, or proposed regulations required by paragraph (3)(A), the Secretary shall prepare a fishery management plan or plan amendment and any accompanying regulations to stop overfishing and rebuild affected stocks of fish within 9 months under subsection (c).

(6) During the development of a fishery management plan, a plan amendment, or proposed regulations required by this subsection, the Council may request the Secretary to implement interim measures to reduce overfishing under section 305(c)) until such measures can be replaced by such plan, amendment, or regulations. Such measures, if otherwise in compliance with the provisions of this Act, may be implemented even though they are not sufficient by themselves to stop overfishing of a fishery.

(7) The Secretary shall review any fishery management plan, plan amendment, or regulations required by this subsection at routine intervals that may not exceed two years. If the Secretary finds as a result of the review that such plan, amendment, or regulations have not resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks, the Secretary shall--

(A) in the case of a fishery to which section 302(a)(3) applies, immediately make revisions necessary to achieve adequate progress; or

(B) for all other fisheries, immediately notify the appropriate Council. Such notification shall recommend further conservation and management measures which the Council should consider under paragraph (3) to achieve adequate progress.

1.2.1 National Standard 1 guidelines

Further clarification on stock rebuilding under the Magnuson-Stevens Act for National Standard 1 is provided in the excerpt below from the Final Rule on National Standard Guidelines published in the *Federal Register* on January 16, 2009 (74 FR 3178).

Sec. 600.310 National Standard 1— Optimum Yield.

(j) Council actions to address overfishing and rebuilding for stocks and stock complexes in the fishery—

(1) Notification. The Secretary will immediately notify in writing a Regional Fishery Management Council whenever it is determined that:

(i) Overfishing is occurring;
(ii) A stock or stock complex is overfished;
(iii) A stock or stock complex is approaching an overfished condition; or
(iv) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress.

(2) Timing of actions—

(i) If a stock or stock complex is undergoing overfishing. FMPs or FMP amendments must establish ACL and AM mechanisms in 2010, for stocks and stock complexes determined to be subject to overfishing, and in 2011, for all other stocks and stock complexes (see paragraph (b)(2)(iii) of this section). To address practical implementation aspects of the FMP and FMP amendment process, paragraphs (j)(2)(i)(A) through (C) of this section clarifies the expected timing of actions.

(A) In addition to establishing ACL and AM mechanisms, the ACLs and AMs themselves must be specified in FMPs, FMP amendments, implementing regulations, or annual specifications beginning in 2010 or 2011, as appropriate.
(B) For stocks and stock complexes still determined to be subject to overfishing at the end of 2008, ACL and AM mechanisms and the ACLs and AMs themselves must be effective in fishing year 2010.
(C) For stocks and stock complexes determined to be subject to overfishing during 2009, ACL and AM mechanisms and ACLs and AMs themselves should be effective in fishing year 2010, if possible, or in fishing year 2011, at the latest.

(ii) If a stock or stock complex is overfished or approaching an overfished condition.

(A) For notifications that a stock or stock complex is overfished or approaching an overfished condition made before July 12, 2009, a Council must prepare an FMP, FMP amendment, or proposed regulations within one year of notification. If the stock or stock complex is overfished, the purpose of the action is to specify a time period for ending overfishing and rebuilding the stock or stock complex that will be as short as possible as described under section 304(e)(4) of the Magnuson- Stevens Act. If the stock or stock complex is approaching an overfished condition, the purpose of the action is to prevent the biomass from declining below the MSST.
(B) For notifications that a stock or stock complex is overfished or approaching an overfished condition made after July 12, 2009, a Council must prepare and implement an FMP, FMP amendment, or proposed regulations within two years of notification, consistent with the requirements of section 304(e)(3) of the Magnuson- Stevens Act. Council actions should be submitted to NMFS within 15 months of notification to ensure sufficient time for the Secretary to implement the measures, if approved. If the stock or stock complex is overfished and overfishing is occurring, the rebuilding plan must end overfishing immediately and be consistent with ACL and AM requirements of the Magnuson-Stevens Act.

(3) Overfished fishery.

(i) Where a stock or stock complex is overfished, a Council must specify a time period for rebuilding the stock or stock complex based on factors specified in Magnuson-Stevens Act section 304(e)(4). This target time for rebuilding (Ttarget) shall be as short as possible, taking into account: The status and biology of any overfished stock, the needs of fishing communities, recommendations by international organizations in which the U.S. participates, and interaction of the stock within the marine ecosystem. In addition, the time period shall not exceed 10 years, except where biology of the stock, other environmental conditions, or management measures under an international agreement to which the U.S. participates, dictate otherwise. SSCs (or agency scientists or peer review processes in the case of Secretarial actions) shall provide recommendations for achieving rebuilding targets (see Magnuson-Stevens Act section 302(g)(1)(B)).
The above factors enter into the specification of Ttarget as follows:

(A) The ‘‘minimum time for rebuilding a stock’’ (Tmin) means the amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. In this context, the term ‘‘expected’’ means to have at least a 50 percent probability of attaining the Bmsy.

(B) For scenarios under paragraph (j)(2)(ii)(A) of this section, the starting year for the Tmin calculation is the first year that a rebuilding plan is implemented. For scenarios under paragraph (j)(2)(ii)(B) of this section, the starting year for the Tmin calculation is 2 years after notification that a stock or stock complex is overfished or the first year that a rebuilding plan is implemented, whichever is sooner.

(C) If Tmin for the stock or stock complex is 10 years or less, then the maximum time allowable for rebuilding (Tmax) that stock to its Bmsy is 10 years.

(D) If Tmin for the stock or stock complex exceeds 10 years, then the maximum time allowable for rebuilding a stock or stock complex to its Bmsy is Tmin plus the length of time associated with one generation time for that stock or stock complex. ‘‘Generation time’’ is the average length of time between when an individual is born and the birth of its offspring.

(E) Ttarget shall not exceed Tmax, and should be calculated based on the factors described in this paragraph (j)(3).

(ii) If a stock or stock complex reached the end of its rebuilding plan period and has not yet been determined to be rebuilt, then the rebuilding F should not be increased until the stock or stock complex has been demonstrated to be rebuilt. If the rebuilding plan was based on a Ttarget that was less than Tmax, and the stock or stock complex is not rebuilt by Ttarget, rebuilding measures should be revised, if necessary, such that the stock or stock complex will be rebuilt by Tmax. If the stock or stock complex has not rebuilt by Tmax, then the fishing mortality rate should be maintained at Frebuild or 75 percent of the MFMT, whichever is less.

(iii) Council action addressing an overfished fishery must allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery.

(iv) For fisheries managed under an international agreement, Council action addressing an overfished fishery must reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(4) Emergency actions and interim measures. The Secretary, on his/her own initiative or in response to a Council request, may implement interim measures to reduce overfishing or promulgate regulations to address an emergency (Magnuson-Stevens Act section 304(e)(6) or 305(c)).

In considering a Council request for action, the Secretary would consider, among other things, the need for and urgency of the action and public interest considerations, such as benefits to the stock or stock complex and impacts on participants in the fishery.

(i) These measures may remain in effect for not more than 180 days, but may be extended for an additional 186 days if the public has had an opportunity to comment on the measures and, in the case of Council recommended measures, the Council is actively preparing an FMP, FMP amendment, or proposed regulations to address the emergency or overfishing on a permanent basis.

(ii) Often, these measures need to be implemented without prior notice and an opportunity for public comment, as it would be impracticable to provide for such processes given the need to act quickly and also contrary to the public interest to delay action. However, emergency regulations and interim measures that do not qualify for waivers or exceptions under the Administrative Procedure Act would need to follow proposed notice and comment rulemaking procedures.

1.3 Scope of Analysis

This EA relies heavily on the information and analysis contained in previous NEPA documents and Stock Assessment and Fishery Evaluation (SAFE) Reports. Relevant information from these documents are summarized in the appropriate chapters. This EA also contains recent information on PIBKC and the fisheries and resources impacted by this action.

This EA incorporates information from the Programmatic Supplemental Environmental Impact Statement (NMFS 2004b), as well as the EA for Amendment 17 to the Crab FMP, which established the current rebuilding plan for the PIBKC stock (NPFMC/NMFS/ADF&G 2003), and the EA for Amendment 21a to the BSAI groundfish FMP, which established the PIHCZ as a no-trawl area year-round (NPFMC 1994).

This analysis further incorporates information contained in the Bering Sea Aleutian Islands Crab Fisheries Final Environmental Impact Statement/Regulatory Impact Review/Initial Regulatory Flexibility Analysis/Social Impact Assessment (Crab EIS) (NMFS 2004a) by reference. Additional information concerning the crab fisheries and management under the Crab Rationalization Program, and impacts of these on the human environment are contained in that document. Chapter 3 of the Crab EIS contains a complete description of the human environment, including the physical environment, habitat, crab life history, marine mammals, seabirds, crab fisheries, a management history, the harvesting sector, the processing sector, and community and social conditions. These descriptions are incorporated by reference.

The Council on Environmental Quality regulations encourage agencies preparing NEPA documents to, "tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review." Specifically, 40 CFR 1502.20 states the following:

> Whenever a broad environmental impact statement has been prepared (such as a program or policy statement) and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy (such as a site specific action) the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action. (40 CFR 1502.20)

This EA also relies heavily on the information and analysis contained in the Council's annual BSAI Crab SAFE Reports, available from the Council web site at:
http://alaskafisheries.noaa.gov/npfmc/resources-publications/safe-reports.html, or
http://www.alaskafisheries.noaa.gov/npfmc/PDFdocuments/resources/SAFE/CrabSAFE/CrabSAFE2011.pdf

The SAFE Reports contain the annually estimated status of the PIBKC stock as well as annual stock assessments for all ten BSAI crab stocks.

2 Description of Alternatives

Six alternatives are considered in this analysis. All of the alternatives consider time and area closures to better protect the Pribilof Islands blue king crab (PIBKC) stock, either through year-round closures or prohibited species catch (PSC) limits that trigger area closures. The groundfish fisheries that are included in the suite of alternatives are Pacific cod hook-and-line, Pacific cod pot, other flatfish trawl, and yellowfin sole trawl. Alternatives 2 through 6 retain all of the current protection measures in place for the PIBKC stock and apply additional measures as described in the specific alternatives and options. Section 2.8 contains a comparison of the different alternatives and a discussion of the rationale for the selection of the preferred alternative. Section 2.9 includes a description of alternatives considered but not carried forward for analysis.

2.1 Alternative 1: Status Quo

Alternative 1 retains the current protections for PIBKC stock. Pribilof Islands blue king crab is currently managed under the rebuilding plan that was implemented in 2004 (69 FR 17651, April 5, 2004). The rebuilding plan closes the directed fishery until the stock is completely rebuilt. Since 1999, Alaska Department of Fish and Game (ADF&G) has closed the Pribilof Islands red king crab fishery to minimize bycatch of blue king crab. ADF&G also closes an area to the snow crab fishery to minimize blue king crab bycatch. As a result, the bycatch of blue king crab in the crab fisheries is minimal.

Two management measures in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI groundfish FMP) minimize blue king crab bycatch. First, blue king crab is a prohibited species and must be avoided while fishing for groundfish, and must be returned to the sea with minimum of injury (NPFMC 2012). Second, the Pribilof Islands Habitat Conservation Zone (PIHCZ) is closed to all trawl gear as shown in Figure 2-1.

The PIHCZ was implemented in January 1995. Amendment 21a to the BSAI groundfish FMP established the PIHCZ, a year-round closure to prohibit the use of all trawl gear in a specified area around the Pribilof Islands (Figure 2-1). The intent of this closure was to protect the unique habitat and ecosystem surrounding the Pribilof Islands so the islands could contribute long term benefits to the fisheries surrounding the waters of the Pribilof Islands area (NPFMC 1994). The Pribilof Islands area provides habitat for commercially important groundfish species, blue king crab, red king crab (*Paralithodes camtschaticus*), Tanner crab (*Chionoecetes bairdi*), snow crab (*Chionoecetes opilio*), juvenile groundfish, Korean hair crab (*Erimacrus isenbeckii*), marine mammals, seabirds, and their prey species.

This area was established based upon the distribution and habitat of the blue king crab in the NMFS annual trawl surveys and on observer data. Blue king crabs do not exist uniformly across the Bering Sea and are instead found in isolated populations. The PIHCZ was intended to protect a majority of the crab habitat in the Pribilof Islands area (NPFMC 1994).

Currently there is no mechanism to close the groundfish fisheries if bycatch exceeds the PIBKC overfishing limit (OFL) during a fishing season. NMFS does have authority to make an inseason adjustment under 50 CFR 679.25 to close areas to directed fishing for specified groundfish species if the closures are necessary to prevent excessive prohibited species bycatch. However, currently PIBKC crab bycatch in groundfish fisheries is tabulated annually for consideration in the subsequent stock assessment to account for total catch. An “overfishing” determination would be made the following year in the process of annual status determination for BSAI crab stocks. Thus, if the OFL for PIBKC were exceeded due to bycatch in the groundfish fisheries, it would be too late for an in-season management measure to further restrict bycatch of PIBKC in that season. Absent measures to explicitly establish in-season management measures in the groundfish fisheries to implement a fishery closure should the OFL or annual catch limit for PIBKC be reached, no additional restrictions would be taken to limit bycatch in the groundfish fisheries.

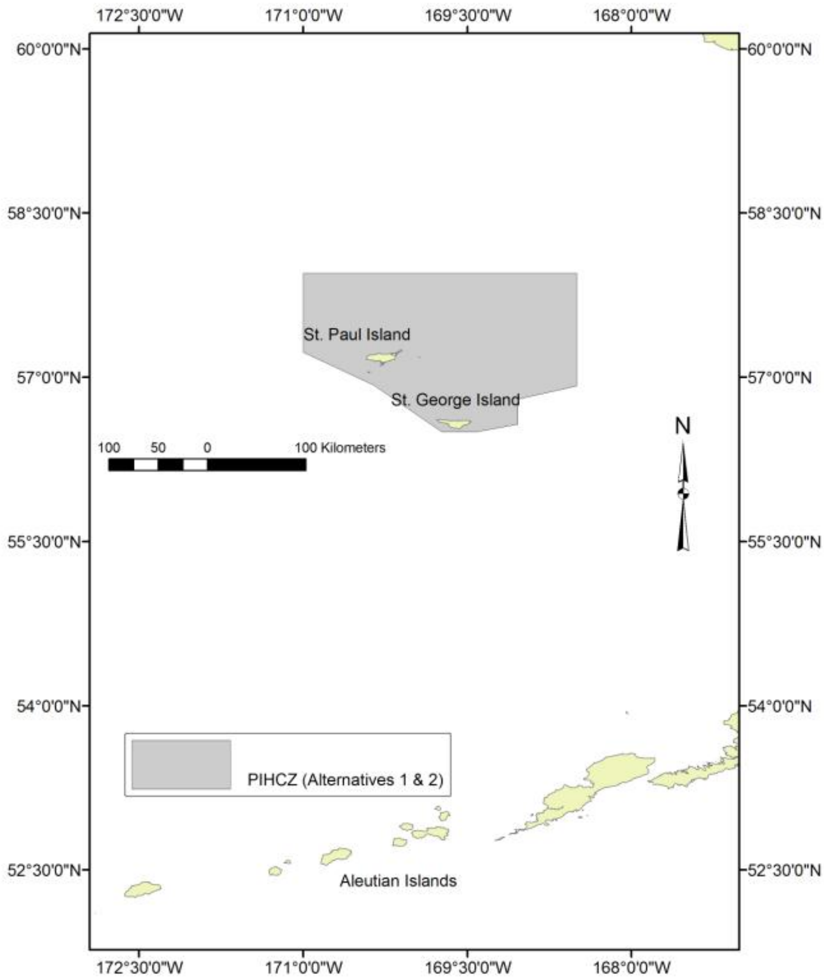


Figure 2-1 Pribilof Islands Habitat Conservation Zone (PIHCZ): Alternatives 1 and 2.

2.2 Alternative 2: Expand the current Pribilof Islands Habitat Conservation Zone to apply to select groundfish fisheries or only Pacific cod pot fishing. (Preferred Alternative (PA))

Under Alternative 2, the existing PIHCZ, as described in Alternative 1 (Figure 2-1), would be modified to apply to additional fisheries (i.e., rather than just to the trawl fisheries as under the status quo). There are two options under Alternative 2 for year-round closures (Option 2a and 2b). Option 2c provides for additional observer coverage in the Pacific cod pot fishery with a closure based on reaching a PSC limit.

Option 2a: In addition to the trawl fisheries, closure in the PIHCZ would apply to all groundfish fisheries that have PIBKC bycatch greater than 5% of acceptable biological catch (ABC) from 2003 to

2010 (Table 2-1). The non-trawl groundfish fisheries that exceed the 5% threshold are pot and hook-and-line Pacific cod fisheries. No fisheries currently have bycatch greater than 10% of ABC.[2]

Table 2-1 List of fisheries and gear types with recorded bycatch of Pribilof Islands blue king crab greater than 5% of ABC in the Pribilof District (for observed and fishticket) from 2003–2010 (as of 12/15/2010). The records column indicates the data source where a record of bycatch since 2003 was used. PSC = NMFS RO estimates from catch accounting system (CAS) in Area 513 only, OBS = Observer data, and FT = Fishticket from Alaska Department of Fish and Game Statistical areas used to define the Pribilof area.

Target	Gear	Records
Pacific cod	Pot	PSC, FT, OBS
	Hook-and-line	PSC, FT, OBS
Yellowfin sole	Trawl	PSC, OBS
Other Flatfish	Trawl	OBS

Option 2b (Preferred Alternative): In addition to the existing trawl closure in the PIHCZ, all Pacific cod pot fishing would be prohibited in this zone year-round. Option 2b applies only to the Pacific cod pot fishery as this fishery has the highest annual contribution to PIBKC bycatch in most years as shown in Table 2-2. In February 2012, the North Pacific Fishery Management Council (Council) designated Option 2b as the preliminary preferred alternative (PPA) because the Pacific cod pot fishery comprises the highest amounts of bycatch of PIBKC over the timeframe examined (2003–2010) despite the limitations in observer coverage of this fishery. The PIHCZ has been identified as an important habitat for and area of concentration of blue king crab, and with the implementation of Amendment 21a to the BSAI groundfish FMP, has been closed to trawl gear. Thus closure to additional gear types in the PIHCZ is consistent with the approach taken under Amendment 21a.

Table 2-2 Proportion of the Pribilof Islands blue king crab bycatch (Area 513 only) among target species between 2003/04 and 2010/11 crab fishing seasons. Total mortality is the total bycatch multiplied by the handling mortality (50% fixed gear, 80% trawl gear).

	Yellowfin sole	Pacific cod	Flathead sole	Rock sole	Total Mortality	TOTAL (# crabs)
Crab fishing season	%	%	%	%	million lbs	
2003/04	47	22	31		0.0008	252
2004/05		100			0.0009	259
2005/06		97	3		0.0028	757
2006/07	54	20		26	0.0003	96
2007/08	3	96	1		0.0046	2,950
2008/09	77	23			0.0010	295
2009/10	51	39	10		0.0013	487
2010/11		86	14		0.0002	256

[2] Previously rock sole trawl was included in the fisheries that met the 10% threshold, however it was later removed from consideration due to all observed catch occurring outside of the defined Pribilof District. See Section 0 for additional information.

[1]Total number of crab calculated using the average weight over all gears in a given Crab Fishing Year from the Observer database (NMFS RO).

Option 2c: In addition to the existing trawl closure in the PIHCZ, vessels fishing for Pacific cod with pot gear in the PIHCZ must carry 100% observer coverage. Pacific cod pot fishing in the PIHCZ will be closed for the year if total PIBKC bycatch across all fisheries in all areas reaches:

i) 20%
ii) 30%
iii) 50%

of the overall trigger closure cap (75% ABC).

Under Option 2c, additional measures are placed on the Pacific cod fishery as this fishery has the highest annual contribution to PIBKC bycatch in most years. Under this option Pacific cod pot vessels must carry 100% observer coverage in order to be authorized to fish within the PIHCZ. Furthermore, if overall PIBKC bycatch in all fisheries exceeds any of the three threshold sub-options (i–iii), fishing for Pacific cod with pot gear within the PIHCZ would then be prohibited for the remainder of the year.

2.3 Alternative 3: ADF&G crab closure areas applied to select groundfish fishing and to just Pacific cod pot fishery.

Under Alternative 3, the existing ADF&G crab closure areas between 168° and170° West longitude, and between 57° and 58° North latitude would be closed to additional fishing effort, in addition to the groundfish trawl closure as under status quo, as described in the options below. The existing closure configuration is indicated in Figure 2-2. There are two closure options under Alternative 3:

Option 3a: Closure applies to all groundfish fisheries that have contributed greater than a designated threshold to bycatch of PIBKC since 2003. The closure to a fishery would be based on bycatch of PIBKC in that fishery between 2003 and 2010 meeting either a threshold of greater than 5% of ABC or greater than 10% of ABC. Under the 5% criteria threshold the closure would apply to the following fisheries: yellowfin sole trawl, other flatfish trawl, Pacific cod pot, and Pacific cod hook-and-line fisheries. None of the fisheries met the 10% threshold.[3] The fisheries and the threshold criteria are described in more detail in Section 4.2 and Table 2-1.

Option 3b: Under this option no Federal Pacific cod fishing with pot gear would be allowed within the confines of the closures shown in Figure 2-2. Option 3b applies only to the Pacific cod pot fishery as this fishery has the highest annual contribution to PIBKC bycatch in most years as shown in Table 2-2.

[3] Previously rock sole trawl was included in the fisheries that met the 10% threshold, however it was later removed from consideration due to all observed catch occurring outside of the defined Pribilof District. See Section 0 for additional information.

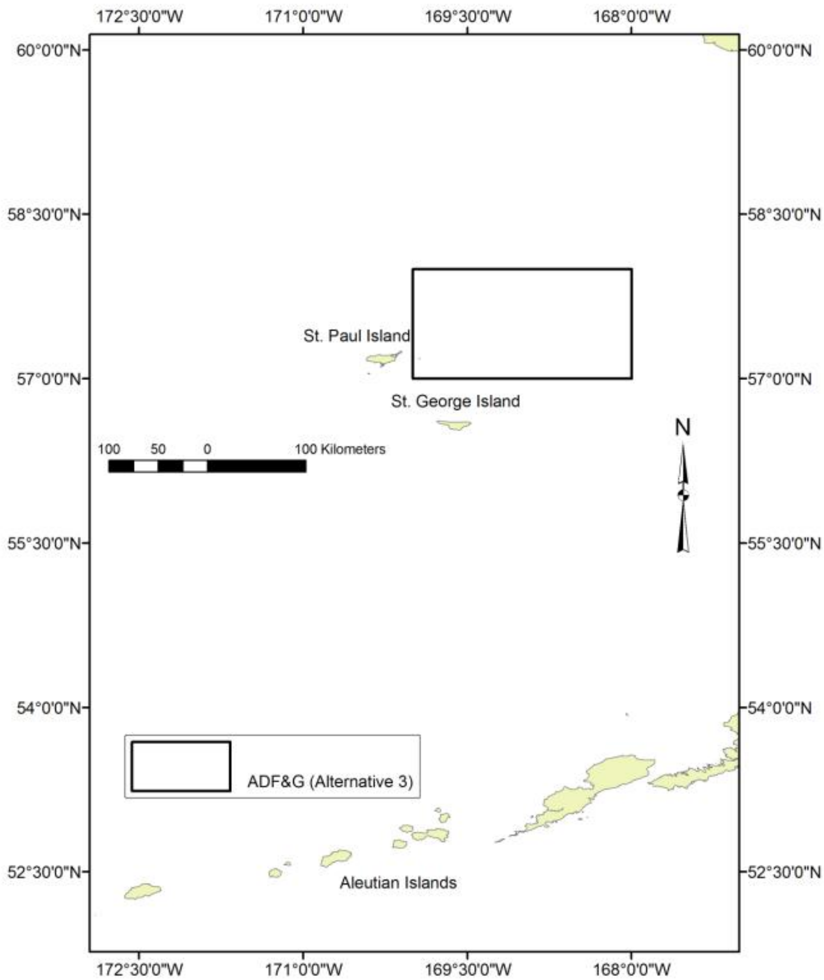


Figure 2-2 Alaska Department of Fish and Game (ADF&G) closure area (Alternative 3).

2.4 Alternative 4: Closure that covers the entire distribution of the Pribilof Islands blue king crab stock.

This alternative proposes a new closure configuration as shown in Figure 2-3 (A and B) that covers the entire distribution of the PIBKC stock. The distribution of the entire PIBKC stock is defined in two ways depending upon the data used to establish the entire distribution of the stock. Under the first option (Option 1), the closure area consists of the full distribution of the Pribilof Islands stock aggregated from 1975 to 2009 based on the NMFS Eastern Bering Sea (EBS) bottom trawl survey (Figure 2-3A). The smaller closure area (Option 2) consists of the full distribution of the Pribilof Islands stock aggregated from 1984 to 2009. In 1984, there was a constriction of the PIBKC distribution towards the Pribilof Islands that has persisted until 2009 (Figure 2-3B). It is unknown if this constriction is due to declining population abundances, fishery activities, oceanography, or shifts in production. It is plausible, however, that a rebounding PIBKC stock may only be able to inhabit the smaller area.

There are two year-round closure options that can be applied to both closure areas (1975 to 2009 distribution and 1984 to 2009 distribution) under Alternative 4:

Option 4a: Closure applies to all groundfish fisheries that have contributed greater than a designated threshold to bycatch of PIBKC since 2003. The closure to a fishery would be based on bycatch of PIBKC in that fishery between 2003 and 2010 meeting either a threshold of greater than 5% of ABC or greater than 10% of ABC. Under the 5% criteria threshold the closure would apply to the following fisheries: yellowfin sole trawl, other flatfish trawl, Pacific cod pot, and Pacific cod hook-and-line fisheries. No fisheries met the 10% threshold.[4] The fisheries and the threshold criteria are described in more detail in Section 3.2 and Table 2-1.

Option 4b: Closure area applied only to pot fishing for Pacific cod. Under this option no Federal Pacific cod fishing with pot gear would be allowed within the confines of the closure shown in Figure 2-3 (A or B).

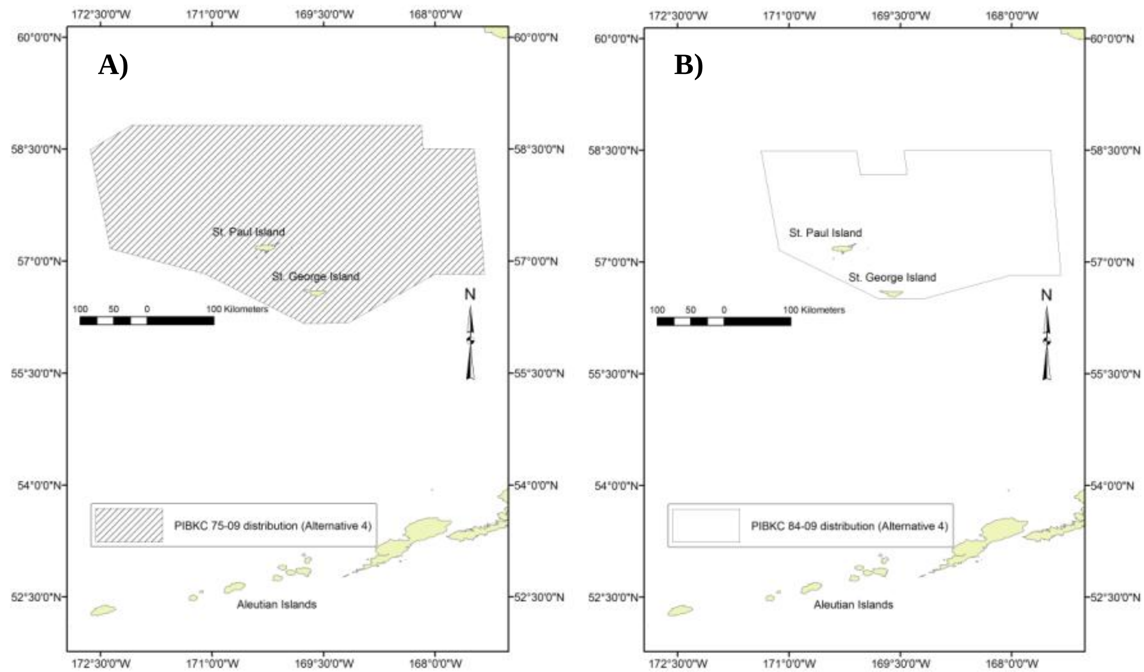


Figure 2-3 Pribilof Islands blue king crab distribution closure area (Alternative 4): A) 1975 to 2009 distribution; B) 1984 to 2009 distribution.

2.5 Alternative 5: PSC limit and triggered closure established for PIBKC in select groundfish fisheries.

Under Alternative 5, a PSC limit would be established equal to either the OFL, the ABC, or a proportion of the ABC for the crab stock. All bycatch of PIBKC in all groundfish fisheries would accrue towards this PSC limit and those groundfish fisheries that are not exempted would be subject to the closure if the limit were reached. Closure applies to all groundfish fisheries that have contributed greater than a designated threshold to bycatch of PIBKC since 2003. The closure to a fishery would be based on bycatch of PIBKC in that fishery between 2003 and 2010 meeting either a threshold of greater than 5% of ABC or

[4] Previously rock sole trawl was included in the fisheries that met the 10% threshold, however it was later removed from consideration due to all observed catch occurring outside of the defined Pribilof District. See Section 2.9 for additional information.

greater than 10% of ABC. Under the 5% criteria threshold the closure would apply to the following fisheries: yellowfin sole trawl, other flatfish trawl, Pacific cod pot, and Pacific cod hook-and-line fisheries. The fisheries and the threshold criteria are described in more detail in Section 4.2 and Table 2-1.

Four options are considered for the PSC limits (labeled under each closure option as Sub-option 1 through 4 considered for each closure).

2.5.1 Sub-option 1: PSC Limit = OFL

The PSC limit would be set equal to the annual PIBKC OFL based on the most recent stock assessment. The OFL for 2012/2013 is 2,557 lb (1.16 t), which corresponds to the 5-year average of bycatch in groundfish and crab fisheries from 1999/2000 to 2005/2006 in Federal reporting area 513. While the PIBKC stock is in Tier 4 of the Tier system, it is at stock status “c” therefore the OFL calculation employs a Tier 5 methodology of average catch in crab and groundfish fisheries to determine a bycatch only OFL. Since the implementation of a total catch OFL in 2008, bycatch in crab and groundfish fisheries have been the only catch that has accrued towards the OFL. A complete discussion of the PIBKC OFL is provided in Section 4.1.2.

Due to issues of stock boundary differentiation between the St. Matthew blue king crab stock and the PIBKC stocks, as an interim measure, the Federal reporting area 513 has been used for purposes of calculating the PIBKC OFL and estimating the bycatch which accrues towards the OFL. This notably excludes Federal reporting areas 524 and 521 that are near the Pribilof Islands and a portion of which should be included in the appropriate stock boundary for PIBKC. Blue king crab bycatch in Areas 521 and 524 accumulates towards the St. Matthew blue king crab OFL given that the majority of that stock is contained within those areas. A complete discussion of the PIBKC stock boundary issue is provided in Section 4.2.

For purposes of this sub-option, the PSC limit is considered to be the bycatch component of the OFL. Currently the entire OFL is the bycatch component due to the low stock status. Should the biomass of the stock increase above minimum stock size threshold, the OFL would be determined using the Tier 4 control rule. The stock assessment will include information on the proportion of the total catch OFL anticipated to come from bycatch. This would constitute the bycatch-OFL for purposes of determining the annual PSC limit. The current rebuilding plan includes a provision that the directed fishery is closed until the stock is rebuilt (second consecutive year above B_{MSY}). Once the stock is rebuilt, the directed fishery could be re-opened. The PSC limit would continue to be annually estimated as the bycatch-component of the OFL. Should the crab fisheries begin to contribute to the bycatch of the stock, an estimate of the groundfish-only component of the OFL would need to be made to appropriately specify the PSC limit as a component of the total OFL level.

Note that a PSC limit = OFL would allow catch to exceed the ABC under the current bycatch-OFL.

2.5.2 Sub-option 2: PSC Limit = ABC

The PSC limit would be set equal to the ABC recommended annually by the SSC to the Council. Under Amendment 38 to the Crab FMP, an ABC control rule is employed annually to determine the maximum permissible ABC, understanding that the SSC may recommend a lower value on an annual basis. Currently, given that the OFL for this stock is assessed using Tier 5, the SSC has recommended that the ABC be calculated using the Tier 5 formula of ABC = 90% of OFL. This results in a 2012/2013 ABC = 2,301 lb (1.04 t), which is 256 lb below the OFL. Once the OFL is set using Tier 4, the ABC control rule would be established using a P* approach with the recommended P* value = 0.49.

2.5.3 Sub-option 3: PSC Limit = 90% of ABC

This sub-option sets the PSC limit equivalent to 90% of the ABC. Given the ABC as specified under Sub-option 2, this equates to a PSC limit of 2,071 lb.

2.5.4 Sub-option 4: PSC Limit = 75% of ABC

This sub-option sets the limit equivalent to 75% of the ABC. Given the ABC as specified under Sub-option 2, this equates to a PSC limit of 1,726 lb.

The following table compares the different PSC limit sub-options in weight (lb) as well as in numbers of crab (Table 2-3). Here the conversion from pounds to numbers of crab uses the mean observed weight (lb) for crabs from 7/1/09-6/30/10. This is consistent with annual calculations of bycatch by weight against the OFL by the NMFS Regional Office (RO).

Table 2-3 Comparison of PSC limit sub-options in lbs and numbers of crab. The mean observed weight of PIBKC bycatch from 7/1/09 – 6/30/10 was used to calculate the number of crab. The mean weight employed was 2.671 lbs.

PSC limit sub-option	PSC limit description	PSC limit (lb)	PSC limit (numbers of crab)
1	OFL	2,557	957
2	ABC	2,301	862
3	90% ABC	2,071	775
4	75% ABC	1,726	646

There are 4 closure options under Alternative 5:

Option 5a: The existing PIHCZ, as described in Alternative 1 (Figure 2-1), would be modified to apply to additional fisheries (i.e., rather than just to the trawl fisheries as under the status quo). The fisheries to which this closure would apply would be Pacific cod pot and hook-and-line as the non-exempt trawl fisheries are already closed form this area year-round. The closure would be triggered by attainment of a fishery-wide PSC limit set at the options below. PSC limit options are the following:

Sub-option 1: PSC limit = OFL
Sub-option 2: PSC limit = ABC
Sub-option 3: PSC limit = 90% ABC
Sub-option 4: PSC limit = 75% ABC

Option 5b: The existing ADF&G crab closure areas between 168° and170° West longitude, and between 57° and 58° North latitude would be closed to additional fishing effort as indicated in Figure 2-2. The fisheries to which this closure would apply are Pacific cod pot and hook-and-line, yellowfin sole trawl, and other flatfish trawl (see Table 2-1). The closure would be triggered by attainment of a fishery-wide PSC limit set at the options below. PSC limit options are the following:

Sub-option 1: PSC limit = OFL
Sub-option 2: PSC limit = ABC
Sub-option 3: PSC limit = 90% ABC
Sub-option 4: PSC limit = 75% ABC

Option 5c: The closure area consists of the full distribution of the Pribilof Islands stock aggregated from 1975 to 2009 based on the NMFS EBS bottom trawl survey (Figure 2-3A). The fisheries to which this closure would apply are Pacific cod pot and hook-and-line, yellowfin sole trawl, and other flatfish trawl (see Table 2-1). The closure would be triggered by attainment of a fishery-wide PSC limit set at the options below. PSC limit options are the following:

Sub-option 1:	PSC limit = OFL
Sub-option 2:	PSC limit = ABC
Sub-option 3:	PSC limit = 90% ABC
Sub-option 4:	PSC limit = 75% ABC

Option 5d: The closure area (Option 2) consisting of the full distribution of the Pribilof Islands stock aggregated from 1984 to 2009 without the portion which extends east of the 168 Pribilof District boundary (Figure 2-4). The fisheries to which this closure would apply are Pacific cod pot and hook-and-line, yellowfin sole trawl, and other flatfish trawl (see Table 2-1). The closure would be triggered by attainment of a fishery-wide PSC limit. PSC limit options are the following:

Sub-option 1:	PSC limit = OFL
Sub-option 2:	PSC limit = ABC
Sub-option 3:	PSC limit = 90% ABC
Sub-option 4:	PSC limit = 75% ABC

Under Option 5d, Sub-options 3 and 4, there is an additional option for allocation of the PSC limit by gear types. This allocation is as follows:

Trawl gear:	40%
Pot gear:	40%
Hook-and-line gear:	20%

2.6 Alternative 6: PIHCZ closure to Pacific cod pot fishery and triggered area closure to qualified fisheries

Prior to the selection of Alternative 2b as the PPA, the Council had selected the following combination of a year-round area closure of the PIHCZ (Figure 2-1) to Pacific cod pot fishing with a triggered closure of Area 5d (Figure 2-4) to qualified fisheries as a PPA. This alternative is no longer designated as a PPA due to issues noted by the Council on management concerns, data limitations, and the appropriate boundary for the stock at this time. In deference to the current issues with respect to the appropriate stock boundary for the PIBKC stock, and the impact modifying the stock boundary would have upon the qualified fisheries, the Council modified their PPA to reflect only the cod pot closure under Alternative 2b as a move to constrain known sources of bycatch mortality while continuing to move forward to address issues of additional bycatch and stock boundaries. The Council further noted that it may consider additional measures to minimize PIBKC bycatch should the stock boundary be resolved in this assessment cycle.

This alternative combines elements of Alternative 2, Option 2b with Alternative 5, Sub-option 4, Option 5d. The fisheries to which the triggered closure would apply are the following: Pacific cod pot and hook-and-line, yellowfin sole trawl, and other flatfish trawl.

Component 1: The first component of this alternative is a year-round closure of the PIHCZ to fishing for Pacific cod with pot gear. This closure would be in addition to the existing closure to all trawl gear of the PIHCZ. Thus only fishing with hook-and-line gear would be allowable inside the PIHCZ.

Component 2: The second component of this alternative is a triggered closure of the area representing the distribution of the PIBKC stock between 1984 and 2009 (see Figure 2-3). The PSC limit associated with this closure is established as a fishery-wide level at 75% of the ABC.

Option a: Set bycatch cap in numbers of crab based on the average weight in the previous season.
Option b: Set bycatch cap in numbers of crab based on a rolling five year average weight.

Option 1: This PSC limit is then further allocated to sectors by gear type as follows:
Trawl Gear – 45% of trigger cap
Pot Gear – 45% of trigger cap
H&L Gear – 30% of trigger cap

This allocation notably over-allocates the cap which is specifically intended to allow for greater fishing flexibility by gear type. Nevertheless, when the overall aggregate cap is reached the closure would be triggered regardless if some gear types have not yet reached their individual sector allocation. Furthermore as with Alternative 5, bycatch accrual is by all fisheries in the Pribilof District and not restricted to those fisheries that are not exempted from the closures themselves.

Option 2: The trigger cap is seasonally allocated to all fisheries in aggregate. Any unused PSC will roll to the following season.

a) 25% to first quarter, 25% to second quarter, 50% to last half of year
b) 50% to first half of year, 50% to last half of year
c) 75% to first half of year, 25% to second half of year

2.7 Option for Increased Observer Coverage

For each of the Alternatives, this option would increase observer coverage requirements. This increase could be applied to all fisheries (Option 1, below) or for a specific fishery (Option 2, below) depending upon the selection of the individual application of an alternative under Alternatives 2 through 6.

Option1: Apply increased observer coverage to fisheries which contributed to PIBKC bycatch above a threshold criteria since 2003 for which a cap (PSC or trigger) or closure applies.
Option 2: Apply increased observer coverage to specific fisheries.

Sub-option (applies to both Options 1 and 2): This would sunset under implementation of the restructured North Pacific Groundfish and Halibut Observer Program (Observer Program).

Under these options, increased observer coverage would be added to fisheries that contributed to PIBKC bycatch above a threshold criteria since 2003 (as listed in Table 2-1) or to only specific fisheries.[5] Selection of the sub-option would indicate that any mandatory increased observer coverage on a fishery would sunset upon implementation of the observer restructuring program. The Council took final action on this analysis in October 2010. The new Observer Program was implemented in 2013.

The Council's motion is available at:
http://alaskafisheries.noaa.gov/npfmc/current_issues/observer/ObserverMotion1010.pdf. Additional information is available in the public review draft of the analysis for this action:
http://alaskafisheries.noaa.gov/npfmc/current_issues/observer/Observer_restructuring910.pdf

[5] Additional specificity would be required as to which specific fisheries this increased observer coverage would apply.

In discussion of this option at the October 2011 Council meeting, the Council requested that additional information be provided to the Council regarding the Council's ability to request additional coverage on specific fisheries under the restructured Observer Program for 2013 rather than by including that as a requirement under these options of the Council's preferred alternative. This information is included in Chapter 3, Section 3.4.1 of this document.

2.8 Comparison of Alternatives and Rationale for the Preferred Alternative

Alternatives 1 through 6 address different closure configurations applied to either the trawl-only fisheries (Alternative 1) or to include Pacific cod pot, Pacific cod hook-and-line, or yellowfish sole fisheries. A comparison of the relative extent of the closures across these alternatives is shown in Figure 2-4. Table 2-4 shows a comparison of the different features of all six alternatives.

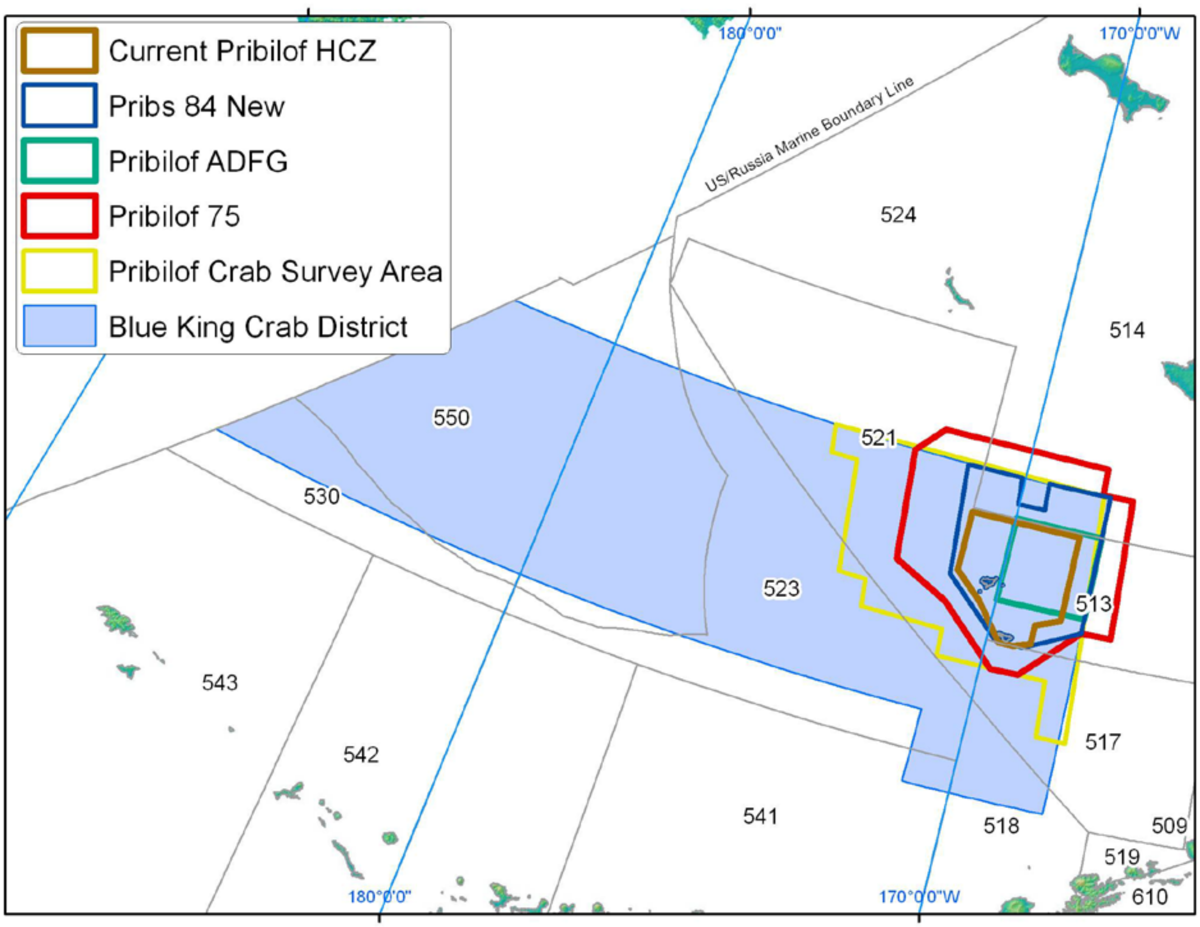


Figure 2-4 Comparison of alternative closure configurations under Alternatives 1 through 6 with Federal reporting areas (numbered) and the Pribilof District (shaded area). Note that Alternative 6 is the area labeled "Pribilof 84 New."

Table 2-4 Comparison of major features of Alternatives 1 through 6.

<table>
<tr><th>Alternative</th><th>Area Closure</th><th>Fisheries</th><th>Timing and Triggers</th></tr>
<tr><td>1 Status Quo</td><td>PIHCZ</td><td>All groundfish trawl</td><td>Year-round</td></tr>
<tr><td>2 Year round closure (PA)</td><td rowspan="2">PIHCZ</td><td>(a) Pacific cod pot, hook-and-line Pacific cod
(b) Pacific cod pot (PA)</td><td>Year-round</td></tr>
<tr><td>2 Area closure triggered by a portion of the 75% of ABC PSC limit</td><td>(c) Pacific cod pot[6]</td><td>When bycatch by all fisheries
(i) > 20% of PSC limit
(ii) > 30% of PSC limit
(iii) > 50% PSC limit</td></tr>
<tr><td>3 Year round closure</td><td>ADF&G</td><td>(a) Yellowfin sole, Pacific cod pot, hook-and-line Pacific cod
(b) Pacific cod pot</td><td>Year-round</td></tr>
<tr><td rowspan="2">4 Year round closure</td><td>(a) 1975–2009 distribution</td><td rowspan="2">(1) Yellowfin sole, Pacific cod pot, hook-and-line Pacific cod
(2) Pacific cod pot</td><td rowspan="2">Year-round</td></tr>
<tr><td>(b) 1984–2009 distribution</td></tr>
<tr><td rowspan="4">5 Area closure triggered by PSC limit</td><td>(a) PIHCZ</td><td rowspan="4">(1) Pacific cod pot, hook-and-line Pacific cod[1]

(2) Yellowfin sole, Pacific cod pot, hook-and-line Pacific cod</td><td rowspan="4">(i) PSC limit = OFL
(ii) PSC limit = ABC
(iii) PSC limit = 90%ABC
(iv) PSC limit= 75 % ABC

Sub-option: Allocate PSC limit:
40% Trawl
40% Pot
20% Hook-and-line</td></tr>
<tr><td>(b) ADF&G</td></tr>
<tr><td>(c) 1975–2009 distribution</td></tr>
<tr><td>(d) Revised 1984–2009 distribution</td></tr>
<tr><td>6 (1) Year-round closure to Pacific cod pot fishing and</td><td>PIHCZ</td><td>Pacific cod pot</td><td>Year-round</td></tr>
<tr><td>(2) PSC limit that triggers a larger area closure to additional fisheries; PSC limit allocated by gear type</td><td>Revised 1984–2009 distribution</td><td>Yellowfin sole, Pacific cod pot, hook-and-line Pacific cod</td><td>PSC limit =75% ABC
(1) allocated:
45% Trawl
45% Pot
30% Hook-and-line
(2) seasonally allocated by quarter aggregate fisheries
(a) 25%, 25%, 50%
(b) 50%, 50%
(c) 75% , 25%</td></tr>
</table>

[6] 100% observer requirement to fish inside PIHCZ. Under the option for increased observer coverage, this provision could be added to other alternatives as well but the Council has not specified any increased observer covereage outside of Alternative 2c for Pacific cod pot fishing.

The Council took final action on this analysis in June 2012 and selected Alternative 2, Option 2b as the PA. In selecting this alternative, the Council noted that the best scientific information from survey data on PIBKC based on location of crab, observed catch rates, and habitat type indicate that this area represents the highest concentration of PIBKC as well as PIBKC habitat. Observer data from the Pacific cod pot fishery show the highest average rate of PIBKC bycatch inside the PIHCZ; therefore, a prohibition of Pacific cod pot fishing in the PIHCZ is highly likely to reduce PIBKC bycatch in an area where the stock is concentrated. The Council considered this alternative to be preferable to others under consideration due to a number of reasons. First as noted, the bycatch rate by this fleet represents the highest rate of all groundfish fisheries, and is concentrated in the area of known survey concentration of the stock. The Council acknowledged stock distribution issues and observer coverage issues noted in this analysis with respect to extending any alternative closure to additional fisheries and in a broader area at this time (Alternatives 3, 4, and 5). Observer coverage requirements have been modified starting in 2013, thus additional information will likely be forthcoming regarding the observed amounts of PIBKC bycatch in all groundfish fisheries, which will assist in accruing catch towards the PIBKC OFL and ABC and provide additional information on relative catch rates by all fleets. The Council also acknowledged these issues in relation to the difficulty in establishing an appropriate PSC cap level to trigger a closure under Alternatives 5 and 6, as discussed in Chapter 3. The Council noted in recommending Alternative 2, Option 2b that the analysis suggests that fairly high catches by vessels using pot gear that occur within the PIHCZ could be effectively harvested outside of the boundary of the PIHCZ thus the overall catch of Pacific cod would not be reduced.

Any action taken to decrease the mortality on this stock may increase the likelihood that this stock rebuilds. Analysis of the impacts of the alternative closure configurations on the rebuilding potential for the PIBKC stock shows limited effect on rebuilding between the ranges of alternative closures. This is based on the assumptions of the projection model, low PIBKC abundance, and the lack of observed recruitment for this stock in multiple years. The PA would close the PIHCZ, the area known have key habitat components important to PIBKC, to fishing for Pacific cod pot gear, the gear type with the highest observed bycatch. This would decrease the mortality on this stock and prevent overfishing due to bycatch.

2.9 Alternatives Considered but Not Carried Forward for Analysis.

Several alternatives have been considered but not carried forward for analysis for a variety of reasons as described below. Appendix 2 provides a discussion of additional closure configurations that the Council considered.

Gear modification: One alternative that was considered for this analysis but not carried forward for analysis included a gear modification for a slick ramp modification for pot gear to deter blue king crab. Development of this type of modification to pot gear is being researched and may be effective in the future for decreasing mortality of blue king crab when directly fishing Pacific cod. This gear, however, will not be available or field tested for inclusion in this analysis as a viable alternative for consideration within the time frame that a new rebuilding plan must be implemented.

PSC limit fishery-wide: Another alternative considered but not carried forward at this time is to establish a PSC limit for the PIBKC stock and to divide this cap by individual groundfish fisheries. Given the lack of sufficient observer coverage in the Pacific cod pot fishery near the Pribilof Islands and other fisheries in this region, the ability to close individual fisheries upon reaching a fishery-specific catch level is problematic.

Two additional PSC limit alternatives were considered in the preliminary review draft and removed from the analysis at that time. The first was a PSC cap to which bycatch of PIBKC within the 513 reporting area would apply and upon attainment of which all groundfish fishing would cease. This alternative was considered to be unnecessary with the addition of the closure alternatives under Alternative 5 in this analysis as well as ill-conceived in that areas outside of the range of PIBKC stock would close to fishing once the cap was reached. Alternative 5 closures are better representative of the areas under consideration for PIBKC bycatch. Finally, under Alternatives 2 through 5 one of the options would have applied these closures to all groundfish fisheries in the Bering Sea regardless of whether those fisheries have contributed to PIBKC bycatch. Therefore in October 2010, the Council moved to remove from consideration for closures any fisheries that have not contributed to PIBKC bycatch since 2003. The Council in December 2010 further established a threshold criterion of bycatch contribution such that fisheries would be exempted if they caught less than 5% of the ABC or less than 10% of the ABC over that time frame. Based on these criteria, additional fisheries (pollock and Greenland turbot) were excluded from closure consideration.

Halibut IFQ fishery: In April 2010, the SSC commented that the rebuilding plan analysis should *"consider likely crab PSC in the halibut fishery. This review should be brought into the analysis to consider the efficacy of the alternatives to achieve stock rebuilding"* (SSC minutes April 2010). This was in response to the indications that fixed gear (specifically long line fisheries) have accounted for a significant proportion of total bycatch of PIBKC in some years, thus the potential exists for bycatch in the halibut longline fishery operating in the area as well.

To assess the potential bycatch of PIBKC in the halibut fishery, data from 2004 to 2009 halibut fisheries and halibut surveys were provided by the International Pacific Halibut Commission (IPHC). Within the largest proposed area closure (PIBKC75), the IPHC survey occupies approximately 32 stations (Figure 2-5) within 26 IPHC statistical units distributed mostly in and around the Pribilof Islands. From 2004 to 2009 no blue king crab were caught during this survey based on an assessment of the first 20 hooks of each skate in a set. Between 2004 and 2009 a range of 96 to 308 total effective skates were sampled during the survey. An effective skate is an 1800 foot skate with 100 hooks with hook spacing greater than 4 feet. For comparison to the IPHC survey, logbook data shows that between 5,800 and 7,400 effective skates were fished that caught halibut (per year) between 2004 and 2008. Between 486,000 and 966,000 lbs of halibut were caught per year in the area of the largest proposed closure (Figure 2-6).

At this time, specific bycatch data on PIBKC (from commercial logbooks) are not available due to confidentiality issues with reporting the data. However, it is noted that that the bycatch encounter rates in the IPHC survey are generally not representative of the commercial fleet. The survey fishes on a standardized spatial layout (10nm x 10nm grid) whereas the commercial fishery is targeting halibut.

In evaluating the data necessary to characterize the initial applicable fisheries for the alternative closures in this analysis, there were fishticket records from 2007 indicating bycatch of PIBKC in the directed halibut longline fishery,[7] however this did not meet the revised criteria and thus is no longer included in the list of fisheries.

Alternative management measures for PSC limit: Per Council request other means of managing a PSC limit by fishery were considered (as described under Section 2.5.3). For comparison, three thresholds were considered at 50%, 75%, and 90% of the ABC. For each threshold the fishery that contributed the most to bycatch at that threshold level would then be closed from fishing in that area for the remainder of the season. All three thresholds were reached in 2006 and 2007. Additionally in 2005 and 2009, the 50% threshold was reached. According to the proposed concept of the implications of exceeding the threshold, the fisheries that contributed the most bycatch toward the threshold would then be prohibited from fishing for the remainder of the year.

[7] Note that the "target" as listed on these records was other species taken with longline gear.

In 2005, the 50% threshold was exceeded on December 10. The Pacific cod pot fishery was the highest contributor to PSC catch of PIBKC and would thus be closed for the remainder of the year. In 2006, both the 50% and 75% threshold were exceeded on April 15. At that time the highest contributors were the yellowfin sole trawl fishery, followed by the Pacific cod hook-and-line fishery. The following week on April 22, the 90% threshold was reached and at that time the rock sole trawl fishery was the highest (remaining) contributor. In 2007, the 50%, 75%, and 90% thresholds were all exceeded on September 22 by the Pacific cod pot fishery.

Table 2-6 below shows a summary of the thresholds considered qualitatively as a potential management tool and the years in which each threshold would have been reached historically. While the applicable fisheries closed for each threshold are described above no further economic analysis was done on this threshold as this option was not included in the alternatives and options for analysis.

Evaluation of Applicable Fisheries for Cap and Closures
At the December 2010 Council meeting, the Council moved to exempt fisheries from closures if their contribution to bycatch of PIBKC between 2003 and 2010 was below one of two threshold criteria. The two criteria options are the following:

Option a) less than 5% of the acceptable biological catch (ABC)

Option b) less than 10% of the ABC

Based upon the 2010 PIBKC ABC of 3,600 lb, option a would result in a threshold level of 180 lb while Option b would result in a threshold of 360 lb.

In order to evaluate which fisheries have contributed to the bycatch by these threshold levels of PIBKC since 2003, three databases were queried: the NMFS CAS for prohibited species catch estimates of PIBKC (Area 513 only), the Observer Program database (OBS) for actual observed (only) bycatch of PIBKC, and fishtickets (FT) for documented recordings of PIBKC bycatch. As described in Chapter 3, the current CAS method for estimating bycatch in groundfish fisheries is done by Federal reporting areas. Thus only Area 513 was included to avoid overlap with St. Matthew blue king crab bycatch in Area 521. The OBS and FT records include more refined areas based upon State statistical areas defined as representing the Pribilof Islands area. These three databases were then summarized for all incidences of PIBKC bycatch from 2003 to 2010. The Council received periodic information from analysts regarding the difficulties in ascertaining the qualified fisheries based upon catch above the thresholds compared with spatial information of catch outside of the current stock distribution for PIBKC. As a result, the only fisheries that are currently included in the suite of alternatives are the following: Pacific cod hook-and-line, Pacific cod pot, other flatfish trawl, and yellowfin sole trawl. Additional information on the area over which the overfishing limit is currently specified and issues involved in that specification are contained in Section 2.5.1

Qualified fisheries: In establishing the catch thresholds for the qualified fisheries as described under Alternative 2, the Council had previously included several other fisheries that met these catch thresholds. These fisheries included other flatfish, Pacific cod trawl, and rock sole trawl. Upon examination of the actual catch of PIBKC by these fisheries, it was determined that the catch occurred outside of the current delineation of the Pribilof District, which was assumed to be the boundary of the PIBKC stock. Given this indication, the Council removed these fisheries from the list of qualified fisheries, leaving the remaining fisheries for the analysis as only Pacific cod pot and hook-and-line, and the yellowfin sole trawl fisheries.

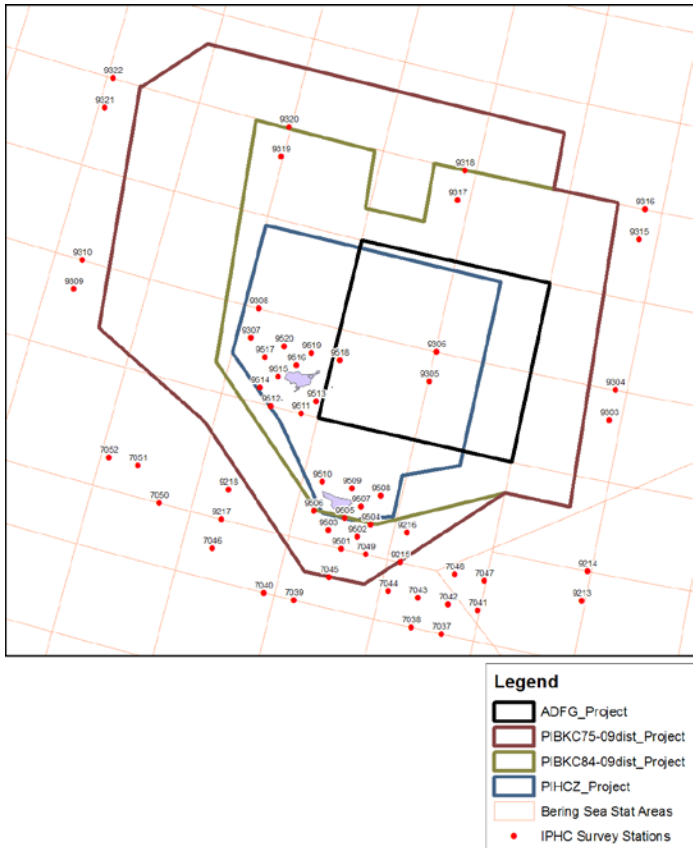


Figure 2-5 International Pacific Halibut Commission survey stations located within the proposed closure areas around the Pribilof Islands.

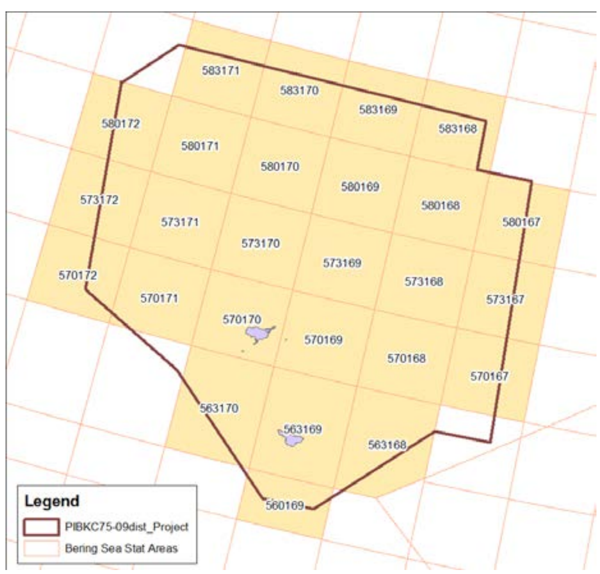


Figure 2-6 International Pacific Halibut Commission statistical areas located within the proposed closure areas around the Pribilof Islands.

Table 2-5 Pacific halibut catch from 2004 to 2008 in International Pacific Halibut Commission areas that overlap with Pribilof Islands blue king crab 1975–2009 distribution area.

	Logbook Data			Ticket Data	
Year	Net lbs	Effective skates hauled	Distinct # of vessels	Net wt (lbs)	Distinct # of vessels
2004	602,063	6,867	25	965,598	40
2005	473,426	6,180	21	534,876	23
2006	401,420	5,785	17	486,359	20
2007	439,683	7,071	15	546,842	21
2008	597,274	7,448	25	791,283	32

Table 2-6 Three cap level thresholds (expressed as % of ABC) for management of PSC and years in which each threshold would have been reached historically 2003 through 2010.

Threshold (% of ABC)			
Year	90%	75%	50%
2003			
2004			
2005			x
2006	x	x	x
2007	x	x	x
2008			
2009			x
2010			

3 Monitoring, Management, and Enforcement Considerations

This chapter evaluates monitoring, management, and enforcement considerations under the alternatives. The sections in this chapter describe inseason management, the harvest specification process, prohibited species catch estimation, observer data collection, and monitoring and enforcement.

As described in Chapter 2, the proposed alternatives contain two management approaches:

1. Year-round area closures for specific directed fisheries.
2. PSC limits that, when reached, trigger closure of a specific area.

Under Alternatives 1 through 4 and Alternative 6, a designated area would be closed year-round to specific fisheries. In Alternative 1, the status quo, the Pribilof Islands Habitat Conservation Zone (PIHCZ), defined by Figure 10 to 50 CFR Part 679, is closed to all trawl gear. Under Alternative 2 this same area would be closed year round to Pacific cod pot gear or hook-and-line gear. Under Alternatives 3 and 4, new year-round closures would be created for specific fisheries as listed in Table 2-1 (or for Pacific cod pot gear under Options 3b and 4b).

Under Alternative 5, a PSC limit would be established equal to either the overfishing limit (OFL), the acceptable biological catch (ABC), or a proportion of the ABC for the crab stock. All bycatch of Pribilof Islands blue king crab (PIBKC) in all groundfish fisheries would accrue towards this prohibited species catch (PSC) limit and those groundfish fisheries that are not exempted would be subject to the area closure if the limit were reached.

Alternative 6 would combine elements of Alternative 2, Option 2b, with Alternative 5, Sub-option 4, Option 5d. Specifically, this alternative would:

1. Close the PIHCZ (Figure 2-1) year-round to directed fishing for Pacific cod with pot gear.
2. Establish a PSC limit that, when reached, triggers closure of a larger area (the 1984 to 2009 distribution Figure 2-3(B)) hereafter referred to in this chapter as the Pribilof Islands Blue King Crab Savings Area (PIBKC Savings Area) to specified directed fisheries.
3. Accrue all blue king crab caught by vessels using any gear type in all directed groundfish and halibut fisheries (Community Development Quota [CDQ] and non-CDQ combined) in the Pribilof District (Figure 4-11) or whatever PIBKC stock boundary is decided against this PSC limit. Note that the area in which blue king crab will accrue against the PSC limit is larger than the area that would close once the PSC limit is reached.
4. Close the PIBKC Savings Area when specific PSC limits are reached.[8]

The PSC limit and trigger closure alternatives pose the most challenges for management, therefore, much of the discussion in this chapter addresses the implementation of this type of an approach.

3.1 Inseason Management

3.1.1 Year-round closure areas

Under Alternatives 1 through 4 and Component 1 of Alternative 6, a designated area would be closed year-round to specific fisheries. This is currently how status quo is regulated, with the PIHCZ, defined by Figure 10 to 50 CFR Part 679, closed to all trawl gear.

[8] The affected fisheries are subject to change depending upon final definition of the PBIBKC stock boundary.

Under Alternative 2 this same area would be closed year-round to Pacific cod fisheries using pot gear or pot and hook-and-line gear (as the other fisheries listed in Table 2-1 are already excluded as trawl fisheries). Under Alternatives 3 and 4, new year-round closures would be for specific fisheries as listed in Table 2-1 (or for Pacific cod pot gear under Options 3b and 4b). Under Component 1 of Alternative 6, the PIHCZ would be closed year-round to directed fishing for Pacific cod by vessels using pot gear, in addition to the existing closure of this area to all vessels using trawl gear.

The inseason management of the area closures in Alternatives 2 and Component 1 of Alternative 6 would be the same as the status quo. NMFS and NOAA Office of Law Enforcement monitor compliance with this closure area using location information from observer and vessel monitoring system (VMS) data. The management of the closure proposed in Alternatives 3 and 4 would also be similar to the status quo, but the closures would be in different areas than the PIHCZ and thus these alternatives would require monitoring of two different areas (the PIHCZ for trawl gear and another area for the PIBKC closure). Some additional enforcement considerations for closure areas are described at the end of this chapter.

3.1.2 Trigger closure areas

Alternatives 2c, 5, and 6 also include "triggered closure areas," which are areas that would close upon attainment of a newly specified PSC limit. Closures would apply to various combinations of gear type and directed fishery. NMFS would monitor the PSC of PIBKC in the groundfish and halibut fisheries based on best available data (discussed below) and would issue fishery closures once the overall PSC limit was reached. Operators of vessels identified in the closure notices would be prohibited from directed fishing in the area once NMFS closed the area to a fishery. The methods for estimating the catch of PIBKC in the groundfish fisheries is described below in Section 3.3. Hook-and-line fisheries for halibut under the individual fishing quota and CDQ programs also occur in the action area. However, NMFS is not, at this time, able to use observer data to estimate the PSC of PIBKC in the halibut fisheries. As described in Section 3.4 below, under the restructured observer program, the halibut fleet will be subject to observer coverage starting in 2013. Therefore, data may be available in the future to estimate the PSC of PIBKC in the halibut fisheries.

Under Alternative 6, the apportionment of the PSC limit among gear types is 45% trawl, 45% pot, and 30% hook-and-line. As the sum of these apportionments is greater than the amount of the PSC limit, this apportionment means that each gear type is not guaranteed to have the full amount of the PIBKC apportioned to it available as a PSC limit for their fisheries. This structure for the PSC limit means that vessels subject to the triggered closure would be operating under two levels of the PSC limit at all times. Their directed fishery would be closed when the portion of the PSC limit that applies to their gear type is reached, or (2) the overall PSC limit is reached, whichever occurs first. If the full amount of the PIBKC PSC limit is reached during the year, one of the gear types will not be allowed the full amount of their PSC limit apportionment. For example, if both trawl gear and pot gear fully harvest their 45% apportionment of the PSC limit, then 90% of the PSC limit would have been taken and only 10% of the PSC limit remained available for vessels using hook-and-line gear, even though these vessels have an apportionment of 30% of the PSC limit. Because of the small number of PIBKC that would be the PSC limit and with the PSC accruing against each of the three gear apportionments throughout the year, it is possible that the PSC limit may be reached before any of the three gear types completes groundfish fishing in the Pribilof blue king crab district, triggering an area closure under Alternatives 2, 5, and 6.

Inter-sector rollovers

In its October 2011 motion, the North Pacific Fishery Management Council (Council) requested that NMFS discuss its ability "to manage sector-level triggers through inter-sector rollovers". A "rollover" is a management action taken by NMFS that would re-allocate PIBKC PSC from one sector to one or more other sectors through a notice in the *Federal Register*. Rollovers generally apply when one sector has finished fishing for a season or for the year without reaching its PSC limit. Under these circumstances, the remaining amount of the PSC limit may be made available to other sectors to maximize the amount of groundfish that may be harvested for a given PSC limit. The opportunity to apply rollovers under Alternative 2b, the PA, is limited because the gear type apportionments of the PSC limit are annual limits that add up to more than 100%. Therefore, if one sector (gear) has completed fishing in the Pribilof king crab stock area without exceeding its apportionment of the PSC limit, the remaining amount of its apportionment of the PSC limit is not necessarily fully available to the other sectors. For an inter-sector rollover to occur, NMFS would have to know that all vessels of a specific gear type have completed fishing in the Pribilof blue king crab district for the year. If this occurred, NMFS could re-apportion the remaining percent of the PIBKC PSC limit originally apportioned to the gear type that had completed fishing among the two other gear types that still could fish in the area. If both other gear types had remaining fishing opportunities in the Pribilof blue king crab district, then NMFS would need guidance about how to apportion the remaining percentage PSC limit among the two gear types. If the Council recommends that NMFS undertake rollovers, but does not provide guidance about how they should occur, NMFS would evaluate the specific circumstances and develop a rationale for a particular rollover approach based on which sectors were still fishing and the remaining fishing expected to occur. However, this could be a complicated and controversial decision that representatives of the remaining gear types may not agree with, therefore, the decision about how to affect the rollover may take more time than is available in the remaining season. In addition, the fact that the PSC limit will be relatively low and PSC amounts difficult to predict likely would limit NMFS's willingness to undertake sector re-allocations.

Seasonal rollovers

An alternative approach that has been discussed, but has not yet been fully analyzed, would be to allocate the PIBKC PSC limit by season instead of by gear type. Under this scenario, all PIBKC caught by any vessels fishing for groundfish, regardless of gear type, would accrue toward the seasonal limit of PSC. If PIBKC was allocated by seasons and the seasonal limit was not reached at the end of a season it would be possible for the PSC limit to be added to the respective seasonal apportionment for the next season during a current fishing year. Seasonal rollovers are simpler for NMFS to implement because the season is based on a clear-cut definition (time) and do not require the agency to determine if everyone is finished fishing or not, as is necessary under inter-sector rollovers, nor are there issues with multiple sectors being potentially able to receive the rollover.

NMFS could not implement both inter-sector rollovers and seasonal rollover combined. This limitation is due to the small number crab that could be specified to both sectors (gear) and season for the PIBKC PSC limit under Alternative 6.

Transfers

None of the proposed alternatives under this action will create a transferable PSC allocation program and thus PSC limits of PIBKC will not be allocated to entities or cooperatives under this action. As such, none of the proposed alternatives support quota transfers as has been implemented in PSC allocation programs such as Amendment 91 or Amendment 80.

3.1.3 Applying the Trigger Cap to the CDQ fisheries

The PIHCZ currently is closed to all trawling, including vessels using trawl gear to fish under the CDQ Program. Under Alternative 2b, the PA, closure of this area to vessels directed fishing for Pacific cod using pot gear would apply to vessels in the CDQ and non-CDQ fisheries.

Two options exist to apply the trigger cap for the PIBKC Savings Area to the CDQ Program and CDQ fisheries: (1) allocate a portion of the PSC limit to the CDQ Program and among the CDQ groups and manage these limits separately from the portion of the PSC limit allocated to the non-CDQ fisheries, or (2) do not allocate a portion of the PSC limit to the CDQ Program and manage the trigger cap for the CDQ and non-CDQ fisheries combined. **Due to the relatively small number of blue king crab that could be specified for the PIBKC PSC limit under the alternatives, NMFS recommends that this trigger cap be managed as a single cap that applies to the CDQ and non-CDQ fisheries together.** This management approach is similar to how the red king crab savings subarea (RKCSS) trigger cap currently is managed. Catch of blue king crab by both CDQ and non-CDQ vessels would accrue against the same PSC limit and if the trigger cap is reached, closure of the PIBKC Savings Area would apply to the CDQ and non-CDQ fisheries.

3.2 Allocation of the PSC Limit in the Groundfish Harvest Specification Process

Both Alternatives 5 and 6 include PSC limits. A PSC limit may either be set as an explicit amount or as an explicit percentage of the ABC (such as that included as an option under Alternative 5d, Sub-options 3 and 4). If the PSC limit is based on a percentage of the annual ABC, which fluctuates each year, then the limit and apportionments must be specified under the annual groundfish harvest specifications process. The following describes the process by which this could occur.

The regulations at 50 CFR 679.21 would establish the PIBKC PSC limits; describe any apportionments of the PSC limit to fishery categories, sectors, or gear types; and establish closure areas, as determined by the Council's final action. Each year, the PIBKC PSC limit and the fishery apportionment thereof would be determined as part of the groundfish harvest specification process set out at 50 CFR 679.20(c). At the October Council meeting, the SSC would determine the ABC for PIBKC based on the best available scientific information in the most recent stock assessment prepared by the Crab Plan Team. The apportionment of the PIBKC PSC limit among groundfish fisheries and fishery categories, if further apportioned, would be recommended to the Council by their Advisory Panel.[9] The Council would recommend to NMFS proposed PIBKC PSC limits and the BSAI fishery apportionments thereof for up to two years. NMFS would review the recommendations and publish in the *Federal Register* proposed harvest specifications in November or early December. At the December Council meeting, the Council would consider public comments on the proposed harvest specifications, public testimony, and any changes from the Advisory Panel, and then recommend to NMFS final PIBKC PSC limits. NMFS would review the recommendations and publish in the *Federal Register* final harvest specifications in approximately February or March the following year.

3.2.1 CDQ allocations

The Council has the authority to recommend allocations of PSC limits to the CDQ Program and among the CDQ groups. Section 305(i)(1)(B)(i) of the Magnuson-Stevens Act establishes the CDQ Program

[9] Note this recommendation is necessary if the Council does not set a fixed percentage for each fishery in conjunction with final action. If the Council does recommend fixed percentages, these percentages would be in regulation and annual recommendations during the harvest specifications process would not be necessary.

allocations, stating that "the annual percentage of the total allowable catch, guideline harvest level, or other annual catch limit allocated to the program in each directed fishery of the Bering Sea and Aleutian Islands shall be the percentage approved by the Secretary, or established by Federal law, as of March 1, 2006… ." PSC limits established in the BSAI groundfish fisheries, and the corresponding allocations from those limits to the CDQ Program, are not directed fisheries and regulations at 50 CFR 679.21(b)(2) require operators of vessels engaged in directed fishing for BSAI groundfish to minimize its catch of PSC. Therefore, the requirements of section 305(i)(1)(B)(i) do not apply to allocations or prohibited species quota and these allocations remain under the authority of the Council to recommend.

The CDQ Program receives allocations of the PSC limits for halibut, red king crab in Zone 1, *C. bairdi* Tanner crab in Zone 1, *C. bairdi* Tanner crab in Zone 2, *C. opilio* crab, Bering Sea Chinook salmon, Aleutian Islands Chinook salmon, and non-Chinook salmon. Once allocated to the CDQ Program, the PSC limit is known as a "prohibited species quota" or PSQ. The PSQs are further subdivided among the six CDQ groups based on percentage allocations established in 2005 (71 FR 51804; August 31, 2006). The PSC limits for crab are trigger caps that once reached close specific areas (Zone 1 or Zone 2) to fishing with trawl gear. Once a CDQ group's PSQ for a particular crab species is reached, operators of vessels fishing on behalf of that CDQ group are prohibited from using trawl gear to harvest groundfish CDQ in the specified area.

The CDQ Program does not receive allocations of the herring PSC limit or the RKCSS portion of the red king crab zone 1 PSC limit. An allocation of the herring PSC limit was not made to the CDQ Program in the 1998 expansion of the program to include the remainder of the groundfish species and prohibited species, because of the conflict between NMFS's proposal to require full retention of herring for proper accounting and State of Alaska regulations prohibited the retention of herring by vessels using trawl gear (63 FR 30381, June 4, 1998). Any closures of the herring savings areas apply equally to vessels CDQ and non-CDQ fishing.

Regulations at 50 CFR 679.21(e)(3)(ii)(B) establish the RKCSS with a trigger cap set by the Council during the annual groundfish specifications at a maximum of 25% of the red king crab PSC limit. Once this trigger cap is reached, the RKCSS is closed to vessels fishing with non-pelagic (bottom) trawl gear. The RKCSS trigger cap is not allocated among the CDQ and non-CDQ fisheries. Once the cap is reached, the closure to non-pelagic trawl gear applies to vessels participating in both the CDQ and non-CDQ fisheries equally.

3.3 Prohibited Species Catch (PSC) Estimation

3.3.1 PSC estimation under Status Quo

NMFS determines the number of crab caught in the groundfish fisheries using the catch accounting system (CAS) and details of the groundfish and PSC catch estimation methods are described in a NOAA Technical Memorandum (Cahalan et al. 2010). The CAS was developed to receive catch reports from multiple sources, evaluate data for duplication and errors, and estimate total catch by species (or species group). The catch estimates are specific to species and fisheries to allow effective monitoring of the catch allocations in the annual harvest specifications. In general, the degree to which a seasonal or annual allocation requires NMFS management is often inversely related to the size of the allocation. Typically, the smaller the catch allocation, the more intensive the management required to ensure that it is not exceeded.

Data from the North Pacific Groundfish and Halibut Observer Program (Observer Program) and mandatory fishing industry reports are the two sources of information used to estimate catch and bycatch in the groundfish fisheries. Industry reports of landings and production are generated for all fishing activity in Federal groundfish fisheries through a web-based interface known as eLandings. eLandings was implemented in 2005 by NMFS, Alaska Department of Fish and Game (ADF&G), and the International Pacific Halibut Commission as a joint program to reduce reporting redundancy and consolidate industry-reported fishery landing information. Each industry report submitted via eLandings undergoes error checking. Data are then stored in a database and made available to the three collaborating agencies. There are two basic eLandings report types used for catch estimation:

- Production Reports: At-sea production reports are mandatory for catcher/processors (CPs) and motherships that are issued a Federal Fisheries Permit. At-sea production reports include information about the gear type used, area fished, and product weights (post-processed) by species, and the amount of groundfish and prohibited species discard. Since 2009, the at-sea fishing fleet has submitted these reports electronically each day. Prior to 2009, these reports were submitted weekly. Shore-based plants also complete production reports, but these are not used for catch estimation.
- Landing Reports: when a catcher vessel (CV) makes a delivery to a shoreside processor or a mothership a landing report is required. Upon making a landing, a representative of the shoreside processor or mothership submits the landing report into eLandings and a paper "fish ticket" is printed for both the processor and the CV representative to sign. The collection period for a landing report is a trip for CVs that deliver to shoreside processors and a delivery for each CV that delivers to a mothership. A trip for CVs delivering to a shoreside processor is defined as the time period starting when the harvesting of groundfish is begun until the offload or transfer of all fish or fish product from the vessel (50 CFR 679.2). Landing reports are mandatory for all processors required to have a Federal Processor Permit, including motherships who receive groundfish from federally permitted CVs.

NMFS estimates of PSC are derived from observer data, which is an independent source of information, rather than from industry reported catch. In the CAS, the observer data are used to create PSC rates (a ratio of the estimated PSC in the sampled hauls to the estimated total catch in sampled hauls). On observed trips with unsampled hauls, an estimate of total PSC (by species) for the trip is derived by expanding a PSC rate from sampled hauls during the trip to the total catch of groundfish (retained + discarded) during the trip. For trips that are unobserved, the PSC rates are applied to industry reported landings of retained catch. Depending on the observer data that are available, the extrapolation from observed vessels to unobserved vessels is based on varying levels of post-stratification. Data are matched based on processing sector (e.g., CV or CP), week, fishery (e.g., Pacific cod), gear (e.g., pot), and Federal reporting area. If data are not available from an observed vessel within the same sector then rates are applied based on observer data from all sectors in the same target fishery, using the same gear, and fishing in the same Federal reporting area. If observer data are not available from any vessels within the same week then a three-week average is used from all vessels in the same target fishery using the same gear and fishing in the same Federal reporting area. If data are not available within a three-week period then a three-month average is used. Finally, if data from the same Federal reporting area are not available then observer data from the fishery and the fishery management plan (FMP) area (e.g., BSAI) as a whole will be applied.

The PSC for crab are currently estimated in numbers of crab. When the Observer Program obtains samples of crab, both the weight and the number of crab in the sample are collected. NMFS then converts the sample weights into numbers of crabs in the haul. The number of crabs in each sampled haul is then used in PSC estimation (as described above) so that NMFS can monitor PSC limits on the number of crabs.

The catch estimation methods are designed to provide an estimate of catch and bycatch as quickly as possible so that inseason managers have information to make decisions. The CAS makes use of observer data as soon as they are available, but the estimates are updated as more observer data becomes available.

It can take anywhere from a day to over a week for NMFS to receive preliminary observer data. After deployment in the field, which maybe as long as three months, observers review their data with staff from the Alaska Fisheries Science Center's Fisheries Monitoring and Analysis Division to ensure that data were collected following NMFS protocols. It is normal for there to be some data modifications during this "debriefing" and quality control process. For these reasons, PSC estimates change on a regular basis, and there can be variations in the estimates until the observer data are finalized in late February to early March of the year following the fishery.

Although catch of blue king crab may occur in the halibut fisheries in the Pribilof king crab stock area, these fisheries are not observed and no reliable data exists on which to base estimates of this catch. As described in a later section, observer data collected by halibut vessels under the restructured Observer Program may provide additional information about whether blue king crab are caught in the halibut fisheries and, if so, the extent of this catch.

3.3.2 PIBKC area-specific estimation

The current PSC estimation methodology uses observer data to create PSC rates that are applied to unobserved trips and when direct observations from nearby vessels in the same week and fishery (same target and gear) are not available, it is necessary to move to broader time scales and eventually to the entire FMP area. For blue king crab estimation this is especially relevant because observer coverage is low on the Pacific cod pot fishery in the Pribilof Islands. Due to the lack of observer data, PSC estimations in this fishery can involve extrapolations from the region closest to St. Matthew Island where concentrations of blue king crab are higher than in the Pribilof Islands. This issue is highlighted in 2007 (Table 3-1) when the high rate used to extrapolate the unobserved landings near the Pribilof Islands originated from the St. Matthew Island region, leading to a pot bycatch estimate of approximately 2,800 crabs. Potential modifications to the estimation methods would rely on increased observer data within the region in order to have the estimation use rates from vessels within that area rather than using one from the broader FMP area. It is anticipated that with the implementation of the restructured Observer Program in 2013 this type of issue can be resolved simply by shifting observer coverage to less observed fleets for better estimation of regional bycatch.

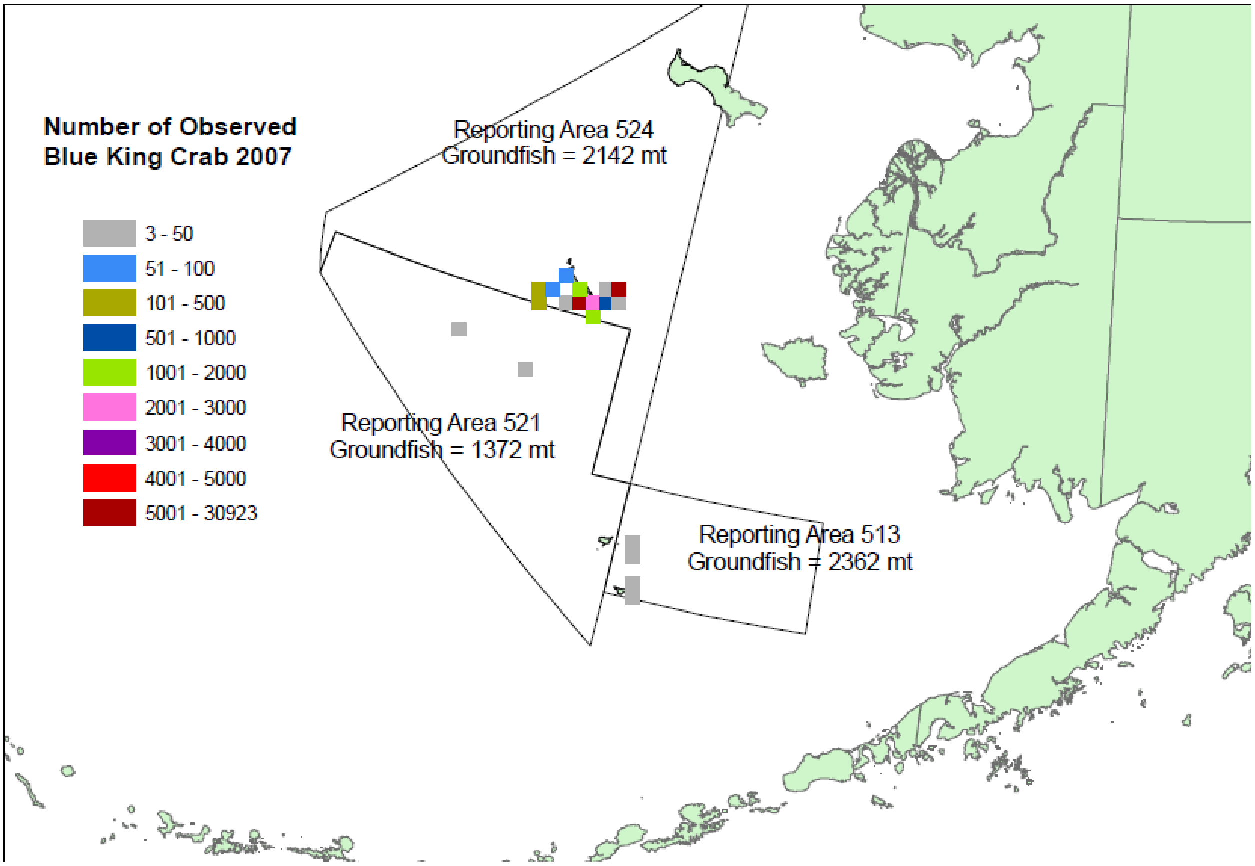


Figure 3-1 Observations of blue king crab used in PSC rate calculations in 2007.

For purposes of this analysis, the Council requested estimates of PIBKC bycatch that do not include observer data outside of the Pribilof District. Two area-specific estimates were put together by the Alaska Fisheries Information Network (AKFIN) and utilized an 8-step algorithm to match observed hauls from 2003 to 2010 to landings from the same period. The method utilized various levels of detail similar to the current catch accounting system methods, but on a much coarser temporal scale. The algorithm compiled all landings that occurred in Area 513 as well as all observations that occurred in the Pribilof Statistical Area (as determined by ADF&G). For these area-specific estimates, landings and observations in Area 513 or the Pribilof Statistical Area were compiled. The observations were first summed at the vessel, target code, target date and FMP gear level. The amount of blue king crab observed was then divided by the total groundfish weight in the haul to arrive at an estimated rate of blue king crab. This rate was then matched to the landings that occurred in Area 513. The other steps summed and matched at reduced levels of granularity. The time frame was first relaxed, extending to monthly then annual estimates. Next the trip target was removed and the time frame was likewise relaxed. The steps were then repeated without the vessel information. The resulting final step was a join of FMP, gear, and year. The algorithm then selected the highest step at which a rate was populated and applied the rate associated with that step to the landing. The result was an Area 513 estimate based on observations in a specified area. Results are shown in Table 3-1.

Table 3-1 Annual catch of blue king crab in the groundfish fisheries in Federal Reporting Area 513 in pounds(left) and numbers (right). The Pribilof District Area-Specific Estimate was compiled from observed hauls that occurred in the Pribilof Statistical Areas determined by ADF&G and applied to landings in 513. The 513 Area Specific Estimate was compiled from observed hauls in 513 and applied to landings in 513. The Area Specific Estimate utilizes various levels of detail similar to AKRO, but on a much coarser temporal scale.

Year	PSC Amount (lbs)	Pribilof District Area-Specific Estimate (lbs)	513 Area-Specific Estimate (lbs)	Year	PSC Amount (# crab)	Pribilof District Area-Specific Estimate (# crab)	513 Area-Specific Estimate (# crab)
2003	1,563	210	405	2003	491	66	127
2004	669	543	1,087	2004	210	171	342
2005	1,920	1,547	1,701	2005	552	444	489
2006	3,600	633	1,119	2006	973	171	302
2007	16,774	1,672	1,809	2007	5,376	536	580
2008	905	739	1,389	2008	580	474	891
2009	1,919	225	68	2009	604	71	22
2010	983	8	0	2010	376	3	0

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA; NMFS AFSC Observer Program sourced through NMFS AKR, data compiled by AKFIN in Comprehensive_OBS; and NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

The area-specific estimation method enables an estimate without using observer data from the St. Matthew Island region; however, the lack of observed hauls in Area 513 meant that the area-specific rates had to be temporally aggregated for the entire year. As such, this method could not be used to provide weekly estimates of bycatch and would not be appropriate for inseason management or monitoring bycatch caps and trigger closures.

3.3.3 PIBKC PSC estimation for year-round closures (Alternatives 2a, 2b, 3, and 4)

Under Alternatives 2 through 4, a designated area would be closed year-round to specific fisheries. The PSC estimation would not need to change for these alternatives. However, as described in the status quo section, the current method for estimating PSC in the groundfish fisheries is done at the level of federal reporting areas and does not align with the PIBKC stock distribution. Therefore, to provide data for the PIBKC stock assessment, NMFS intends to work with the Council's Crab Plan Team to modify the CAS to generate estimates of PIBKC PSC at the spatial resolution of the stock boundary instead of the Federal reporting area.

3.3.4 PIBKC PSC estimation under a trigger closure (Alternatives 5 and 6)

Under trigger closures proposed in Alternatives 5 and 6, NMFS would need to monitor the amount of PIBKC PSC in the Pribilof blue king crab district (or the ultimate PIBKC stock boundary designation) to make inseason management decisions about when to issue closure notices to prevent exceeding the PSC limit. As described in the status quo section, the current method for estimating PSC in the groundfish fisheries is done at the level of Federal reporting areas. Under the alternatives that involve a PSC limit that triggers an area closure, catch of PIBKC in the Pribilof blue king crab district would accrue against the PSC limit. Federal reporting area 513 is entirely inside the Pribilof blue king crab district; however the known stock distribution does not entirely cover Federal Reporting Area 513. Federal reporting area

521 contains both Pribilof and St. Matthew blue king crab stocks. Therefore, to provide data for inseason management and stock assessment, NMFS would modify the CAS to generate estimates of PIBKC PSC at the spatial resolution of the PIBKC stock boundary instead of the Federal reporting area. The estimation method would be similar to how the catch accounting system accounts for catch of red king crab in the Red King Crab Savings Area. Essentially, a new area would be defined in the CAS that matches the Pribilof blue king crab district and PSC estimates would be generated for the district.

The current PSC estimation methodology uses observer data to create PSC rates that are applied to unobserved trips. The current method uses the observer data that are available and if observer data are not available, the system aggregates (post-stratifies) until an appropriate PSC rate can be generated. When direct observations from nearby vessels in the same week and fishery (same target and gear) are not available, it is necessary to move to broader time periods and eventually to the entire FMP area. For estimation of PIBKC this is especially relevant because there has been low observer coverage in some fisheries in the area around the Pribilof Islands. Under the current method, when there is a lack of observer data, PSC estimations can require extrapolations from the region closest to St. Matthew Island where concentrations of blue king crab are higher than in the Pribilof Islands area. This issue is highlighted in 2007 (Table 3-1) when the high rate used to extrapolate the unobserved landings near the Pribilof Islands originated from the St. Matthew Island region, leading to a pot PSC estimate of approximately 2,800 crabs. Because of the misalignment of these two Federal reporting areas with the PIBKC stocks, as a temporary measure, only PSC occurring in Area 513 has been attributed towards the PIBKC OFL.

Under this action, there are two ways that NMFS could derive estimates of PIBKC PSC in the groundfish fisheries on the spatial scale consistent with PIBKC stock boundary. One possibility would be for NMFS to use the VMS-Observer Enabled Catch-In-Areas (VOE-CIA) database to provide estimates of crab PSC. The VOE-CIA database integrates catch data from the CAS (at the spatial resolution of a Federal reporting area) into a database that resolves the GIS data into polygons with areas of approximately seven kilometers. The VOE-CIA could provide annual PSC estimates at a fine spatial resolution, however the VOE-CIA is a tool for analysis and is not designed to provide real-time estimates of catch for inseason management. In addition, the VOE-CIA uses the data from the catch accounting system, so it does not modify the underlying catch estimation process.

Alternatively, NMFS could modify the catch accounting system to generate PSC estimates of blue king crab at the spatial resolution of the Pribilof blue king crab district. As such, the PSC estimates would only include observer data from outside this area if a three-month average were used to generate the PSC rate. NMFS anticipates that extrapolation of observer data to the small number of unobserved trips within the Pribilof blue king crab district will not require using observer data from outside of the district. To completely avoid using observer data from outside the district, NMFS could modify the catch accounting system to never use observer data from outside the Pribilof blue king crab district to generate the PSC estimate. However, if there was a trigger closure that required NMFS to monitor the PSC and issue inseason management actions, this approach could mean that NMFS would have no data available to generate a PSC estimate, and the agency would not have the data to make a timely inseason management decision. NMFS would need to evaluate how to estimate catch in situations where observer data is unavailable, e.g., expand temporal strata. ***NMFS recommends using the catch accounting system to generate PSC estimates of blue king crab and modifying the current method to generate estimates at the spatial resolution of the Pribilof blue king crab district or whatever PIBKC stock boundary is ultimately decided.***

3.3.5 PSC limits in weight versus number

As described in the section on the status quo, observers collect data on the weight of crab in their samples and then, prior to 2011, NMFS converts the weight to estimate crab PSC in numbers of individuals. The crab stock assessment authors, however, need estimates of crab bycatch in total weight. Thus, to obtain an estimate for the stock assessment authors, NMFS converts total PSC estimates of number of crabs back to weight of crab using a global average weight per crab by gear (fixed or trawl), species, and crab fishery year. This process results in multiple conversions, from weight to number and then back to weight, that relies on averages that do not necessarily correspond with the sampling frame. NMFS changed this algorithm for PSC crab estimates in 2011 to report weights (as well as numbers) based on the observer sample. However, the use of estimated numbers in management continues to be an issue given observers often have to enumerate parts and pieces of crabs to determine a count and annual catch limits are in terms of weights.

In the future, NMFS would recommend setting PSC limits as weight of crab rather than numbers to avoid the problem of converting numbers into weight and vice versa. PSC limits set as weight would require changes in regulations and the FMP, with careful consideration of limits for all PSC crab species. Because of the complexity of changing crab reporting from numbers to weights and the need to implement the rebuilding plan in a timely manner, ***NMFS does not recommend making this change as part of this proposed action***.

3.3.6 PSC discard mortality rates

Discard mortality rates are currently applied to the crab bycatch estimates from the groundfish fishery during the stock assessment process. Specifically, the OFL and ABC/annual catch limit (ACL) calculation accounts for all losses to the stock not attributable to natural mortality. The OFL and ABC/ACL are total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, a handling mortality rate is multiplied by discards in each fishery. Currently the rates applied to the groundfish discards are 80% for trawl fisheries and 50% for combined fixed (pot and hook-and-line) fisheries.

It would be possible to modify the current method and instead of applying discard mortality rates during the stock assessment, apply discard mortality rates in "real-time" as the PSC limit is monitored. This could be similar to halibut PSC estimates, which incorporate discard mortality rates inseason. However, unlike halibut, there is currently no sampling process for evaluating crab mortality rates in the groundfish fishery and the required data and implementation process have not been evaluated. This is a complicated issue and is not limited to blue king crab (for example, NMFS has been approached about applying discard mortality rates to sablefish and octopus). ***NMFS recommends that discard mortality rates on species other than halibut be evaluated through a separate analysis.*** If processes were established to develop discard mortality rates, then NMFS could work with the Council in the future to determine if such an approach could be implemented for the PIBKC PSC limits.

3.4 Observer Coverage

3.4.1 Restructured Observer Program

In October 2010, the Council took final action to restructure the Observer Program and the new program was implemented as Amendment 86 as the BSAI FMP on January 1, 2013 (77 FR 70062, November 21, 2012). Deployment methods for 2013 and 2014 (Annual Deployment Plan: ADP) were posted on the Alaska Region website at http://alaskafisheries.noaa.gov/sustainablefisheries/observers/default.htm .

The actions being considered for PIBKC would be implemented under the restructured observer program. This program is expected to improve observer data quality under all of the alternatives. Since implementation of the domestic Observer Program in 1990, and prior to implementation of the restructured program in 2013, NMFS has required 100 precent observer coverage (full coverage) for vessels greater than 125 feet length overall (LOA) and for shoreside/stationary floating processors that processed at least 1,000 t of groundfish monthly. Observer coverage was increased to full coverage for certain catch share program programs (e.g., Amendment 80, AFA Pollock), but the core method of deployment for vessels <125' LOA and the funding mechanism remained unchanged until 2013. The historical deployment method provided no at-sea coverage for vessels less than 60', vessels fishing IFQ, or vessels using jig gear. Vessel operators were required to select when they carried an observer if their vessel was 60' or greater and less than 125' LOA, which potentially biased fishery data due to the sampling of non-representative fishing behaviour. Additionally, NMFS had no flexibility to annually adjust coverage based on scientific and management requirements.

The restructured observer program was implemented to resolve the previously discussed data quality and cost equity concerns with the pre-restructured observer program. Under the new program, NMFS is able to determine when and where to deploy observers in accordance with an ADP. In addition, full coverage was required on almost all CPs, which increased the amount of observer data available. The restructure rule dived deployment methodology and funding of observers into two broad categories: (1) the partial coverage category that provides NMFS with the discretion to deploy observers randomly and uses a fee-based funding model; and the (2) full coverage category that requires vessels to carry and pay for observers when fishing. The 2013 ADP further divided the partial coverage category into two selection pools for deployment; the vessel selection pool for vessels between 40' LOA and 57.5', and the trip selection pool for vessels greater than 57.5 feet. The vessel selection pool randomly selects vessels that must carry an observer on all trips during a NMFS-selected 2-month period. The trip selection pool randomly selects individual fishing trips for coverage. A detailed discussion about the vessel and trip selection pools is described in NMFS (2013).

The restructured program requires nearly all CPs to have at least 100% observer coverage, regardless of vessel length. Full observer coverage is also required for Amendment 91 fisheries (AFA pollock fisheries) (American Fisheries Act pollock fishery) and the groundfish CDQ fisheries in the Bering Sea. In addition, the majority of non-pelagic trawl catcher vessels (40 out of approximately 50-60 vessels in the BSAI) in the partial coverage category will have full observer coverage in 2013.

CVs fishing in the Pribilof blue king crab district (Figure 4-11) with hook-and-line, pot, and non-pelagic trawl gear are in the partial coverage category under the restructured Observer Program and NMFS would deploy observers in a randomized fashion for vessels not carry full coverage. These CVs harvest a very small proportion of the total retained groundfish from the Pribilof blue king crab district. Between 2007 and 2010, vessels that would be in the partial coverage category generally accounted for less than 0.5% of the total groundfish retained in the Pribilof blue king crab district. One exception was 2008, when CV effort increased and accounted for approximately 2.8% of the total retained groundfish. The majority of the CV harvest in the Pribilof blue king crab district was taken by CVs using pot gear. From 2008 through 2010, pot gear accounted for an average of 85% of the groundfish harvest by the CV sector (which, again, is a nominal portion of the overall harvest) in the Pribilof blue king crab district.

The overall amount of groundfish fishing effort in the Pribilof blue king crab district has been fairly consistent between years. For example, between 2007 and 2010 there were approximately 33 trips made by 12 to 16 distinct vessels. An exception to this stability occurred in 2008 when the number of trips was substantially higher (121) than other years because of increased pot and non-pelagic trawl effort.[10]

Observer coverage and resulting data is anticipated to increase in the Pribilof blue king crab district under the restructured Observer Program because CPs would have all fishing days observed. This level of coverage would account for all trips being observed for 97–99% of the groundfish harvest in the Pribilof king crab district (based on data from 2008 through 2010). NMFS also anticipates an increase of observer data available from the CV sector in the Pribilof blue king crab district via the randomized deployment process anticipated under the restructured program.

Additional observer coverage in the CV sector in the Pribilof blue king crab district could be accomplished in a couple of different ways under the restructured Observer Program if the Council deemed it necessary. Through rule-making, the Council could place any class of vessels in the full coverage category. These vessels would obtain their own observer coverage at their own cost and the funds would not come out of the financial pool used for the partial coverage category.This approach would be consistent with that taken for CVs included in the full coverage category while participating in certain fisheries (e.g., Bering Sea pollock fisheries) and included in the partial coverage category while participating in others (e.g., the Gulf of Alaska Pacific cod fishery).

As the restructured observer program matures, NMFS will have improved data from which to evaluate estimation issues in the Pribilof Islands blue king crab conservation area. Analysis of data and deployment patters may suggest scientifically valid methods from which to optimize coverage in the Pribilof Islands areas. In evaluating these methods, NMFS would have to consider issues such as costs associated with coverage and the extent to which estimation is improved. Predicting costs for a small area is difficult because fishing effort is highly variable between years. This unpredictability increases the risk of cost overruns, which would impact NMFS's ability to collect data in other fisheries. In addition, special consideration of data impacts due to changes in area-specific coverage will also be required. For example, incorrectly weighting or stratification schemes may compromise data estimation in areas outside of the Pribilof island blue king crab district by introducing bias or important reductions in sample sizes.

Consistent with the Council's motion on Observer Program restructuring, NMFS does not recommend 100% observer coverage for the CV sector while fishing in the Pribilof blue king crab district. The CP sector would have 100% observer coverage under a restructured Observer Program, resulting in an increase in sampling and improved quality of estimates. NMFS expects that estimates of blue king crab PSC in the CV sector would be improved through randomized observer deployment under the restructured Observer Program and a revised spatial algorithm for estimating blue king crab. NMFS anticipates it will also modify the spatial algorithm for estimating the numbers and weight of blue king crab so that observer information used to estimate bycatch rates reflects areas appropriate stock assessment areas.

3.5 Observer Sampling Protocol

NMFS uses observer sample data to estimate the weight and/or number of each species caught by fishing vessels. NMFS utilizes a robust sampling design to minimize the effects of sampling error, and observer sampling methods are based on randomized sampling designs. None of the alternatives would change NMFS's sampling protocol.

[10] The increased effort was likely due to low pollock total allowable catch limits and high Pacific cod prices that encouraged fishing.

3.5.1 Status Quo

Observer Sampling aboard Trawl CPs

All CP trawl vessels fishing in the Bering Sea, are required to use flow scales to weigh all catch prior to any sorting as well as any sampling by an observer. Observers monitor the processing of these hauls and select samples following a random sampling methodology. The size of the samples is limited by the observers' workload. The greater the diversity of species found in the haul, the greater the observer's workload in processing samples. However, observers attempt to obtain several discrete samples totalling between 300 and 500 kg for each haul. Observers count and weigh all species, including PSC, found in their samples and take any necessary biological samples from these same fish/crab. The samples are expanded by NMFS to the total haul weight for an estimate of total catch of each species. Other expansion algorithms are applied when there are unsampled hauls.

Observer Sampling aboard Trawl CVs

In contrast to trawl CPs, catch on trawl catcher vessels is not weighed at sea and observers rely on volumetric methods to estimate catch weight. When volumetric methods are not possible due to safety or operational characteristics of the vessel, the captain's estimate of catch weight can be used. Within those catches, observers generally take samples on deck before the fish are sorted and moved into below deck bins. Observers attempt to take multiple samples from throughout individual hauls; however this is often constrained by the deck layout, limited workspace, and the vessel's catch handling procedures. Therefore, it is common for NMFS to only obtain one sample from a haul, which limits NMFS's ability to calculate within-haul variances for this component of the fleet, and it has potential for bias since the sample only comes from one portion of the haul.

Observer Sampling aboard Longline Vessels

Observer information collected aboard vessels fishing with longline gear consists of the following components. First, observers obtain an average hook count at least two times per week. An average hook count is a count of the number of hooks on an individual gear segment, and of at least one fifth of the number of segments in a regular set. For example, if a vessel regularly sets 20 segments (rails, magazines, tubs) in a set, the observer will count all the hooks on five individual segments and this will be done at least twice per week. The number of segments of gear in an individual set is verified on a regular basis, specifically, observers compare their own observations to the vessel logbook to verify that the logbook information regarding total segments in a set is reliable. Then, observers monitor portions of the gear retrieval following a random sampling methodology. During these sample or "tally" periods, observers count everything caught by the gear. Most observers find that they can sample at least 1/3 of a set and still have time to complete their other sampling duties (AFSC 2011). The crewmember at the roller sets aside bycatch, and PSC, as requested by the observer. This bycatch collection is used to determine an average weight per bycatch species. Finally, observers obtain a weight sample from each species caught for an average weight. These weight samples are collected either during the tally period or as close to it as possible. The average weight, coupled with the count, allows NMFS to estimate the total catch of each species (NMFS 2010a).

Observer Sampling aboard Pot Vessels

Observer-collected data aboard pot vessels consist of the following components. First, observers independently verify the number of pots in each set. The number of segments of gear in an individual set is verified on a regular basis, specifically, observers compare their own observations to the vessel logbook to verify that the logbook information regarding total segments in a set is reliable. Then, observers select specific pots to sample following a random sampling methodology. When these selected pots are retrieved, observers count and weigh everything caught in the selected pot, including PSC. Most observers find that they can sample at least 1/3 of a set and still have time to complete their other sampling duties (AFSC 2011). This sample collection is used to determine an average weight per species.

The average weight, coupled with the count, allows NMFS to estimate the total catch of each species (NMFS 2010a).

3.5.2 PIBKC sampling protocol under a trigger closure

Any of the trigger closures under consideration would challenge NMFS's ability to monitor a small amount of bycatch of a relatively rare species. NMFS's current process to account for PSC relies on observer sampling and rare events create special difficulties in a sampling environment. Given current sample sizes in diverse fisheries, the probability of detection of a rare species in any single sample is low. This presents a challenge for NMFS since the infrequent occurrence of blue king crab in the samples limits the ability to predict when a limit will be reached. For example, one 2 kg crab in a 300 kg sample from a 30 mt haul would expand to an estimated 100 crab at 200 kg. Given the tight limitations on the numbers of crab being proposed for the PSC limit, a handful of crab in very few samples could account for the entire PSC limit. This may make it difficult to monitor a PSC limit and anticipate when the limit will be reached in time to take an inseason action.

Despite these limitations, the current sampled-based estimation uses the best available scientific information and is the best approach currently available. As such, under this action, ***NMFS will continue to use the current observer sampling protocol***. Ideas about improving the estimation and issues associated with alternative approaches are provided below.

The observer restructuring analysis articulated the long term goal of evaluating catch estimates in order to improve and inform choices about the allocation of limited observer resources. As discussed in the observer coverage section, almost all (97–99%) of the groundfish catch in the Pribilof blue king crab district will be observed under the restructured Observer Program due to the full observer coverage requirements on all CPs. Thus, improved point estimates for CPs will be accomplished through that action. In addition, as the restructured observer program matures, NMFS will have a better understanding about methods to improve catch estimates in the partial coverage category. The random deployment of observers facilitates statistical evaluation of estimators.

In lieu of sampling, a census could be conducted to monitor blue king crab PSC in groundfish fisheries. The Council could recommend a census under any trigger closure alternative. A census, by definition, means sorting and counting every blue king crab from every haul, set, or pot. The advantage of a census is that counting every crab eliminates the need to estimate catch and thus eliminates concerns about imprecision. However, a critical disadvantage to a census is that if any crabs are missed, the census will be biased low. As the catch composition in the fishery is diverse, NMFS expects that observer labor would need to be devoted to composition sampling. Thus, vessel crew would need to sort all crab, and camera monitoring of that activity would be required to ensure sorting occurred. Observers would then need to separate the blue king crab from other species, and count and weigh them. The time dedicated to this activity would likely increase the mortality of the crab as returning them to the sea would be delayed. Moreover, full observer coverage would be needed at processing plants to ensure that all crabs are counted.

On January 20, 2011, NMFS implemented a census approach for salmon PSC in the Bering Sea pollock fishery. So far, the approach appears to be successful, but it is labor and cost intensive for NMFS and the industry. Because a census involves sorting and counting every animal from every haul, set, or pot, intensive and ongoing monitoring measures are needed to ensure the census is correct. Using the Chinook salmon census in the Bering Sea pollock fishery as a model, a census approach for blue king crab with observer verification would likely require:

- at least 100% coverage of all vessels which participated in this fishery with the potential for 200% for vessels with 24 hours per day operations;

- crew responsibilities to sort and set all crab aside for observer identification, counting and weighing;
- dedicated space on the vessels for crab to be stored prior to observer conducting crab identification, counting, and weighting;
- video systems to verify that the crab catch was being sorted and retained for the observer identification and counts.
- mechanisms to ensure that no blue king crab were being sorted and discard by crew;
- full observer coverage at processing plants to ensure that no blue king crab were missed in the vessel sorting;
- electronic reporting to NMFS via the NMFS ATLAS computer software and logbooks in order to monitor the small limit in real time.

An observer verified census approach in a single fishery, such as pollock where the catch is relatively consistent, may not provide the best model for this action. It is not clear what would be required to enable a practical census approach for blue king crab on vessels where catch can be diverse. If it is even logistically feasible, there would likely be a high NMFS overhead cost in a census approach for managing and monitoring camera systems, observers, the resulting data, and in working with industry members to ensure their responsibilities are completed correctly. However, these costs have not been fully identified or analyzed.

The systems and accounting mechanisms for a census could be required at all times, or they could be required only when fishing in the area of concern. If required only when fishing in the area of concern, NMFS would also need to engineer the internal catch accounting system to utilize the census within the defined areas, and combine it with the existing estimation processes outside of them. The ability to switch back and forth between sampling protocols would make it logistically challenging for observers, and mechanisms would need to be developed to facilitate observer data collection to ensure the quality of the data. In addition, the use of a census would require design changes to the NMFS observer data reporting applications, logbooks, and data storage and processing systems.

All of the implementation issues and costs associated with an observer verified census approach, along with the higher levels of observer coverage necessary for such an approach, would need to be considered relative to implementation of the restructured Observer Program. **In summary, NMFS recommends continuing to use the current observer sampling protocol, and the agency does not recommend increasing observer coverage beyond that which occures under the restructured program.**

3.6 Enforcing Directed Fishing Closures in Special Management Areas

The closures proposed in Alternative 2 and Component 1 of Alternative 6 allow some fishing for groundfish in both the existing PIHCZ and the proposed PIBKC Savings Area, while prohibiting other directed fisheries. The PIHCZ currently is closed to vessels using trawl gear. These alternatives would add closure of this area to vessels directed fishing for Pacific cod using pot gear, but not to other directed fisheries using pot gear as per the threshold criteria described in Table 2-1 and Section 4-2. Under Alternative 5 and Component 2 of Alternative 6, the trigger caps proposed for the PIBKC Savings Area could lead to closure of the area to directed fishing for Pacific cod by vessels using hook-and-line or pot gear, and directed fishing for yellowfin sole by vessels using trawl gear, while the area remained open to other directed fisheries. All of these types of closures require NMFS or the U.S. Coast Guard to determine what species or species group a vessel operator is directed fishing for in areas that are different from the larger Federal reporting area (e.g., “special management areas”). Similar types of triggered closures of special management areas exist for all of the other PSC species, except halibut (e.g., the chum salmon savings area, the Red King Crab Savings Area, the RKCSS, the herring savings areas)

Monitoring, management, and enforcement of the area closures in these alternatives would be similar to the process currently used to monitor, close, and enforce existing area closures. Determining what a vessel operator is directed fishing is based on several different data sources, including the vessel operator's reports of retained catch on board, landed catch weight, observer reports, and VMS data. A VMS is required on Pacific cod trawl, hook-and-line, and pot vessels operating in the Bering Sea. Observer coverage is 100% for American Fisheries Act and Amendment 80 vessels, and at the same or lower levels for other nonpelagic trawl vessels in the flatfish fisheries depending on vessel size. VMS data is helpful to determine vessel location in relation to closure areas, but it may not conclusively indicate whether a vessel is fishing, transiting through a closed area, or targeting a particular species. Location information for a vessel without VMS or an observer would be available from eLanding reports.

When an area is closed to directed fishing for some species or species groups, but open for others, maximum retainable amounts (MRAs) are the primary tool to make a determination about what directed fishery or fisheries a vessel has been participating in. Regulations at § 679.20(e) and (f) and Table 11 to 50 CFR part 679 establish MRA percentages for groundfish species and species groups in the BSAI. MRAs are used to allow some retention of a species or species group closed to directed fishing (incidental species) while catching groundfish species or species groups open to directed fishing (basis species). An MRA is the maximum round weight of an incidental species or species group, closed to directed fishing, that may be retained on board a vessel. Compliance with an MRA is determined by comparing the round weight of incidental species retained to the round weight of basis species retained. The percent of incidental species or species group retained in relation to the basis species must not exceed the MRAs listed in Table 11. For example, the MRA for Pacific cod as an incidental species, caught in a directed fishery for rock sole as a basis species, is 20%. When rock sole is open to directed fishing and Pacific cod is closed to directed fishing, a vessel operator may retain at any point in time during a fishing trip an amount of Pacific cod up to 20% of the amount of round weight equivalent of rock sole that is on board the vessel. All incidental catch of Pacific cod in excess of the 20% MRA must be discarded.

For catcher vessels, the maximum retainable amount for vessels fishing during a fishing trip in areas closed to directed fishing is the lowest MRA applicable in any area, and this MRA must be applied at any time and to all areas for the duration of the fishing trip. ***For catcher/processors***, MRAs apply at any point in time for the duration of the fishing trip. The only exception is that for non-AFA trawl catcher/processors, the MRA for pollock is calculated at the end of each offload.

To properly account for compliance with directed fishing closures in the PIHCZ and the PIBKC Savings Area, NMFS may need to revise catcher vessel logbooks to add information about whether the vessel fished within one of these areas during a time when a directed fishing closure applied to vessels using the particular gear type. This information would assist vessel operators and enforcement officers in determining which MRA should apply to the entire trip.

Compliance with MRAs for catcher/processors is based on retained catch on board the vessel either at any point in time or, in some cases, at the time of offload. This information is submitted to NMFS electronically in a daily production report in eLandings. The daily production report, which includes an MRA worksheet, would be modified by NMFS to add the new special areas of the PIHCZ and the PIBKC Savings Area that may have different directed fishing closures. The addition of the new special areas to eLandings would allow vessel operators to calculate and record retained catch on board from areas with different directed fishing closures and maximum retainable amounts. No regulatory revisions are needed to add special areas to the daily production report and the MRA worksheet.

4 Pribilof Islands Blue King Crab

Blue king crab, *Paralithodes platypus*, are found off Hokkaido in Japan, with disjunct populations occurring in the Sea of Okhotsk and along the Siberian coast to the Bering Straits. In North America, they are known from the Diomede Islands, Point Hope, outer Kotzebue Sound, King Islands, and the outer parts of Norton Sound. In the remainder of the Bering Sea, they are found in the waters off St. Matthew Island and the Pribilof Islands. In more southerly areas as far as southeastern Alaska in the Gulf of Alaska, blue king crabs are found in widely-separated populations that are frequently associated with fjord-like bays. The State divides the Aleutian Islands and eastern Bering Sea blue king crab into the Pribilof Islands and St. Matthew management registration areas (Alaska Department of Fish and Game [ADF&G] 2006). PIBKC are managed under the Bering Sea king crab Registration Area Q Pribilof District, which has as its southern boundary a line from 54° 36' N lat., 168° W long., to 54° 36' N lat., 171° W long., to 55° 30' N lat., 171° W. long., to 55° 30' N lat., 173° 30' E long., as its northern boundary the latitude of Cape Newenham (58° 39' N lat.), as its eastern boundary a line from 54° 36' N lat., 168° W long., to 58° 39' N lat., 168° W long., to Cape Newenham (58° 39' N lat.), and as its western boundary the United States-Russia Maritime Boundary Line of 1991 (ADF&G 2008).

4.1 Assessment Overview

The PIBKC stock biomass is below its estimated B_{MSY} (9.28 million lb of mature male biomass, at the time of mating). The PIBKC stock biomass continues to be low. From recent surveys there is no indication of recruitment. Pre-recruit biomass has followed similar patterns as total biomass with no indication of above average recruitment in the past three years although small male and female recruits have been noted.

Survey estimates of total biomass were highest at the beginning of the time series with a peak of 176.5 million lb in 1980, dropped dramatically to 3.3 million lb, increased again to 29.5 million lb in 1995 and then steadily decreased to a low of 0.5 million lb in 2004. Survey estimated mature-male biomass at mating increased from 0.25 million lb in 2008 to 1.13 million lb in 2009 (Foy and Rugolo 2009; Figure 4-1). Model estimated mature-male biomass increased from 1.22 million lb in 2008 to 1.38 million lbs in 2009. The 2010 survey estimated mature male biomass, however, decreased to 0.63 million lb (Foy 2010). Based on the 2011 NMFS bottom-trawl survey, the estimated total mature-male biomass increased to 1.02 lb (Foy 2010). The 2011 assessment of PIBKC (Foy 2011) is based on survey estimates using area swept methods.[11] Survey abundance in specified length bins is summed across strata defined by single or multiple tows. Weight and maturity schedules are applied to these abundances and summed to calculate biomass.

The Pribilof blue king crab stock biomass continues to be low. From recent surveys there is no indication of recruitment. The estimated mature-male biomass increased to 1.3 million lb in 2012/13 from 0.8 million lb in 2011/12. The 2013/14 MMB at mating is projected to be 0.6 million lb, which is 7% of the proxy for B_{MSY}.

[11] The analyses in this chapter are based on a new assessment model. The results are therefore not identical to those in Foy (2010).

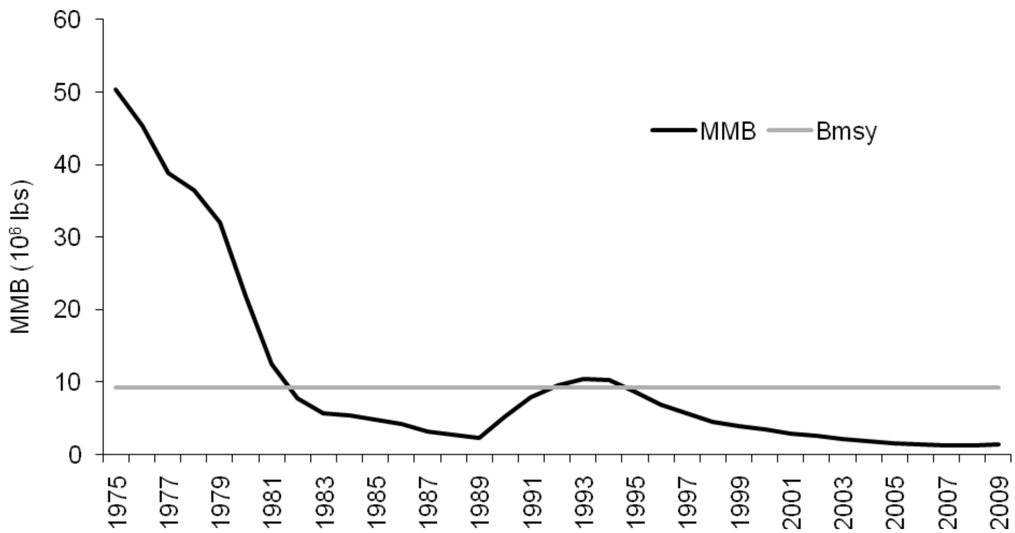


Figure 4-1 Estimated mature male biomass (MMB) time series relative to the current B_{MSY} based on mean mature male biomass from 1980–1984 and 1990–1997.

4.1.1 Pribilof Islands blue king crab distribution

This section provides information from the NMFS trawl survey on the distribution of blue king crab from 2009 to 2011.

In 2009, PIBKC were observed in 6 of the 41 stations in the Pribilof District, all of which were in the high-density sampling area (Chilton et al. 2009) (Figure 4-2). Legal-sized males were caught at three stations east of St. Paul Island, with a density ranging from 73 to 131 crab/nmi2. The 2009 abundance estimate of legal-sized males was 0.07 ± 0.08 million crab, representing 15% of the total male abundance and below the average of 0.56 million crab for the previous 20 years (Figure 4-1). Only four legal-sized male PIBKC were captured on the survey: one in molting or softshell condition and one in new hardshell condition, while two were in very oldshell condition. Large female PIBKC were caught at three stations in the Pribilof District with an abundance estimate of 0.6 ± 0.9 million crab representing 95% of the total female abundance. (Figure 4-3) Fourteen of the 29 large female PIBKC sampled during the survey were brooding uneyed or eyed embryos. Among sampled mature females, 24% were new hardshell crab all with newly extruded embryos while 76% were oldshell females of which 24% were brooding eyed embryos and 52% had empty egg cases.

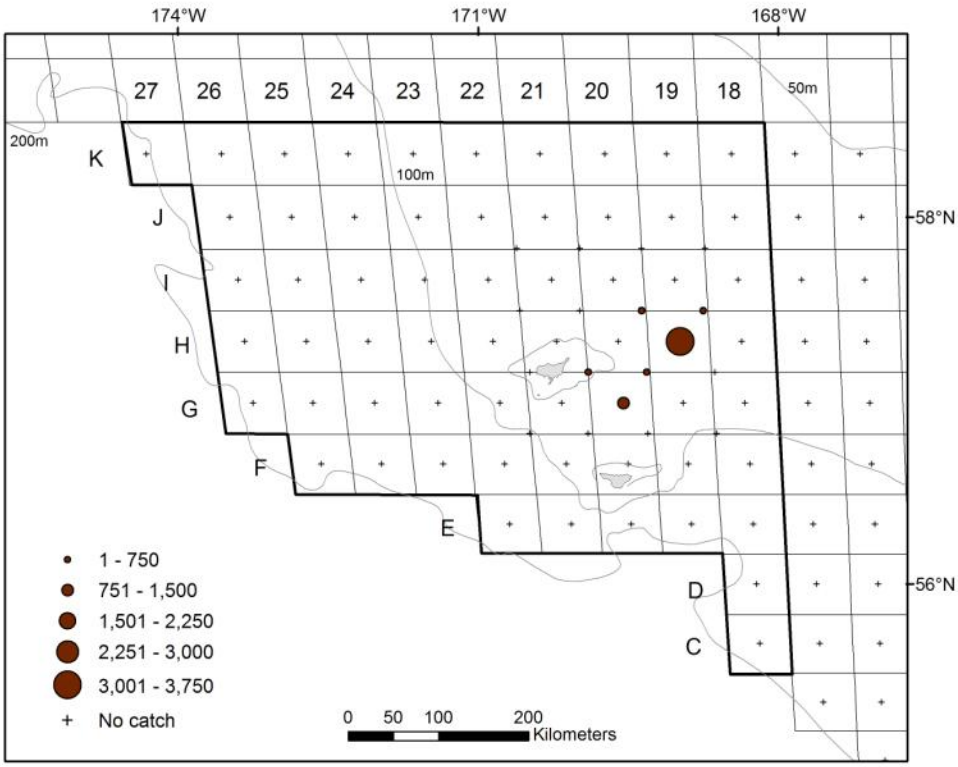


Figure 4-2 Total density (number/nm²) of Pribilof Islands blue king crab in the 2009 eastern Bering Sea bottom trawl survey.

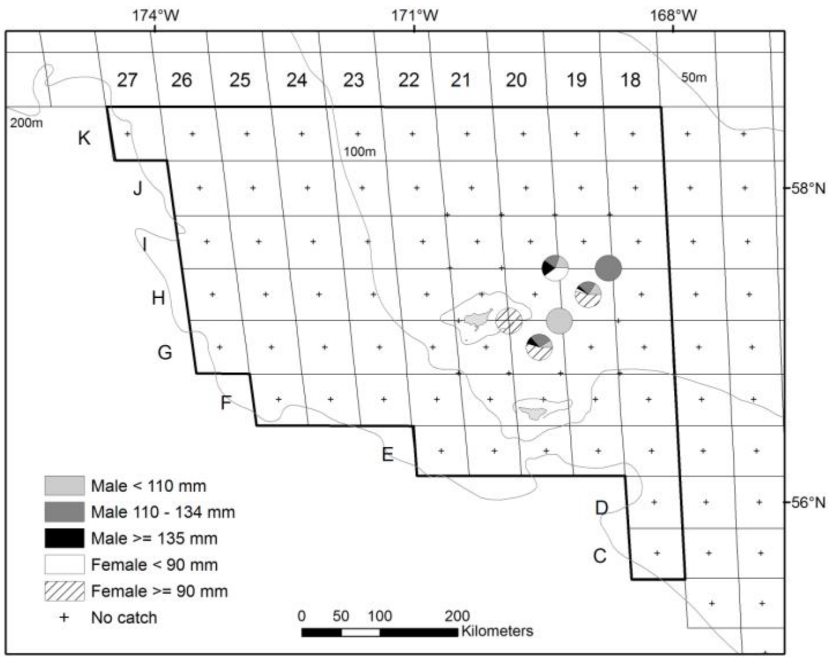


Figure 4-3 Sex and maturity of Pribilof Islands blue king crab in the 2009 eastern Bering Sea bottom trawl survey

In 2010 the highest number of crab were caught to the east of St. Paul Island (Figure 4-4). This station was a mixture of mature females (50%) with immature and mature males and immature females comprising the remaining contribution (Figure 4-5). Mature females were observed south of St. Paul Island. Unlike 2009 however, blue king crab were caught at stations outside of the Pribilof District line and to the east in the first block of the 20 km grid east of the district boundary (Figure 4-4 and Figure 4-5). This station contained entirely immature females (Figure 4-5).

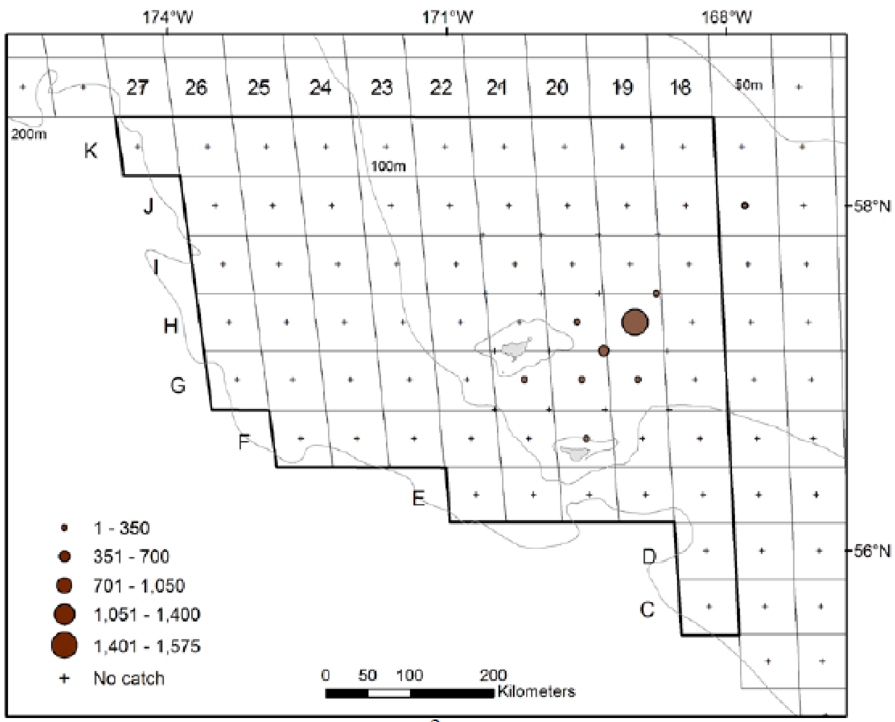


Figure 4-4 Total density (number/nm^2) of Pribilof Islands blue king crab in the 2010 eastern Bering Sea bottom trawl survey.

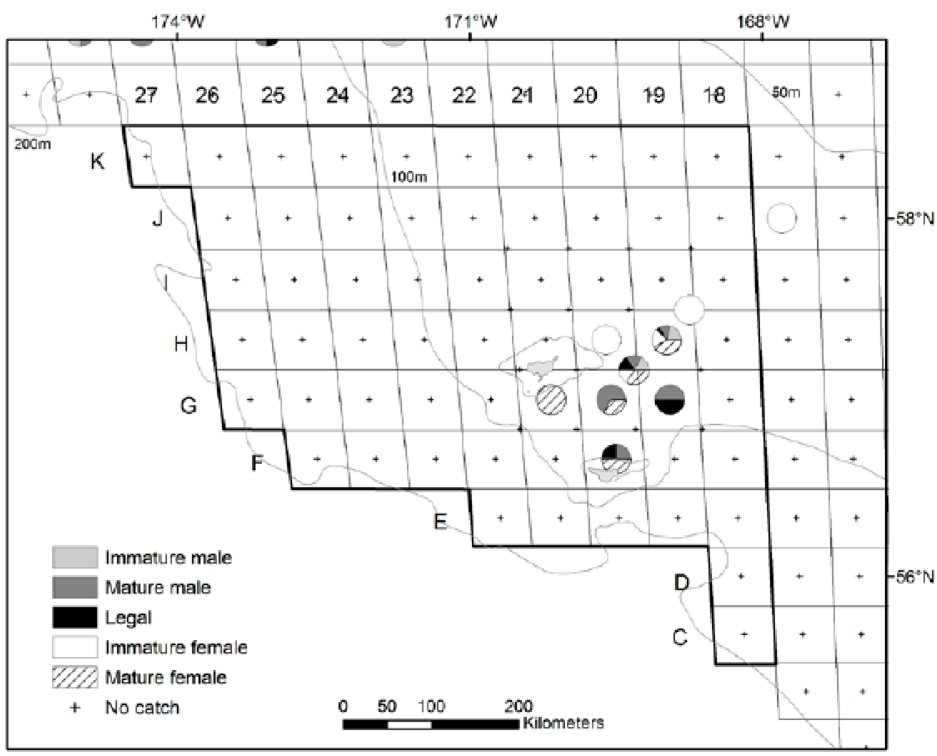


Figure 4-5 Sex and maturity of Pribilof Islands blue king crab in the 2010 eastern Bering Sea bottom trawl survey.

In 2011, Pribilof District blue king crab were observed in five of the 77 stations in the Pribilof District, all of which were in the high-density sampling area (Chilton et al. 2011).(Figure 4-6). Legal-sized males were caught at two stations east of St. Paul Island and one station north of St. George Island, with a density ranging from 74 to 454 crab/nmi2 (Figure 4-7). The 2011 abundance estimate (± 95% CI) of legal-sized males was 399 ± 693 t, representing 86% of the total male biomass and below the average of 1,603 ± 1,293 t for the previous 20 years. Blue king crab mature males were caught at three stations in the Pribilof District high-density sampling representing 100% of the total male abundance. No immature male blue king crab were caught in the Pribilof District. One mature female blue king crab brooding uneyed embryos was caught at a station in the Pribilof District high-density sampling area with a biomass estimate of 22 ± 43 t representing 60% of the total female biomass (Figure 4-7). As with 2010, blue king crab were observed outside of the Pribilof District boundary to the east (Figure 4-6 and Figure 4-7). In the 20 km grid east of 168W (one 20km grid further east than 2010) one station observed blue king crab. As with 2010 results, these crab were entirely comprised of immature females (Figure 4-6 and Figure 4-7).

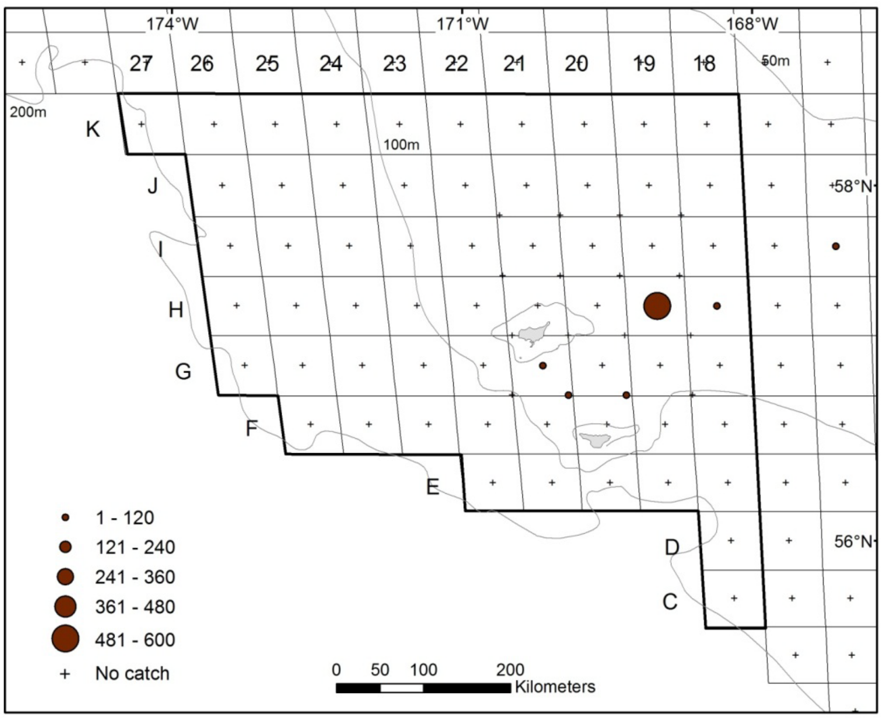


Figure 4-6 **Total density (number/nm2) of Pribilof Islands blue king crab in the 2011 eastern Bering Sea bottom trawl survey.**

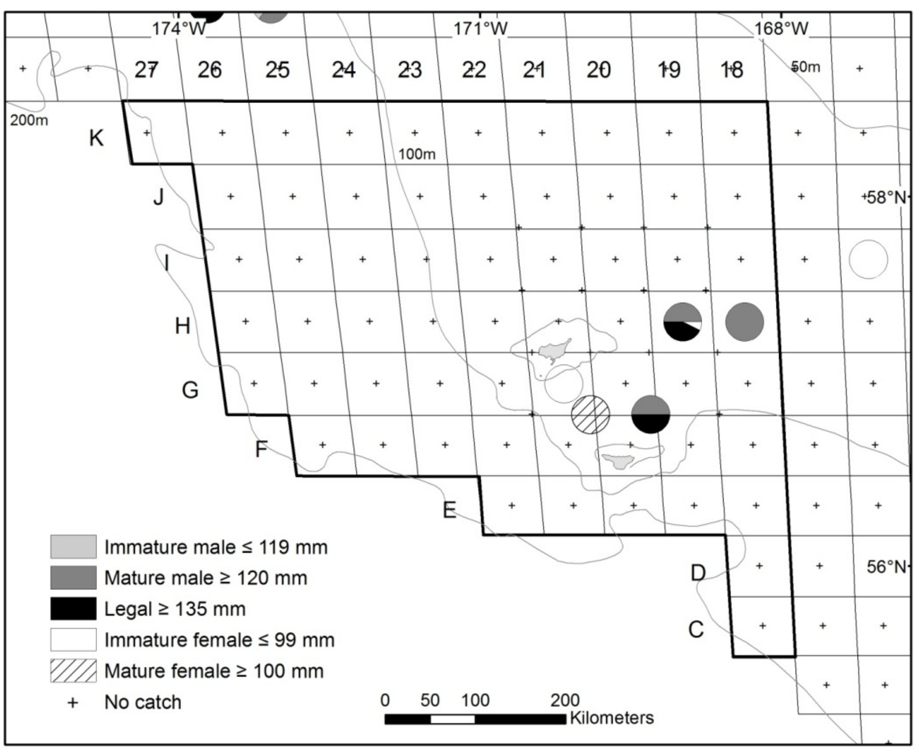


Figure 4-7 Sex and maturity of Pribilof Islands blue king crab in the 2011 eastern Bering Sea bottom trawl survey.

4.1.2 Overfishing Limit (OFL)

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criteria and acceptable biological catch (ABC) levels are annually formulated. The annual catch limit (ACL) for each stock equals the ABC. Each crab stock is annually assessed to determine its status and whether (1) overfishing is occurring or the rate or level of fishing mortality for the stock is approaching overfishing, (2) the stock is overfished or the stock is approaching an overfished condition, and (3) the catch has exceeded the ACL.

For crab stocks, the overfishing level (OFL) equals maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Overfishing is determined by comparing the OFL with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. NMFS will also determine whether the ACL was exceeded by comparing the ACL with the catch estimates for the previous crab fishing year. Catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL and ACL will be set for and compared to the retained catch.

Annually in the stock assessment process, the Council and the Council's SSC and Crab Plan Team review (1) the stock assessment documents, (2) the OFLs and ABCs, and total allowable catches or guideline harvest levels, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, (4) NMFS's determination of whether any stocks are overfished, and (5) NMFS's determination of whether catch exceeded the ACL in the previous crab fishing year.

The stock status, OFL and maxABC levels are determined using a five-tier system (Table 4-1). First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the Crab Plan Team process to the SSC. The SSC recommends tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the proposed OFLs and ABCs based on the five-tier system.

Table 4-1 Five-Tier System for setting overfishing limits (OFLs) and acceptable biological catches (ABCs) for crab stocks. The tiers are listed in descending order of information availability. Table 5-2 contains a guide for understanding the five-tier system.

Information available	Tier	Stock status level	F_{OFL}	ABC control rule
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, B_{MSY}, F_{MSY}	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, $F_{35\%}$*, $B_{35\%}$*	3	a. $\frac{B}{B_{35\%*}} > 1$	$F_{OFL} = F_{35\%}$ *	
		b. $\beta < \frac{B}{B_{35\%}*} \le 1$	$F_{OFL} = F^*_{35\%} \frac{\frac{B}{B^*_{35\%}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{35\%}*} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, M, $B_{msy^{prox}}$	4	a. $\frac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$	
		b. $\beta < \frac{B}{B_{msy^{prox}}} \le 1$	$F_{OFL} = \gamma M \frac{B/B_{msy^{prox}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy^{prox}}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
Stocks with no reliable estimates of biomass or M.	5		OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information.	ABC≤0.90 * OFL

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.
† An $F_{OFL} \le F_{MSY}$ will be determined in the development of the rebuilding plan for an overfished stock.

Table 4-2 A guide for understanding the five-tier system.

- F_{OFL} — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). F_{OFL} is determined as a function of:
    - F_{MSY} — the instantaneous F that will produce MSY at the MSY-producing biomass
        - A proxy of F_{MSY} may be used; e.g., $F_{x\%}$, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value
    - B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production.
        - A proxy of B may be used; e.g., mature male biomass
    - B_{MSY} — the value of B at the MSY-producing level
        - A proxy of B_{MSY} may be used; e.g., mature male biomass at the MSY-producing level
    - β — a parameter with restriction that $0 \leq \beta < 1$.
    - α — a parameter with restriction that $0 \leq \alpha \leq \beta$.
- The maximum value of F_{OFL} is F_{MSY}. $F_{OFL} = F_{MSY}$ when $B > B_{MSY}$.
- F_{OFL} decreases linearly from F_{MSY} to $F_{MSY} \cdot (\beta-\alpha)/(1-\alpha)$ as B decreases from B_{MSY} to $\beta \cdot B_{MSY}$
- When $B \leq \beta \cdot B_{MSY}$, F = 0 for the directed fishery and $F_{OFL} \leq F_{MSY}$ for the non-directed fisheries, which will be determined in the development of the rebuilding plan.
- The parameter, β, determines the threshold level of B at or below which directed fishing is prohibited.
- The parameter, α, determines the value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$ and the rate at which F_{OFL} decreases with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.
    - Larger values of α result in a smaller value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$.
    - Larger values of α result in F_{OFL} decreasing at a higher rate with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.
- The parameter, b_y, is the value for the annual buffer calculated from a P* of 0.49 and a probability distribution for the OFL that accounts for scientific uncertainty in the estimate of OFL.
- P* is the probability that the estimate of ABC, which is calculated from the estimate of OFL, exceeds the "true" OFL (noted as OFL') (P(ABC>OFL')).

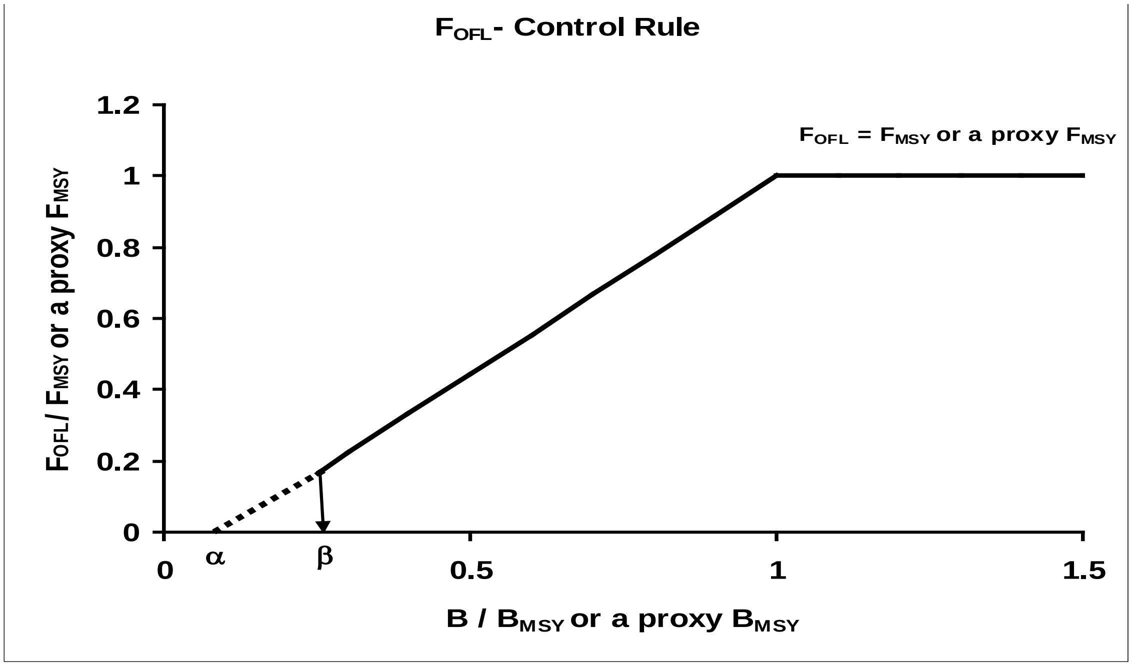


Figure 4-8 Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below β.

Based on the availability of annual information on survey data, the PIBKC stock is assigned to Tier 4. For Tiers 1 through 4, once a stock is assigned to a tier, the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 4-1). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β). In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β. At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the minimum stock size threshold.

Based upon the ratio of the current biomass to the estimated B_{MSY} proxy, the PIBKC stock falls into stock status "c." Under the control rule (see Figure 4-8), directed fishing is prohibited and the appropriate F_{OFL} must be determined in conjunction with the development of a rebuilding plan. The stock has been under a rebuilding plan since 2003, and has been closed to directed fishing since 1999. Since 2008, due to this stock status "c" under the tier system, the OFL has been set based upon an average of catch mortality in the groundfish fisheries in Federal reporting area 513 between 1999 and 2005 (Table 4-3). This represents a period after the directed crab fishery was closed and prior to the increased bycatch in the groundfish fisheries in 2006 and 2007. This average catch is intended to reflect the best available science to estimate an OFL for this stock as it is not possible to directly estimate F_{MSY} in order to specify an F_{OFL} less than or equal to F_{MSY} per Tier 4. The catch accounting database was revised in 2009 to account for unmeasured crab in the data and for PIBKC this resulted in a lower catch estimate over those years (Table 4-3). For that reason the OFL was previously set at 1.81 t (4,000 lb) and is now set at 1.16 t (2,557 lb).

Table 4-3 Non-retained total catch mortalities from directed and non-directed fisheries for Pribilof District blue king crab (Federal reporting area 513). Handling mortalities (pot and hook/line= 0.5, trawl = 0.8) were applied to the catches. Groundfish fishery data is not available prior to 1991/1992 and ADF&G catch data is not available prior to 1996/1997 (Bowers et al. 2011; D. Pengilly, ADF&G, pers. comm.; J. Mondragon, NMFS, pers. comm.).

	Crab pot fisheries			Groundfish fisheries	
Year	Legal male non-retained (t)	Sublegal male (t)	Female (t)	All fixed (t)	All Trawl (t)
1991/1992				0.03	4.96
1992/1993				0.44	48.63
1993/1994				0.00	27.39
1994/1995				0.02	5.48
1995/1996				0.05	1.03
1996/1997	0.00	0.40	0.00	0.02	0.05
1997/1998	0.00	0.00	0.00	0.73	0.10
1998/1999	1.15	0.23	1.86	9.90	0.06
1999/2000	1.75	2.15	0.99	0.40	0.02
2000/2001	0.00	0.00	0.00	0.06	0.02
2001/2002	0.00	0.00	0.00	0.42	0.02
2002/2003	0.00	0.00	0.00	0.04	0.24
2003/2004	0.00	0.00	0.00	0.17	0.18
2004/2005	0.00	0.00	0.00	0.41	0.00
2005/2006	0.00	0.00	0.05	0.18	1.07
2006/2007	0.00	0.00	0.05	0.07	0.06
2007/2008	0.00	0.00	0.05	2.00	0.11
2008/2009	0.00	0.00	0.00	0.07	0.38
2009/2010	0.00	0.00	0.00	0.17	0.43
2010/2011	0.00	0.09	0.00	0.07	0.02

Federal reporting area 513 has been used since 2008 for calculating the catch mortality in the groundfish fisheries which accrues towards the OFL (as well as the catch quantities used to estimate an overage over that time frame) due to difficulties in refining the spatial scale of crab stock boundaries with the Federal reporting area boundaries for purposes of the NMFS CAS. This issue is discussed further in the next section.

The ABC is set at 90% of the OFL, based upon the maxABC control rule for a Tier 5 stocks rather than the maxABC control rule for a Tier 4 stock due to the establishment of an OFL based upon a Tier 5-like calculation. The current ABC is 1.04 t (2,301 lb). The OFL and ABC are annually established under the current process for crab specifications. This process begins with the assessment author's recommended OFL and ABC, the Crab Plan Team review of the assessment and resulting recommendations, and finally the final OFL and ABC recommendations from the SSC to the Council in October.

4.2 Stock Distribution Compared to the OFL Area

The NMFS summer survey provides biomass estimates by standard stations for calculating PIBKC stock status. Data from 2003–2011 survey estimates are shown in Figure 4-9 in conjunction with the standard survey grid. The same stations are sampled annually. The alternative closures considered in this analysis were recommended by the Crab Plan Team and later the SSC to cover the best range of alternative closure configurations around the Pribilof Islands. Specifically the Crab Plan Team was requested to consider a closure that covered the "full distribution of the PIBKC stock." As noted previously in the analysis, this was evaluated by using historical survey data and defined in two different periods: 1975–2009 (broader distribution) and 1984–2009 (smaller distribution) based upon an observed constriction of the stock (based on survey data) first observed beginning in 1984 and leading to the more eastern distribution (Figure 4-10). Note that the observed survey stations extend beyond the boundary of the Pribilof District and the closure configuration was based upon survey distribution not the boundaries of the registration district.

Due to issues of stock boundary differentiation between the St. Matthew blue king crab stock and the PIBKC stocks, as an interim measure, the Federal reporting area 513 has been used for purposes of calculating the PIBKC OFL and estimating the bycatch that accrues towards the OFL. This notably excludes Federal reporting areas 524 and 521 that are near the Pribilof Islands and a portion of which should be included in the appropriate stock boundary for PIBKC. Currently, blue king crab bycatch in Areas 521 and 524 accumulates towards the St. Matthew blue king crab OFL given that the majority of that stock is contained within those areas.

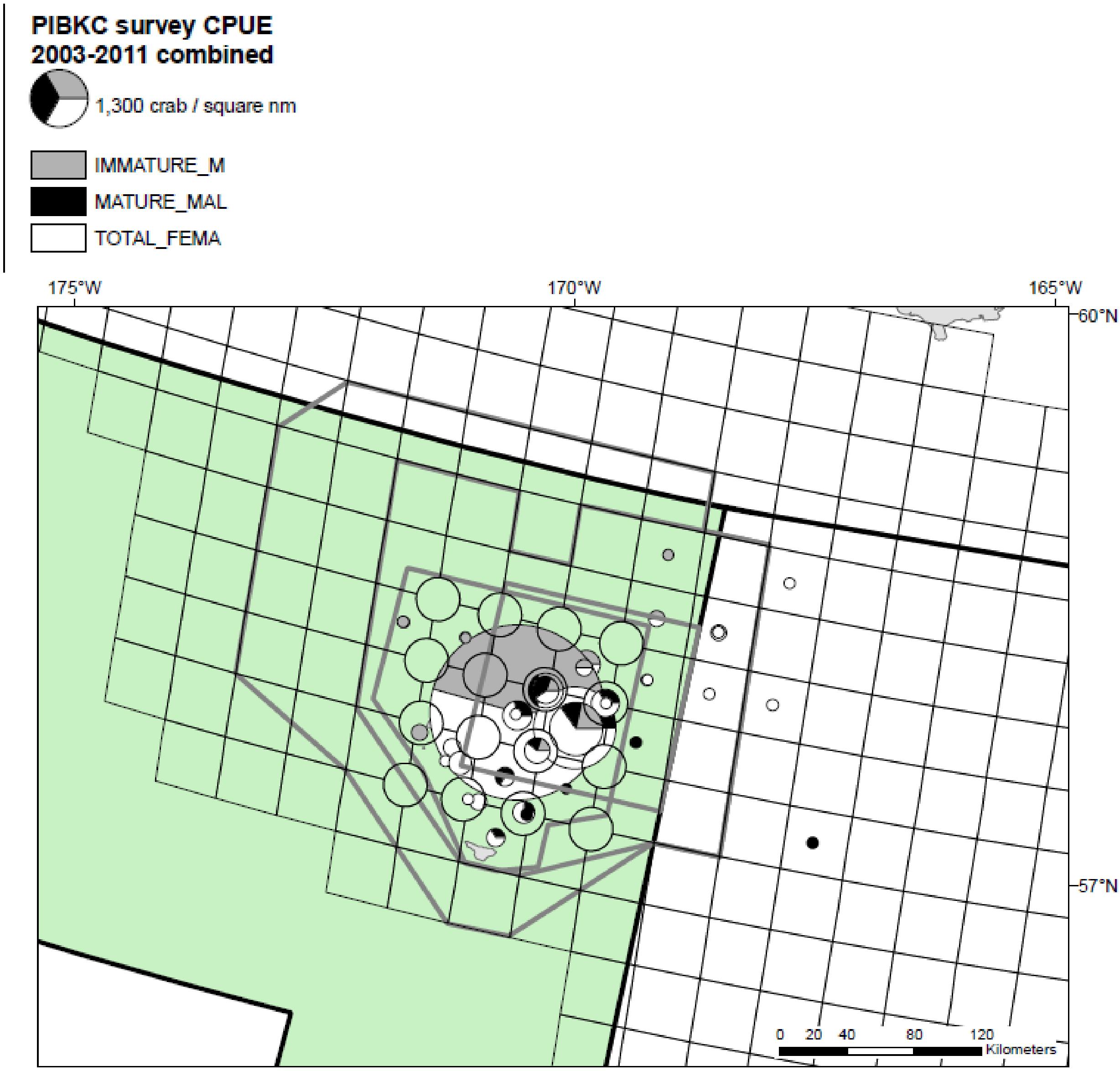


Figure 4-9 **Survey catch per unit effort 2003–2011, survey grids (20 nm blocks) and the proposed closures under consideration. Note that the size of the circles is relative to the number of crab caught. The shaded area is the Pribilof District.**

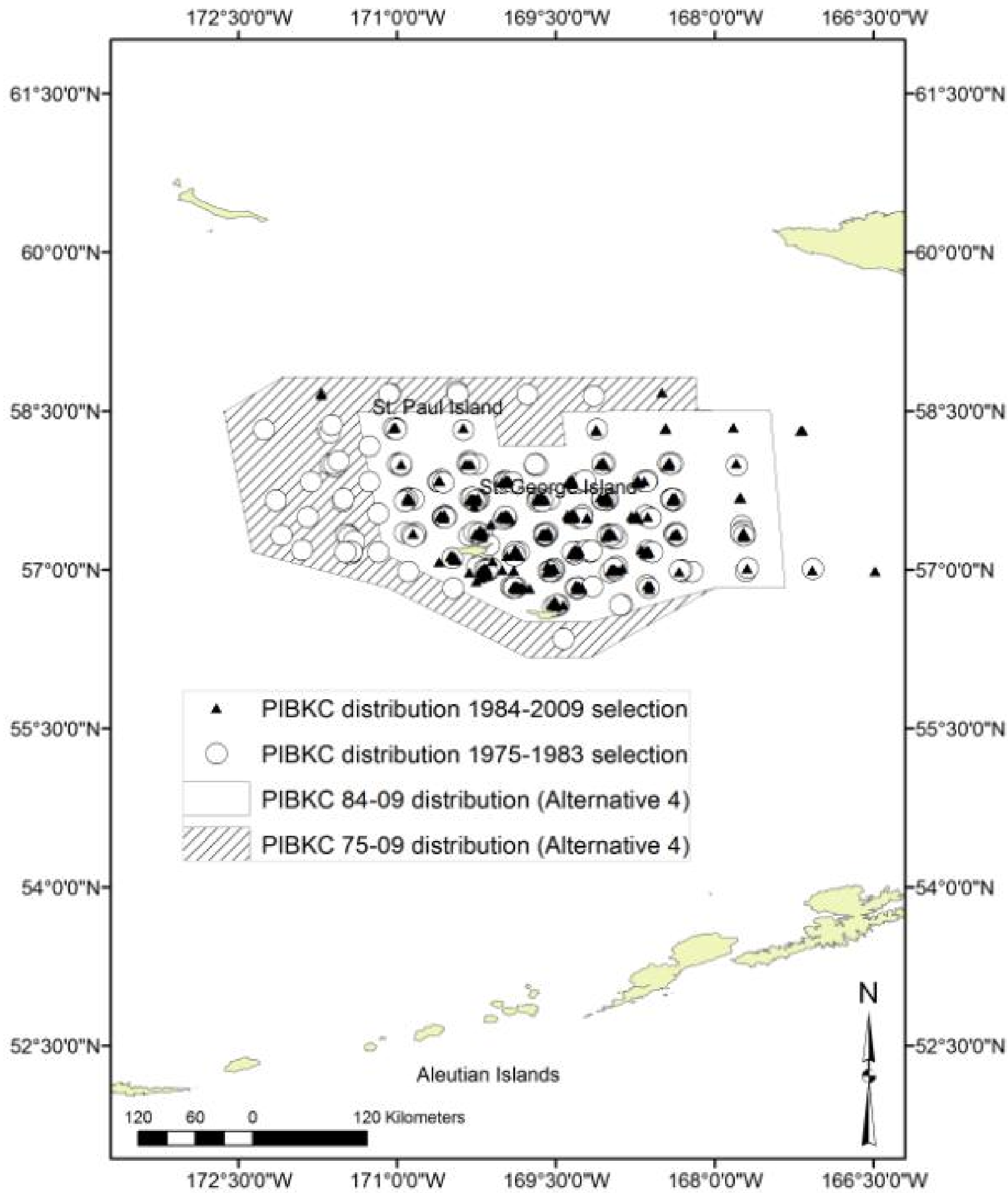


Figure 4-10 **Distribution of Pribilof Islands blue king crab (PIBKC) from survey stations over two time frames 1975–1983 and 1984–2009 showing the change in relative distribution to the east after 1984. Closure options proposed under Alternatives 4 and 5 are shown in white block and hatched box.**

4.2.1 Registration areas and Crab Rationalization fisheries

Registration Areas in the Crab FMP are defined by the State of Alaska. The Crab FMP provides for registration areas, as well as district, subdistrict, and section management units. Several king crab management units are depicted in Figure 4-11. Modification of registration areas is a Category 2 measure under the FMP and deferred to the State of Alaska under guidelines in the FMP. The Pribilof District is part of king crab Registration Area Q (Bering Sea); the Pribilof District is defined as that portion of Registration Area Q south of the latitude of Cape Newenham (58°39' N. lat), and west of 168° W long (Figure 4-11). Similarly, the western boundary for Registration Area T (Bristol Bay, 5 AAC 34.800) is 168° W. long. Any change to the Pribilof District eastern boundary would require modification of these two registration areas.

The western boundary of the Bristol Bay Area (168° W long.) was initially drawn to cover the distribution of the Bristol Bay red king crab stock, which began domestically in the late 1960s. The Pribilof District fishery started as a blue king crab target in 1973, while Pribilof District red king crab fishery began in the early 1990s. Currently the Pribilof District red king crab fishery is closed due primarily to concerns of blue king crab bycatch in that red king crab fishery. Any modification of the Pribilof District line to the east for blue king crab would need to consider the impact on harvest and management of Bristol Bay red king crab. Currently directed fishing for red king crab is allowed east of 168° W long. as Bristol Bay red king crab.

As an FMP Category 2 measure, these two boundaries can be changed by the Alaska Board of Fisheries, and must comply with FMP and National Standards. The next in-cycle Board of Fisheries meeting for Bering Sea and Aleutian Islands king and Tanner crabs will be in 2013/2014, although the Board has discretion to take a proposal out-of-cycle for coordination with Federal actions. Specifically, regulation 5 AAC 39.999(b) says: “The board will, in its discretion, change its schedule for consideration of proposed regulatory changes as reasonably necessary for coordination of state regulatory actions with Federal fishery agencies, programs, or laws.”

Changing the Pribilof District registration boundary would need to consider effects to red, blue and golden king crab fisheries in the Pribilof District, although the eastern boundary probably has no association with golden king crab habitat. The Pribilof District designation is also used for hair crab, a non-FMP species, by the State of Alaska. Bristol Bay is an exclusive registration area, whereas Pribilof District is a non-exclusive registration area. Some consideration would have to be given as to how to treat historical data and any other effects of bycatch management not related to the issue at hand. The fish ticket database, eLandings, and stock assessments would have to be modified if the 168° W long. line were moved.

In 2005, in implementing the Crab Rationalization Program, NMFS used the ADF&G registration areas to define the boundaries of each Crab Rationalization fishery (See Table 1 to 50 CFR 680 and Figure 4-11). Pribilof Islands king crab quota share can only be used within the boundaries established in Federal regulation. However, these fishery boundaries were not meant to define the stock area for the purposes of OFL/ABC setting.

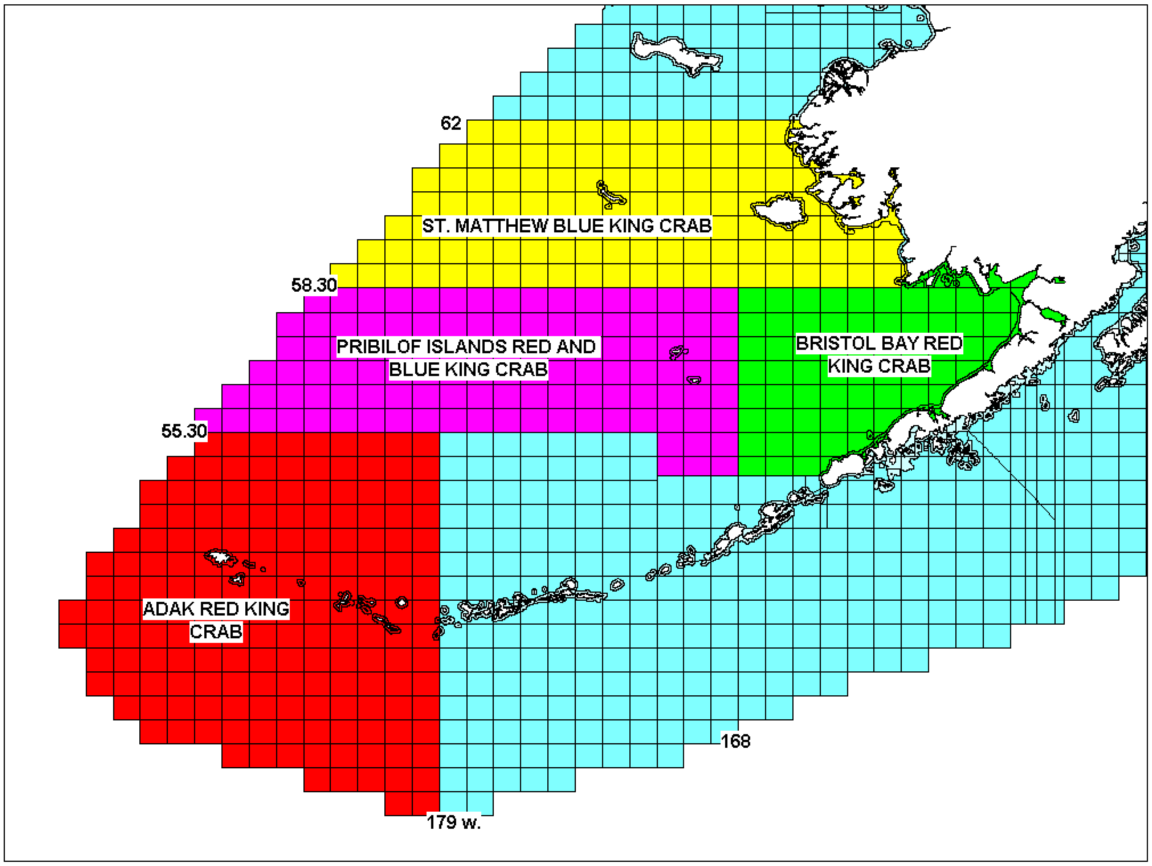


Figure 4-11 Crab Rationalization Fishery areas showing the Pribilof Islands king crab quota share fishery as defined in Federal regulation.

4.2.2 Modifying the OFL area

The Crab Plan Team and SSC have recommended modifying the PIBKC stock boundary for the purposes of OFL setting and accrual of catch to the OFL.

Currently, as an interim measure, only catch in Federal reporting area 513 accrues towards the OFL, rather than the entire district or known distribution of the stock. Federal reporting area 513 has been used to define the area of groundfish catch mortalities due to the configuration of Areas 524 and 521 and their proximity to St. Matthew Island and the blue king crab stock in that region. As catch mortalities from groundfish fisheries have always been reported on Federal reporting area scale, these areas were excluded because more of the catch reported in them was assumed to come primarily from catch in the St. Matthew stock area. However, some observed catch is near the Pribilof Islands and within those Federal reporting areas.

The Crab Plan Team has recommended and NMFS agrees that as the spatial resolution of data in the CAS and available observer information increase that the estimation method will be modified so that crab mortality from all fisheries will be accounted for by the appropriate stock boundary area for each stock. While still being planned, this has not yet occurred, thus interim measures on Federal reporting scales are still being employed to account for bycatch by crab stock. Note that for Bering Sea wide stocks such as Tanner crab and snow crab this is not a problem. This is an issue when dealing with the smaller stock area boundaries between similar crab stocks such as the red king crab stocks (Bristol Bay, Pribilof Islands, Adak and Norton Sound), blue king crab stocks (St. Matthew and Pribilof Islands) and golden king crab stocks (Aleutian Islands, Pribilof Islands). The CAS is still moving towards these better spatial resolutions for bycatch of these stocks.

Per SSC recommendation, the boundary for the OFL will be modified for the 2013/14 Crab Fishing Year. This modification does not necessitate modification of the registration area or Federal regulations. The new boundary for purposes of setting (and accrual toward) the OFL will be the current PIBKC registration area as well as the 20-nm survey grid to the east. The rationale for this additional area is that the survey consistently finds blue king crabs in stations 20 nm to the east of the registration area boundary, and the SSC indicated that these stations be included in the stock boundary area (Figure 4-12).

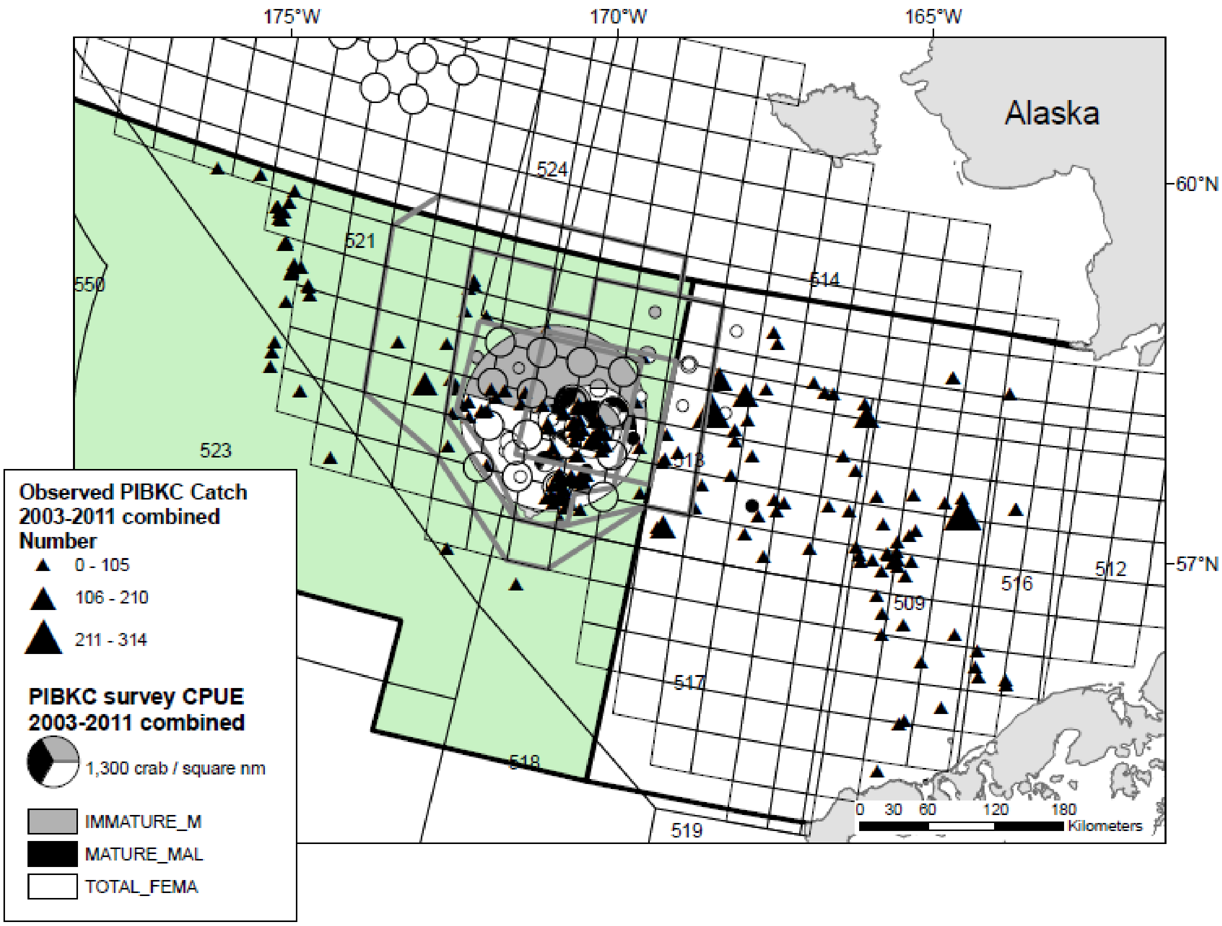


Figure 4-12 Observed bycatch of blue king crab (all gear types) in triangles in the Pribilof District and Bristol Bay in conjunction with observed survey catch in circles 2003–2011. Note grid represents the NMFS bottom trawl survey grid (20 nm blocks). The shaded area represents the Pribilof District.

4.2.3 Implications of modifying the OFL area

Modifying the OFL area would not change the alternative closure configurations. These closure configurations were drawn irrespective to registration or Federal reporting areas and are based on either existing closures (PIHCZ, ADF&G crab closures) or consideration of survey distribution of PIBKC. However, a modification of the area over which the groundfish bycatch under the OFL is to accrue may affect the qualified fisheries under the closures. This could occur outside of the analytical process to refine the rebuilding plan, however for consistency and for the implications to applicable fisheries it would be best to indicate the proposed modification at this time for inclusion in the analysis. Modifying the stock boundary area (and thus the area of catch accrual) for either Option 2 or 3 would change the non-exempt fisheries for closure purposes under the current suite of alternatives. Retaining only Area 513 would also modify the qualified fisheries. While more analysis would be necessary to evaluate the inclusion of bycatch in Area 509 under Option 2, modifying the area for Options 2 or 3 for consistency with observed bycatch and known survey locations would likely indicate that fisheries previously considered under this analysis and currently exempt may now be subject to closures absent a change in the Council's "qualification requirement".[12]

Specifically, several flatfish fisheries have been iteratively removed from consideration in this analysis when their observed bycatch was found to be outside of the Pribilof District boundary (and most notably in the 20 nm strip to the east under consideration). These include the flathead sole fishery, rock sole fishery, and "other flatfish" fisheries. These fisheries under either Option 2 or 3 for the OFL area would most likely be included back for consideration in the closures. Note this would also occur if Area 513 (only) were selected for the stock area.

In the future, the OFL average catch amount would need to be reconsidered (in the next assessment cycle) to account for catch in a more spatially refined area of the PIBKC OFL stock boundary that will include portions of Areas 513, 524, 523, and 521. Moving forward, the area over which the OFL is to accrue will be defined as a special area in the CAS and catch estimates produced accordingly as described in Chapter 3. A historical reconstruction of the catch in any of these OFL boundary areas would be necessary in order to estimate an average catch over an appropriate time period for calculating an OFL in this manner. Should the stock ever rebound such that its biomass in relation to $B_{MSYPROXY}$ is above the critical β threshold, (i.e. $B/B_{MSY}^{prox} > \beta$) the OFL would no longer be determined based upon average catch (or some other means as recommended by the SSC) but would rather be determined by application of the sloping control rule as described in Table 4-1 and Figure 4-8. However, until such a time, an alternative means to establish the OFL is needed.

The harvest strategy has incorporated protection measures for PIBKC due to its overfished status so total allowable catch has been zero in recent years. Under the current rebuilding plan (implemented as Amendment 17 to the Crab FMP), there can be no directed harvest of PIBKC until the stock is rebuilt.

4.3 Blue King Crab Spatial Relationship between Pribilof Islands and St. Matthew

To assess the potential relationship between blue king crab in the Pribilof Islands and St. Matthew Island, the analysts consulted report entitled "Guidelines for determination of spatial management units for exploited populations in Alaskan groundfish fishery management plans" by Spencer et al. (2010). Per this document, aspects of blue king crab harvest and abundance trends, phenotypic characteristics, behavior, movement, and genetics will be considered. Also, over 200 samples have been collected to support a genetic study on blue king crab population structure by a graduate student at the University of Alaska. Data from this genetics study will not be available in time for this rebuilding plan but will be incorporated into the stock assessment and considered during the rebuilding period.

Following the methods of Spencer et al. (in preparation), aspects of PIBKC stocks that might lead to a conclusion about the spatial relationship with the St. Matthew stock were discussed (Table 4-4). The

[12] The current suite of alternatives indicates that any fishery with greater than 5% of the ABC of bycatch between 2003–2010 is subject to the closures considered under the rebuilding plan.

items labeled TBD still require analysis (Table 4-4). The data that is available suggests that the environments around the Pribilof Islands and St. Matthew Island are different and likely lead to variable crab production in the two regions. Recent publications looking at snow crab larval advection suggest that the may be physical mechanisms to entrain crab larvae from the south to the north. It is unknown, however, the magnitude (if any) that blue king crab larval drift from the Pribilof Islands may contribute to the total larval production supporting the St. Matthew stock. Further analyses will be considered to compare phenotypic characteristics based on survey data collection.

Table 4-4 Preliminary assessment of the potential relationship between blue king crab in the Pribilof Islands and St. Matthew Island. Factors and criterion were based on information contained in Spencer et al. (in preparation).

Harvest and Trends

Factor and criterion	Justification
Fishing mortality (5-year average percent of F_{max})	Fishing mortality rates are low in the Pribilof Islands and although rates near St. Matthew Island have increased in the past two years, they are much lower than F_{max}.
Spatial concentration of fishery relative to abundance (Fishing is focused in areas smaller than management areas)	Harvests in the St. Matthew stock are concentrated south of St. Matthew Island likely due to the accessibility of the stock. Since much of the stock biomass is north of St. Matthew Island, localized depletion may be an issue.
Population trends (Different areas show different trend directions)	Population trends are very different between St. Paul and St. Matthew stocks suggesting different productivities or better recruitment conditions.

Barriers and phenotypic characters

Generation time (e.g., >10 years)	Generation time in <10 years.
Physical limitations (Clear physical inhibitors to movement)	No apparent physical barriers to adult dispersal but larval dispersal may be affected by local oceanography (see Parada et al. 2010).
Growth differences (Significantly different Length-at age, Weight-at-age, or Length-weight parameters)	Unknown although warmer temperatures in the Pribilof Islands likely lead to higher growth rates.
Age/size-structure (Significantly different size/age compositions)	TBD
Spawning time differences (Significantly different mean time of spawning)	Unknown
Maturity-at-age/length differences (Significantly different mean maturity-at-age/length)	TBD
Morphometrics (Field identifiable characters)	Unknown
Meristics (Minimally overlapping differences in counts)	Unknown

Behavior and movement

Spawning site fidelity (Spawning individuals occur in same location consistently)	Unknown
Mark-recapture data (Tagging data may show limited movement)	TBD
Natural tags (Acquired tags may show movement smaller than management areas)	Unknown

Genetics

Isolation by distance (Significant regression)	No apparent isolation by distance.
Dispersal distance (smaller than Management areas)	Not available
Pairwise genetic differences (Significant differences between geographically distinct collections)	TBD

4.4 Spatial Relationship between Pribilof Islands Blue King Crab and Red King Crab Stocks

To address the potential for species interactions between blue king crab and red king crab as a potential reason for PIBKC shifts in abundance and distribution, we compared the spatial extent of both species in the Pribilof Islands from 1975 to 2009 (Figure 4-13). In the early 1980s when red king crab first became abundant, blue king crab males and females dominated the 1 to 7 stations where the species co-occurred in the Pribilof District (Figure 4-13A). Spatially, the stations with co-occurance were all dominated by blue king crab and broadly distributed around the Pribilof Islands (Figure 4-14A). In the 1990s the red king crab population biomass increased substantially as the blue king crab population biomass decreased. During this time period, the number of stations with co-occurance remained around a max of 8 but they were equally dominated by both blue king crab ands red king crab sugggesting a direct overlap in distribution at the scale of a survey station (Figure 4-13A). Spatially during this time period, the red king crab dominated stations were dispersed around the Pribilof Islands (Figure 4-14B). Between 2001 and 2009 the blue king crab population has decreased dramatically while the red king crab have fluctuated (Figure 4-13B). Interstingly, the number of stations dominated by blue king crab is similar to those dominated by red king crab for both males and females suggesting continued competition for similar habitat (Figure 4-13A). Spatially the only stations dominated by blue king crab exist to the north and east of St. Paul Island (Figure 4-14C). It is noted that although the blue king crab protection measures also afford protection for the red king crab in this region, the red king crab stocks continue to fluctuate even considering the uncertainty in the survey.

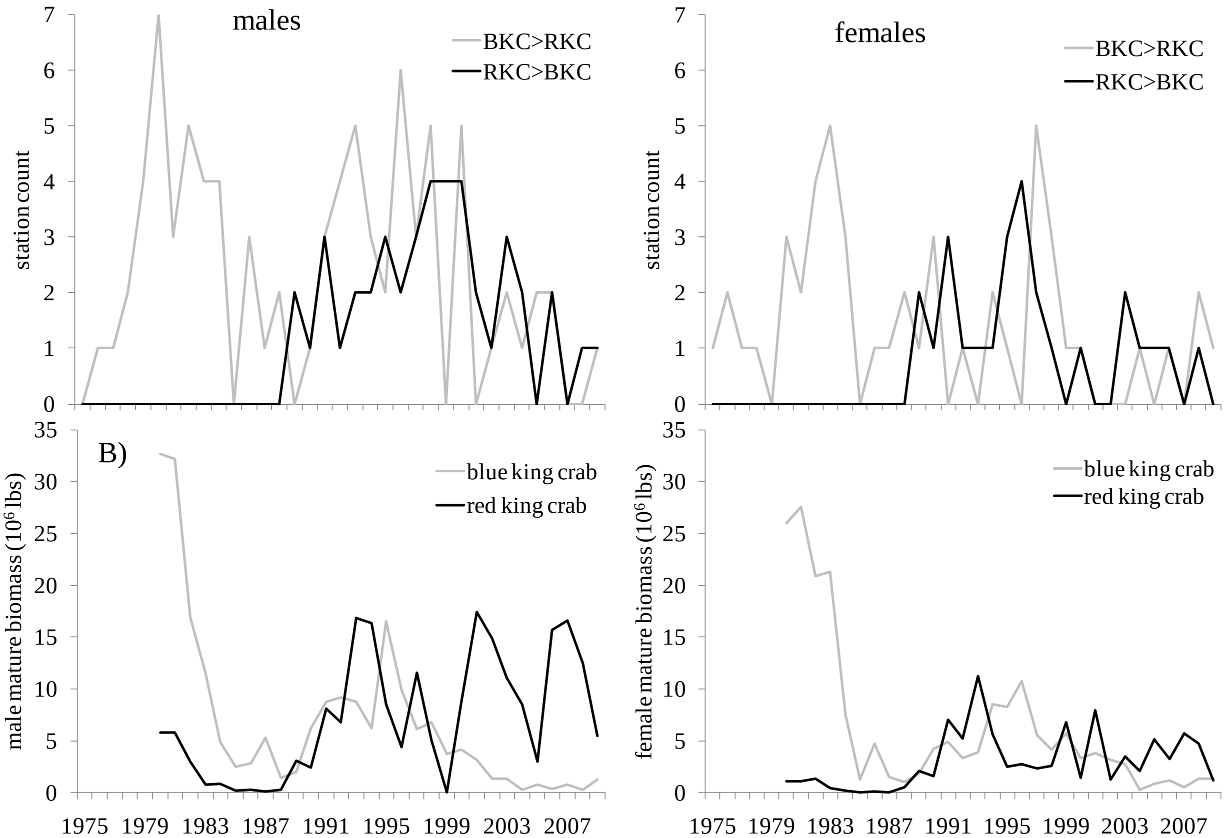


Figure 4-13 Time series of overlap between blue king crab and red king crab for males and females in the eastern Bering Sea showing A) the number of stations with blue king crab (BKC) or red king crab (RKC) as the dominant species and B) the mature biomass of both species.

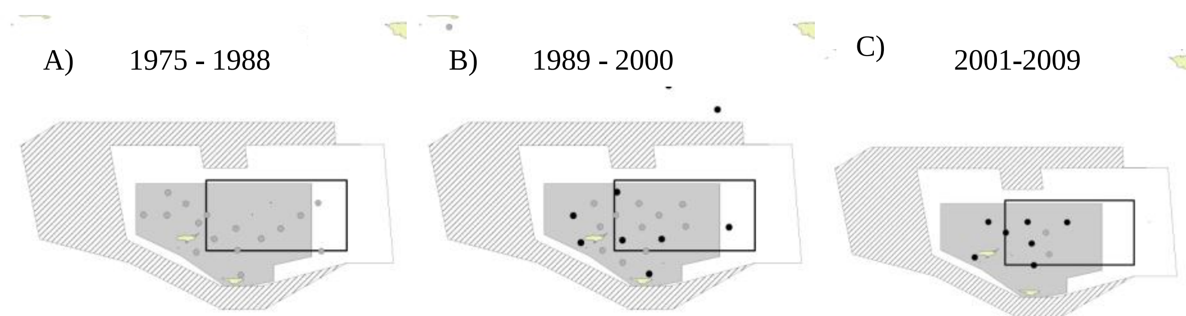


Figure 4-14 Spatial distribution of stations where there is overlap between blue king crab and red king crab males showing the dominant species (blue king crab=gray circles; red king crab=black circles) corresponding to time periods of major changes in biomass of both species.

4.5 Impacts of Alternatives on Pribilof Islands blue king crab

4.5.1 Significance criteria

The significance criteria used to evaluate the effects of the action on PIBKC are in Table 4-5. These criteria have been adapted from the 2006–2007 groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (NMFS 2007a).

Table 4-5 Criteria used to estimate the significance of impacts on nontarget and prohibited species.

Adverse impact	There are incidental takes of PIBKC.
Beneficial impact	Natural at-sea mortality of PIBKC would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	Fisheries are subject to operational constraints under PSC management measures. Groundfish fisheries without the PSC management measures would be a significantly adverse effect on prohibited species. A significantly adverse impact to PIBKC would be an increase in the take of PIBKC to a level that exceeds the OFL set for this stock.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on PIBKC, and significantly beneficial impacts are not defined for PIBKC.
Unknown impact	Not applicable

In summary, no significant impacts on PIBKC were identified for Alternatives 2-6. However, under Alternative 1, the potential for PIBKC bycatch to exceed the OFL exists and there are no measures to prevent overfishing. Therefore, there is the potential for significant adverse impacts. Alternatives 2 through 6 would reduce this potential for bycatch exceeding the OFL, with difference degrees of effectivness. As shown in the analysis, Alternative 2b, which would close the existing PIHCZ to fishing for Pacific cod with pot gear, would eliminate the vast majority of PIBKC bycatch in the area of known blue king crab habitat. The other area closure alternatives would close areas where marginally more bycatch occurs and would prevent fishing by fisheries with marginally more bycatch. The analysis of the effectiveness of the alternatives at preventing overfishing is in section 4.5.3. None of the year-round area closure alternatives are expected to have significant adverse impacts on PIBKC because they will reduce bycatch. The trigger closure alternatives likewise would have no significant impacts on PIBKC because they would also limit bycatch. However, as explained in Chapters 2 and 3, the existing data limitations, uncertainty of the PIBKC stock boundary, and groundfish fishery management pose complex challenges for creating a viable trigger closure mechanism that minimizes bycatch without being unfairly constraining.

4.5.2 Stock rebuilding

As described in Chapter 2, six alternatives are under consideration for measures to minimize bycatch, prevent overfishing, and assist in the rebuilding of the PIBKC stock. The impacts of these alternatives on the potential for stock rebuilding are considered by using the draft assessment model. The potential impact of PIBKC bycatch in groundfish fisheries as a limiting factor on stock recovery was estimated by conducting a sensitivity analysis on the rebuilding time frame under different catch scenarios.

Projection Methodology for Pribilof Islands Blue King Crab Stock Rebuilding

A four-stage catch-survey assessment (CSA) model was used to estimate size specific PIBKC abundance (NPFMC 2008b). This model is under development and has not yet been approved by the SSC for use in annually assessing the stock. The model is being used provisionally in this analysis only as a mean of projecting the potential for rebuilding the stock and the time frame for doing so. As such there are caveats associated with the results indicated on projections of this stock rebuilding. All descriptions of model fits and estimates of rebuilding are provided here but caution should be taken in interpreting these as true estimates of rebuilding (or indications of good model fits) as the model is still under development and until approved by the SSC will not be used to assess stock status.

The CSA model uses multiple years of trawl survey and harvest data to estimate abundance in four classes of male crabs: pre-recruit two [105–119 mm carapace length (CL)]; pre-recruit one (120–134 mm CL); recruit (new-shell, 135–148 mm CL); and, post-recruit (greater than148 mm CL and old-shell, 135–148 mm CL). For each stage of crab, the molting portions of crab "grow" into different stages based on a growth matrix, and the non-molting portions of crab remain in the same stage or become post-recruits. The model links the crab abundances in four stages in year t+1 to the abundances and catch in the previous year through natural mortality, molting probability, and the growth matrix:

$$
\begin{aligned}
P2_t^b &= (P2_t e^{-0.5M} - hc2_t e^{-(0.5-y_t)M_t})\, e^{-0.5M_t - st_2 Ft_t - sf_2 Ff_t}(1 - sp_2 Ho_t h),\\
P1_t^b &= (P1_t e^{-0.5M_t} - hc1_t e^{-(0.5-y_t)M_t})\, e^{-0.5M_t - st_1 Ft_t - sf_1 Ff_t}(1 - sp_1 Ho_t h),\\
P2_{t+1} &= P2_t^b[(1 - m2_t) + m2_t\, G_{P2,P2}] + N_{t+1},\\
P1_{t+1} &= P1_t^b[(1 - m1_t) + m1_t\, G_{P1,P1}] + P2_t^b\, m2_t\, G_{P2,P1},\\
R_{t+1} &= P2_t^b\, m2_t\, G_{P2,R} + P1_t^b\, m1_t\, G_{P1,R},\\
P_{t+1} &= [(P_t + R_t)e^{-0.5M_t} - rc_t e^{-(0.5-y_t)M_t}]e^{-0.5M_t - Ft_t - Ff_t}(1 - Ho_t h),
\end{aligned}
\qquad (1)
$$

Where $P2_t^b$ and $P1_t^b$ are prerecruit-2 and prerecruit-1 abundances after handling mortality in year t, $hc2_t$ and $hc1_t$ are pot bycatch for prerecruit-2s and pre-recruit 1s; st_2, st_1, sf_2, sf_1, sp_2, and $sp1$ are selectivities for pre-recruit 2s and pre-recruit 1s bycatch from groundfish trawling, groundfish fixed gear, and directed pot fisheries; Ho_t is the bycatch mortality rate from other crab fisheries; h is handling mortality rate; $H2^q$ and $H1^q$ are fishery selectivities for pre-recruit 2s and pre-recruit 1s; N_t is new crab entering the model in year t; $m2_t$ and $m1_t$ are molting probabilities for pre-recruit 2s and pre-recruit 1s in year t; $G_{i,j}$ is a growth matrix containing the proportions of molting crab growing from stage i to stage j; M_t is natural mortality in year t; rc_t is estimated commercial catch in year t; and y_t is the time lag from the survey to the mid-point of the fishery in year t. By definition, all recruits become post-recruits in the following year.

The retained catch is estimated to be:

$$rc_t = (P_t + R_t)hr, \qquad (2)$$

Where hr is legal harvest rate at the survey time. The pot bycatch from the directed fishery are:

$$
\begin{aligned}
hc2_t &= sp_2\, hr\, P2_t\, h,\\
hc1_t &= sp_1\, hr\, P1_t\, h.
\end{aligned}
\qquad (3)
$$

The bycatch from the groundfish fisheries are computed as:

$$
\begin{aligned}
tc2_t &= P2_t^b(1-e^{-st_2\,Ft_t}),\\
tc1_t &= P1_t^b(1-e^{-st_1\,Ft_t}),\\
tc_t &= (P_t+R_t)e^{-0.5M_t} - rc_t e^{-(0.5-y_t)M_t},\\
fc2_t &= P2_t^b(1-e^{-sf_2\,Ff_2}),\\
fc1_t &= P1_t^b(1-e^{-sf_1\,Ff_1}),\\
fc_t &= (P_t+R_t)e^{-0.5M_t} - rc_t e^{-(0.5-y_t)M_t},
\end{aligned}
\qquad (4)
$$

Where $tc2_t$, $tc1_t$, tc_t, $fc2_t$, $fc1_t$ and fc_t are crab bycatch of pre-recruit 2s, pre-recruit 1s, and legals from the trawl and fixed gear fisheries.

The pre-recruit 1, recruit, and post-recruit size classes were combined to provide an estimate of abundance of mature males; the recruit and post-recruit classes were combined to provide an estimate of legal males (Table 4-6).

Table 4-6 Estimated Pribilof Islands male blue king crab stock abundances (millions of crab).

Year	Pre-recruit 2	Pre-recruit 1	Recruit	Post-Recruit	Legal	Mature
1975	4.47	6.09	4.07	4.86	8.93	15.02
1976	0.91	0.58	1.11	1.87	2.97	3.55
1977	1.90	1.28	3.35	8.42	11.77	13.04
1978	1.96	2.22	1.04	2.88	3.92	6.14
1979	0.25	1.28	1.46	2.54	4.00	5.28
1980	0.45	1.42	1.17	3.04	4.21	5.63
1981	0.65	0.63	0.52	2.74	3.26	3.90
1982	0.59	0.25	0.49	1.54	2.04	2.29
1983	0.49	0.50	0.34	0.98	1.32	1.82
1984	0.06	0.16	0.16	0.30	0.45	0.61
1985	0.02	0.16	0.12	0.15	0.27	0.43
1986	0.00	0.02	0.09	0.37	0.46	0.48
1987	0.02	0.07	0.07	0.76	0.83	0.90
1988	0.00	0.00	0.04	0.20	0.24	0.24
1989	0.29	0.00	0.00	0.24	0.24	0.24
1990	1.10	1.10	0.42	0.16	0.58	1.68
1991	0.52	0.74	0.61	0.63	1.24	1.98
1992	0.78	0.76	0.40	0.77	1.17	1.92
1993	0.47	0.76	0.37	0.71	1.08	1.84
1994	0.39	0.35	0.21	0.71	0.91	1.26
1995	0.43	0.88	0.43	1.80	2.23	3.11
1996	0.40	0.44	0.16	1.11	1.27	1.71
1997	0.13	0.27	0.33	0.60	0.93	1.20
1998	0.26	0.17	0.10	0.67	0.77	0.94
1999	0.12	0.16	0.07	0.36	0.42	0.59
2000	0.04	0.20	0.02	0.51	0.53	0.73
2001	0.06	0.08	0.00	0.45	0.45	0.52
2002	0.00	0.02	0.04	0.17	0.21	0.23
2003	0.00	0.02	0.00	0.21	0.21	0.23
2004	0.02	0.03	0.00	0.02	0.02	0.05
2005	0.00	0.00	0.00	0.09	0.09	0.09
2006	0.03	0.02	0.00	0.03	0.03	0.05
2007	0.06	0.05	0.00	0.05	0.05	0.10
2008	0.07	0.00	0.02	0.00	0.02	0.02
2009	0.15	0.18	0.03	0.03	0.07	0.25
2010	0.04	0.07	0.02	0.05	0.07	0.14
2011	0.00	0.04	0.05	0.07	0.13	0.17

Survey measurement errors were assumed to be log-normally distributed, and a nonlinear least-squares approach that minimizes the measurement errors was used to estimate model parameters. The following model parameters were estimated for male crabs: male mature biomass (MMB, Figure 4-15), recruits to the model each year (Figure 4-16), total abundance in the first year, natural mortality, trawl survey catchabilities for pre-recruits 1 and 2, and molting probabilities for pre-recruits 1 and 2. The CSA model used here was updated to include data for 1975 through 2009. Fits to observed survey biomass data track with the overall trend in biomass including a steep decline in the late 1970s, a short rebound in the 1990s, and a slow decline to current biomass levels (Figure 4-17). Large inter-annual fluctuations in observed survey biomass are not well fit by the model. In addition, the model overestimates estimated survey biomass in the 2000s. However, coefficients of variation of survey MMB for the most recent year is 71.3% and has ranged between 16.8 and 79.9% since the 1980 peak in biomass.

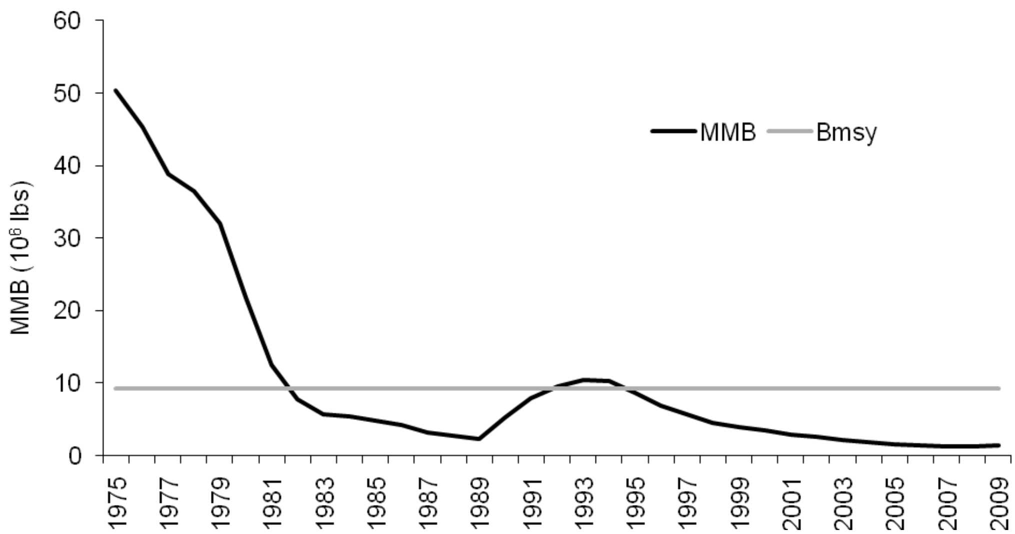


Figure 4-15 Estimated mature male biomass (MMB) time series relative to the current B_{MSY} based on mean mature male biomass from 1980–1984 and 1990–1997.

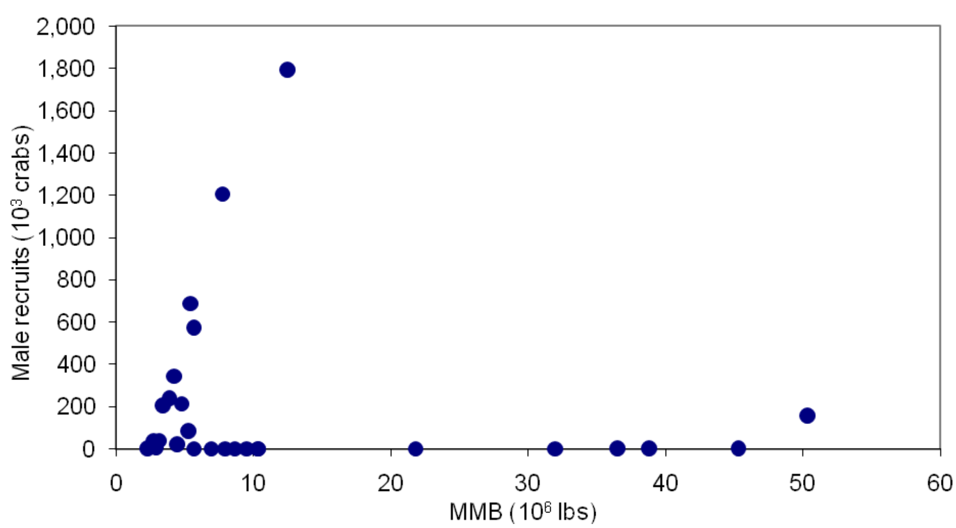


Figure 4-16 Model estimated male recruits relative to mature male biomass (MMB) from 1975 to 2009.

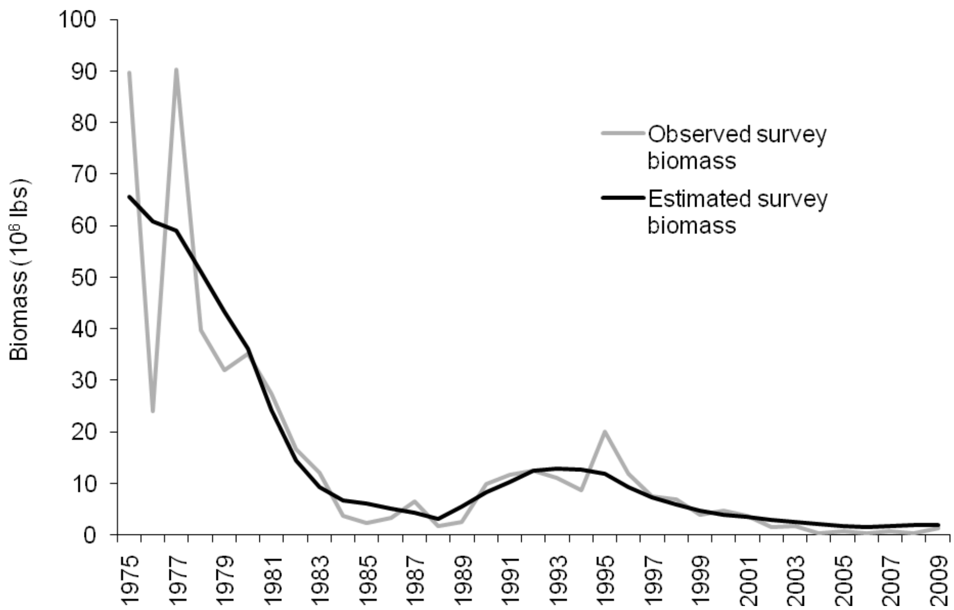


Figure 4-17 Time series comparison of estimated survey biomass from the Catch Survey Assessment model and observed survey biomass based on area swept estimate.

Data sources for the model include:

Data Component	Years
NMFS bottom trawl survey	1975–2009
ADF&G pot survey	2003, 2005, 2008
Retained catch	1975–2009
Trawl bycatch	1989–2007
Fixed gear bycatch	1996–2007

Survey biomass was included in the model for the entire time series of available data from the NMFS eastern Bering Sea trawl survey. Also, Alaska Department of Fish and Game pot survey data from 2003, 2005, and 2008 were included in the analysis. Spatially the stock is completely covered by the trawl survey and most of the post survey. A growth matrix (for four stages) of probabilities of molting to the next stage was developed based on literature values of size frequency and weight. Selectivity was set at 0.8 and 0.9 for recruit 2 and recruit 1 respectively to account for effect of small size on the directed pot fisheries. Molting probability was set to 0.94, 0.75, 1.0, and 1.0 for pre-recruit 1, pre-recruit 2, recruits, and post-recruits respectively. Handling mortality was set to 0.2, 0.5, and 0.8 for directed pot, other fixed gear, and trawl gear respectively.

Rebuilding scenarios were started in 2009 and were projected for 50 years where a buffer of 1.0 was applied, each scenario had 1,000 replicates, and it was assumed that no directed fishing would take place. The probability of being overfished was defined as the proportion of replicates where the MMB was below minimum stock size threshold (1/2 B_{MSY}). The probability of being rebuilt was defined as the proportion of replicates where MMB is equal to or above B_{MSY} for two years in a row. Table 4-7 lists summaries of the posterior distributions for the key parameters that determine the productivity of the population for the Beverton-holt and Ricker stock-recruitment relationships. The distributions for F_{MSY} and B_{MSY} are the same for the two stock-recruitment relationships, which is expected given the way the values for R_0 and steepness are set (larger steepness values indicate higher productivity).

Table 4-7 Posterior means and 90% intervals for key parameters of the Pribilof Islands blue king crab population dynamics model used for projection purposes.

Parameter	Distribution
Beverton-Holt stock-recruitment relationship	
Virgin MMB	27.0 (25.3, 28.6)
Steepness, h	0.250 (0.501, 0.538)
F_{MSY} ($F_{35\%}$)	0.18
B_{MSY} ($B_{35\%}$)	9.0 (8.5, 9.4)
σ_R	10.1 (7.7, 12.5)*
Ricker stock-recruitment relationship	
Virgin MMB	21.2 (20.1, 22.4)
Steepness, h	0.543 (0.519, 0.564)
F_{MSY} ($F_{35\%}$)	0.18
B_{MSY} ($B_{35\%}$)	9.0 (8.5, 9.4)
σ_R	10.1 (7.6, 12.5)*

* σ_R was set to 1.5 for the projections

Rebuilding Projections

The rebuilding projections were for multiple recruitment scenarios:

1. Random recruitment selected from recruitments estimated between 1984 and 2009, inclusive;
2. The Beverton-Holt stock-recruitment relationship was applied; and
3. The Ricker stock-recruitment relationship was applied.

For the purposes of this PIBKC rebuilding plan analysis, three recruitment scenarios were compared for status quo groundfish bycatch. The highest observed bycatch was used as a starting point for estimating the impact of levels of bycatch reduction on rebuilding the PIBKC stock. While none of the models were sensitive to bycatch reduction scenarios, estimated MMB was similar with the Ricker and Beverton-Holt stock recruit models increasing from 1.5 million lbs to 9.4 and 9.9 million lbs, respectively, over the 50 year projection (Figure 4-18), reaching the B_{MSY} of 9.28 million lb between 2055 and 2058. These projections were highly imprecise as shown by the large confidence intervals shown in Figure 5-15. The MMB using the random recruitment model had lower error in the projected time series but was substantially lower than the other models ranging from 1.5 to 3.3 million lbs. Only the results of the projections using the Ricker stock-recruit relationship are presented for the remaining results.

To assess the impacts of alternatives on rebuilding the PIBKC stock, four scenarios were considered where groundfish bycatch was reduced by a specified amount that brackets the reduction in bycatch corresponding to the closure configurations in the analysis:

1. No reduction of PIBKC bycatch in the groundfish fisheries (Alternative 1);
2. 50% reduction in all PIBKC bycatch in the groundfish fisheries;
3. 80% reduction in all PIBKC bycatch in the groundfish fisheries; and
4. 100% reduction in all PIBKC bycatch in the groundfish fisheries

The probability of being overfished decreased very little across scenarios from 1 to 0.08, 0.07, 0.07, and 0.06 for the status quo, 80% reduction, 50% reduction, and 100% reduction alternatives, respectively (Figure 4-19). A similar decrease was observed for the pot cod only bycatch reduction (Option b under each alternative) (Figure 4-20). For both the options of all groundfish (Option a) and pot cod only closures (Option b), the MMB relative to B_{MSY} increased similarly for each scenario from 0.16 to 1.02 over the 50 year projection (Figure 4-21 and Figure 4-22). For Option a (application of closures to all groundfish fisheries), the retained catch increased from 0 to 0.86, 0.87, 0.87, and 0.87 for the status quo, 80% reduction, 50% reduction, and 100% reduction alternatives, respectively (Figure 4-23). The estimated recruitmentg under Option a also increased between 0.1 and 1 million crabs over the projected time series (Figure 4-24). The model results show that all of the alternatives would have similar impacts on PIBKC stock abundance in the long term.

Although the projection model currently represents the best available science for estimating rebuilding, there is clearly a high level of imprecision in the model projections due to assumptions of recruitment, biomass estimation, and model formulation. As a result, the degree to which a reduction in bycatch would substantially alter rebuilding projections is unknown. It is possible that this stock may have declined below a critical threshold for rebuilding. The causes of decline are thought to be predominantly due to environmental changes that inhibit blue king crab reproduction. While it is possible that within 50 years the PIBCK stock may be rebuilt, rebuilding this stock likely requires multiple years of above average recruitment and/or a change in environmental conditions to increase larval production around the Pribilof Islands. Measures to restrict any additional bycatch of this stock and prevent overfishing may further protect this stock and allow it the opportunity to rebuild. From a qualitative perspective, management measures that reduce bycatch mortality are precautionary and may improve the stocks ability to rebuild by improving crab survival.

Figure 4-18 Estimates of mature male biomass (MMB, thick lines) and associated 95 percent confidence intervals (thin lines) for the status quo reduction in groundfish bycatch of Pribilof Islands blue king crab. Estimates are based on a projection model using a random recruitment function (dashed line), Ricker recruitment function (black solid line), or Beverton-Holt (BH) recruitment function (grey solid line).

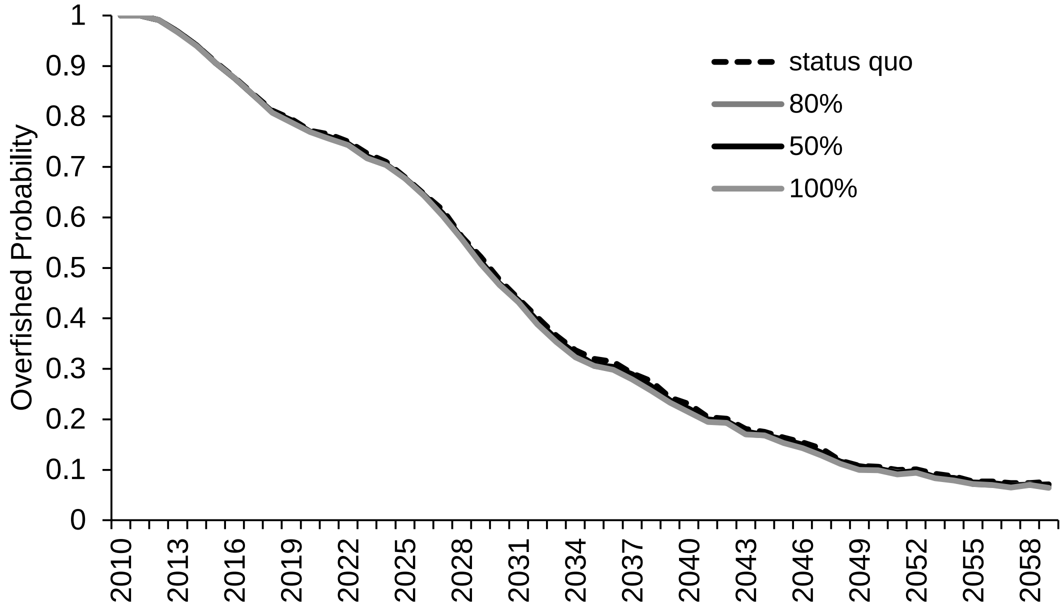


Figure 4-19 Estimates of the probability of overfishing for each groundfish bycatch scenario under Option a and using a projection model with a a Ricker recruitment function. .

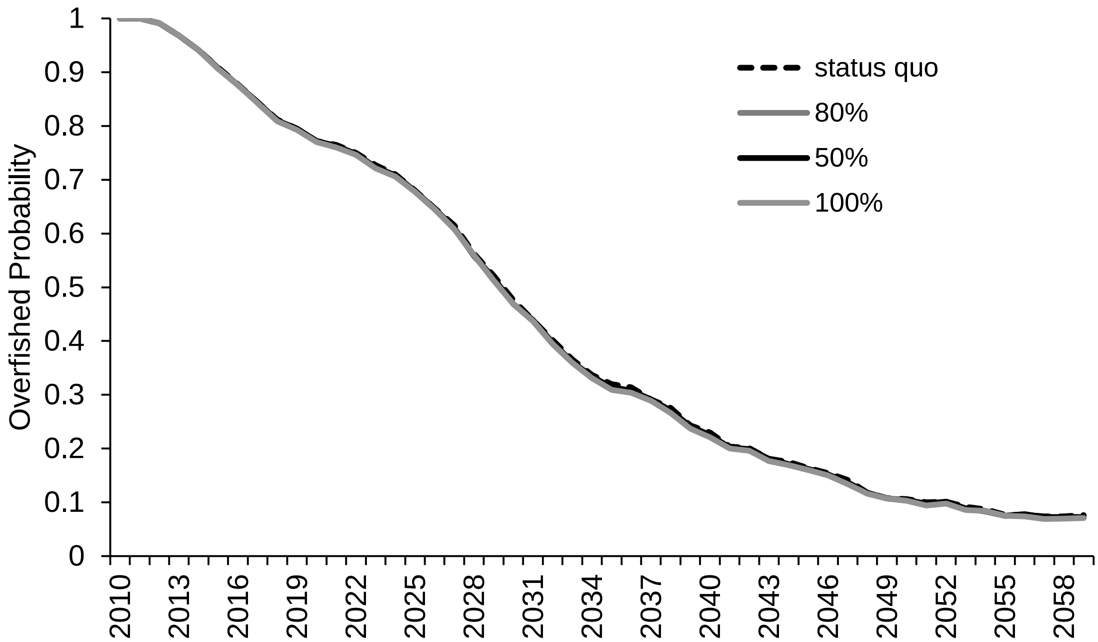


Figure 4-20 Estimates of the probability of overfishing for each groundfish reduction scenario under Option b using a projection model with a a Ricker recruitment function.

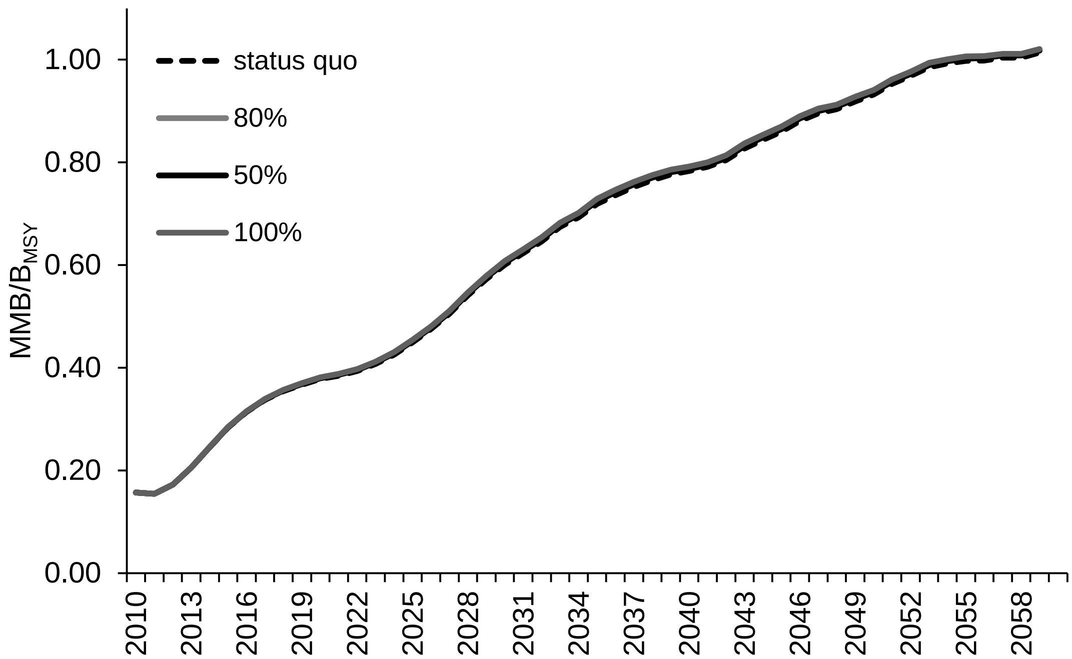


Figure 4-21 Estimates of MMB relative to B_{MSY} for each groundfish bycatch scenario under Option a and using a projection model with a Ricker recruitment function.

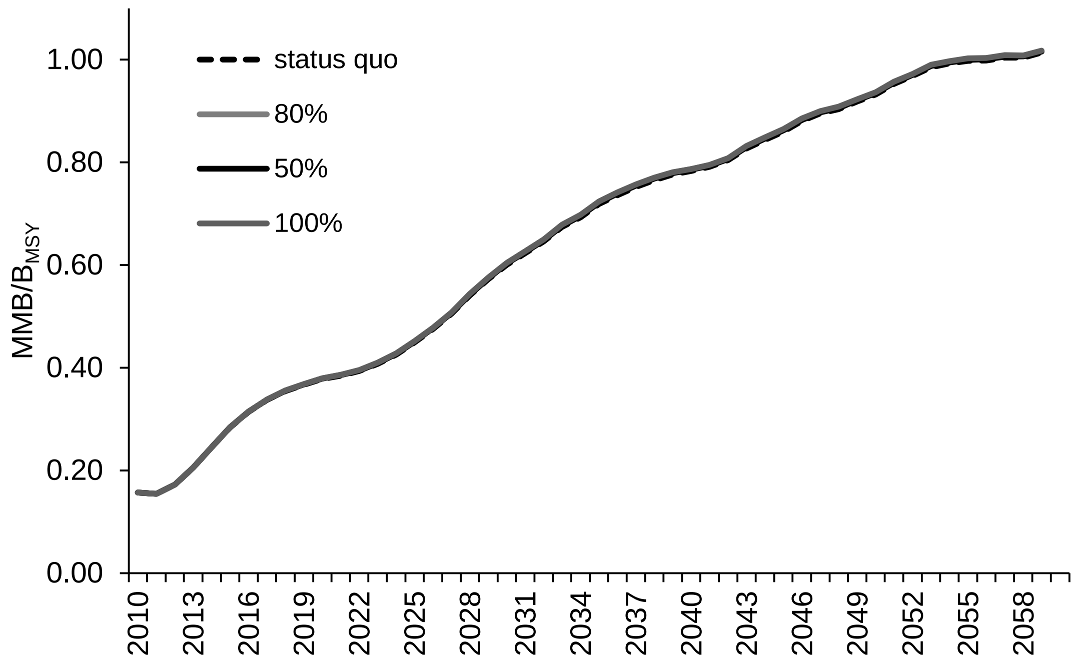


Figure 4-22 Estimates of the ratio of mature male biomass (MMB) and B_{MSY} for each groundfish bycatch scenario under Option b and using a projection model with a Ricker recruitment function.

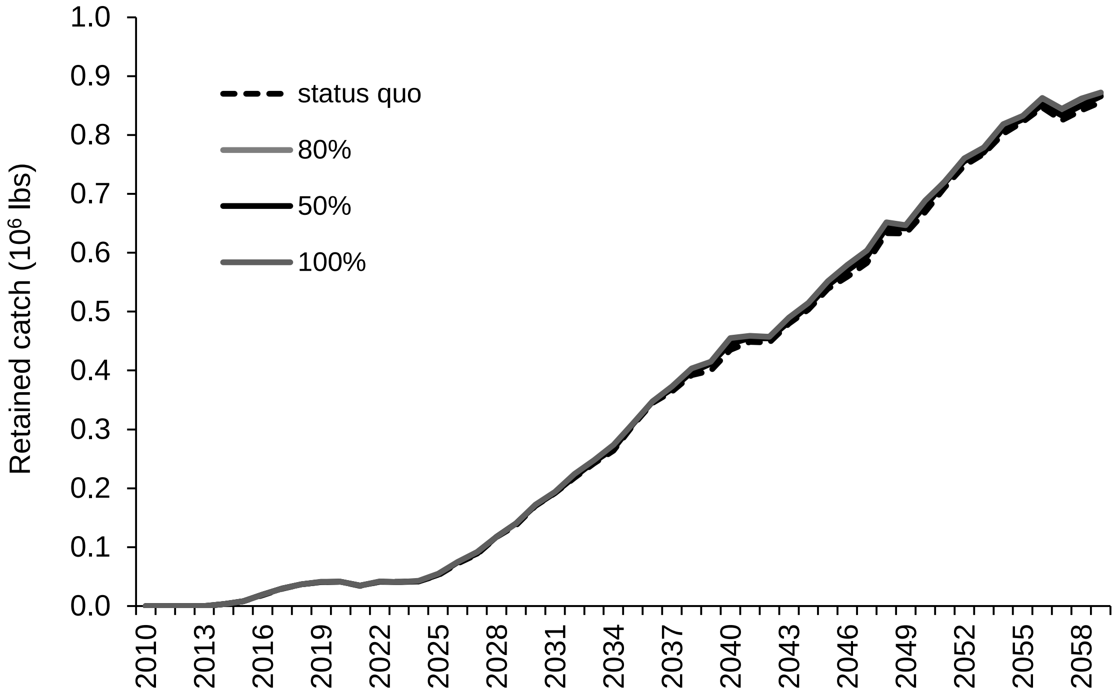


Figure 4-23 Estimates of the number of legal male PIBK retained in the directed crab fishery using a projection model based on a Ricker recruitment function for each groundfish bycatch scenario under Option a.

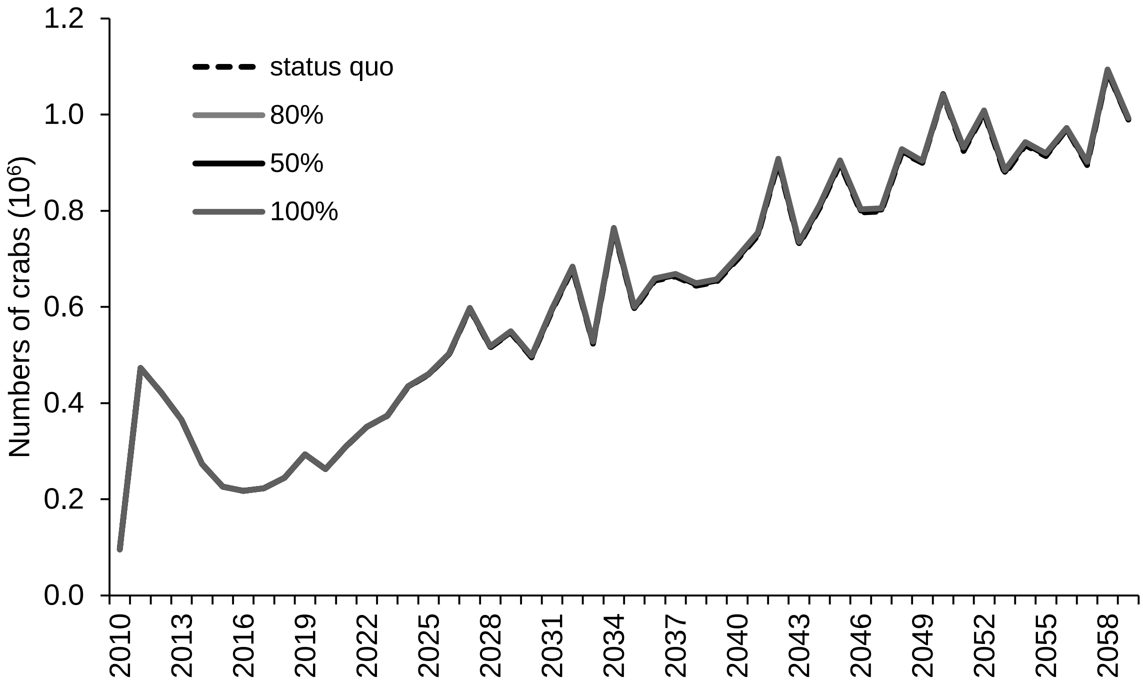


Figure 4-24 **Projected estimate of the number of crabs based on a Ricker recruitment model for each groundfish bycatch scenario under Option a.**

4.5.3 Preventing overfishing and exceeding the ACL

If the stock is overfished and experiencing overfishing, then the plan must include provisions to immediately end overfishing. At this time, the PIBKC stock is not experiencing overfishing, and therefore, the rebuilding plan is not require to have mechanisms to immediately end overfishing. Absent a specific provision in the proposed action, if overfishing occurred, NMFS would immediately inform the Council and action would need to be taken to immediately end overfishing.

The National Standard 1 Guidelines require accountability measures in fisheries management to prevent exceeding ACLs and prevent overfishing (74 FR 3178, January 16, 2009). Accountability measures may be applied within the fishery season or applied at the end of the fishery year, depending on the availability of information for making management decisions and the nature of the management for a particular fishery. Total catch of PIBKC (including research and discards in groundfish and other fisheries) is applied to determine whether catch is below the ACL and OFL. If catch is above the OFL, then overfishing is occurring. If the ACL is exceeded more than once in four years, under National Standard 1 guidelines, the accountability measures should be re-evaluated by the Council.

Alternative 1 does contain the accountability measure currently implemented for the PIBKC; the closure of this fishery to directed fishing, measure to minimize blue king crab bycatch in other crab fisheries, and the closure of the PIHCZ to trawl gear. However, as discussed in Section 2.1, there is no mechanism to prevent overfishing due to bycatch in the groundfish fisheries, except NMFS does have authority to make an inseason adjustment under 50 CFR 679.25(a)(2)(ii)(C) to close areas to directed fishing for specified groundfish species if the closures are necessary to prevent excessive prohibited species bycatch. The OFL corresponds to the five-year average of bycatch in groundfish and crab fisheries from 1999/2000 to

2005/2006. There were years when catch was higher than or near the OFL, so presumably catch could exceed the OFL again in the future without any additional action to control bycatch. The historical average bycatch estimates contained a certain amount of annual variation as a result of changes in annual fishing patterns, at-sea sampling, and catch accounting rate extrapolation.

Alternatives 2 through 6 contain additional accountability measures to directly address the bycatch of PIBKC in the groundfish fisheries (see section 5.5.4). The area closure alternatives prevent overfishing by closing the areas where blue king crab bycatch occurs, but bycatch could still occur outside of the closure area. Under Alternative 2b, the PA, the accountability measures for the PIBKC ACL would implement a year-round closure to Pacific cod pot fishing in the PIHCZ. As shown in the subsequent analysis, the PA would eliminate the vast majority of PIBKC bycatch in the area of known blue king crab habitat. The other areas closure alternatives would close areas where marginally more bycatch occurs and would further restrict fisheries with marginally more bycatch. However, all of the year-round area closure alternatives are expected to greatly reduce the risk of exceeding the OFL.

Under Alternatives 5 and 6a larger area closure would be subject to a trigger closure when the PSC limit is reached. These accountability measures could be implemented in the yellowfin sole, Pacific cod pot, and Pacific cod hook-and-line fisheries. A PSC limit with a trigger closure is a way to allow fishing in a given area while monitoring catch and closing the fishery to prevent exceeding the PSC limit. The trigger closures are intended to control catch to below the PSC limit. However, the PSC limits under the trigger closure alternatives are very small, which pose problems in managing to the PSC limit and in preventing overfishing. The trigger closure alternatives do reduce the risk of overfishing relative to status quo, but, given the small cap numbers, the risk still exists. The risk still exists because the OFL is very low and even an apparently large buffer of 75% of the ABC would equate to an actual buffer of approximately 486 crabs (1,300 lb). In addition, given the small sector caps for the trigger closures and natural delay between when catch is actually observed and inseason is able to manage with the estimate, there is about a 1 week time lag that inseason must contend with when forecasting area closures. Therefore, the PSC limit could be reached quickly and without much warning, so there may not be enough time for inseason to respond by closing the fishery. And, during this time lag, there is the potential that catch could not only exceed the PSC limit but exceed the ACL and even the OFL. Additionally, the ACL or OFL could be exceeded after NMFS closes the trigger area by PIBKC PSC outside of the closure area. None of the trigger closure alternatives address these risks of exceeding the OFL.

With the implementation of the restructured North Pacific Observer Program (Observer Program), additional observer data will provide a better foundation to ascertain more specifically where and how much PIBKC bycatch is occurring in specific groundfish fishing and the halibut fishery, allowing for more precise identification of fisheries that should be managed to prevent potential exceedences of the PIBKC ACL and to identify any additional management measures for these fisheries. If the ACL for PIBKC is exceeded more than once in 4 years, NMFS would work with the Council to evaluate the accountability measures and any new information from the restructured Observer Program to determine any changes that may be necessary to prevent future exceedences of the PIBKC ACL and prevent overfishing.

4.5.4 Bycatch of PIBKC in groundfish fisheries

The relative bycatch of PIBKC is compared across alternatives, using the best estimates of status quo bycatch for comparison. Under status quo there are many issues with tabulating the bycatch of the PIBKC stock by year as noted in Chapter 3 and the previous sections of this chapter. Total removals by year from 1991–2010 for both directed crab fisheries as well as groundfish fisheries (by aggregate gear type) are shown Table 4-3. Bycatch of PIBKC is currently constrained by the trawl closure around the

PIHCZ and the directed fishery closures of the PIBKC and PIRKC stocks. There are no additional restrictions on other groundfish fisheries.

From the 2003/2004 through the 2010/2011 crab fishing seasons between 300 lbs (136 kg) and 4,600 lbs (2087 kg) of PIBKC were caught incidentally during crab and groundfish fisheries in Federal reporting area 513. Annually, yellowfin sole comprised between 3 and 77%, Pacific cod between 20 and 100%, flathead sole between 1 and 31% of the bycatch, and rock sole 26% of the bycatch in the 2006/07 crab fishing season (Table 4-8). Hook-and-line fisheries accounted for between 1 and 99%, non-pelagic trawls between 1 and 79%, and pot gear between 18 and 95% of the total bycatch (Table 4-9). Since the 2010/2011 crab fishing season (through 2012/13) there have been no catches of blue king crab in the pot fishery in area 513. Anectodal reports indicate that pot fishers have avoided fishing in the area to avoid blue king crab. Catch of blue king crab in the hook-and-line and trawl fisheries has remained below levels that occurred in the 2006/07 crab fishing year.

Table 4-8 Proportion of the Pribilof Islands blue king crab bycatch (Area 513 only) among target species between 2003/2004 and 2010/2011 crab fishing seasons. Total mortality is the total bycatch multiplied by the handling mortality (50% fixed gear, 80% trawl gear).

Crab fishing season	Yellowfin sole %	Pacific cod %	Flathead sole %	Rock sole %	Total Mortality million lbs	TOTAL[1] (# crabs)
2003/04	47	22	31		0.0008	252
2004/05		100			0.0009	259
2005/06		97	3		0.0028	757
2006/07	54	20		26	0.0003	96
2007/08	3	96	1		0.0046	2,950
2008/09	77	23			0.0010	295
2009/10	51	39	10		0.0013	487
2010/11		86	14		0.0002	256

[1] Total number of crab calculated using the average weight over all gears in a given Crab Fishing Year from the Observer database (NMFS RO).

Table 4-9 Proportion of the Pribilof Islands blue king crab bycatch (Area 513 only) among gear types in the 2003/2004 through 2010/2011 crab fishing seasons. Total mortality is the total bycatch multiplied by the handling mortality (50% fixed gear, 80% trawl gear).

Crab fishing season	hook-and-line %	non-pelagic trawl %	pot %	Total Mortality million lbs	TOTAL[1] (# crabs)
2003/04	21	79		0.0008	252
2004/05	99	1		0.0009	259
2005/06	18	3	79	0.0028	757
2006/07	20	20		0.0003	96
2007/08	1	3	95	0.0046	2,950
2008/09	23	77		0.0010	295
2009/10	21	61	18	0.0013	487
2010/11	4	14	83	0.0002	256

[1] Total number of crab calculated using the average weight over all gears in a given Crab Fishing Year from the Observer database (NMFS RO).

Pribilof Islands blue king crab bycatch mortality by gear type and target species are absolute values based on the CAS as of August 2011 (Table 4-10 and Table 4-11). The total columns are based on a revised database that accounts for a previous discrepancy in how unmeasured crab were apportioned. Unfortunately due to the complexity of this issue, only total values of crab mortality are available in years prior to 2009. To apportion bycatch mortality to target species and gear type in those year, the relative proportion of bycatch based on the pre-August 2009 database was applied to the total. It is noted that this method assumes that the unmeasured crab errors were equally distributed across gear type and target species. (Mortality rates assume 50% mortality in fixed gear and 80% mortality in trawl gear).

Table 4-10 Bycatch mortality by fishery 2003/2004–2009/2010.

Crab fishing season	yellowfin sole	pacific cod	flathead sole	Rock sole	TOTAL (mill lbs)	TOTAL[1] (# crabs)
2003/04	0.0004	0.0002	0.0002		0.0008	252
2004/05		0.0009			0.0009	259
2005/06		0.0027	0.00008		0.0028	757
2006/07	0.0002	0.0001	0.0000	0.0001	0.0003	96
2007/08	0.0001	0.0044	0.00005		0.0046	2,950
2008/09	0.0008	0.0002	0.0000		0.0010	295
2009/10	0.0007	0.0005	0.0001		0.0013	487

[1] Total number of crab calculated using the average weight over all gears in a given Crab Fishing Year from the Observer database (NMFS RO).

Table 4-11 Bycatch mortality by gear type 2003/2004–2009/2010.

Crab fishing season	hook-and-line	non-pelagic trawl	pot	TOTAL (mill lbs)	TOTAL[1] (# crabs)
2003/04	0.0002	0.0006		0.0008	252
2004/05	0.0009			0.0009	259
2005/06	0.0005	0.0001	0.0022	0.0028	757
2006/07	0.0001	0.0001		0.0003	96
2007/08	0.00005	0.0001	0.0044	0.0046	2,950
2008/09	0.0002	0.0008		0.0010	295
2009/10	0.0003	0.0008	0.0002	0.0013	487

[1] Total number of crab calculated using the average weight over all gears in a given Crab Fishing Year from the Observer database (NMFS RO).

Currently bycatch within Federal Reporting Area 513 is counted as bycatch of PIBKC stock. Until a more defined area is specified for bycatch accrual, this is the area that is used to define the spatial extent of this stock. This will be modified in the stock assessment in the future as a more spatially-explicit area can be defined to refine bycatch estimates for accruing towards the OFL (note that Area 513 does not cover the entire distribution of this stock). Not all groundfish fisheries, however, contribute towards any bycatch of PIBKC.

Distributions of observed PIBKC bycatch by gear type are shown in each of the proposed closure areas for three periods: 2003–2007 to correspond to available data on groundfish fishery impacts, 1995–2007 to correspond to the adoption of Amendment 17 and the creation of the PIHCZ, and 1987–1994 corresponding to pre-PIHCZ. Total observed bycatch ranged from 21 to 57 crabs per year, were mostly females, and included crab with average lengths between 125.5 and 182.1 mm CL (Foy 2010).

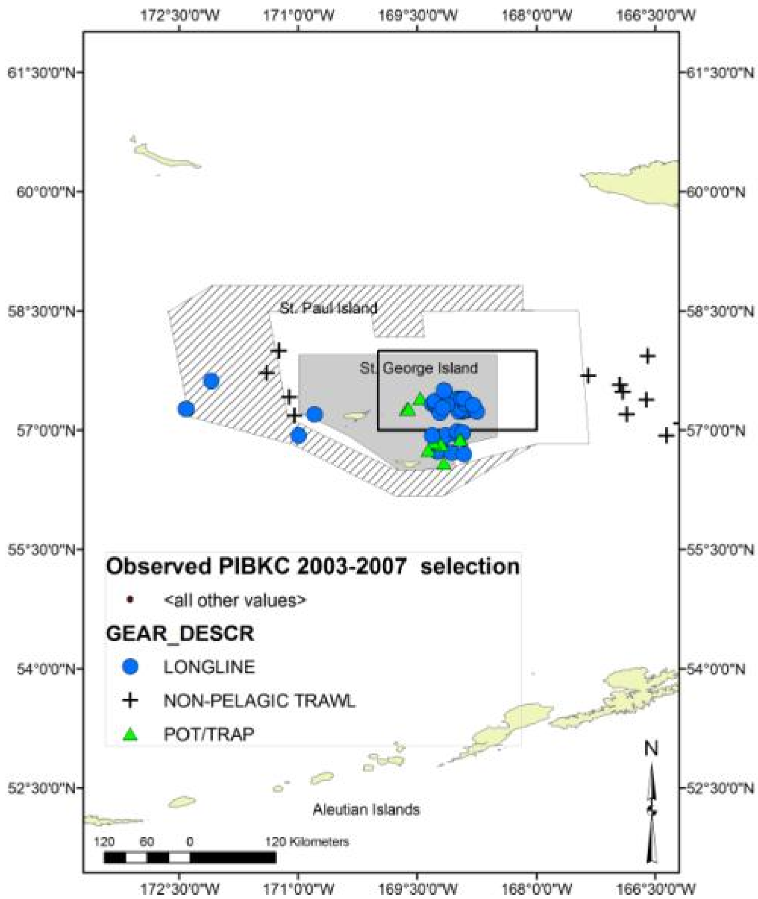


Figure 4-25 Distribution of 2003–2007 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.

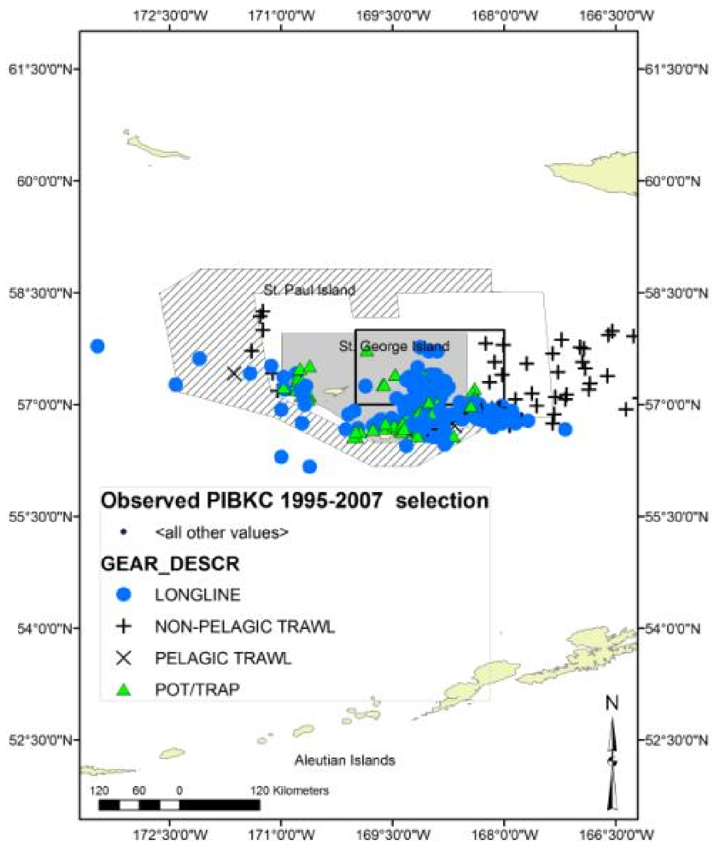


Figure 4-26 Distribution of 1995–2007 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.

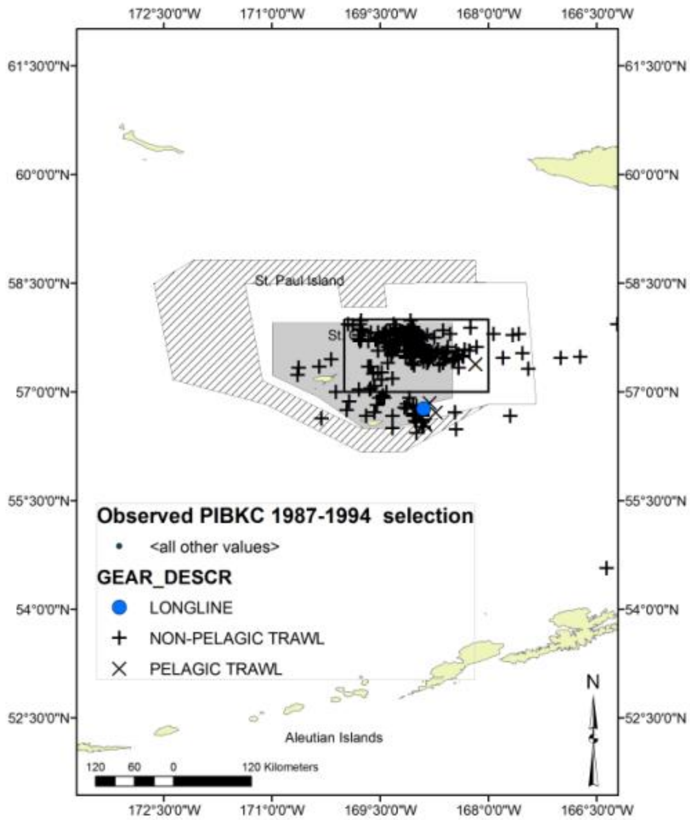


Figure 4-27 Distribution of 1987–1994 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.

4.5.5 Area closure impacts: Alternatives 1 through 4

As noted in Chapter 3, the current PSC estimation method does not provide PSC estimates at small-scale spatial resolution and thus does not enable comparison across the proposed closure areas. The Catch-in Areas (CIA) database does provide a method to apportion catch at smaller spatial scales, however, the underlying PSC estimates are still derived from the Catch Accounting System (CAS) and in some years the lack of observer data from fishing effort near the Pribilof Islands meant that PIBKC estimates in CAS (and therefore also in the CIA) were derived from observer data from the St. Matthew Island region. To avoid the confounding effect of PSC rates that contain PSC data from other areas, impacts analysis for PIBKC bycatch does not employ CAS nor CIA estimates. Instead, a comparison of the observed bycatch rates by gear type and closure in 20 km grids from 2005 to 2011 are shown (Figure 4-28). The breakdown of the scale of bycatch rates (numbers per ton of groundfish) is equivalent across all gear types in order to facilitate cross-comparison.

Pot gear has the highest observed rates across all gear types in these alternative closures (Figure 4-28). Within the closures, the highest rates observed for pot gear is located to the northeast of St. Paul Island while the next highest rates are observed to the east of St. Paul Island. Nearly all of the observed bycatch is within the PIHCZ, with only one 20 km grid block falling slightly outside of this closure. Thus a closure of the PIHCZ to pot gear (as under Alternative 2b, the PA) would close the area to the highest observed bycatch from 2005 to 2011.

For hook-and-line gear the highest observed rates over this time period are to the northeast of St. Paul Island as well as just north of St. George Island (Figure 4-28). Most of the observed bycatch for hook-and-line gear falls within the PIHCZ, while some of the lower observed rates fall in areas to the east of St. George outside of the PIHCZ as well as to the west and north of the Pribilof Islands.

For non-pelagic trawl gear, highest rates are observed to the east of the PIHCZ boundary (note that trawling is prohibited inside the PIHCZ). Observed bycatch for non-pelagic trawl gear is also to the west and north. There are no observations of pelagic trawl bycatch within any of the alternative closures (Figure 4-28).

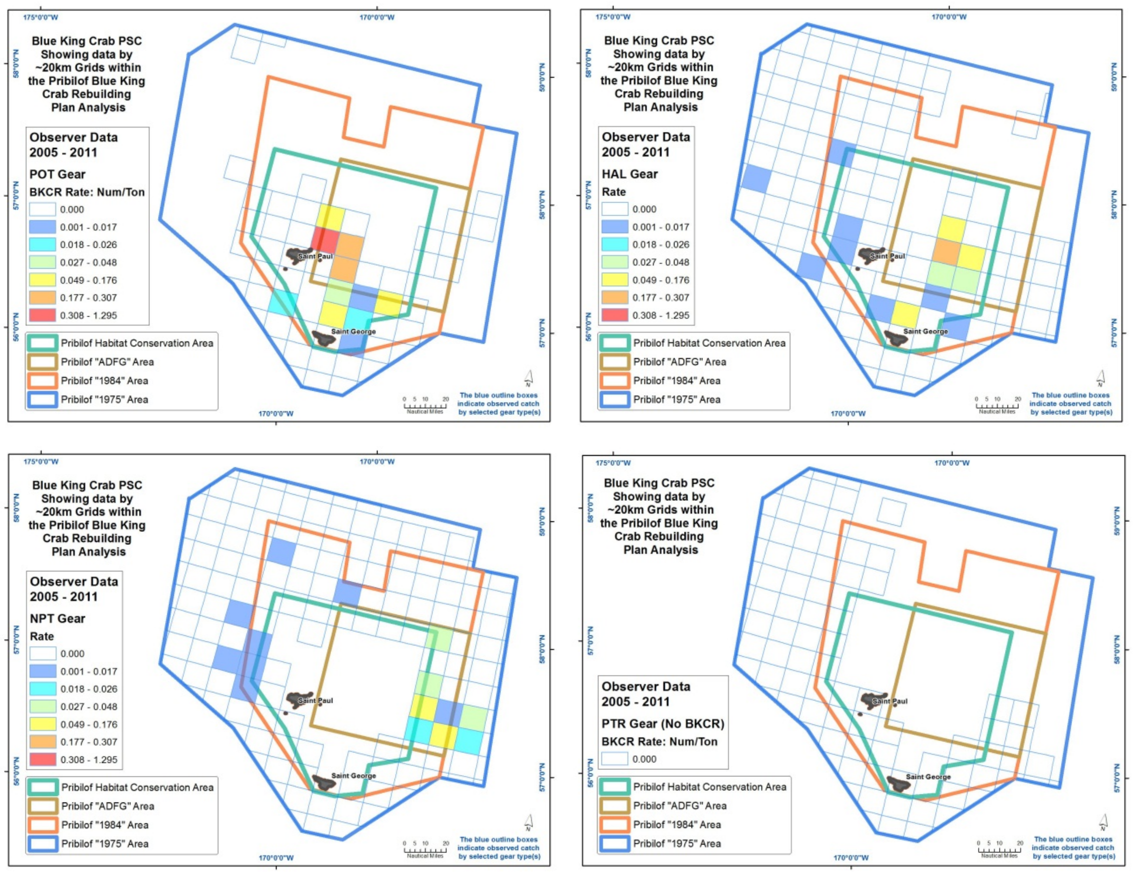


Figure 4-28 Distribution of PIBKC rates (# of crab per ton of groundfish) in observed sets between 2005 and 2011 relative to the four proposed closures areas. Each map shows the ADF&G state statistical areas where there were observer sets by gear type, where POT = pot gear; HAL = hook-and-line; NPT = non-pelagic trawl gear; and PTR= pelagic trawl gear.

4.5.5.1 Impact of closing PIHCZ to fishing for Pacific cod with hook-and-line or pot gear year-round (Alternative 2)

As described in Chapter 2, under Alternative 2 the PIHCZ would be closed year round to Pacific cod fisheries using pot gear or pot and hook-and-line gear. Two trawl fisheries (listed in Table 2-1) meet the threshold criteria, however under the status quo, the PIHCZ is already closed to trawl fisheries. The non-trawl fisheries that meet that threshold criteria are the Pacific cod fishery with hook-and-line gear

(Alternative 2a) and the Pacific cod fishery with pot gear (Alternative 2b). The Council identified Alternative 2b as their PA.

The impacts of these two alternatives are estimated using observer data to account for the very limited observations in the Pacific cod fishery combined with the groundfish catch projection method to estimate PIBKC "saved" by the closure in comparison with what would have been caught without the PIHCZ closure in place. Observer data were queried from both inside the PIHCZ and a defined study area outside the PIHCZ referred to as the groundfish catch projection area. Detailed information on the groundfish catch projection method is found in Chapter 4. In summary, the method reapportions groundfish catch from the closed area to the open area to estimate where the fishing effort might have occurred if the PIHCZ had been closed. This is done by using historical groundfish fishing patterns in the area outside of the PIHCZ to move catch from the closed area to the open area. The groundfish catch projection area was defined as the maximum distance a vessel will travel in a day if the trip originated from the PIHCZ boundary, which was a maximum of approximately 50 nm. Spatial precision of the catch projection area boundary is limited to the underlying 7 km^2 grid used by the CIA to apportion groundfish catch information.

All the sampled sets inside the PIHCZ from vessels using pot or hook-and-line gear and targeting Pacific cod between 2005 and 2011 were queried from NMFS observer data. The retrieval locations of sets, recorded in the observer data, were geo-referenced to the underlying ADF&G state statistical areas. A lack of observer data prevented calculation of a year-specific average rate and therefore a mean bycatch rate was calculated across years to increase sample size and spatial coverage.

Data from the aggregated time series were used to calculate separate average PIBKC catch rates for the PIHCZ closed area versus the catch projection area:

$$\hat{\hat{C}}_{2005-2011} = \frac{\sum_{v=2005}^{2011} \sum_{i=1}^{I} \hat{c}_{vi}}{\sum_{v=2005}^{2011} \sum_{i=1}^{I} \hat{g}_{vi}}$$

Thus, a simple average catch rate (per kg of groundfish) of PIBKC is the summation of the number of crab ($\hat{c}$) for haul *i* in year *v* divided by the sum of the groundfish ($\hat{g}$) for haul *i* in year *v*. The mean crab rate is "self-weighted" to years and areas with more sets due to variations in sample sizes.

The annual estimate of PIBKC bycatch was calculated of by using the average crab rate. For each year (*v*), the estimated PIBKC catch (TC) is the product of the average crab bycatch rate and the estimated groundfish catch, specific to either the PIHCZ or the catch projection area.

$$TC_v = \hat{\hat{C}}_{2005-2011} \bullet \sum_{k=1}^{K} \hat{G}_{k_v}$$

The highest PIBKC rates with pot gear, averaged across hauls for each state statistical area, occurred in the PIHCZ. These rates ranged from 0 to a high of 14 crabs per ton of groundfish, with the highest crab rates occurring in the middle to southern part of the PIHCZ (Figure 4-29). The sample size in the PIHCZ was 378 observed sets (48,045 pot lifts), accounting for approximately 3,664 mt of groundfish (Table 4-12). The average bycatch rate observed for the entire closure area was 0.052 crab per metric ton. The amount of observer data was variable each year, ranging from a high of 90 sets in 2005 to 0 observed sets in 2010 (Table 4-12). The estimated number of crab per observed haul was highly variable, ranging from

112 crabs in 2005 to 0 crabs in 2006, 2008, and 2011. Note those years all had observed sets with no observed crabs.

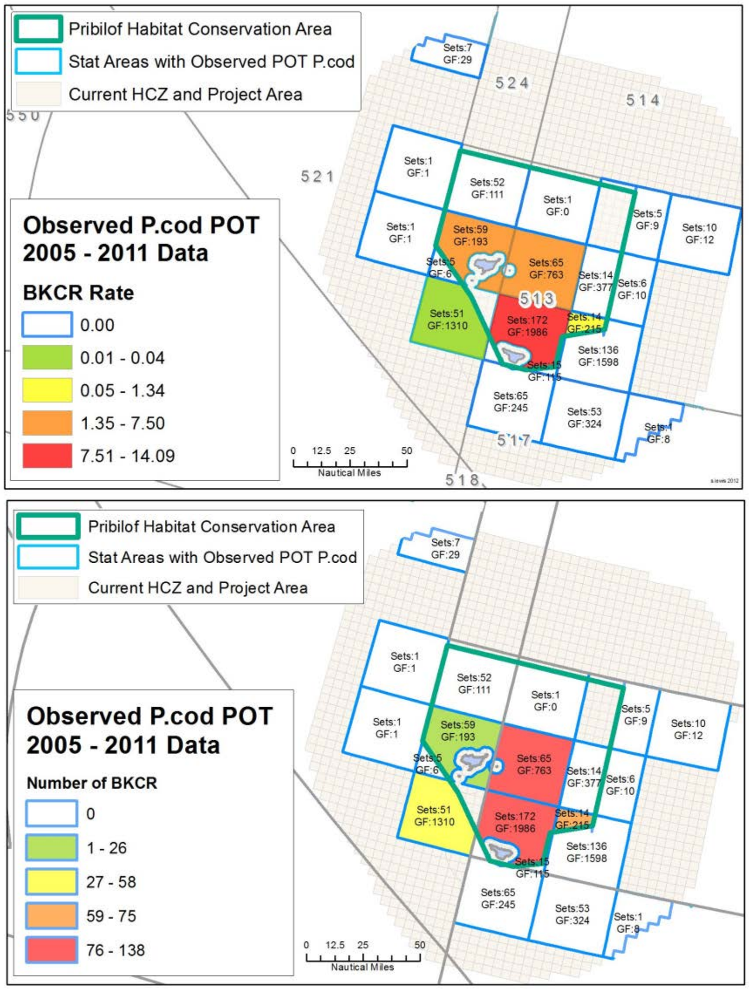


Figure 4-29 Summary of PIBKC caught on observed sets in the Pacific cod pot fishery between 2005 and 2011 (2011 includes data through 6/19/11). The colors indicate either numbers of crab (lower map) or rate (# of crab per ton of groundfish; upper map) for each ADF&G state statistical area inside and outside the PIHCZ that had observer data. In addition, the amount of observed groundfish and number of observed sets are shown by state statistical area.

Table 4-12 Summary of observer and CIA information in the Pacific cod pot fishery used to estimate the number of crabs caught inside PIHCZ.

Year	Observed Groundfish catch (mt)	Observed PIBKC (#)	Pots on observed sets (#)	Observed sets (#)	Estimated Groundfish catch from CIA (mt)	Estimated PIBKC (#)
2005	1,551	112	15,789	80	2,927	151
2006	803	0	8,479	41	1,784	92
2007	854	62	11,255	90	2,149	111
2008	338	0	8,216	84	1,264	65
2009	82	15	2,167	56	238	12
2010	--	--	--	--	125	7
2011*	36	0	2,139	27	17	1
Total	3,664	189	48,045	378	8,504	439

Average Crab Rate 0.052 crab per metric ton of groundfish
*2011 includes data through 6/19/11.

Observed bycatch rates of PIBKC for the open area were considerably lower than rates in the PIHCZ. Blue king crab was only observed in one state statistical area in the outside area, which had a rate of 0.04 crabs per ton of groundfish. Observer data in this area occurred near the closure area boundary, but cannot be displayed due to confidentiality restrictions. Sample sizes for the entire catch projection area were comparable to the PIHCZ, with 358 observed sets containing 3,664 mt of groundfish. Approximately 75% of these sets occurred in the state statistical area just outside the southeast corner of the conservation area, resulting in low sample sizes for other State statistical areas in the rest of the catch projection area (Figure 4-29).

The average bycatch rate for the open area was 0.0049 crab per metric ton of groundfish. The number of PIBKC caught across years was 0 except in 2008 when 18 crab were caught, indicating homogeneity in bycatch across years and thus low variability in the observed PIBKC bycatch rate (Table 4-13). However, the number of observed sets was not homogenous, which increases the chance of incorrect inferences in areas with less observer coverage (mainly areas boarding the northeast and northwest sides of the PIHCZ).

Table 4-13 Summary of observer and CIA information in the Pacific cod pot fishery used to estimate the number of crabs caught outside the PIHCZ when fishing effort is displaced outside of the closure.

Year	Observed groundfish catch (mt)	Observed PIBKC (#)	Pots on observed sets (#)	Observed sets (#)	Estimated Groundfish catch from (mt)	Estimated PIBKC (#)
2005	194	0	1,869	10	2,609	13
2006	671	0	6,457	34	790	4
2007	419	0	5,250	32	2,149	11
2008	1,173	18	16,515	105	1,264	6
2009	570	0	8,350	93	141	0.7
2010	244	0	3,246	21	114	0.6
2011*	427	0	6,105	63	17	0.08
Total	3,699	18	47,792	358	7,083	35

Average Crab Rate 0.0049 crab per metric ton of groundfish
*2011 includes data through 6/19/11.

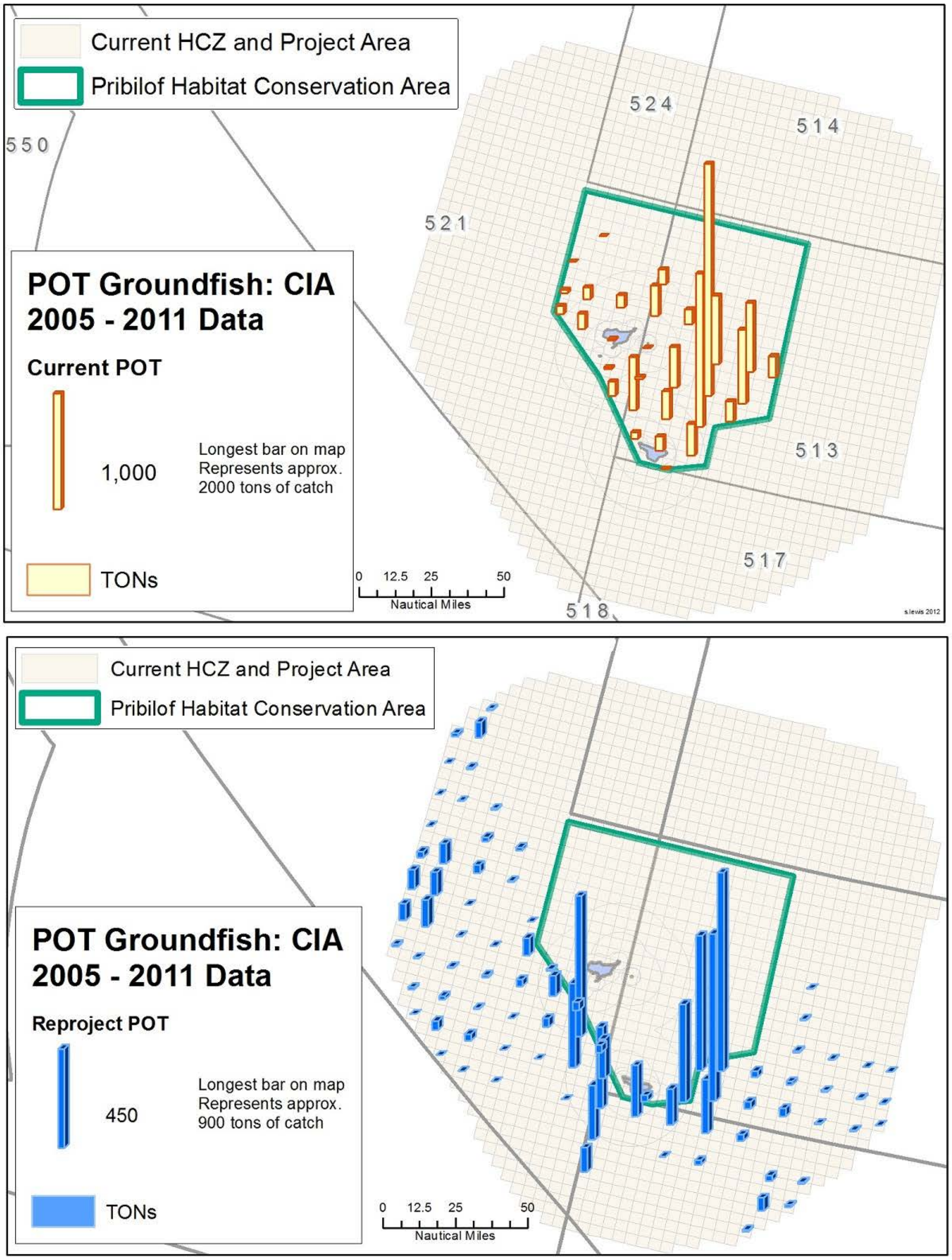


Figure 4-30 **Comparison of historical catch inside the PIHCZ (top map) with the spatial distribution of re-projected groundfish catch if the PIHCZ was closed to fishing with pot gear for the years 2005 through 2011 (2011 includes data through 6/19/11). The bars indicate the amount of groundfish caught per 20 km^2 unit and the green line indicates the boundary of the PIHCZ.**

The highest PIBKC rates in the hook-and-line Pacific cod fishery occurred in the PIHCZ and the rates range from 0 to 0.41 crabs per metric ton of groundfish (Figure 5-30). The average rate inside the PIHCZ was 0.0176 from 2005-2011 (Table 5-12). The average bycatch rate for the open area was 0.00015 crabs per metric ton of groundfish and substantially lower rate results in higher estimated PIBKC in the closure area (Table 5-13) .

Table 4-14 Summary of the observer and CIA information in the Pacific cod hook-and-line fishery used to estimate the number of crabs caught inside the PIHCZ.

Year	Observed Groundfish Catch (mt)	Observed PIBKC (#)	Estimated Groundfish Catch from CIA (mt)	Estimated PIBKC (#)
2005	4,301	87	5,950	105
2006	2,106	109	3,998	70
2007	1,630	41	2,444	43
2008	972	12	1,479	26
2009	860	0	1,171	21
2010	2,410	0	3,189	56
2011*	2,507	11	1,476	26
Total	14,786	260	19,706	347

Average Crab Rate 0.0176 crab per metric ton of groundfish used for each year.
*2011 includes data through 6/19/11.

Table 4-15 Summary of the observer and CIA information in the Pacific cod hook-and-line fishery used to estimate the number of crabs caught outside the PIHCZ when fishing effort is displaced outside of the closure.

Year	Observed Groundfish Catch (mt)	Observed PIBKC (#)	Estimated Groundfish Catch from CIA (mt)	Estimated PIBKC (#)
2005	18,276	6	5,950	1
2006	19,388	6	3,998	1
2007	12,609	0	2,444	<1
2008	10,212	0	1,479	<1
2009	11,389	0	1,171	<1
2010	14,922	0	3,189	<1
2011*	15,068	4	1,476	<1
Total	105,729	16	19,706	3

Average Crab Rate 0.00015 crab per metric ton of groundfish used for each year.
*2011 includes data through 6/19/11.

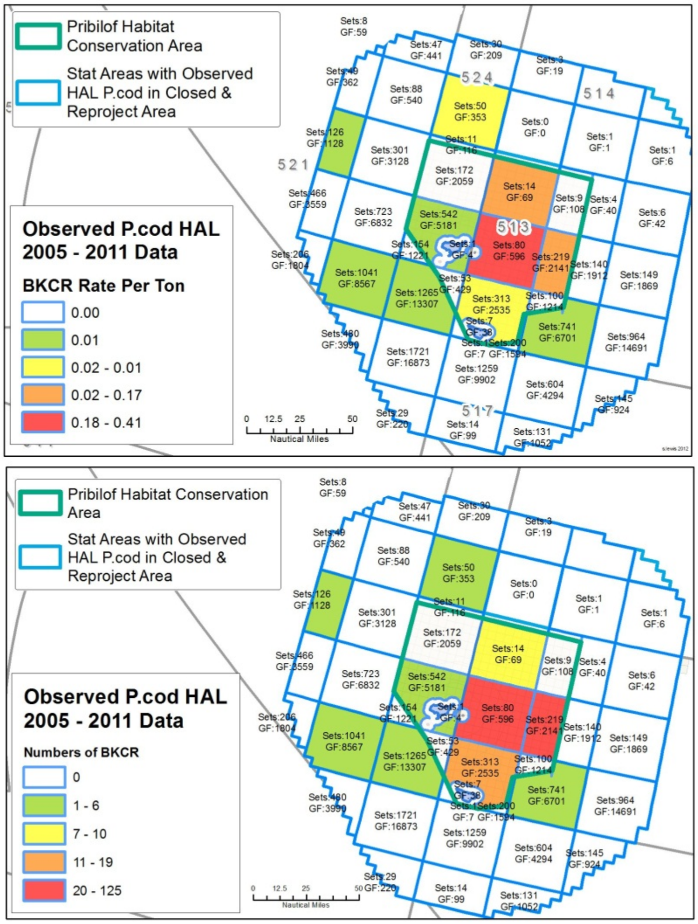


Figure 4-31 Summary of the PIBKC caught in observed sets in the Pacific cod hook-and-line fishery between 2005 and 2011 (2011 includes data through 6/19/11). The colors indicate either numbers of crab (lower map) or rate (# crab per ton of groundfish; upper map) for each ADF&G state statistical area inside and outside of the PIHCZ that had observer data. In addition, the amount of observed groundfish and number of observed sets are shown by state statistical area.

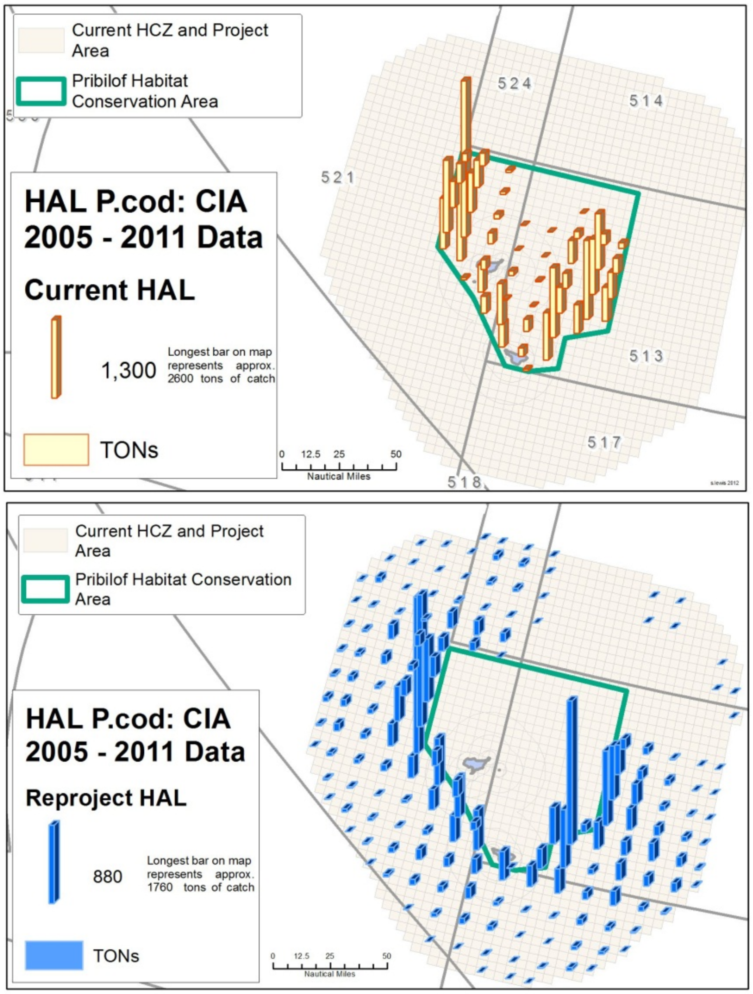


Figure 4-32 Comparison of the historical catch inside of the PIHCZ (top) with the spatial distribution of re-projected catch if the PIHCZ was closed to fishing with hook-and-line gear for the years 2005–2011 (2011 includes data through 6/19/11). The bars indicate the amount of groundfish catch per 20 km^2 unit and the green line indicates the boundary of the PIHCZ.

Potential Bycatch Savings

The observer data show the average bycatch rate in the Pacific cod pot fishery in the PIHCZ to be higher than the open area by a factor of about 10 (Table 4-12 and Table 4-13). This large difference in bycatch rates results in much higher estimated PIBKC in the closure area. However, since the fishing effort from the closed area will be displaced into the open area (Figure 5-29), the potential PIBKC savings can be estimated as the number of PIBKC estimated to be caught in the closed area (Table 4-12) minus the number of PIBKC estimated to be caught in the open area when the fishing effort is redistributed (Table 4-13). Thus, closure of the area is estimated to have saved 404 crabs in the Pacific cod pot fishery for the period between 2005 and 2011.

Small amounts of groundfish in the Pacific cod pot fishery were projected to areas with no observer data and thus the estimated groundfish catch in the open area was slightly lower. In these situations, analysts assumed that the estimated open-area rate adequately represents catch rates across the entire displacement area and the non-matched catch was assumed to be foregone catch. This is reasonable given observer data and survey data show high catch rates in areas near or in the PIHCZ, with comparatively low catch to the west (see Appendix 2). This is consistent with the original justification for creation of the PIHCZ, which was established to encompass important crab habitat based on survey and observer information (NPFMC 1994). However, even with the inclusion of this catch in the open area, the estimated saving by closing the PIHCZ is 398 crabs. The large observed catches in the PIHCZ between 2005 and 2007 did not occur in the open area even when the fishing effort was redistributed into the open area. Only one “spike” was observed in the open area: in 2008 a spike of 18 crabs was observed, with all other years showing no crab caught on observed hauls in the open area. Several statistical areas in the open area have a low number of sets. These areas are not seriously problematic in terms of estimation due to corresponding low amount of redistributed groundfish.

The average bycatch rate of PIBKC in the PIHCZ in the hook-and-line fishery is about three times less than in the pot fishery (Table 5-10 and 5-12). However, the amount of groundfish caught inside the PIHCZ in the hook-and-line fishery is greater. When the fishing effort in the hook-and-line fishery is displaced to the open area (Figure 5-31), the potential savings of the closure area is estimated be 344 crabs for the period between 2005 and 2011, with 2005 and 2006 accounting for half of the savings. The hook-and-line fishery is almost entirely managed under a voluntary cooperative management structure http://www.alaskafisheries.noaa.gov/analyses/groundfish/rirea_fllme0512.pdf). While the potential bycatch savings are not significantly less in the Pacific cod hook-and-line fishery than the pot fishery during the same period, the hook-and-line fishery can respond to PIBKC bycatch through cooperative management measures.

The observer data is considered the best available information for analysis of Alternative 2. However, there are assumptions inherent with using observer data in this analysis. One important assumption is that observer data characterizes PIBKC caught in the pot and hook-and-line Pacific cod fisheries. The observer coverage is not a random sample of fishing trips, but rather is reliant on regulatory requirements that vessels must take (they choose when) observers on 30% of their trips. It is unknown whether vessels are choosing trips based on avoiding PSC or for some other criteria that may influence bycatch statistics. Regardless, there is substantial fixed-gear observer information (pot and hook-and-line) indicating crabs are concentrated in the PIHCZ (See Appendix 2).

In summary, the closure of the PIHCZ to vessels fishing with pot gear under Alternative 2b, the PA, is likely to reduce overall bycatch and also stabilize the time series of crab PSC estimates due to low annual variability outside the area. This alternative focuses on the fishery with the highest rate of PIBKC bycatch in the PIHCZ and is highly likely to reduce PIBKC bycatch in an area where PIBKC are concentrated as well as prevent overfishing of the PIBKC stock. The reprojection analysis (Figure 5-29) indicates this closure would not reduce Pacific cod pot fishing catch, thus allowing the Pacific cod pot fishery to reach optimum yield.

4.5.6 Triggered closure impacts: Alternatives 5 and 6

Alternative 5 would trigger a range of area closures when the specified PSC limit of PIBKC in the groundfish fisheries is reached. Bycatch from all fisheries within the PIBKC stock distribution would accrue towards this limit but when reached a specified area (as listed under Options a through d) would close to all groundfish fishing. The impacts of closing these areas and the relative extent of groundfish catch in the regions over time are analyzed in the Regulatory Impact Review. The difficulties in managing trigger closures for PIBKC and the data limitations are described in Chapter 3.

The methodology to forecast trigger closures uses the CAS estimates, which represent the official catch and are the estimates that would be used by inseason management to manage the trigger closures. As discussed in Chapter 3, NMFS plans on changing the CAS estimates to match the PIBKC stock boundary.

This analysis does not examine the impact on PSC from changing the CAS estimation because (1) it will take time and resources to change the CAS estimation procedure, so until that programming change is made, the current PSC estimation methodology will be used; (2) retrospective analysis of trigger caps requires consideration of inseason actions, which are based on current CAS PSC estimation procedures; and (3) the structure of CAS is not amendable to reprogramming for analytical simulations. Therefore, observer data was used to analyze the area closure alternatives and the CAS was used to analyze the trigger closure alternatives.

Four cap levels are considered under this alternative, a PSC limit set at either the OFL, the ABC, 90% of the ABC or 75% of the ABC . In analysing the impacts of closing groundfish fisheries, consideration was given to when the cap itself is reached, triggering area closures as defined in Alternative 5. The only year that the cap was reached historically was in 2007. At that time, the OFL would have been exceeded the week of September 22nd. Likewise the ABC (or ACL) level was also exceeded in the same week-ending date as were both additional cap options. It is not possible to differentiate between the range of cap levels in this impact analysis as both were exceeded historically within the same week thus for analytical purposes these four caps are considered to be equivalent.[13] Nevertheless, while the potential impacts differ on groundfish fisheries across alternative management measures depending upon the time frame for reaching the cap and the impacts (closure of various fisheries from the specified areas) when a cap is reached, none of the alternative management measures themselves differ in their ability to rebuild the stock over the time frame of the simulation. Given models were not sensitive to bycatch reduction scenarios, NMFS does not know whether and to what degree the alternatives differ.

4.5.6.1 Groundfish fleet impacts: Trigger Closures

Alternative 5: Fleet closures/redistribution of effort Alternative 5d, Sub-options 3 and 4 (PSC cap established at 90% and 75% of ABC respectively) include an option for a specific allocation by gear type at 40% to trawl fisheries, 40% to pot fisheries and 20% to hook-and-line fisheries. Absent this allocation, the PSC caps themselves were reached historically in only two years, 2006 and 2007 on 4/15/06 and 9/22/07 week-ending dates. These are the only times when the trigger cap would have closed the areas included under Alternative 5. However with the allocation to gear group considered, there are additional constraints by gear type in other years. Sub-options 3 and 5 under Alternative 5 are predicted to result in closures:

- **Under Sub-option 3 (90% of ABC)**, when the allocation by gear type is applied historically, there were closures by the hook-and-line (Pacific cod) fleet in 2004 on November 27th, and in 2006 on September 23rd. For pot gear closures would have occurred on February 12th in 2005, and September 22nd in 2007. For trawl gear, the allocation would have been exceeded in 2006 on April 15th (Table 5-17).
- **Under Sub-option 4 (75% of ABC)**, application of the gear allocation historically results in the same closures noted under Sub-option 3 as well as an additional closure in 2003 for trawl gear, where the allocation was exceeded on August 16th (Table 5-17).

Table 4-16 shows a summary of the PSC cap options and the allocation option and years in which each would have been reached historically by gear type. The economic impacts of closing these fisheries from that area are described in the Regulatory Impact Review.

[13] The OFL here is 4,000 lbs while under the Tier 5 assumption the ACL is considered to be 3,600 lbs, a difference of only 400 lbs. This difference would be even smaller under a “true” Tier 4 ACL determination using the P* approach of 0.49 established under the Council’s preferred alternative.

Table 4-16 PSC cap options and allocation percentage. "X" indicated when a constraint was reached historically 2003–2010 using the proposed caps and allocations.

	90% ABC			75% ABC		
	40%-TRW	40%-POT	20%-HAL	40%-TRW	40%-POT	20%-HAL
2003				x		
2004			x			x
2005		x			x	
2006	x		x	x		x
2007		x			x	
2008						
2009						
2010						

Alternative 6: Alternative 6 contains two allocation options, one by gear type, the other by seasonal apportionment to all fisheries. The first is a gear-allocation, which allocated 45% of the limit to trawl gear, 45% of the limit to pot gear, and 30% to hook-and-line gear. This notably over-allocates the total limit to allow for greater flexibility in fishing practices by gear type. However, should the overall limit be reached fishery-wide the area would close regardless if one gear type had not reached their individual allocation.

The second allocation option is a "seasonal release" of a fishery-wide PSC cap by portions of the year. This approach allows for a fishery-level (combined all sectors as well as CDQ and non-CDQ) seasonal allocation that would allow for maximizing fishing opportunities under the existing cap options in the analysis. The Alternative 6 PSC limit (75% of the ABC) only is examined here as this option is contained only under this alternative. Quartiles of the PSC limit are compared with bycatch in each year.

Three seasonal allocation caps are proposed for consideration: 1) seasonal allocation of 25% of the bycatch in the first quarter of the year, 25% in the second quarter and 50% for the remainder of the year, 2) 50% of the bycatch (for all gear types combined) beginning January 1–June 10, with 50% remaining June 11–December 31; and 3) 75% January 1–June 10, with 25% remaining June 11–December 31. Cap allocations by year are shown in Table 4-17 through Table 4-20 . The inherent assumption is that the bycatch that accrues towards this cap apportionment is for all fisheries combined. When the cap itself is reached however, only the fisheries that are subject to this action (yellowfin sole, Pacific cod pot and Pacific cod hook-and-line fisheries) would be subject to whichever closure constraint is proposed by the Council.

Table 4-17 PSC limits by year based upon the Alternative 6 limit of 75% of the ABC (in numbers of crab using average weight in the previous year only) and associated seasonal allocation options of 50/50 and 75/25 % by season. Note the first allocation is from January 1–June 10 while the second is from June 11–December 31. Bycatch accrues fishery-wide for these caps although the constraint (associated area closure) is only for qualified fisheries as specified in the analysis.

Year	cap (#s of crab)	Seasonal allocation(option 2) 50%	Seasonal allocation (option 3) 75%	25%
2003	2,151	1,076	1,613	538
2004	850	425	637	212
2005	776	388	582	194
2006	730	365	547	182
2007	865	432	648	216
2008	1,732	866	1,299	433
2009	797	398	598	199
2010	1,011	505	758	253

A preliminary examination of all fisheries bycatch under these two seasonal allocation schemes was conducted using the CIA database to estimate total bycatch of PIBKC by all gear types in the Pribilof District (note these results are preliminary and contingent upon CIA database estimation of bycatch within the Pribilof District). Bycatch was tabulated in the Pribilof District by year and compared against the proportion of the cap estimated in that year. Results were compiled for consideration with and without a rollover of unused bycatch from the first allocation (January 1–June 10) to the second (June 11–December 31). These date ranges are meant to bracket the full range of applicable seasons for all gear types understanding that not all gear types are able to fish under the full seasonal allocation time frame.

The week-ending dates that an estimated constraint would be reached by seasonal allocation are shown in Table 4-18, Table 4-20, and Table 4-20 below. The tables indicate the constraint in the second seasonal allocation period with and without a rollover from the first seasonal allocation.

For both the 25/25/50 and 50/50 seasonal allocation, the only year the cap would have been estimated to be reached in the first and second seasons would have been in 2005. For the second season however, without a rollover the cap would have been reached in 2006, 2007 and 2009. With the seasonal allocation the cap would be reached later in 2006 but the same week-ending date in 2007. In 2007 the cap levels for all caps under consideration were reached in the week of September 22nd. Under the rollover for this option the cap would not have been reached in 2009.

For the 75/25 allocation, the cap is not reached in any year in the first seasonal allocation. In the second season, absent a rollover the smaller proportion of the cap is reached in multiple years (2004, 2006, 2007, 2009, and 2010). However, with the rollover the cap is only reached in 2006 on September 2nd and in 2007 on September 22nd (when all cap levels are reached due to bycatch in that period as noted previously).

Table 4-18 **25/25/50 seasonal allocation of a fishery-wide PIBKC PSC cap and the associated week-ending date it would have been reached with and without a rollover form the first to the second season.**

Year	Cap by season (#s crab) 25%	Cap by season (#s crab) 25%	Cap by season (#s crab) 50%	Week-ending date cap reached by season			
				January 1-March 20	March 21-June 10	June 11-December 31	Date cap reached if rollover allowed
2003	538	538	1,076	----	----	----	----
2004	212	212	425	----	----	----	----
2005	194	194	388	Feb 12	Feb 12	----	----
2006	182	182	365	----	----	Aug 19	Sep 2
2007	216	216	432	----	----	Sep 22	Sep 22
2008	433	433	866	----	----	----	----
2009	199	199	398	----	----	Sep 26	----
2010	253	253	505	----	----	----	----

Table 4-19 **50/50 seasonal allocation of a fishery-wide PIBKC PSC cap and the associated week-ending date it would have been reached with and without a rollover form the first to the second season.**

Year	Cap by season for 50/50 allocation (#s crab)	Week-ending date cap reached by season January 1-June 10	June 11-December 31	Date cap reached if rollover allowed
2003	1,076	----	----	----
2004	425	----	----	----
2005	388	Feb 12	----	----
2006	365	----	Aug 19	Sep 2
2007	432	----	Sep 22	Sep 22
2008	866	----	----	----
2009	398	----	Sep 26	----
2010	505	----	----	----

Table 4-20 **75/25 seasonal allocation of a fishery-wide PIBKC PSC cap and the associated week-ending date it would have been reached with and without a rollover form the first to the second.**

Year	Cap by season (#s crab) 75%	Cap by season (#s crab) 25%	Week-ending date cap reached by season		
			January 1-June 10	June 11-December 31	Date cap reached if rollover allowed
2003	1,613	538	----	----	----
2004	637	212	----	Aug 7	----
2005	582	194	----	----	----
2006	547	182	----	Aug 19	Sep 2
2007	648	216	----	Sep 8	Sep 22
2008	1,299	433	----	----	----
2009	598	199	----	Sep 19	----
2010	758	253	----	Sep 26	----

4.5.7 Options for specifying cap in numbers based on average weight

In December 2011, the Council requested clarification on the issues related to managing a PSC cap for PIBKC in the groundfish fisheries that is based on numbers of crab rather than the overall weight of crab accruing towards a set cap level. These issues relate to both the calculation itself, from observer data, as well as the fluctuation in cap levels as a result of using an annually-varying average weight calculation.

Chapter 3 describes the process by which observers collect data on crab weight in their samples and explains how NMFS uses the weight to estimate crab PSC in numbers of individuals. As noted in Chapter 3, this process results in multiple conversions, from weight to number and then back to weight These conversions rely on averages that do not necessarily correspond with the sampling frame. Nonetheless this is the current process and absent a modification, in conjunction with this amendment analysis, any PSC limit recommended by the Council will be in numbers of crab rather than weight.

The Council's trigger caps are formulated as a proportion of the OFL, which is a quantity managed in weight. Two options are included under Alternative 6 for specification of the cap number based on weight. The first uses the average weight in the previous year to set the cap while the second uses the rolling five-year average weight to set the cap in the following year. Table 4-21 and Table 4-22 compare these two methods. Note that due to data limitations with average weight the rolling five-year average weight is only shown from 2007/08 on. It is clear that the use of the rolling average damps down the inter-annual fluctuations in cap numbers considerably.

For this analysis both options are employed, by year, applied historically to the cap proportions to estimate the number of crab PSC for purposes of the analysis. This is intended to reflect the reality of managing a weight-based cap in numbers, on an inter-annual basis, and demonstrate the time-varying nature of the caps based solely upon the average-weight estimate employed to convert to numbers of crab. The table below shows the cap levels in numbers of crab following conversion of weight to numbers employing the average weight as listed. Also shown is the annual average weight employed by NMFS in that year for conversion of crab PSC back to weights for accrual in the annual stock assessment. Note that actual average weights have only been used since 2008. Crab PSC catch by groundfish fisheries did not accrue towards an OFL for crab stocks until 2008 because that was the first year that annually estimated OFLs for crab stocks were implemented. Note that the annual variation of the PSC limit (Table 4-21) is due solely to the average weight of king crab caught over all gear types the previous season and is not related to the abundance of PIBKC. This fluctuation in cap numbers, by year, has an impact on the relative constraints estimated in the analysis in each year. By comparison, Table 4-22 shows the option to set the limit based on the rolling five-year average weight in pounds. Here given that average weight is not available for earlier years thus the rolling average calculation begins in 2007/2008. Basing the PSC limit on a rolling five-year average results in less inter-annual variability in the limit (Table 4-22).

Table 4-21 PSC limit specified in numbers of crab based on the average weight in lbs in the previous year.

Crab fishing year	Average weight in lb	Cap options in numbers under consideration: Option 1: OFL	Option 2: ABC	Option 3: 90%ABC	Option 4: 75%ABC
2003/04	1.255	3,187	2,869	2,582	2,151
2004/05	3.177	1,259	1,133	1,020	850
2005/06	3.480	1,149	1,034	931	776
2006/07	3.700	1,081	973	876	730
2007/08	3.123	1,281	1,153	1,037	865
2008/09	1.559	2,565	2,309	2,078	1,732
2009/10	3.388	1,181	1,063	956	797
2010/11	2.671	1,498	1,348	1,213	1,011

Table 4-22 PSC limit specified in numbers of crab based on the rolling five-year average weight in lbs. Note that this calculation is available from 2007/2008 on; years prior to this do not have 5 years of data available for average weight in order to calculate the limit thus the average weight in that year is used.

Crab fishing year	Average weight in lb	Cap options in numbers based on rolling 5 year average weight*:			
		Option 1: OFL	Option 2: ABC	Option 3: 90%ABC	Option 4: 75%ABC
2003/04	1.255	3,187	2,869	2,582	2,151
2004/05	3.177	1,259	1,133	1,020	850
2005/06	3.480	1,149	1,034	931	776
2006/07	3.700	1,081	973	876	730
2007/08	3.123	1357	1222	1099	916
2008/09	1.559	1330	1197	1077	898
2009/10	3.388	1311	1180	1062	885
2010/11	2.671	1385	1246	1122	935

*2007/08 on due to availability of 5-year average weight estimate historically

5 Other Marine Resources

This section considers other marine resources in the Pribilof Islands region and the potential impact on these resources categories of the Alternatives under consideration. Under all proposed alternatives for rebuilding the PIBKC stock, harvest levels in the directed crab fisheries would remain the same (the directed fishery is closed). Further, no changes to the distribution of crab fisheries are anticipated under the proposed actions. To the extent that crab fishing effort is reduced, and consequently adverse interactions with incidental catch species though bycatch or disturbance are also reduced, there could be some benefit to these species. Therefore, impact analysis focuses upon changes in catch of groundfish and prohibited species resulting from moving the groundfish fisheries out of the proposed closures.

5.1 Groundfish Resources

5.1.1 Overview of groundfish resources

Groundfish fisheries that occur in the same species general distribution as the PIBKC fishery include: Pacific cod, pollock, Arrowtooth flounder (*Atheresthes stomias*), Atka mackerel (*Pleurogrammus monopterygius*), yellowfin sole (*Limanda aspera*), rock sole (*Lepidopsetta bilineata*), flathead sole (*Hippoglossoides elassodon*), skates, and sculpins (NPFMC 1994). Bycatch of blue king crab in these fisheries is low. Since the implementation of the Pribilof Islands Habitat Conservation Zone (PIHCZ), the overlap between the flatfish trawl fisheries and the PIBKC fishery has declined. Very little is known about the trophic interactions of blue king crab, however similar trophic interactions are presumed as for red king crab. A number of fish species are known to feed on larval red king crab, including pollock, Pacific herring (*Clupea pallasii*), sockeye salmon (*Oncorhynchus nerka*), and yellowfin sole. Once the crabs settle on the sea floor, they are prey to a number of commercial and non-commercial fish species, such as most flatfish species, halibut, sablefish (*Anoplopoma fimbria*), skates, sculpins, and other benthic invertebrates, such as sea stars. A high rate of cannibalism by juvenile red king crab on younger crab also exists. Studies have documented that Pacific cod consume soft-shelled female adult red king crab. A discussion of the specific trophic interactions between blue king crab and groundfish and other species is contained in the annual SAFE report chapter for the PIBKC stock (see Foy and Rugolo 2009).

5.1.2 Impact Analysis Methodology

To assess the effects of the proposed alternatives on groundfish stocks data from observers and data on vessel movements acquired by satellite through the Vessel Monitoring System (VMS) were integrated by NMFS/Alaska Region. This VMS-Observer Enabled Catch-In-Areas (VOE-CIA) database was used to assess the spatial resolution of the observed and unobserved groundfish fisheries in each of the alternative coverages. The VOE-CIA database integrates catch data from the CAS, which has the spatial resolution of a Federal Reporting Area, into a database that resolves the GIS data into polygons with areas of approximately seven kilometers. In an unrestricted area, 64 grid IDs fit inside one state statistical area.

The VOE-CIA database uses an iterative, ordered process to match VMS records, Observer collected data and VMS/Catch Accounting System indicators to a fishing vessel. This gives analysts the capability to analyze unobserved vessels that may have been transparent when only using earlier analytical tools such as observer data. It should be noted that VOE-CIA data only go back as far as 2003. This is due to the unavailability of reliable VMS data and a vessel linked catch accounting system before 2003.

This section documents the methodology that was used to reproject groundfish catch from within proposed closure areas, under the various alternatives and their options, to areas that would remain open either annually or following a trigger closure at some point in the year. This reprojection of groundfish catch is a retrospective analysis that is intended to be exemplary of where catch might have occurred had the closure been in place. This analysis utilized observed data as compiled in the VMS Enabled NOAA Fisheries Alaska Region Catch In Areas (CIA) Database as developed by Steve Lewis of the Alaska Region Analytical Team. The CIA database was given favorable reviews by the Council's SSC in February of 2009. This analysis utilized an algorithmic approach to reproject catch using the data, and assignment of that data to a spatial grid, contained within the CIA database. The reprojection is based on historic catch grouped by vessel, harvest sector, gear, and target. This representation is not intended to be interpreted as a predictive model of where fleets will redeploy when faced with a closure but rather is a reprojection of historical groundfish catch to locations where fishing occurred.

The re-distribution of groundfish catch using the CIA relies on several main assumptions: 1) historical catch characteristics outside the area may approximate future catch patterns after the area is closed, 2) vessels will travel a maximum of 50 nm outside the closure area boundary, and 3) vessel will harvest a similar amount of groundfish in the displacement area (open area) that they historically harvested in the closure area.

A hierarchal process was used to match fishing characteristics in the open area with those in the closure area. This insures that the "flavor" of fishing events in the closure area are matched with similar fishing events outside the closure area. At the core of this process, the fishing characteristics (covariates) associated with groundfish catch define post strata that are used aggregate groundfish catch (Table 5-1). These post-strata are the basis from which catch is apportioned across the projection area.

Table 5-1 Post strata used to aggregate groundfish catch in the displacement area outside of the closure areas.

	Post Strata Criteria (covariates)						
Post Strata (*j*)	Sector	Pacific cod target	Pot Gear	Week	Month	Vessel	State Waters
1	X	X	X	X	X	X	X
2	X	X	X	X	X		X
3		X	X	X	X		X
4		X	X		X		
5		X	X		X		X

The projection of catch relies on two separate processes, depending on whether catch occurred in the closure area. Groundfish catch (g) occurring in the closure area is summed within each stratum. This provides the amount of groundfish that is projected to the open area (OA) after the closure. Projecting catch into the open area from the closed area requires groundfish historically caught in the open area to be normalized into grid-specific proportions. First, the total amount of groundfish for each trip (*i*) in the open area (OA) that is attributed to each post-stratum (*j*) is summed. Second, the amount of catch attributed to each 7 km^2 grid (*k*)is normalized by the first step. This proportion (P_{jk}) is specific to the post strata (*j*), grid (*k*), and based on data in the open area only:

$$p_{jk} = \frac{\sum_{\substack{i=1 \\ i \in OA}}^{I} g_{ijk}}{\sum_{\substack{k=1 \\ k \in OA}}^{K} \sum_{\substack{i=1 \\ i \in OA}}^{I} g_{ijk}}$$

For example, a post-stratum may have catch distributed across 10 grids with 1 metric ton of catch in each grid: the proportion of catch occurring in each grid square would be 1/10 of the total stratum catch across all grids. Further, a single grid may have groundfish catch (g) across multiple post-strata, resulting in the grid containing several unique proportions.

The next step projects the catch in the closure area to the grid-specific proportions (p_{jk}) calculated in the open area. This step requires the covariates associated with the open area catch and the PIHCZ catch to be the same. This is accomplished using a CIA algorithm that matches the post-strata levels for data in the closure area with the open area (OA) data; ensuring projected catch is matched based on similar fishing characteristics (Table 5-1). After the match occurs, the proportion of catch within each grid (p_{jk}) is multiplied against the catch in the closure area (CA), noting that the post stratum level (*j*) must match:

$$\hat{G}_{jk} = p_{jk} \bullet \sum_{\substack{i=1 \\ i \in CA}}^{I} g_{ij}$$

$$where: j_{OA} = j_{CA}$$

The final grid-specific catch estimates area simply the sum of catch in each grid, across all post-strata:

$$\hat{G}_k = \sum_{j=1}^{J} \hat{G}_{jk}$$

The final output provides a spatially-referenced projection of groundfish caught if the area was closed. Because of confidentiality, the high resolution data at the 7 km spatial resolution was also able to be displayed, so the final estimates shown are aggregated to the 20 km level.

Details about the procedures used in each post-stratification step are as follows:

Vessel-Based Strata

In the first step of the catch reprojection operation the catch of each vessel that operated in the area proposed for closure (the alternative areas) in each week of the season (using week ending date) is reprojected into grid cells (7 km x 7 km) occurring within 50 nautical miles of the closure boundary in the area outside of the closure area (the open area).[14] This assignment is proportional to the actual observed catch by that same vessel and within the same target fishery and gear type in each of the 7 km square grids cells the vessel actually fished and in the same week of the season. In this way catch is matched first at the observed vessel level and based on that vessel's own proportion of weekly catch within a grid square. If a vessel fished in only one grid square outside the closure in a particular week when the closure would have been in place (either an annual or triggered closure) then all of the reprojected catch is assigned to that single grid square. If that vessel fished in two cells, with a 60-40% split then 60% and 40% of the reprojected catch is assigned to the cells respective of the proportion observed in each cell. In many cases this match reprojects most of the catch that could potentially be forgone; however, there are instances when a specific vessel fished within a closure area but not outside of it in a particular week. In such cases, a second matching step is applied to attempt to reproject vessel level unmatched catch to the open area.

Vessel Type/Target/Gear-Based Strata

In the second step, a vessel's catch that occurred inside the closure area in a week when that vessel was not observed fishing within 50 km outside of the closure boundary is reprojected proportional to the catch of vessels in its sector of the fleet that had recorded catch outside of the closure area using the same gear

[14] Please note that this data is aggregated to 20 km grids for reprojection in the maps in this appendix due largely to the extreme quantities of data, (in excess of 3 terabytes per process) processing time generated for each map, and also because the vertical catch bars overlap each other excessively in the smaller grid display.

type, in the same species target fishery, and with the same vessel type (catcher/processor [CP] or catcher vessel [CV]). In this way, catch is reprojected based on recorded catch in grid cells in the open area where the same vessel type, operating in the same target fishery, and with the same gear type, had recorded catch. This second step serves to reproject catch that could not be reprojected at the individual vessel and week level proportional to catch of similar vessels. However there are some instances, particularly with the limited number of CVs potentially affected by some alternatives, when a relaxation of the vessel type is necessary to match catch to grid cells outside of a closure area, and that relaxation of the vessel type match is undertaken in the next step.

All Vessels/Target/Gear Strata

In this third matching step, the vessel type matching constraint is relaxed and the match is made proportional to all vessels, CPs and CVs combined, in a target fishery with the same gear type. This third step gathers all remaining catch and reprojects it, where possible, to grid cells proportional to the catch of all vessels within target fishery, gear type, and week of the season recorded in those grid cells. However, there are instances when no effort occurs outside of the proposed closure area by any vessel type within target, gear type, and in the specific week in question. In such cases, a final step is used, which relaxes the week of the season constraint.

All Vessels/Target/Gear/Month Strata

The final step in the reprojection algorithm relaxes the constraint of trying to match catch within the same week of the season. In this step, remaining unmatched catch is reprojected proportional to catch by any vessel type, within same target, same gear type, and within the same month of the catch that occurred within the closure area. While this last step broadens the match criteria significantly, there are nonetheless some cases where a match still cannot be made. In a couple of particular cases, to be discussed in the accompanying Regulatory Impact Review, even this step does not provide a match. The interpretation of this finding is that the closure area was essentially the only area that had recorded catch within the target and gear combination in question and serves to highlight the importance of that area to the potentially affected fleet.

Limitations of the Reprojection Analysis

Projected catch using the CIA method relies on the assumption that a closure would result in groundfish catch being displaced, in proportion, to the same areas where groundfish fishing historically occurred outside the closure area. Predicting future fishing locations is difficult at best; however, fishermen are likely to fish in historically similar areas unless there are large changes in the distribution of groundfish. Distributional changes in groundfish biomass that may influence fishing patterns were not quantitatively evaluated in this analysis. Forecasting biomass changes and fishery selectivity on a small spatial and temporal scale is not feasible for this analysis due to the small spatial and temporal scale.

Regardless of these uncertainties, the CIA data provides a tool to evaluate how catch is likely to be re-distributed and is currently the best projection method available. Data from 2003 to 2009 for each of the proposed closed areas including the target species, management program, harvest sector, gear type, and species were assessed to quantify the potential impacts of the alternatives on groundfish fisheries (see also the Regulatory Impact Review/Initial Regulatory Flexibility Analysis for this analysis). Further, Alternative 2b (the preliminary preferred alternative) relied on additional methodology, described in Section 4.5.5.1, that melded reproject catch with observer information on PIBKC.

5.1.3 Impacts of Alternatives on groundfish resources

The significance criteria used to evaluate the effects of the action on groundfish target species are in Table 5-2. These criteria are adopted from the significance criteria used in the Habitat Areas of Particular Concern Environmental Assessement (NMFS 2006).

Table 5-2 Criteria used to estimate the significance of effects on the FMP-managed groundfish stocks.

Effect	Criteria			
	Significantly Negative (-)	**Insignificant (I)**	**Significantly Positive (+)**	**Unknown (U)**
Stock Biomass: Potential for increasing and reducing stock size	Changes in fishing mortality are expected to jeopardize the ability of the stock to sustain itself at or above its MSST.	Changes in fishing mortality are expected to maintain the stock's ability to sustain itself above MSST.	Changes in fishing mortality are expected to enhance the stock's ability to sustain itself at or above its MSST.	Magnitude and/or direction of effects are unknown.
Fishing mortality	Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Action allows the stock to return to its unfished biomass.	Magnitude and/or direction of effects are unknown.
Spatial or temporal distribution	Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself.	Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself.	Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown.
Change in prey availability	Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown.

Table 5-3 shows the relative impact of moving effort out of the closed areas on the incidental catch of non-target and groundfish species based on the alternative closures. Appendix 1 Tables A2 through A12 show the comparison of total groundfish catches by species and year from 2003–2010 from each of the alternative closure configurations considered in this analysis. Pacific cod and pollock represent the highest removals by weight by year in the PIHCZ, under Alternatives 1 and 2. Pacific cod and yellowfin sole represent the highest removals by weight by year in the ADF&G closures under Alternative 3. For Alternative 4, Option 1 (distribution based upon 1975–1984 distribution area) and Option 2 (distribution based on the 1984–2008 area), the highest removals by weight by year are pollock, Pacific cod, and yellowfin sole.

As described in Section 5.1.2, an analysis was done to estimate the redistribution of the fleet outside of the closed areas to look at the impact on target catch, incidental catch, PSC catch, and the economic impact of fleet redistribution. Analysis indicated that the major catch as indicated in the tables (Appendix 1 Tables A2 through A12) could be caught equally outside of the closure area. Estimating the areas where catch would likely be concentrated outside these closures shows that catch is primarily in adjacent areas, thus no impact on localized depletion would be anticipated or any other adverse impacts on target groundfish stocks under these alternatives. See Section 7.2, and Appendix A to the Regulatory Impact Review (RIR) appended separately and incorporated by reference.

The implications of fleet redistribution outside of the closed areas were also examined for incidental catch of groundfish and prohibited species. The impacts of imposing area closures on the qualified fisheries and the resulting change in incidental catch caught outside of the area closures are shown in Table 5-3. A comparison of incidental catch amounts of groundfish inside and outside the closures shows that there is no estimated change in incidental catch by target fishery over the range of incidentally caught groundfish regardless of the implementation of the closures. The fleet redistribution analysis also indicates that there is no change to the targeted catch in that the fishery will still be able to attain their catch outside of the closures. Therefore the impact of these closures groundfish stocks is insignificant.

Table 5-3 Incidental catch of groundfish species averaged over all years (2003–2010) by target fishery (combined flatfish and Pacific cod).

Closure	Species	FF Target Closed	Reprojected	Pcod target Closed	Reprojected	FF outside/inside	Pcod outside/inside
Current	AKPL	349	349	23	23	1.000	1.000
	AMCK			1	1		1.046
	ARTH	7	7	135	135	1.000	1.000
	FSOL	8	8	114	114	1.000	1.000
	NORK			1	1		1.000
	OTHR	31	31	3,609	3,582	1.000	1.007
	PLCK	38	38	641	639	1.000	1.002
	POPA			0	0		1.001
	ROCK	0	0	2	2		1.001
	SQID			0	0		0.999
	SRRE			0	0		0.999
ADF&G	AKPL	1,021	1,021	1	1	1.000	1.000
	AMCK			0	0		1.008
	ARTH	78	78	17	17	1.000	1.000
	FSOL	202	202	12	12	1.000	1.000
	NORK			0	0		1.000
	OTHR	357	357	1,293	1,293		1.000
	PLCK	948	948	310	310	1.000	1.000
	POPA	0	0			1.002	
	ROCK			0	0		1.000
	SQID	1,021	1,021	1	1	1.000	1.000
	SRRE			0	0		1.008
Prib_75	AKPL	33,459	28,880	345	334	1.159	1.033
	AMCK	2	2	22	21	1.091	1.019
	ARTH	1,476	1,327	1,961	1,942	1.113	1.009
	FSOL	6,923	5,968	2,182	2,110	1.160	1.034
	NORK	0	0	22	22	1.425	1.001
	OTHR	6,980	6,549	18,749	18,573	1.066	1.010
	PLCK	20,951	19,288	6,228	6,195	1.086	1.005
	POPA	3	3	0	0	1.065	1.020
	ROCK	1	1	21	21	1.029	
	SQID	0	0	0	0		1.001
	SRRE	0	0	1	1	1.008	1.000
Prib_84	AKPL	15,590	15,584	188	177	1.000	1.059
	AMCK	0	0	3	3		1.018
	ARTH	849	845	760	744	1.005	1.021
	FSOL	2,621	2,621	979	907	1.000	1.079
	NORK	0	0	2	2	1.000	1.000
	OTHR	3,138	3,136	9,453	9,370		1.009
	PLCK	10,472	10,457	2,898	2,883	1.001	1.005
	POPA	0	0	0	0		1.000
	ROCK	0	0	4	4		1.000
	SQID			0	0		1.000
	SRRE			0	0		0.999

5.2 Prohibited Species

This section focusses upon other prohibited species (outside of PIBKC specifically) incidentally caught in groundfish fisheries. In particular an overview of four species is included here as well as estimated impacts of the alternatives on these four. King crab, Pacific halibut, Chinook salmon, and non-Chinook salmon. Of these only king crab and halibut are caught incidentally with any regularity in the target fisheries and location under consideration in this action. Since blue king crab is addressed in the previous section this section addresses only red king crab, and specifically the Pribilof Islands red king crab as it is the only red king crab stock in the location of this action (Bristol Bay red king crab and Adak red king crab are located in other regions of the Bering Sea and are considered separate stock groupings). There is some incidental catch of salmon species in the region thus despite the low levels of catch this is also considered for evaluation of impacts.

5.2.1 Pribilof Islands red king crab

Red king crab stocks in the Bering Sea and Aleutian Islands are managed by the State through the Crab FMP (NPFMC 1998). ADF&G has not published harvest regulations for the Pribilof District red king crab fishery. The king crab fishery in the Pribilof District began in 1973 with blue king crabs being targeted. A red king crab fishery in the Pribilof District opened for the first time in September 1993. Beginning in 1995, combined red and blue king crab guideline harvest levels (GHL) were established. Declines in red and blue king crab abundance from 1996 through 1998 resulted in poor fishery performance during those seasons with annual harvests below the fishery GHL. The Council established the Bering Sea Community Development Quota for Bering Sea fisheries including the Pribilof Islands red and blue king crab fisheries, which was implemented in 1998. Since 1999, the Pribilof Islands fishery was not open due to low blue king crab abundance, uncertainty with estimated red king crab abundance, and concerns for blue king crab bycatch associated with a directed red king crab fishery.

Pribilof Islands red king crabs occur as bycatch in the eastern Bering Sea snow crab, eastern Bering Sea Tanner crab, Bering Sea hair crab, and PIBKC fisheries. Many of these fisheries have been closed or recently re-opened so the opportunity to catch Pribilof Islands red king crab is limited. Limited non-directed catch exists in crab fisheries and groundfish pot and hook-and-line fisheries.

From 1980 to 2010, the Pribilof Islands red king crab stock exhibited widely varying mature male and female abundances. The estimate of mature male biomass from the 2010 survey was 5.44 million pounds. Recruitment is not well understood for Pribilof red king crab. Pre-recruitment indices have remained relatively consistent in the past 10 years, although pre-recruits may not be well assessed with the survey. The point estimates of stock biomass from the survey in recent years has decreased since the 2007 survey with a substantial decrease in all size classes in 2009, but the stock increased in 2010 relative to 2009. The 2010 size frequency for males shows a decrease in the number of old shell and very old shell legal sized males in comparison to 2008 shell conditions, but an increase when compared to 2009. Red king crab were caught at 13 of the 41 stations in the Pribilof District high-density sampling area in 2010 (Foy 2010). Red king crabs have been historically harvested with blue king crabs and are currently the dominant of the two species in this area.

5.2.2 Chinook and Chum salmon status

Chinook salmon status

Since 1979, four separate stock composition estimates of Chinook salmon bycatch samples from the eastern Bering Sea groundfish fisheries have been made, all showing that the majority of Chinook salmon samples were from western Alaska stocks (Myers and Rogers 1988; Myers et al. 2004; NMFS 2009; Gray et al. 2011; Guyon et al. 2010). The environmental impact statement (EIS) for Amendment 91 (NMFS/NPFMC 2009) provides information on the adult-equivalency (AEQ) analysis of the Chinook salmon bycatch in the Bering Sea. The AEQ methodology applies the extensive observer datasets on the length frequencies of Chinook salmon caught in the pollock fishery and converts these to ages, appropriately accounting for the time of year that catch occurred. The age data is coupled with information on the proportion of salmon that return to different river systems at various ages, and the bycatch-at-age data is used to pro-rate how any given year of bycatch affects future potential spawning runs of salmon. Overall, the estimate of AEQ Chinook mortality from 1994 to 2007 ranged from about 15,000 fish to over 78,000 with the largest mortality comprised of stocks in the coastal west-Alaska (NMFS 2009a).

North Pacific Chinook salmon are the target of subsistence, commercial, and recreational fisheries. Approximately 90% of the subsistence harvest is taken in the Yukon and Kuskokwim river systems. For more information on state management of salmon subsistence fisheries, refer to the ADF&G website at www.adfg.alaska.gov/index.cfm?adfg=fishingSubsistence.main and the Alaska Subsistence Salmon Fisheries 2007 Annual Report at www.subsistence.adfg.state.ak.us/techpap/TP346.pdf. The majority of the Alaska commercial catch is made in Southeast, Bristol Bay, and the Arctic-Yukon-Kuskokwim areas. Fish taken commercially average about 18 pounds. The majority of the catch is made with troll gear or gillnets.

The Chinook salmon is the most highly prized sport fish on the west coast of North America. In Alaska it is extensively fished by anglers in the Southeast and Cook Inlet areas. The Alaska sport fishing harvest of Chinook salmon is over 76,000 annually, with Cook Inlet and adjacent watersheds contributing over half of the catch. Unlike non-Chinook species, Chinook salmon rear in inshore marine waters and are, therefore, available to commercial and sport fishermen all year.

Directed commercial Chinook salmon fisheries in Alaska occur in the Yukon River, Nushagak District, Copper River, and the Southeast Alaska troll fishery. In all other areas of Alaska, Chinook are taken incidentally and mainly in the early portions of the sockeye salmon fisheries. Catches in the Southeast Alaska troll fishery have been declining in recent years, due to United States/Canada treaty restrictions and declining abundance of Chinook salmon in British Columbia and the Pacific Northwest. Chinook salmon catches were moderate to high in most regions between 1984 and 2004 (Eggers 2004). However, western Alaska Chinook salmon stocks declined sharply in 2007 and have remained depressed since. In recent years of low Chinook salmon returns, the in-river harvest of western Alaska Chinook salmon has been severely restricted and, in some cases, river systems have not met escapement goals.

Chinook salmon production in the Yukon River has been declining in recent years. The Yukon River Chinook stocks have been classified as stocks of concern (Eggers 2004), and this classification was continued as a stock of yield concern in February 2007, based on the inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above the stocks' escapement needs since 1998. In December 2009, ADF&G recommended continuing this classification as a stock of yield concern.

Kuskokwim River Chinook salmon abundance is generally on a decline following a period of exceptionally high abundance years in 2004, 2005, and 2006 that ranged from 360,000 to 425,000 fish. Kuskokwim River Chinook salmon were discontinued as a stock of yield concern by the Board of Fisheries (BOF) in February 2007 (ADF&G 2007). The BOF discontinued the stock of yield concern designations based on Chinook salmon runs being at or above the historical average each year since 2002. In 2010, Chinook salmon abundance in the Kuskokwim River was poor and escapements were below average at all monitored locations. Kogrukluk River Chinook estimated escapement was within the escapement goal range, while Kwethluk, Tuluksak, and George rivers did not achieve the lower end of their respective Chinook escapement goal ranges. Chinook salmon harvest and catch rates were below the recent 10-year average in Kuskokwim Bay.

The primary managed Bristol Bay Chinook salmon stocks are in the Nushagak River, although management occurs on rivers within each of the districts comprising Bristol Bay. The harvest of Bristol Bay Chinook salmon was 31,400, which is 48% of the average harvest for the last 20 years

(NPFMC 2012b). Escapement into the Nushagak River was 36,625; this is the first time since enumeration began, in 1980, that the minimum escapement goal of 40,000 was not met. Sport fishing was closed completely and subsistence fishing was reduced to 3 days per week in the Nushagak river.

In 2010, in Norton Sound, Chinook salmon had the poorest run on record and precluded commercial fishing directed on Chinook salmon for the fifth consecutive season; restrictions and early closures to the Chinook salmon subsistence and sport fisheries in Shaktoolik (Subdistrict 5) and Unalakleet (Subdistrict 6) were also implemented to meet escapement needs. Chinook salmon in Subdistricts 5and 6 were designated a stock of yield concern in 2004 and the Alaska BOF continued this designation in February 2007 and January 2010. In Norton Sound only the eastern area has sizeable runs of Chinook salmon. The primary assessment tools for gauging Chinook salmon run strength are the Unalakleet River test net and floating weir, enumeration towers on Kwiniuk, Niukluk, and North rivers, aerial surveys, and inseason subsistence catch reports.

Chum salmon status

Stock composition for Chum salmon in the Bering Sea is currently available by aggregate groupings (micro-satellite baseline): East Asia, North Asia, Western Alaska (includes lower Yukon), Upper/Middle Yukon, Southwest Alaska, and Pacific Northwest (includes stocks from Prince William Sound to Washington State). Aggregations were developed based on a combination of genetic characteristics and relative contributions to the mixture. To determine the stock composition mixtures of chum salmon in the Bering Sea, a number of genetics analyses have been completed (i.e., Marvin et al. 2011, Gray et al. 2011, and McCraney et al. 2010). These studies have shown that genetic samples collected from chum salmon bycatch in the Bering Sea were predominantly from Asian stocks. Substantial contributions were also from western Alaska and the Pacific Northwest. There appeared to be a higher contribution from East Asia and lower contribution from Western Alaska in more recent years (Guyon et al. 2010). Overall, the estimate of AEQ chum salmon mortality from 1994–2010 ranged from about 16,000 fish to just over 540,000 (NPFMC 2012b). Additional funding and research focus is being directed towards both collection of samples from the eastern Bering Sea trawl fishery for Chum salmon species as well as the related genetic analyses to estimate stock composition of the bycatch. Updated information will be provided in the EA for Bering Sea chum salmon prohibited species catch management to be reviewed at a future meeting of the Council.

Chum salmon fisheries in Alaska occur in 11 management regions which are detailed on the ADF&G website at http://www.cf.adfg.state.ak.us/region3/finfish/salmon/salmhom3.php. These include chum salmon fisheries in the Arctic-Yukon-Kuskokwim (AYK) management area and target hatchery runs in Prince William Sound and Southeast Alaska. Chum salmon runs to AYK rivers have fluctuated in recent years. Chum salmon in the Yukon River and in some areas of Norton Sound had been classified as stocks of concern (Eggers 2004). In response to the guidelines established in the Sustainable Salmon Policy, the BOF discontinued the Yukon River summer and fall chum salmon as stocks of concern during the February 2007 work session.

The Bering-Aleutian Salmon International Survey study has observed significant increases in juvenile chum in the Bering Sea through 2005. Further, bycatch of adult chum in Bering Sea trawl fisheries has increased. Although not all of these fish are bound for western Alaska, higher bycatch may be an indicator of favorable ocean conditions, and chum ocean survival may have increased significantly.

Yukon summer chum salmon runs have exhibited steady improvements since 2001 with the drainage wide optimum escapement goal of 600,000 fish exceeded annually. Summer chum runs have provided a harvestable surplus the last 7 years (2003–2009), and since 2007, there has been a renewed market interest for summer chum salmon in the lower river Districts 1 and 2. In 2010, a surplus of summer chum salmon was anticipated above escapement and subsistence needs; however, the extent of a directed chum commercial fishery is dependent on the strength of the Chinook salmon run. The ADF&G took an unprecedented action to cancel the commercial period on a short notice to avoid harvesting a significant number of Chinook salmon because test fishery information showed an abrupt drop in the summer chum entering the river. The summer chum salmon harvest of 232,888 was 193% above the 2000–2009 average harvest of 79,438 fish (ADF&G 2010). Chum salmon escapements ranged from above average to below average at all monitored locations (ADF&G 2010).

In 2010, the preliminary total run size for Yukon fall chum salmon, primarily calculated from the main river sonar at Pilot Station, was approximately 396,000 fish, and the postseason estimates was 480,000 fish. For the Yukon fall chum salmon stocks, considerable uncertainty has been associated with these run projections, particularly recently because of unexpected run failures (1997 to 2002), which were followed by a strong improvement in productivity from 2003 through 2006 (ADF&G 2010). Weak salmon runs prior to 2003 have generally been attributed to reduced productivity in the marine environment and not a result of low levels of parental escapement.

Throughout the Kuskokwim area in 2010, chum abundance was considered very good, and amounts necessary for subsistence use is expected to have been achieved throughout the area. Kuskokwim River chum salmon are an important subsistence species, as well as the primary commercially targeted salmon species on the Kuskokwim River in June and July. Kuskokwim River chum salmon were designated a stock of concern under yield concern in September 2000, and this designation was discontinued in February 2007. Since 2000, chum salmon runs on the Kuskokwim have been improving (ADF&G 2010).

The 2010 Norton Sound commercial chum salmon harvest was the largest since 1986. Commercial chum salmon harvests were the highest observed since the mid-1980s in most Norton Sound Subdistricts. The Norton Sound preliminary ex-vessel value of $1,220,487 was record setting and was 123% above the recent 5-year average (2005–2009) (ADF&G 2010). Improved market conditions and the strong chum salmon run led to increased participation and the high value of the Norton Sound salmon fishery in 2010. A record number of 494 subsistence salmon permits were issued for the Nome Subdistrict in 2010. The Nome Subdistict escapement of chum salmon in 2010 is a new record and is 180% above the upper bounds of the Biological Escapement Goal range of 23,000–35,000 fish. Subsistence harvests for chum were above average in all areas except for Golovnin Bay (despite the large surpluses available for subsistence) (ADF&G 2010). In 2010, Chum salmon escapement was well above average to record setting across Norton Sound and the Port Clarence area (ADF&G 2010).

Chum salmon also is harvested in the Kotzebue area. In 2010, the commercial fishery was extended by emergency order three days past the regulation closure date because of a very strong chum salmon run and the commercial harvest of 270,343 chum salmon was the highest since 1995 (ADF&G 2010). The 2010 overall chum salmon run was estimated to be above average based on the commercial harvest rates, subsistence fishery reports, and the Kobuk river test index as the fifth best in the 18-year project history. Escapement is monitored by a test fishery project on the Kobuk River. Each year, the majority of chum salmon are usually 4–5 year old fish; in 2010 there was a record number (88%) of 4-year old and a record low (6%) of 5-year old fish in the commercial catch. No stocks in the Kotzebue area are presently identified as being of management or yield concern and the commercial fishery is allowed to remain open continuously with harvest activity regulated by buyer interest. In 2010, the ex-vessel value for the Kotzebue fishery was $860,125 and was the highest value since 1988. No subsistence harvest information is available from 2010 other than comments that chum salmon fishing on the Kobuk River and Noatak River was very good (ADF&G 2010).

5.2.3 Pacific halibut

On an annual basis, the International Pacific Halibut Commission (IPHC) assesses the abundance of Pacific halibut and sets annual harvest limits for the commercial setline fishery (individual fishing quota [IFQ] fishery). The stock assessment is based on data collected during scientific survey cruises, information from commercial fisheries, and an area-specific harvest rate that is applied to an estimated amount of exploitable biomass. This information is used to determine a biological limit for the total area removals from specific regulatory areas. The biological target is known as the "Constant Exploitation Yield" (CEY) for a specific area and year. Removals from sources other than the IFQ fishery are subtracted from the CEY to obtain the "Fishery CEY". These removals include bycatch mortality greater than 26 inches in total length (discard) or O26 bycatch, O26 halibut killed by lost and abandoned gear, halibut harvested for personal use, and sport catch. Halibut under 26 inches (U26) halibut bycatch is accounted for in the setting of the harvest rate, which is applied to the total exploitable biomass calculated by the IPHC on an annual basis. Finally, the amount of halibut recommended for the IFQ fishery may be different from the Fishery CEY level due to other considerations by the IPHC.

The IPHC holds an annual meeting where IPHC commissioners review IPHC staff recommendations for harvest limits and stock status (e.g., CEY). The IPHC stock assessment model uses information about the age and sex structure of the Pacific halibut population, which ranges from northern California to the Bering Sea. The most recent halibut stock assessment was developed by IPHC staff in December 2010 for the 2011 fishery. This assessment resulted in a coast wide exploitable biomass of 318 million pounds, up from 275 million pounds estimated in 2010. Based on the currently estimated age compositions, both exploitable and spawning biomass are projected to increase over the next several years as several strong year classes recruit to the fishable and spawning components of the population. Using scientific survey estimates of relative abundance, an apportionment methodology was used to estimate biomass in each IPHC regulatory area.

The 2011 and 2012 halibut PSC limit for the Bering Sea and Aleutian Islands (BSAI) is allocated between the trawl fishery and the non-trawl fisheries. The trawl fishery has a halibut PSC limit that may not exceed 3,675 mt (§ 679.21(e)(1)(iv)). The non-trawl fishery has a halibut PSC limit that may not exceed 900 mt. The Bering Sea pollock fishery is currently exempted from fishery closures due to reaching a halibut PSC limit. Regulations at 50 CFR 679.21(e)(7)(i) exempt vessels using pelagic trawl gear and targeting pollock from being closed due to reaching their bycatch allowance or seasonal apportionment. This exemption allows the pollock fishery to continue fishing even if their allowance of halibut PSC (for the combined pollock/Atka mackerel/other species fisheries) has been reached. As a result, NMFS balances the halibut PSC limit in the pollock trawl fishery against halibut PSC limits in the non-pollock trawl fishery categories. This process ensures the overall BSAI trawl PSC limit is not exceeded.

5.2.4 Impacts of alternatives on prohibited species

The significance criteria used to evaluate the effects of the action on nontarget and prohibited species are in Table 5-4. These criteria are from the groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA) (NMFS 2007a). The only difference here from that document is that no impact is interpreted to be no change in the incidental take of the non-target or prohibited species in question.

Table 5-4 Criteria used to estimate the significance of impacts on nontarget and prohibited species.

No impact	No change in incidental take of the nontarget and prohibited species in question.
Adverse impact	There are incidental takes of the nontarget and prohibited species in question.
Beneficial impact	Natural at-sea mortality of the nontarget and prohibited species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	Fisheries are subject to operational constraints under PSC management measures. Groundfish fisheries without the PSC management measures would be a significantly adverse effect on prohibited species. Operation of the groundfish fisheries in a manner that substantially increases the take of nontarget species would be a significantly adverse effect on nontarget species.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on the nontarget and prohibited species, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

Changes in catch by gear type are shown for Chinook salmon, non-Chinook salmon, halibut, and red king crab (Table 5-5). Overall catch numbers for salmon species are extremely low for these target fisheries and as such are averaged over all years to show some contrast between catch averages inside and outside of the proposed closures. Chinook and non-Chinook salmon are more commonly caught in the pollock fishery and are not caught in any significant quantities in the fisheries under consideration in this analysis. Nevertheless changes in catch inside and outside of the proposed closures are tabulated for these species and indicate no change under most closure configurations and a small increase in catch outside of the closures under Alternative 4a and b for Chinook, however the numbers (averaged over all years) remain extremely small (less than 680 fish averaged over all years). This increase is a function of the reprojection analysis and may not be indicative of a true change in catch outside of the closure, however to the extent that there is an increase in catch for the non-pelagic trawl catch of Chinook and chum there is an adverse impact.

ESA-listed salmon

For Chinook salmon, the amount of salmon taken under the closures scenario PSC_75 (1975 to 1983 distribution of PIBKC) for non-pelagic trawl could potentially double from 768 salmon (catch within the closure area) to 1,447 salmon (reprojected catch outside the closure area). Scenario PSC_75 corresponds to Alternatives 5 and 6. NMFS has consulted the NWFSC on the the groundfish fisheries incidental take of salmon under Amendment 91 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands (BSAI groundfish FMP) to limit Chinook salmon PSC in the Bering Sea pollock fishery. However, the level of anticipated salmon bycatch under scenario PSC_75 is higher than projected under Amendment 91, so if the alternative selected included scenario PSC_75, consultation on Chinook salmon would be needed.

For all other gear types there is no change in incidental take therefore there is no impact under these alternatives.

Table 5-5 Prohibited species catch (Chinook salmon, non-Chinook salmon, halibut, and red king crab) by closure and gear type averaged over all years (2003–2010).

Species	Gear	Closure Scenario	PSC Inside	PSC Reprojected (outside)	Outside/ Inside	Groundfish catch (t)
CHNK	HAL	Current	5	9	1.572	52,396
		ADFG	3	3	0.845	19,129
		PSC_75	29	61	2.122	296,388
		PSC_84	16	23	1.452	139,165
	NPT	Current	1	1	0.992	3,787
		ADFG	2	4	2.424	31,154
		PSC_75	768	1,447	1.884	601,243
		PSC_84	417	542	1.301	312,087
	POT	Current	1	2	2.564	3,735
		ADFG	0	0	1.000	957
		PSC_75	3	1	0.209	5,137
		PSC_84	1	7	5.565	5,047
	PTR	PSC_75	0	0	0.973	0
HLBT	HAL	Current	1,218,236	1,235,647	1.014	52,396
		ADFG	469,987	429,992	0.915	19,130
		PSC_75	6,844,980	6,761,907	0.988	296,617
		PSC_84	3,095,962	3,306,750	1.068	139,211
	NPT	Current	9,800	10,739	1.096	3,796
		ADFG	94,169	79,223	0.841	31,154
		PSC_75	2,522,202	1,499,953	0.595	601,959
		PSC_84	876,852	977,290	1.115	312,443
	POT	Current	4,865	4,370	0.898	15,523
		ADFG	620	628	1.012	6,431
		PSC_75	12,002	12,384	1.032	24,441
		PSC_84	5,561	5,308	0.955	19,654
	PTR	PSC_75	0	0	1.028	0
NCHK	HAL	Current	41	37	0.885	52,383
		ADFG	0	2	5.689	19,130
		PSC_75	94	132	1.406	296,485
		PSC_84	58	55	0.952	139,177
	NPT	Current	3	6	1.920	3,787
		ADFG	12	13	1.083	31,154
		PSC_75	1,351	1,559	1.154	601,286
		PSC_84	266	379	1.426	312,266
	POT	Current	0	0	0	1,910
		ADFG	0	0	0	838
		PSC_75	0	0	0	2,918
		PSC_84	0	0	0	2,730
RKCR	HAL	Current	588	508	0.865	52,396
		ADFG	336	259	0.771	19,130
		PSC_75	1,550	1,368	0.882	296,566
		PSC_84	1,494	923	0.617	139,205
	NPT	Current	36	97	2.692	3,796
		ADFG	248	345	1.390	31,154
		PSC_75	13,632	16,735	1.228	601,820
		PSC_84	8,410	9,637	1.146	312,338
	POT	Current	10,322	7,583	0.735	17,986
		ADFG	1,105	1,109	1.003	6,828
		PSC_75	14,849	4,568	0.308	23,645
		PSC_84	12,831	6,645	0.518	20,889

Halibut is frequently caught in the yellowfin trawl fishery and as such is tabulated here for comparison of catch inside and outside of proposed closures. The ratio of catch for all closures and gear types indicates no change across all closures and gears for catch of halibut inside or outside of the proposed closure. For Alternative 4b for non-pelagic trawl gear (indicating the flatfish target fishery), the ratio is greater than 1 indicating an increase (and thus more catch outside than inside the closure); however, as this is averaged over all years, this is a very small indication of any relative change in catch and is not considered to be significant. Furthermore, this action is not changing the halibut limit for these fisheries which ensure a limit on the amount of halibut taken, regardless of where it is taken in the BSAI. Therefore, this action would still ensure the PSC constraints remain in place and the effects on halibut PSC would be insignificant.

Red king crab is also caught in the region of the Pribilof Islands region and as such is tabulated here for comparison of catch inside and outside of proposed closures. The ratio of catch for all closures for pot gear and hook-and-line gear indicates either no change or a positive benefit in catch of red king crab outside of the proposed closures. However for non-pelagic trawl there is a slight increase in catch in the closures proposed under Alternative 3 and 4a and 4b. The numbers are higher for closures under 4a and 4c, while relative numbers are very small for closure under Alternative 3. These numbers are also averaged over all years and are considered to be minor changes over all years. However while this increase is a function of the reprojection analysis and may not be indicative of a true change in catch outside of the closure, to the extent that there is an increase in catch for the non-pelagic trawl catch of red king crab there is an adverse impact. For all other gear types there is no change in incidental take or a decrease therefore there is no impact under these alternatives.

5.3 Marine Mammals and Seabirds

The Bering Sea supports one of the richest assemblages of marine mammals in the world. Twenty five species are present from the orders Pinnipedia (seals, sea lion, and walrus), Carnivora (sea otter and polar bear), and Cetacea (whales, dolphins, and porpoises). Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, the continental shelf, sea ice, shores and rocks, and nearshore waters (Lowry et al. 1982). The Alaska Groundfish Fisheries PSEIS (NMFS 2004a) describes the range, habitat, diet, abundance, and population status for marine mammals. Marine mammals that may occur in the action area and their status under the ESA are listed in Table 5-6 and Table 5-7.

The most recent marine mammal stock assessment reports (SARs) for strategic BSAI marine mammals stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, fin whales, and bowhead whales) were completed in 2012 based on a review of data available through 2011 (Allen and Angliss 2012). Pacific walrus status was updated in 2010 (Allen and Angliss 2011). The SARs provide population estimates, population trends, and estimates of the potential biological removal (PBR) levels for each stock. The SARs also identify potential causes of mortality and whether the stock is considered a strategic stock under the Marine Mammal Protection Act (MMPA). The SARs are available on the Protected Resources Division web site at http://www.nmfs.noaa.gov/pr/sars/region.htm.

A number of concerns may be related to marine mammals and potential impacts of fishing. For individual species, these concerns may include:

- Listing as endangered or threatened under the Endangered Species Act (ESA);
- Protection under the MMPA and inclusion in the MMPA List of Fisheries;
- Announcement as a candidate or being considered as a candidate for ESA listing;
- Declining populations in a manner of concern to state or Federal agencies;
- Large bycatch or other mortality related to fishing activities; or

- Vulnerability to direct or indirect adverse effects from fishing activities.

The Alaska Groundfish Harvest Specifications EIS (NMFS 2007a) and the Amendment 94 EA/RIR/FRFA (NMFS 2010a) provide information on the effects of groundfish fisheries on marine mammals. Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. This discussion focuses on those marine mammals species that may interact or be affected by groundfish fisheries impacted by the proposed action in the Bering Sea, as listed in the List of Fisheries for 2011 (75 FR 68468, November 8, 2010) or in the 2010 Alaska Marine Mammal Stock Assessments (Allen and Angliss 2011). These species are listed in Table 5-6 and Table 5-7.

Table 5-6 Status of pinniped stocks potentially affected by the Bering Sea groundfish fisheries in the action area.

Species and stock	***ESA Status***	***MMPA Status***	***Population Trends***	***Distribution in action area***
Steller sea lion - Western and Eastern Distinct Population Segment (DPS)	Endangered (W) Threatened (E)	Depleted, strategic	For the western DPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the western DPS appears stable (Fritz et al. 2008). The eastern DPS is steadily increasing and is being considered for delisting (NMFS 2010b).	Western DPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Islands chain and into Russian waters. Eastern DPS inhabit waters east of Prince Williams Sound to California. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Is., Aleutian Is., St. Lawrence Is. And off mainland. Use marine areas for foraging. Critical habitat designated around major rookeries and haulouts and foraging areas.
Northern fur seal – Eastern Pacific	None	Depleted, strategic	Recent pup counts show a continuing decline in productivity in the Pribilof Islands. During 1998–2006, pup production declined 6.1% annually on St. Paul Island and 3.4% annually on St. George Island. Despite near exponential growth on Bogoslof Island, the overall abundance estimate continues to decline in the Bering Sea.	Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 55% of the worldwide abundance of fur seals is found on the Pribilof Islands (NMFS 2007b). Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter and spring in the N. Pacific.
Harbor seal – Gulf of Alaska Bering Sea	None	None	Moderate to large population declines have occurred in the Bering Sea and Gulf of Alaska stocks.	GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands. Bering Sea stock found primarily around the inner continental shelf between Nunivak Island and Bristol Bay and near the Pribilof Islands.
Ringed seal – Alaska	Threatened – Arctic, Okhotsk, and Baltic subspecies Endangered – Ladoga subspecies	None	Reliable data on population trends are unavailable.	Found in the northern Bering Sea from Bristol Bay to north of St. George Island and occupy ice (Figure 6-1.
Bearded seal – Alaska	Threatened - Beringa and Okhotsk DPSs	None	Reliable data on population trends are unavailable.	Found in the northern Bering Sea from Bristol Bay to north of St. George Island and inhabit areas of water less than 200 m that are seasonally ice covered (Figure 6-1).
Ribbon seal – Alaska	None	None	Reliable data on population trends are unavailable.	Found throughout the offshore Bering Sea waters (Figure 6-1).
Spotted seal - Alaska	Status under review	None	Reliable data on population trends are unavailable.	Found throughout the Bering Sea waters (Figure 6-1).
Pacific Walrus	Status under review	Strategic	Population trends are unknown. Population size estimated from a 2006 ice survey is 15,164 animals, but this is considered a low estimate. Further analysis is being conducted on the 2006 survey to refine the population estimate.	Occur primarily is shelf waters of the Bering Sea. Primarily males stay in the Bering Sea in the summer. Major haulout sites are in Round Island in Bristol Bay and on Cape Seniavin on the north side of the Alaska Peninsula.

Species and stock	*ESA Status*	*MMPA Status*	*Population Trends*	*Distribution in action area*
Source: Allen and Angliss 2011 and List of Fisheries for 2011 (75 FR 68468, November 8, 2010). Northern fur seal pup data available from http://www.alaskafisheries.noaa.gov/newsreleases/2007/fursealpups020207.htm.				

Table 5-7 Status of Cetacean stocks potentially affected by the Bering Sea groundfish fisheries in the action area.

Species and stock	*ESA Status*	*MMPA Status*	*Population Trends*	*Distribution in action area*
Killer whale – AT1 Transient; Eastern North Pacific GOA, AI, and BS transient;	None	AT1 Transient Depleted, strategic	AT1 group is estimated at 7 animals. Unknown abundance for the eastern North Pacific Alaska resident; West Coast transient; and Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea transient stocks.	Transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes Gulf of Alaska transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.
Dall's porpoise – Alaska	None	None	Reliable data on population trends are unavailable.	Found offshore waters from coastal western Alaska to Bering Sea.
Humpback whale- Western North Pacific Central North Pacific	Endangered	Depleted, strategic	Reliable data on population trends are unavailable for the western North Pacific stock. Central North Pacific stock thought to be increasing. The status of the stocks in relation to optimal sustainable population (OSP) is unknown.	W. Pacific and C. North Pacific stocks occur in Alaskan waters and may mingle in the North Pacific feeding area shown in Figure 6-2. Humpback whales in the Bering Sea identity to western or Central North Pacific stocks, or to a separate, unnamed is stock difficult.
North Pacific right whale Eastern North Pacific	Endangered	Depleted, strategic	Abundance not known, stock is considered to represent only a small fraction of its pre-commercial whaling abundance.	See Figure 6-4 for distribution and designated critical habitat.
Fin whale Northeast Pacific	Endangered	Depleted, strategic	Abundance may be increasing but surveys only provide information for portions of the stock in the central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula, and much of the North Pacific range has not been surveyed.	Found in the Bering Sea and coastal waters of the Aleutian Islands and Alaska Peninsula. Most sightings in the central-eastern Bering Sea occur in a high productivity zone on the shelf break (Figure 7-1).
Minke whale Alaska	None	None	Considered common but abundance not known and uncertainty exists regarding the stock structure.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA.
Sperm Whale North Pacific	Endangered	Depleted, strategic	Abundance and population trends in Alaska waters are unknown.	Inhabit waters 600 m or more depth, south of 62°N lat. Males inhabit Bering Sea in summer.
Gray Whale Eastern North Pacific	None	None	Minimum population estimate is 17,752 animals. Increasing populations in the 1990's but below carrying capacity.	Most spend summers in the shallow waters of the northern Bering Sea and Arctic Ocean. Winters spent along the Pacific coast near Baja California.
Beluga whale Bristol Bay, Eastern Bering Sea, Cook Inlet, Eastern Chukchi Sea	Endangered (CI)	Depleted (CI)	Cook Inlet estimate is 280 whales, declining at 1.1% per anum. BB – 1,600, EBS – 18,000, ECS – 3,700, BS – 40,000	Bering Sea coastal waters year round. Cook Inlet population restricted to Cook Inlet.
Source: Allen and Angliss 2011 and List of Fisheries for 2011 (72 FR 68468, November 8, 2010). North Pacific right whale included based on Brix 2006 and Brix 2008 www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm				

5.3.1 ESA-listed marine mammals

Endangered Species Act Section 7 consultations have been completed for all ESA-listed marine mammals under NMFS jurisdiction in the Bering Sea (e.g., NMFS 2010b). Polar bears are not likely to be affected by the groundfish fisheries (73 FR 28212, May 15, 2008) and therefore have not been consulted on under Section 7 of the ESA. The Alaska Groundfish Harvest Specifications EIS provides a detailed description of the status of ESA Section 7 consultations through December 2006 (Section 8.2 of NMFS 2007a). This section provides information on Section 7 consultations that have taken place since that document was published.

5.3.1.1 Steller sea lions

The Steller sea lion has been listed as threatened under the ESA since 1990. In 1997, two stocks or distinct population segments (DPS) were recognized, based on genetic and demographic dissimilarities. Because of a pattern of continued decline, the western DPS was listed as endangered on June 5, 1997 (62 FR 30772), while the eastern DPS remains listed as threatened. NMFS has proposed delisting the eastern DPS (77 FR 23209, April 18, 2012). The western DPS inhabits an area of Alaska approximately from Prince William Sound (west of 144° W longitude) westward to the end of the Aleutian Islands chain and into Russian waters. One rookery, and several regularly used haulouts occur in the Pribilof Islands.

In 2006, NMFS reinitiated an FMP-level Section 7 consultation on the effects of the groundfish fisheries on Steller sea lions, humpback whales, and sperm whales to consider new information on these species and their interactions with the fisheries. The final Biological Opinion (BiOp) was released in November 2010, and NMFS implemented the Steller sea lion protection measures in the Reasonable and Prudent Alternative (RPA) on January 1, 2011 (NMFS 2010b) by interim final rule (75 FR 77535, December 13, 2010, corrected 75 FR 81921, December 29, 2010). The RPA did not change the Steller sea lion protection measures in the Eastern Bering Sea. Incidental take statements for Steller sea lions, humpback whales, fin whales, and sperm whales were completed on February 10, 2011 (Balsiger 2011).

A detailed discussion of Steller sea lion population trends in the WDPS is included in the most recent Biological Opinion (NMFS 2014) is incorporated by reference.

5.3.1.2 Ice seals

In December 2007, NMFS was petitioned by the Center for Biological Diversity (CBD) to list ribbon seals as endangered or threatened under the ESA (CBD 2007). The petition was based on the dependence of this species on sea ice and the loss of sea ice due to global climate change. The petition presented information on (1) global warming which is resulting in the rapid melt of the seals' sea-ice habitat; (2) high harvest levels allowed by the Russian Federation; (3) current oil and gas development; (4) rising contaminant levels in the Arctic; and (5) bycatch mortality and competition for prey resources from commercial fisheries. NMFS determined that the petition presented substantial information that a listing may be warranted and started a status review of the species (73 FR 16617, March 28, 2008). Detailed information on the biology, distribution and potential threats on ribbon seals is contained in CBD 2007.
NMFS determined that the listing was not warranted due to modeling of future sea ice extent and population estimates (73 FR 79822, December 30, 2008). On March 31, 2009, the CBD and Greenpeace filed a 60-day notice of intent to sue NMFS for failing to propose listing ribbon seals under the ESA. The CBD and Greenpeace filed a complaint for declaratory and injunctive relief on September 3, 2009, asking for the 12-month finding to be remanded. In December 2011, NMFS announced that it was initiating a new status review of ribbon seals to determine whether it should be listed under the ESA (76 FR 77467, December 13, 2011).

On May 28, 2008, the CBD petitioned NMFS to list ringed, bearded, and spotted seals under the ESA due to threats to the species from (1) global warming, (2) high harvest levels allowed by the Russian Federation, (3) oil and gas exploration and development, (4) rising contaminant levels in the Arctic, and (5) bycatch mortality and competition for prey resources from commercial fisheries (CBD 2008). NMFS initiated the status review for ringed, bearded, and spotted seals (73 FR 51615, September 4, 2008). Pursuant to a court settlement, NMFS completed the status review and issued a 12-month finding on October 15, 2009, for the spotted seal (74 FR 53683, October 20, 2009). NMFS determined that the status of the stocks of spotted seals occurring in Alaska indicated that no listing was needed. On December 10, 2010, NMFS completed its status reviews of ringed and bearded seals. The agency proposed listing four subspecies of ringed seals found in the Arctic Basin (including the Bering Sea) and the North Atlantic as threatened, and two DPSs of bearded seals in the Bering Sea and Okhotsk Sea as threatened under the ESA. In December 2011, NMFS extended the date for the final determination to list two DPSs of bearded seals as threatened, and four subspecies of ringed seals as threatened. On December 28, 2012, NMFS issued a final determination to list the Arctic, Okhotsk, and Baltic subspecies of the ringed seal as threatened and the Ladoga subspecies of the ringed seal (77 FR 76706, December 28, 2012) and the Beringia and Okhotsk DPSs of the bearded seal (77 FR 76740, December 28, 2012) as endangered under the ESA. Critical habitat for the ringed and bearded seal subspecies will be designated in a future rulemaking. Listing of ringed or bearded seals would require ESA consultation on Federal actions that may adversely affect them or any designated critical habitat.

The National Marine Mammal Laboratory surveyed ice seals during April through June 2007 from the U.S. Coast Guard vessel *Healy* in the Bering Sea. Figure 5-1 shows the abundance and distribution of bearded, ribbon, and spotted seals over the survey area. Satellite tagged ribbon and spotted seals from late spring through July showed that the animals mostly stayed in the Bering Sea south and west of St. Matthew Island with a few animals traveling north through the Bering Strait (Boveng et al. 2008).

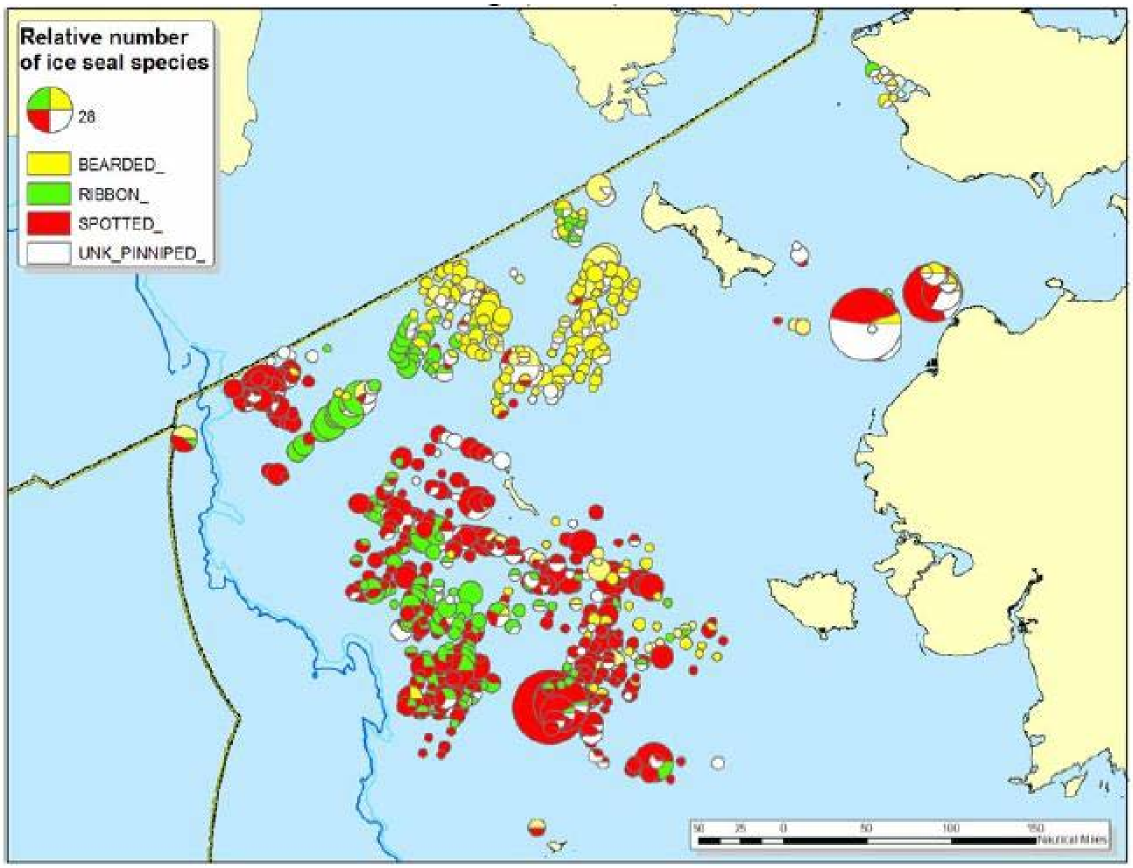


Figure 5-1 Ice seal survey during Healy cruises in summer in Bering Sea 2007 (Cameron and Boveng 2009).

5.3.1.3 North Pacific right whale

North Pacific right whales (*Eubalaena japonica*) were distinguished from North Atlantic right whales (*Eubalaena glacialis*) in 2008 (73 FR 19000, April 8, 2008). Eastern North Pacific right whales are arguably the most endangered stock of large whales in the world (Allen and Angliss 2011), with a minimum population estimate of 17 individuals. Critical habitat for North Pacific right whales consists of an area in the southeast Bering Sea and a small area southeast of Kodiak Island (Fig. 7-4), although most North Pacific right whale sightings have occurred within critical habitat in the Bering Sea.

After the North Pacific species was designated, the NMFS Alaska Region Sustainable Fisheries Division requested Section 7 consultation under the ESA on the effects of the Alaska groundfish fisheries. However, NMFS Protected Resources Division concluded that because an analysis in 2006 (Brix 2006) determined that the groundfish fisheries were unlikely to adversely affect North Pacific right whales or their critical habitat, and the 2008 action was a change in taxonomic status, no further consultation was required. Recently, NMFS has published a Notice of Intent to prepare a recovery plan for the North Pacific right whale (77 FR 22760, April 17, 2012).

Gillnets were implicated in the death of a North Pacific right whale off the Kamchatka Peninsula (Russia) in October of 1989 (Kornev 1994). No other incidental takes of right whales are known to have occurred in the North Pacific. North Atlantic right whales are known to become entangled in fishing gear, including lobster pot and sink gillnet gear, and entanglement is considered a major source of mortality for right whales in the Atlantic (Waring et al. 2004). Any mortality to North Pacific right whales from fishing activities or other human-caused mortality would be considered significant.

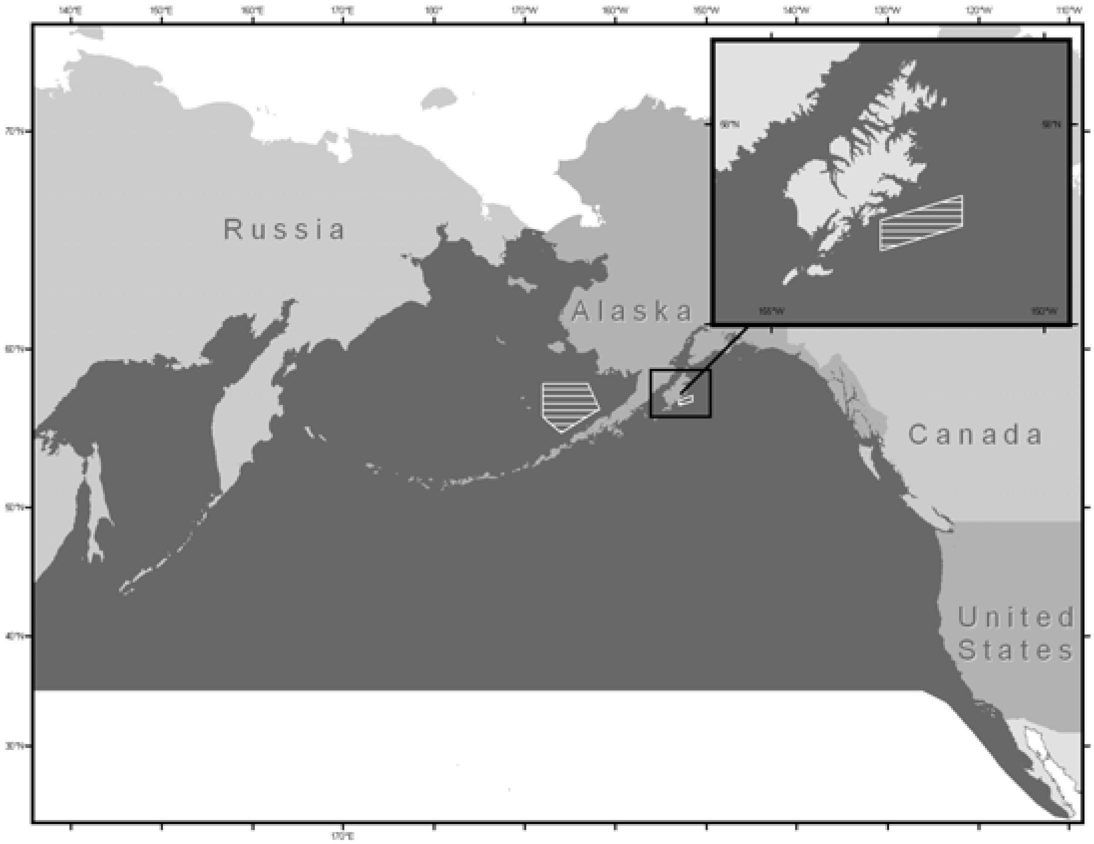


Figure 5-2. North Pacific right whale distribution and critical habitat shown in lined boxes. (Allen and Angliss 2012).

5.3.1.4 Pacific walrus

Pacific walrus (*Odobenus rosmarus divergens*) are managed by the U.S. Fish and Wildlife Service (USFWS). They occur throughout the shallow, continental shelf waters of the Bering and Chukchi Seas, occasionally moving into the East Siberian Sea and the Beaufort Sea. During the summer months, most of the population migrates into the Chukchi Sea, but several thousand animals, primarily adult males, aggregate at coastal haulouts in the Bering Straits region, Gulf of Anadyr, and Bristol Bay. The size of the Pacific walrus population has never been known with any certainty, and recent population estimates have provided unsatisfactory results because of differences in survey methods that produced large variances and unknown biases. The most recent population estimation (Speckman et al. 2011) is 129,000 with 95% confidence limits of 55,000 to 507,000.

The USFWS has determined that listing the Pacific walrus as threatened or endangered under the ESA is warranted, but precluded at this time by higher priority actions (76 FR 7634, February 10, 2011). Therefore, the agency has added the Pacific walrus to the candidate species list. As priorities allow, the USFWS will develop a proposed rule to list the Pacific walrus.

In the Bering Sea, the most heavily used coastal haulouts are Round Island (Walrus Islands State Game Sanctuary), Cape Peirce, and Cape Newenham (Togiak National Wildlife Refuge), and Cape Seniavin on the Alaska Peninsula. Recently, thousands of walrus have hauled out on beaches near Point Lay in the

Chukchi Sea as sea ice recedes off of the continental shelf and over deep, Arctic basin waters. At these dense haulouts, young walrus may be at increased risk of death by trampling if the adults stampede into the water (Garlich-Miller et al. 2011).

Pacific walrus occasionally interact with trawl and longline gear of groundfish fisheries. No data are available on incidental catch of walrus in fisheries operating in Russian waters, although trawl and longline fisheries are known to operate there. Incidental mortality during the 5-year period 2002–2006 was recorded only for the BSAI non-pelagic trawl fishery. No incidental injury was recorded during this time period.

5.3.1.5 Cook Inlet beluga whale

In a memorandum dated March 26, 2010, the NMFS Alaska Region Protected Resources Division (PRD) concurred with the Alaska Region Sustainable Fisheries Division (SFD) determination that Federal and State of Alaska parallel groundfish fisheries were not likely to adversely affect Cook Inlet beluga whales (Brix 2010). This consultation included Amendment 91 to the BSAI FMP to limit Chinook salmon PSC in the pollock fishery and determined the effects of the action on Cook Inlet beluga whales directly through vessel interaction and indirectly through potential prey competition were discountable and insignificant.

No chum salmon with coded wire tags (CWT) from Cook Inlet have ever been recorded in the BSAI groundfish fisheries, although the numbers of Cook Inlet CWT salmon are low, and none have been released since 1991. Genetic analyses indicate that a significant portion of the chum salmon PSC in BSAI groundfish fisheries are of Asian origin, although genetic baseline data from BSAI groundfish fisheries do not represent Cook Inlet populations well. Therefore, no definitive conclusions can be drawn regarding the percentage of chum salmon caught in the Bering Sea with Cook Inlet origins. However, data available for salmon PSC in the Gulf of Alaska (GOA) and BSAI fisheries indicates that the potential amount of Cook Inlet chum salmon harvested in the BSAI is small, and there is not likely to be a measurable direct effect to prey otherwise available to Cook Inlet beluga whales. Therefore, effects from the Alaska groundfish fisheries and Amendment 93 were considered insignificant.

In April, 2011 critical habitat for Cook Inlet beluga whales was designated which necessitated reinitiation of consultation on the effects of Alaska groundfish fisheries on Cook Inlet beluga whale critical habitat. In January 2012, SFD requested consultation on the effects of Alaska groundfish fisheries and Amendment 93 to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA groundfish FMP) on Cook Inlet beluga whales. In a memo dated February 15, 2012, PRD concurred with SFD that the two actions may affect, but are not likely to adversely affect, the Cook Inlet beluga whale or its critical habitat (Rivera 2012).

5.3.1.6 Sea otters

On August 9, 2005, the USFWS listed the southwest Alaska distinct population segment (SWDPS) of the northern sea otter as threatened under the ESA. The range of the SWDPS of the northern sea otter is from Attu Island at the western end of Near Islands in the Aleutians, east to Kamishak Bay on the western side of lower Cook Inlet, and includes waters adjacent to the Aleutian Islands, the Alaska Peninsula, the Kodiak archipelago, and the Barren Islands. While sea otters used be abundant in the Pribilof Islands at the time of the Russian discovery of the Islands, they were hunted to near extermination and now are very rarely seen[15]. The SWDPS of the northern sea otter has declined from an estimated 94,050 to 128,650 sea

[15] http://docs.lib.noaa.gov/noaa_documents/NOS/ORR/TM_NOS_ORR/TM_NOS-ORR_17/HTML/Pribilof_html/Pages/resources_marine_mammals.htm

otters in the mid-1970s to an estimated 53,674 sea otters, based on surveys conducted from 2000 to 2008 and adjusted for animals not detected (USFWS 2010). Sea otters are generally found between the shoreline and the outer limit of the kelp colonies, however sea otters can also inhabit marine environments that have soft sediment substrates (50 FR 46366, August 9, 2005). Sea otters dive to the seafloor to forage, and their diving ability to 100 meters determines their seaward range (50 FR 76455, December 16, 2008). The USFWS states that evidence suggests that increased predation by killer whales, rather than disease, starvation, or contaminants are responsible for the increase in morality (USFWS 2009).

5.3.2 Effects on marine mammals

5.3.2.1 Significance criteria for marine mammals

Criteria to assess the impacts of the action on marine mammals are listed below. These criteria are adopted from the 2006–2007 groundfish harvest specifications EA/FRFA (NMFS 2007a). As the alternatives being considered constitute a change from status quo, impacts are assessed as a change from status quo. Although impacts from commercial fisheries cannot be considered beneficial (incidental take, reduced prey availability, and increased disturbance are all adverse impacts), it is possible that an alternative considered in this analysis could reduce the harmful effects of commercial fisheries on marine mammals, if it can be demonstrated that they reduce incidental take, competition for prey, or disturbance.

Table 5-8 Criteria for determining significance of impacts to marine mammals.

	Incidental take and entanglement	Prey availability	Disturbance
Adverse impact	Mammals are taken incidentally to fishing operations or become entangled in marine debris.	Fisheries reduce the availability of marine mammal prey.	Fishing operations disturb marine mammals.
Beneficial impact	There is no beneficial impact.	There is no beneficial impact.	There is no beneficial impact.
Insignificant impact	No substantial change in incidental take by fishing operations, or in entanglement in marine debris	No substantial change in competition for key marine mammal prey species by the fishery.	No substantial change in disturbance of mammals.
Significantly adverse impact	Incidental take is more than PBR or is considered major in relation to estimated population when PBR is undefined.	Competition for key prey species likely to constrain foraging success of marine mammal species causing population decline.	Disturbance of mammal is such that population is likely to decrease.
Significantly beneficial impact	Not applicable	Not applicable	Not applicable
Unknown impact	Insufficient information available on take rates.	Insufficient information as to what constitutes a key area, prey species, or important time of year.	Insufficient information as to what constitutes disturbance.

5.3.3 Incidental Take Effects

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on marine mammals (Ch. 8 of NMFS 2007a) and is incorporated by reference.

Individual takes of marine mammals in the BSAI groundfish fisheries are small in comparison to the total mean annual human caused mortality, and in comparison to the PBR, where that has been determined. Table 5-9 provides more detail on the levels of take based on the most recent SAR (Allen and Angliss 2012). Overall, very few marine mammals are reported taken in the Bering Sea groundfish fisheries.

Table 5-10 provides the marine mammals taken in the potentially affected fisheries as published in the List of Fisheries for 2011 (75 FR 68468, November 8, 2010). Table 5-10 provides more detail on the levels of take based on the most recent SAR (Allen and Angliss 2011). Impacts to marine mammals are evaluated relative to their PBR, an estimate of the number of animals that may be removed from a population without impacting the stocks' ability to reach or maintain their optimum sustainable population. For all species in the action area for which PBR has been estimated, the total mean annual human-caused mortality is below the PBR (Table 5-10). Cook Inlet beluga whales and eastern North Pacific southern resident killer whales are included in Table 5-10 because of their reliance on Chinook salmon, despite the fact that they are not found in the action area. Increased bycatch mortality of Chinook salmon may affect these two stocks despite their isolation from the action area.

Table 5-9 Potentially affected fisheries with documented marine mammal takes from the List of Fisheries for 2011 (75 FR 68485, November 8, 2010).

	Marine Mammal Stocks Taken
BSAI Flatfish Trawl	Bearded Seal, Alaska Harbor Porpoise, Bering Sea Harbor Seal, Bering Sea Killer Whale, Alaska Resident Northern fur seal, Eastern Pacific Ribbon seal, Alaska Spotted seal, Alaska Steller sea lion, Western Alaska Walrus, Alaska
Cod Longline	Killer whale, Alaska Resident Ribbon seal, Alaska Steller sea lion, Western Alaska
Cod Pot	None documented

Table 5-10 Estimated mean annual mortality of marine mammals from potentially affected BSAI fisheries compared to the total mean annual human-caused mortality and potential biological removal.

Marine Mammal	Mean annual mortality, from affected BSAI fisheries	Total mean annual human-caused mortality *	PBR
Steller sea lions (western) **	5.0	223	254
Northern fur seal	1.4	565	13,809
Harbor seal (BS)	1.3	100	603
Spotted seal	1.2	5,266	N/A
Bearded seal	0	6,789	N/A
Ribbon seal	0	194	N/A
Killer whale – Eastern North Pacific, Alaska Resident	1.2	1.2	20.8
Beluga whale – Eastern Bering Sea	0	197	298
Beluga whale – Cook Inlet	0	0.4	Undetermined
Harbor Porpoise (BS)	2.45	N/A	Undetermined
Pacific Walrus	0	4,960 – 5,475	Undetermined
Killer whale – Eastern North Pacific Southern Resident	0	0.2	0.17

Mean annual mortality, expressed in number of animals, includes both incidental takes and entanglements, as data are available, and averaged over several years of data. Years chosen vary by species (Allen and Angliss 2011).

* Does not include research mortality. Other human-caused mortality is predominantly subsistence harvests for seals and sea lions.

** ESA listed stock

Table 5-11 Estimated mean annual mortality of marine mammals from observed BSAI groundfish fisheries and potential biological removal. Mean annual mortality is expressed in numbers of animals and includes both incidental takes and entanglements. The averages are from the most recent 5 years (Allen and Angliss 2011).

Marine Mammal Species and Stock	Years	Mean annual mortality					Potential Biological Removal (PBR)
		BSAI pollock trawl	BSAI flatfish trawl	BSAI cod trawl	BSAI cod HAL	BSAI Greenland Turbot HAL	
*Steller sea lions (western)	2002-2006	3.83	3.01	0.85	1.98		254
Northern fur seal	2002-2006	0.21	0.30		1.08		13,809
Harbor seal (BS)	2002-2006	0.29	1.31	1.33			603
Spotted seal	2002-2006	N/A	1.18				Undetermined
Ringed seal	2002-2006	N/A	0.46				Undetermined
Ribbon seal	2002-2006	N/A	0.27				Undetermined
Killer whale Eastern North Pacific AK resident	2002-2006	N/A	0.35		0.84		20.8
Killer whale, GOA, BSAI transient	2002-2006	0.41				0.75**	5.5
Dall's porpoise	2002-2006	1.09					Undetermined
*Fin whale, Northeast Pacific	2002-2006	0.23					11.4
Pacific walrus	N/A	N/A					2,580

* ESA-listed stock
** Data from 2007–2008

The maps of redistribution of fishing effort (Appendix A to the RIR attached separately) were used to estimate the movement of the fishing fleets as a result of imposition of the closures and to determine the likely impacts of the alternatives.

Recorded incidental take of the SWDPS of the northern sea otters is very rare. An observer documented the bycatch of eight sea otters in Pacific cod pots set (Narita 2012). In 1997, a fisherman self-reported the retrieval of a dead otter in a Bering Sea/Aleutian Islands groundfish trawl; however, it was indeterminate if the sea otter was dead or alive when it was caught in the net. Funk (2003) also noted a take resulting in mortality in the Aleutian Islands king crab pot fishery in 1975 through a self-report. Based on the very limited numbers of sea otters in the Pribilof Islands and the very rare occurrence of incidental take, any impacts to the SWDPS of the northern sea otter from these alternatives are expected to be insignificant.

5.3.3.1 Incidental Take Effects under Alternative 1: Status Quo

The effects of the status quo fisheries on the incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a and the Chinook Salmon Bycatch Management Measures EIS

(NPFMC/NMFS 2009). The mean annual take of marine mammals in the BSAI groundfish fisheries is well below PBRs for those species for which PBR has been calculated (Table 5-11). It is unlikely that under the Status Quo alternative there will be a substantial change in incidental take of marine mammals, or in entanglement in marine debris. Therefore, impacts from Alternative 1 are considered insignificant to the populations of these mammals.

5.3.3.2 Incidental Take Effects under Alternative 2

Under Alternative 2, the existing PIHCZ would be modified to extend to additional fisheries, on a year round basis. Under this alternative, more fisheries would be excluded from areas near the Pribilof Islands, thereby reducing the likelihood of incidental take in those fisheries. The area from which they would be excluded would not be expanded beyond the existing PIHCZ. Overall, any potential change to the likelihood of incidental take would be incremental, and is likely to be insignificant to the populations of these mammals.

5.3.3.3 Incidental Take Effects under Alternative 3

Alternative 3 would close the existing ADF&G crab closure to additional fishing effort. Under this alternative, some fisheries would be excluded from a greater area than under status quo, which could potentially reduce the likelihood of incidental take in those fisheries. Any potential change to the likelihood of incidental take would be incremental and is likely to be insignificant to the populations of these mammals.

5.3.3.4 Incidental Take Effects under Alternative 4

Alternative 4 would close the entire distribution of the PIBKC stock, from either 1975–2009 or 1984–2009. The closure would apply to either yellowfin sole trawl, other flatfish trawl, Pacific cod pot, and Pacific cod hook-and-line, or only to Pacific cod pot fishing, depending on options. The closure area would be larger than areas currently closed around the Pribilof Islands, potentially reducing the likelihood of incidental take in those fisheries. Because the area is larger than other closure areas being considered, the potential reduction in incidental take could be greater, although that result in not certain. Any potential change to the likelihood of incidental take would be incremental and is likely to be insignificant to the populations of these mammals.

5.3.3.5 Incidental Take Effects under Alternative 5

Alternative 5 would establish a PSC limit equal to the overfishing limit, the ABC, or a proportion of the ABC for the crab stock. A closure would apply to all groundfish fisheries that have contributed greater than a designated threshold to bycatch of PIBKC since 2003. The closure would apply to yellowfin sole trawl, other flatfish trawl, Pacific cod pot, and hook-and-line fisheries. Under various options in Alternative 5, the closure would either be the existing PIHCZ (Alternatives 1 and 2), the ADF&G crab closure area (Alternative 3), or the distribution of PIRKC (Alternative 4). Each option has the potential to incrementally decrease the likelihood of incidental catch of marine mammals. Any potential change to the likelihood of incidental take would be incremental and is likely to be insignificant to the populations of these mammals.

5.3.3.6 Incidental Take Effects under Alternative 6

Alternative 6 combines elements of Alternative 2 and Alternative 5. Alternative 6 exists of a year-round closure of the PIHCZ for fishing for Pacific cod with pot gear, and a fishery-wide closure of the area representing the distribution of the PIBKC stock from 1984–2009. Under Alternative 6, the combination of the PIHCZ and revised blue king crab distribution closure has the potential to reduce incidental take of marine mammals. Any potential change to the likelihood of incidental take would be incremental and is likely to be insignificant to the populations of these mammals.

5.3.4 Harvest of prey species

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on marine mammals in the BSAI (Ch. 8 of NMFS 2007a), and is incorporated here by reference. Additionally, recent Section 7 consultations (e.g., NMFS 2010b) have evaluated the effects of groundfish harvest on ESA listed marine mammals (Steller sea lion, humpback whale, sperm whale, fin whale). Those consultations concluded that groundfish fisheries were not likely to cause jeopardy or adverse modification of critical habitat for humpback, sperm, or fin whales, and included a reasonable and prudent alternative to remove the likelihood of jeopardizing the continued existence or adversely destroying or modifying designated critical habitat for the western DPS of Steller sea lions. Therefore, this evaluation considers impacts relative to the status quo (Alternative 1), and evaluates impacts according to the significance criteria outlined in Section 6.3.2.1, above.

Table 5-12 shows the Bering Sea marine mammals that may occur in the action area that may be impacted by the affected fisheries, and their prey species. Impacts to these species could either be in the form of direct competition for prey species (targeted catch or bycatch) or indirect competition due to impacts to habitat that supports prey species. Gray whales, sperm whales, Pacific walrus, bearded seals, spotted seals, ringed seals, and harbor seals are unlikely to compete with affected fisheries for prey, and are not considered further in this analysis.

For sea otters, research has indicated that 84% of foraging occurs in depths between 2 and 30 m and that 16% of all foraging was between 30 and 100 m (50 FR 76455, December 16, 2008). Most of this foraging area occurs within State-managed waters (from mean high tide to 4.8 km [3 mi] offshore) (50 FR 46367, August 9, 2005). Prey tends to be sessile or slow-moving benthic invertebrates such as mollusks; crustaceans; and echinoderms, including sea urchins (73 FR 76457, December 16, 2008). The type of prey and size depend on the location; time of year; duration at the location; and habitat type. The very rare occurrence of sea otters in the action area indicates that the Pribilof Islands are likely not an important foraging area for sea otters and that overall effects on benthic prey by the alternatives is not likely to affect sea otters. Therefore, the effects on sea otter prey from the alternatives is not further analyzed in this analysis.

Table 5-12 Marine mammal species in the Bering Sea that may compete with commercial fisheries for prey, and known prey items for those species.

Species	Prey
Gray whale	benthic invertebrates
Sperm whale	squid, some fish, shrimp, sharks, skates and crab
Beluga whale	wide variety of invertebrates and fish
Resident killer whale	wide variety of fish
Pacific walrus	benthic invertebrates, occasional seals and birds
Bearded seal	primarily benthic invertebrates, some fish (Arctic cod, saffron cod, sculpin, and pollock)
Spotted seal	primarily pelagic and nearshore fish, occasional cephalopods and crustaceans
Ringed seal	primarily arctic cod, saffron cod, herring, and smelt, crustaceans in spring
Ribbon seal	Arctic and saffron cod, pollock, capelin, eelpouts, sculpin and flatfish, crustaceans and cephalopods
Harbor seal	crustaceans, squid, fish, mollusks
Steller sea lion	pollock, Atka mackerel, Pacific herring, capelin, Pacific sand lance, Pacific cod, salmon, others
Northern fur seal	wide variety of fish (pollock, capelin, Pacific herring, others) and squid

5.3.4.1 Northern fur seals

In the eastern Bering Sea, pollock, squid, and capelin account for about 70% of the energy intake for northern fur seals (Perez 2007). In contrast, Pacific cod, rockfish, sablefish, flatfish and other fish generally constitute very little of the northern fur seal diet (Sinclair et al. 1994). It is possible that northern fur seals from different rookeries and haulouts feed on different species, as population trends (Towell et al. 2011) and foraging areas (Robson et al. 2004) differ.

The BSAI groundfish fisheries spatially and temporally overlap with northern fur seal foraging areas and may compete with fur seals for prey. The EIS for setting the annual subsistence harvest of northern fur seals on the Pribilof Islands (NMFS 2005) identified the harvest of northern fur seal prey by the BSAI groundfish fisheries as having the potential to have a conditionally significant cumulative effect when considered with the fur seal subsistence harvest. The EIS notes that the following factors lower the probability of adverse impacts stemming from spatial or temporal concentration of fisheries in northern fur seal foraging areas: (1) much of the catch of the fisheries occurs during the winter or A season when female and juvenile male fur seals are not commonly found in the areas fished, (2) the PIHCZ limits prey removals in waters surround the Pribilof Islands rookeries. The EIS concludes that conditionally significant adverse effects could occur with changes in harvesting activity and/or concentrating of harvesting activity in space and time such as increased groundfish fishing near the Pribilof Islands during June through August. None of the alternatives considered here would increase groundfish fishing in fur seal habitat during summer months, and the general effect of these alternatives is to move fishing activities farther from the Pribilof Islands.

Because northern fur seals from the Pribilof Islands forage in different areas of the Bering Sea (Robson et al. 2004), there is the potential that regulations that redistribute fishing effort could disproportionately affect seals from one of the islands more than the other. However, predictions of areas where catch is likely to be redistributed (see Appendix A to RIR) show that the catch is likely to be dispersed throughout a larger area than is currently fished, and is not expected to be concentrated in an area that could cause disproportionate effects to northern fur seals of a single island or rookery.

None of the alternatives considered here would increase the total allowable catch (TAC) for any of the affected fisheries. However, some alternatives have the potential for a very small increase in the PSC catch of Chinook and non-Chinook salmon (see Table 5-5). Because northern fur seals may take

Chinook and non-Chinook salmon seasonally (Sinclair et al. 1994), it is possible that these alternatives may have incrementally greater impacts on northern fur seals than the other alternatives. However, the number of additional salmon that may be taken is so small that the impact is likely to be insignificant to either individual northern fur seals or the northern fur seal population. Because no additional catch would be allowed, and the alternatives disperse the fleet from northern fur seal rookery and haulout areas, no substantial change in competition for prey resources is expected for northern fur seals from any alternative, and any effects are anticipated to be insignificant.

5.3.4.2 Steller sea lion

Harvest of prey species by groundfish fisheries is recognized as a very important potential impact on Steller sea lions and was considered in detail in the 2001 SEIS and BiOp (NMFS 2001), the 2003 Supplemental BiOp (NMFS 2003), and the 2010 BiOp (NMFS 2010b) and is addressed in the Steller sea lion recovery plan. The latest BiOp (NMFS 2010b) includes a reasonable and prudent alternative designed to remove the likelihood of jeopardy or adverse modification of the western DPS of Steller sea lions. A recent ruling by the U.S. District Court for Alaska remanded the EA that accompanied the BiOp back to NMFS, and required that NMFS prepare an EIS to assess alternative Steller sea lion mitigation measures in the western and central Aleutians. However, the determination that groundfish fisheries have the potential to negatively affect Steller sea lion existence or recovery, or alter designated critical habitat was retained. Therefore, any RPA that results from the EIS will remove the likelihood of jeopardy or adverse modification of the western DPS of Steller sea lions, and will remain in effect under all of the alternatives considered here.

Steller sea lion protection measures control the spatial and temporal harvest of groundfish species recognized as important prey for Steller sea lions to mitigate the potential for competition for prey with groundfish fisheries. This is accomplished by a number of measures including an overall harvest control rule, seasonal apportionments of harvests, limits on the amount of harvests in areas important to foraging Steller sea lions and restrictions on fishing in certain portions of Steller sea lion designated critical habitat. The Steller sea lion protection measures include measures to control spatial and temporal harvest of pollock, Pacific cod, and Atka mackerel, which are considered key Steller sea lion prey species (50 CFR 679.20(d)(4)). This ensures that on a global scale, the groundfish fisheries do not remove quantities of the available biomass that could potentially reduce foraging success for Steller sea lions. The global harvest of Pacific cod and Atka mackerel would be controlled by the harvest control rule for all alternatives considered here.

None of the alternatives considered here would increase the TAC for any of the affected fisheries. However, some alternatives have the potential for a very small increase in the PSC catch of Chinook and non-Chinook salmon (see Table 5-5). Because Steller sea lions feed on Chinook and non-Chinook salmon, it is possible that these alternatives may have incrementally greater impacts on Steller sea lions than the other alternatives. However, the number of additional salmon that may be taken is so small that the impact is likely to be insignificant to either individual Steller sea lions or the Steller sea lion population. Because existing Steller sea lion protection measures would continue under all alternatives, and no additional catch would be allowed, and the alternatives disperse the fleet from Steller sea lion haulout areas at the Pribilof Islands, no substantial change in competition for prey resources is expected for Steller sea lions from any alternative, and any effects are anticipated to be insignificant.

5.3.4.3 Fish-eating killer whales

Based on information presented in the PSEIS (NMFS 2004a), fish-eating killer whales (resident ecotype) compete with longline groundfish fisheries for prey. In the BSAI, killer whales have been observed feeding off of longline gear targeting sablefish and Greenland turbot. Consumption of other groundfish species by resident killer whales is largely unknown. The importance of groundfish as prey items for killer whales is unknown, but no evidence suggests exclusive reliance on commercially important groundfish fisheries. It is unlikely that any of the alternatives considered here will have any more than insignificant impacts to fish-eating killer whales.

5.3.4.4 Beluga whales

Beluga are opportunistic feeders, feeding on a wide variety of fishes and invertebrates (e.g., Loseto et al. 2009), and focusing on specific species when they are seasonally abundant. The Cook Inlet population of beluga whales was listed as Endangered under the ESA in October 2008. The Cook Inlet beluga whales rely on salmon year round (NMFS 2008), and Chinook salmon are likely to be seasonally important as they aggregate in summer to spawn. Some alternatives have the potential for a very small increase in the PSC catch of Chinook and non-Chinook salmon (See Table 5-5). However, it is unlikely that the increased Chinook and non-Chinook PSC will have a measureable effect on salmon used by the Bering Sea or Cook Inlet beluga whale stocks. Chinook salmon taken as bycatch in the Bering Sea fisheries are of mixed origin, with the majority coming from western Alaska. Cook Inlet belugas likely rely on Chinook salmon returning to Cook Inlet rivers and streams. The amount of increased salmon PSC that may occur from alternatives considered here is so small that it is not possible to measure a potential effect on the prey available for this ESA-listed beluga whale stock. Therefore, it is unlikely that any of the alternatives considered here will have any more than insignificant impacts to Bering Sea or Cook Inlet beluga whales.

5.3.5 Disturbance

The Alaska Groundfish Harvest Specifications EIS analyzed the potential disturbance of marine mammals by the groundfish fisheries (NMFS 2007a). The EIS concluded that the status quo fishery does not cause disturbance to marine mammals that may cause population level effects and fishery closures limit the potential interaction between fishing vessels and marine mammals. Because all proposed alternatives would relocate fishing further from shore-based habitat, it is not likely that any discernible increase in disturbance to nearshore marine mammals would occur. Because no increase in fishing activity would occur under any of the alternatives, it is also unlikely that any discernible increase in disturbance to offshore marine mammals would occur compared to status quo. Therefore, any disturbance impacts on marine mammals are likely to be incremental and insignificant.

5.4 Seabirds

Seabird breeding populations in the Bering Sea are estimated at 36 million birds, and total population size (including breeding and non-breeding birds) is estimated to be approximately 30% higher. More than 30 species of seabirds occur in the BSAI, including resident species, migratory species that nest in Alaska, and migratory species that occur in Alaska only outside of the breeding season. A list of species present in the BSAI is provided in Table 5-13, below.

Seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity (NMFS 2004a). These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. Because seabirds are long-lived animals it may take many years or decades before relatively small changes in survival rates result in observable impacts on the breeding population. Moloney et al. (1994) estimated a 5- to 10-year time lag in detecting a breeding population decline from modeled hook-and-line incidental take of juvenile wandering albatross, and a 30- to 50-year population stabilization period after conservation measures were put into place.

More information on seabirds in Alaska's exclusive economic zone (EEZ) may be found in several NMFS, NPFMC, and USFWS documents:

- The USFWS Migratory Bird Management program webpage may be accessed at: http://alaska.fws.gov/mbsp/mbm/index.htm.
- Section 3.7 of the PSEIS (NMFS 2004a) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf.
- The annual Ecosystems Considerations chapter of the Stock Assessment and Fishery Evaluation (SAFE) reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.
- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center may be accessed at http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.php.
- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage may be accessed at http://alaskafisheries.noaa.gov/protectedresources/seabirds.htm.
- The BSAI and GOA groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.alaskafisheries.noaa.gov/npfmc/default.htm.
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/communications/onlinepubs.html.
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a).
- Final Draft EA/RIR/IRFA for a Regulatory Amendment to Revise Regulations for Seabird Avoidance Measures in the Hook-and-Line Fisheries Off Alaska in IPHC Area 4E at: http://www.alaskafisheries.noaa.gov/analyses/seabirds/4E_earirirfa_0109.pdf.

Table 5-13 Seabird species in Alaska.

Species nesting in Alaska		
Tubenoses	Northern Fulmar	*Fulmarus glacialis*
	Fork-tailed Storm Petrel	*Oceanodroma furcate*
	Leach's Storm Petrel	*Oceanodroma leucorhoa*
Cormorants	Double-crested cormorant	*Phalacrocorax auritus*
	Brandt's Cormorant	*Phalacrocorax penicillatus*
	Pelagic Cormorant	*Phalacrocorax pelagicus*
	Red-faced Cormorant	*Phalacrocorax urile*
Waterfowl	Common Eider	*Somateria mollissima*
	King Eider	*Somateria spectabilis*
	Spectacled Eider	*Somateria fischeri*
	Steller's Eider	*Polysticta stelleri*
Jaegers, Gulls, Terns	Pomarine Jaeger	*Stercorarius pomarinus*
	Parasitic Jaeger	*Stercorarius parasiticus*
	Long-tailed Jaeger	*Stercorarius longicaulus*
	Bonaparte's Gull	*Larus philadelphia*
	Mew Gull	*Larus canus*
	Herring Gull	*Larus argentatus*
	Glaucous-winged Gull	*Larus glaucescens*
	Glaucous Gull	*Larus hyperboreus*
	Sabine's Gull	*Xema sabini*
	Black-legged Kittiwake	*Rissa tridactyla*
	Red-legged Kittiwake	*Rissa brevirostris*
	Arctic Tern	*Sterna paradisaea*
	Aleutian Tern	*Onychoprion aleuticus*
Auks & Puffins	Common Murre	*Uria aalge*
	Think-billed Murre	*Uria lomvia*
	Black Guillemot	*Cepphus grylle*
	Pigeon Guillemot	*Cephus columba*
	Marbled Murrelet	*Brachyramphus marmoratus*
	Kittlitz's Murrelet	*Brachyramphus brevirostris*
	Ancient Murrelet	*Synthliboramphus antiquus*
	Cassin's Auklet	*Ptychoramphus aleuticus*
	Parakeet Auklet	*Aethia psittacula*
	Least Auklet	*Aethia pussila*
	Whiskered Auklet	*Aethia pygmaea*
	Crested Auklet	*Aethia cristatella*
	Rhinoceros Auklet	*Cerorhinca monocerata*
	Tufted Puffin	*Fratercula cirrhata*
	Horned Puffin	*Fratercula corniculata*
Non-breeders in Alaska		
Tubenoses	Short-tailed Albatross	*Phoebastria albastrus*
	Black-footed Albatross	*Phoebastria negripes*
	Laysan Albatross	*Phoebastria immutabilis*
	Sooty Shearwater	*Puffinus griseus*
	Short-tailed Shearwater	*Puffinus tenuirostris*

Species nesting in Alaska		
Gulls	Ross's Gull	*Rhodostethia rosea*
	Ivory Gull	*Pagophila eburnea*

5.4.1 ESA-Listed seabirds in the Bering Sea

Three species of ESA-listed seabirds live in the Bering Sea: the endangered short-tailed albatross (STAL) and the threatened Steller's eider and spectacled eider. Kittlitz's murrelet and the Yellow-billed Loon are candidate species for listing under the ESA.

Short-tailed Albatross (*Phoebastria albatrus*)

The short-tailed albatross once ranged throughout most of the North Pacific Ocean and Bering Sea. Short-tailed albatross populations were decimated by feather hunters and volcanic activity at nesting sites in the early 1900s, and the species was considered extinct by 1949. In 1952, a small colony of 25 birds was discovered on Toroshima Island, Japan. Toroshima is an active volcano located southeast of Japan, and is the only known breeding colony for STAL. Prohibition of hunting and habitat enhancement work has allowed the population to grow at approximately 7–8% per year based on egg counts from 1990 to 1998, however the volcanic nature of this island places the only known rookery at great risk. To alleviate some of this risk, an international, collaborative effort was begun to translocate STAL chicks to a safer island within their historic breeding range in hopes that they would establish a new colony there. In February, 2008, 10 STAL chicks were moved from Toroshima Island to Mukojima Island. All 10 chicks fledged successfully. Recently, one of the fledged chicks has returned to Mukojima, promising data that the chicks may return to Mukojima to breed.

Short-tailed albatross feed at continental shelf breaks and areas of upwelling and high productivity (USFWS 2008). Short-tailed albatross feeding grounds are continental shelf breaks and areas of upwelling and high productivity (USFWS 2008). Although recent reliable diet information is lacking, STAL likely feed on squid and forage fish (USFWS 2008). Piatt et al. (2006) described STAL hotspots as areas characterized by vertical mixing and upwelling caused by currents and bathymetric relief which persist over time. In the Bering Sea, hotspots occur at Zhemchug, St. Matthew, Pervenets, and Pribilof Canyons along the Continental shelf (Piatt et al. 2006). Piatt et al. (2006) noted a single STAL flock in 2004 that was estimated to contain approximately 10% of the known world's population at Pervenets Canyon.

Because the STAL population is increasing at approximately 7% per anum (Zador et al. 2008), the potential for interaction with North Pacific fisheries is also increasing. However, recent modeling of the impacts of trawling (Zador et al. 2008) suggest that maintaining existing take limits (four observed takes during a two-year reporting period) are sufficient to achieve the species' proposed recovery goals, barring catastrophic stochastic events at the breeding colony.

Steller's Eider (*Polysticta stelleri*)

Steller's eiders are diving ducks that spend most of the year in shallow, near-shore marine waters. Molting and wintering flocks congregate in protected lagoons and bays, rocky headlands, and inlets. Steller's eiders feed by diving and dabbling for mollusks and crustaceans in shallow water. In summer they nest on coastal tundra adjacent to small ponds or within drained lake basins. During the breeding season they feed on aquatic insects and plants in freshwater ponds and streams.

There are five distinct areas of critical habitat in western Alaska; Izembeck, Nelson, Seal Island, Kuskokwim Shoals, and the Yukon-Kuskokwim Delta (USFWS 2001a). Current nesting habitat in

Alaska consists of a portion of the central Arctic coastal plain between Wainwright and Prudhoe Bay, primarily near Barrow. Biologists estimate that the total world's population of Steller's eiders is approximately 220,000 birds, the majority of which nest in Russia. The number of pairs nesting in Alaska's Arctic coastal plain is roughly estimated at 1,000. Overall the world's population of Steller's eiders may have decreased by as much as 50% over the last 30 years. At least 150,000 Steller's eiders winter in Alaska from the eastern Aleutian Islands to lower Cook Inlet. During their northward spring migration Steller's eiders can be found in large flocks close to shore from northern Bristol Bay to Hooper Bay (USFWS 2002).

There are no reported takes of Steller's eider in Alaskan fisheries, although incidental catch is considered a "major threat" in Baltic gillnet and setnet fisheries (OSPAR 1999)

Spectacled Eider (*Somateria fischeri*)

Spectacled eiders are large diving sea ducks that spend most of the year in marine waters where they primarily feed on bottom-dwelling mollusks and crustaceans. Spectacled eiders historically had a discontinuous nesting distribution from the Nushagak Peninsula north to Barrow, and east nearly to the Canadian border. Today, two breeding populations remain in Alaska in the Yukon-Kuskokwim Delta, and on the North Slope between Icy Cape and the Shaviovik River. Spectacled eiders molt in North Sound and Ledyard Bay, where they congregate in large, dense flocks that may be particularly susceptible to disturbance and environmental perturbations. During winter, spectacled eiders congregate in exceedingly large and dense flocks in pack ice openings between St. Lawrence and St. Matthew Islands in the central Bering Sea. Spectacled eiders from all three known breeding populations use this wintering area (USFWS 2001b). Larned and Tiplady (1999) estimated the entire wintering population, and possibly the world's population, at 374,792 birds.

Between the 1970s and 1990s, spectacled eiders on the Yukon-Kuskokwim Delta declined by about 96% from 48,000 pairs to fewer than 2,500 pairs in 1992 (USFWS 2001). The breeding population on the North Slope is currently the largest breeding population of spectacled eiders in North America. The most recent population estimate is approximately 4,750 pairs. However, this breeding area is approximately nine times the size of the Yukon-Kuskokwim Delta, so although more breeding pairs may occur on the North Slope, the density of breeding spectacled eiders on the North Slop is about 25% of that on the Yukon-Kuskokwim Delta.

Critical habitat has been designated for the spectacled eider in their wintering area between St. Lawrence and St. Matthew Islands (USFWS 2001b). Kuletz and Labunski (2008) reported that observes aboard the USCG Cutter *Healy* observed an estimated 250,000 to 300,000 spectacled eiders about 80 km off SW Cape on St. Lawrence Island. The most important feature of the critical habitat is the density of benthic fauna available for foraging eiders (G. Balogh, personal communication, in NMFS 2010a). A 2001 survey of prey eaten by spectacled eiders in this winter habitat showed almost exclusive use of *Nuculana radiata* clams (Lovvorn et al. 2003). Spectacled eiders do eat other bivalve species and may eat other benthic prey, such as polychaetes and amphipods, depending on abundance (Lovvorn, personal communication, in NMFS 2010a).

There is no recorded take of spectacled eiders in Alaskan fisheries.

Kittlitz's Murrelet (*Brachyramphus bravirostris*)

Kittlitz's murrelet is a small diving seabird that forages in shallow waters for small forage fish, zooplankton, and other invertebrates. The entire North American, and most of the world's population, inhabits Alaskan coastal waters discontinuously from Pt. Lay to Southeast Alaska. The Alaskan population is estimated to be between 9,000 and 25,000 breeding birds, and some populations have recently undergone significant declines in several of its core population centers—Prince William Sound (up to 84%), Malaspina forelands (up to 75%), Kenai Fjords (up to 83%), and in Glacier Bay. The USFWS believes that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species.

No Kittlitz's murrelets were reported taken in the observed groundfish fisheries from 2007 to 2010 (NMFS 2011). While Kittlitz's murrelets have been observed in the Bering Sea, their foraging techniques, diet composition, and the apparent fact that they are not attracted to fishing vessels reduces the likelihood of incidental take in groundfish fisheries (K. Rivera, personal communication, in NMFS 2010a).

Yellow-Billed Loon (*Gavia adamsii*)

Yellow-billed loons breed abundantly in the Alaska tundra on the North Slope all summer, in association with large, permanent fish-bearing lakes more than two meters deep. They are believed to be long-lived and dependent upon high annual adult survival to maintain current populations. The global population is estimated to be 16,500 and the total Alaska population is estimated to be between 3,700 and 4,900 animals. Limitations to current data and limited surveys preclude meaningful population trends. Yellow-billed loons are threatened by destruction of habitat, introduced predators, disturbance, and pollutants from oil and gas exploration and development. Human disturbances can cause changes in yellow-billed loon behavior, including abandonment of chicks and eggs, at distances of up to a mile.

There have been no reported takes of yellow-billed loons in groundfish fisheries in Alaska.

Other Seabird Species of Conservation Concern in the Bering Sea

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973". Birds of Conservation Concern (USFWS 2008b) identifies non-ESA listed birds with the highest conservation priorities and those in need of conservation action. USFWS (2008b) lists 28 species of birds in Region 7 (Alaska). Many of these species do not interact with Alaska fisheries and are not addressed in this analysis.

Black-Footed Albatross (*Phoebastria nigripes*)

Although not listed on the ESA, the black-footed albatross is a bird of conservation concern (USFWS 2008b) because some of the major colony population counts may be decreasing or are of unknown status. World population estimates range from 275,000 to 328,000 individuals (Brooke 2004), with a total breeding population of 58,000 pairs (USFWS 2006). Most of the population breeds in the Hawaiian Islands.

Black-footed albatrosses occur in Alaska waters mainly in the northern GOA, but do occur in the Bering Sea (USFWS 2006). Black-footed albatross are taken in the tuna and swordfish pelagic longline fisheries in the North Pacific, and to a lesser extent in the Alaska groundfish demersal longline fishery. From 2007 to 2010, an estimated 39 Black-footed albatross (5 to 18 estimated annually) were taken in Bering Sea Federal groundfish fisheries (NMFS 2011). An assessment of the black-footed albatross is available online at http://pubs.usgs.gov/sir/2009/5131/pdf/sir20095131.pdf.

Red-Legged Kittiwake (*Rissa brevirostris*)

The red-legged kittiwake is a small gull that breeds only at a few locations in the world, all of which are in the Bering Sea (USFWS 2006). Red-legged kittiwakes feed primarily on small forage fish, squid, and marine zooplankton. During the summer breeding period, they forage over deep water by plunging or dipping into the water. Red-legged kittiwakes feed both during the day and the night, but the large eyes of the red-legged kittiwake may be adapted to catch diurnal migrants at the surface during the nighttime (Byrd and Williams 1993).

Eighty percent of the world's population of red-legged kittiwakes nests on St. George Island in the central Bering Sea, the remainder nest on St. Paul Island, the Otter Islands, and Bogoslof and Buldir Islands. The global population is estimated at around 209,000 birds (USFWS 2006). Severe population declines have been reported, but remain unexplained (NMFS 2004a).

No red-legged kittiwakes were reported taken in Alaska groundfish fisheries from 2007 to 2010, although 20 "kittiwakes" (either red-legged or black-legged) were reported taken in the Bering Sea demersal longline fishery (NMFS 2011).

5.4.2 Impacts on seabirds

Table 5-14 contains the significance criteria for analyzing the effects of changes to groundfish fisheries in the action area on seabirds. These criteria are adapted from the Amendment 94 EA/RIR/FRFA (NMFS 2010a). Significantly beneficial impacts to seabirds are generally not possible with the management of groundfish fisheries as no beneficial impacts to seabirds are likely with groundfish harvest. Changes to fisheries increase or decrease potentially adverse impacts. Therefore, these alternatives are evaluated on their potential to increase or decrease impacts on seabirds from the status quo.

Table 5-14 Criteria for determining significance of impacts to seabirds.

	Incidental take	Harvest of prey species
Adverse impact	Significantly more seabirds are taken incidentally relative to baseline.	Significantly more competition for key seabird prey species relative to baseline.
Beneficial impact	Significantly fewer seabirds are taken incidentally relative to baseline.	Significantly less competition for key seabird prey species relative to baseline.
Insignificant impact	No substantial change in incidental take of seabirds relative to baseline	No substantial change in competition for key seabird prey species relative to baseline.

The Programmatic Supplemental EIS for groundfish fisheries in the GOA and BSAI contains a detailed description of the effects of the groundfish fishers on seabirds in the BSAI (NMFS 2004a) and is included here by reference. Additionally Section 7 consultations (e.g., NMFS 2009) have evaluated the effects of groundfish harvest on ESA-listed seabirds (Short-tailed albatross, Steller's eider). Those consultations have concluded that groundfish fisheries, with existing seabird avoidance measures,[16] were not likely to

[16] Current seabird avoidance regulations articulated in 50 CFR 679.24 apply to all operators of federally permitted vessels fishing for groundfish in the BSAI with hook-and-line gear. There are specific operation and discharge requirements along with specific gear requirements that apply to vessels of certain lengths operating in designated waters.

cause jeopardy or adverse modification of critical habitat for ESA-listed species. Therefore, this analysis evaluates impacts according to the significance criteria outlined above.

5.4.2.1 Incidental Take

The availability of “free food” in the form of offal and bait attracts many birds to fishing operations. Birds may then come in contact with fishing gear, either by ingesting bait and hooks, or by contacting gear such as wires during flight or while on the surface of the water. The probability of a bird being caught or injured is a function of many interrelated factors including: type of operation and gear used, length of time gear is at or near the surface, behavior of the bird, water and weather conditions, size of the bird, availability of food (including bait and offal), and physical condition of the bird. Current seabird avoidance measures would remain in place for all alternatives considered here.

Short-Tailed Albatross

Recently, three short-tailed albatross have been taken in Bering Sea groundfish hook-and-line fisheries The most recent take occurred on October 25, 2011 (Figure 5-3) (NMFS 2011). As a result of consultation with the USFWS under the ESA, USFWS issued an incidental take statement of four birds during each two-year period for the BSAI and GOA hook-and-line groundfish fisheries. In instances where the amount or extent of incidental take is exceeded, reinitiation of formal ESA consultation is required. To date, the incidental take levels have not been reached during the current or any previous Biological Opinions.

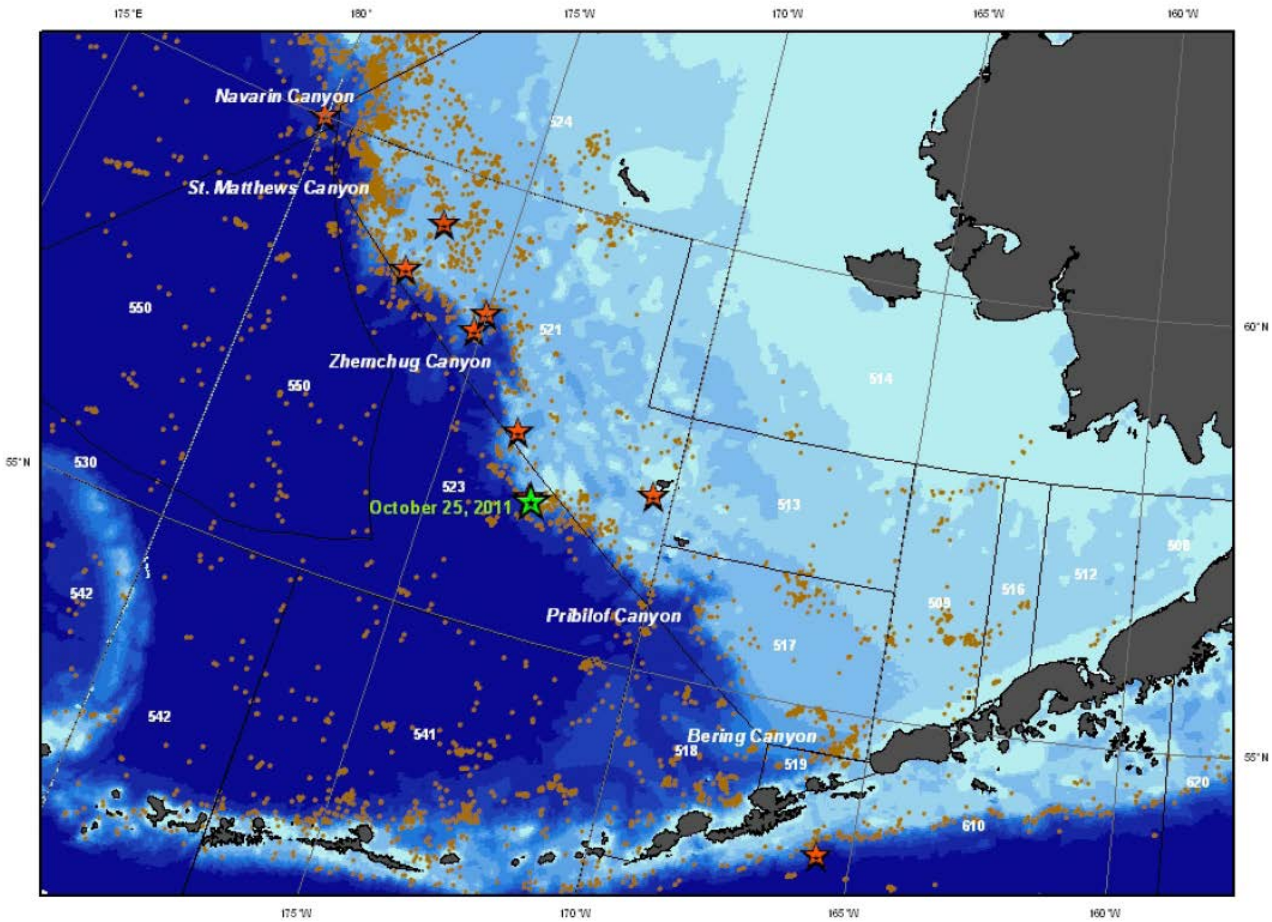


Figure 5-3 **Locations (brown dots) of short-tailed albatross instrumented with satellite-linked transmitters from September to November, 200 –2010. Also shown are reported takes (red stars), and most recent take (green star) of short-tailed albatross in Alaska fisheries for 1983–2011.**

The short-tailed albatross population has been growing rapidly at approximately 7% per year (Zador et al. 2008), which may increase the potential for interactions with Bering Sea fisheries. The alternatives considered here have the general effect to displace groundfish fisheries from their current (Status Quo) locations. If fishing activity is shifted to an area of short-tailed albatross concentration, there is the potential for an increase in interactions and incidental take of short-tailed albatross. Figure 5-4 shows the reprojected distribution of the Pacific cod hook-and-line effort, along with STAL sightings and incidental catch. It appears from this projection of displaced fishing effort that the alternatives considered here are unlikely to relocate hook-and-line fishing effort into areas of known STAL concentration. Any increase in interactions or incidental take due to displaced fishing effort is likely to be incremental and insignificant to the STAL population.

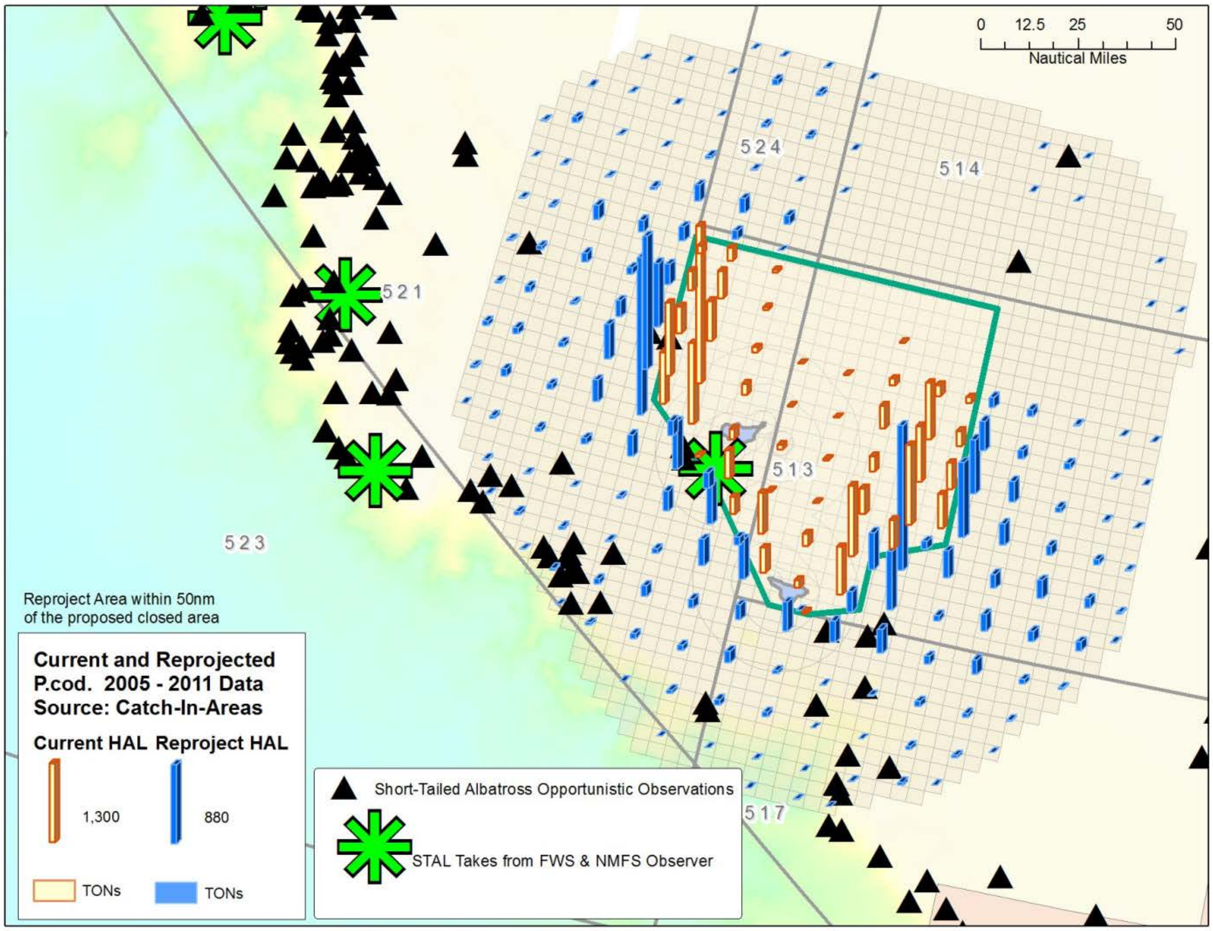


Figure 5-4 **Current and reprojected hook-and-line fishing effort, opportunistic short-tailed albatross sightings (black triangles) and recent short-tailed albatross takes (green stars) in the project area.**

Steller's and Spectacled Eiders, Kittlitz's murrelet, Yellow-billed loon

The fisheries potentially affected by these alternatives do not, generally, operate in the areas important to Steller's and Spectacled eiders, Kittlitz's murrelets, or yellow-billed loons. Nor are they expected to be displaced into their critical habitat. Therefore, for all alternatives, no substantial change in incidental take of these species is expected, and any impact to them is expected to be insignificant.

Other Seabird Species of Conservation Concern

Black-footed albatross are taken most often in the GOA, and much less frequently in Bering Sea fisheries. None of the alternatives analyzed here are expected to displace fisheries from the Bering Sea into the GOA, and any change in the distribution of fishing activity in the Bering Sea is expected to be minor, relative to the overall distribution of Black-footed albatross. For these reasons, it is expected that no substantial change in takes of black-footed albatross will occur, and any potential impacts to black-footed albatross are expected to be insignificant.

The majority of the world's red-legged kittiwakes nest on St. George and St. Paul Islands. Although they are found in close proximity to the potentially affected fisheries, very few kittiwakes (red- or black-legged) are taken in the Bering Sea groundfish fisheries. The effect of these alternatives, generally, is to displace the fleets farther from the Pribilof Islands. This may reduce the potential for kittiwakes to interact with the fleets because the density of vessels in the area near the Pribilof Islands would be reduced. However, no substantial change in the level of incidental take is expected, and any impacts to kittiwakes from these alternatives are expected to be insignificant.

5.4.3 Harvest of prey species

Fisheries management measures affecting availability and abundance of forage fish or other prey species can affect seabird populations. Seabirds feed on a variety of fish species in the water column and in the benthic habitat. Groundfish fishing operations may target some of these species and take others as bycatch, thereby reducing the supply of forage foods. By selectively harvesting certain species, groundfish operations may affect predator-prey relationships and seabird prey availability. Groundfish operations that alter benthic habitats may change their productivity and affect prey availability as well. Groundfish operations may fish down the food chain from larger predator species to smaller forage species that constitute seabird prey.

The PSEIS (NMFS 2004a) describes the impacts of prey abundance and availability on seabirds, and the Groundfish Harvest Specifications EIS (NMFS 2007a) described the qualitative judgments that are necessary to assess the impacts of groundfish fishing on seabird prey availability in the absence of a specific model. They note that seabirds may not depend heavily on the species and size classes of fish harvested by the directed groundfish fisheries, that forage fish harvests are restricted by regulation, and that there does not appear to be evidence that fishing operations are fishing down the food chain.

Short-tailed Albatross

Although some studies have shown that reproductive success of some seabird species is reduced when commercial fishing occurs within the species' foraging area during the breeding season (see http://www.penguins.cl), NMFS (2004a) considered the effects of commercial fishing governed by the BSAI and GOA groundfish FMPs to be discountable to the forage base of the short-tailed albatross for several reasons. First, STAL are wide-ranging and not restricted to a limited foraging area. Second, the birds' breeding area in Japan is a significant distance from the action area, and it is unlikely that STAL focus their foraging efforts during the breeding season in the areas where these fisheries occur. Third, STAL diet is believed to consist primarily of squid, shrimp, crustaceans, and surface-feeding fish. The fisheries potentially affected by the alternatives do not target these species. Finally, the high population growth rate and fledgling survival rate indicates that STAL are not food-limited during the energetically-demanding reproductive period or at other less energetically demanding times. None of the alternatives here would significantly change the harvest of STAL prey items, nor significantly change competition for prey species. Therefore, any effects on the harvest of prey species from these alternatives are likely to be insignificant.

Steller's and Spectacled Eiders, Kittlitz's murrelet, Yellow-billed loon

The fisheries potentially affected by the alternatives assessed here do not target prey species for Steller's and spectacled eiders, Kittlitz's murrelet, or yellow-billed loons. Nor do any of these species regularly follow fishing vessels. Therefore, it is unlikely that any of the alternatives discussed here would have any significant impact on the potential for competition between these species and potentially affected fisheries. Therefore impacts, if any, are expected to be insignificant.

Other Seabird Species of Conservation Concern

Black-footed albatross and red-legged kittiwakes do not feed on the species and size classes of fish harvested by the direct groundfish fisheries potentially affected by these alternatives. It is, therefore, unlikely that any of the alternatives would have any significant impact on the potential competition between these species and commercial fisheries. Therefore impacts, if any, are expected to be insignificant.

5.5 Habitat and Ecosystem Considerations

The marine waters and benthic substrates in the BSAI management area comprise the habitat of all marine species. Additionally the adjacent marine waters outside the EEZ, adjacent State waters inside the EEZ, shoreline, freshwater inflows, and atmosphere above the waters, constitutes habitat for prey species, other life stages, and species that move in and out of, or interact with, the fisheries' target species, marine mammals, seabirds, and the ESA-listed species. The issues of primary concern with respect to the effects of fishing on benthic habitat are the potential for damage or removal of fragile biota within each area that are used by fish as habitat and the potential reduction of habitat complexity, benthic biodiversity, and habitat suitability. Habitat complexity is a function of the structural components of the living and nonliving substrate and could be affected by a potential reduction in benthic diversity from long-lasting changes to the species mix. Many factors contribute to the intensity of these effects, including the type of gear used, the type of bottom, the frequency and intensity of natural disturbance cycles, history of fishing in an area and recovery rates of habitat features. This process is presented in more detail in Section 3.2 of the Habitat Areas of Particular Concern (HAPC) EA (NMFS 2006) as well as Section 3.4.3 of the EFH EIS (NMFS 2005). A specific description of the effects of nonpelagic trawl on habitat is in Section 3.2.1 of the HAPC EA and is adopted here by reference. Benthic habitat that has not been previously fished could potentially be fished in the future due to global warming and the potential for some target fish stocks to migrate into northern waters.

Criteria used in this EA to evaluate effects of the proposed action on habitat are provided in Table 5-15. The reference point against which the criteria are applied is the current size and quality of marine benthic habitat and other essential fish habitat in the Bering Sea and are adopted from the HAPC EA (NMFS 2006).

Table 5-15 Criteria used to determine significance of effects on habitat

Effect	Criteria			
	Significantly Negative (-)	**Insignificant (I)**	**Significantly Positive (+)**	**Unknown (U)**
Habitat complexity: Mortality and damage to living habitat species	Substantial increase in mortality and damage; long-term irreversible impacts to living habitat species.	Likely not to substantially change mortality or damage living habitat species.	Substantial decrease in mortality or damage to living habitat species.	Information, magnitude, and/or direction of effects are unknown.
Habitat complexity (non-living substrates such as gravel, sand, and shell hash)	Substantial increase in the rate of removal or damage of non-living substrates.	Likely not to substantially change, alter, or damage non-living substrates.	Substantial decrease in the rate of removal or damage of non-living substrates.	Information, magnitude, and/or direction of effects are unknown.
Benthic biodiversity	Substantial decrease in community structure from baseline.	Likely not to substantially change community structure.	Substantial increase in community structure from baseline.	Information, magnitude, and/or direction of effects are unknown.
Habitat suitability	Substantial decrease in habitat suitability over time.	Likely not to substantially change habitat suitability over time.	Substantial increase in habitat suitability over time.	Information, magnitude, and/or direction of effects are unknown.

The maps of redistribution of fishing effort (Appendix A to the RIR attached separately) were used to estimate the movement of the fishing fleet as a result of imposition of the closures and to determine the likely impacts of the alternatives. Section 4.3.2.1 of the EFH EIS addressed the effects of Alternative 1 (status quo) on fish habitat in the Bering Sea (NMFS 2005). The status quo in the EFH EIS was rated as an indiscernible effect. No new information is available to change this determination and under all proposed alternatives here, the distribution and extent of groundfish fisheries will change only incrementally; therefore, the current alternatives considered in this analysis likely has the same effect as the status quo in the EFH EIS and is thus rated as insignificant

Ecosystem characteristics of the BSAI management areas have been described annually since 1995 in the "Ecosystem Considerations" section of the annual SAFE reports. The proposed action could affect the marine ecosystem through spatial removals of fish biomass or alteration of the habitat. Three primary means of measurement of ecosystem change are evaluated here: predator-prey relationships, energy flow and balance, and ecosystem diversity. The criteria used to evaluate the significance of the effects on the ecosystem from the proposed action are provided in Table 5-16. The reference point for predator-prey relationships against which the criteria are compared are fishery induced changes outside the natural level of abundance or variability for a prey species relative to predator demands. The reference point for energy flow and balance will be based on bottom gear effort (qualitative measure of unobserved gear mortality, particularly on bottom organisms) and a quantitative assessment of trends in retained catch levels over time in the area. The reference point for ecosystem diversity will be a qualitative assessment whether removals of one or more species (target, non-target) effects overall species or functional diversity of the area.

Table 5-16 Significance thresholds for fishery-induced effects on ecosystem attributes.

Effect	Criteria			
	Significantly Negative (-)	Insignificant (I)	Significantly Positive (+)	Unknown (U)
Predator-prey relationships	A decline outside of the natural level of abundance or variability for a prey species relative to predator demands.	No observed changes outside the natural level of abundance or variability for a prey species relative to predator demands	Increases of abundance or variability for a prey species relative to predator demands	Magnitude or direction of effects are unknown
Energy flow and balance:	Long-term changes in system biomass, respiration, production or energy cycling, due to removals.	No observed changes in system biomass, respiration, production or energy cycling, due to removals.	Increases in system biomass, respiration, production or energy cycling, due to lack of removals.	Magnitude or direction of effects are unknown
Ecosystem Diversity	Removals from area decreases either species diversity or the functional diversity outside the range of natural variability. Or loss in one or more genetic components of a stock that would cause the stock biomass to fall below minimum biologically acceptable limits	No observed changes outside the natural level for species diversity, functional diversity or genetic components of a stock.	Non-removal from the area increases the species diversity or functional diversity or improves the genetic components of a stock.	Magnitude or direction of effects are unknown

Fisheries can remove predators, prey, or competitors and thus alter predator-prey relationships relative to an unfished system. Fishing has the potential to impact food webs, but each ecosystem must be examined to determine how important the potential impacts to the food webs are for that ecosystem. A review of fishing impacts to marine ecosystems and food webs of the North Pacific under the status quo and other alternative management regimes was provided in the programmatic groundfish PSEIS (NMFS 2004a) and in Appendix C of NMFS 2007a.

Section 4.3.8.6 of the EFH EIS provided an analysis of the effects of Alternative 1 (through its evaluation of EFH – Action 3 Alternatives 4 and 5 for effects on the ecosystem) (NMFS 2005). Because the scale of the proposed action is similar in area and the impacts of this action to the ecosystem are similar, the effects of the alternatives are also similar on marine ecosystems. The Alternative closure configurations would be more protective of ecosystem relationships within the additional closure areas.

Predator-Prey Relationships — Insignificant effects on predator-prey relationships are expected for Alternatives 2 through 6. No substantial changes would be anticipated in biomass or numbers in prey populations. No increase in the catch of higher trophic levels, nor changes in the risk of exotic species introductions are expected because there would be no change in fishing activities that would result in these types of effects. No large changes would be expected in species composition in the ecosystem. The trophic level of the catch would not differ much from the status quo, and little change would be expected in the species composition of the groundfish community, or in the removal of top predators. Alternatives 2 through 6 likely would have a slight positive effect on predator-prey relationships because fishing to additional gear types or closures in other areas would restrict catches in these regions and may lead to more prey availability. This effect is not likely to be observable because predator-prey relationships are not well documented in the northern portion of the Bering Sea. Therefore, Alternatives 2 through 6 would have an insignificant effect on predator-prey relationships.

Energy Flow and Balance — The amount and flow of energy in the ecosystem under the alternatives and option would be the same as the status quo with regard to the total level of catch biomass removals from groundfish fisheries. No substantial changes in groundfish catch or discarding would be expected. Therefore, the effects on energy flow and balance under Alternatives 2 through 6 are the same and insignificant.

Diversity — The impact of the closures themselves may lessen the impact of nonpelagic trawling in areas where it is not already closed or the impact of additional gear types, and therefore may be more protective of benthic habitat in general, but is not expected to have observable effects on diversity. Thus, species level diversity would remain the same relative to the status quo, and is rated as insignificant for Alternatives 2 through 6.

Given that an overall increase in fishing activity is not expected under the alternatives under consideration, and fleet movement as estimated by the maps of redistribution of fishing effort is expected to be very small in scale, the potential effects of this action on an ecosystem-wide scale are very limited. As a result, no significant adverse impacts on ecosystem relations are anticipated.

6 Cumulative Impacts

NEPA requires an analysis of the potential cumulative effects of a proposed federal action and its alternatives. 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 which 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 if evaluating each action individually. Concurrently, the Council on Environmental Quality (CEQ) guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful. Based on the preceding analysis, the effects that are meaningful are potential effects on Pribilof Islands blue king crab. The cumulative effects on the other resources have been analyzed in numerous documents and the impacts of this proposed action and alternatives on those resources is minimal, therefore there is no need to conduct an additional cumulative impacts analysis.

This EA analyzes the cumulative effects of each alternative and the effects of past, present, and reasonably foreseeable future actions (RFFA). The past and present actions are described in the previous sections in this chapter.

This section provides a review of the RFFA that may result in cumulative effects on Pribilof Islands blue king crab. 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). CEQ regulations require consideration of actions, whether taken by a government or by private persons, that are reasonably foreseeable. This requirement is interpreted to indicate actions that are more than merely possible or speculative. In addition to these actions, this cumulative effects analysis includes climate change and ocean acidification.

Actions are considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or NMFS's publication of a proposed rule. Actions only "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. Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

The following RFFAs are identified as likely to have an impact Pribilof Islands blue king crab within the action area and timeframe:
Fishery Ecosystem Plan for the Bering Sea
Pribilof Island Blue King Crab Enhancement
Crab fishery management
Crab bycatch in the groundfish fisheries
Climate Change

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

Fishery Ecosystem Plan for the Bering Sea

Ecosystem-sensitive management is likely to benefit Pribilof Islands blue king crab. The Council is discussing the possibility of developing a Fishery Ecosystem Plan for the Bering Sea, which if developed, would provide an ecosystem-level reference tool to help inform fisheries management decision-making in the Bering Sea. This actions would enhance the ability to further incorporate ecosystem considerations into the management process. This understanding in combination with increased integration of ecosystem considerations into fisheries decision-making is likely to result in fishery management that reduces potential adverse impacts of the proposed action on target stocks.

Pribilof Island Blue King Crab Enhancement

While hatchery efforts for blue king crab are not currently active in the Pribilof Islands region, there has been effort underway as part of the Alaska King Crab Research and Rehabilitation program to assess the feasibility of stock enhancement of blue king crab. Blue king crab have been successfully cultured in the laboratory and field studies are proposed in the Pribilof Islands region.

Crab fishery management

Several ongoing management efforts are considered here in traditional management tools. These include ongoing management of the crab fisheries under crab rationalization, ACLs for crab stocks, rebuilding plans for other crab stocks, and management changes that may impact incidentally caught crab species in the Bering Sea groundfish fisheries.

The Crab Rationalization Environmental Impact Statement (NMFS 2004b) and Amendment 24 to the Crab FMP (NPFMC 2008a), incorporated into this analysis by reference, assess the potential direct and indirect effects of crab fishery harvest levels in combination with other factors that affect physical and biological resource components of the BSAI environment.

The Council took final action in 2010 on an analysis of implementing ACLs for all BSAI crab stocks including the PIBKC stock as well as a revised rebuilding plan for the eastern Bering Sea snow crab stock. Acceptable biological catch (ABC) are annually specified by the Council's SSC. This includes the ABC for the PIBKC stock regardless of the fact that the directed fishery is closed.
No further constraint on crab fisheries are anticipated as a result of those actions.[17]

Crab bycatch in the groundfish fisheries

The Council is also considering a discussion paper evaluating crab bycatch in the groundfish fisheries. Accountability measures (AMs) are a required provision of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (Public Law 109-479) in conjunction with provisions for ACL requirements. The discussion paper is anticipated to evaluate AMs and how these relate to crab PSC limits in the groundfish fisheries. Bycatch is currently limited through area-specific crab PSC limits in the groundfish fisheries. Without further Council action, crab bycatch in the groundfish fisheries will be accounted for by reducing harvest in the directed crab fisheries. If alternative management measures are implemented in the future this could have an impact on groundfish fleet effort and distribution.

[17] The Council did not revise the existing rebuilding plan for snow crab at final action. The Council's action thus continues the existing rebuilding plan modified only by changing the definition of "rebuilt" to be equivalent to a single year of biomass above B_{MSY} as opposed to two consecutive years under the existing plan. No additional changes were recommended in the Council's action from October 2010.

Some of the recent BSAI groundfish fisheries actions that modify the way fisheries are prosecuted and could have an impact on the PIBKC stock include modification to the halibut PSC limits, an allocative split between the Aleutian Islands and Bering Sea total allowable catch for Pacific cod, and designation of habitat areas of particular concern.

The Council is always in process of considering management changes to the BSAI groundfish fisheries. Actions under consideration in the next few years include measures to reduce salmon bycatch, including testing a salmon excluder device through an exempted fishing permit and regulatory revisions to encourage the development of local, small-vessel Pacific cod fisheries in the Western Alaska Community Development Quota groups.

Climate Change

Changes in the Bering Sea due to global climate change may be of a concern to the organisms that live in this environment. The release of carbon to the atmosphere from the burning of fossil fuels likely contributes to global warming. The impacts of global warning in the Bering Sea can include a rise in sea surface temperature, retreat of sea ice and acidification of marine waters.

Compelling evidence from studies of changes in Bering Sea and Arctic climate, ocean conditions, sea ice cover, permafrost, and vegetation indicate that the area is experiencing warming trends in ocean temperatures and major declines in seasonal sea ice. While climate warming trends are being studied and increasingly understood on a global scale, the ability for fishery managers to forecast biological responses to changing climate continues to be difficult. The North Pacific Ocean is subject to periodic climatic and ecological "regime shifts." These shifts change the values of key parameters of ecosystem relationships, and can lead to changes in the relative success of different species.

Many efforts are underway to assess the relationship between oceanographic conditions and groundfish species. Diversity among groundfish species means that the uncertainty in predicting biological responses to climate change remains large, and the specific impacts of changing climate on salmon cannot be assessed.

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 GOA through the presentation of the "Ecosystem Considerations" chapter of the annual SAFE reports). 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.

7 FMP and Magnuson-Stevens Act Considerations

7.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Act. A discussion of the consistency of the preferred alternative with those National Standards is included following the description of each.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.

In terms of achieving "optimum yield" from the fishery, the Act defines "optimum," with respect to yield from the fishery, as the amount of fish which—

(A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

(B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and

(C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

The preferred alternative prevents overfishing of Pribilof Islands blue king crab (PIBKC) by closing the area of known concentration of blue king crab to the fishery with the highest observed prohibited species catch (PSC) catch rates. Given that the reprojection analysis indicates no reduction of catch for the Pacific cod pot fishery within the Pribilof Islands Habitat Conservation Zone (PIHCZ), this closure will not impact the fishery's ability to achieve optimum yield.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

Information in this analysis represents the most current, comprehensive set of information available to the North Pacific Fishery Management Council (Council), recognizing that some information (such as operational costs) is unavailable. It represents the best scientific information available, recognizing that this is a data-poor stock and that efforts are ongoing to improve our understanding of this stock.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

This stock is managed as a single unit within the area defined as the stock boundary. Concerns have been raised that the current stock boundary area does not represent the actual PIBKC distribution. Therefore, it may not be appropriate to use the existing stock boundaries to establish trigger closure areas and PSC limits (Alternatives 2c, 5d, and 6-2). The stock boundary is not an issue with the preferred alternative as it represents a year-round area closure in the known area of stock concentration to the gear type with the highest observed catch rates of blue king crab.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

Nothing in the alternatives considers residency as a criterion for the Council's decision. Residents of the various states, including Alaska and states of the Pacific Northwest, participate in the fishery affected by this decision. No discriminations are made based on residency or any other criteria.

Furthermore, the preferred alternative, Alternative 2b is fair and equitable because it does not constrain Pacific cod harvests. Even though, in some years, the amount of bycatch of PIBKC inside the PIHCZ by the hook-and-line fishery is comparable to the amount taken by the Pacific cod pot fishery, the hook-and-line fishery is managed though cooperatives and capable of controlling fishing behavior without NMFS action. In the absence of a cooperative, additional management measures are necessary to minimize bycatch in the pot fishery.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

The wording of this standard was changed in the recent Magnuson-Stevens Act authorization, to consider rather than promote efficiency. Efficiency in the context of this change refers to economic efficiency, and the reason for the change, essentially, is to de-emphasize to some degree the importance of economics relative to other considerations (Senate Report of the Committee on Commerce, Science, and Transportation on S. 39, the Sustainable Fisheries Act, 1996). The analysis presents information relative to these perspectives and provides information on the economic risks associated with the proposed PSC reduction methods.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

All of the alternatives under consideration appear to be consistent with this standard.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

All of the alternatives under consideration appear to be consistent with this standard.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

Many of the coastal communities in Alaska and the Pacific Northwest participate in the Pacific cod pot fishery in one way or another such as homeport to participating vessels, the location of processing activities, the location of support businesses, the home of employees in the various sectors, or as the base of ownership or operations of various participating entities. A summary of the level of fishery engagement and dependence in these communities of Pacific cod is provided in the Regulatory Impact Review (RIR).

The sustained participation of these fishing communities is not put at risk by any of the alternatives being considered. Economic impacts to participating communities would not likely be noticeable at the community level, so consideration of efforts directed at a further minimization of adverse economic impacts to any given community is not relevant.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The proposed action is specifically intended to reduce PIBKC bycatch. The practicability of bycatch reduction under all of the alternatives is discussed in the analysis of the impacts of the various alternatives and options. The preferred alternative minimizes bycatch to the extent practicable by closing the fishery with the highest observed rates of PIBKC bycatch to fishing in the area of known concentration of this stock.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The alternatives under consideration appear to be consistent with this standard. None of the alternatives or options proposed would change safety requirements for fishing vessels. No safety issues have been identified relative to the proposed action.

7.2 Section 303(a)(9) – Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that any plan or amendment include a fishery impact statement which shall assess and describe the likely effects, if any, of the conservation and management measures on (a) participants in the fisheries and fishing communities affected by the plan or amendment; and (b) participants in the fisheries conducted in adjacent areas under the authority of another Council, after consultation with such Council and representatives of those participants taking into account potential impacts on the participants in the fisheries, as well as participants in adjacent fisheries.

The alternative actions considered in this analysis are described in Section 2. The impacts of these actions on participants in the fisheries and fishing communities are the topic of sections in the RIR and Initial Regulatory Flexibility Analsysis.

Fishery Participants

At present, the PIBKC stock is under a rebuilding plan with no directed fishery allowed. In addition, the Pribilof Islands red king crab fishery has been closed since the 1999 season due to the imprecision of abundance estimates and concerns about bycatch of blue king crab.

As depicted in this environmental assessment, there does not appear to be potential for a directed fishery for PIBKC to occur, nor does it appear likely that the Pribilof Islands red king crab fishery will be opened in the foreseeable future. Thus, the PIBKC stock rebuilding plan will serve primarily to sustain the stock at levels sufficient to allow bycatch of PIBCK in the groundfish fisheries that occur around the Pribilof Islands. These groundfish fisheries are described in detail in the Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement (NMFS 2004a) and those descriptions are incorporated by reference.

The alternatives analyzed herein have the potential to affect several of the groundfish fisheries of the Bering Sea and Aleutian Islands management area (BSAI). These include target fisheries for Pacific cod and the various flatfishes; however, the Council has specifically exempted any fisheries that do not meet PIBKC bycatch thresholds, including the pollock fishery (see the discussion of the exemption in the description of the alternatives presented in Chapter 2). A detailed description of the potentially affected fisheries, including participation, landings, gross revenue, and market disposition can be found in the 2010 groundfish economic Stock Assessment and Fishery Evaluation (SAFE) Report (Hiatt et al. 2011), which is incorporated here by reference. The analysis uses specific data from the 2010 Economic SAFE to estimate potential gross revenue impacts and to compare such potential impacts with total values earned within target/gear combinations.

The analysis of Alternative 2b, the preferred alternative, provides a tabulation of the hypothetical aggregate tonnage of groundfish catch that would be put "at risk" by extending the PIHCZ closure to the Pacific cod pot and hook-and-line fisheries. These tabulations show that the effect of Option b (Pacific cod pot only) would have ranged from 125 tons (2010) of Pacific cod catch, put at risk, to as much as 2,769 tons (2005). The gross revenue put at risk, in round weight equivalent first wholesale value, would have ranged from approximately $200,000 (2010) to $4.4 million (2007). The Pacific cod pot fishery would have had impacts ranging from as high as 19.78% in 2005 to a low of 0.63% in 2010.

The analysis also provides catch reprojection to areas that remain open under this action. The reprojection analysis for Alternative 2b shows considerable inter-annual variability in both the locations and the relative intensity of catch that occurred within the closure area. In general, years with a few locations accounting for a majority of the catch within the closure area also reproject to a similar number of locations with similar catch intensity. In instances where catch within the closure area is more dispersed, the reprojection outside the closure area is similarly more dispersed. Thus, it is difficult to discern a consistent pattern that would suggest operational impacts due to reprojection of catch via effort relocation.

This analysis concludes that it is likely that some or all of the catch can be made up outside of the smallest proposed closure areas (e.g., PIHCZ of Alternative 2b) and under the triggered closures and/or threshold based triggered closures. The larger closure areas, based on historic stock distribution and catch reprojection analysis contained herein, would create potential impacts on catch and gross revenue of more than 10% of total fishery gross revenue in several years and nearly 30% in the worst case under examination here.

Fishing Communities

The 2010 Groundfish Economic SAFE (Hiatt et al. 2011, Table 35, page 70) indicates that the Being Sea pollock processors, which include American Fisheries Act shoreside processors operating in King Cove, Akutan, Sand Point, Dutch Harbor, and two floating processors earned approximately 80% of their all species combined gross revenue from groundfish processing in 2010. In these communities groundfish processing provides the majority of first wholesale processor gross revenue and changes in BSAI groundfish harvests and deliveries to these communities would have indirect effects on processor earnings, crew wages, municipal finance, and community structure.

In the Pribilof Islands, where a shore plant and a floating processor receive deliveries of nearly half of the Bering Sea snow crab quota, and a small share of the Bristol Bay red king crab quota, diversification into groundfish processing does not exist within the community of Saint Paul. Saint Paul is heavily dependent on the Bering Sea snow crab fishery and only receives between $1 and $2 million worth of halibut landings from area 4C and 4D halibut individual fishing quota (Sholtz et al. 2007). Actual halibut landings are confidential due to the existence of a single processing plant. The plant in Saint Paul does not process groundfish at present and would not be affected by changes in BSAI groundfish harvest and deliveries to shore plants.

This analysis has shown that redeployment of effort to recover small amounts of catch, while potentially increasing operating cost, will not have appreciable impacts on landings, fishing communities, markets, or consumers. However, as impacts increase with the size of the closure area it is less likely that all catch can be made up and, thus, there may be decreased landing and gross revenue, decreased tax gross revenue and vessel expenditures in fishing communities, and potentially contraction in supply to fish markets potentially affecting consumers via increased prices. A comprehensive treatment of these potential effects would require information on vessel operating costs, spatial modeling of effort location choice, vessel port expenditure information, as well as comprehensive domestic market supply and demand models. Unfortunately, these kinds of information are not available at present and, thus, this analysis has relied on analysis of gross revenue at risk as the best available proxy. Nonetheless, the potential effects of each alternative on secondary operations will scale with the potential effects, in percent of gross revenue terms, on those fishing entities directly affected by the proposed action as analyzed herein.

Participants in Fisheries in Adjacent Areas

Neither the proposed action nor the alternatives considered would significantly affect participants in the fisheries conducted in adjacent areas under the authority of another fishery management council.

8 References

ADF&G. 2006. 2006-2008 commercial king and Tanner crab fishing regulations. Alaska Department of Fish and Game, Juneau, AK. 160 pp.

ADF&G. 2007. 2007 Kuskokwim Area Salmon Fishery News Release Preliminary 2007 Kuskokwim Area Salmon Fishery Summary. http://www.cf.adfg.state.ak.us/region3/finfish/salmon/catchval/07ksksalsum.pdf.

ADF&G. 2008. Annual Management Report for the Commercial and Subsistence Shellfish Fisheries of the Aleutian Islands, Bering Sea and the Westward Region's Shellfish Observer Program, 2006/07. Alaska Department of Fish and Game, Division of Sport Fish and Commercial Fisheries, Fishery Management Report 08-02, Kodiak.

ADF&G. 2010. Annual Management Report for the Commercial and Subsistence Shellfish Fisheries of the Aleutian Islands, Bering Sea, and the Westward Region's Shellfish Observer Program, 2 008/09. Fisheries Management Report No. 10-24, ADF&G, Anchorage, AK.

AFSC. 2011 Observer Sampling Manual. Fisheries Monitoring and Analysis Division, North Pacific Groundfish Observer Program. AFSC, 7600 Sand Point Way N.E., Seattle, Washington, 98115.

Allen, B.M. and Angliss, R.P. 2011. Alaska marine mammal stock assessments, 2010. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AKFSC-233, 292 p.

Allen, B. M., and R. P. Angliss. 2012. Alaska marine mammal stock assessments, 2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-234, 292 p.

Balsiger, J. W. 2011. Memorandum to the Record regarding Amendment of Incidental Take Statement in the 2010 Biological Opinion Issued for the Alaska Groundfish Fisheries of the Bering Sea, Aleutian Islands, and Gulf of Alaska Addressing the Incidental Take of Six Marine Mammal Stocks listed under the Endangered Species Act. February 10, 2011. NMFS Alaska Region, P. O. Box 21668, Juneau, AK 99802. Available at http://www.alaskafisheries.noaa.gov/protectedresources/stellers/esa/biop/final/its_auth_022011.pdf.

BOEM. 2011. Biological Evaluation, Oil and gas leasing and exploration activities in the Beaufort Sea and Chukchi Sea planning areas: U.S Dept. of Interior, Bureau of Ocean Energy Management, Alaska OCS region, Office of the Environment.

Boveng, P. L., J. L. Bengtson, T. W. Buckley, M. F. Cameron, S. P. Dahle, B. A. Megrey, J. E. Overland, and N. J. Williamson. 2008. Status review of the ribbon seal (*Histriophoca fasciata*). U. S. Dep. Commer. NOAA Tech Memo. NMFS-AFSC-191, 115 p.

Bowers, F., M. Schwenzfeier, K. Herring, M. Salmon, H. Fitch, J. Alas, B. Baechler. 2011. Annual management report for the commercial and subsistence shellfish fisheries of the Aleutian Islands, Bering Sea, and the Westward Region's Shellfish Observer Program, 2009/2010.

Brix, K. 2006. Reinitation of Endangered Species Act (ESA) Section 7 Consultation on the Effects of the Alaska Groundfish Fishery Management Plans (FMPs) on Nothern Right Whale Critical Habitat in the Pacific Ocean. Memorandum. August 31, 2006. NMFS. Juneau, AK.

Brix, K. 2008. Re-initiation of Consultation on the Effects of the Alaska Groundfish Fishery Mangement Plans on the North Pacific Right Whales. Memorandum to S. Salveson. July 10, 2008. NMFS, Juneau, AK.

Brix, K. 2010. ESA Section 7 Consultation on the effect of the federal and parallel groundfish fisheries on Cook Inlet beluga whales. Memorandum to S. Salveson. March 26, 2010. NMFS. Juneau, AK.

Brooke, M. 2004. Albatrosses and Petrels Across the World. Oxford University Press, Oxford.

Byrd, G.V., andJ.C. Williams. 1993. Red-Legged kittiwade: *Rissa brevirostris*. American Ornithologists' Union. 1993.

Cahalan, J., J. Mondragon, and J. Gasper. 2010. Catch Sampling and Estimation in the Federal Groundfish Fisheries off Alaska. NOAA Tech. Memo NMFS-AFSC 205. USDOC, NOAA, NMFS. February 2010.

Cameron, M. and P. Boveng. 2009. Habitatu use and seasonal movements of adult and and sub-adult bearded seals. Alaska Fisheries Science Center Quarterly Report, October – November – December 2009. NMFS, Seattle, WA.

CBD. 2007. Petition to List the Ribbon Seal (*Histriophoca fasciata*) as a Threatened or Endangered Species under the Endangered Species Act. December 20, 2007. The Center for Biological Diversity, 1095 Market Street, Suite 511, San Francisco, CA 94103.

CBD. 2008. Petition to list three seal species under the Endangered Species Act: Ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), and spotted sea l(*Phoca largha*). May 28, 2008. The Center for Biological Diversity, 1095 Market Street, Suite 511. San Francisco, CA 94103.

Chilton, E.A., C.E. Armistead, and R.J. Foy. 2009. The 2009 Eastern Bering Sea continental shelf bottom trawl survey: Results for commercial crab species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-210, 101 p.

Chilton, E.A., C.E. Armistead, and R.J. Foy. 2011. The 2010 Eastern Bering Sea Continental Shelf Bottom Trawl Survey: Results for commercial crab species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-216, 139 p.

Demaster, D. 2009. Memorandum to Doug Mecum regarding Aerial Survey of Steller Sea Lions in Alaska, June–July 2009 and Update on the Status of the Western Stock in Alaska. December 2, 2009, Alaska Fisheries Science Center, National Marine Mammal Laboratory (NMML), 7600 Sand Point Way NE, Seattle WA 98115. http://www.afsc.noaa.gov/nmml/PDF/SSL-Survey-09-memo-11-30-09.pdf.

Eggers, D. 2004. "Historical Trends in Alaskan Salmon." In J. Boldt, ed., Ecosystem Considerations for 2005. North Pacific Fishery Management Council. 605 W 4th Ave, Suite 306, Anchorage, AK 99501. November 2004. pp. 131-137.

Foy, R.J. and L. Rugolo. 2009. 2009 Stock Assessment and Fishery Evaluation Report for the Pribilof Islands Blue King Crab Fisheries of the Bering Sea and Aleutian Islands Regions. North Pacific Fishery Management Council. 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.

Foy, R.J. 2010. Stock Assessment and Fishery Evaluation Report for the Pribilof Islands Blue King Crab Fisheries of the Bering Sea and Aleutian Islands Regions. North Pacific Fishery Management Council. 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.

Foy 2011. 2011 Stock Assessment and Fishery Evaluation Report for the Pribilof Isalnds Blue King Crab Fisheries of the Bering Sea and Alueitan Islands Regions. North Pacific Fishery Management Council. 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.

Fritz, L., K. Sweeney, C. Gudmondson, T. Gelatt. 2008. Survey of adult and juvenile Steller sea lions, June-July 2008. Memorandum for The Record. 17 November, 2008. NMML, NMFS. Seattle, WA.

Funk, F. 2003. Overview of state-managed marine fisheries in Southwestern Alaska with reference to the Southwest stock of sea otters. Alaska Department of Fish and Game, Juneau Alaska, 119 p.

Gray, A., T. McCraney, C. Marvin, C. M. Kondzela, H. T. Nguyen, and J. R. Guyon. 2011. Genetic Stock Composition Analysis of Chum Salmon Bycatch Samples from the 2008 Bering Sea Groundfish Fisheries. Auke Bay Laboratories, Alaska Fisheries Science Center, NOAA Fisheries, 17109 Pt. Lena Loop Road Juneau, AK 99801.

Guyon, J.R., C. Kondzela, T. McCraney, C. Marvin and E. Martinson. 2010. Genetic Stock Composition Analysis of Chum Salmon Bycatch Samples from the 2005 Bering Sea Groundfish Fishery. Auke Bay Laboratories, Alaska Fisheries Science Center, NOAA Fisheries, 17109 Pt. Lena Loop Road Juneau, AK 99801.

Hiatt, T., M. Dalton, R. Felthoven, B. Fissel, B. Garber-Yonts, A. Haynie, S. Kasperski, D. Lew, C. Package, J. Sepez and C. Seung. 2011. Economic Status of Groundfish Fisheries off Alaska, 2011. North Pacific Fishery Management Council. Anchorage, AK.

Kornev, S.I. 1994. A note on the death of a right whale (*Eubalaena glacialis*) off Cape Lopakta (Kamchatka). Rep. Int. Whal Comm. (Special Issue 15):443-444.

Kuletz, K., and E. Labunski. 2008. Briefing on pelagic distribution of seabirds in the Bering Strait region. *USFWS, Anchorage, AK* 99503.

Larned, W.W., and T.J. Tiplady. 1999. Late winter population and distribution of Spectacled Eiders (Somateria fischeri) in the Bering Sea, 1998. US Fish and Wildlife Service, Migratory Bird Management, Waterfowl Branch. Anchorage, AK.

Loseto, L.L., G.A. Stern, T.L. Connely, D.Deibel, B. Gemmill, A. Prokopowicz, L. Fortier, S.H. Ferguson. 2009. Summer diet of beluga whales inferred by farty acid analysis of the eastern Beaufort Sea food web. J. Exp. Mar. Biol. And Ecol. 374:12-18.

Lovvorn, J.R., S.E. Richyman, J.M. Grebmeier, and L.W. Cooper. 2003. Diet and body condition of spectacled eiders wintering in pack ice of the Bering Sea. Polar Biology 26(4):259-267.

Lowry, L.F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Document Nos. 19 and 19A, NPFMC, Anchorage, AK.

Marvin, C. Wildes, S, Kondzela C, Nguyen H, and J.R. Guyon. 2011. Genetic Stock Composition Analysis of Chum Salmon Bycatch Samples from the 2006 Bering Sea Groundfish Fisheries. Auke Bay Laboratories, Alaska Fisheries Science Center, NOAA Fisheries, 17109 Pt. Lena Loop Road Juneau, AK 99801.

McCraney, W.T., C.M. Kondzela, J. Murphy, and J.R. Guyon. 2010. Genetic stock identification of chum salmon from the 2006 and 2007 Bering-Aleutian Salmon International Survey. NPAFC Doc. 1288. 11 p. Auke Bay Laboratories, Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 17109 Pt. Lena Loop Road, Juneau, AK 99801, USA. (Available at http://www.npafc.org).

Moloney, C.L., J. Cooper, P.G. Ryan, W.R. Siegfried. 1994. Use of a population model to assess the impact of longline fishing on wandering albatross *Diomedea exulans* populations. Biological Conservation 70(3):195-203.

Myers, K.W., and D.E. Rogers. 1988. Stock origins of Chinook salmon in incidental catches by groundfish fisheries in the Eastern Bering Sea. Contribution 744, School of Fisheries, University of Washington, Seattle. North American Journal of Fisheries Management 8:162–171.

Myers, K.W., R.V. Walker, J.L. Armstrong, and N.D. Davis. 2004. Estimates of the bycatch of Yukon River Chinook salmon in U.S. groundfish fisheries in the eastern Bering Sea, 1997-1999. Final Report to the Yukon River Drainage Fisheries Association, Contr. No. 04-001. SAFS-UW-0312, School of Aquatic and Fishery Sciences, University of Washington, Seattle. 59 p.

Narita, Ren. 2012. “Re: Sea Otter Takes”. Sarah Ellgen, Melanie Brown, Martin Loefflad, Jim Thomason. Personal communication, 9 January 2012.

NMFS. 2001. Final Supplemental Environmental Impact Statement. Steller sea lion protection measures. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2003. Supplmenent to the Endangered Species Act Section 7 Consultation and Biological Opinion and Incidental Take Statement 2001. Authorization of the BSAI and GOA groundfish fisheries and State Parallel fisheries. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2004. Final Environmental Impact Statement for Bering Sea and Aleutian Islands Crab Fisheries. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2004a. Alaska Groundfish Fisheries Final Programmatic Supplemental Enivronmental Impact Statement. Available online at: http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/.

NMFS. 2005. Setting the annual subsistence harvest of northern fur seals on the Pribilof Islands: Final environmental impact statement. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.URL: http://www.alaskafisheries.noaa.gov/protectedresources/seals/fur/eis/final0505.pdf.

NMFS. 2005. Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.. Available from http://www.fakr.noaa.gov/habitat/seis/efheis.htm.

NMFS 2006. Final Environmental Assessment/Regulatory Impact Review/Regulatory Flexibility Analysis for Amendments 65/65/12/7/8 to the BSAI Groundfish FMP, GOA Groundfish FMP, BSAI Crab FMP, Scallop FMP and Salmon FMP to provide Habitat Areas of Particular Concern. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2007a. Alaska Groundfish Harvest Specifications Environmental Impact Statement. January 2007. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.Available from http://www.alaskafisheries.noaa.gov/analyses/groundfish.

NMFS. 2007b. Conservation plan for the Eastern Pacific stock of northern fur seal (*Callorhinus ursinus*). NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2008. Conservation Plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2009a. ESA Section 7 Biological Opinion on the Effects of the Pacific Coast Salmon Plan on Southern Resident Killer Whales. May 2009. NMFS Northwest Region, Seattle, WA.

NMFS. 2009b. Supplemental Biological Opinion Reinitiating Consultation on the January 11, 2007 Biological Opinion regarding Authorization of Bering Sea/Aleutian Islands (BSAI) Groundfish Fisheries. December 2, 2009. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA.

NMFS. 2009c. Final EA/RIR/FRFA for the Arctic FMP and Amendment 29 to the FMP for BSAI King and Tanner Crabs. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS 2010a. Final Environmental Assessment/Regulatory Impact Review/ Regulatory Flexibility Analysis for Amendment 94 to the BSAI Groundfish FMP to require trawl sweep modification in the Bering Sea flatfish fishery, establish a modified gear trawl zone, and revise boundaries of the Northern Bering Sea Research Area and Saint Matthew Island Habitat Conservation Area. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668..

NMFS. 2010b. Draft ESA Section 7 Biological Opinion on the Alaska Groundfish Fisheries. July 2010. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2011. Preliminary seabird by catch estimates for Alaska groundfish fisheries, 2007-2010. NMFS, NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2014. Alaska Groundfish Harvest Specifications Supplementary Information Report. January 2014. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NPFMC. 1994. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility analysis for Amendment 21a to the Fishery Management Plan for Bering Sea and Aluetian Islands Groundfish. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NPFMC. 2011a. Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. NPFMC, Anchorage, AK.

NPFMC. 2011b. Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions. NPFMC, Anchorage, AK.

NPFMC. 2012. Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area. NPFMC, Anchorage, AK.

NPFMC. 2012b. Initial Review Draft for Chum Salmon Bycatch Management Measures. Anchorage, AK. Available at www.alaskafisheries.gov/npfmc.

NPFMC. 2008a. Amendment 24. Final Environmental Assessment for Amendment 24 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs to Revise Overfishing Definitions. Prepared by staff of the Alaska Department of Fish and Game, National Marine Fisheries Service, and the North Pacific Fishery Management Council. North Pacific Fishery Management Council, 605 West 4th Ave, Anchorage, AK. 99501.

NPFMC. 2008b. Stock Assessment and Fishery Evaluation Report for the King and Tanner Carb Fisheries of the Bering Sea and Aleutian Islands Regions. NPFMC, 605 W. 4th Ave. #306, Anchorage, AK.

NMFS/NPFMC. 2009. Bering Sea Chinook salmon bycatch management–Volume 1, Final Environmental Impact Statement, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Regional Office, Juneau, AK. NPFMC. 2011. Chum Salmon PPSC Management Measures EA/RIR/IRFA initial review draft, North Pacific Fishery Management Council, 605 West 4th Ave, Anchorage, AK.

NPFMC/NMFS/ADF&G. 2003. Environmental Assessment for Amendment 17 to the Fishery Management Plan for the King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands. A Rebuilding Plan for the Pribilof Islands Blue King Crab Stock. North Pacific Fishery Management Council, 605 West 4th Ave, Anchorage, AK. 99501.

OSPAR Commission. 1999. Background Document for Steller's eider *Polysticta stelleri*. 16 pp.

Parada, C., D.A. Armstrong, B. Ernst, J.M. Orensanz. 2010. Spatial dynamics of snow crab (*Chionoecetes opilio*) in the eastern Bering Sea – putting together the pieces of the puzzle. Bulletin of Marine Science. 86(2):413-437.

Perez, M. A. 2007. Analysis of marine mammal bycatch data from the trawl, longline, and pot groundfish fisheries of Alaska, 1998-2004, defined by geographic area, gear type, and catch target groundfish species. U.S. Dep. Commer, NOAA Tech. Memo., NMFS-AFSC-167, 194 p. (.pdf, 3.83MB).

Piatt, J.F., J. Wetzel, K. Bell, A. R. DeGange, G.R. Balogh, G.S. Drew, T. Geernaert, C. Ladd, G.V.

Byrd. 2006. Predictable hotspots and foraging habitat of the endangered short-tailed albatross (*Phoebastria albatrus*) in the North Pacific: Implications for conservation. Deep-Sea Research II 53:387-398.

Rivera, K. 2012. Endangered Species Act section 7 consultation on the effects of the Alaska Groundfish Fisheries on Cook Inlet beluga whale critical habitat and the effects of Amendment 93 to the Fishery Management Plan for Groundfish in the Gulf of Alaska on both the Cook Inlet beluga whales and its critical habitat. U.S. Dept. Commer. NOAA, NMFS. Juneau, AK.

Robson, B.W., M.E. Goebel, J.D. Baker, R.R. Ream, T.R. Loughlin, R.C. Francis, G.A. Antonelis, and D.P. Costa. Separation of foraging habitat among breeding sites of a colonial marine predator, the northern fur seal (*Callorhinus ursinus*). Can. J. Zool. 82:20-29.

Scholz, Astrid J., Kruse, S.A., Huntington, H., Petersen Lewis, R.S., Klain, S., Ahmann, J. 2007. Socioeconomics Baseline Information for the Pribilof Islands. NPRB Project 528, Ecotrust, Portland, OR.

Sinclair, E., T. Loughlin, W. Pearcy. 1994. Prey selection by northern fur seals (*Callorhinus ursinus*) in the eastern Bering Sea. Fish. Bull. 92(1):144-156.

Speckman, S.G., V. Chernook, D.M. Burn, M.S. Udevitz, A.A. Kochnev, A. Vasilev, C.V. Jay, A. Lisovsky, A.S. Fischbach, R.B. Benter. 2011. Results and evaluation of a survey to estimate Pacific walrus population size, 2006. Marine Mammal Science 27(3):514-553.

Spencer, P., M. Canino, J. DiCosimo, M. Dorn, A.J. Gharrett, D. Hanselman, K. Palof, M. Sigler. 2010. Guidelines for determination of spatial management units for exploited populations in Alaskan groundfish fishery management plans. Paper prepared for the September 201 NPFMC Plan Team meeting.

Towell, R., R. Ream, J. Bengtson, J. Sterling. 2011. 2010 northern fur seal pup production and adult male counts in the Pribilof Islands, Alaska. Memorandum to The Record. Alaska Fisheries Science Center, NMML.

USFWS, 2001a. 50 CFR Part 1, RIN 1018–AF95, Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Alaska-Breeding Population of the Steller's Eider AGENCY: Fish and Wildlife Service, Interior. ACTION: Final rule.

USFWS. 2001b. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Spectacled Eider. FR 66(25):9146.

USFWS. 2002. Steller's Eider Recovery Plan. Fairbanks, Alaska.

USFWS. 2006. Report to the North Pacific Fishery Management Council, October 2006. Agenda Item B(5).

USFWS. 2008. Report to the North Pacific Fishery Management Council, October 2008. Agenda Item B(5).

USFWS. 2008b. Birds of Conservation Concern 2008. US DoI, FWS, Division of Migratory Bird Management. Arlington, VA. 85 pp.

USFWS. 2009. Sea Otter Critical Habitat in Southwest Alaska – Fact Sheet. U.S. Fish and Wildlife Service, Region 7, Alaska.

USFWS. 2010. Southwest Alaska Distinct Population Segment of the Northern Sea Otter (*Enhydra lutris kenyoni*) - Draft Recovery Plan. U.S. Fish and Wildlife Service, Region 7, Alaska. 171 p.

Waring, G.T., P.M. Richard, J.M. Quinta, C.P. Fairvield, and K. Maze-Foley (Eds). 2004. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NE-182, 287 pp.

Zador, SG, A.E. Punt, J.K. Parrish. 2008. Population impacts of endangered short-tailed albatross bycatch in the Alaskan trawl fishery. Biol Conserv 141: 872-882.

9 List of preparers and persons consulted

<u>Lead Preparers:</u>

Bob Foy (AFSC)
Scott Miller (NMFS)
Diana Stram (NPFMC)
Michael Fey (AKFIN)
Steve Lewis (NMFS)
Jason Gasper (NMFS)
Gretchen Harrington (NMFS)

<u>Additional contributors and persons consulted:</u>

Steve Maclean (NPFMC)
Nicole Kimball (ADFG)
Clayton Jernigan (NOAA General Counsel)
Maura Sullivan (NOAA General Counsel)
Jennifer Mondragon (NMFS)
Mary Furuness (NMFS)
Sarah Ellgen (NMFS)
Melanie Brown (NMFS)
Sally Bibb (NMFS)
NPFMC Crab Plan Team

10 Appendix 1: Groundfish catch by closure area, target species and gear type 2003–2009

Table A1 Species codes in groundfish catch tables.

Species code	Common name
PCOD	Pacific Cod
ARTH	Arrowtooth Flounder
RSOL	Rock Sole
YSOL	Yellowfin Sole
GTRB	Greenland Turbot
POPA	Pacific Ocean Perch
HLBT	Halibut
PLCK	Pollock
SABL	Sablefish
SQID	BSAI Squid
RKCR	Red King Crab
BTCR	Bairdi Tanner Crab
OTCR	Opilio Tanner (Snow) Crab
HERR	Herring
STLH	Steelhead Trout
BKCR	Blue King Crab
GKCR	Golden (Brown) King Crab
CHNK	Chinook Salmon
CHUM	Chum Salmon
COHO	Coho Salmon
PINK	Pink Salmon
SOCK	Sockeye Salmon
AMCK	Atka Mackerel
NCHN	Non-Chinook Salmon
AKPL	BSAI Alaska Plaice
NORK	Northern Rockfish
GREN	Grenadier
HAKE	Pacific Hake
REYE	BSAI Rougheye Rockfish
SRKR	BSAI Shortraker Rockfish
FSOL	Flathead Sole
FLO5	BSAI Other Flatfish
PEL7	GOA Pelagic Shelf Rockfish
ROCK	Other Rockfish
NONQ	Non-Quota species
OTHR	Other Species

Table A2 **Groundfish catches (t) in the ADF&G closure area between 2003 and 2009. C represents a confidential value. Species code names found in Appendix 1 Table A1.**

Species	2003	2004	2005	2006	2007	2008	2009
AKPL	46.7	2.2	81.5	8.6	457.9	437	3.27
AMCK		0	C	C			
ARTH	3.9	7.5	9.6	21.6	4.9	71	3.06
FLO5	3	2	4.1	1.7	108.1	69	0.76
FSOL	8	24.3	13.4	26.6	46.2	184.6	1.23
GTRB			C	C			
NORK		0					
OTHR	189.7	108.6	410.4	272.9	409.3	245.4	66.99
PCOD	1132.8	1757.5	4749.8	1973.9	1970.8	955	269.21
PLCK	646.7	3429.7	1041.1	2046.7	167	215.8	20.12
POPA					C		C
ROCK		C			C		C
RSOL	266.5	24.5	275.3	83.7	154.2	280.8	5.26
SABL			C				
USKT			C				
YSOL	1589	57.1	541.3	80.8	3687.8	5575.8	7.925399

Table A3 **Groundfish catches (t) in the Pribilof Islands blue king crab 1975 to 2009 distribution area (Alternative 4) between 2003 and 2009. C represents a confidential value. Species code names found in Appendix 1 Table A1.**

Species	2003	2004	2005	2006	2007	2008	2009
AKPL	2811.06	2045.68	5230.71	6144.12	6648.04	3052.31	3068.79
AMCK	26.08	48.78	146.71	80.93	1.58	5.37	0.70
ARTH	2230.63	2128.19	919.34	1211.98	1736.82	814.67	518.96
BSKT					C		
DEM1	3.53						
DFL4	0.27						
FLO5	68.3	178.22	207.04	91.76	292.25	95.98	20.17
FSOL	6505.89	6639.13	3494.26	4175.13	5498.23	4659.14	2949.39
GTRB	20.3	30.95	3.52	9.13	45.31	6.16	9.36
NORK	12.67	4.91	15.34	25.59	12.94	7.84	5.18
OTHR	3943.18	4952.31	4752.88	4787.51	4508.9	2876.37	2402.20
PCOD	20441.1	25625.09	27050.89	23805.02	16817.21	16084.11	11326.55
PEL7	0.39		C				C
PLCK	156257.6	135226.8	171928.5	110899.7	114518.4	98157.62	109329.87
POPA	30.49	31.98	29.5	38.03	61.68	6.38	16.40
REXS			C				
REYE		0.45	0.1	0.11	0.01	0.16	0.42
ROCK	7.99	8.78	4.16	5.04	7.89	4.2	1.56
RSOL	3065.19	4273.2	5955.45	3587.82	3491.96	1681.15	1659.25
SABL	111.84	1.57	2.16	11.28	0.81	8.39	43.25
SFL1	0.38		C		C		C
SQID	22.76	13.19	28.41	32.11	31.39	14.14	2.25
SRKR		10.93	4.92	0.29	1.12	2.46	2.38
SRRE	8.38						
THDS	6.11						2.30
USKT			4.76		C		0.44
YSOL	18626.66	20670.73	50288.53	23257.97	34578.35	18457.86	14628.91

Table A4 **Groundfish catches (t) in the Pribilof Islands blue king crab 1984 to 2009 distribution area (Alternative 4) between 2003 and 2009. C represents a confidential value. Species code names found in Appendix 1 Table A1.**

Species	2003	2004	2005	2006	2007	2008	2009
AKPL	2096.72	1021.31	4073.45	2440.17	1882.07	2585.37	930.4366
AMCK	8.18	44.59	114.46	16.67	0.12	0.45	0.14
ARTH	1045.58	1036.87	531.97	565.26	1090.16	490.76	203.50
BSKT					C		
DEM1	3.53						
DFL4	0.27						
FLO5	40.85	101.67	136.09	46.53	233.21	87.81	6.57
FSOL	2802.2	2782.98	1858.87	1499.6	2674.1	2487.75	1132.59
GTRB	10.64	6.58	1.88	2.56	1.44	1.55	1.10
NORK	0.28	0.83	12.43	0.81	0.06	0.18	0.42
OTHR	2003.05	2067.34	2867.57	1974.07	1922.39	1676.59	933.06
PCOD	10413.82	12741.2	18184.63	12493	9414.95	7341.05	3727.89
PEL7	0.39						
PLCK	38058.53	75092.87	46230.32	18850.34	21793.93	17508.1	13679.10
POPA	8.59	18.84	23.47	0.85	15.54	0.03	0.84
REXS			C				
REYE		0.05	C	C	C	0.02	0.00
ROCK	4.77	2.82	0.77	0.4	0.13	0.2	0.19
RSOL	1902.29	1811.81	4333.92	1183.77	1621.72	1011.36	702.91
SABL	110.07	0.56	1.58	C	0.09	0.04	C
SFL1	0.38				C		
SQID	0.74	1.02	0.41	0.46	0.34	0.25	0.15
SRKR		0.92	C	C	C	0.09	0.35
SRRE	4.85						
THDS	6.11						
USKT			C		C		
YSOL	14461.82	11625.25	30371.47	10753.54	10902.81	16752.7	3947.835

Table A5 Groundfish catches (t) in the Pribilof Islands Habitat Conservation Zone between 2003 and 2009.

C represents a confidential value. Targets: c = Pacific cod, I=halibut, K=rockfish, S=sablefish, and W=arrowtooth flounder, NULL= no target identified. Program: CDQ=Community Development Quota, OA=Open Access, IFQ=Individual Fishing Quota. Sector: CV=catcher vessel and CP=catcher processor. Gear: HAL = hook-and-line, POT = pot , JIG = jig.

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
c	CDQ	CP	HAL		50.04	1110.83	192.91	196.95	129.31	349.92
c	OA	CP	HAL	3405.58	3994.91	4926.2	3352.41	2055.74	1304.8	892.20
c	OA	CP	POT	C	1881.55	C	C	1423.65	C	303.10
c	OA	CV	HAL	C		C				
c	OA	CV	JIG		0.14					C
c	OA	CV	POT	C	533.1	991.78	733.78	731.88	794.98	C
I	CDQ	CV	HAL				C	C		
I	IFQ	CV	HAL	4	0.48	C			1.61	
I	OA	CV	HAL		C	C				
K	IFQ	CV	HAL	0.37						
K	OA	CP	HAL	C						
K	OA	CV	HAL	1.38						
K	OA	CV	JIG	C						
NULL	OA	CP	POT		C				C	
O	OA	CP	HAL				C			
O	OA	CV	HAL	C	C					
S	IFQ	CV	HAL	32.18				C		
S	OA	CP	HAL	18.42						
S	OA	CV	HAL	74.7						
T	OA	CP	HAL	1.65						
W	OA	CP	HAL					C		

Table A6 Groundfish catches (t) in the Pribilof Islands Habitat Conservation Zone between 2003 and 2009.

C represents a confidential value. Species code names found in Appendix 1, Table A1. Gear: HAL = hook and line, POT = pot , JIG = jig.

Gear	Species	2003	2004	2005	2006	2007	2008	2009
HAL	AKPL	C		0.03	C	C		C
HAL	AMCK		0.03	C		C		0.04
HAL	ARTH	14.74	12.28	16.1	14.01	6.59	8.73	8.96
HAL	DEM1	3.52						
HAL	DFL4	0.27						
HAL	FLO5	3.15	2.38	3.94	2.03	7.76	0.79	0.09
HAL	FSOL	5.56	13.27	14.69	19.33	10.16	11.9	7.10
HAL	GTRB	0.74	0.14	0.15	0.06	C	0.03	0.25
HAL	NORK	0.1	0.08	0.14	0.08	0.03	C	0.06
HAL	OTHR	360.64	516.47	789.24	434.47	395.11	215.06	218.95
HAL	PCOD	2913.59	3381.84	5072.66	2990.94	1763.68	1172.93	980.21
HAL	PEL7	0.03						
HAL	PLCK	105.64	104.22	96.35	47.62	51.39	20.45	20.73
HAL	POPA			C	C			C
HAL	REYE		0.02	C			0.01	C
HAL	ROCK	0.58	0.99	0.34	0.05	0.04	0.08	0.10
HAL	RSOL	1.21	1.46	19.96	2.46	0.43	0.29	0.50
HAL	SABL	109.24	C	0.32	C	C	0.03	C
HAL	SFL1	0.38						
HAL	SQID						C	
HAL	SRKR		0.19	C	C		0.08	0.21
HAL	SRRE	4.78						
HAL	THDS	6.11						
HAL	USKT			C				
HAL	YSOL	10.91	12.05	23	35.15	19.72	5.35	6.84
JIG	DEM1	C						
JIG	PCOD		0.14					
JIG	PEL7	C						
JIG	ARTH							C
JIG	FSOL							C
JIG	OTHR							C
JIG	PCOD							C
JIG	PLCK							C
POT	AKPL	C						
POT	AMCK		C		C	0.04	C	
POT	ARTH		C		C		C	C
POT	FLO5		C		C		C	
POT	FSOL	C	C	0.03	C	C	0.01	
POT	GTRB				C		C	C
POT	NORK		C			C	0.07	C
POT	OTHR	8.76	17.18	14.1	36.81	45.6	22.69	3.45
POT	PCOD	378.61	2392.89	2742.12	1600.95	2096.1	1363.52	291.10
POT	PLCK	2.43	1.97	1.73	1.84	0.51	0.16	C
POT	ROCK		C			C	0.04	C
POT	RSOL	C	0.03	0.07	C	C	0.01	
POT	YSOL	C	2.52	10.97	4.06	11.55	1.84	C

Table A7 Groundfish catches (t) in the Alaska Department of Fish and Game closure area between 2003 and 2009.

C represents a confidential value. Targets: B=pollock (bottom), c=Pacific cod, I=halibut, L=flathead sole, P=pollock (midwater), R=rock sole, W=arrowtooth flounder, Y=yellowfin sole. Program: CDQ=Community Development Quota, OA=Open Access, AFA=American Fisheries Act. Sector: CV=catcher vessel, and CP=catcher processor. Gear: HAL=hook and line, POT=pot , NPT=non-pelagic trawl, PTR=pelagic trawl.

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
B	CDQ	CP	PTR			C				
B	OA	CP	NPT				C			
B	OA	CP	PTR			C				
C	CDQ	CP	HAL		C	C	C	C	C	C
c	OA	CP	HAL	1134.6	785	3182.2	1983.4	1828.8	515.2	313.22
c	OA	CP	NPT	C	C		C			
c	OA	CP	POT		C	C	C	C	C	C
c	OA	CV	HAL			C				
c	OA	CV	POT	C		123.1				
I	CDQ	CV	HAL					C		
L	OA	CP	NPT		82.4	C		C	C	C
P	AFA	CV	PTR		C			C		
P	CDQ	CP	PTR		278.9		C			
P	CDQ	CV	PTR		C	C				
P	OA	CP	PTR	C	3054.7	468.6	1501.9			C
P	OA	CV	PTR	C		C				
R	CDQ	CP	NPT		C			C		
R	CDQ	CV	NPT					C		
R	OA	CP	NPT	C	C	507.4	C			C
W	OA	CP	HAL					C		
Y	CDQ	CP	NPT					C	C	
Y	CDQ	CV	NPT					C		
Y	OA	CP	NPT	2388.6	40.1	612.4	20.5	3226.4	7072.2	C
Y	OA	CV	NPT				C		C	

Table A8 **Groundfish catches (t) in the Alaska Department of Fish and Game closure area between 2003 and 2009.**

C represents a confidential value. Species code names found in Appendix 1, Table A1. HAL=hook and line, POT=pot , NPT= non-pelagic trawl, PTR =pelagic trawl.

Gear	Species	2003	2004	2005	2006	2007	2008	2009
HAL	AKPL	C		C	0	C		
HAL	AMCK		C					
HAL	ARTH	2.7	1.3	3	2.9	1.2	1.3	2.33
HAL	FLO5	2.7	1.8	0.2	0.6	1.5		0.02
HAL	FSOL	2.4	2.4	2.1	1.8	0.6	0.5	0.62
HAL	GTRB			C	C			
HAL	NORK		C					
HAL	OTHR	131.5	91.2	370.1	218.5	321.7	67.4	65.18
HAL	PCOD	950.9	664.1	3067.3	1737.3	1381.1	426	245.14
HAL	PLCK	37.6	18.5	85.9	59.2	94	20.7	6.46
HAL	ROCK		C					0.02
HAL	RSOL	0.1	0.1	0.9	0.1	0.2	0	C
HAL	SABL			C				
HAL	USKT			C				
HAL	YSOL	6.7	6.9	25.5	32.6	34.2	6.7	1.90
NPT	AKPL	46.7	2.2	81.4	8.6	457.9	437	3.27
NPT	ARTH	1.2	6.2	6.6	C	3.7	69.7	C
NPT	FLO5	C	C	3.9	1.1	106.7	69	C
NPT	FSOL	5.6	21.4	11.2	23.4	44.3	184.1	0.56
NPT	OTHR	58.1	10.5	32.8	47.8	86.7	178	1.06
NPT	PCOD	180.6	17.1	97.6	80.9	82	461.8	1.39
NPT	PLCK	590.2	15.1	111.8	223.7	66.9	195.1	4.16
NPT	POPA					C		C
NPT	RSOL	266.4	15.8	270.9	83.3	154	280.8	5.17
NPT	YSOL	1582.3	48.7	508.1	47.7	3653.5	5569.1	4.44
POT	FLO5		C					
POT	FSOL			0		C		
POT	OTHR	C	C	5.4	C	C	C	C
POT	PCOD	C	C	1563.7	C	C	C	C
POT	PLCK	C	C	1.5	C	C		C
POT	ROCK					C		
POT	RSOL		C	0	C	C		
POT	YSOL	C	C	7.7	C	C	C	C
PTR	AKPL		0		0			C
PTR	AMCK		0	C	C			
PTR	ARTH	C	0	C	0.2	C		C
PTR	FLO5		0		C	C		C
PTR	FSOL	C	0.6	0.1	1.3	C		C
PTR	OTHR	C	2.4	2.1	0.8	C		C
PTR	PCOD	C	11.8	21.3	14.9	C		C
PTR	PLCK	C	3395.2	842	1763.5	C		C
PTR	RSOL	C	8.5	3.5	0.2	C		C
PTR	YSOL	C	0.3		0.3			

Table A9 Groundfish catches (t) in the Pribilof Islands blue king crab 1975 to 1983 distribution area (Alternative 4) between 2003 and 2009.

C represents a confidential value. Targets: c=Pacific cod, I=halibut, K=rockfish, S=sablefish, W=arrowtooth flounder, P=pollock (midwater), Y=yellowfin sole, B=Pollock (bottom), E=Alaska plaice, F=other flatfish, L=flathead sole, O=other, R=rock sole, T=Greenland turbot, NULL=no target identified, all catch discarded. Program: CDQ=Community Development Quota, OA=Open Access, AFA=American Fisheries Act, SMPC= State managed Pacific cod, IFQ=Individual Fishing Quota. Gear: HAL=hook-and-line, POT=pot, JIG=jig, NPT=non-pelagic trawl, PTR=pelagic trawl.

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
A	OA	CP	NPT	C	93.95	254.01	C			
B	AFA	CV	PTR	215.12	C	C	C	938.47	1175.29	3260.21
B	CDQ	CP	PTR		C	C			C	717.34
B	CDQ	CV	PTR						38.56	C
B	OA	CP	NPT	C			54.47			
B	OA	CP	PTR	C	C	C	1878.35	2076.02	4192.13	5231.55
B	OA	CV	PTR	C					C	C
c	CDQ	CP	HAL		1133.55	2085.45	905.89	848.79	494.88	1182.05
c	OA	CP	HAL	18787.57	21600.46	21571.45	20492.55	11350.53	10280.79	8069.22
c	OA	CP	NPT	1490.2	3364.94	1030.32	2712.02	1419.34	270.37	190.56
c	OA	CP	POT	C	1923.93	C	2043.33	2175.05	C	C
c	OA	CV	HAL	5.83	C	C	C	C	C	C
c	OA	CV	JIG	0.07	0.71	C	C	C	C	C
c	OA	CV	NPT	91.59		C	C	380.85	499.08	145.74
c	OA	CV	POT	612.57	642.36	1193.16	740.31	981.29	3084.24	C
c	SMPC	CV	JIG				C			
E	OA	CP	NPT					C	78.11	
F	OA	CP	NPT		C	C	C	31.12		
I	CDQ	CV	HAL			C	C	0.02	0.26	
I	IFQ	CV	HAL	4.11	3.27	0.32	C	0.17	3.11	2.35
I	OA	CP	HAL		C					
I	OA	CV	HAL	C	C	C			C	
I	OA	CV	JIG					C		
K	IFQ	CV	HAL	0.37						
K	OA	CP	HAL	C						
K	OA	CP	NPT	C	C		C			
K	OA	CV	HAL	1.38						
K	OA	CV	JIG	C						
L	CDQ	CP	NPT					C		C
L	OA	CP	NPT	11214.05	14733.56	5450.35	8933.11	10883.38	8218.46	5073.54
NULL	OA	CP	HAL	C			C	C		
NULL	OA	CP	NPT		C		C			
NULL	OA	CP	POT		C			C	C	
O	OA	CP	HAL				C			
O	OA	CP	NPT	C	C		C	C		
O	OA	CV	HAL	C	C					
O	OA	CV	POT		C					
P	AFA	CV	NPT							C
P	AFA	CV	PTR	52356.7	29907.04	70920.58	27943.73	40579.23	55029.57	40400.39
P	CDQ	CP	PTR	4.11	14663.86	15454.28	15491.98	15382.35	7540.1	15059.84
P	CDQ	CV	PTR	C	C	C	C	C	C	C
P	OA	CP	NPT			C				
P	OA	CP	PTR	79024.89	76781.63	66316.76	50981.59	44931.98	21427.06	32040.36
P	OA	CV	PTR	19010.35	2595.12	10193.83	7996.13	4840.29	5245.33	8835.83
R	CDQ	CP	NPT		C	C	C	C		C
R	CDQ	CV	NPT					C		
R	OA	CP	NPT	1176.47	2585.5	4897.1	2456.5	1357.38	389.7	731.49
S	CDQ	CV	POT						C	
S	IFQ	CV	HAL	32.2		C	12.5	C	C	C

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
S	IFQ	CV	POT	C		C	C		C	
S	OA	CP	HAL	C				C		
S	OA	CV	HAL	75.44						
T	OA	CP	HAL	3.42	C					
T	OA	CP	POT		C					
W	CDQ	CP	NPT			C		C		
W	OA	CP	HAL					C		
W	OA	CP	NPT	73.91	C	21.06	51.01	C	24.69	18.23
W	OA	CP	POT		C					
Y	CDQ	CP	NPT		C			C	C	
Y	CDQ	CV	NPT					C		
Y	OA	CP	NPT	27864.8	23079.97	64580.73	32310.66	45366.73	23404.11	20034.37
Y	OA	CV	NPT		C	C	364.35		C	

Table A10 Groundfish catches (t) in the Pribilof Islands blue king crab 1975 to 1983 distribution area (Alternative 4) between 2003 and 2009.

C represents a confidential value. Species code names found in Appendix 1, Table A1. Gear: HAL =hook-and-line, JIG = jig, NPT= non-pelagic trawl, POT=pot , PTR =pelagic trawl.

Gear	Species	2003	2004	2005	2006	2007	2008	2009
HAL	AKPL	0.03	0.09	0.07	0.1	C	0.01	C
HAL	AMCK	0.06	0.79	0.47	C	C	C	0.05
HAL	ARTH	132.39	125.99	98.13	97.29	59.57	94	158.82
HAL	BSKT					C		
HAL	DEM1	3.52						
HAL	DFL4	0.27						
HAL	FLO5	20.36	22.57	16.26	18.55	21.98	3.18	2.28
HAL	FSOL	74.19	129.82	87.15	127.49	50.23	56.23	30.15
HAL	GTRB	3.43	3.1	0.82	0.82	0.95	0.71	4.49
HAL	NORK	1.47	2.18	2.61	1.21	0.42	0.44	1.00
HAL	OTHR	2229.13	2994.95	3007.27	2554.46	1710.22	1486.39	1202.12
HAL	PCOD	15494.49	18662.36	19938.44	18133.72	9984.07	8799.33	7584.86
HAL	PEL7	0.38		C				C
HAL	PLCK	767.95	623.62	364.62	375.42	312.3	301.51	261.70
HAL	POPA	C	0.02	C	C		C	0.03
HAL	REYE		0.44	0.08	C	C	0.13	0.41
HAL	ROCK	2.91	6.64	3.1	1.45	0.56	1.48	1.27
HAL	RSOL	3.74	10.48	22.4	7.11	1.51	1.06	1.10
HAL	SABL	110.97	0.98	0.76	10.11	0.79	2.32	42.88
HAL	SFL1	0.38		C		C		C
HAL	SQID						C	
HAL	SRKR		2.17	C	C	0.1	0.39	2.31
HAL	SRRE	6.45						
HAL	THDS	6.11						2.30
HAL	USKT			C		C		0.44
HAL	YSOL	73.2	154.04	112.3	109.93	56.06	35.16	17.64
JIG	DEM1	C						
JIG	PCOD	0.07	0.71	C	0.33	2.01	C	C
JIG	PEL7	C						
JIG	PLCK							C
NPT	AKPL	2807.32	2044.36	5228.72	6142.57	6647.65	3044.64	3064.89
NPT	AMCK	24.84	46.63	137.64	49.97	0.37	0.7	0.15
NPT	ARTH	2069.07	1988.09	803.49	1088.76	1530.78	696.45	276.78
NPT	FLO5	45.03	143.15	162.8	69.15	259.82	90.12	14.18
NPT	FSOL	6044.58	6217.67	3014.21	3852.51	5020.85	4299.22	2408.32
NPT	GTRB	15.66	27.37	2.26	7.29	43.72	3.9	4.16
NPT	NORK	C	1.39	12	8.76	0.07	0.08	C
NPT	OTHR	1527.54	1726.49	1540.7	2066.6	2602.32	1108.05	862.84
NPT	PCOD	3208.07	3698.68	3164.23	2374.52	3197.06	2345.87	1169.52
NPT	PLCK	5115.69	4363.94	6378.9	4964.34	4858.42	2950.7	3590.40
NPT	POPA	21.91	21.64	23.26	12.87	25.81	3.06	0.26
NPT	REXS			C				
NPT	REYE		C		C		C	C
NPT	ROCK	4.48	1.68	C	3.02	C	1.79	0.03
NPT	RSOL	2826.44	3888.28	5714.59	3439.74	3381.52	1470.3	1136.57
NPT	SABL	0.78	C	1.37	1.03	C		
NPT	SQID	C				C	C	C
NPT	SRKR		C		C			C
NPT	SRRE	C						
NPT	USKT			C				
NPT	YSOL	18391.28	20348.81	50163.12	22994.17	34435.5	18354.07	14515.54

Gear	Species	2003	2004	2005	2006	2007	2008	2009
POT	AKPL	C						
POT	AMCK	C	C		0.01	0.1	3.61	
POT	ARTH	C	0.08	C	0.03		1.3	C
POT	FLO5		C		C		0	C
POT	FSOL	C	C	0.03	C	C	0.2	
POT	GTRB	C	C	C	0.44		C	C
POT	NORK		C			C	0.72	C
POT	OTHR	21.33	19.49	16.81	49.36	61.95	75.12	14.54
POT	PCOD	1126.17	2541.5	3058	2724.97	3069.84	4123.26	1599.20
POT	PLCK	3.79	2.01	1.8	4.04	1.3	0.9	1.22
POT	POPA				C		0.01	C
POT	REYE		C				C	
POT	ROCK	C	0.02	C	C	C	0.43	C
POT	RSOL	C	0.04	0.08	0.01	C	0.12	C
POT	SABL	C	C	C	C		C	
POT	SRKR			C				
POT	SRRE	C						
POT	YSOL	1.27	2.94	11.86	4.78	21.41	6.77	24.03
PTR	AKPL	3.7	1.23	1.91	1.45	0.38	7.65	3.88
PTR	AMCK	1.18	1.06	8.61	30.88	1.08	0.98	0.49
PTR	ARTH	29.16	14.03	17.72	25.9	146.47	22.92	83.33
PTR	FLO5	2.9	12.46	27.98	4.05	10.45	2.69	3.71
PTR	FSOL	387.11	291.63	392.87	195.13	425.57	303.5	510.92
PTR	GTRB	1.21	0.31	0.44	0.59	0.63	1.48	0.65
PTR	NORK	6.27	1.33	0.74	15.63	12.44	6.6	4.17
PTR	OTHR	165.18	211.39	188.11	117.09	134.41	206.82	322.57
PTR	PCOD	612.31	721.83	890.22	571.49	564.23	815.65	970.85
PTR	PLCK	150107.94	129856.34	164630.23	105945.18	108331.17	94072.01	105476.34
PTR	POPA	8.56	10.32	6.23	25.12	35.87	3.3	16.02
PTR	REYE		C	0.02	C	0.01	0.01	C
PTR	ROCK	0.6	0.44	0.61	0.57	0.59	0.5	0.23
PTR	RSOL	234.99	374.41	218.39	140.95	108.82	209.67	521.57
PTR	SABL	0.06	0.01	0.01	C	0.01	C	0.37
PTR	SQID	22.44	13.19	28.41	32.11	31.29	14.12	2.21
PTR	SRKR		8.68	4.86	0.15	1.02	2.07	
PTR	SRRE	1.85						
PTR	YSOL	160.92	164.94	1.25	149.09	65.38	61.85	71.71

Table A11 **Groundfish catches (t) in the Pribilof Islands blue king crab 1984 to 2008 distribution area (Alternative 4) between 2003 and 2009.**

C represents a confidential value. Targets: c= Pacific cod, I=halibut, K=rockfish, S=sablefish, W=arrowtooth flounder, P=pollock (midwater), Y=yellowfin sole, B=Pollock (bottom), E=Alaska plaice, F=other flatfish, L=flathead sole, O=other, R=rock sole, T=Greenland turbot, NULL=no target identified, all catch discarded. Program: Gear: HAL =hook-and-line, JIG = jig, NPT= non-pelagic trawl, POT=pot , PTR =pelagic trawl.

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
A	OA	CP	NPT	C	C	C	C			
B	AFA	CV	PTR	192.87	C	C		788.42	247.01	303.87
B	CDQ	CP	PTR		C	C			C	
B	CDQ	CV	PTR						C	C
B	OA	CP	NPT	C			34.44			13.95
B	OA	CP	PTR		C	C	224.06	C	3152.18	2798.90
B	OA	CV	PTR	C					C	C
c	CDQ	CP	HAL		243.44	1500.27	555.57	380.45	297.13	655.26
c	IFQ	CP	HAL							C
c	OA	CP	HAL	9079.69	9797.25	13288.89	10408.49	6328.07	4518.5	2519.85
c	OA	CP	JIG							C
c	OA	CP	NPT	1168.28	1340.57	901.78	1073.94	524.82	259.24	177.42
c	OA	CP	POT	C	1888.95	C	C	1813.22	C	C
c	OA	CV	HAL	1		C				C
c	OA	CV	JIG		0.63		C			
c	OA	CV	NPT	C		C	C	C		139.85
c	OA	CV	POT	406.67	619.35	1193.16	733.78	809.17	1323.23	C
c	SMPC	CV	JIG				C			
E	OA	CP	NPT					C	77.77	
F	OA	CP	NPT		C	C	C	C		
I	CDQ	CV	HAL				C	C	0.07	
I	IFQ	CV	HAL	4	0.73	C			1.8	
I	OA	CV	HAL		C	C			C	
K	IFQ	CV	HAL	0.37						
K	OA	CP	HAL	C						
K	OA	CP	NPT	C			C			
K	OA	CV	HAL	1.38						
K	OA	CV	JIG	C						
L	CDQ	CP	NPT					C		
L	OA	CP	NPT	4749.4	6462.16	3377.2	3324.72	6035.57	3993.03	1852.00
NULL	OA	CP	HAL	C				C		
NULL	OA	CP	NPT		C		C			
NULL	OA	CP	POT		C				C	
O	OA	CP	HAL				C			
O	OA	CP	NPT	C	C		C			
O	OA	CV	HAL	C	C					
O	OA	CV	POT		C					
P	AFA	CV	NPT							C
P	AFA	CV	PTR	13564.61	19227.29	16308.59	843.23	7550.59	2307.08	5806.50
P	CDQ	CP	PTR	C	9667.97	2054.47	2674.17	2521.01	2318.83	452.91
P	CDQ	CV	PTR		C	C	C	C	C	C
P	OA	CP	NPT							C
P	OA	CP	PTR	16130.58	37963.98	15607.62	10431.98	7118.82	6563.29	2383.01
P	OA	CV	PTR	4942.15	940.58	6615.79	C	C	1443.94	1006.77

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
R	CDQ	CP	NPT		C	C	C	C		C
R	CDQ	CV	NPT					C		
R	OA	CP	NPT	1011.65	1145.52	4526.38	1169.02	530.45	287.65	459.23
S	IFQ	CV	HAL	32.2				C		
S	OA	CP	HAL	C						
S	OA	CV	HAL	74.7						
T	OA	CP	HAL	C						
W	CDQ	CP	NPT					C		C
W	OA	CP	HAL					C		C
W	OA	CP	NPT	C	C	C	C	C	C	
Y	CDQ	CP	NPT		C			C	C	
Y	CDQ	CV	NPT					C		
Y	OA	CP	NPT	21054.68	12795.84	39631.84	13724.74	12766.67	20750.77	5475.28
Y	OA	CV	NPT		C	C	61.61		C	

Table A12 Groundfish catches (t) in the Pribilof Islands blue king crab 1975 to 1983 distribution area (Alternative 4) between 2003 and 2009.

C represents a confidential value. Species code names found in Appendix 1, Table A1. HAL = hook and line, POT = pot , JIG = jig

Gear	Species	2003	2004	2005	2006	2007	2008	2009
HAL	AKPL	0.01	C	0.07	0.07	C	C	C
HAL	AMCK		0.14	0.21	C	C		0.05
HAL	ARTH	40.05	50.41	33.44	35.55	21.12	26.06	24.90
HAL	BSKT					C		
HAL	DEM1	3.52						
HAL	DFL4	0.27						
HAL	FLO5	14.49	12.02	10.22	12.16	12.34	1.37	0.12
HAL	FSOL	43.7	65.77	51.22	62.25	27.96	31.22	15.20
HAL	GTRB	1.18	0.37	0.21	0.16	0.14	0.1	0.33
HAL	NORK	0.18	0.33	0.3	0.51	0.05	C	0.11
HAL	OTHR	1050.98	1257.55	1820.42	1146.3	1029.72	793.28	543.77
HAL	PCOD	7536.01	8296.81	12523.68	9415.77	5346.48	3727.06	2509.22
HAL	PEL7	0.38						
HAL	PLCK	344.37	263.35	241.27	190.61	211.99	209.73	69.11
HAL	POPA	C	C	C	C		C	0.01
HAL	REYE		0.04	C	C		0.02	0.00
HAL	ROCK	0.6	2.35	0.54	0.3	0.05	0.1	0.14
HAL	RSOL	1.93	5.11	21.04	4.08	0.9	0.52	0.58
HAL	SABL	109.28	C	0.64	C	C	0.04	C
HAL	SFL1	0.38				C		
HAL	SQID						C	
HAL	SRKR		0.21	C	C		0.09	0.35
HAL	SRRE	4.85						
HAL	THDS	6.11						
HAL	USKT			C		C		
HAL	YSOL	57.43	86.91	84.38	99.12	52.73	27.89	13.43
JIG	ARTH							C
JIG	DEM1	C						
JIG	FSOL							C
JIG	OTHR							C
JIG	PCOD		0.63		C			C
JIG	PEL7	C						
JIG	PLCK							C
NPT	AKPL	2096.56	1021.04	4073.28	2439.95	1881.81	2585.31	930.04
NPT	AMCK	C	43.84	114.18	15.6	C	0.18	0.09
NPT	ARTH	990.07	981.61	493.06	526.07	1017.47	458.06	159.42
NPT	FLO5	25.62	83.9	121.21	34.19	220.42	85.68	6.03
NPT	FSOL	2641.87	2596.81	1713.97	1402.41	2510.38	2397.83	1047.46
NPT	GTRB	9.39	6.15	1.62	1.96	1.27	1.4	0.70
NPT	NORK	C	0.19	C	C	C	C	C
NPT	OTHR	904.29	672.26	978.51	764.28	806.21	764.36	307.85
NPT	PCOD	1954.52	1502.67	2307.49	882.25	1382.96	1215.16	343.45
NPT	PLCK	3243.37	2407.07	4400.36	1702.96	2058.52	1541.9	1022.34
NPT	POPA	7.78	18.8	C	C	15.52	C	0.16
NPT	REXS			C				
NPT	ROCK	C	C	C	C	C		0.01
NPT	RSOL	1845.44	1577.93	4215.51	1133.28	1586.49	870.84	517.57

Gear	Species	2003	2004	2005	2006	2007	2008	2009
NPT	SABL	0.78	C	0.93	C			
NPT	SQID	0.32				C		C
NPT	SRKR				C			
NPT	USKT			C				
NPT	YSOL	14384.46	11474.03	30274.19	10608.67	10775.59	16722.05	3912.18
POT	AKPL	C						
POT	AMCK	C	C		C	0.06	0.22	
POT	ARTH		0		C		0.11	C
POT	FLO5		C		C		C	
POT	FSOL	C	C	0.03	C	C	0.12	
POT	GTRB				C		C	C
POT	NORK		C			C	0.12	C
POT	OTHR	13.62	18.94	16.32	41.63	51.58	31.8	10.20
POT	PCOD	717.94	2484.21	3051.23	2082.65	2553.82	2069.47	647.96
POT	PLCK	2.69	2	1.79	3	0.93	0.4	C
POT	POPA						C	C
POT	ROCK		C			C	0.07	C
POT	RSOL	C	0.04	0.08	C	C	0.08	C
POT	YSOL	0.85	2.85	11.83	4.22	14.28	2.59	22.08
PTR	AKPL	0.16	0.25	0.1	0.15	0.24	0.04	0.39
PTR	AMCK	0.46	0.38	0.07	1.06	0.03	0.04	0.00
PTR	ARTH	15.46	4.85	5.46	3.62	51.56	6.53	19.17
PTR	FLO5	0.74	5.71	4.66	0.17	0.45	0.77	0.42
PTR	FSOL	116.62	120.4	93.65	34.94	134.17	58.57	69.93
PTR	GTRB	0.07	0.05	0.05		0.03	C	0.03
PTR	NORK	0.1	0.31	0.13	0.29	0.01	0.01	0.30
PTR	OTHR	34.17	118.58	52.32	21.85	34.88	87.15	71.23
PTR	PCOD	205.35	456.89	302.23	112.32	131.69	329.35	227.02
PTR	PLCK	34468.11	72420.45	41586.89	16953.77	19522.5	15756.07	12587.14
PTR	POPA	0.8	0.04	0.8	0.46	0.02	C	0.62
PTR	REYE		C	C		C		C
PTR	ROCK	0.04	0.03	C	0.02	0.03	0.03	0.03
PTR	RSOL	54.92	228.73	97.29	46.39	34.23	139.91	184.75
PTR	SABL	0.01				C		
PTR	SQID	0.42	1.02	0.41	0.46	0.24	0.24	0.14
PTR	SRKR		C	C		C		
PTR	YSOL	19.07	61.47	1.07	41.52	60.21	0.17	0.14

11 Appendix 2: Additional closure configuration considerations.

In December 2010, the North Pacific Fishery Management Council moved to consider whether an additional closure configuration to Alternatives 4c and 5e would be more appropriate based upon a combined analysis of recent bycatch and survey distribution. Previous closure Alternatives 4c and 5e were based solely on the historical time series of survey biomass. The distribution of survey data was compared to observed bycatch locations of blue king crab in the Pribilof District in 5-year intervals from 1976 to 2010 (Figure 12-1). In broadening this analysis it was also discovered that a substantial bycatch of blue king crab has been observed in the Bristol Bay District to the east of the Pribilof Islands. It was noted that these catches are never observed in the trawl survey and may represent movement by the crab between the survey and the fishery or catches of small crab not encountered in the survey trawl.

In the earliest years, the bycatch is sparse over the entire distribution, while the survey data catches up to 26,000 crab per nm^2 which suggests a distribution close to the Pribilof Islands (Figure 12-2A). Mothership landings and trawl catch accounted for the majority of the bycatch ranging from 1 to 800 crabs per haul (13-2A). From 1981 to 1990 the concentration of very dense observed catches is located to the north and east of the Pribilof Islands dominated by trawl fisheries (Figure 12-2B and Figure 12-2C) while the survey biomass decreased over this time period from catches around 20,000 crabs per nm^2 to less than 10 crabs per nm^2 (Figure 12-2C). During this early time period the survey biomass fell within the existing Pribilof Islands Habitat Conservation Zone (PIHCZ) while the bycatch was distributed roughly half inside the Alternative 4 Option b area and half inside the Bristol Bay District. In 1991 to 1995 the bycatch concentration shrunk back to the Pribilof Islands area surrounding the relatively stable biomass estimates from the trawl survey (Figure 12-2D), and the composition of the bycatch source shifted to more pot and longline gear (Figure 12-2D). From 1996 to 2010 survey biomass plummeted and the relative contribution of trawl caught bycatch decreased while longline and pot bycatch increased in and around the Pribilof Islands (Figure 12-2E through Figure 12-2 G).

To put the changes in survey biomass and bycatch by gear type into context with management efforts both data sources were plotted during years affected by the trawling ban due to the PIHCZ closure in 1995 and the reduction of the overfishing limit and total allowable catch associated with the 2003 declaration of overfished status (Figure 12-3). When the PIHCZ was enacted in 1995 the bycatch focused mainly south and east of the Pribilof Islands (Figure 12-3) and was comprised of mostly longline and pot gear (Figure 12-4). The majority of this bycatch would be contained within the Alternative 4 Option a or b scenarios. Note that a portion of the bycatch was outside of the actual management area for Pribilof Islands blue king crab. After the overfished declaration in 2003, bycatch has continued to mostly come from the pot and longline gear centered within the existing PIHCZ with small catches from the trawl fleet in recent years in the Bristol Bay District (Figure 12-6).

Due to the lack of temporal clarity and patterns in the bycatch of Pribilof Islands blue king crab, the analysts did not add another closure configuration to the existing alternatives. In the early time series when biomass was at its peak around the Pribilof Islands, it was clear that a substantial amount of trawl bycatch occurred to the north and east. By the time the local trawl ban was enacted in the Pribilof Islands the biomass had decreased and bycatch mortalities shifted to the south of the islands. The existing alternative closures adequately covers this region while also accounting for potentially important habitat north and east of the Pribilof Islands.

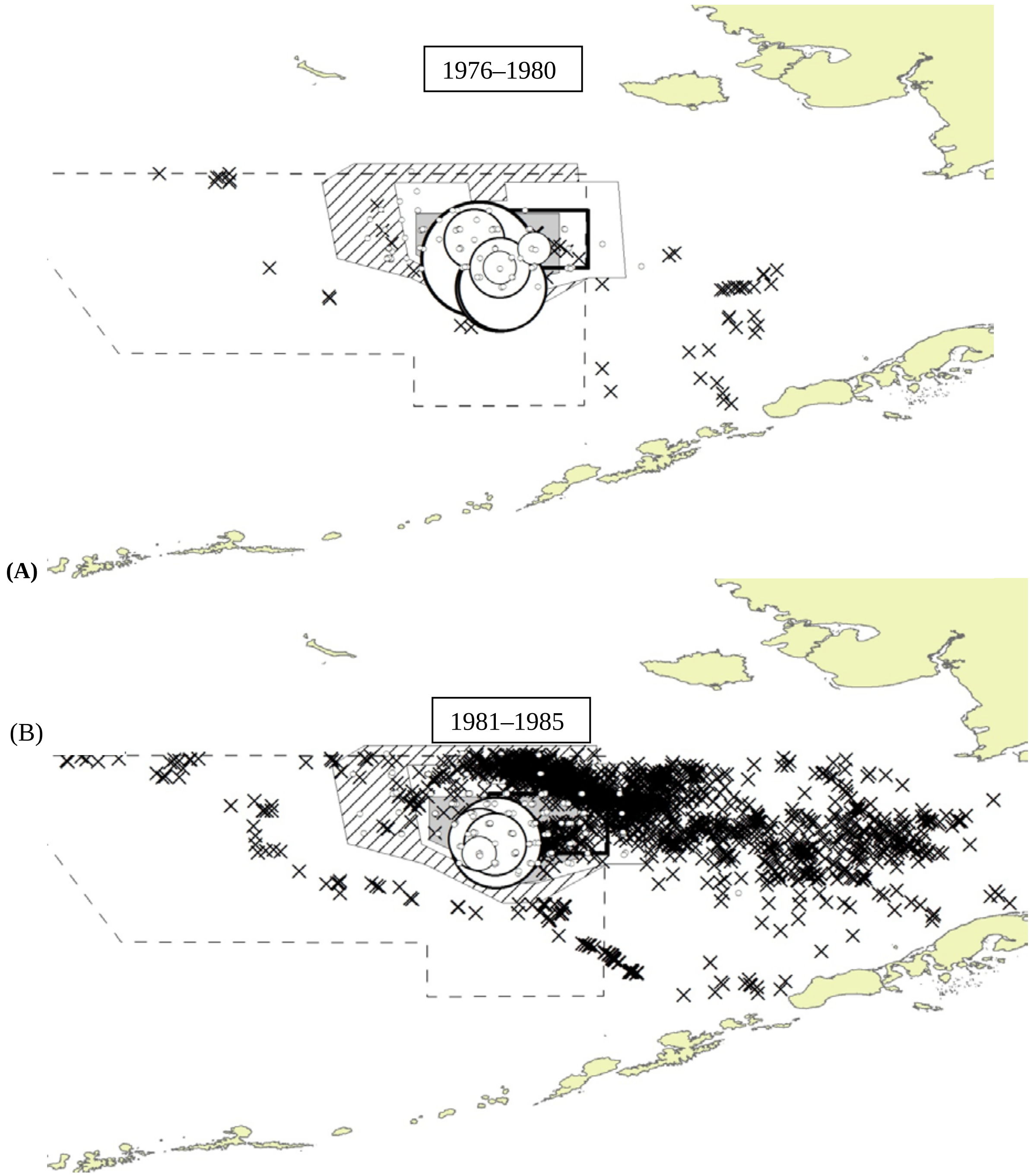
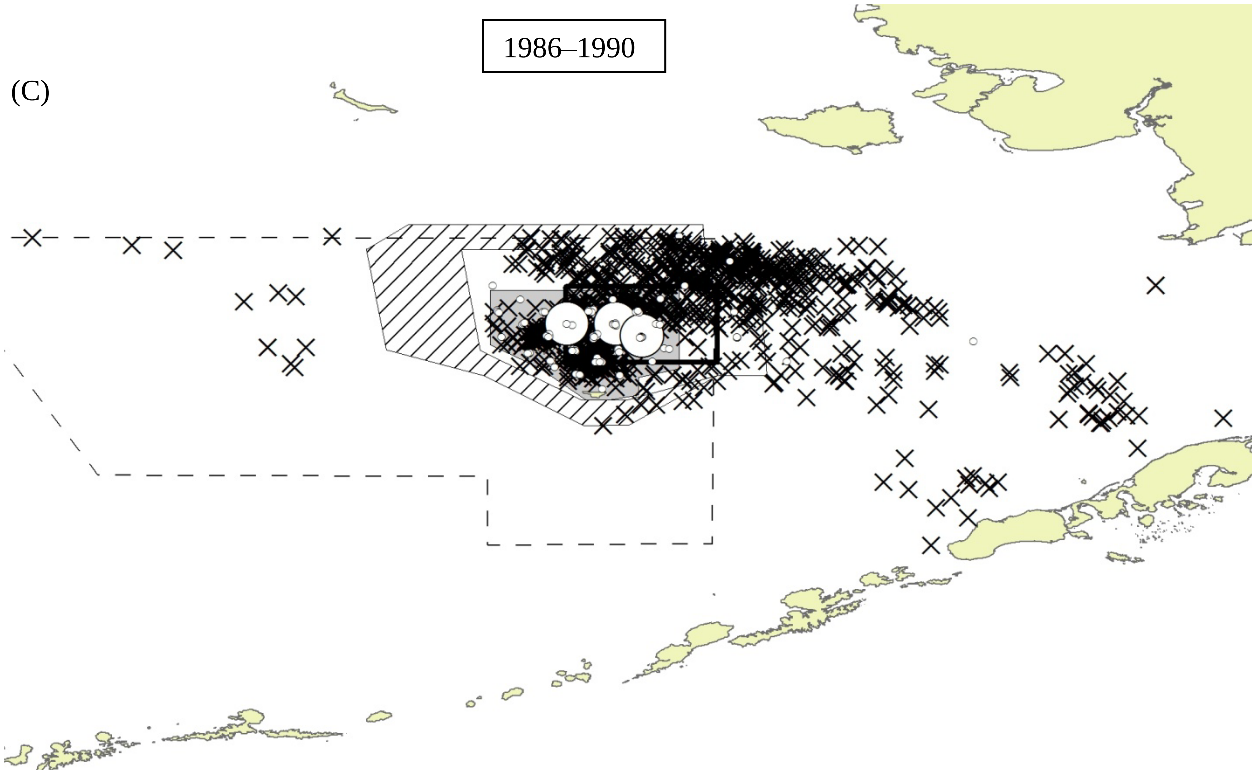
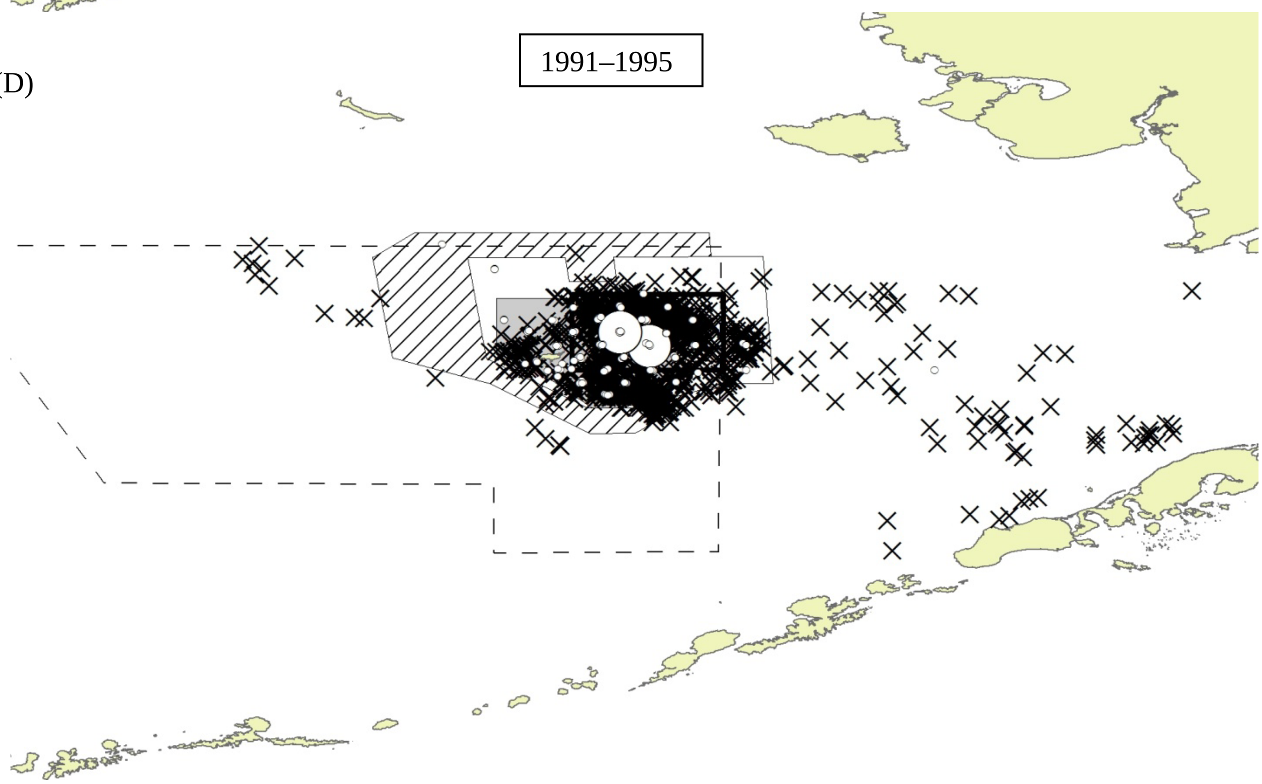


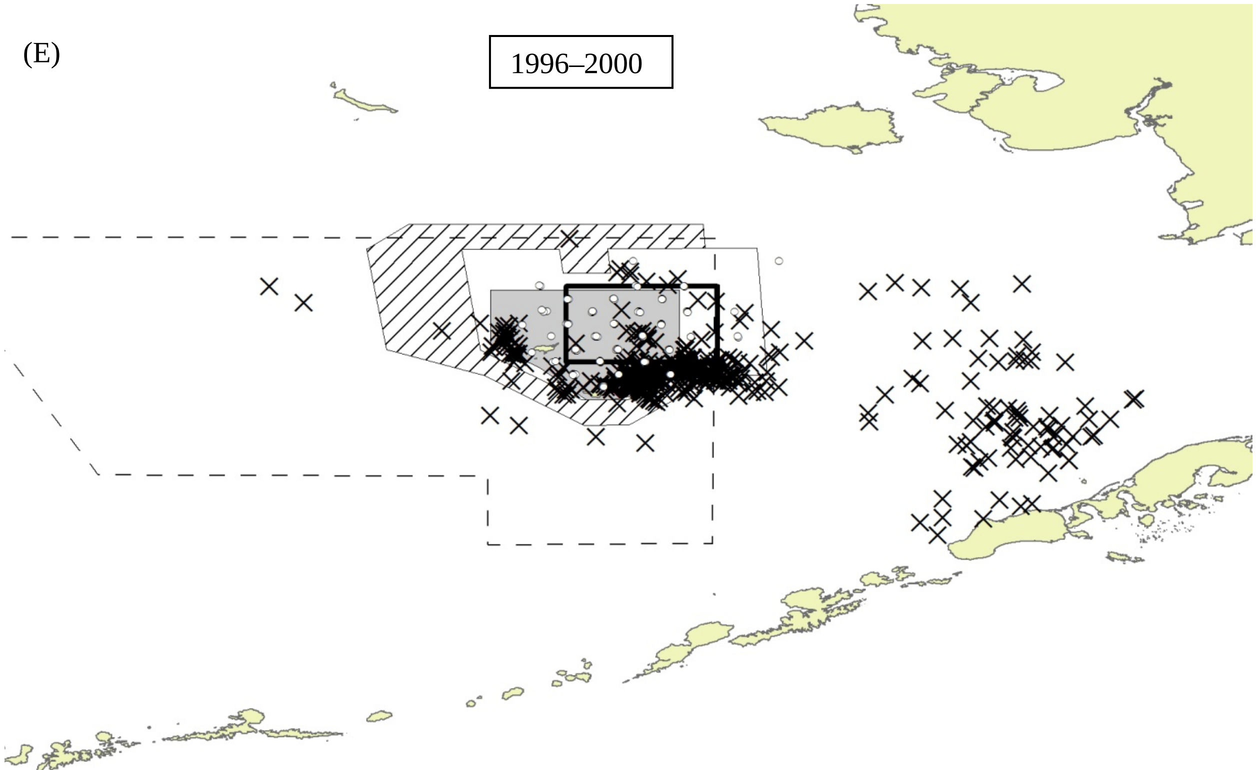
Figure 12-1 The distribution of survey data (open circles: smallest=30–5,000 crab/nm^2; largest=21,000–26,000 crab/nm^2) and observed bycatch locations (X) of blue king crab in the Pribilof District (dashed region) and the Bristol Bay District to the east in 5-year intervals from 1976 to 2010 (A–G). Also shown are the four alternative regions.

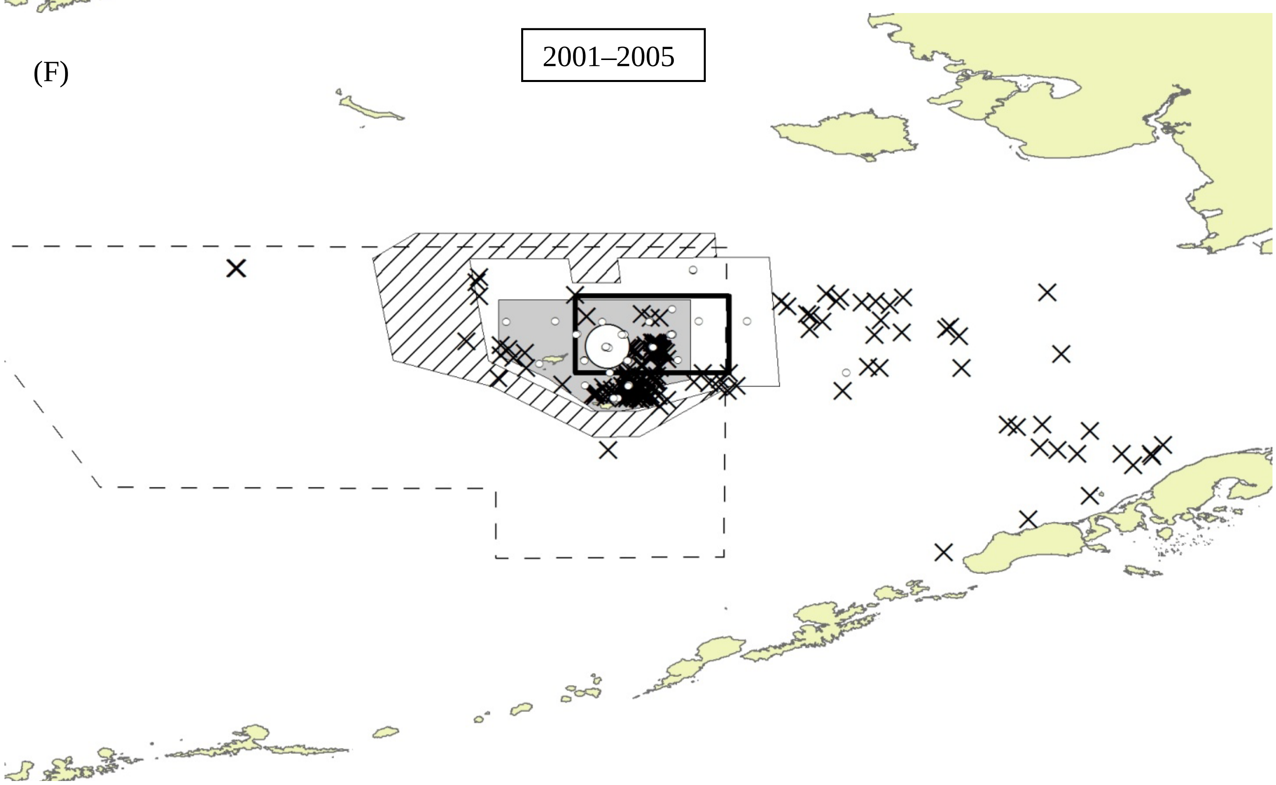
(C)

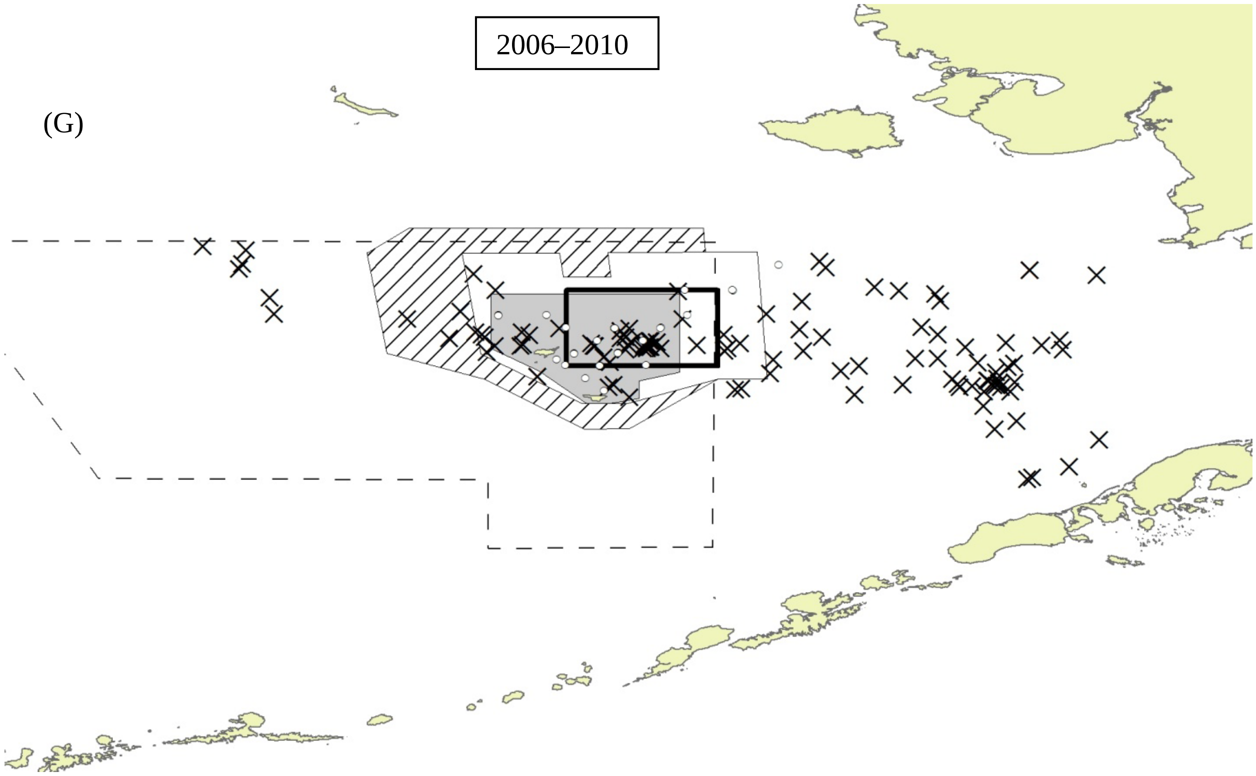


(D)




(E)
1996–2000


(F)
2001–2005


2006–2010
(G)

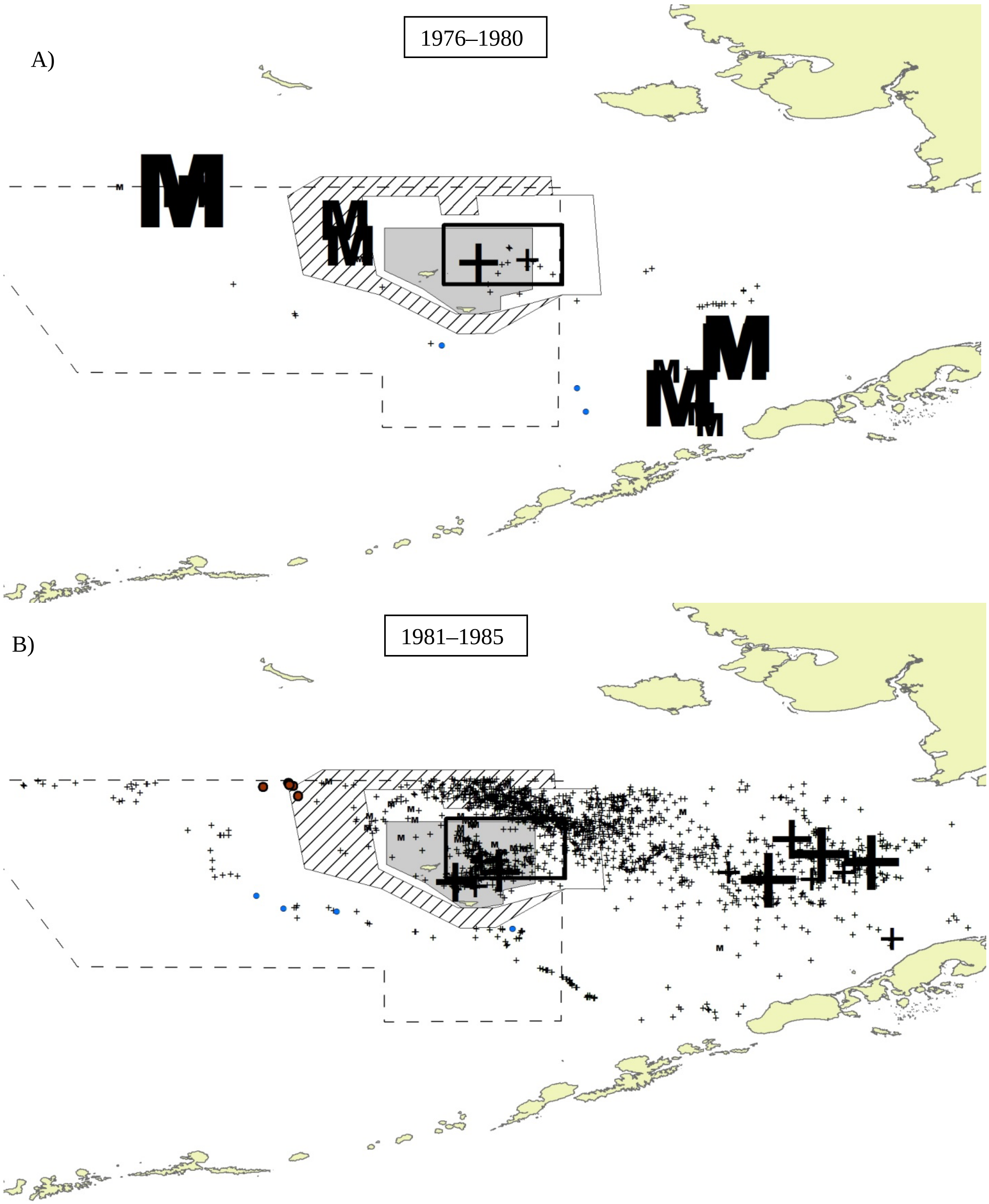
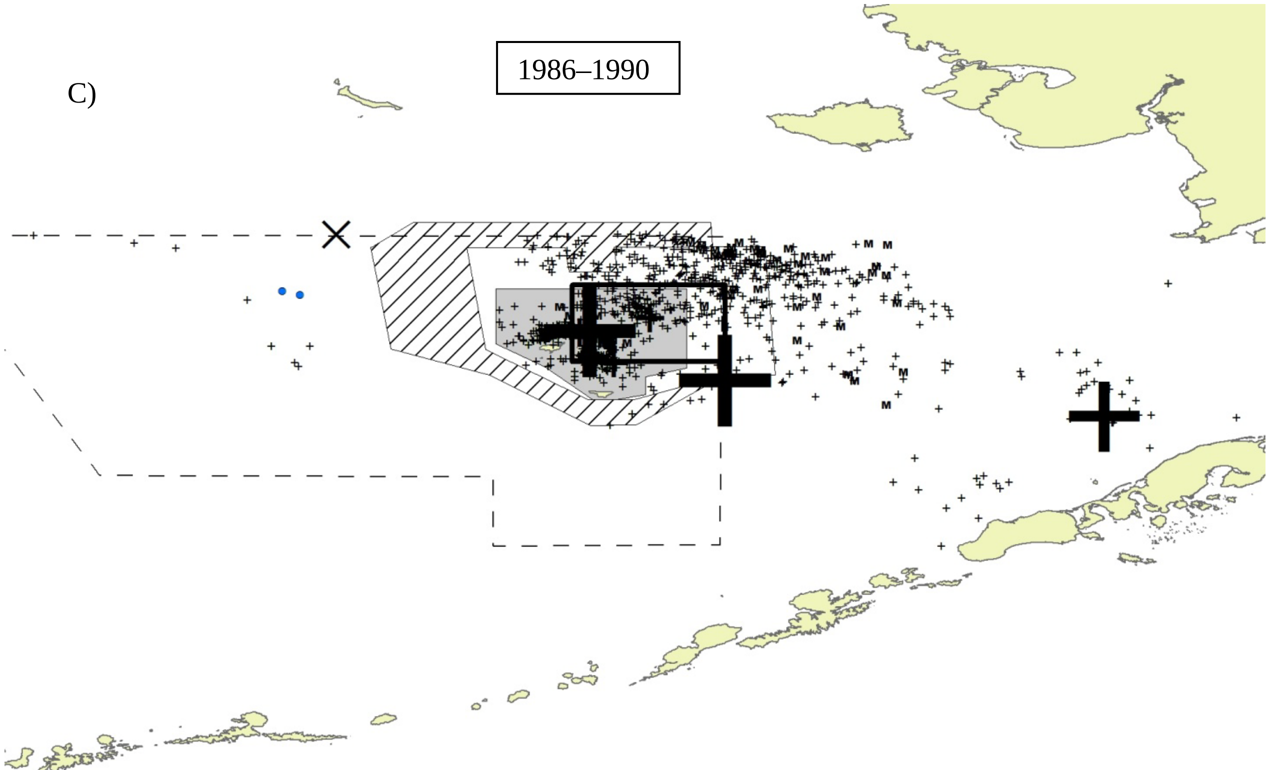
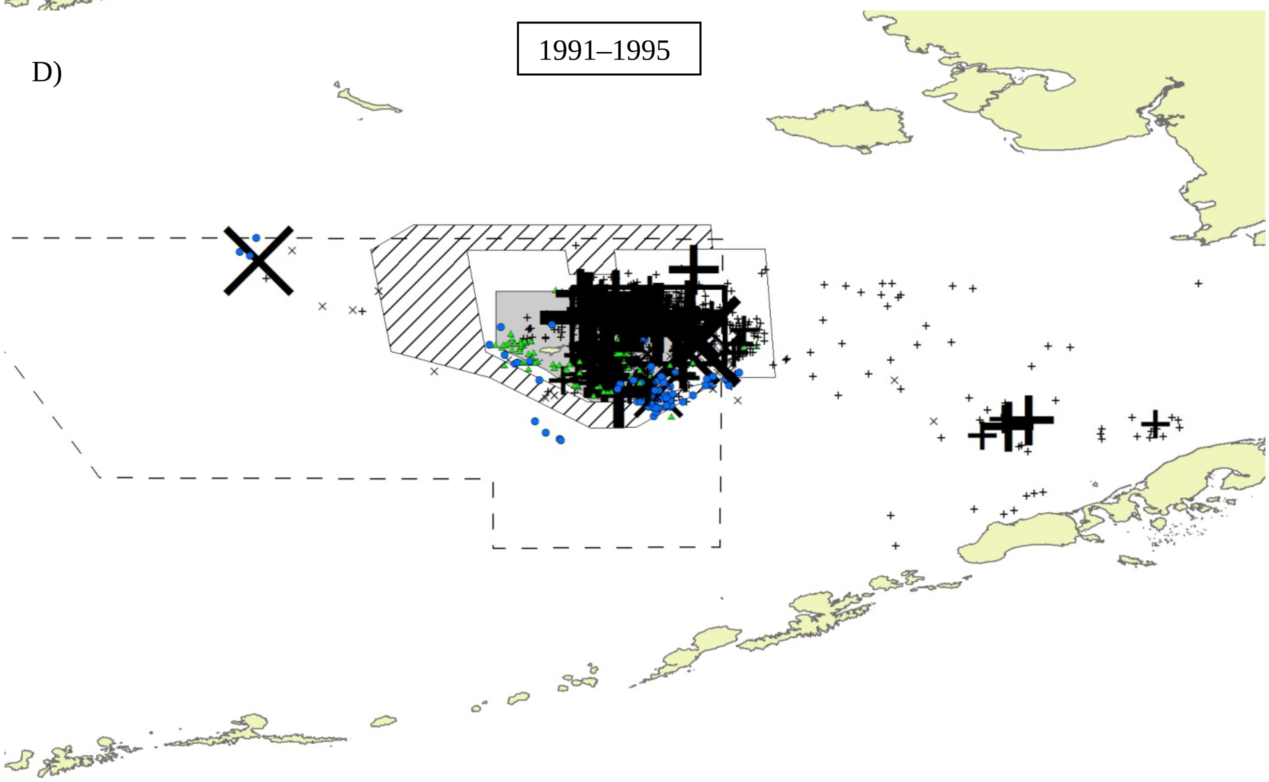
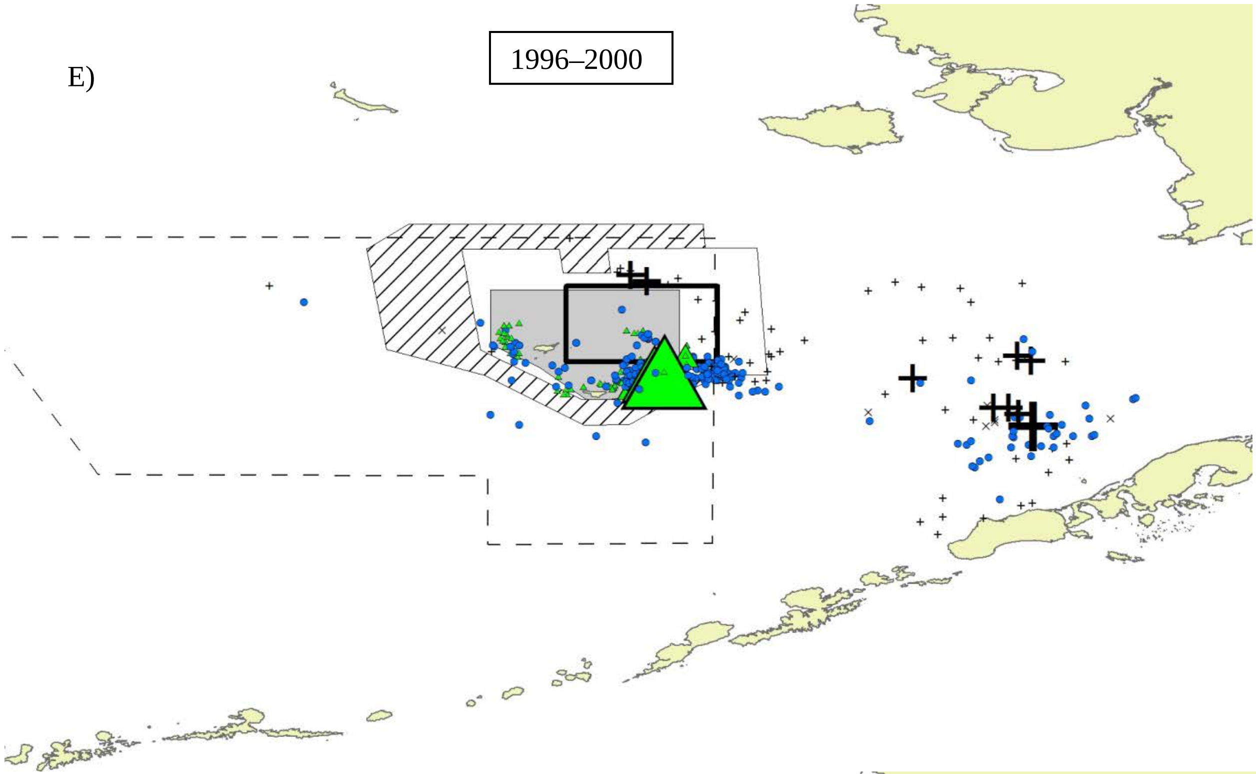


Figure 12-2 **The distribution of observed bycatch of blue king crab in the Pribilof District (dashed region) and the Bristol Bay District to the east in 5-year intervals between 1976 and 2010 (A–G) by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1–200 observed crabs and the largest symbol equals 800–1,000 observed crabs. Between 1976 and 1990, gear type data is unavailable so vessel type is used to discern gear used. In these years M refers to mothership.**

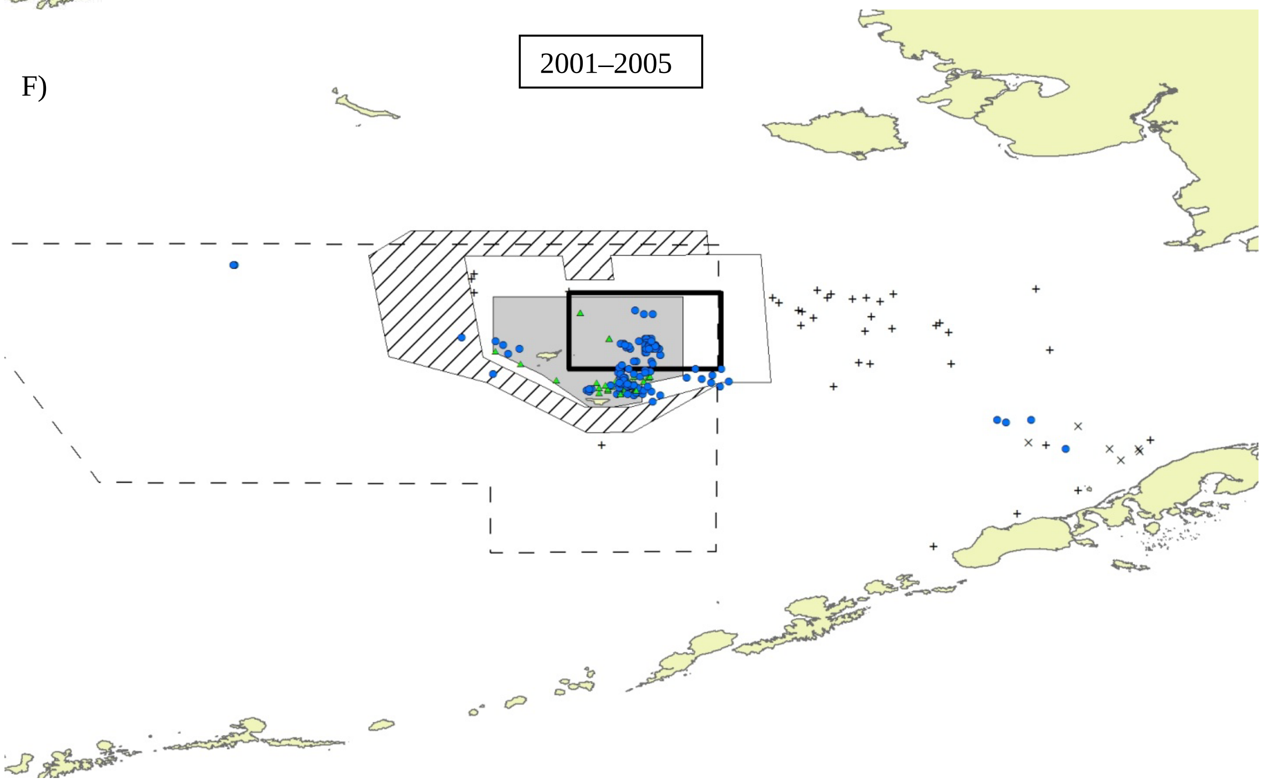

C)
1986–1990


D)
1991–1995

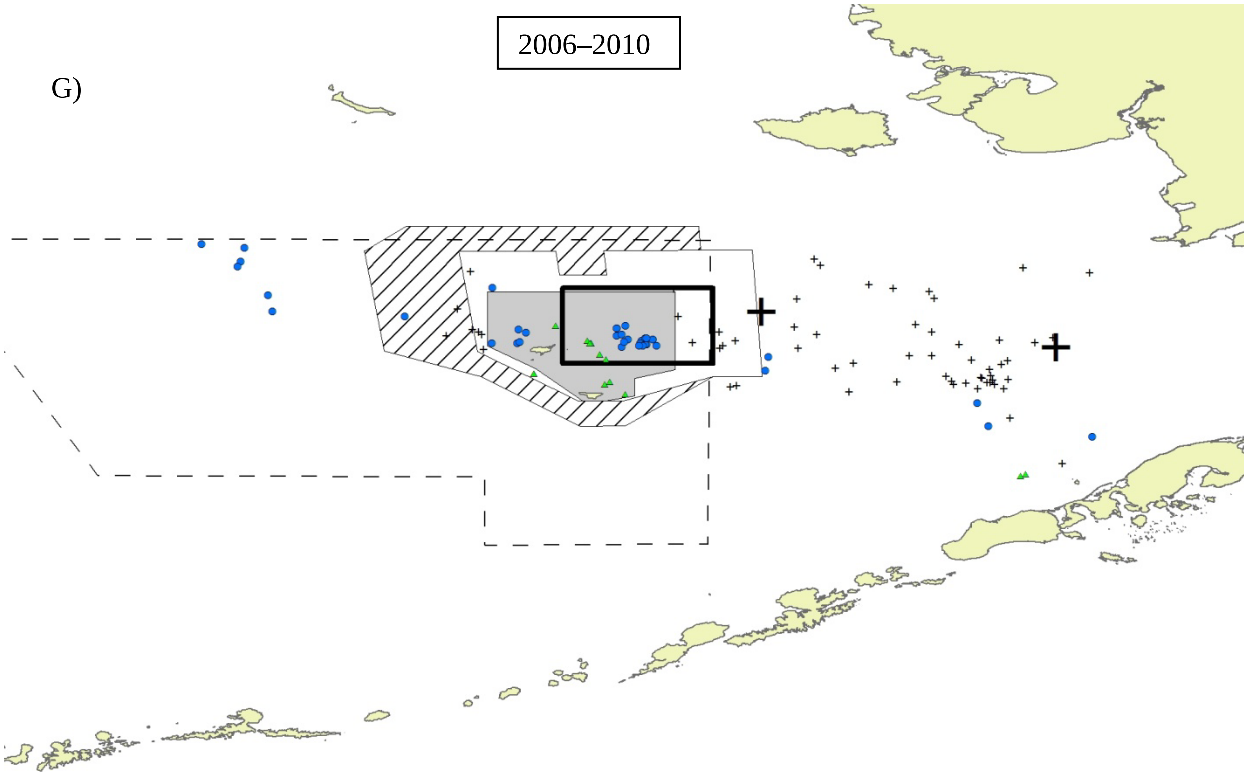
E)



F)



G)



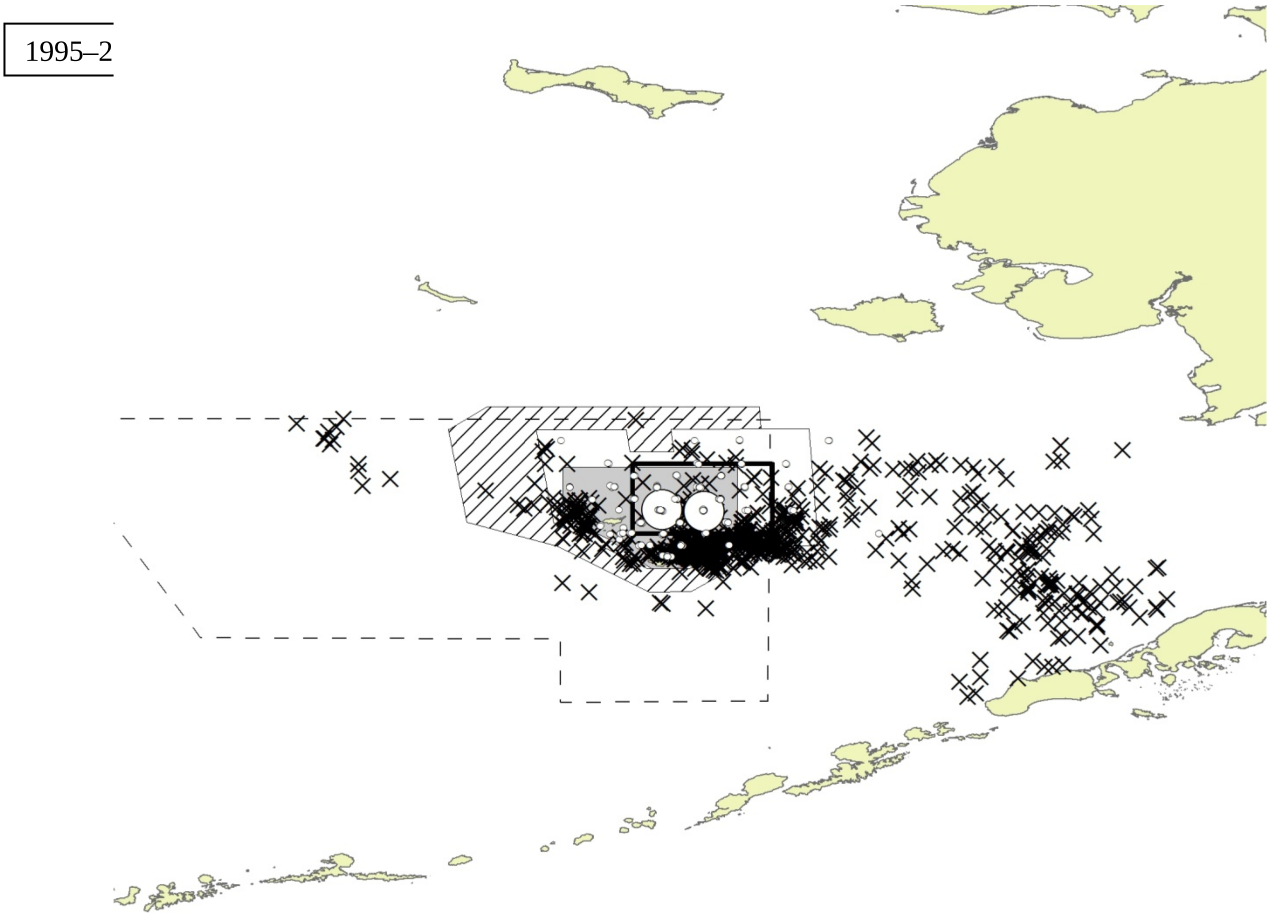


Figure 12-3 The distribution of survey data (open circles: smallest=30–5,000 crab/nm^2; largest=21,000–26,000 crab/nm^2) and observed bycatch locations (X) of blue king crab in the Pribilof District (dashed region) and the Bristol Bay District to the east between 1995 and 2010,the years after the PIHCZ no trawl zone was implemented.

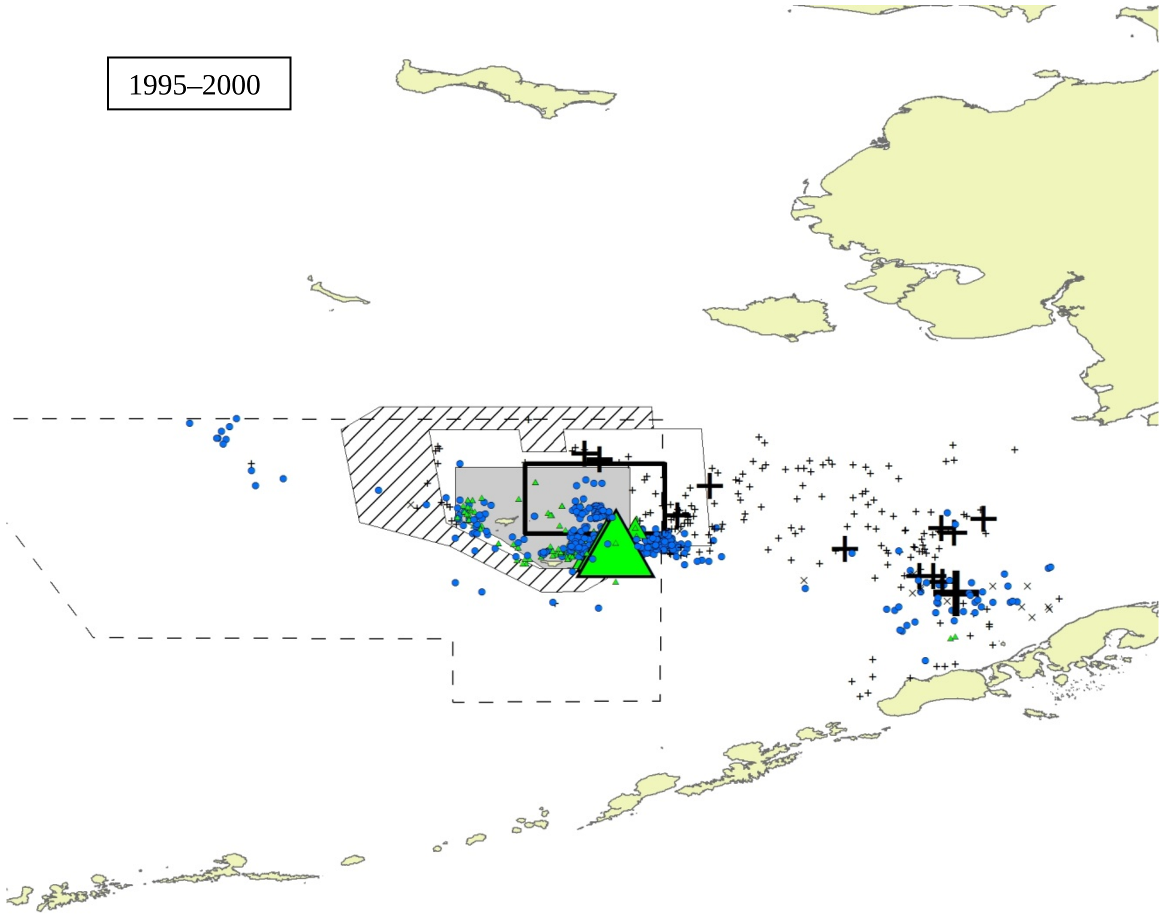


Figure 12-4 The breakdown of the observed bycatch by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1–200 observed crabs and the largest symbol equals 800–1,000 observed crabs. The data is aggregated from the time of the trawling ban in the PIHCZ beginning in 1995 and continuing to 2010.

A) 2003–2010

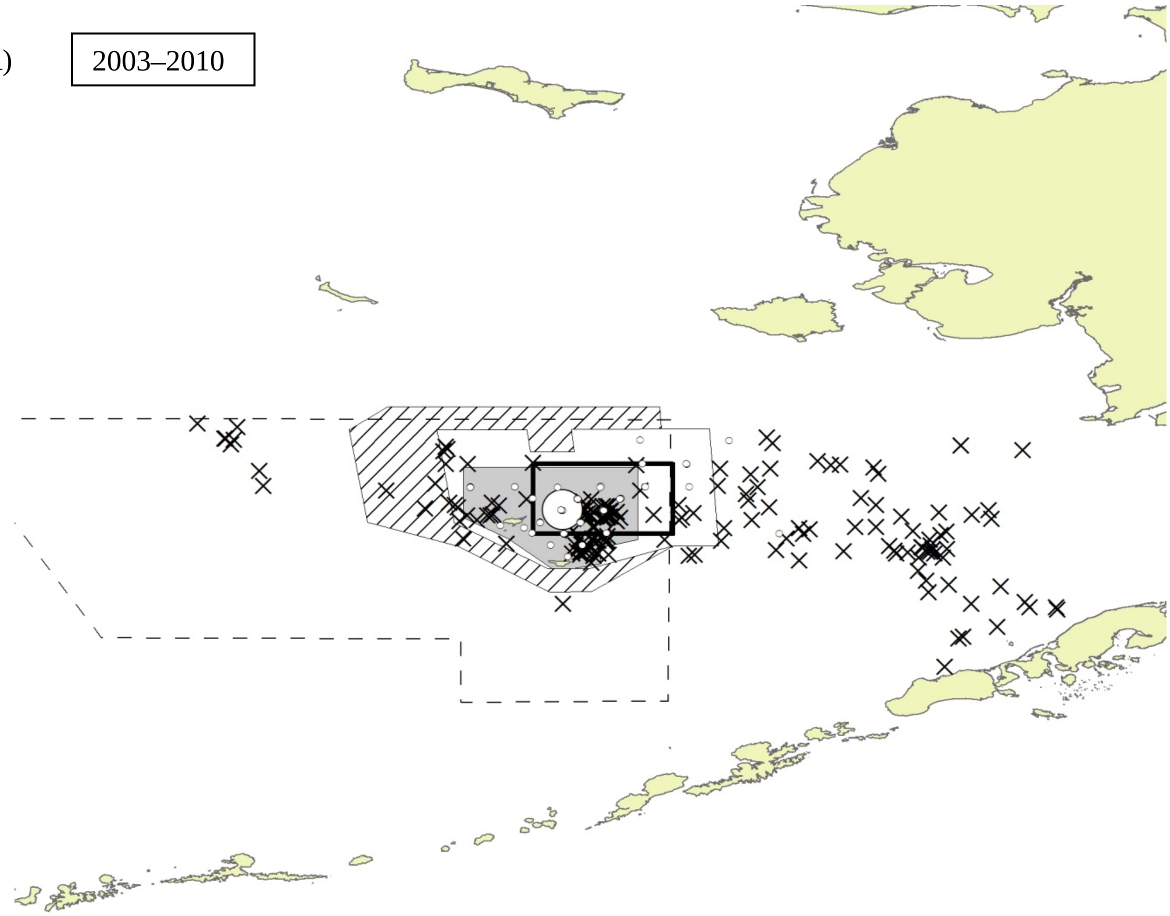


Figure 12-5 The distribution of survey data (open circles: smallest=30–5,000 crab/nm^2; largest=21,000–26,000 crab/nm^2) and observed bycatch locations (X) of blue king crab in the Pribilof District (dashed region) and the Bristol Bay District to the east between 2003 and 2010, years after the Pribilof Islands blue king crab stock was declared overfished.

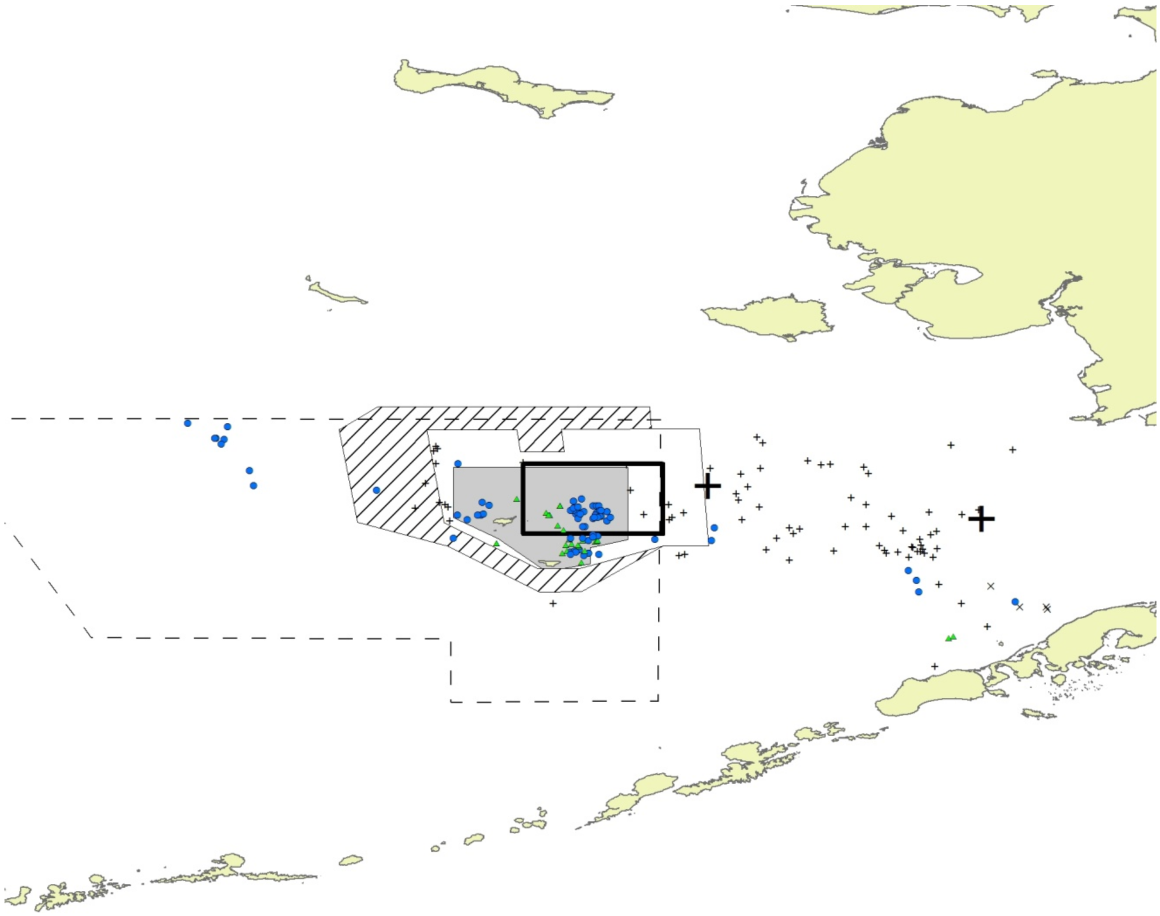


Figure 12-6 The breakdown of the observed bycatch by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1–200 observed crabs and the largest symbol equals 800–1000 observed crabs. The data is aggregated from the time of the overfished declaration for Pribilof Islands blue king crab 2003 to 2010.