Agenda Item C-3(d)
September 2011

Public Review Draft

ENVIRONMENTAL ASSESSMENT

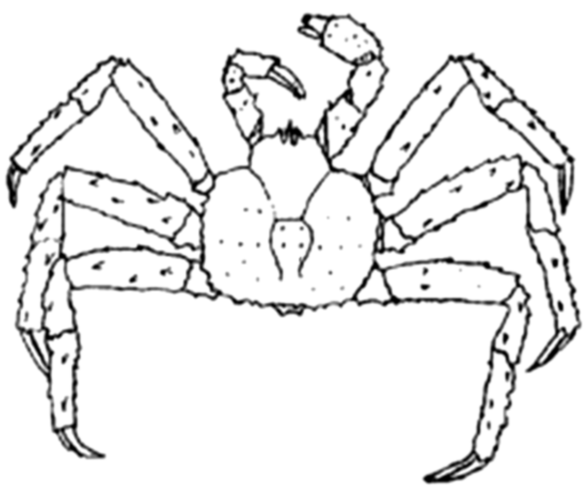
for proposed amendment to the

FISHERY MANAGEMENT PLAN FOR THE BERING SEA AND ALEUTIAN ISLANDS KING AND TANNER CRABS

and the

FISHERY MANAGEMENT PLAN FOR THE GROUNDFISH OF THE BERING SEA AND ALEUTIAN ISLANDS

to revise the rebuilding plan for Pribilof Islands blue king crab.



Abstract

This draft environmental assessment evaluates five proposed alternative rebuilding measures for the Pribilof Islands blue king crab (*Paralithodes platypus*) stock. 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. This revised rebuilding plan considers five alternatives. 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. The impacts of these alternatives on rebuilding the Pribilof Island blue king crab stock as well as the environmental and social/economic impacts of these measures are considered in this analysis.

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Executive Summary

The king and Tanner crab fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) of the Bering Sea and Aleutian Islands (BSAI) off Alaska are managed under the Fishery Management Plan for Bering Sea and Aleutian Islands King and Tanner Crabs (FMP). The 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 FMP including its goals and objectives, the Magnuson-Stevens Act, and other applicable Federal laws.

This proposed action is a revised rebuilding plan for the Pribilof Islands blue king crab (PIBKC) stock. The PIBKC stock remains overfished. The purpose of this proposed action is to reduce the risk of overfishing the PIBKC stock by developing an amended rebuilding plan for this stock in compliance with the Magnuson-Stevens Act and the national standard guidelines.

Five alternatives are considered in this analysis. Four of the alternatives consider time and area closures to better protect the PIBKC stock. The fifth alternative considers trigger caps and associated time and area closures in groundfish fisheries which have contributed historically to bycatch of this stock. Alternatives 2-5 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.

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). Alternative 3 proposes to apply the existing State of Alaska (State) 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. For each of Alternatives 2-5, there is the option of increasing observer coverage, either to all fisheries to which a cap or closure applies (Option 1), or to specific fisheries (Option 2).

Analysis of the impacts of these closure configurations on the rebuilding potential for the PIBKC stock shows limited effect on rebuilding between the ranges of alternative closures. Final action is scheduled for October 2011.

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1 Introduction

The king and Tanner crab fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) of the Bering Sea and Aleutian Islands (BSAI) off Alaska are managed under the Fishery Management Plan for Bering Sea and Aleutian Islands King and Tanner Crabs (FMP). The groundfish fisheries of the Bering Sea and Aleutian Islands are managed under the Fishery Management Plan for groundfish fisheries of the Bering Sea and Aleutian Islands region. These FMP 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 FMP, including its goals and objectives, the Magnuson-Stevens Act, and other applicable Federal laws. The 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 a 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 BSAI Crab and the BSAI groundfish FMPs. 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 RIR/IRFA is included in this analysis.

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 MSST and was overfished. A rebuilding plan was implemented in 2003 including provisions prohibiting directed fishing until the stock was rebuilt. The PIBKC fishery has been closed since 1999 and bycatch in 2009/10 was below the overfishing level. The Council was notified on September 29, 2009 that the current rebuilding plan has not achieved adequate progress to rebuild the stock by 2014. A revised rebuilding plan must be developed for the PIBKC stock and implemented within two years of notification. This plan must be implemented prior to the start of the 2011/12 crab fishing year. To comply with section 304(e)(7) of the Magnuson-Stevens Act, the Council is preparing an amended PIBKC rebuilding plan. The primary rebuilding alternatives address bycatch in groundfish fisheries as the provision of the rebuilding plan (a ban on directed fishing until the stock is rebuilt) remains in effect and the only additional catch of this stock is by groundfish fisheries. Annual Catch Limit (ACL) provisions for the PIBKC stock were considered in a separate analysis.

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 reduce the risk of overfishing and to rebuild the PIBKC stock in as short as possible with the understanding that the biology of this stock and environmental conditions will likely dictate that the time needed to rebuild will exceed 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; however no similar action has been taken for groundfish fisheries. 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 MSA 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.

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. The National Marine Fisheries Service (NMFS) published National Standard Guidelines (50 CFR sections 600.310-600.355) to provide comprehensive guidance for the development of FMPs and FMP amendments that comply with the Magnuson-Stevens Act National Standards. The Guidelines provide guidance for status determination criteria and rebuilding overfished stocks, including specifying the time period for rebuilding.

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA, Public Law 109-479) includes provisions intended to prevent overfishing by requiring that FMPs establish a mechanism for specifying ACLs in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability. ACLs and accountability measures (AMs) are required by fishing year 2010 if overfishing is occurring in a fishery, and they are required for all other fisheries by fishing year 2011. Since overfishing is not occurring for any crab stock, all crab fisheries must have ACL and AM mechanisms by the 2011/2012 crab fishing year. The MSRA includes a requirement for the SSC to recommend Annual Biological Catch (ABC) levels to the Council, and provides that ACLs may not exceed the fishing levels recommended by the SSC. These actions were considered under a separate analysis (see NPFMC 2010 Amendment 38 EA). The MSRA also amended section 304(e)(3) of the Magnuson-Stevens Act, which now requires the Council and 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.

1.3 Scope of Analysis

This Environmental Assessment (EA) relies heavily on the information and analysis contained in the Bering Sea Aleutian Islands Crab Fisheries Final Environmental Impact Statement/Regulatory Impact Review/Initial Regulatory Flexibility Analysis/Social Impact Assessment (NMFS 2004a), which is available on the NMFS Alaska Region web site at:
http://www.fakr.noaa.gov/sustainablefisheries/crab/eis/default.htm.

Throughout this analysis, that document is referred to as the Crab Environmental Impact Statement, or "Crab EIS." Additional information concerning the crab fisheries and management under the Crab Rationalization Program (Program), and impacts of these on the human environment are contained in that document.

The Crab EIS provides the status of the environment and analyzes the impacts of the crab fisheries on the human environment. This EA tiers off of the Crab EIS to focus the analysis on the issues ripe for decision and eliminate repetitive discussions. The proposed action would establish ACLs for the crab stocks under the FMP and rebuilding plans for the Eastern Bering Sea (EBS) snow crab and Tanner crab stocks. This EA details the specific impacts of the proposed action.

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 (CEQ) 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 Stock Assessment and Fishery Evaluation (SAFE) Reports, available from the Council web site at:
http://www.fakr.noaa.gov/npfmc/SAFE/SAFE.htm, or
http://fakr.noaa.gov/npfmc/membership/plan_teams/CPT/CRABSAFE2010_910.pdf

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

2 Description of Alternatives

There are five alternatives considered in this analysis. All of the alternatives consider time and area closures to better protect the PIBKC stock, either through year-round closures or trigger caps applied to these closures, while other alternatives consider a prohibited species cap on bycatch in groundfish fisheries. Alternatives 2-5 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 2.7 contains a comparison of the different alternatives. Section 2.10 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. These include a directed fishery closure until the stock is completely rebuilt, and the closure to all trawl gear of the Pribilof Islands Habitat Conservation Zone (PIHCZ) as shown in Figure 10-1.

Amendment 21a to the BSAI groundfish FMP established the PIHCZ, effective January 20, 1995. This closure prohibits the use of trawl gear in a specified area around the Pribilof Islands year-round (Figure 10-1). 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 Pribilof Islands Habitat Conservation Area was intended to protect a majority of the crab habitat in the Pribilof Islands area (NPFMC, 1994). The closure was implemented in January 1995.

2.2 Alternative 2: Modify the current Pribilof Islands Habitat Conservation Zone to apply to select groundfish fisheries and only Pacific cod pot cod fishing.

Under Alternative 2, the existing PIHCZ, as described in Alternative 1 (Figure 10-1), 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: Closure applies to all groundfish fisheries which have contributed greater than a designated threshold to bycatch of PIBKC since 2003. These fisheries and the threshold criteria are described in section 3.2 and Table 11-1.

Option 2b: Closure applies to all fishing for Pacific cod with pot gear. In addition to the existing trawl closure, all Pacific cod pot fishing would also be prohibited in this zone year-round.

2.3 Alternative 3: ADF&G crab closure areas applied select groundfish fishing and 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 as described in the options below. The existing closure configuration is indicated in Figure 10-2.

There are two closure options under Alternative 3:

Option 3a: Closure applies to all groundfish fisheries which have contributed greater than a designated threshold to bycatch of PIBKC since 2003. These fisheries and the threshold criteria are described in section 3.2 and Table 11-1.

Option 3b: 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 closures shown in Figure 10-2.

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 10-3 (a and b), which 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 EBS bottom trawl survey (Figure 10-3a). 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 10-3b). 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 closure options under Alternative 4:

Option 4a: Closure applies to all groundfish fisheries which have contributed greater than a designated threshold to bycatch of PIBKC since 2003. These fisheries and the threshold criteria are described in section 3.2 and Table 11-1. Under this option no federal groundfish fishing for those fisheries would be allowed within the confines of the closure shown in Figure 10-3 (a or b).

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 10-3 (a or b).

Under either option the closure would apply year-round.

2.5 Alternative 5: Trigger closures with cap levels established for PIBKC in all groundfish fisheries.

Under Alternative 5, a trigger cap 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 trigger cap and those groundfish fisheries which are not exempted would be subject to the closure. The closure applies to all groundfish fisheries which have contributed greater than a designated threshold to bycatch of PIBKC since 2003. These fisheries and the threshold criteria are described in section 3.2 and Table 11-1. There is currently no feedback between catch of PIBKC accrual towards the OFL under the BSAI Crab FMP and any catch restrictions in the groundfish fisheries. This alternative would provide explicit feedback by closing groundfish fisheries when the PSC cap for PIBKC is reached.

Four options are considered for the cap levels (labelled under each closure option as sub-option 1 through 4 considered for each closure).

2.5.1 Sub-option 1: PSC Cap = OFL

Here the aggregate PSC cap would be established at the level of the annual OFL for the PIBKC stock based on the most recent stock assessment. The OFL for PIBKC stock is 0.004 million pounds in the 2010/11 fishing year. The OFL is a total-catch OFL and is computed as the sum of catches by three different sources of removals: (1) the retained legal males in directed (pot) fishery for PIBKC; (2) discards of males and females in the directed fishery; and (3) bycatch in the groundfish pot and trawl fisheries. The directed fishery for PIBKC has been closed since 1998. 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. The OFL was not reached in the 2009/10 fishing year.

Currently the OFL for 2010/11 is established at 0.004 million lbs (0.0018 kt) corresponding to the five year average of bycatch in groundfish and crab fisheries from 1999/2000-2005/2006[1]. While the PIBKC stock is in Tier 4 of the Crab OFL Tier system, it is at stock status 'c' therefore the directed fishery $F_{directed}$ = 0 as $B/B_{MSYprox}$ is < beta and $F_{OFL}<F_{MSY}$ is determined by the PIBKC rebuilding plan. The OFL calculation employs a 'Tier 5" methodology of average catch in crab and groundfish fisheries to determine a bycatch-F_{OFL}. For purposes of this sub-option the cap is considered to be the bycatch component of the OFL. Currently the entire OFL is the bycatch component due to the low stock status in relation to the sloping control rule. Should the biomass of the stock increase above the beta threshold, the OFL would be determined using the true 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 cap for purposes of determining the annual PSC cap. 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 cap 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 specific the cap level.

2.5.2 Sub-option 2: PSC Cap = ABC

Here the PSC cap would be established at the level of the ABC to be recommended annually by the SSC to the Council. The Council took final action on an ACL analysis (Amendment 38 to the Crab FMP) in October 2010. The Council's preferred alternative establishes an ABC control rule to be employed annually to determine the maximum permissible ABC, understanding that the SSC may recommend a lower value on an annual basis. The Council's ABC control rule would be established using a P* approach with the recommended P* value = 0.49. Currently for PIBKC as a Tier 4 stock, using P* = 0.49 and employing only model-based (sigma-w) uncertainty this results in an ABC = 99.32% of OFL. This would result in an ABC = 3,973 lbs, or 27 lbs lower than the OFL. Given that the OFL for this stock is

[1] This 4,000 lb OFL was based upon data available in 2008. Since that time the data have been revised slightly and would result in a lower OFL if averaged over the same time period. The OFL has remained at the 4,000 lb level in order to allow for estimated incidental catch needs in groundfish fisheries.

not truly assessed using a Tier 4 formula based upon stock status, it seems reasonable to establish an ABC using the Tier 5 ABC formula in the Council's preferred alternative which is that ABC = 90% of OFL. This results in an ABC = 3,600 lbs (or 400 lbs less than the OFL). For analytical purposes this is the cap considered under these alternatives.

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

This sub-option sets the cap equivalent to 90% of the ABC. Given the ABC as specified under sub-option 2 this equates to a cap of 3,240 lbs.

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

This sub-option sets the cap equivalent to 75% of the ABC. Given the ABC as specified under sub-option 2 this equates to a cap of 2,700 lbs.

The following table compares the different cap sub-options in weight (lbs) as well as in numbers of crab (Table 2-1). Here the conversion from pounds to numbers of crab uses the mean observed weight (lbs) 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 RO.

Table 2-1 Comparison of cap sub-options in lbs and numbers of crab. Here the mean observed weight of PIBKC bycatch from 7/9/10 – 6/20/10 was used to calculate the number of crab. The mean weight employed was 2.671 lbs.

Cap sub-option	Cap description	Cap (lbs)	Cap (numbers of crab)
1	OFL	4,000	1,497
2	ABC	3,600	1,348
3	90% ABC	3,240	1,213
4	75% OFL	2,700	1,011

There are 4 closure options under Alternative 5:

Option 5a: The existing PIHCZ, as described in Alternative 1 (Figure 10-1), 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 are listed in Table 11-1. The closure would be triggered by attainment of a fishery-wise cap set at the options below. Cap options are the following:
Sub-option 1: Cap level = OFL
Sub-option 2: Cap level = ABC
Sub-option 3: Cap level = 90% ABC
Sub-option 4: Cap level = 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 10-2. The fisheries to which this closure would apply are listed in Table 11-1. The closure would be triggered by attainment of a fishery-wise cap set at the options below. Cap options are the following:
Sub-option 1: Cap level = OFL

Sub-option 2: Cap level = ABC
Sub-option 3: Cap level = 90% ABC
Sub-option 4: Cap level = 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 10-3A). The fisheries to which this closure would apply are listed in Table 11-1. The closure would be triggered by attainment of a fishery-wise cap set at the options below. Cap options are the following:
Sub-option 1: Cap level = OFL
Sub-option 2: Cap level = ABC
Sub-option 3: Cap level = 90% ABC
Sub-option 4: Cap level = 75% ABC

Option 5d: 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 10-3B). The closure would be triggered by attainment of a fishery-wise cap set at the options below. Cap options are the following:
Sub-option 1: Cap level = OFL
Sub-option 2: Cap level = ABC
Sub-option 3: Cap level = 90% ABC
Sub-option 4: Cap level = 75% ABC

Under Option 5d, suboptions 3 and 4, there is an additional option for allocation of the cap by gear types. This allocation is as follows:
Trawl gear: 40%
Pot gear: 40%
Hook and Line gear: 20%

2.6 Option for Increased Observer Coverage

For each of the Alternatives, and the sub-option of each Alternative that is ultimately selected, apply an option to 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 2-5.

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 observer program.

Under these options, increased observer coverage would be added to fisheries which contributed to PIBKC bycatch above a threshold criteria since 2003 (as listed in Table 11-1) or to only specific fisheries[2]. Selection of the sub-option would indicate that any mandatory increased observer coverage on

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

a fishery would sunset upon implementation of the observer restructuring program. The Council took final action on this analysis in October 2010. The main elements of the Council's preferred alternative as it relates to this are the ability to annually modify coverage in fleets based on fishery management monitoring needs and Council and NMFS priorities. The new program is anticipated to be implemented in 2013.

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

2.7 Comparison of Alternatives

Alternatives 1-5 all address different closure configurations applied to either the trawl-only fisheries (Alternative 1) or to include pot fisheries or additional fisheries as noted in section 3.2. A comparison of the relative extent of the closures across these alternatives is shown in Figure 10-5.

2.8 Management and monitoring considerations of alternatives

Under Alternatives 1-4, a designated area would be closed year-round to specific fisheries. This is currently how status quo is specified, with the PIHCZ closed to all trawl gear. Under Alternative 2 this same area would be closed year round to Pacific cod fixed gear fisheries (as the other fisheries listed in Table 11-1 are already excluded as trawl fisheries). Under Alternatives 3 and 4, new year-round closures would be specified for specific fisheries as listed in Table 11-1 (or for Pacific cod pot gear under options 3b and 4b). Here management of these areas as closures would be similar to Status quo management of the PIHCZ, however the closure is specified based upon fisheries and not upon gear type. All trawl gear would remain prohibited within the PIHCZ under all alternatives, however additional overlapping fishery restrictions would apply to the areas specified under these alternatives. Under Alternative 4, these areas are larger than the PIHCZ, thus the entire PIHCZ would contain an additional fishery restriction and the remaining closure outside of it would have a fishery (but not gear-specific) restriction associated with it. For Alternative 3, some of the area overlaps the PIHCZ while the remainder is outside of it. This would entail additional consideration of fishery-specific (i.e., pot gear) restrictions over a portion of the PIHCZ but not the entire area and a different fishery (and gear) restriction for the remaining area outside of the PIHCZ. This would impose an additional burden on NMFS in enforcing the closure.

For Alternative 5 these same area considerations on overlapping fishery and gear restrictions exist, as well as a trigger limit to be monitored and closure notices then issued. Again the PIHCZ closure to all trawl gear would remain year-round under this alternative and any closure would be in addition to this. Here NMFS would issue fishery closures once the overall groundfish fishery limit (as specified under the sub-options 1-4) was reached and the closure would then apply to the selected fisheries. Vessel operators would be prohibited from directed fishing in the area once NMFS closed the area to a fishery.

Under Alternative 5d, a PSC cap would be monitored and managed by NMFS with fisheries subject to the closure closed once the PSC cap (or allocation thereof) is reached. This imposes an additional management burden on in-season management as either a fishery-wide cap or 3 separate allocations of the cap will need to be managed on an annual basis.

2.8.1 Allocation of the PSC

If an allocation is specified at final action, it would either be specified as an explicit percentage (such as that included as an option under Alternative 5d, suboptions 3 and 4) or specified in the annual specifications process. If the allocation must the specified under the annual groundfish specifications process, the following describes the process by which this could occur.

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). The regulations at 50 CFR 679.21 would establish the PIBKC PSC limits and the BSAI fishery apportionments thereof for the applicable groundfish fisheries[3] by vessels using hook-and-line, pot, and trawl gear. The Council also will determine the percentage of the PIBKC PSC limits that will be made to the groundfish CDQ Program as PSQ reserves. The regulations would define closure area(s) and establish a PSC limit for PIBKC in the Bering Sea subarea of the BSAI based on the proportion of the annual ABC for PIBKC . 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 PSC limit for the groundfish fisheries would be calculated based upon the proportion of the ABC for PIBKC established by the Council at final action on the PIBKC rebuilding plan amendment.
The apportionment of the PIBKC PSC limit amongst groundfish fisheries, fishery categories (for the BSAI trawl limited access and Amendment 80 limited access sectors) and CDQ would be recommended to the Council by their Advisory Panel[4]. 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. In December, the Council would consider public comments on the proposed harvest specifications and public testimony, 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.

2.8.2 Additional enforcement issues of gear-specific closures

Enforcement of the area closures would be similar to the process currently used to monitor and issue existing triggered area closures (i.e. the chum salmon savings area closure). NMFS would have to determine whether a vessel was directed fishing for either Pacific cod by gear type or the flatfish fisheries specified under the options when a closure was issued. This would require NMFS to use several different data sources including VMS, catch and effort information from a vessel's catch reports, and observer information.

NMFS currently uses a combination of VMS, industry reported catch information, and observer data to monitor vessel activities in special management areas, such as habitat conservation areas and species-specific savings areas (e.g., salmon savings area). These data sources are used by NMFS on a daily basis to monitor fishery limits. Information from VMS is useful for determining 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.

The Coast Guard has noted some concerns with enforcing gear-specific and particularly trawl-only closures. An excerpt from the white paper presented to the Council's Enforcement Committee in 2011 is included below to further note these concerns (USCG, 2011).

[3] Fisheries which meet the Council's threshold for PSC limits and closures are the following: Pacific cod pot, Pacific cod hook and line, rock sole trawl, yellowfin sole trawl, and 'other flatfish' trawl fisheries. These limits (and associated closures) would only apply to those fisheries.
[4] 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.

Aircraft Surveillance:
Due to the size of the Alaska region and the number of enforcement assets available, one of the most effective means of surveillance is by aircraft. While an aircraft can identify the type of vessel (e.g. - long liner, trawler, seiner, pot boat, etc.), there is no way for aircraft to readily identify whether a trawl vessel is using pelagic or non-pelagic trawl gear.

Because of these definitions, the only time an aircraft would be able to determine whether a vessel was using pelagic or nonpelagic trawl gear would be if they witnessed a haulback and noted chafing gear on the foot rope or roller gear. By definition, this would make the vessel a nonpelagic trawler. All other definitions used to identify whether a vessel is conducting pelagic or non-pelagic trawl activities must be conducted by a boarding team on the vessel.

At-sea Enforcement:
Outside the pollock fishery which has specific crab bycatch limits to define bottom contact, it is almost impossible to define how much time a trawl net is in contact with the sea floor.
Specific to pollock vessels using pelagic trawl gear in the BSAI and GOA, these vessels are held to the performance indicator of not having more than 20 crabs of any species with a carapace of more than 1.5 inches, but there are no performance indicator definitions for other target species where vessels use pelagic or nonpelagic trawl gear.

Recent proposals focus specifically in allowing the pollock pelagic trawlers into areas prohibited to nonpelagic trawl gear for the protection of crab. In order for the Coast Guard to enforce this regulation on the catcher/processor fleet, a boarding team would be required to be on board for significantly more time than they currently are. The boarding team would remain on board to witness a haul back of the gear, during which time they could check the net for the roller and chafing gear that would define the vessel as nonpelagic. The boarding team would also have to remain on board until the entire catch was sorted. This would necessitate that there is no mixing of catch from different hauls, and may impact the operations of some trawlers.

In speaking with Marlon Concepcion with the NMFS Fisheries Monitoring and Analysis Division in Dutch Harbor, this would require Coast Guard Boarding Teams to remain on the vessels approximately 12 hours vice the current 3-6 hour average. This time would allow the team to witness the haul back, the dumping of the catch from the bag into the hold, and sorting time for the entire catch. The boarding team would have to watch for any crab discard on the deck, and then observe the entire sorting process to ensure compliance with the 20 crab limit.

Current fishing practice is for the vessel to allow the catch to sit for 4-6 hours after it is dumped into the hold before beginning processing. During this time, boarding personnel would have to remain in the area to witness the sorting to ensure catch of not more than 20 crab greater than 1.5 inches. Based upon an average catch size for this fleet of between 80 and 110 metric tons per haul, and a 15 metric ton/hour processing rate, this would require an additional 6-8 hours of time for the boarding team to monitor for crab catch.

The average boarding time is approximately 3-6 hours in duration. If the boarding team must remain on board to observe the sorting of all the catch, the result is a boarding taking 6-8 hours longer. This additional time would reduce the total number of boardings the Coast Guard can conduct in a given time period, reducing the overall contact rate for the fleet.

The additional boarding time also imposes an additional logistical burden on boardings due to increased ship to ship personnel transfers, small boat hours, meals, etc. The duration of the boarding also increases the likelihood of night operations, which presents increased risk.

Current practice, when in large fleets of vessels, is often to send boarding teams to more than one vessel. Due to the duration of the boarding, cutters would likely be restricted in the number of boardings they can conduct simultaneously due to the risk to boarding team members and concerns for the recovery of personnel at the completion of the boarding. If cutters had teams on multiple vessels, they would likely have to restrict the movement of fishing vessels until the boarding was complete to ensure appropriate response distances for the safety of boarding teams.

During the boarding, vessels would not be permitted to mix the catch from various cod ends, as the 20 crab measure would be compromised should the catch from more than one haul be in the hold at any given time during the boarding.

Conclusions and possible mitigating factors:
At-sea enforcement of areas where pelagic trawl gear is permitted and nonpelagic trawl gear is prohibited is problematic. Aerial surveillance remains the most effective means to monitor closed or restricted gear areas. While aircraft can readily identify the type of vessel by gear, identification of pelagic or nonpelagic trawl gear by aircraft is virtually impossible.

Identification of pelagic or nonpelagic trawl gear can easily be done by definition during an at sea boarding based upon the definition of rollers and chafing gear, but becomes more problematic in cases where gear that appears to be pelagic in nature is in contact with the sea floor more than the allowable ten percent of the time. It is nearly impossible for a boarding team to determine how much time pelagic trawl gear is in contact with the bottom, and this regulation is almost unenforceable. The exception to this is in the pollock fleet where bottom contact is defined by the number of crab caught.

In order to monitor the crab metric, boarding teams would have to remain on board for a much longer duration, possibly impacting vessel operational procedures, vessel freedom of movement, and safety of boarding personnel.

One possible mitigating factor, at least for the aerial surveillance factor, would be to have vessels declare what they are targeting and what gear they are using through their VMS units. This is a system that is used extensively in other regions of the country, and allows enforcement personnel to quickly identify locations of various fleets by gear type and targeted species. It does not, however; address the issue of the 20 crab limit, which would still have to be monitored by boarding personnel in a protracted boarding.

2.8.3 Catch Accounting issues for PIBKC PSC

There are two catch accounting issues related to this analysis. The first is the area in which catch is estimated and changes forthcoming in the future and the second issues is the ability to estimate a 'rare' species as bycatch in the groundfish fisheries, such as blue king crab without adequate observer coverage.

The defined stock area for the Pribilof blue king crab stock is shown in Figure 10-15. This area comprises technically the region within which all bycatch of PIBKC in all fisheries would be tabulated in order to compute the catch accruing against the OFL and ABC on an annual basis. The known stock distribution however is much smaller than this region (this is discussed in section 2.4). Currently bycatch in groundfish fisheries is tabulated by NMFS reporting areas. Area 513 is considered to be entirely Pribilof Island blue king crab stock, while Area 521 comprises both Pribilof and St. Matthew blue king crab. For this reason, and as a temporary measure, bycatch accruing from groundfish fisheries towards the OFL has only been counted within Area 513. In the future, bycatch for all crab stocks will be accrued on the spatial scale consistent with stock boundaries in the Bering Sea as shown in Figure 10-15. All bycatch reported in this analysis is from the NMFS RO estimate of PSC from Area 513 only. For purposes of comparison for future catch accrual, the Council requested an estimate of the catch in the Pribilof District by the fisheries under consideration in this analysis. This comparison is shown in Table 11-3 and Table 11-4.

The PSC estimation methodology is described in Cahalan et al., 2010 and not repeated here. Of particular note for this discussion is the issue of estimation of unsampled trips given that observer coverage is low on the Pacific cod pot fishery in the Pribilofs. When direct observations from nearby vessels are not possible, it is necessary to move to broader regions and eventually to the entire FMP area. For blue king crab this can involve extrapolations from the region closest to the St. Matthew Islands where concentrations of blue king crab are higher than in the Pribilofs. This issue is highlighted in 2007 (Figure 10-6) when the high rate used to extrapolate the unobserved landings near the Pribilofs originated form the St. Matthew region, leading to a pot bycatch estimate of ~2,800 crabs. This type of extrapolation is still the best estimate of catch aboard unobserved vessels and uses the approved methodology. The only modification that will improve this estimation would be an increase in the observed vessels in 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.

At the Council's request and for purposes of this analysis only, the analysts were requested to create a modified extrapolation methodology that would not include observer data outside of the Pribilof District. Two area-specific estimates were put together by AKFIN and utilized an 8-step algorithm to match observed hauls from 2003-2010 to landings from the same period. The method utilized various levels of detail similar to AKRO, but on a much coarser temporal scale. The algorithm compiled all landings that occurred in 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 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 BKCR observed was then divided by the total groundfish weight in the haul to arrive at an estimated rate of BKCR. This rate was then matched to the landings that occurred in 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 a 513 estimate based on observations in a specified area. Results are shown in Table 11-2.

The area-specific estimation method enables an estimate without using observer data from St. Matthew region; however, the lack of observed hauls in area 513 meant that the area-specific rates had to be temporally aggregated. In order to have a PSC cap toward which catch would accrue from the groundfish fisheries and be managed with in a season, observed data from within the capped fisheries would be necessary.

2.9 Additional closure configuration considerations.

In December 2010, the Council moved to consider whether an additional closure configuration to Alternatives 4C and 5e would be more appropriate based upon a combined analysis of both recent bycatch as well as 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 Islands management district in 5 year intervals from 1976 to 2010 Figure 10-7. 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 suggests a distribution close to the Pribilof Islands (Figure 10-7A). Mother ship landings and trawl catch accounted for the majority of the bycatch ranging from 1 to 800 crabs per haul (Figure 10-8A). 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 10-8B and Figure 10-8C) while the survey biomass decreased over this time period from catches around 20,000 crabs per nm^2 to less than than 10 crabs per nm^2 (Figure 10-7C). During this early time period the survey biomass fell within the existing 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 10-7D) and the composition of the bycatch source shifted to more pot and longline gear (Figure 10-8D). 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 10-7E-Figure 10-7G and Figure 10-8E-Figure 10-8G).

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 OFL and TAC associated with the 2003 declaration of overfished status (Figure 10-9-Figure 10-12). When the PIHCZ was enacted in 1995 the bycatch focused mainly south and east of the Pribilof Islands (Figure 10-9) and was comprised of mostly longline and pot gear (
Figure 10-10). 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.

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.

2.10 Alternatives considered but not carried forward for analysis.

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.

Another alternative considered but not carried forward at this time is to establish a PSC cap 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 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 2-5 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 which 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.

3 Methodology for Impact Analysis

3.1 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 (Zheng and Kruse 2000, Vining and Zheng 2008). 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 CL); pre-recruit one (120-134 mm CL); recruit (new-shell, 135-148 mm CL); and, post-recruit (>148 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:

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

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:

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

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 11-5). 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 10-16), recruits to the model each year (Figure 10-17), total abundance in the first year, natural mortality, trawl survey catchabilities for pre-recruits one and two, and molting probabilities for pre-recruits one and two. The CSA model used here was updated to include data for 1975-2009. Fits to observed survey biomass data track well 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 10-18). Large inter- annual fluctuations in observed survey biomass are not well fit by the model, however, coefficients of variation of survey MMB for the most recent year is 71.3% and has ranged between 16.8 and 79.9% in since the 1980 peak in biomass.

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, ADFG 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.

Fits of size class stage proportions are better in the earlier years and mid 90s than for the larger fluctuations among years from 2001 to 2009 (

Figure 10-19) and residuals of the predicted vs observed trawl survey proportions by stage show a slight trend towards more positive value in more recent years and more, yet inconsistent, variability in the smaller stages (Figure 10-20). Fits of the retained catch biomass were heavily weighted in the analysis and therefore tracked well throughout the time series (Figure 10-21). Minimal discard bycatch existed in the years with the highest catch biomass between 1,000 and 5,000 t. Total trawl bycatch biomass fit well with observed values ranging from 5 t in 1992, peaking at 42 t in 1993 and then declining to near zero in recent years (Figure 10-22). Residual fits to predicted vs observed trawl bycatch proportions did not reveal any consistent patterns attributed to cohorts (Figure 10-23). Total fixed gear bycatch biomass was heavily weighted and therefore fit well with observed values with peaks of 3.5 and 3 t in 1999 and 2008, respectively (Figure 10-24). Residual fits to predicted vs observed trawl bycatch proportions showed random variability with potential trends difficult to determine with such a small number of data points (Figure 10-25).

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 MSST. 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 11-6lists summaries of the posterior distributions for the key parameters which 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. The implications of the alternatives were analysed based on projections from a model based Tier 4 control rule.

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.

3.2 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 2003-2010 was below one of two threshold criteria. The two criteria options are the following:

Option a) less than 5% of the ABC

Option b) less than 10% of the ABC

Based upon the assumption of a Tier 5 calculation for the ABC for this stock (see section 2.5.2 for ABC calculation), the ABC = 3,600 lbs. Option a would result in a threshold level of 180 lbs while option b would result in a threshold of 360 lbs.

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 Catch Accounting System (CAS) for prohibited species catch (PSC) 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. The PSC records are only listed to the Federal reporting area scale thus only area 513 was included to avoid overlap with St. Matthew BKC bycatch in area 521. The OBS and FT records include more refined areas based upon State statistical areas defined as representing the Pribilof area. These three databases were then summarized for all incidences of PIBKC bycatch from 2003-2010. Table 11-1 summarizes the results indicating based upon all three databases which fisheries would be included as having had documented bycatch by threshold option of PIBKC between 2003-2010. Figures showing the overlap of the proposed closures and the Federal and State stat areas encompassed by those regions are shown in Figure 10-13 and Figure 10-14. For comparison against the allocation area defined in regulation see Figure 10-15.

3.3 Impact Analysis for other marine resources

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 Catch Accounting System (which has the spatial resolution of a NMFS Reporting Area) into a database that resolves the GIS data into polygons with areas of approximately seven kilometers. In an unrestricted area, sixty four 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.

Table 11-13 through Table 11-16 show the relative impact of moving effort out of the closed areas on the bycatch of PIBKC, other prohibited species and the incidental catch of non-target and groundfish species. Appendix 1 show the metric tons of groundfish species caught in each proposed closure areas between 2003 and 2009 broken down by target species and gear type (Table A2 through Table A9).

3.3.1 Catch Reprojection Methodology

This section documents the methodology that was used to reproject 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 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 Database as developed by Steve Lewis of the Alaska Region Analytical Team. The Catch In Areas database was given favorable reviews by the Council's Scientific and Statistical Committee 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 Catch In Areas Database. The following maps show reprojection of historic catch that occurred within areas proposed for closure to areas that would remain open under the alternative in question. 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 catch to locations where fishing occurred.

Catch reprojection was done within the Catch In Areas database by following a step-wise procedure of matching with proportional assignment to a fine spatial grid with aggregation to a coarse grid for display purposes. The procedures used are as follows:

Step 1: Vessel Based Match:
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 (7km x 7km) occurring within 50 nautical miles of the closure boundary in the area outside of the closure area (the open area)[5]. 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 7km 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 percent split then 60 percent and 40 percent 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.

Step 2: Vessel Type/Target/Gear Based Match
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 50km outside of the closure boundary is reprojected proportional to the catch

[5] Please note that this data is aggregated to 20km 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.

of vessels in its sector of the fleet that had recorded catch outside of the closure area using the same gear type, in the same species target fishery, and with the same vessel type (Catcher Processor (CP) or Catcher Vessels (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.

Step 3: All Vessels/Target/Gear Match
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.

Step 4: All Vessels/Target/Gear/Month Match
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 RIR, 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:

This reprojection is entirely based on recorded historic catch within and outside the closure areas in question. Reprojection of catch in this way makes the inherent assumption that this reprojection would occur with no impact on vessels that fished within the area to which catch is reprojected to occur, with no impact on localized availability of fish stocks, and with the same catch rates (tons/week in proportionality method) as observed in the areas reprojection is made. In some cases these assumptions may all be true; however, in others these assumptions are likely to fail, especially in cases when the reprojection into a cell is a relatively large proportion of the catch that is being reprojected and/or is larger quantity than originally caught within the cell to which reprojection occurs. Thus, this analysis is exemplary of where catch might be taken in the instance of a closure; however, the analysis is inherently static in that it does not account to the impact that such reprojection of effort, and catch, might have on fishing conditions within grid cells to which reprojection is estimated to potentially occur in this retrospective analysis.
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 Economic Effects and the draft RIR/IRFA for this analysis).

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). The 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 lbs of mature male biomass, at the time of mating) with survey estimated mature male biomass at mating having increased from 0.25 million lbs in 2008 to 1.13 million lbs in 2009 (Foy and Rugolo 2009; Figure 10-16). Model estimated mature male biomass increased from 1.22 million lbs in 2008 to 1.38 million lbs in 2009 (Figure 10-13). The 2010 survey estimated mature male biomass in the most recent assessment, however, decreased to 0.63 million pounds (Foy 2010). Survey estimates of total biomass were highest at the beginning of the time series with a peak of 176.5 million lbs in 1980, dropped dramatically to 3.3 million lbs, increased again to 29.5 million lbs in 1995 and then steadily decreased to a low of 0.5 million lbs in 2004. 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.

The 2010 assessment of PIBKC (Foy and Rugolo 2010) is based on survey estimates using area swept methods[6]. 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.

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 10-17). Legal-sized males were caught at three stations east of St. Paul Island, with a density ranging from 73 to 131 crab/nmi^2. 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 10-18). Only 4 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. 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.

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

The OFL for PIBKC is currently based on the Tier 4 control rule, i.e. the proxy for F_{MSY} is taken to be the product of natural mortality (*M*) and a scalar, γ (NPFMC, 2008; Figure 10-26). The proxy for B_{MSY} is taken to be the average biomass over a specified time period (currently 1980-1984 and 1990-1997). In the absence of data on an unfished stock, this time period was chosen to represent the potential population biomass that this stock could achieve to support maximum sustainable yield assuming that production during the entire time period was constant. It is noted that data are not currently available on the likely variability in production of this stock nor on the factors that influence crab production in this region. In the current OFL setting process assessment authors have the opportunity to revisit the years used to establish B_{MSY} as new data become available. The OFL is a total-catch OFL and is computed as the sum of catches by three different sources of removals: (a) the retained legal males in directed (pot) fishery for PIBKC, (b) discards of males and females in the directed fishery, and (c) bycatch in the groundfish pot and trawl fisheries.

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

4.1.1 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, 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. (In Prep). 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 11-19). The items labelled TBD still require analysis (Table 11-19). 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.

4.1.2 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 speices in the Pribilof Islands from 1975 to 2009 (Figure 10-27). 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 Islands District (Figure 10-27A). Spatially, the stations with co-occurance were all dominated by blue king crab and broadly distributed around the Pribilof Islands (Figure 10-28A). In the 1990’s 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 10-27A). Spatially during this time period, the red king crab dominated stations were dispersed around the Pribilof Islands (Figure 10-28B). Between 2001 and 2009 the blue king crab population has decreased dramatically while the red king crab have fluctuated (Figure 10-27B). 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 10-27A). Spatially the only stations dominated by blue king crab exist to the north and east of St. Paul Island (Figure 10-28C). 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.

4.2 Bycatch of Pribilof Islands blue king crab by fishery

Between the 2003/04 and 2010/11 crab fishing seasons between 300 lbs (136 kg) and 4,600 lbs (2087 kg) of PIBKC were caught incidentally during crab and groundfish fisheries. Annually, yellowfin sole comprised between 3 and 77%, Pacific cod between 20 and 100%, flathead sole between 1 and 31% of the bycatch, and rocksole 26% of the bycatch in the 2006/07 crab fishing season (Table 11-7). 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 11-8).

Pribilof Islands blue king crab bycatch mortality by gear type and target species are absolute values based on the AKRO catch database as of August 2011 (Table 11-11 and Table 11-12). 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).

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 (Table 11-8) 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 2004-2009 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 10-34) within 26 IPHC statistical units (
Figure 10-35) 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' 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 and caught halibut per year between 2004 and 2008 catching between 486,000 and 966,000 lbs of halibut per year in the area of the largest proposed closure (Table 11-9).

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 (see section 3.2), 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.

4.3 Impacts of Alternatives on Pribilof Islands blue king crab

4.3.1 Stock rebuilding

As described in Chapter 2, there are five alternatives under consideration for rebuilding the PIBKC stock. The impacts of these alternatives are considered by using the draft assessment model for projection purposes to estimate stock rebuilding. The impact of bycatch in groundfish fisheries as a limiting factor on stock recovery is estimated by conducting a sensitivity analysis on the rebuilding time frame under different catch scenarios. As noted below however, rebuilding simulations indicate that none of the alternatives rebuild the PIBKC stock in less than 50 years**.**

Distributions of observed PIBKC bycatch by gear type are shown in each of the proposed closure areas for three periods (Figure 10-36 through Figure 10-38): 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). In 2008/2009, 0.001 million lbs of male and female PIBKC were caught in groundfish fisheries according to the AKRO Catch Accounting System analysis. The catch was mostly in non-pelagic trawls (77%) and longline (23%) fisheries. The targeted species in these fisheries were yellowfin sole (77%), and Pacific cod (23%).

For the purposes of this analysis of the PIBKC rebuilding plan only, the 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. Although 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 10-30). 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 were 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 (Alternative 4).

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

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 0% reduction alternatives, respectively (Figure 10-40). A similar decrease was observed for the pot cod only bycatch reduction (option b under each Alternative) (Figure 10-41). For both the options of all groundfish and pot cod only closures, the MMB relative to B_{MSY} increased similarly for each scenario from 0.07 to 0.44 over the 50 year projection (Figure 10-42and Figure 10-43). 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 0% reduction alternatives, respectively (Figure 10-44). The estimated recruitment under option a also increased between 0.1 and 1 million crabs over the projected time series (Figure 10-45).

Alternative 5 would limit the total catch of PIBKC in the groundfish fisheries to the annually specified OFL, ABC or proportion of ABC for PIBKC. Total removals by year from 1991-2008 for both directed crab fisheries as well as groundfish fisheries (by aggregate gear type) are shown in Table 11-18. Currently as described in Chapter 2, there is no feedback between bycatch in the groundfish fisheries of PIBKC and management measures under the BSAI Crab FMP. Thus, if the OFL for PIBKC were exceeded due to bycatch in the BSAI groundfish fisheries, no in-season management measure would be taken to further restrict bycatch of PIBKC. An ‘overfishing’ determination would be made the following year in the process of annual status determination for BSAI crab stocks. Absent measures to explicitly establish in-season management measures in the groundfish fisheries to implement a fishery closure should the OFL or ACL for PIBKC be reached, no additional restrictions would be taken to limit bycatch in the groundfish fisheries. Currently crab bycatch in groundfish fisheries is tabulated after the season is over and in time for consideration in the subsequent assessment in accounting for total removals. In order to have a PSC cap towards which catch could accrue from groundfish fisheries in-season, additional catch accounting considerations may be necessary. Considerations include observer coverage in this area, the extent of the PIBKC stock for purposes of bycatch accounting from Federal areas[8], and the management measures that would be enacted to implement a fishery closure should such a limit be reached.

As noted in the issues of catch accounting in Section 2.8.3, 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. Table 11-18 shows the relative catch by fishery of PIBKC since 2003.

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-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 analysed in the RIR.

Four cap levels are considered under this alternative, a PSC limit set at either the OFL (currently 4,000 lbs), the ABC (estimated at 3,600 lbs), 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

[8] The current system for catch accounting of crab bycatch by stock from Federal reporting areas is being modified to employ smaller statistical areas to better delineate stock-specific boundaries as a result of implementation of total catch OFLs under amendment 24 to the BSAI Crab FMP.

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[9]. 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.

4.3.2 Bycatch of PIBKC in groundfish fisheries

The impacts of imposing area closures on the qualified fisheries and the resulting bycatch of PIBKC caught outside of the area closures are shown in Table 11-13and Table 11-14. The bycatch of PIBKC by the two main target fisheries Pacific cod (mostly pot gear) and combined flatfish (mostly trawl gear) are estimated historically inside the closure configurations and reprojected catch and resulting bycatch outside of the closures (see section 3.3.1for information on the methodology for the reprojection of catch and fleet redistribution). The ratio indicates to what extent the catch outside of the closure (i.e. redistributed catch) was greater than the catch inside the closure in any year from 2003-2010. For the Pacific cod pot fishery (comprising the majority of the catch in Table 11-14), the catch in any year was higher inside of the alternative closures than outside with the singular exception of 2007, the year of the highest recorded bycatch of blue king crab bycatch in this fishery. For the flatfish trawl fishery, very low numbers of catch are recorded with the current closure (Alternative 1, 2), the ADF&G closure (Alternative 3) thus there is no change across years for these closures based on the estimated redistributed catch. For Alternative 4a catch is higher inside the closure in 5 out of 8 years while for 4b catch is higher inside the closure in 4 years, equivalent to outside in 2 of 8 years and higher outside in 2 of the years estimated. Overall catch inside the closure areas is substantially lower in the flatfish fishery than in the Pacific cod fishery.

4.4 Impacts on the groundfish fleet of allocation under Alternative 5d

Alternative 5d, suboptions 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.

Under suboption 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.

Under suboption 4 (75% of ABC), application of the gear allocation historically results in the same closures noted under suboption 3 as well as an additional closure in 2003 for trawl gear, where the allocation was exceeded on August 16th.

Table 4-1 below 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 RIR.

[9] The OFL here is 4,000lbs while under the Tier 5 assumption the ACL is considered to be 3,600lbs, 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 4-1 PSC cap options and allocation %s. '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						

4.4.1 Impacts of threshold cap closures

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 which 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.

In 2005, the 50% threshold was exceeded on 12/10. 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 15th. 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 22nd, 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 22nd by the Pacific cod pot fishery.

Table 4-2below 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.

Table 4-2 Three cap level thresholds (expressed as % of ABC) for management of PSC and years in which each threshold would have been reached historically 2003-2010.

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

4.5 Impacts of Option for increased observer coverage

The options and suboptions contained under Section 2.6 relate to increasing observer coverage on select fisheries. The Council has not yet identified which fisheries would receive increased coverage, however. Presumably, this option would focus on fisheries with less than 100% coverage requirements as candidates for increased coverage. All affected fisheries for this action are listed in Table 11-1. Of these fisheries, only non-pollock catcher vessels (CVs) are in the partially covered category with less than 100% coverage (generally CVs 60' – 125' and pot vessels of all sizes have 30% observer coverage requirements). Note that all Bering Sea pollock CVs have at least 100% observer coverage requirements as a result of BSAI Amendment 91, which was effective starting January 2011. Thus, for purposes of identifying candidate fisheries for increased observer coverage under this analysis, pollock CVs are considered adequately covered.

The implementation of Options 1 and 2 under Section 2.6 requires that the Council identify specific fisheries for which increased coverage in these areas is a priority under this analysis. If specific fisheries were recommended for increased coverage, similar cost-benefit assumptions could be made, consistent with the public review draft analysis for observer restructuring.[10] This analysis estimates that the cost of an observer day under the existing service delivery model is $366.[11] Absent identification of the specific fisheries to receive increased observer coverage under the proposed options, one could multiply the number of fishing days for each sector identified for increased observer coverage by $366/day to estimate the total observer costs by sector. The difference between this estimate and the status quo observer costs would be the net increase in observer costs due to Options 1 and 2. The benefit to increased observer coverage is not estimated quantitatively; it would increase the amount of bycatch data for pot and longline fisheries, refining NMFS's understanding of spatial and temporal removals of PIBKC.

[10] http://www.fakr.noaa.gov/npfmc/current_issues/observer/Observer_restructuring910.pdf
[11] Refer to Appendix 6 of the observer restructuring document for the calculations and assumptions on which this estimate is based.

The Council took action in October 2010 to restructure the groundfish observer program, such that all vessels and processors included under the new program would pay an ex-vessel value fee on their landings (1.25%) to pay for the cost of deploying observers in those sectors. Under the new program, NMFS would contract directly with observer providers, and NMFS would control when and where observers are deployed, based on a statistically sound sampling plan. This new system would allow NMFS and the Council to deploy observers according to stock and management priorities on an annual basis, significantly increasing flexibility in observer deployment compared to the existing regulatory system.

The observer restructuring action is expected to be implemented in 2013. Should the Council take final action on the PIBKC rebuilding plan in late 2011, it is not anticipated that any cap or closure system under a revised plan could be in place until at least late 2012. Thus, if the suboption were selected under Section 2.6, the increased observer coverage requirements would sunset with the new observer program and only be in place for part of one year.

If the suboption was not selected, the impact of this action is to mandate a certain level of coverage in these partially covered fisheries, which is inconsistent with the objective of increased flexibility in a restructured program. As stated previously, one of the primary objectives of the restructured observer program is to allow NMSF and the Council flexibility to shift coverage among fishery sectors necessitating <100% observer coverage, on an annual basis, in accordance with shifting conservation and management priorities and data needs. For example, if questions arise about catch or bycatch by vessels operating in a specific area or time of year, NMFS would have the ability to develop the sample design such that observers are deployed on vessels during specific times or areas to address those questions. Thus, mandated increased coverage may not be necessary under Section 2.6, as the Council and NMFS could prioritize increased coverage for the fisheries, gear types, and areas at issue under a restructured program, recognizing the tradeoffs in the amount of coverage available in other fisheries. The initial year of deployment under a restructured program anticipated a 30% coverage rate, with the understanding that this rate will change and may vary substantially among fisheries, gear types, and areas, as data are collected under the new program. As new, more representative data become available on an iterative basis through a restructured program that employs a randomization scheme for vessel or trip selection, NMFS would be able to determine the sampling effort necessary to achieve desired levels of precision. The proposed program allows for this flexibility on an annual basis.

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.

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 1999). Bycatch of blue king crab in these fisheries is low. Since the implementation of the Pribilof Islands Habitat Conservation area, 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 Impacts of Alternatives on groundfish resources

Appendix Tables A2-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, Alternative 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 3.3.1, 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 Tables A2-A12) could be caught equally outside of the closure area. Estimating the areas where catch would likely be concentrated outside these closures (see Appendix A to RIR appended separately) 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.

The significance criteria used to evaluate the effects of the action on groundfish target species are in Table 4-3. These criteria are adopted from the significance criteria used in the HAPC EA (NMFS 2006a).

Table 4.3 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.

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 focusses upon changes in catch resulting from moving the groundfish fisheries out of the proposed closures.

The implications of fleet redistribution outside of the closed areas was 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 11-15. A comparison of incidental catch amounts of grounfish by 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. Therefore the impact of these closures on incidentally caught groundfish species is insignificant.

5.2 Prohibited species

This section focusses upon prohibited species 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. Red king crab (specifically the Pribilof Island red king crab), Pacific halibut and Chinook and non-Chinook salmon. Of these only red king crab and halibut are caught incidentally with any regularity in the target fisheries under consideration in this action. The salmon species and impact thereon are included here as measures for salmon have been under consideration in other (specifically EBS pollock) trawl fisheries thus impacts of the flatfish fisheries on these species is also considered for comparison.

5.2.1 Pribilof Island red king crab

Red king crab stocks in the Bering Sea and Aleutian Islands are managed by the State through the federal Fishery Management Plan (FMP) for Bering Sea/Aleutian Islands King and Tanner Crabs (NPFMC 1998). The Alaska Department of Fish and Game (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 (Figure 10-3). 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 NPFMC established the Bering Sea Community Development Quota (CDQ) for Bering Sea fisheries including the Pribilof Islands red and blue king crab fisheries which was implemented in 1998. From 1999 to 2008/2009 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 1980-2010, the Pribilof Islands red king crab stock exhibited widely varying mature male and female abundances. The estimate of MMB from the 2010 survey was 5.44 million pounds (Figure 10-29). 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 (Chilton et al. in press, Figure 10-30). 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 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 2009a; Guyon et al. 2010a; Guyon et al. 2010b). The EIS for Amendment 91 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 convert 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 1994–2007 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 percent 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 1984–2004 (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 (Bue and Hayes 2007). In December 2009, Alaska Department of Fish and Game (ADF&G) recommended continuing this classification as a stock of yield concern.

The 2010 preliminary data from the Yukon River Pilot Station Sonar estimated that escapement of 113,410 Chinook salmon was 24% below the recent five–year average (2005–2009) of 148,329 fish. (ADFG 2010b). This is the lowest estimated number for the Pilot Station Sonar since 2001. While escapement goals were generally met throughout the Alaska portion of the Yukon drainage over the past 5 years (2005–2009), combined commercial and subsistence harvests show a substantial decrease in Chinook salmon yield from the 10-year period (1989–1998) to the recent 5-year (2004–2008) average (Howard et al. 2009). The 2010 Yukon harvest estimate for Chinook salmon of 9,897 fish was 64% below the 10-year average (2000–2009) of 27,298 (ADFG 2010b). Through June 2010, the Chinook salmon run was assessed to be large enough to provide for escapement and subsistence uses; however, throughout the drainage there were episodes of high water events with heavy debris loads that preempted subsistence fishing. Additional subsistence restrictions were not imposed because of operating costs and high risks during openings. Subdistrict 5-D Chinook salmon run fell short of the United States/Canada Yukon Treaty obligation, and fishermen were asked to consider voluntary conservation measures. No commercial periods targeting Chinook salmon were allowed in 2010 in the Yukon River mainstream of the Tanana River due to uncertainty of run strength, the need to fulfill the Canadian border passage obligation, meet Alaska escapement needs, and provide for subsistence uses.

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 (NMFS 2009a). Kuskokwim River Chinook salmon were discontinued as a stock of yield concern by the Board of Fisheries (BOF) in February 2007 (ADFG 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 (ADFG 2010c). Total commercial harvest of Kuskokwim River Chinook salmon was above most recent 10-year (2000–2009) and 5-year (2005–2009) averages, with a preliminary harvest of 3,370 fish (ADFG 2010 d). 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 (ADFG 2010d). 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. The preliminary commercial harvest estimate for Bristol Bay Chinook salmon in 2011 is 41,000,000 fish (ADFG 2010f). Projections are based on the most recent 5-year average and the observed mean percent error (MPE) of 28% during that same time period. ADFG is not forecasting a total run for 2011 due to uncertainties in methods used for estimating Chinook salmon abundance. In 2011, new research will begin to attempt to address these uncertainties.

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 (ADFG 2010g). 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 (ADFG 2010g). The North River tower count of 1,302 was the twelfth best in 18 years of counting, but the Sustainable Escapement Goal (SEG) was not reached for the second consecutive year. The Kwiniuk River tower count of 135 Chinook salmon was the lowest count since 1985 and only 45% of the lower bounds of the SEG range. This is the fourth time in the previous 5 years that the SEG has not been reached. At the Niukluk River tower, 42 Chinook salmon was the sixth lowest count since 1995, and the Pilgrim River Chinook salmon count of 44 was the worst since the project began in 2003 (ADFG 2010g).

4.3.1.2 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., Guyon et al. 2010c, Marvin et al. 2010, Gray et al. 2010, 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 2011). 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 Non-Chinook Salmon Bycatch Management.

Chum salmon fisheries in Alaska occur in 11 management regions which are detailed on the ADFG 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 (Bue and Hayes 2007).

The BASIS (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 (OEG) of 600,000 fish exceeded annually (Bergstrom et al. 2009). In 2006, a large number of 5-year-old summer chum salmon returns were observed throughout the AYK Region. Since 2007, run abundance has shifted to near average levels and has allowed for subsistence harvests and a near average available yield for commercial harvests (Bergstrom et al. 2009). 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 ADFG 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 (ADFG 2010b). Chum salmon escapements ranged from above average to below average at all monitored locations (ADFG 2010b).

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 (Bue and Hayes 2007). 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. The commercial harvest estimate for fishery for fall chum salmon was among the lowest on record at 2,550 fish and is 2% of the recent 5-year average (2005–

2009) of 117,983 fish and 4% of the 10-year average of 60,502 fish (ADFG 2010h).The 2010 subsistence harvest of fall chum salmon is expected to be below the most recent 5-year average because of low abundance and high-water level conditions.

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 (NMFS 2007c). 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. Total commercial harvests of chum salmon in 2010 was above most recent 10-year (2000-2009) and 5-year (2005-2009) averages, with a preliminary commercial harvest of103,000 fish (ADFG 2010c).

In Bristol Bay, the 2010 chum salmon harvest was 1.09 million fish was 15% above the 20-year average (ADFG 2010d). Naknek-Kvichak and Nushagak Districts harvested above their 20-year averages; however, Egegik, Ugashik and Togiak Districts harvested below their 20-year averages. Over 509,000 chum salmon were harvested in the Nushagak District.

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) (ADFG 2010g). 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 (BEG) 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) (ADFG 2010g). In 2010, Chum salmon escapement was well above average to record setting across Norton Sound and the Port Clarence area (ADFG 2010g).

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 (ADFG 2010i). 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 (ADFG 2010i).

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 (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. 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 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 4.5. These criteria are from the 2006–2007 groundfish harvest specifications environmental assessment/final regulatory flexibility analysis (EA/FRFA) (NMFS 2006b). 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 5-1 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 are shown for Chinook salmon, non-Chinook salmon, Halibut and red king crab. Overall catch numbers for salmon species are extremely low for these target fisheries. 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 non-Chinook, however the numbers (averaged over all years) remain extremely small. Therefore the impact is considered to be insignificant.

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 > 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.

Red king crab is also caught in the region of the Pribilof Island 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 RKC 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 b. The numbers are higher for closures under 4a and c, 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. The impact of these alternatives on the red king crab in this region is considered to be insignificant.

5.3 Marine mammals, and seabirds

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

- Listing as endangered or threatened under the US ESA;
- Protection under the US Marine Mammal Protection Act (MMPAP;
- 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
- Experiencing large bycatch or other mortality related to fishing activities; or
- Being vulnerable to direct or indirect adverse effects from some fishing activities.

Marine mammals have been given various levels of protection under the current FMPs of the Council, and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts on these species. The Alaska Groundfish Harvest Specifications EIS (NMFS 2007) nand the Amendment 94 EA/RIR/FRFA (NMFS 2010) provide the most recent status information on marine mammals that may be impacted by the action. The status descriptions in that EIS and EA or incorporated here by reference.

The BSAI supports one of the riches assemblages of marine mammals in the world. Twenty-five species are present from the orders Pinnipedia Carnivora, and Cetacea. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982). Marine mammals that are likely to occur in the action area and their status under the ESA are listed in Table 5.2.

Table 5-2 Status and listing of BSAI marine mammals

Common Name	Scientific Name	ESA Status
Northern Right Whale[2]	*Balaena glacialis*	Endangered
Bowhead Whale	*Balaena mysticetus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Steller Sea Lion1	*Eumetopias jubatus*	Endangered
Beluga Whale	*Delphinapterus leucas*	None
Minke Whale	*Balaenoptera acutorostrata*	None
Killer Whale	*Orcinus orca*	None
Dall's Porpoise	*Phocoenoides dalli*	None
Harbor Porpoise	*Phocoena phocoena*	None
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	None
Beaked Whales	*Berardius bairdii and Mesoplodon spp.*	None
Northern Fur Seal	*Callorhinus ursinus*	None
Pacific Harbor Seal	*Phoca vitulina*	None
Pacific Walrus3	*Odobenus rosmarus divergens*	Precluded
Northern Sea Otter3	*Enhydra lutis*	Threatened
Bearded Seal	*Erignathus barbatus*	Proposed Listing
Spotted Seal	*Phoca largha*	Threatened
Ringed Seal	*Phoca hispida*	Proposed Listing
Ribbon Seal	*Phoca fasciata*	None
Polar Bear3	*Ursus maritimus*	Threatened

[1]Steller sea lion are listed as endangered west of Cape Suckling.
[2]NMFS designated critical habitat for the northern right whale on July 6, 2006 (71 FR 38277).
[3]Pacific walrus, sea otter, and polar bear are species under the jurisdiction of the USFWS. Walrus ESA listing is warranted but precluded (76 FR 7634, February 10, 2011).

Direct and indirect interactions between marine mammals and groundfish harvest activity may occur due to overlap of groundfish fishery activities and marine mammal habitat. Fishing activities may either directly take marine mammals through injury, death, or disturbance, or indirectly affect these animals by removing prey important for growth and nutrition or cause sufficient disturbance that marine mammals avoid or abandon important habitat. Fishing also may result in loss or discard of equipment such as fishing nets and line that may ultimately entangle marine mammals causing injury or death.

The PSEIS (NMFS 2004) describes the range, habitat, diet, abundance, and population status for marine mammals. The most recent marine mammal Stock Assessment Reports (SARs) for nearly all marine mammals occurring in the BSAI were completed in 2010 (Allen and Angliss 2011). The USFWS has management authority for polar bears, sea otters, and walrus. Thje stock assessments for polar bears and walrus were last revised on January 1, 2010 and stock assessments for sea otters were last revised in 2009 (USFWS 2011). This information is incorporated by reference. The Alaska Groundfish Harvest Specifications EIS also provides recent information on the effects of the groundfish fisheries on marine mammals including a detailed description of the status of ESA Section 7 consultations (Section 8.2 of NMFS 2007). For Bering Sea marine mammals, ESA Section 7 consultation has been completed for all ESA-listed marine mammals.

Direct and indirect interactions between marine mammals and groundfish harvest 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 foraging and commercial fishing activities. This discussion focuses on those marine mammals that may interact or be affected by fisheries displaced by PIBKC rebuilding alternatives. These species are listed in Table 5.x and 5.x. Steller sea lions, fish-eating killer whales, beluga whales, and northern fur seals are the only marine mammals that may compete with the groundfish fisheries for prey.

Table 5-3 Status of Pinniped Stocks Potentially Affected by the BSAI Groundfish Fisheries.

Pinnipedia species and stock	*Status under the ESA*	*Status under the MMPA*	*Population Trends*	*Distribution in action area*
Steller sea lion – Western and Eastern Distinct Population Segment (DPS)	Endangered (W) Threatened (E)	Depleted & a strategic stock	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 to have stabilized (Fritz et al. 2008). The eastern DPS is steadily increasing and is being considered for delisting (75 FR 77602, December 13, 2010).	Western DPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. Eastern DPS inhabit waters east of Prince William Sound to Dixon Entrance. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Islands, Aleutian Islands, St. Lawrence Island, and off the mainland. Use marine areas for foraging. Critical habitat designated around major rookeries, haulouts, and foraging areas.
Northern fur seal – Eastern Pacific	None	Depleted & a strategic stock	Recent pup counts from the Pribilofs in 2008 suggest a continuing decline in survival rates and show the overall abundance estimate is strongly influenced by the continued rapid decline in pups at St. Paul Island.	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. NMFS has new genetic information on harbor seals in Alaska which indicates that the current division of Alaskan harbor seals into the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks needs to be reassessed.	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	Proposed listing	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.
Bearded seal – Alaska	Proposed listing	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.
Ribbon seal – Alaska	None	None	Reliable data on population trends are unavailable.	Found throughout the offshore Bering Sea waters.

Spotted seal – Alaska	Threatened (Southern DPS)	None	Reliable data on population trends are unavailable.	Found throughout the Bering Sea waters.
Pacific Walrus	Warranted but precluded	Strategic	Population trends are unknown. The stock assessment for Pacific walrus was revised on January 1, 2010 with a minimum population size estimate of 129,000 walruses within the surveyed area.	Occur primarily in shelf waters of the Bering Sea. Primarily males stay in the Bering Sea in the summer. Major haulout sites are on Round Island in Bristol Bay and on Cape Seniavan on the north side of the Alaska Peninsula.

Source: Allen and Angliss 2011; List of Fisheries for 2011 (75 FR 68485, November 8, 2010).
Northern fur seal pup data available from
http://www.alaskafisheries.noaa.gov/newsreleases/2007/fursealpups020207.htm.
Ringed and bearded seal information available from
http://alaskafisheries.noaa.gov/newsreleases/2010/ringedandbeardedseals120310.htm.
Pacific Walrus information available from http://alaska.fws.gov/fisheries/mmm/stock/final_pacific_walrus_sar.pdf and
http://alaska.fws.gov/fisheries/mmm/walrus/pdf/faq_2011.pdf

Table 5-4 Status of Cetacea Stocks Potentially Affected by the BSAI groundfish fisheries.

Cetacea species and stock	***Status under the ESA***	***Status under the MMPA***	***Population Trends***	***Distribution in action area***
Killer whale – AT1 Transient; Eastern North Pacific transient, GOA, AI, and BS transient; West Coast transient; Eastern North Pacific Alaska Resident, and Southern Resident	Southern Resident: Endangered. Remaining Stocks: none	AT1 Transient ,– Depleted & a strategic stock Southern Resident: Depleted	Unknown abundance for the Alaska resident; and Eastern North Pacific GOA, Aleutian Islands, and Bering Sea transient stocks. The minimum abundance estimate for the Eastern North Pacific Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Alaskan waters. Southern residents have declined by more than half since 1960s and 1970s.	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. Southern Resident killer whales do not occur in BSAI.
Dall's porpoise – Alaska	None	None	Reliable data on population trends are unavailable.	Found in the offshore waters from coastal western Alaska to Bering Sea.
Harbor porpoise – Bering Sea	None	Strategic	Reliable data on population trends are unavailable	Primarily in coastal waters, usually less than 100 m.

Humpback whale – Western North Pacific Central North Pacific	Endangered and under status review	Depleted & a strategic stock	Increasing. The Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) abundance estimate for the total North Pacific represents an annual increase of 4.9% over the most complete estimate for the North Pacific from 1991–93. Comparisons of SPLASH abundance estimates for Hawaii to estimates from 1991–93 gave estimates of annual increase that ranged from 5.5 % to 6.0% (Calambokidis et al. 2008).	W. Pacific and C. North Pacific stocks occur in Alaskan waters and may mingle in the North Pacific feeding area. Humpback whales in the Bering Sea (Moore et al. 2002) cannot be conclusively identified as belonging to the western or Central North Pacific stocks, or to a separate, unnamed stock.
North Pacific right whale Eastern North Pacific	Endangered	Depleted & a strategic stock	Abundance not known, but this stock is considered to represent only a small fraction of its precommercial whaling abundance and is arguably the most endangered stock of large whales in the world. A reliable estimate of trend in abundance is currently not available.	Before commercial whaling on right whales, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1965–99, following large illegal catches by the U.S.S.R., there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001).
Fin whale – Northeast Pacific	Endangered	Depleted & a strategic stock	Abundance may be increasing but surveys only provide abundance information for portions of the stock in the central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula. 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.
Minke whale – Alaska	None	None	There are no data on trends in Minke whale abundance in Alaska waters.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA.
Sperm Whale – North Pacific	Endangered	Depleted & a strategic stock	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 18,017 animals. The population size of the Eastern North Pacific gray whale stock has been increasing over the past several decades despite an unusual mortality event in 1999 and 2000. The estimated annual rate of increase, based on shore counts of southward migrating gray whales the unrevised abundance estimates between 1967 and 1988, is 3.3% with a standard error of 0.44% (Buckland et al. 1993); using the revised abundance time series from Laake et al. (2009) leads to an annual rate of increase for that same period of 3.2% with a standard error of 0.5% (Punt and Wade 2010).	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, eastern Chukchi Sea, and Cook Inlet	Cook Inlet: Endangered. Remaining Stocks: None	Cook Inlet: Depleted & a strategic stock	Abundance estimate is 3,710 animals and population trend is not declining for the eastern Chukchi Sea stock. Minimum population estimate for the eastern Bering Sea stock is 14,898 animals and population trend is unknown. The minimum population estimate for the Bristol Bay stock is 2,467 animals and the population trend is stable and may be increasing. Cook Inlet 2008 abundance estimate of 375 whales is unchanged from 2007. Trend from 1999 to 2008 is not significantly different from zero.	Summer in the Arctic Ocean and Bering Sea coastal waters, and winter in the Bering Sea in offshore waters associated with pack ice. Cook Inlet belugas do not occur in BSAI.

Source: Allen and Angliss 2011; List of Fisheries for 2011 (75 FR 68485, November 8, 2010).

The Steller sea lion inhabits many of the shoreline areas of the BSAI, using these habitats as seasonal rookeries and year round haulouts. The Steller sea lion has been listed as threatened under the ESA since 1990. IN 1997 the population was split into two stocks of distinct population segments (DPS) based on genetic and demographic dissimilarities, the western and eastern stocks. Because of a pattern of continued decline in the western DPS, it was listed as endangered on May 5, 1997 (62 FR 30772), while the eastern DPS remained under threatened status. The western DPS inhabits an area of Alaska approximately from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. Steller sea l ions present in the action area would be primarily from the western DPS.

Throughout the 1990s, particularly after critical habitat was designated, various closures of areas around rookeries and haulouts and some offshore foraging areas affected commercial harvest of BSAI groundfish, some of which are important components of the Steller sea l ion diet. In 2001, a biological opinion was release4d that provided protection measures to ensure that the groundfish fisheries would not jeopardize the continued existence of the Steller sea lion nor adversely modify its critical habiat; that opinion was supplemented in 2003. After court challenges, these protection measures remain in effect today (NMFS 2001, Appendix A). A detailed analysis of the effects of these protection measures is provided in the Steller Sea Lion Protection Measures Supplemental EIS (NMFS 2003).

A biological opinion documenting the program level Section 7 formal consultation on the effects of the Alaska groundfish fisheries on Steller sea lions, humpback whales, sperm whales, and fin whales awas completed November 24, 2010 (NMFS 2010). The biological opinion concluded that the fisheries were not likely to jeopardize the continued existence of the eastern DPS of Steller sea lions, the Western North Pacific and Central North Pacific populations of humpback whales, North Pacific sperm whales, or the Northeast Pacific population of fin whales. The biological opinion concluded that the fisheries were not likely to adversely modify designated critical habitat of the eastern DPS of Steller sea lions. The biological opinion, however, concluded that the fisheries were likely to jeopardize the continued existence of the western DPS of Steller sea lions and were likely to adversely modify their designated critical habitat. The biological opinion contained a reasonable and prudent alternative (RPA) designed to remove the likelihood the fisheries would jeopardize the western DPS of Steller sea lions or adversely m odify its designated critical habitat.

This RPA was implemented for the 2011 fishing year (75 FR 77535; December 13, 2010). NMFS issued an interim final rule to implement Steller sea lion protection measures to ensure that the BSAI management area groundfish fisheries are not likely to jeopardize the continued existence of the western DPS of Steller sea lions or adversely modify its designated critical habitat (75 FR 77535). These management measures primarily disperse fishing effort over time and area to provide protection from potential competition for important Steller sea lion prey species in waters adjacent to rookeries and important haulouts. The intended effect of this interim final rule is to protct the endangered western DPS of Steller sea lions as required under the ESA, and to conserve and manage the groundfish resources in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA). An EA determined that this action would not have significant environmental impacts. The protection measures focused on the Atka mackerel and Pacific cod fisheries in the Aleutian Islands.

The Bering Sea subarea has several closures in place for Steller sea lions including no transit zones, rookeries, haulouts, and the Steller Sea Lion Conservation Area. The proposed action would not change the groundfish fisheries or groundfish closures associated with Sea lion Rock, Bogoslof Island/Fire Island, or Adugak Island. The proposed action would change groundfish fisheries around the Pribilof Islands and Walrus Island. The harvest of groundfish in the Bering Sea subarea is temporally dispersed and spatially dispersed through area closures. These harvest restrictions decrease the likelihood of disturbance, incidental take, and competition for prey to ensure the groundfish fisheries do not jeopardize the continued existence or adversely modify the designated critical habitat of Steller sea lions (NMFS 2000, 2001).

Northern fur seals forage in the pelagic area of the Bering Sea and reproduce on the Pribilof and Bogoslof Islands. On June 17, 1988, NMFS declared the Pribilof Islands stock of the northern fur seal to be depleted under the MMPA because it declined to less than 50 percent of levels in the late 1950s, and no compelling evidence suggested that carrying capacity had changed substantially since the late 1950s (NMFS 2007). Recent pup counts from the Pribilofs in 2008 suggest a continuing decline in survival rates and show the overall abundance estimate is strongly influenced by the continued rapid decline in pups at St. Paul Island (Allen and Angliss 2011).

5.3.1 Impacts on Marine Mammals

Table 5-5 contains the significance criteria for analysing the effects of the proposed action on marine mammals. These criteria are from the Amendment 94 EA/RIR/FRFA (NMFS 2010). Significantly beneficial impacts are not possible with the management of groundfish fisheries as no beneficial impacts to marine mammalsl are likely with groundfish harvest. Generally, changes to the fisheries do not benefit marine mammals in relation to incidental take, prey availability, and disturbance. Changes increase or decrease potential adverse impacts. 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. Under all proposed alternatives, the distribution and extent of groundfish fisheries will change only incrementally. The modification is fishing effort from the proposed closures was examined by estimation of the redistribution of fishing effort is expected to be very limited in scale and forms the basis for determination of relative impacts against these criteria on Marine mammals in this section.

Table 5-5 Criteria for Determining Significance of Impacts to Marine Mammals.

	Incidental take and entanglement in marine debris	Harvest of prey species	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 are no beneficial impacts.	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 or 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 or important time of year.	Insufficient information as to what constitutes disturbance.

5.3.2 Incidental Takes

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on marine mammals (Ch. 8 of NMFS 2007) and is incorporated by reference. Potential take in the groundfish fisheries is well below the potential biological removal (PBR) for all marine mammals except killer whales and humpback whales. This means that predicted take would be below the maximum number of animals that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

Table 5-6 provides the marine mammals taken in the potentially affected fisheries as published in the List of Fisheries for 2011 (75 FR 68468). Table 5-7 provides more detail on the levels of take based on the most recent SAR (Allen and Angliss 2011).

Table 5-6 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 5-7 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 AK resident	1.2	1.2	20.8
Harbor Porpoise (BS)	2.45	N/A	Undetermined
Pacific Walrus	0	4,960 – 5,475	Undetermined

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

On December 10, 2010, NMFS announced that it proposed to list two populations of ice seals that occur in the Bering Sea under the ESA: the Pacific bearded seal Beringia DPS, and the Arctic ringed seal. BSAI groundfish fisheries may directly or indirectly affect both populations. Should either of these species be listed on the ESA, Section 7 consultations on the effects of groundfish fisheries may be necessary.

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. Spatial relocation of BSAI groundfish fisheries are not likely to result in discernible additional interactions with marine mammals. Relocated vessels will be required to comply with existing protection measures and federal laws to reduce the potential interactions with these species. Therefore, under all proposed alternatives, any impacts on marine mammal species are likely to be incremental and insignificant.

5.3.3 Harvest of Prey Species

The Alaska Groundfish Harvest Specifications EIS determined that competition for prey species under status quo fisheries is not likely to constrain foraging success of marine mammals or cause population declines (NMFS 2007). Exceptions to this are Steller sea lions and northern fur seals for which potential prey competition with groundfish fisheries may be a concern. Under all proposed alternatives, the harvest of groundfish species is not expected to change, any impacts on marine mammal species are likely to be incremental and insignificant.

5.3.4 Disturbance

The Alaska Groundfish Harvest Specifications EIS analysed the potential disturbance of marine mammals by the groundfish fisheries (NMFS 2007). 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 disturbance of marine mammals would occur. Therefore, any disturbance impacts on marine mammals are likely to be incremental and insignificant.

5.4 Seabirds

Various 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 is provided below.

Species nesting in Alaska
Tubenoses-Albatrosses and relatives: Northern Fulmar, Fork-tailed Storm-petrel, Leach's Storm-petrel
Kittiwakes and terns: Black-legged Kittiwake, Red-legged Kittiwake, Arctic Tern, Aleutian Tern
Pelicans and cormorants: Double-crested Cormorant, Brandt's Cormorant, Pelagic Cormorant, Redfaced Cormorant
Jaegers and gulls: Pomarine Jaeger, Parasitic Jaeger, Long-tailed Jaeger, Bonaparte's Gull, Mew Gull, Herring Gull, Glaucous-winged Gull, Glaucous Gull, Sabine's Gull
Auks: Common Murre, Thick-billed Murre, Black Guillemot, Pigeon Guillemot, Marbled Murrelet, Kittlitz's Murrelet, Ancient Murrelet, Cassin's Auklet, Parakeet Auklet, Least Auklet, Whiskered Auklet, Crested Auklet, Rhinoceros Auklet, Tufted Puffin, Horned Puffin
Eiders: Common, King, Spectacled, Steller's

Species that visit Alaska waters
Tubenoses: Short-tailed Albatross, Black-footed Albatross, Laysan Albatross, Sooty Shearwater, Shorttailed Shearwater
Gulls: Ross's Gull, Ivory Gull

Several species of conservation concern occur in the BSAI as well. Short-tailed albatrosses are listed as endangered under the US ESA, while Kittlitz's Murrelet is a candidate species for listing under the ESA. The USFWS is currently working on a 12-month finding for black-footed albatrosses. The USFWS determined that listing of Yellow-billed loon was warranted, but not a priority.

The USFWs has primary responsibility for managing seabirds, and has evaluated effects of the BSAI and GOA FMP's and the harvest specifications process on currently listed species in two Biological Opinions (USFWS 2003a and 2003b). Both Biological Opinions concluded that the groundfish fisheries are unlikely to jeopardize populations of listed species or adversely modify or destroy critical habitat for listed species.

5.4.1 Effects of Alternatives on Seabirds

The groundfish fisheries have direct and indirect impacts on seabirds. Seabird take is the primary direct effect of fishing operations. Incidental take of seabirds occur primarily in the hook-and-line and the trawl fisheries. Hook-and-line and trawl gear accounts for up to 97 percent of seabird bycatch in the BSAI and GOA groundfish fisheries combined (AFSC 2006). Biological Opinions by the USFWS (2003a and 2003b) concluded that the groundfish fisheries are unlikely to jeopardize populations of ESA-listed species or adversely modify or destroy critical habitat for listed species.

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. Under all proposed alternatives, the distribution and extent of groundfish fisheries will change only incrementally. It is, therefore, likely that any effects to seabirds for all proposed alternatives will be incremental and 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. A detailed discussion of the effects of crab fisheries on essential fish habitat (EFH) is included in the Final EIS for EFH identification and consideration in Alaska (NMFS 2005). That analysis concluded that the impacts of the crab pot fishery on habitat features in the Bering Sea and Aleutian Islands are negligible.

Ecosystem characteristics of the BSAI management areas have been described annually since 1995 in the "Ecosystem Considerations" section of the annual SAFE reports. 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. Under all proposed alternatives, the distribution and extent of groundfish fisheries will change only incrementally. 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 Economic Effects

The analysis of alternatives is presented in the RIR and a summary of effects is re-presented here. These effects will apply to all entities, large and small, operating in the BSAI Pacific cod and flatfish fisheries.

Alternative 1, the status quo, includes a directed Pribilof Islands blue king crab fishery closure until the stock is completely rebuilt, and the closure to all trawl gear of the Pribilof Island Habitat Conservation Zone (PIHCZ). These measures; however, have failed to rebuild the PIBKC stock sufficiently thus necessitating a new rebuilding plan, including additional PIBKC protection measures, as required under the MSA.

Table 1-21through Table 1-23, of the RIR, provide a comparison of the potential impacts, in terms of tons and gross revenue at risk, of each of the Proposed closure areas (Alt. 2, 3, and 4) on the Pacific Cod pot gear fishery. As one would expect, the tons at risk increase with the size of the closure area and that finding is consistent across all years. Non-confidential tonnage put at risk ranges from 306 metric tons (Alt. 2, 2009) to as much as 4,212 metric tons (Alt. 4-1, 2008). Gross revenue effects range from near zero to $9 million and the range of impacts in terms of percent of total gross revenue earned in the BSAI Pacific Cod pot fishery is from 1.77 percent to more than 22 percent (Alt. 4-1, 2008) of total fishery gross revenue. These values are also depicted graphically in Figure 1 of the RIR. These potential impacts would accrue, nearly entirely, upon directly regulated small entities.

Table 1-24 through Table 1-26, of the RIR, provide a comparison of the potential impacts, in terms of tons and gross revenue at risk, of each of the Proposed closure areas on the all groundfish fisheries combined. In contrast to the Pacific cod pot fishery, the distribution of groundfish effort in the flatfish fisheries within the ADF&G area results in larger tons at risk tabulations in the Alternative 3 ADF&G areas than occurs in the Alternative 1 PIHCZ area in several, but not all , years. Though there are a few exceptions, tons at risk tend to increase with the size of the closure area and that finding is consistent across all years. Non-confidential tonnage put at risk ranges from 337 metric tons (Alt. 3, 2009) to more than 96,000 metric tons (Alt. 4-1, 2005). Gross revenue effects range from near zero to $106 million and the range of impacts in terms of percent of total gross revenue earned in the BSAI Pacific Cod and flatfish fisheries is from .14 percent to approximately nearly 30 percent (Alt. 4-1, 2005) of total fishery gross revenue. These values are also depicted graphically in Figure 2 of the RIR. These impacts would accrue to both large and small entities as defined above.

Table 1-27 through 1-29, and Figure 3 through Figure 5, of the RIR, provide comparisons of the effect of the various options of Alternative 5 (triggered area closures) on potentially affected fisheries. Unfortunately, all impacts associated with the flatfish fisheries are confidential and cannot be divulged. In the Pacific cod fishery, the greatest impacts of the triggered closure would have occurred in the hook and line combined CP+CV grouping where 1,312 tons are put at risk were a closure in the largest stock distribution area (A5c) and this option would also result in the largest total impacts of 2,414 metric tons across all of the Pacific cod fisheries potentially affected. The Alternative 5d option, which is the second largest triggered closure area under consideration, would have had the second highest total impact of 1,182 tons, most of which comes from the hook and line CP+CV grouping. Due to confidentiality, only a combined Pacific cod hook and line group could be reported, with 143 metric tons put at risk. Extending the existing trawl closure in the PIHCZ to all groundfish fisheries, as a triggered closure, would have put 271 and 386 tons (658 total) at risk in the Pacific cod pot CP+CV group and the Pacific cod hook and line CP+CV group, respectively. These tonnages, when converted to gross revenue at risk, result in total potential impacts ranging from $0.292 million (ADF&G area) up to just over $3 million (PIBKC75 area). Most of the potential impact estimates, in specific gear and target fisheries, approach or exceed a half a million dollars, while the largest potential gross revenue at risk impacts exceed $1.6 million in the Pacific cod hook and line CP+CV grouping.

In percentage terms, these potential impacts of the Alternative 5 triggered closures are, with the exception of the Pacific cod pot fishery, all less than one percent of the overall target fishery level and the Pacific cod pot fishery impacts are less than two percent of target fishery gross revenue in all areas. However, it is important to recognize that while these values are small, in percentage of overall target fishery gross revenue and aggregate total gross revenue, the potential impacts may be concentrated in a small number of operators and impacts on the Pacific cod pot fishery sector accrue, almost entirely, upon directly

regulated small entities. In addition, the majority hook and line and trawl gear sector entities potentially affected by the proposed action qualify, ignoring affiliations, as directly regulated small entities.
Figure 6 of the RIR provides comparisons of the effect of the various options of Alternative 5d, threshold based triggered area closures on potentially affected fisheries. This graphical comparison is based on the information provided in Table 1-20 of the RIR, which tabulates the tonnage and gross revenue effects of threshold based triggered closures of the area associated with the PIBKC stock distribution from 1984 to 2009 (As defined in Alternative 5d option 4) in the weeks following triggering of the closure in affected fisheries.

Under the 20 percent threshold in the Pacific Cod hook and line fishery closures would have been triggered in 2004 and 2006. These triggered closures would have respectively put 3,547 and 1,909 tons at risk. The 40 percent threshold in the Pacific Cod Pot fishery would have been triggered in 2005 and 2007 and would have put 2,238 and 254 tons at risk, respectively. The 40 percent trawl threshold in the yellowfin sole fishery closures would have been triggered in 2003 and 2006. These triggered closures would have respectively put 3,465 and 4,500 tons at risk,

In terms of gross revenue, the 20 percent threshold closures in the Pacific Cod hook and line fishery would have has associated gross revenue at risk of $4.2 million and $3.3 million. The 40 percent threshold in the Pacific Cod Pot fishery closures would have had associated gross revenue at risk of $3 million and $.5 million, while the 40 percent threshold in the Pacific Cod Pot fishery closures would have had associated gross revenue at risk of $3 million and $.5 million

In percentage terms, the gross revenue at risk associated with the 20 percent threshold in the Pacific Cod hook and line fishery would have represented 3.2 percent and 1.9 percent of annual gross revenue. The gross revenue at risk in the 40 percent threshold closures in the Pacific Cod Pot fishery would have represented 16 percent and 1.4 percent of annual gross revenue, and the gross revenue at risk associated with the 40 percent trawl closures would have represented 2.3 percent and 2.4 percent of annual gross revenue in the yellowfin sole trawl fishery.

Finally, the RIR includes an extensive analysis of catch reprojection from closed to open areas based on historically recorded catch quantities and locations. That analysis is documented in Appendix A, and discussed under each alternative. In general, the reprojection analysis has shown, in most cases, the ability of the fleet to harvest catch put at risk outside the closure area albeit with considerable potential for increased operating costs due to the relative dispersion of catch outside of the areas proposed for closure. This is most prevalent with the large distribution areas of Alternatives 4, options 1 and 2; however catch reprojection dispersion is identified in many cases.

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 and ADF&G areas) 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 ten percent of total fishery gross revenue in several years and nearly 30 percent in the worst case under examination here. Redeployment to recover small amounts of catch, while potentially increasing operating cost won't 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 operation 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.

7 Cumulative Impacts

CEQ regulations require that the analysis of environmental consequences include a discussion of the action's impacts in the context of all other activities (human and natural) that are occurring in the affected environment and impacting the resources being affected by the proposed action and alternatives. This cumulative impact discussion should include incremental impacts of the action when added to past, present, and reasonably foreseeable future actions. A discussion of the cumulative effects of the groundfish fisheries is in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007b). The past and current cumulative effects are discussed in the PSEIS (NMFS 2004). Both of these discussions are incorporated by reference. The reasonably foreseeable future actions that may impact the blue king crab stock are—

- ecosystem-sensitive management;
- traditional management tools;
- actions by other state, federal, and international agencies; and
- private actions.

The following reasonably foreseeable future actions may have a continuing, additive, and meaningful relationship to the direct and indirect effects of the alternatives on PIBKC.

Ecosystem-sensitive management

Ecosystem-sensitive management is likely to benefit target species. The specific actions that will be taken to implement an ecosystem policy for fisheries management are unknown at this time; therefore, the significance of cumulative effects of ecosystem policy implementation on mortality, spatial and temporal distribution of the fisheries, changes in prey availability, and changes in habitat suitability are unclear. However, these actions may enhance the ability of stocks to sustain themselves at or above MSST, as ways are found to introduce ecosystem considerations into the management process.

Traditional management tools

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 2004) and Amendment 24 to the Crab FMP (NPFMC 2008) 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 on an analysis of implementing Annual Catch Limits (ACLs) for all BSAI crab stocks including the PIBKC stock as well as a revised rebuilding plan for the EBS snow crab stock.

No further constraint on crab fisheries are anticipated as a result of those actions[12]. A Tanner crab rebuilding plan is likely to be developed by the Council and NMFS following stock status determination that this stock is below its MSST and a rebuilding plan will be necessary. This rebuilding plan will likely also include alternatives that could further constrain the allowable catch in that crab fishery and may include additional constraints on groundfish fisheries in the Bering Sea.

ABCs will now be annually specified by the SSC. This includes the ABC for the PIBKC stock regardless of the fact that the directed fishery is closed. Given that the PSC cap levels under consideration in Alternative 5 are tied to the annually recommended OFL and ABC, any changes in stock status or modifications in the OFL/ABC recommendation in the future would have an impact on the impacts on fisheries of a PSC cap should one be selected by the Council.

The Council is also considering a discussion paper evaluating crab bycatch in the groundfish fisheries. Currently, there are no hard quotas to cap crab bycatch in the groundfish fisheries, although area closures with associated catch limits are utilized to reduce bycatch. Accountability Measures (AMs) are a required provision of the MSRA in conjunction with provisions for ACL requirements. The intent of AMs are to further protect a crab stock from overfishing by providing for a transparent response mechanism in the event that the established ACLs are exceeded. Without further Council action, crab bycatch in the groundfish fisheries will be accounted for by reducing harvest in the directed crab fisheries. However, the Council did initiate an amendment analysis to consider alternative management measures for bycatch in the groundfish fisheries including additional time/area closures in the Bering Sea as well as hard caps on groundfish fisheries. If alternative management measures are implemented in the future this could have an impact on groundfish fleet effort and distribution.

The Council is always in process of considering management changes to the BSAI groundfish fisheries. Some of the actions under consideration in the next several years that would modify the operation of the combined flatfish and Pacific cod fisheries which catch the majority of the PIBKC bycatch may include modification to the halibut PSC limits, an allocative split between the AI and BS TAC for Pacific cod, designation of HAPC or modification of the BS Habitat Area Conservation boundary. These actions could potentially modify the way these fisheries are prosecuted and could have an impact on the PIBKC stock.

Other government actions

The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) expects that reasonably foreseeable future activities include development of oil and gas deposits over the next 15–20 years in federal waters off Alaska. Potential environmental risks from the development of offshore drilling include the impacts of increased vessel offshore oil spills, drilling discharges, offshore construction activities, and seismic surveys. Adverse environmental impacts resulting from exploration and development in the future could impact salmon, halibut, and herring stocks. The extent to which these impacts may occur is unknown.

Private actions

Fishing activities by private fishing operations, carried out under the authority of the annual harvest specifications, are an important class of private action. The impact of these actions has been considered

[12] 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.

under traditional management tools.

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.

Beyond the cumulative impacts discussed above and documented in the referenced analyses, no additional past, present, or reasonably foreseeable cumulative negative impacts on the biological and physical environment (including fish stocks, essential fish habitat, ESA-listed species, marine mammals, seabirds, or marine ecosystems), fishing safety, or consumers have been identified that would accrue from the proposed actions.

8 References

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9 List of preparers and persons consulted

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10 Figures

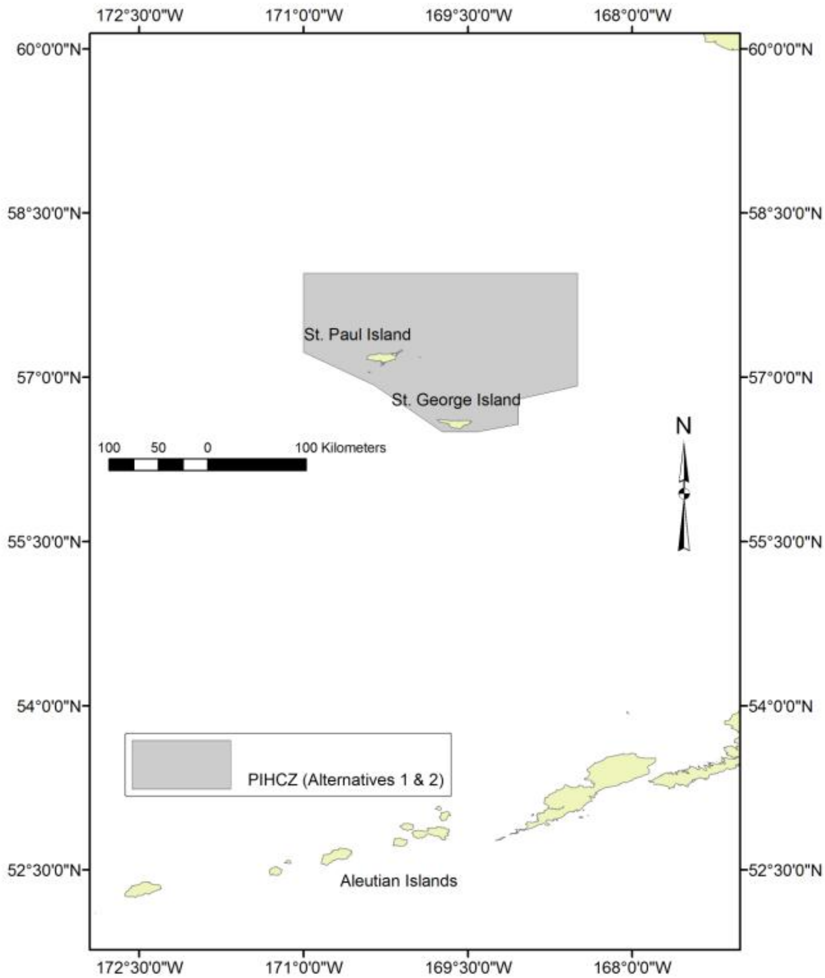


Figure 10-1 Pribilof Islands Habitat Conservation Zone (PIHCZ): Alternatives 1 and 2.

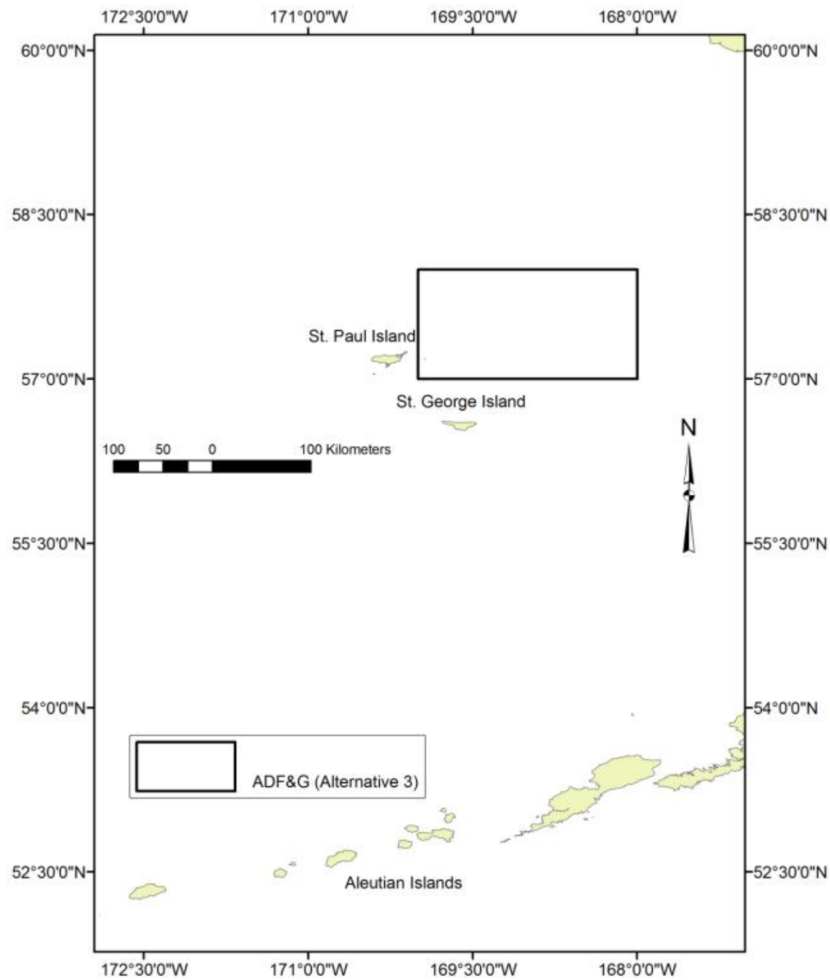


Figure 10-2 Alaska Department of Fish and Game (ADF&G) closure area (Alternative 3).

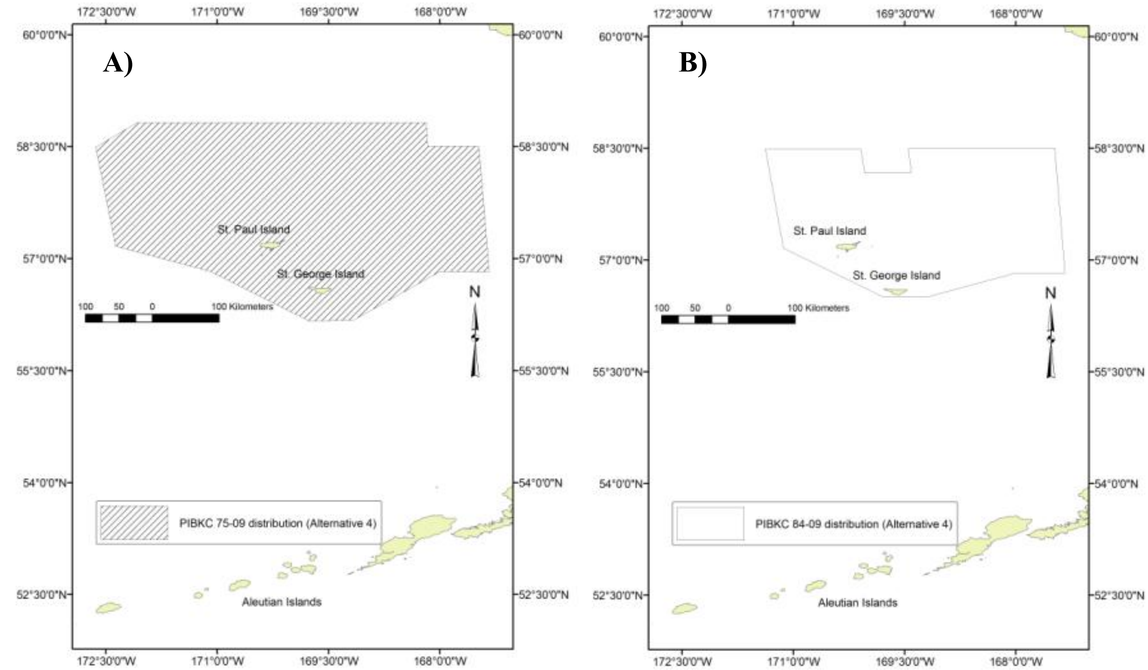


Figure 10-3 Pribilof Islands blue king crab distribution closure area (Alternative 4): A) 1975 to 1983 distribution; B) 1984 to 2009 distribution.

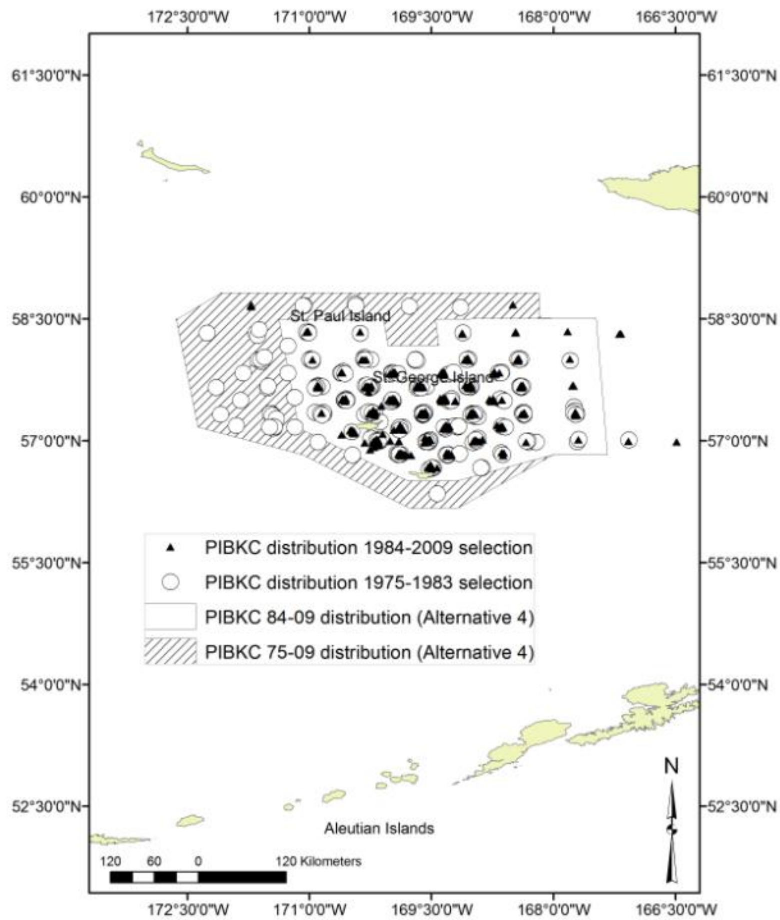


Figure 10-4 **Distribution of Pribilof Islands blue king crab (PIBKC) showing the change in relative distribution to the east in 1984.**

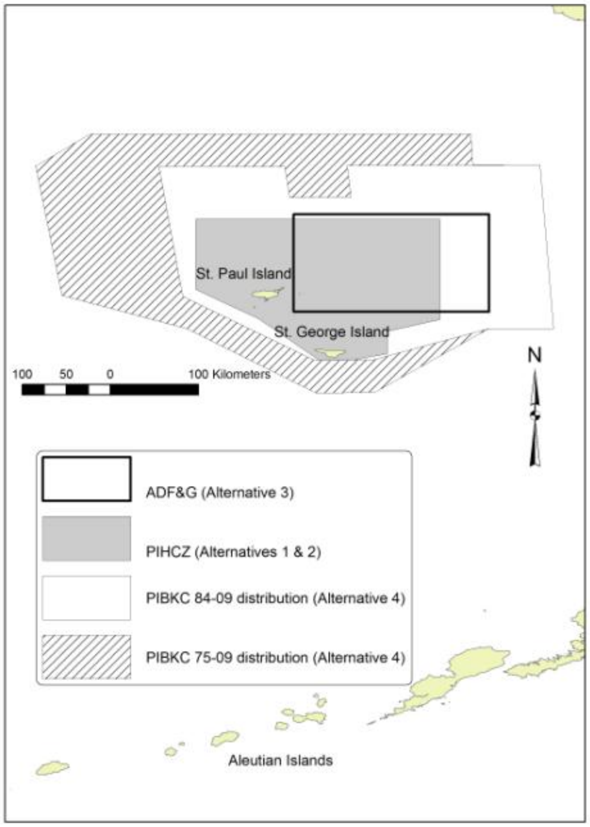


Figure 10-5 A comparison of relative extent of closures under Alternatives 1-4.

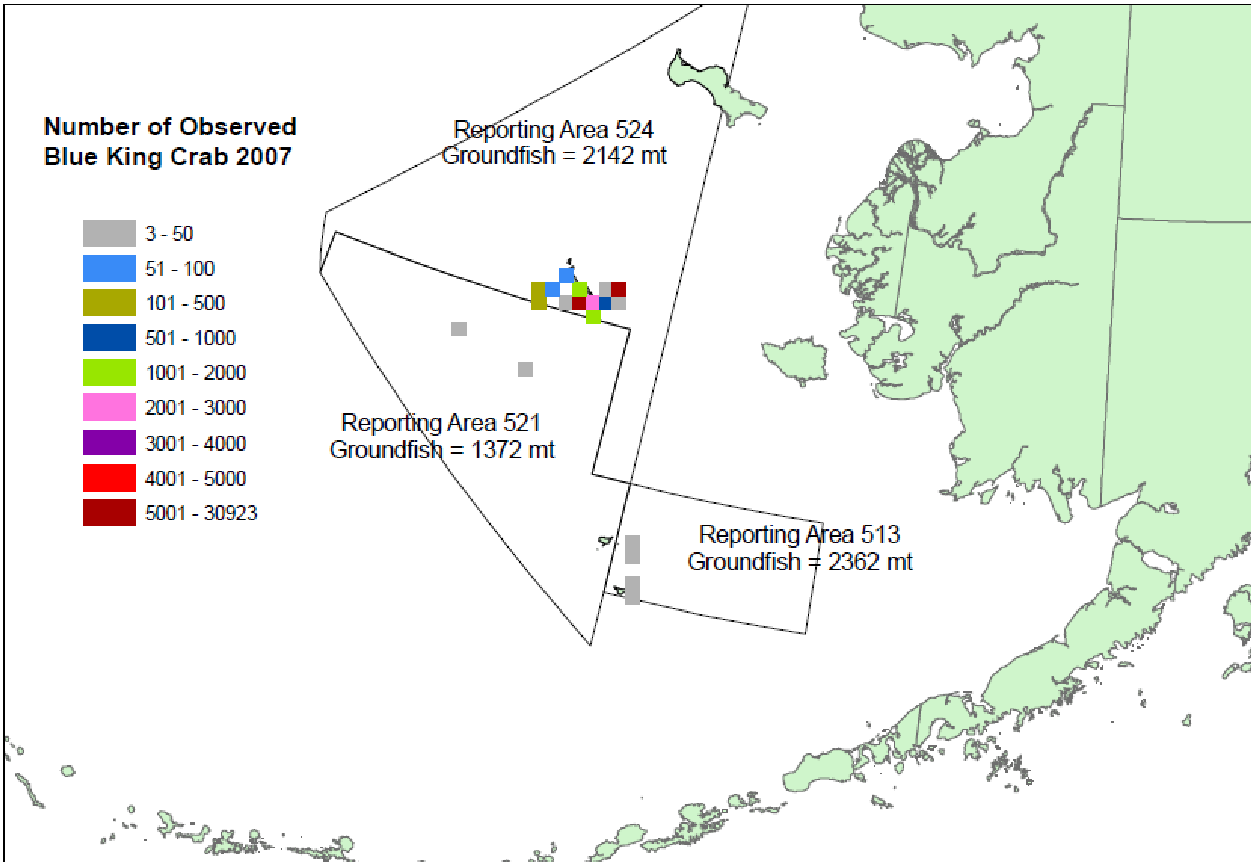
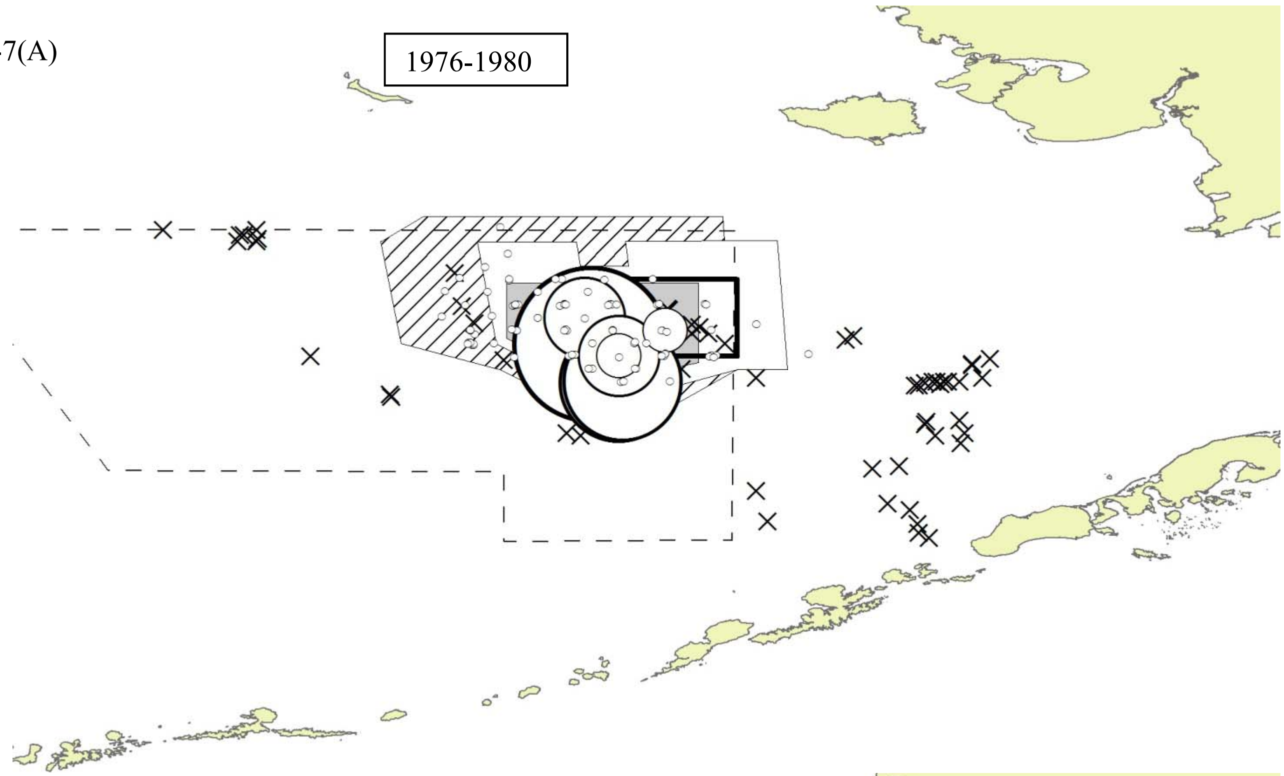


Figure 10-6 Observations of blue king crab used in PSC rate calculations in 2007.

Figure 10-7(A)



10-7(B)

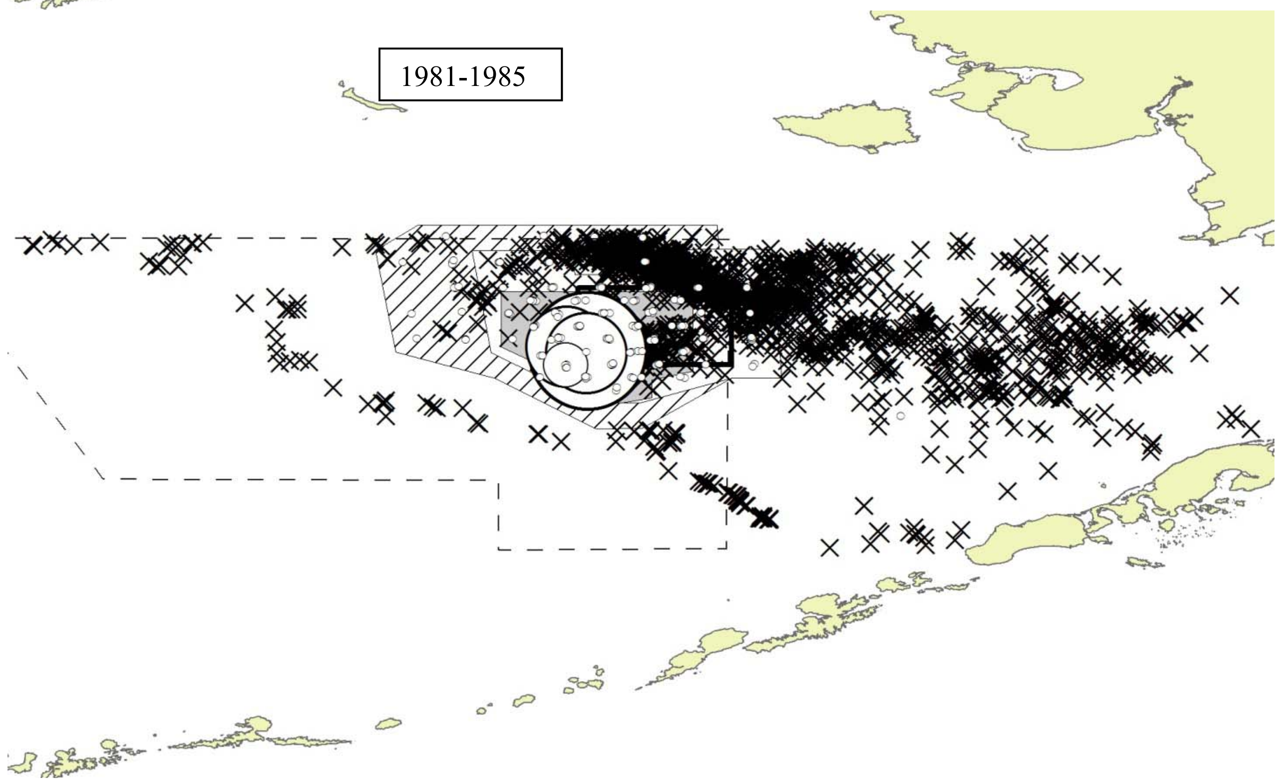
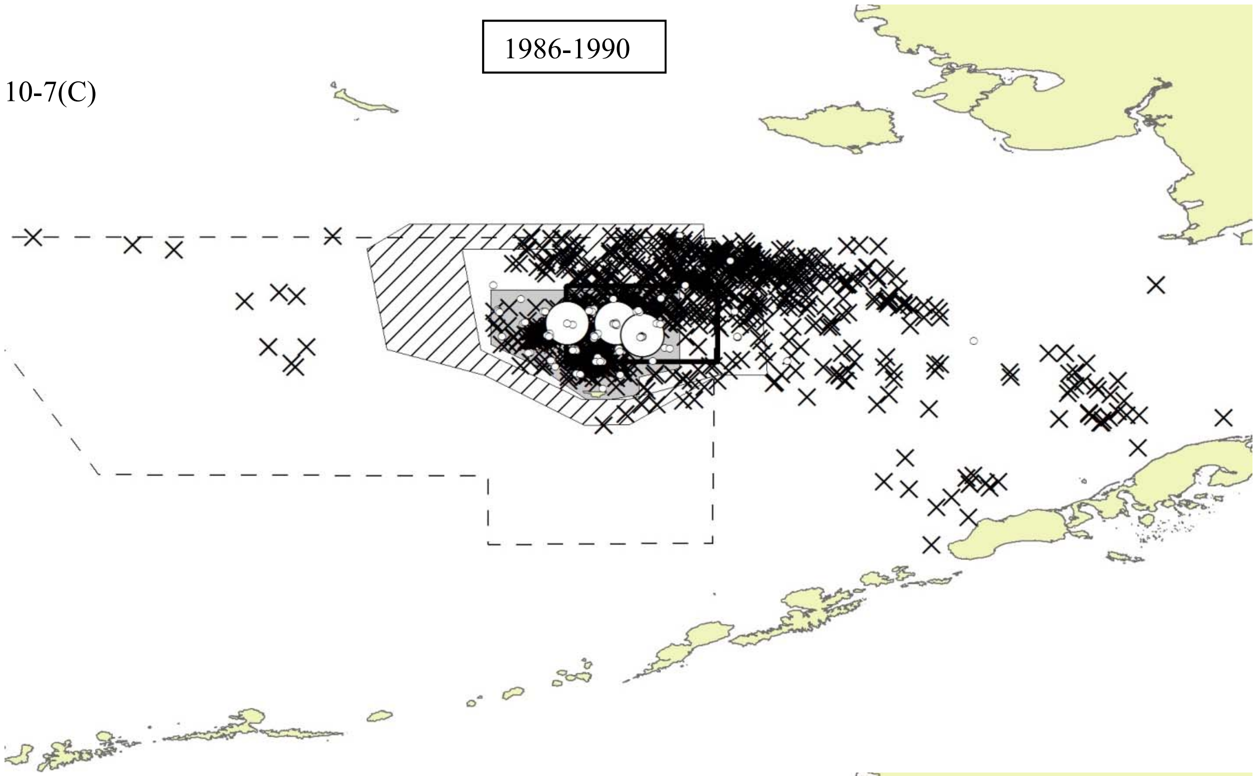
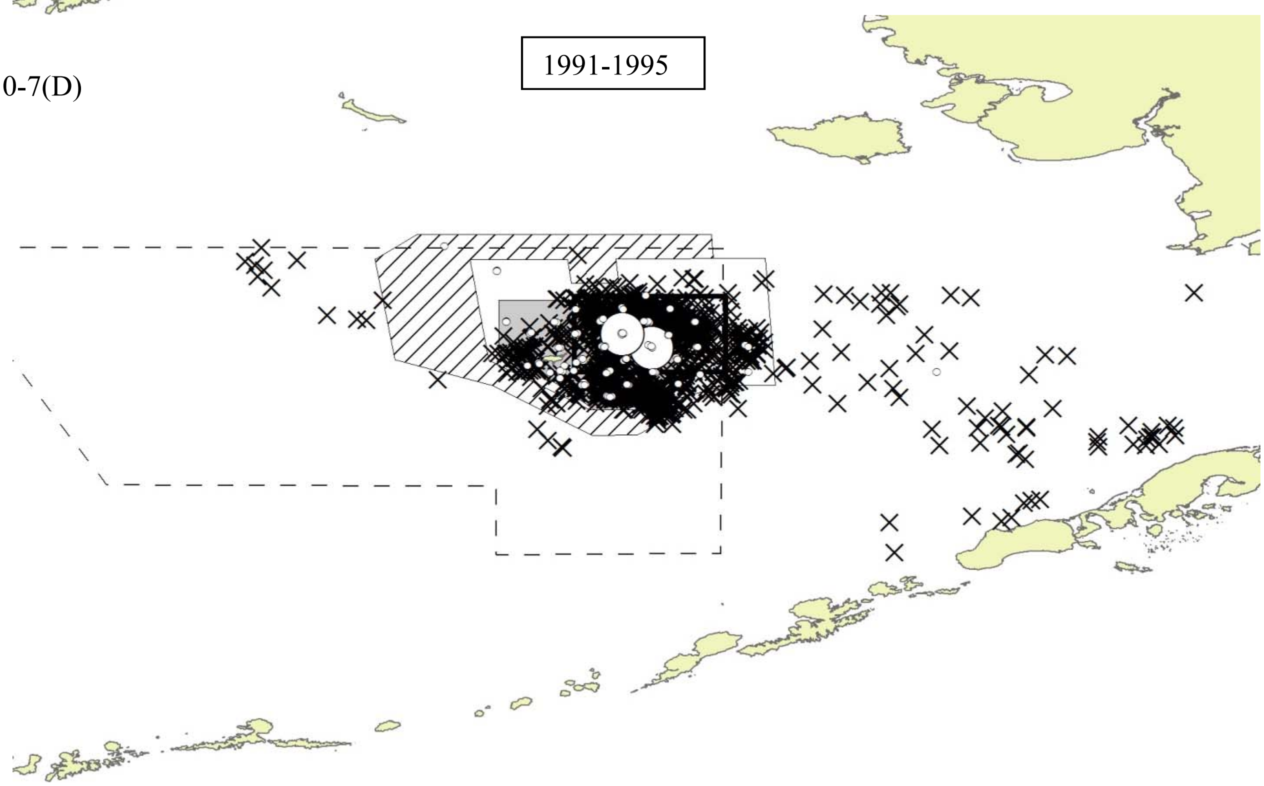


Figure 10-7 The distribution of survey data (open circles: smallest=30-5,000 crab/nm2; largest=21,000-26,000 crab/nm2) and observed bycatch locations (X) of blue king crab in the Pribilof Islands management district (dashed region) and the Bristol Bay District to the east in 5 year intervals from 1976 to 2010 (A-G). Also shown are the four alternative regions.

10-7(C)



10-7(D)



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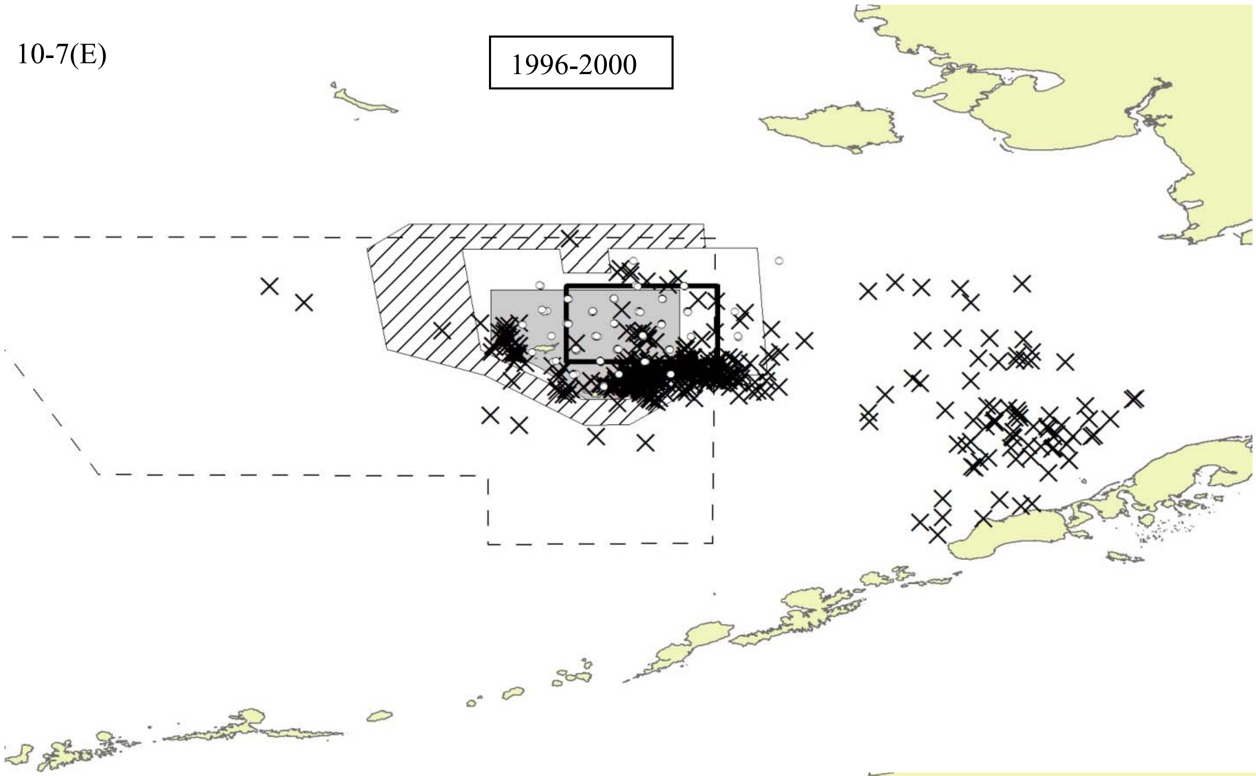
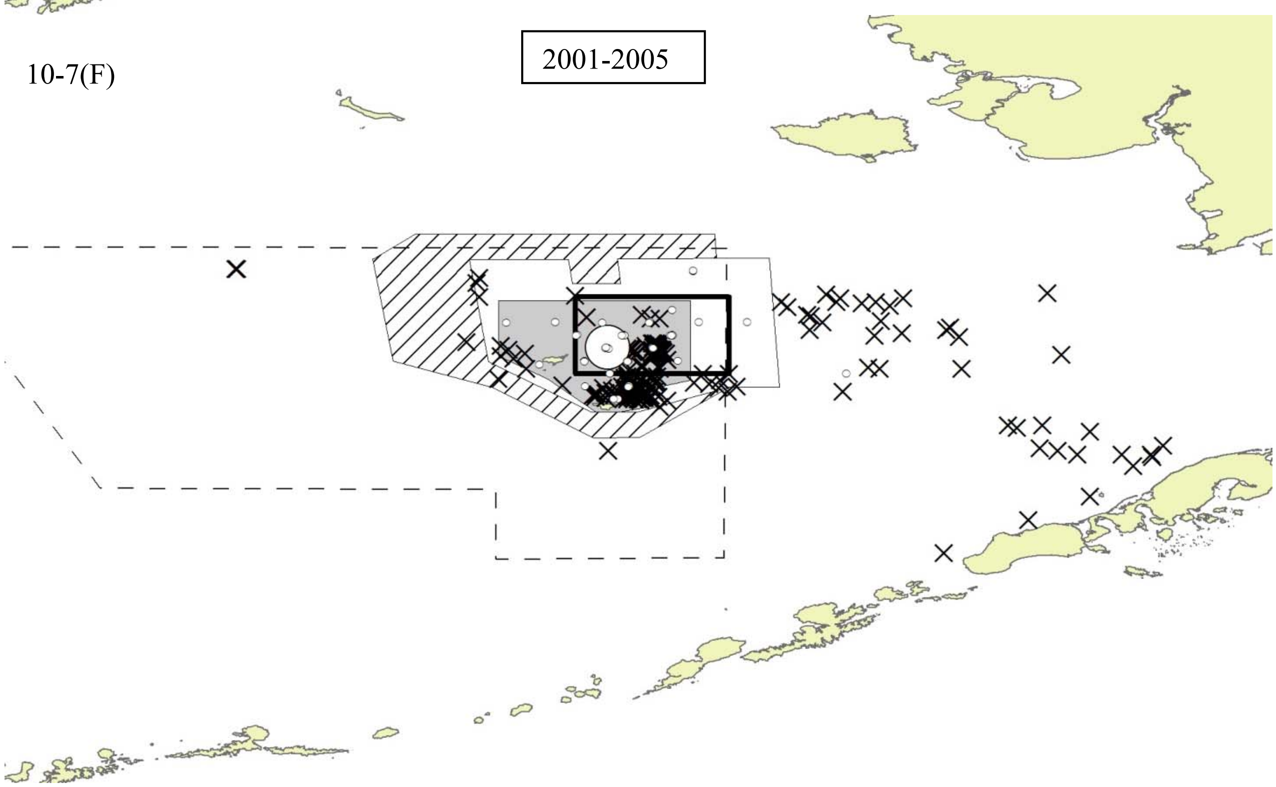
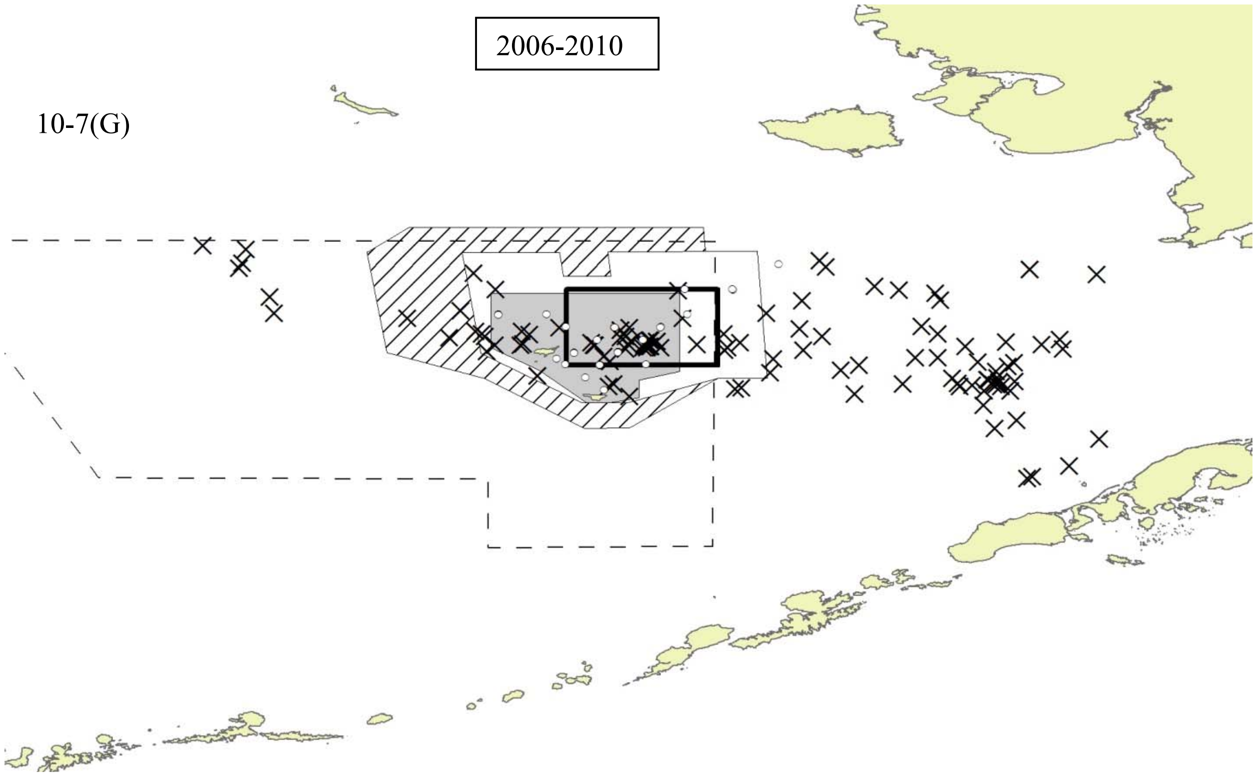
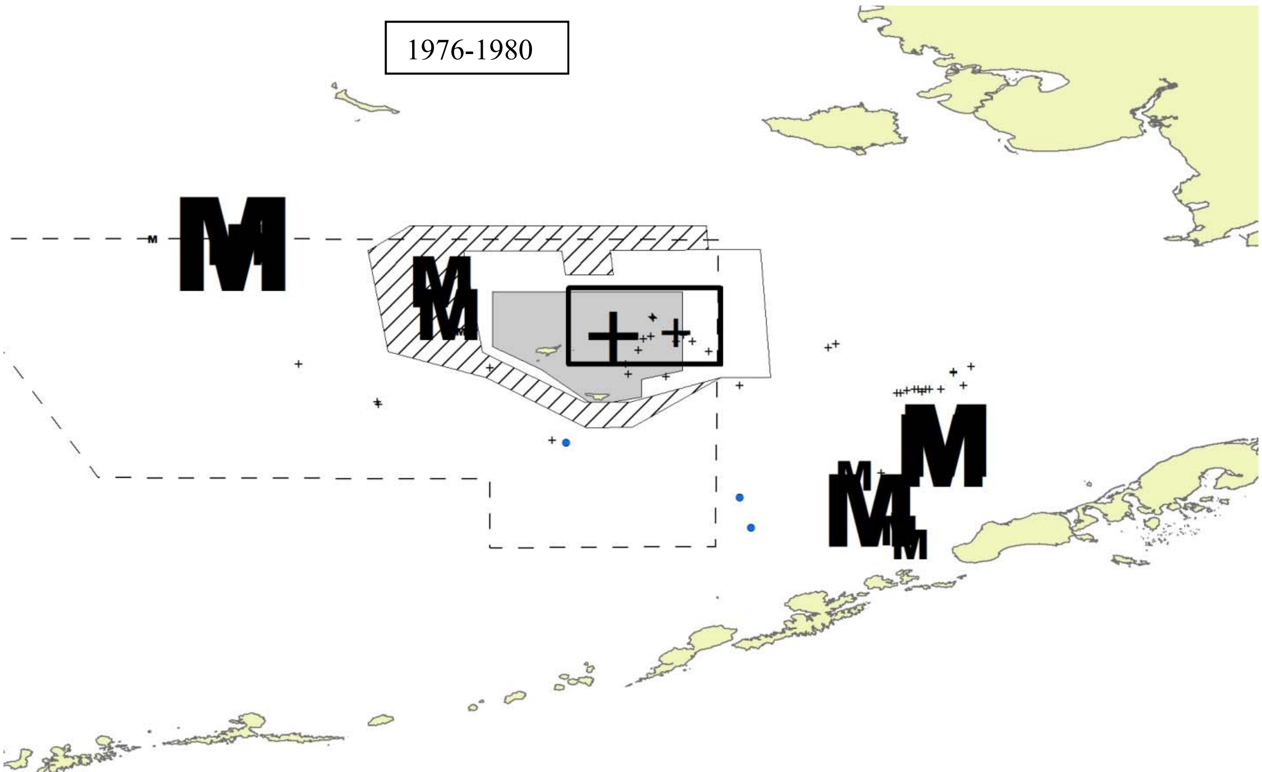


10-7(F)




2006-2010
10-7(G)

A)



B)

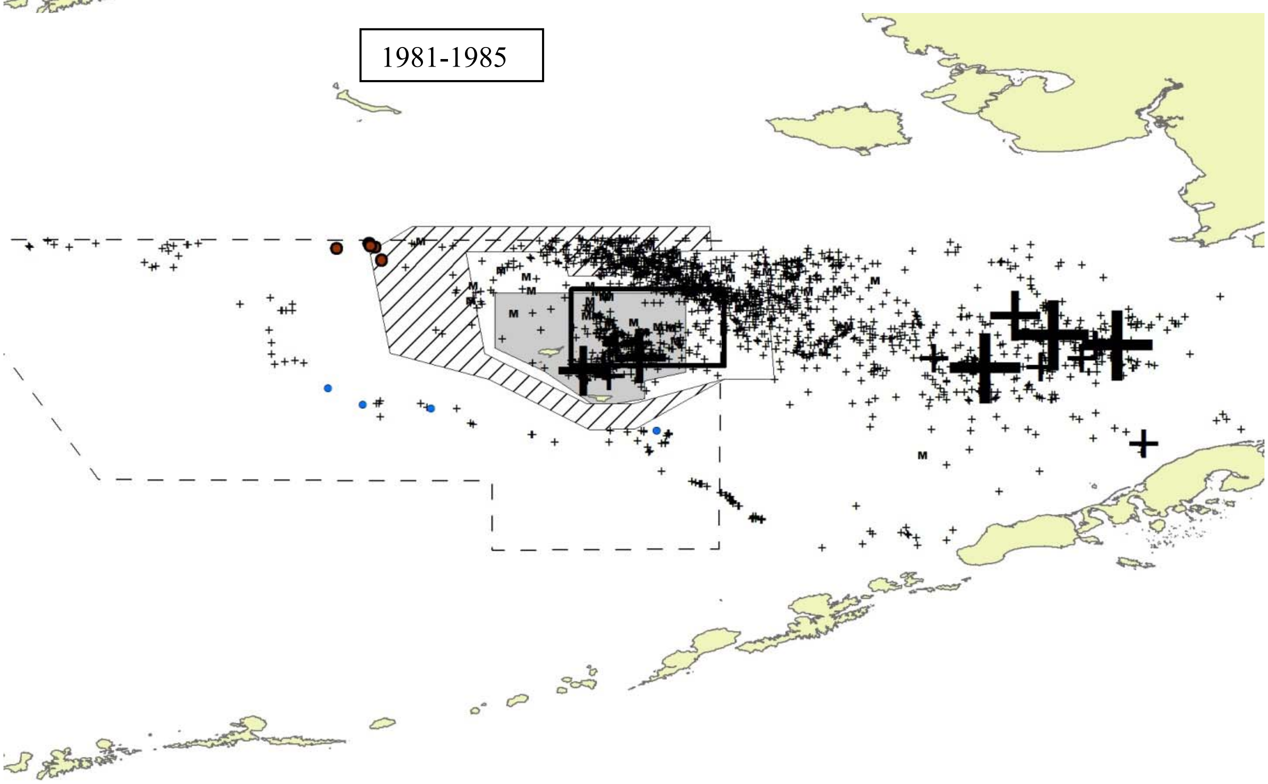
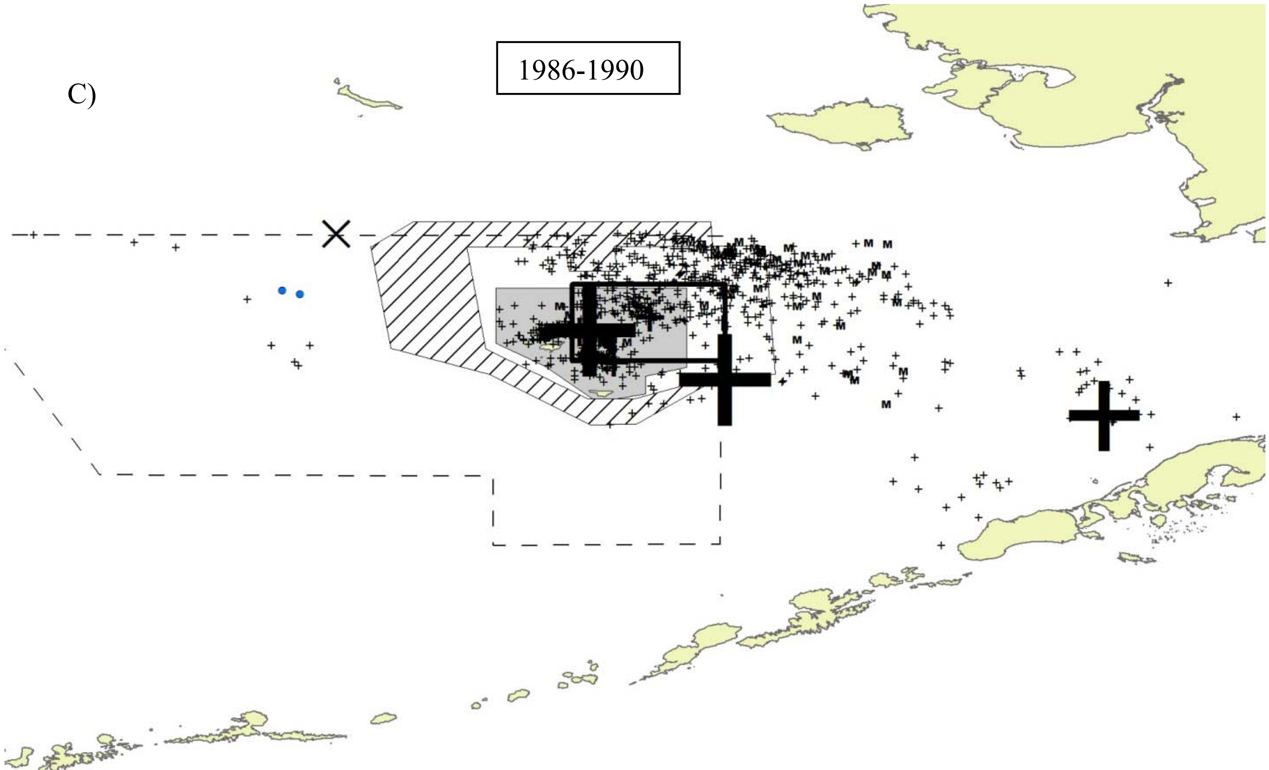
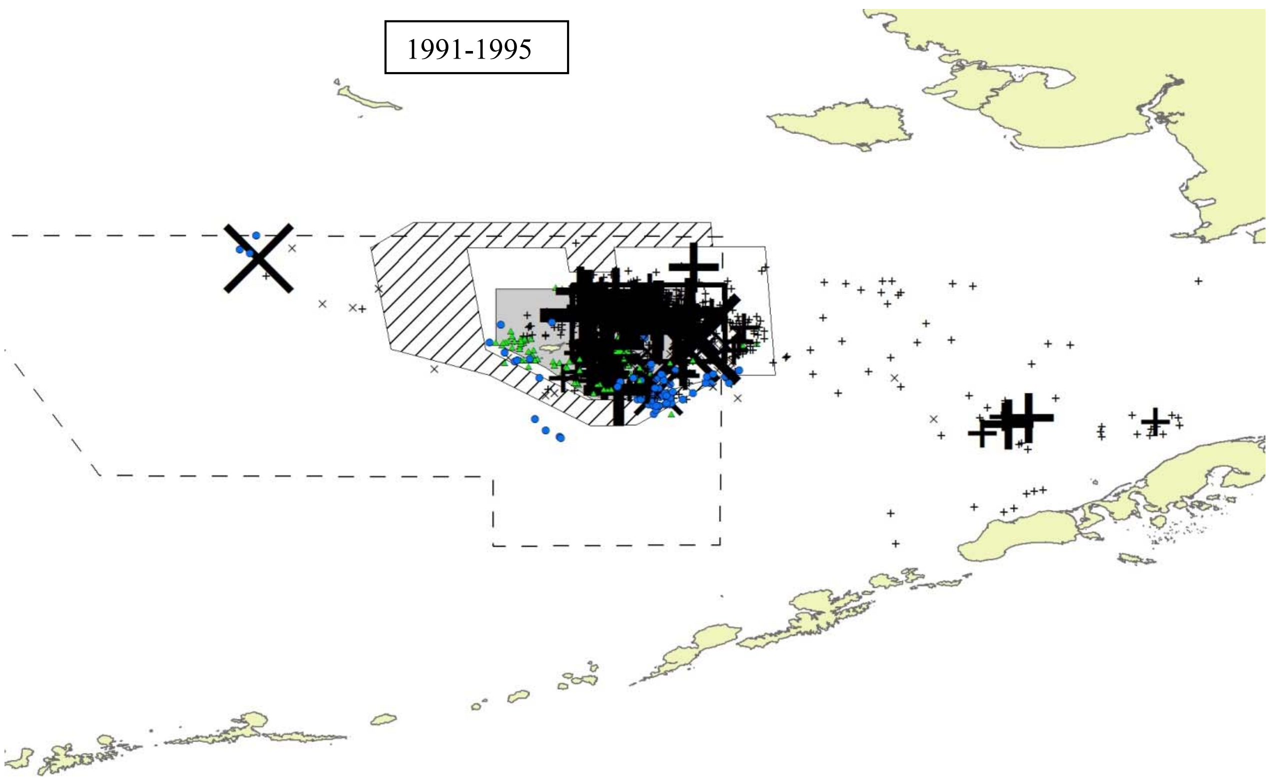


Figure 10-8The distribution of observed bycatch of blue king crab in the Pribilof Islands management district (dashed region) and the Bristol Bay District to the east in 5 year intervals between 1976 and 2010 (A-G) by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1-200 observed crabs and the largest symbol equals 800-1000 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)



D)



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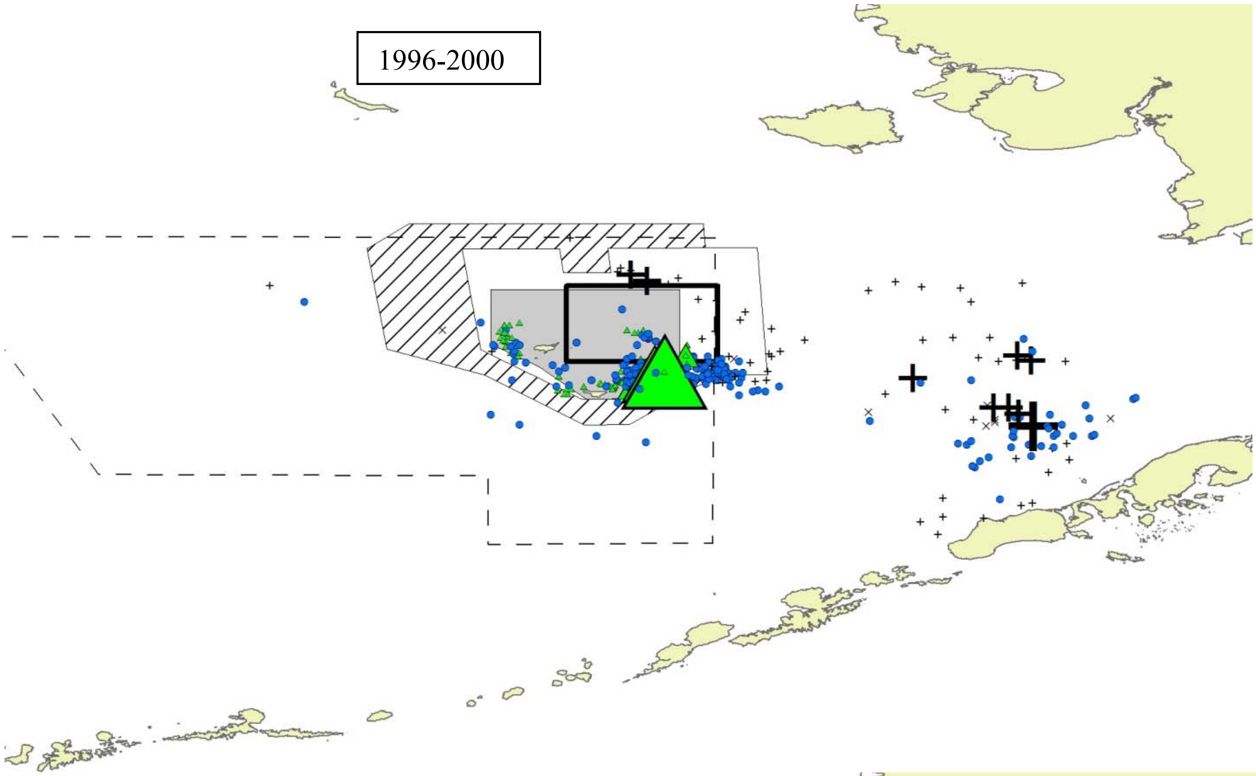
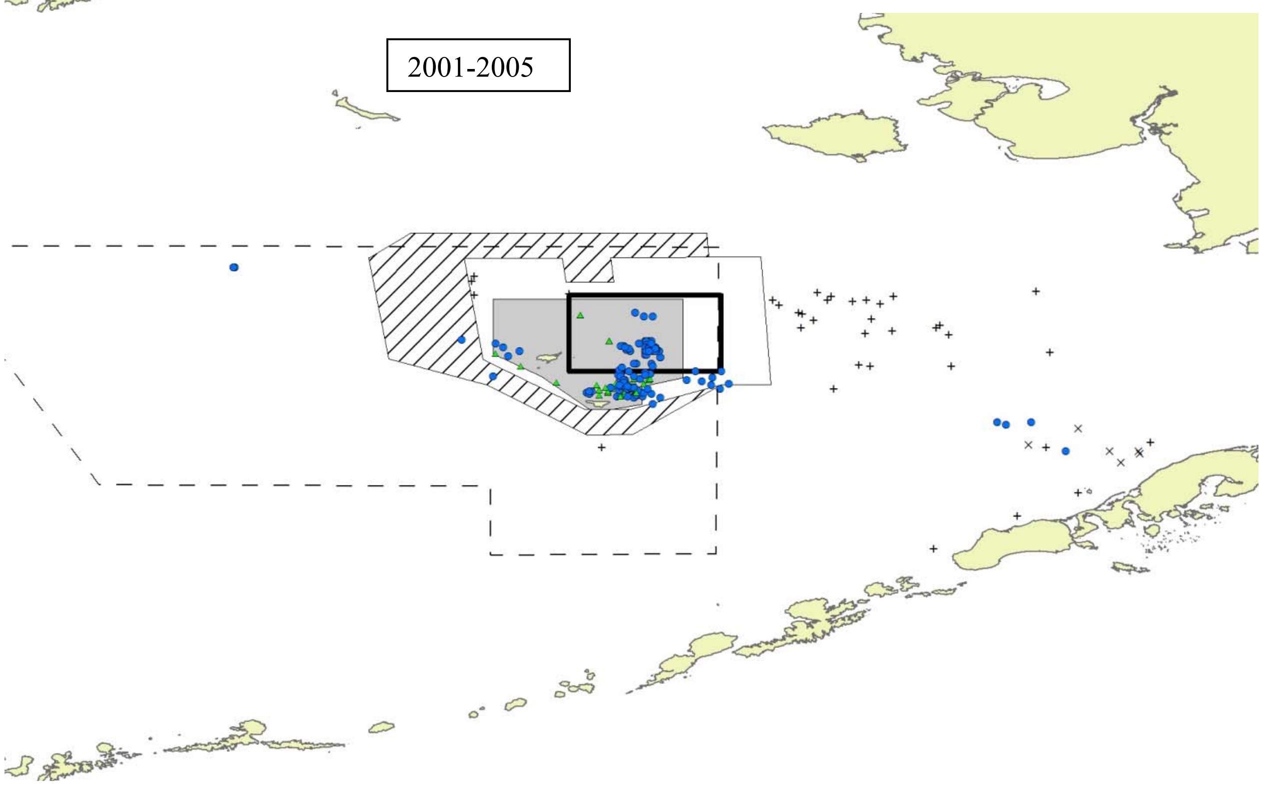
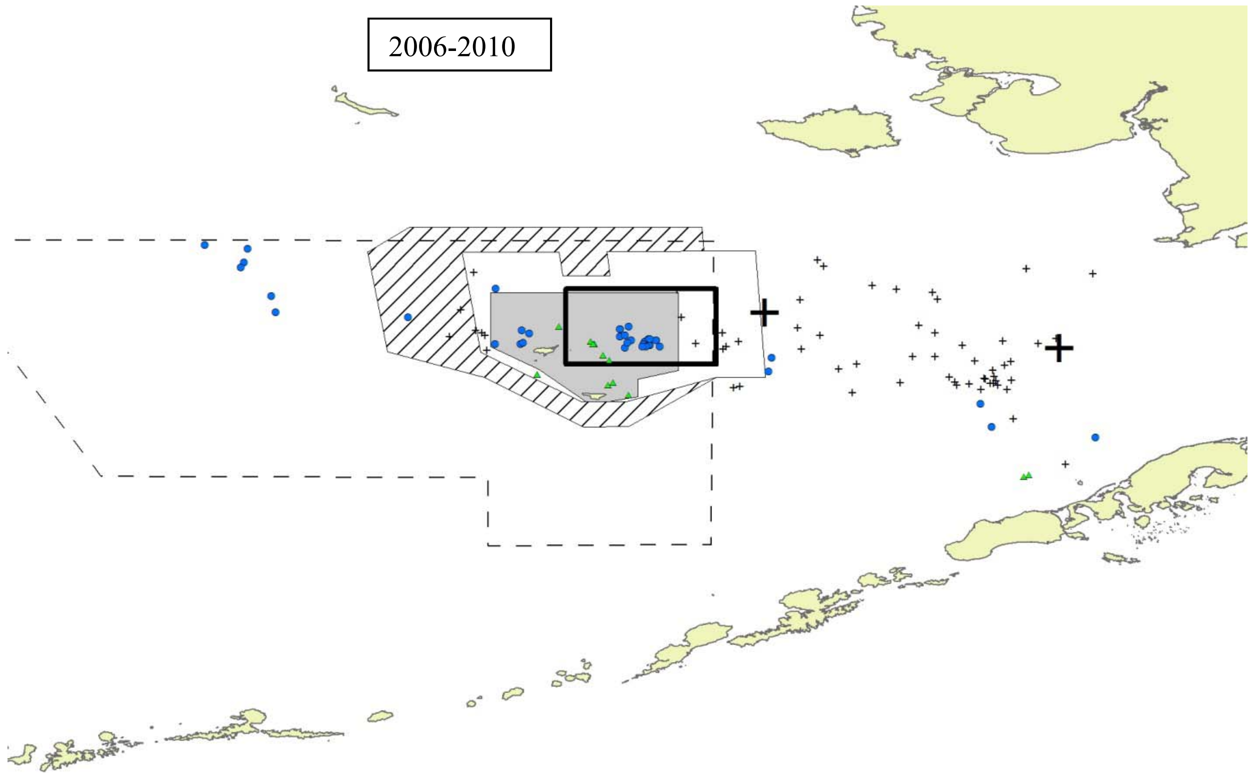


F)



G)



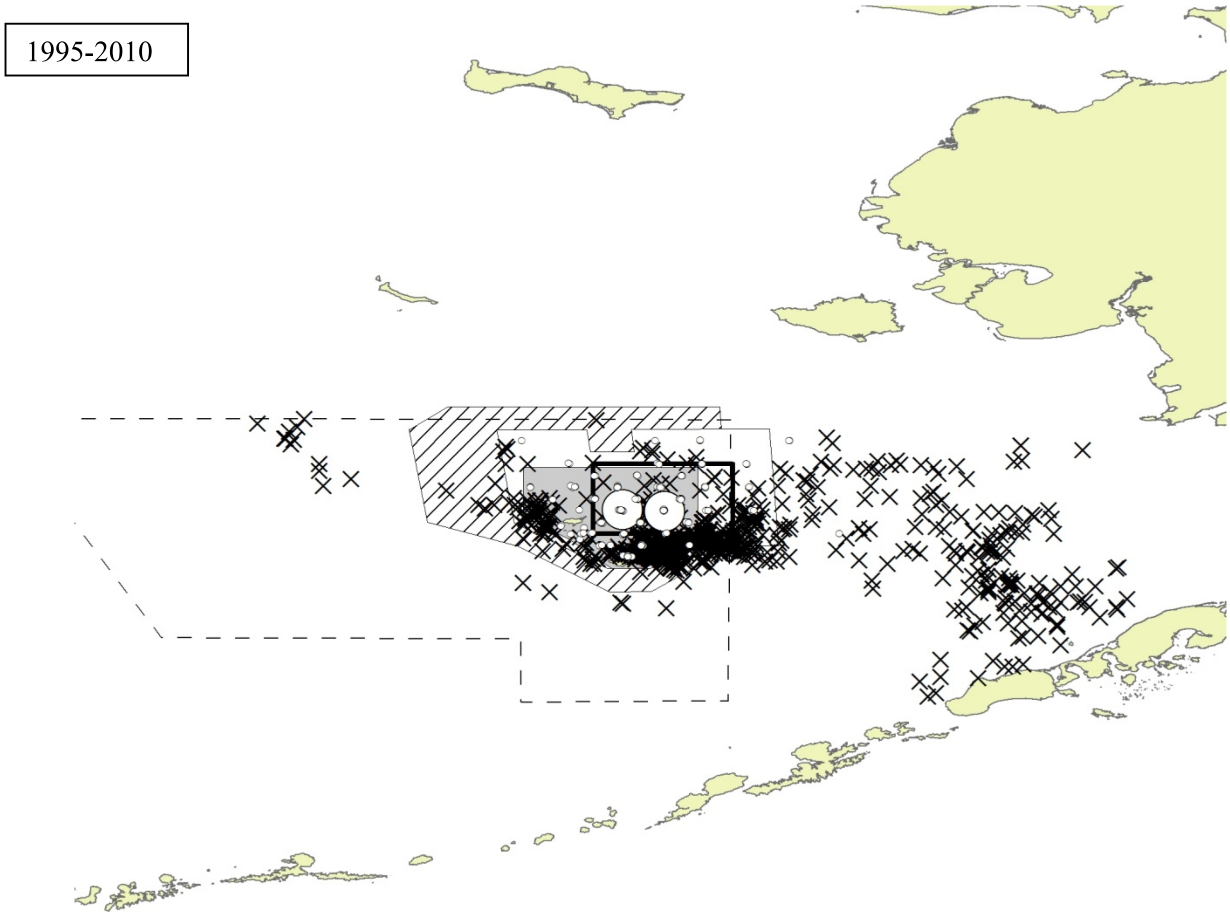


Figure 10-9 The distribution of survey data (open circles: smallest=30-5,000 crab/nm^2; largest=21,000-26,000 crab/nm^2) and observed bycatch locations (X) of blue king crab in the Pribilof Islands management district (dashed region) and the Bristol Bay District to the east between 1995 and 2010, years after the PIHCZ no trawl zone was implemented.

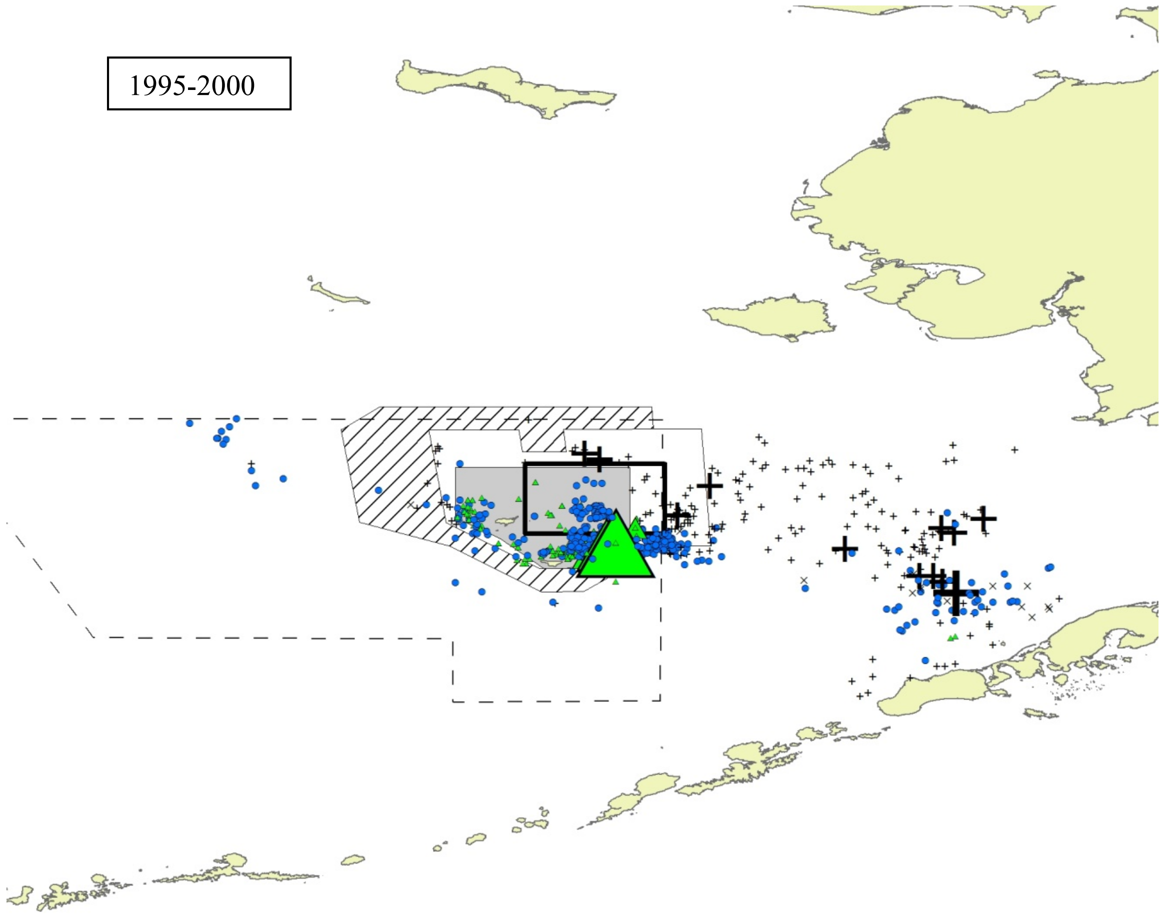


Figure 10-10The breakdown of the observed bycatch by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1-200 observed crabs and the largest symbol equals 800-1000 observed crabs. The data is aggregated from the time of the trawling ban in the PIHCZ from 1995 to 2010.

A) 2003-2010

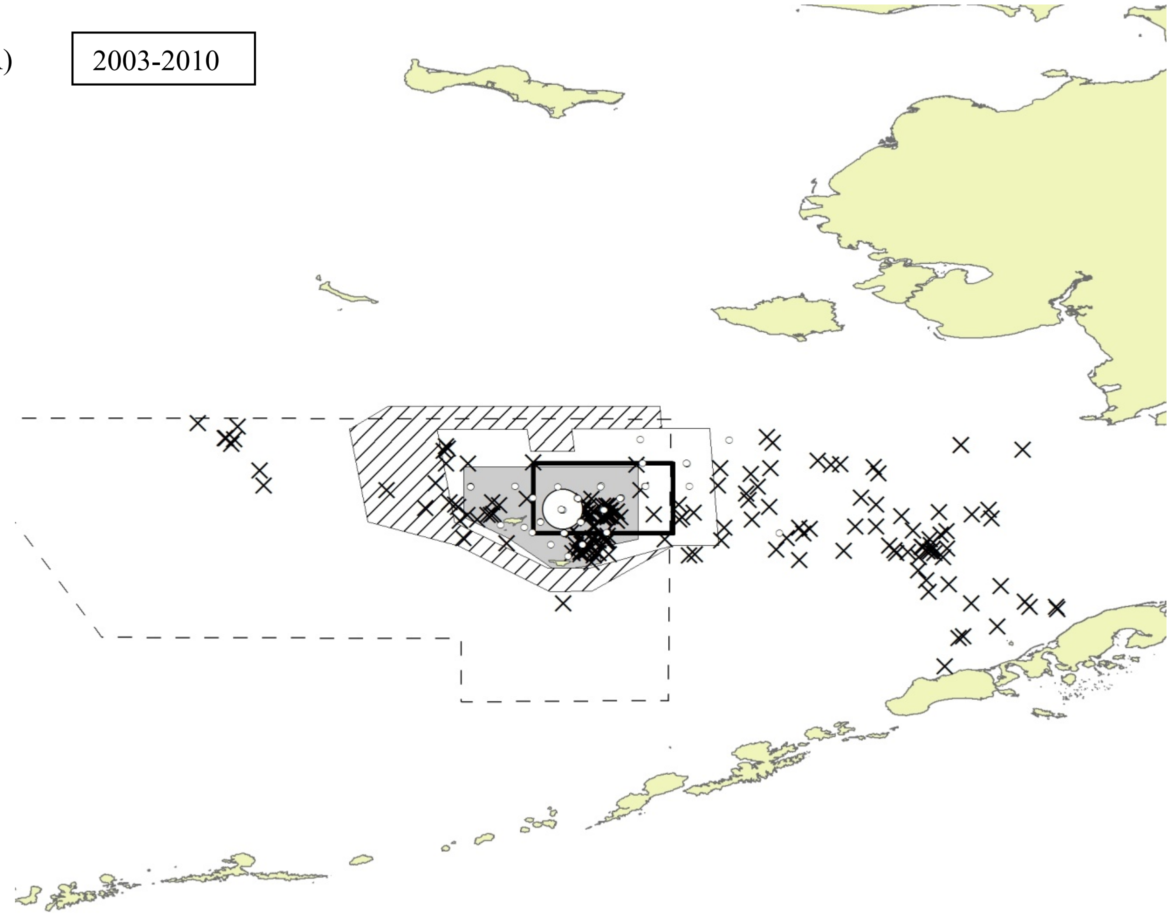


Figure 10-11 The distribution of survey data (open circles: smallest=30-5,000 crab/nm^2; largest=21,000-26,000 crab/nm^2) and observed bycatch locations (X) of blue king crab in the Pribilof Islands management district (dashed region) and the Bristol Bay District to the east between 2003 and 2010, years after the Pribilof Islands blue king crab stock was declared overfished.

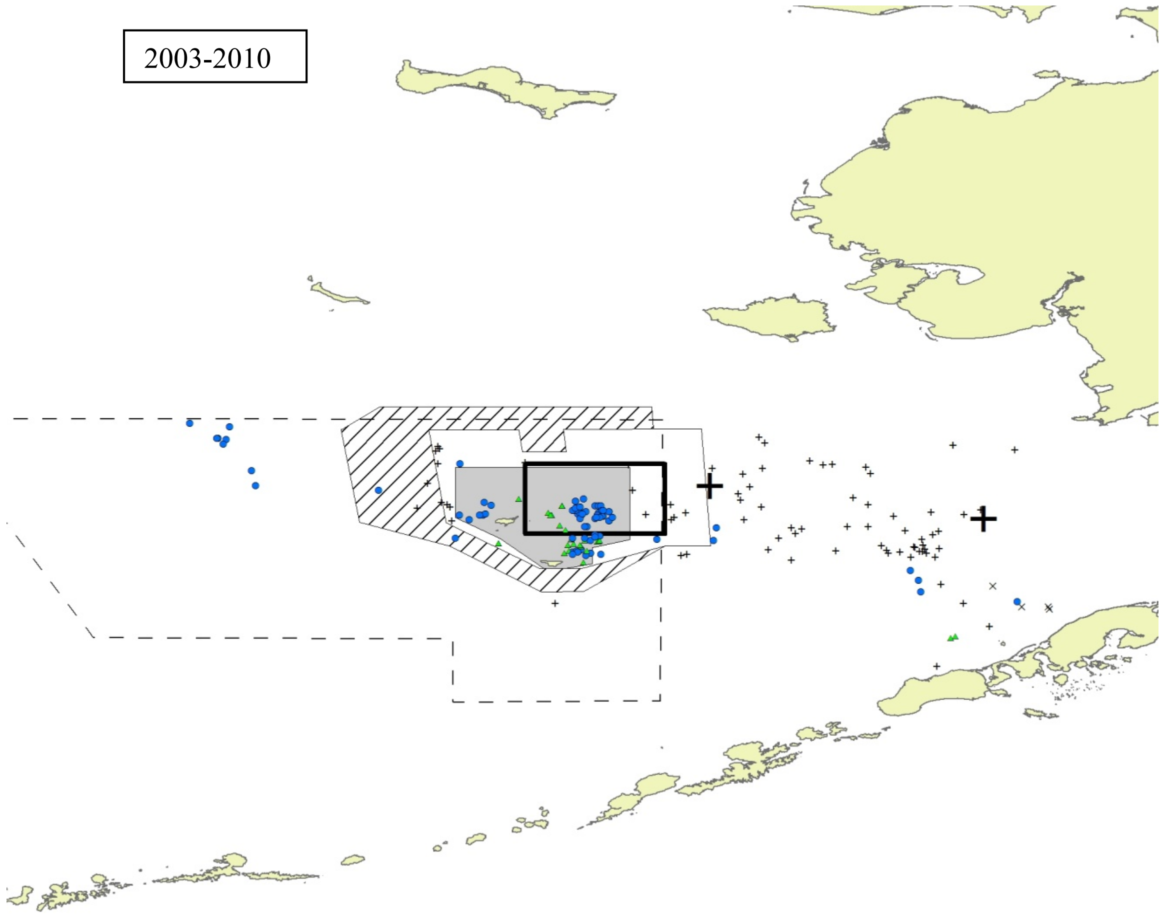


Figure 10-12 The breakdown of the observed bycatch by gear type (longline=circles, non-pelagic trawl=cross, pelagic trawl=x, pot=triangle) where the smallest symbol equals 1-200 observed crabs and the largest symbol equals 800-1000 observed crabs. The data is aggregated from the time of the overfished declaration for Pribilof Islands blue king crab 2003 to 2010.

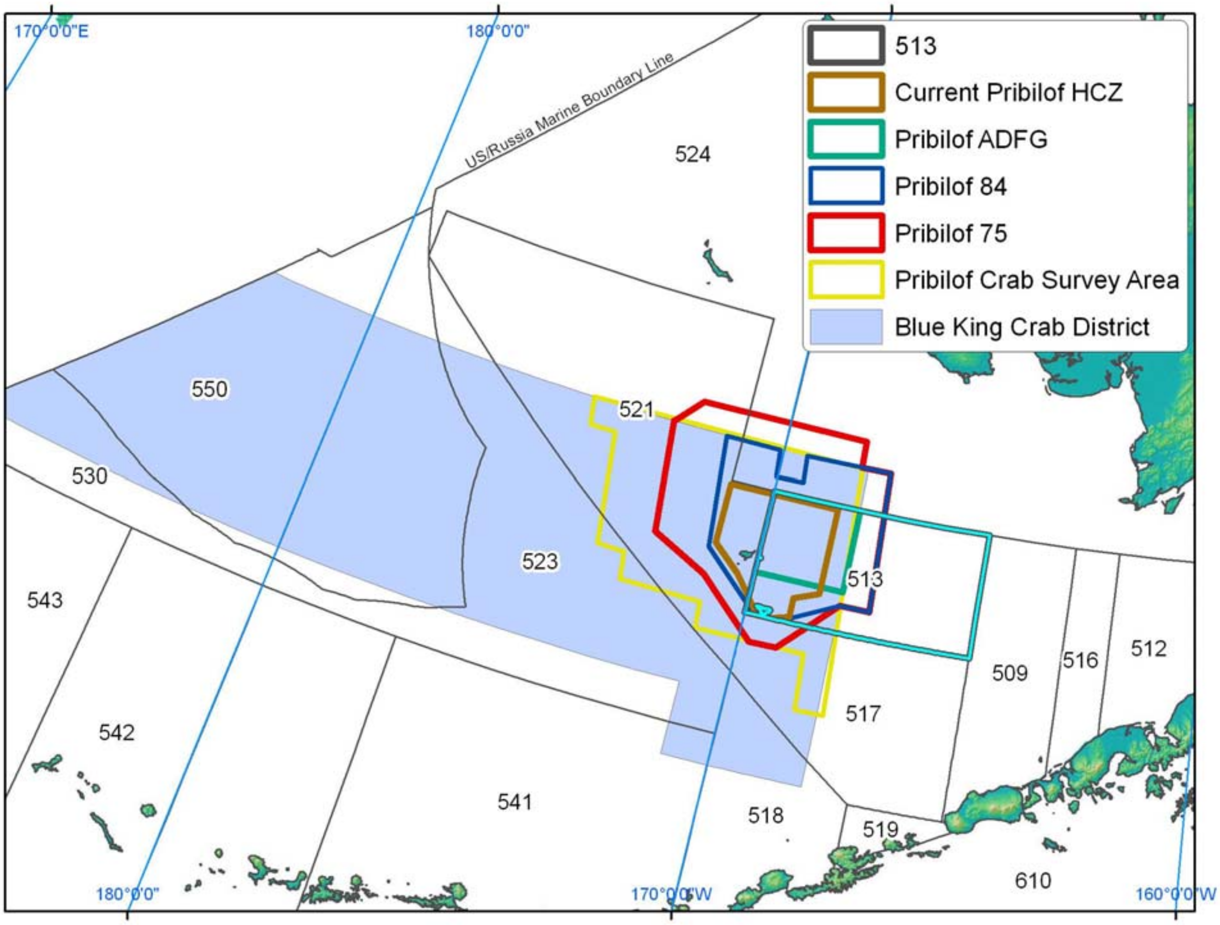


Figure 10-13 **Proposed closures overlaid on National Marine Fisheries Service federal reporting areas. Note as an interim measure for the assessment determination of overfishing annually for bycatch accrual currently only Area 513 is counted. The Pribilof District is shown in the shaded area. In the future, bycatch of PIBKC will accrue only from the shaded Pribilof District.**

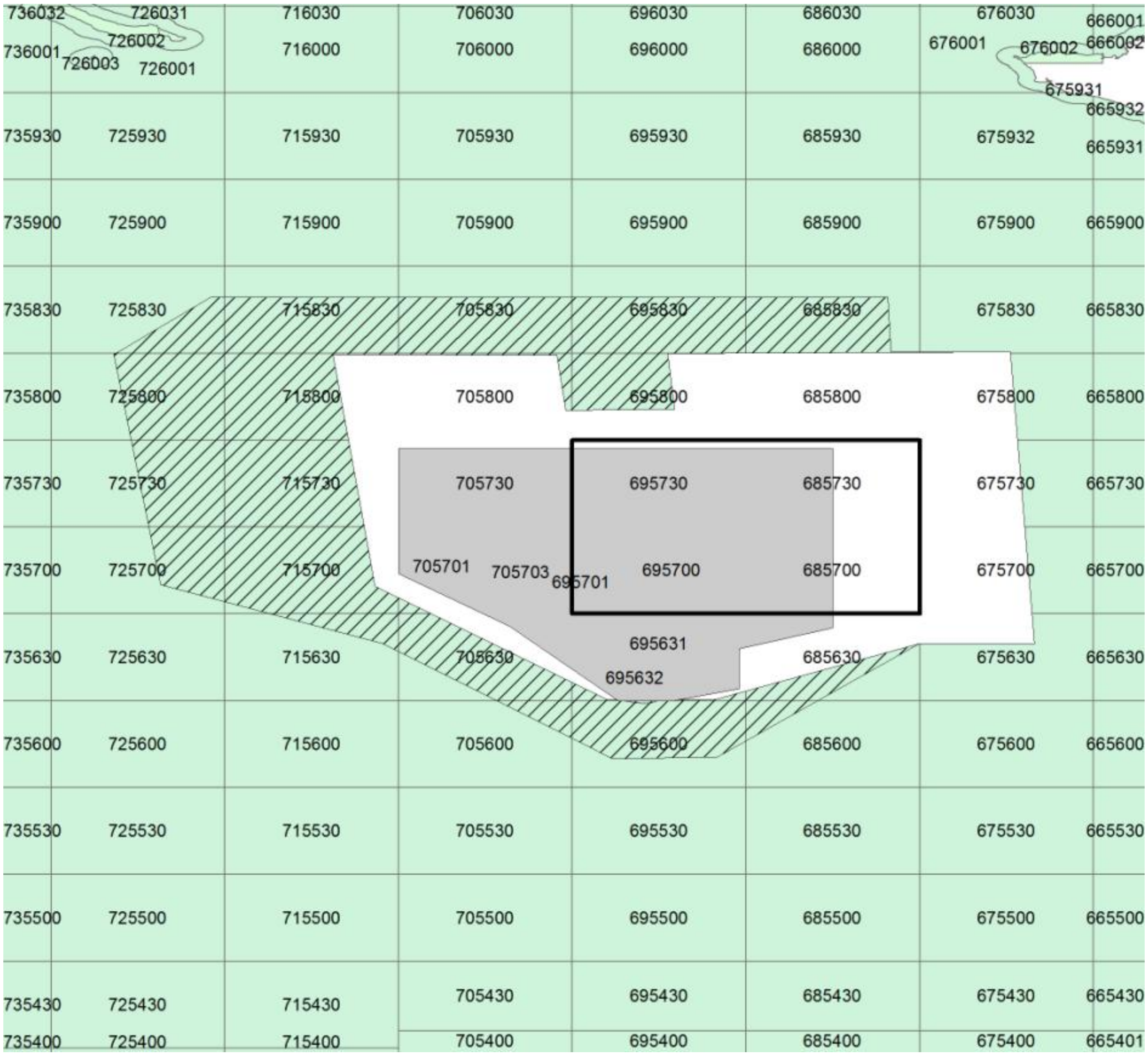


Figure 10-14 Proposed closures overlaid on Alaska Department of Fish and Game Stat areas.

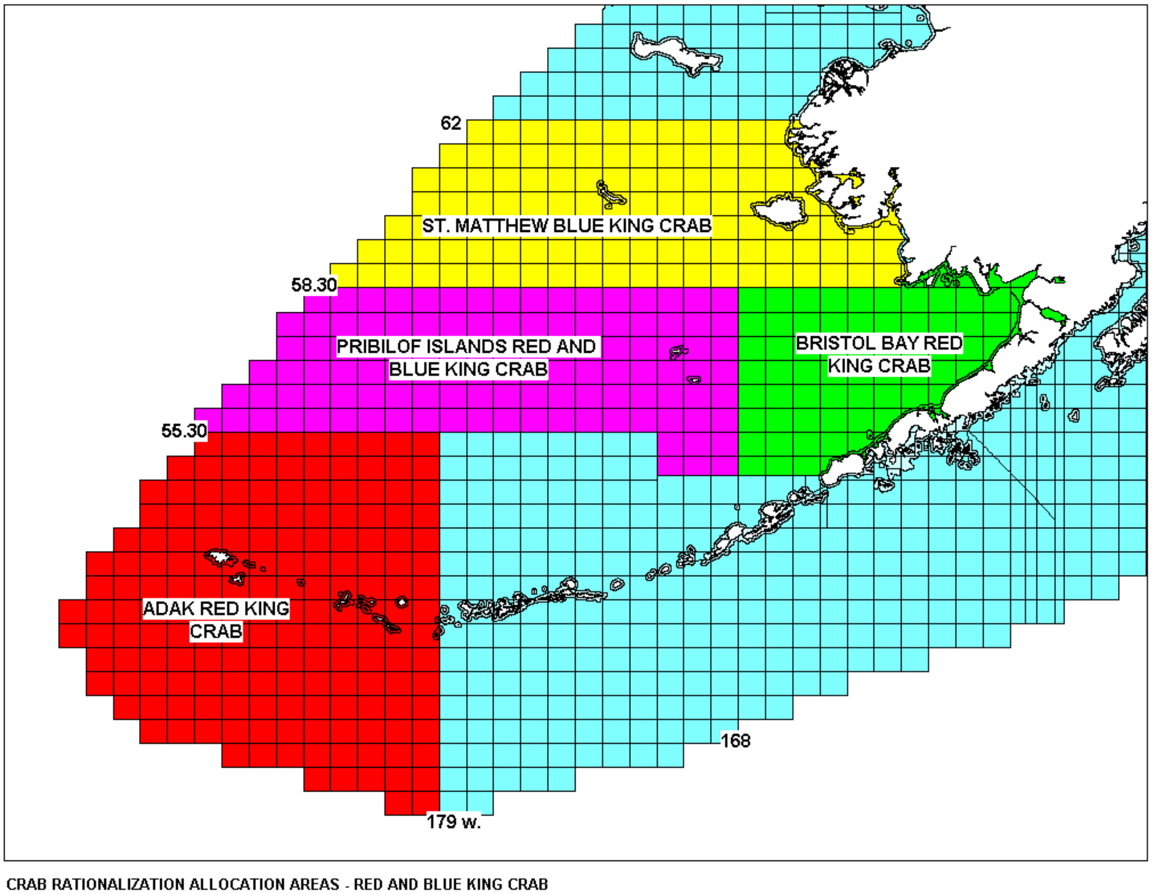


Figure 10-15 Crab Rationalization Allocation areas showing geographic extent of Pribilof Islands stocks in regulation.

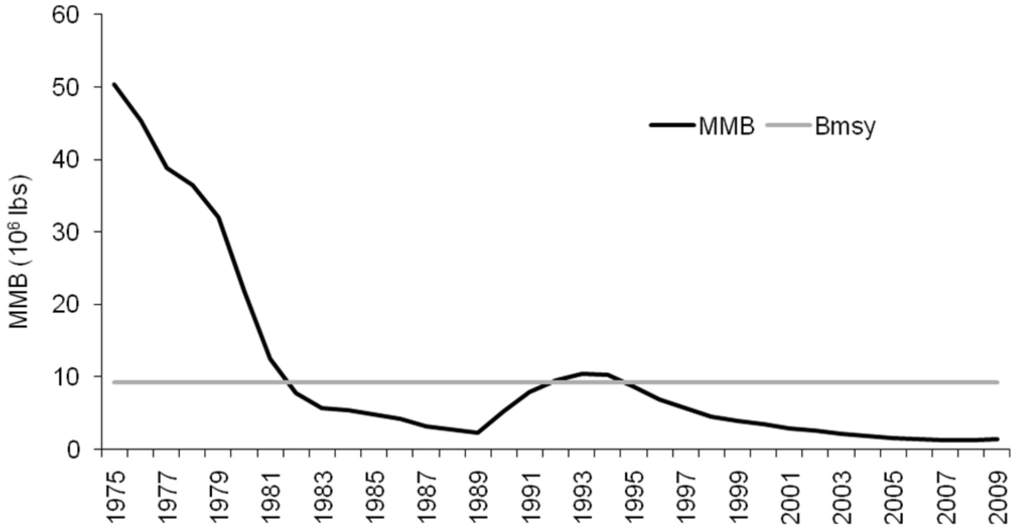


Figure 10-16 Estimated mature male biomass (MMB) time series relative to the current B_{MSY} based on mean mature male biomass from 1980-1984 and 1990-1997.

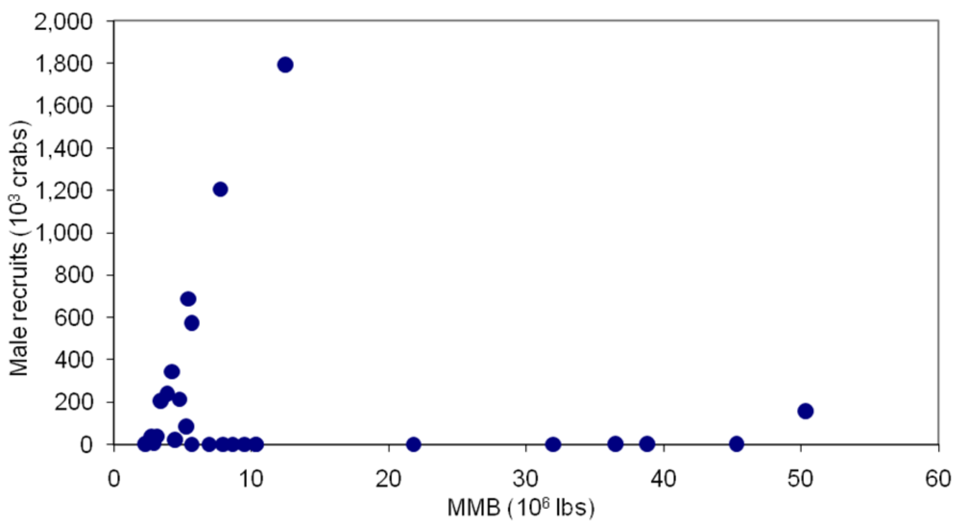


Figure 10-17 Model estimated male recruits relative to mature male biomass (MMB) from 1975 to 2009.

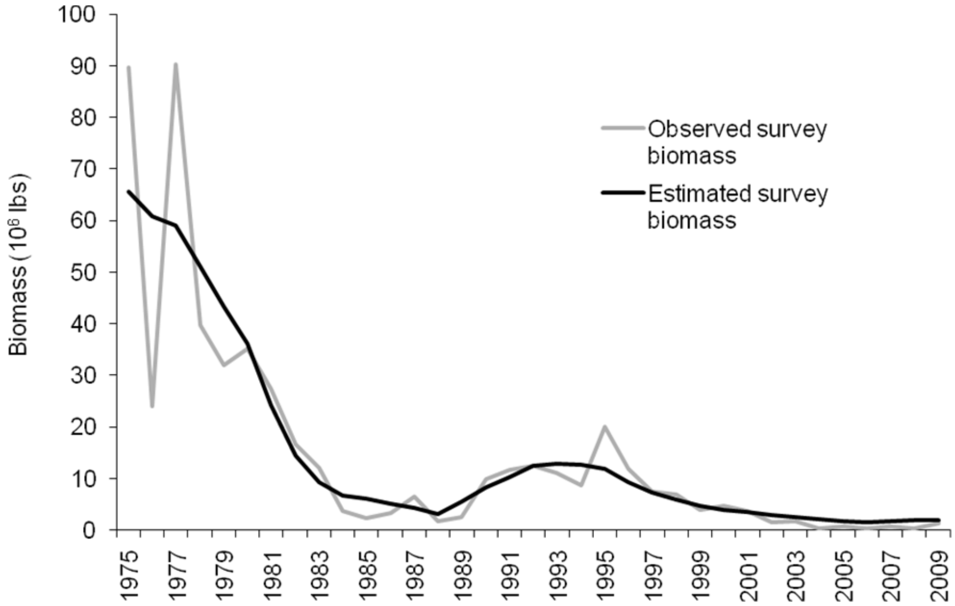


Figure 10-18 Time series comparison of estimated survey biomass from the Catch Survey Assessment model and observed survey biomass based on area swept estimate.

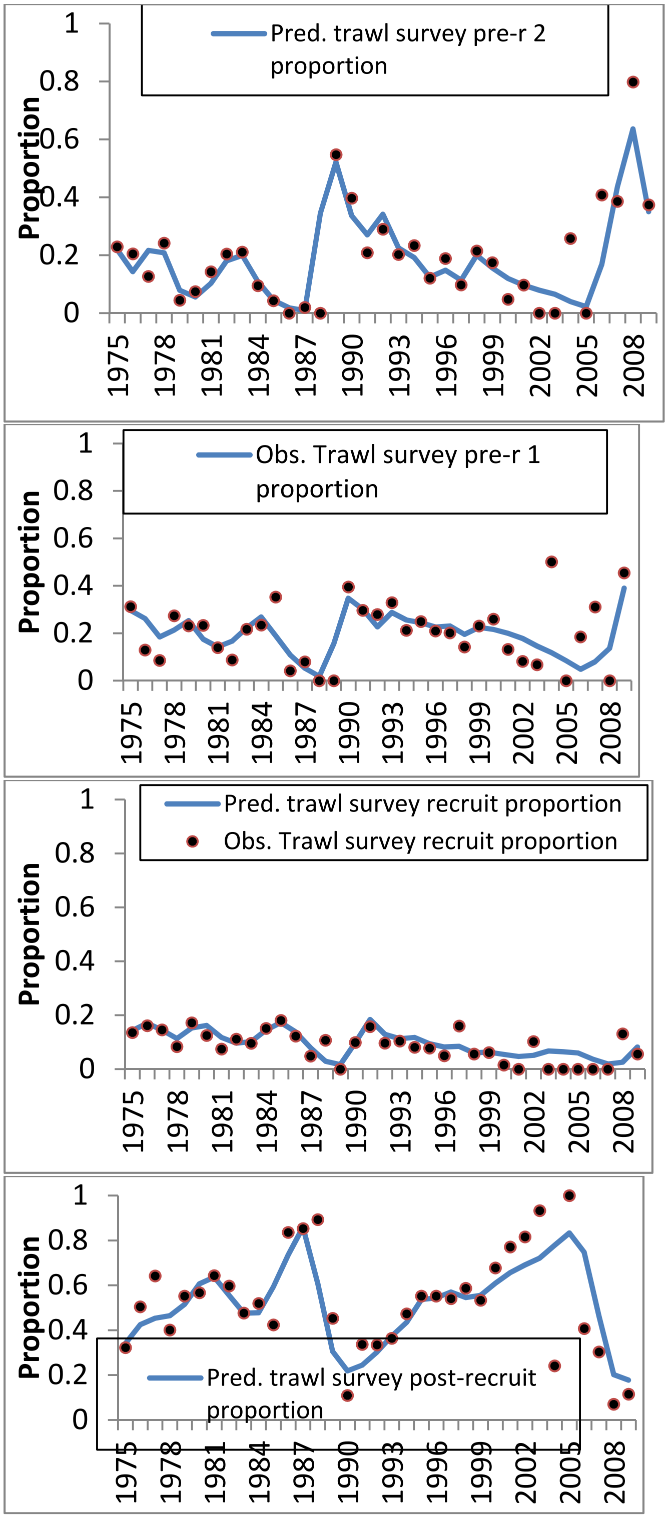


Figure 10-19 Predicted and observed time series of bottom trawl survey size class stage proportions from 1975 to 2009.

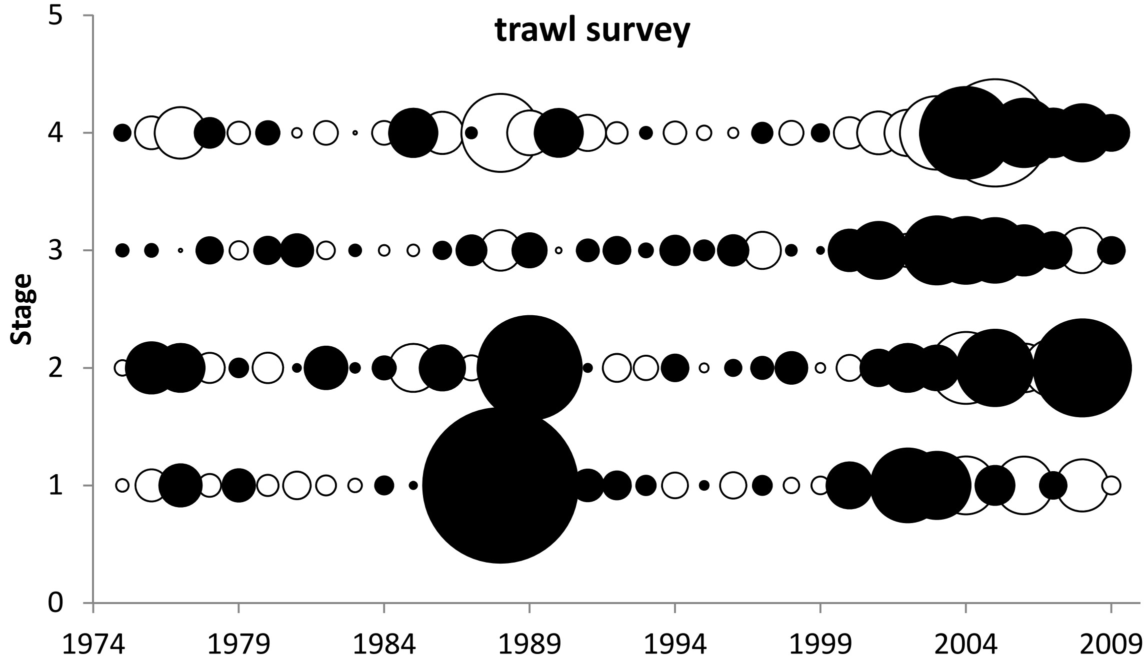


Figure 10-20 Residuals of predicted and observed time series of bottom trawl survey size class stage proportions from 1975 to 2009.

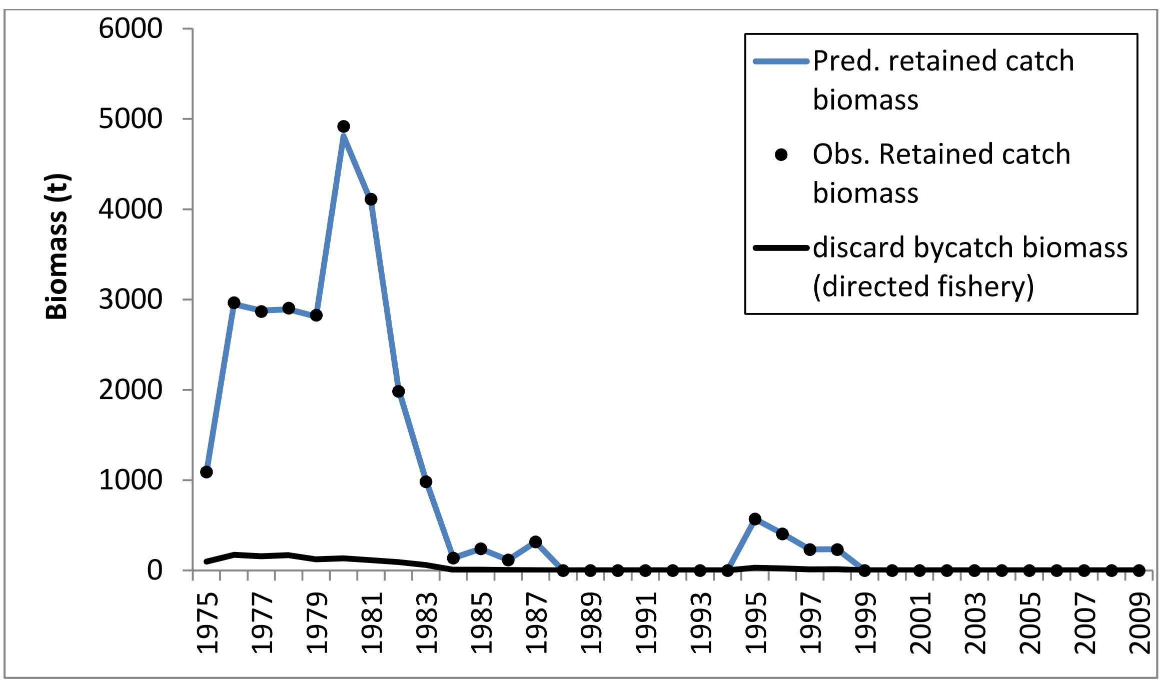


Figure 10-21 Predicted and observed time series of total retained catch biomass from 1975 to 2009. Discard bycatch biomas suring the retained fishery also included for comparison.

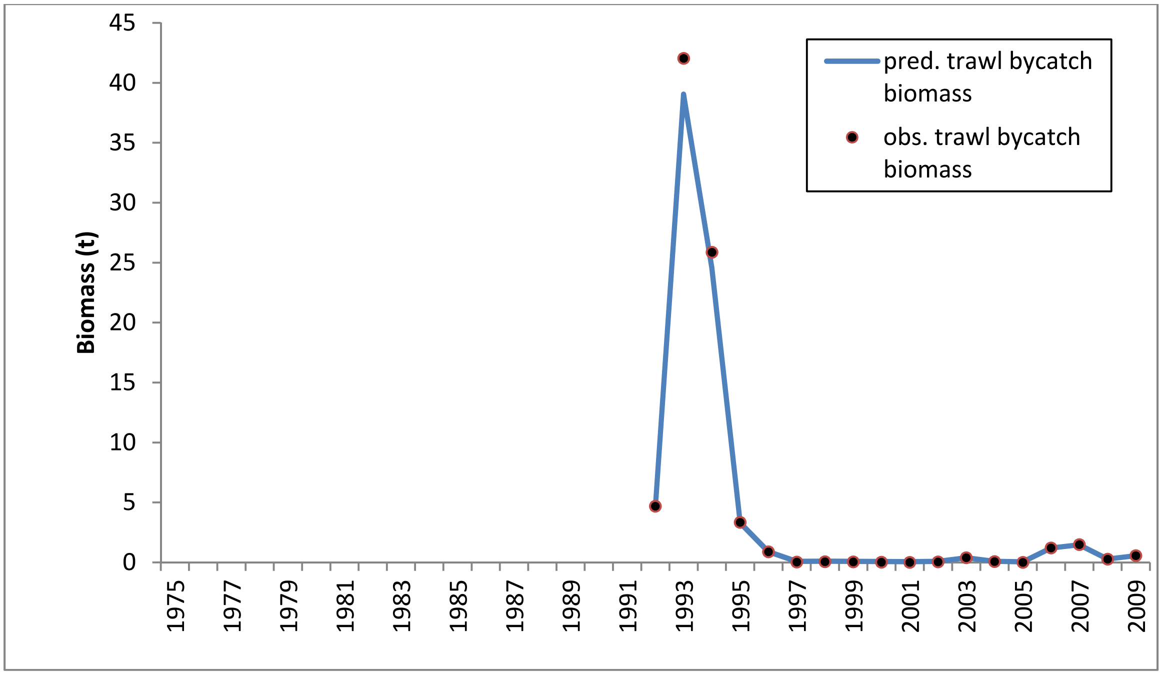


Figure 10-22 Predicted and observed time series of bottom trawl bycatch total biomass from 1992 to 2009.

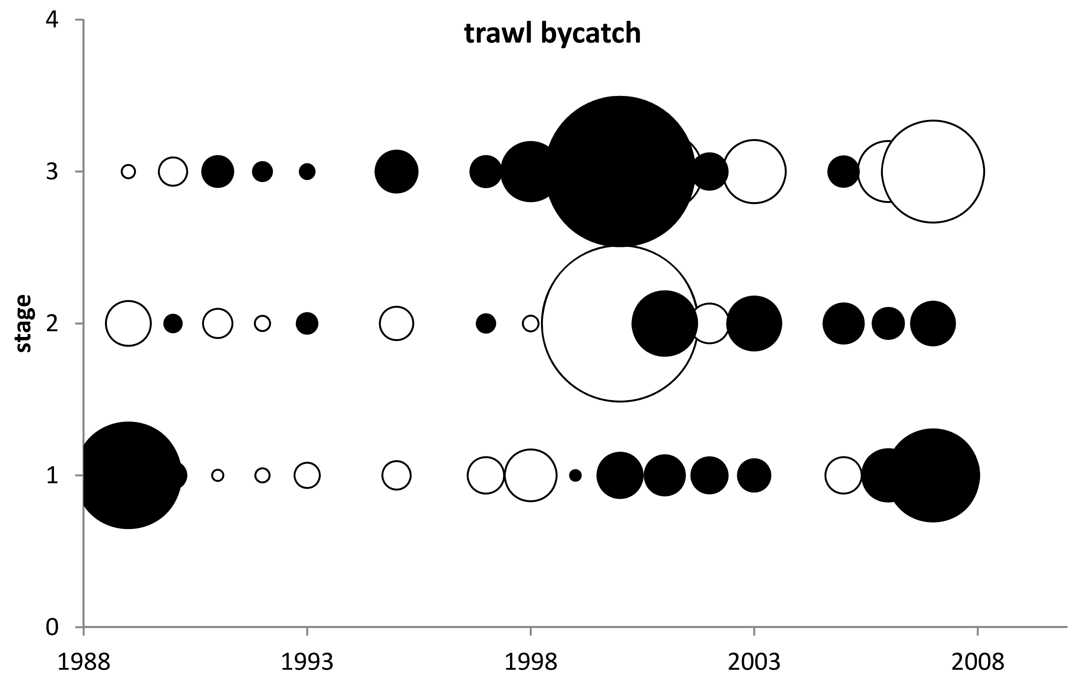


Figure 10-23 Residuals of predicted and observed time series of bottom trawl bycatch size class stage proportions from 1989 to 2009.

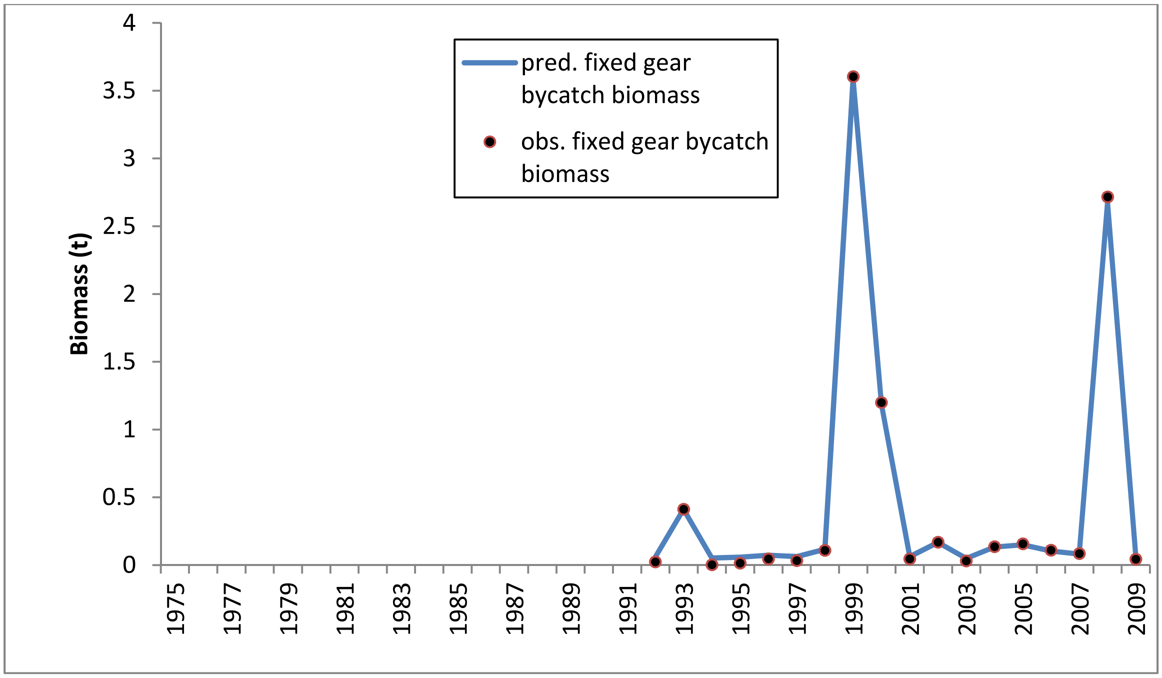


Figure 10-24 Predicted and observed time series of fixed gear bycatch total biomass from 1992 to 2009.

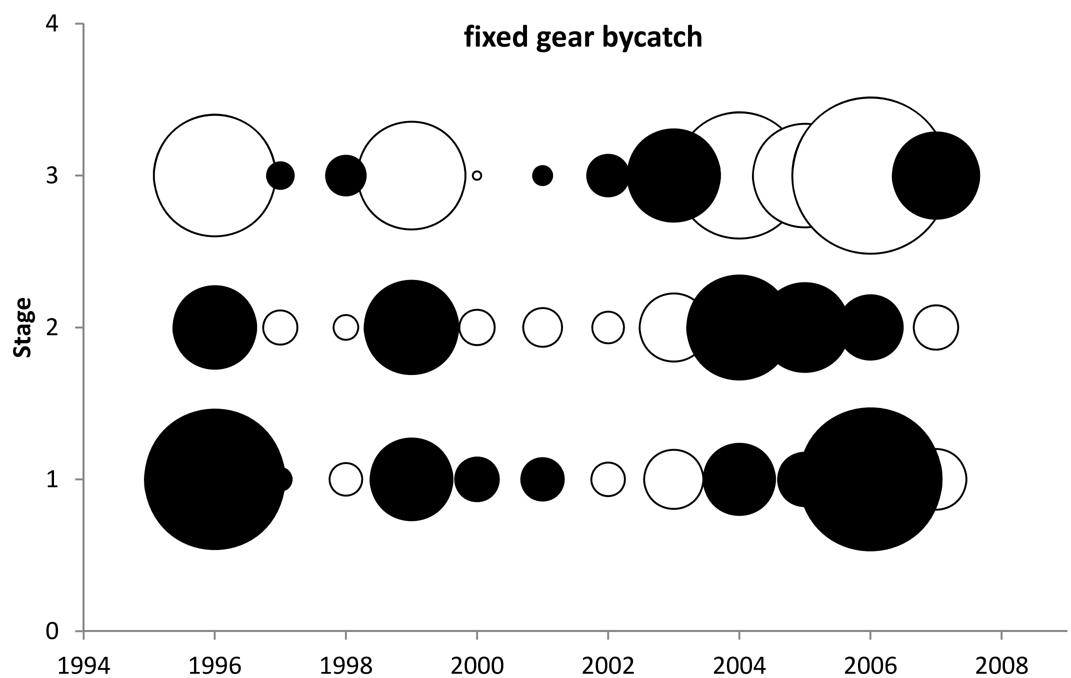


Figure 10-25 Residuals of predicted and observed time series of fixed gear bycatch size class stage proportions from 1996 to 2009.

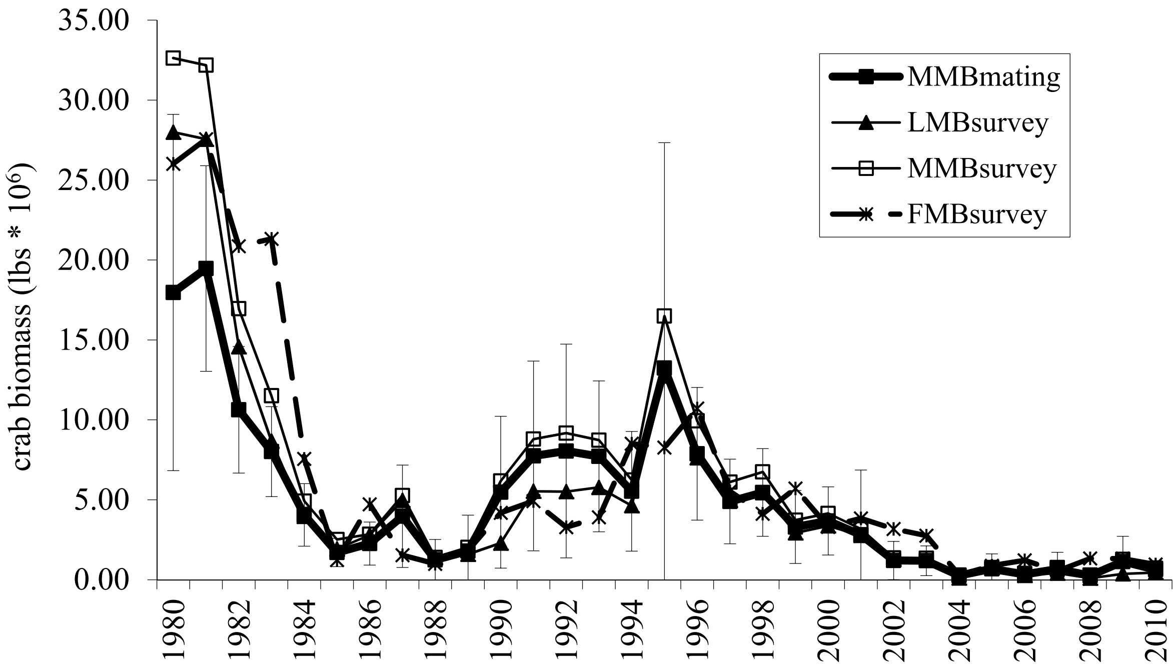


Figure 10-26 Historical trends of Pribilof Islands blue king crab mature male biomass (MMB, 95% CI), mature female biomass (FMB), and legal male biomass (LMB) estimated from the NMFS annual EBS bottom trawl survey.

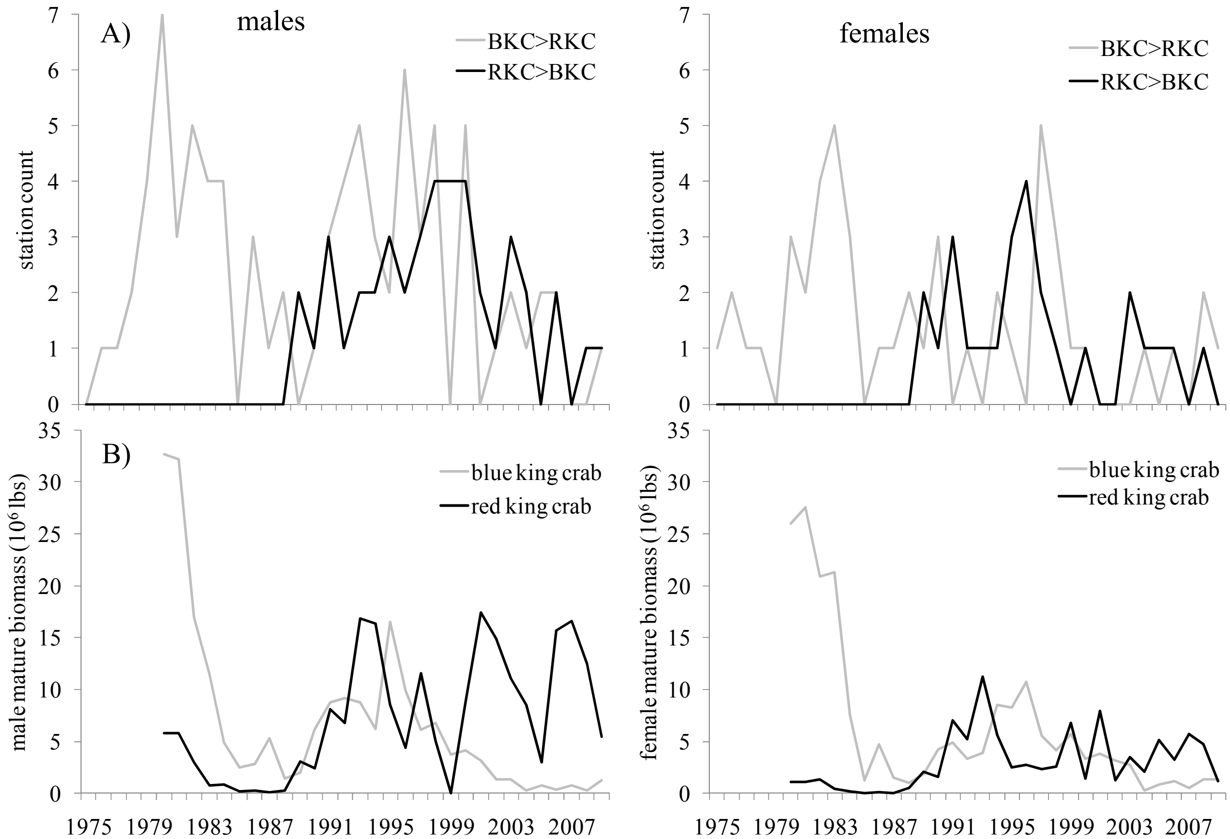


Figure 10-27 Time series of overlap between blue king crab and red king crab for males and females in the eastern Bering Sea showing A) the number of stations with blue king crab (BKC) or red king crab (RKC) as the dominant species and B) the mature biomass of both species.

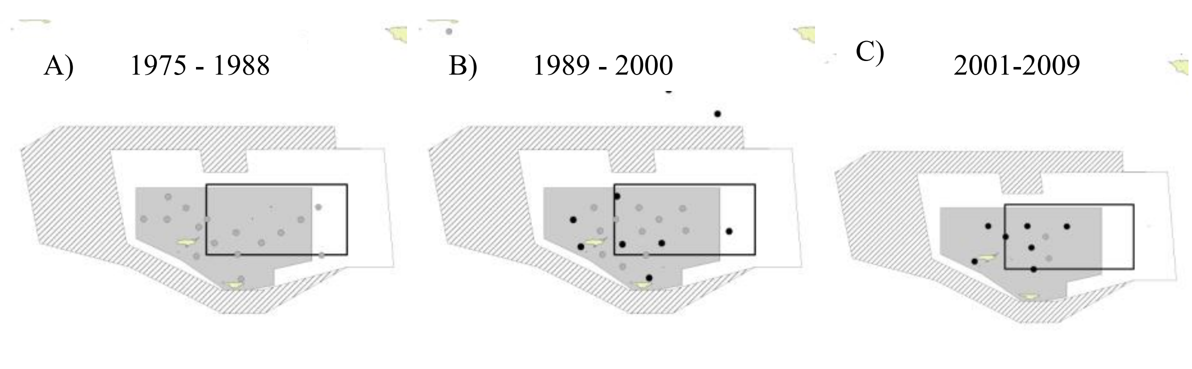


Figure 10-28 Spatial distribution of stations where there is overlap between blue king crab and red king crab males showing the dominant species (blue king crab=gray circles; red king crab=black circles) corresponding to time periods of major changes in biomass of both species.

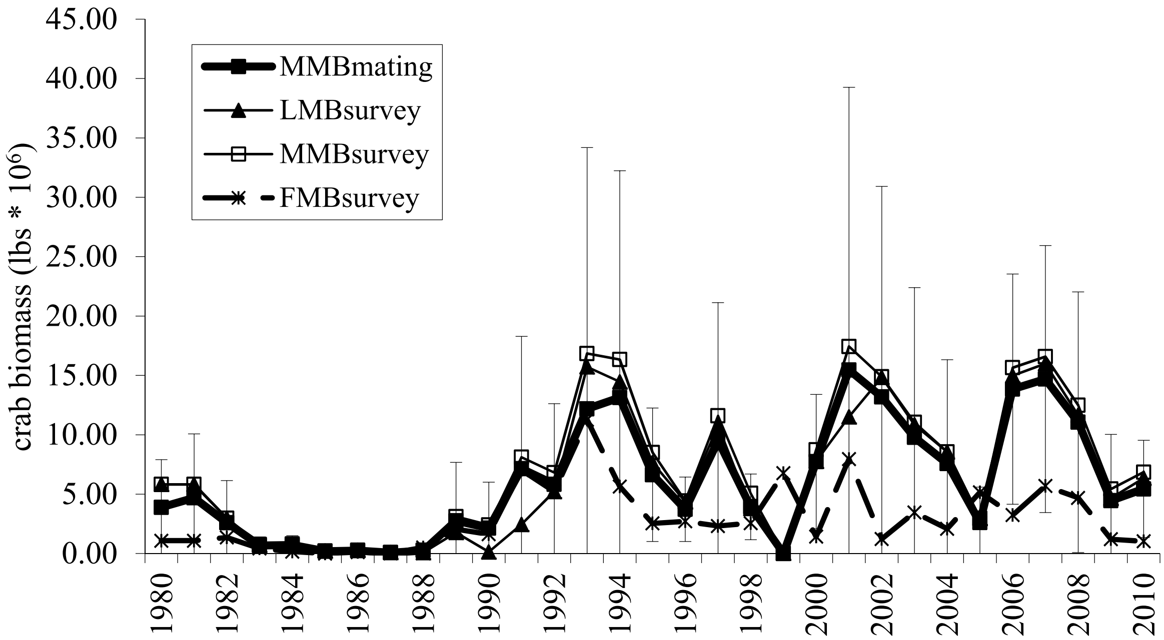


Figure 10-29 **Historical trends of Pribilof Island red king crab mature male biomass (MMB, 95% C.I.), mature female biomass (FMB), and legal male biomass (LMB) estimated from the National Marine Fisheries Service annual eastern Bering Sea bottom trawl survey.**

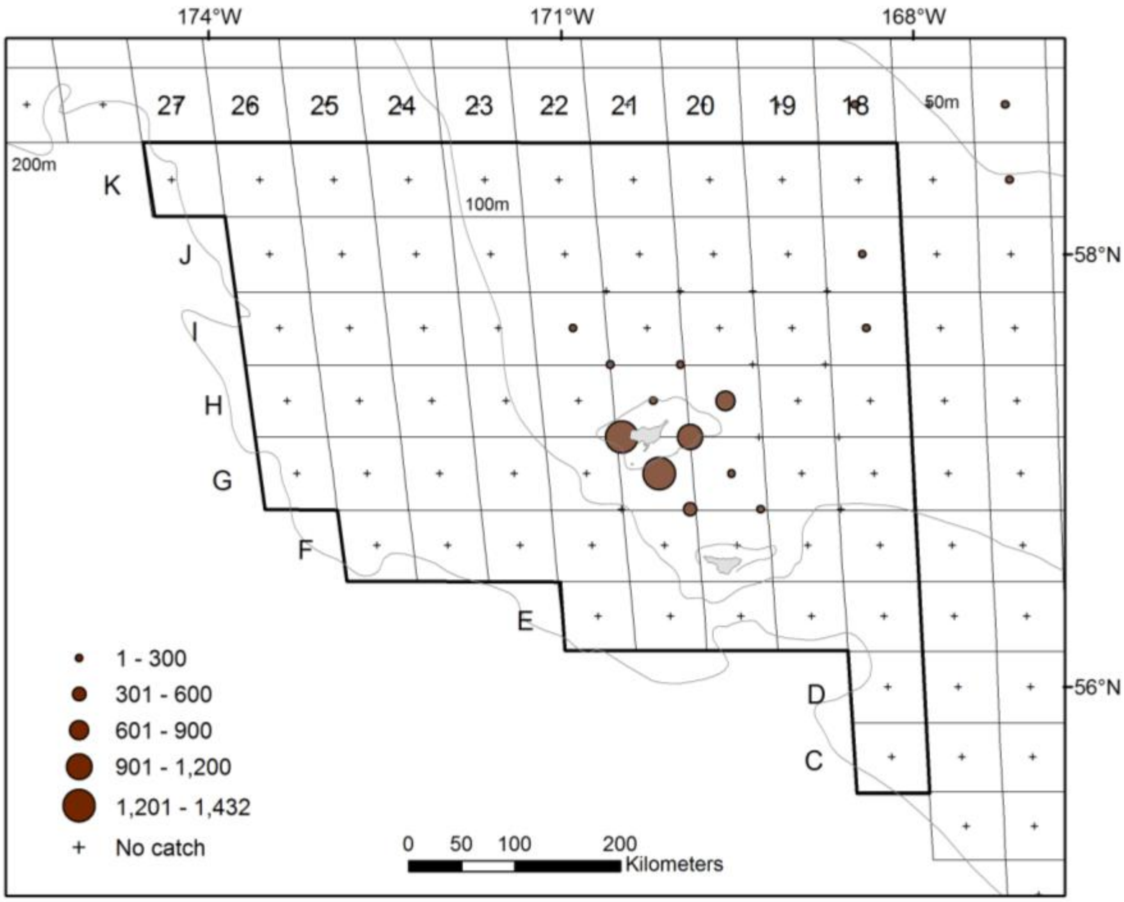


Figure 10-30 Total density (number/nm²) of red king crab in the Pribilof District in the 2010 eastern Bering Sea bottom trawl survey.

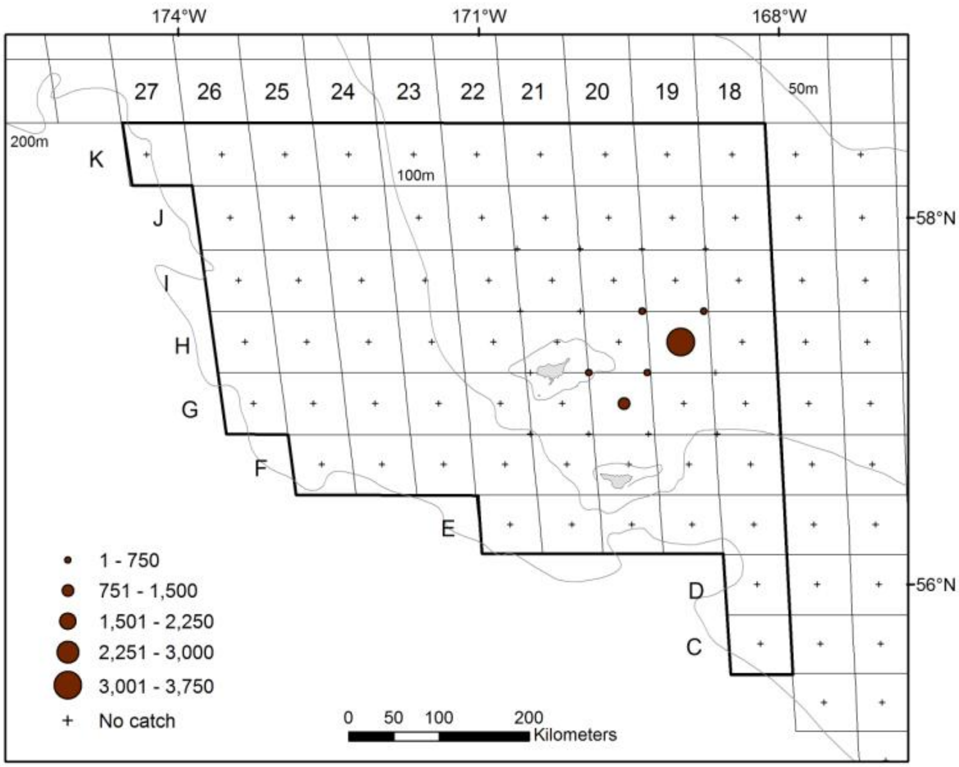


Figure 10-31 Total density (number/nm^2) of Pribilof Islands blue king crab in the 2009 eastern Bering Sea bottom trawl survey.

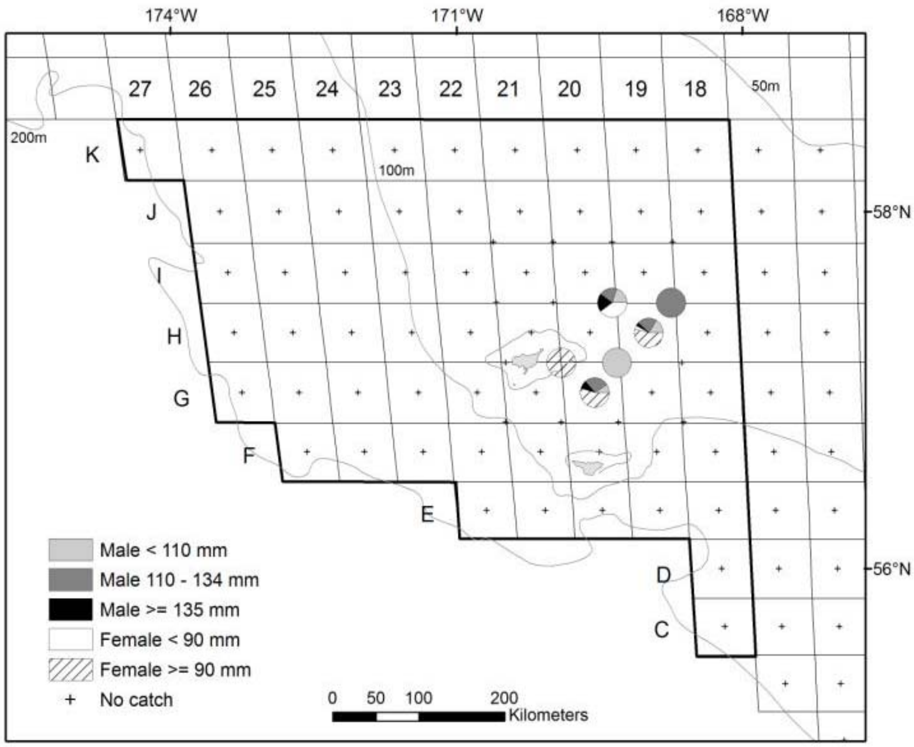


Figure 10-32 2009 eastern Bering Sea bottom trawl survey size class distribution of Pribilof Islands blue king crab.

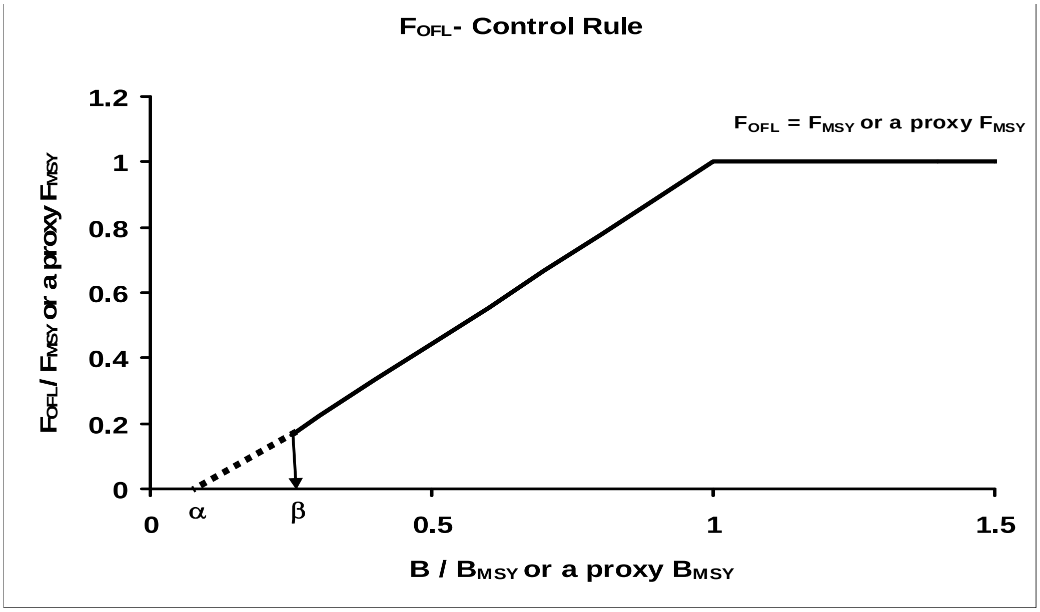


Figure 10-33 F_{OFL} **Control Rule for Tier 4 stocks under Amendment 24 to the Bering Sea Aleutian Islands King and Tanner Crabs fishery management plan. Directed fishing mortality is set to 0 below β.**

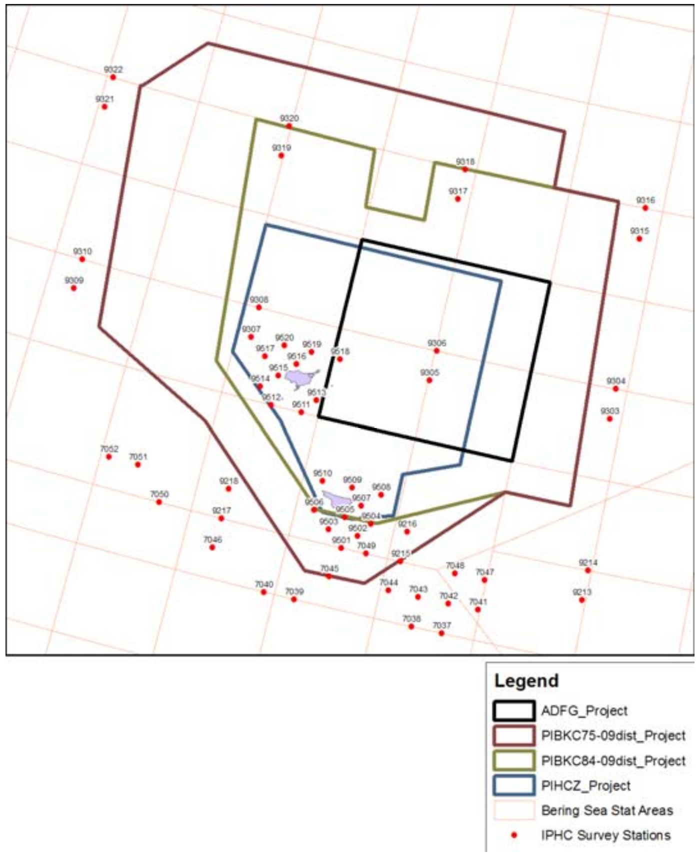


Figure 10-34 International Pacific Halibut Commission survey stations located within the proposed closure areas around the Pribilof Islands.

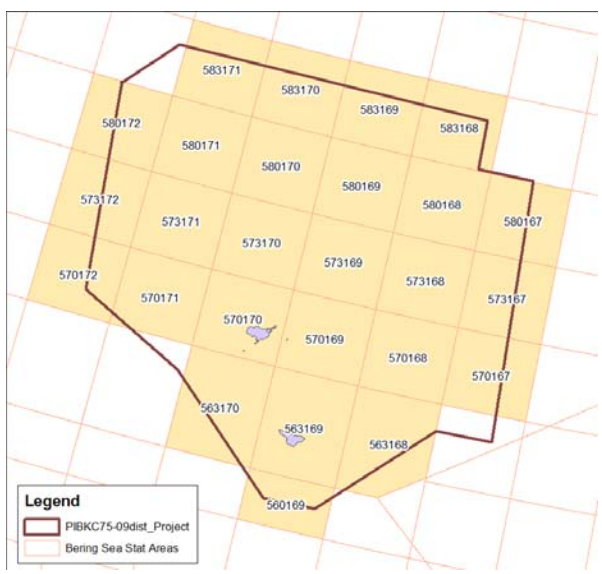


Figure 10-35 International Pacific Halibut Commission statistical areas located within the proposed closure areas around the Pribilof Islands.

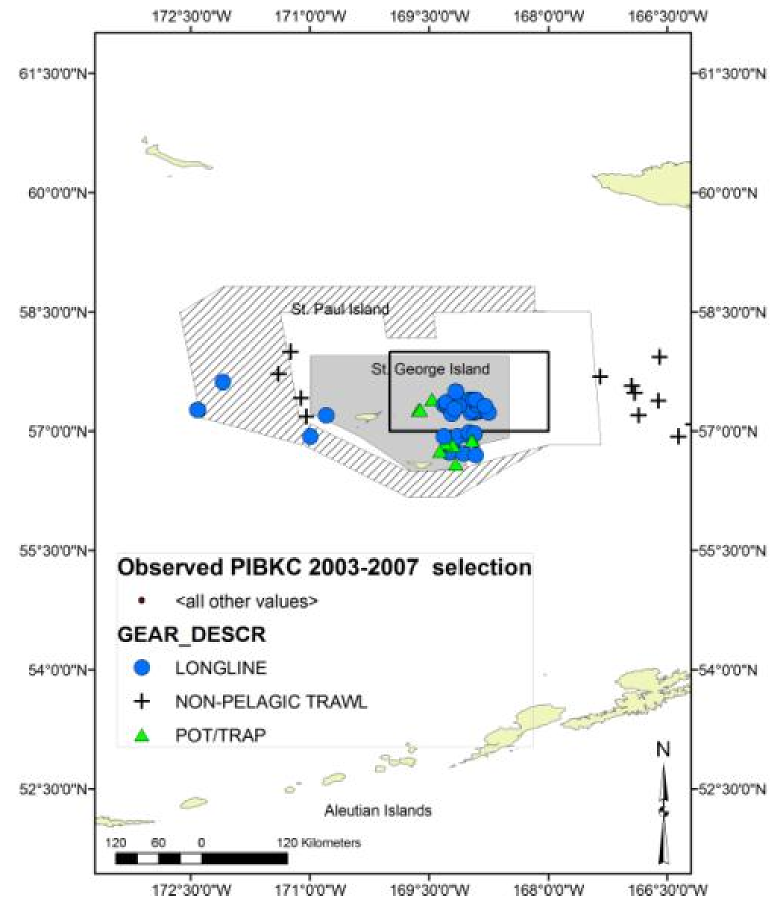


Figure 10-36 Distribution of 2003-2007 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.

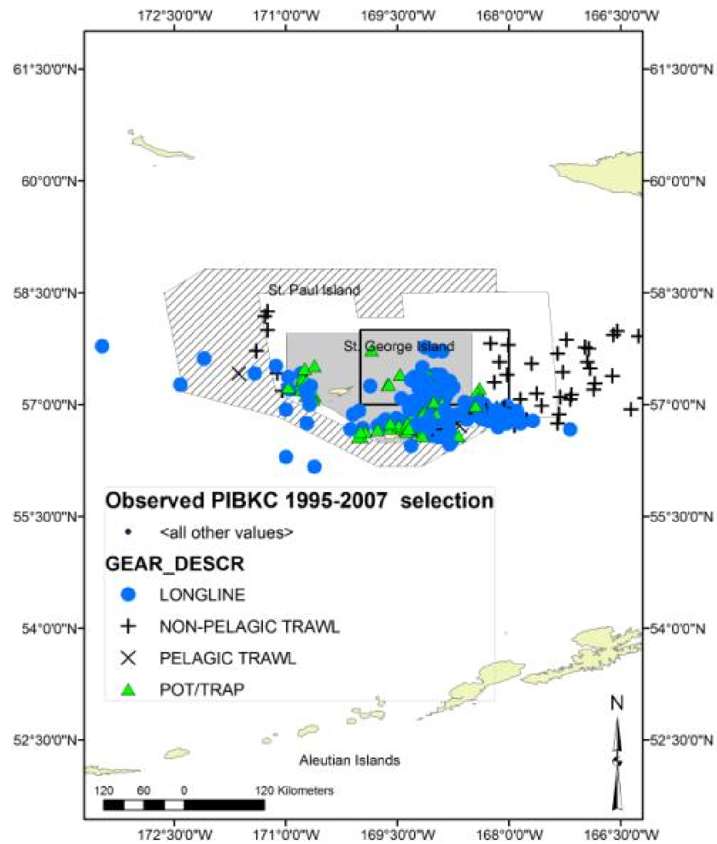


Figure 10-37 Distribution of 1995-2007 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.

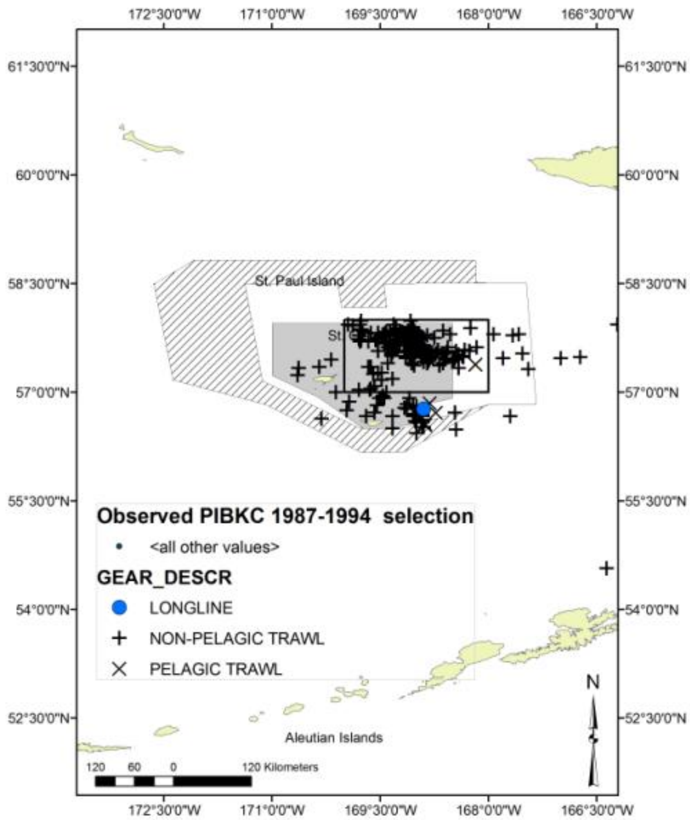


Figure 10-38 **Distribution of 1987-1994 Pribilof Islands blue king crab (PIBKC) catches in groundfish fisheries relative to the four proposed closure areas based on alternatives.**

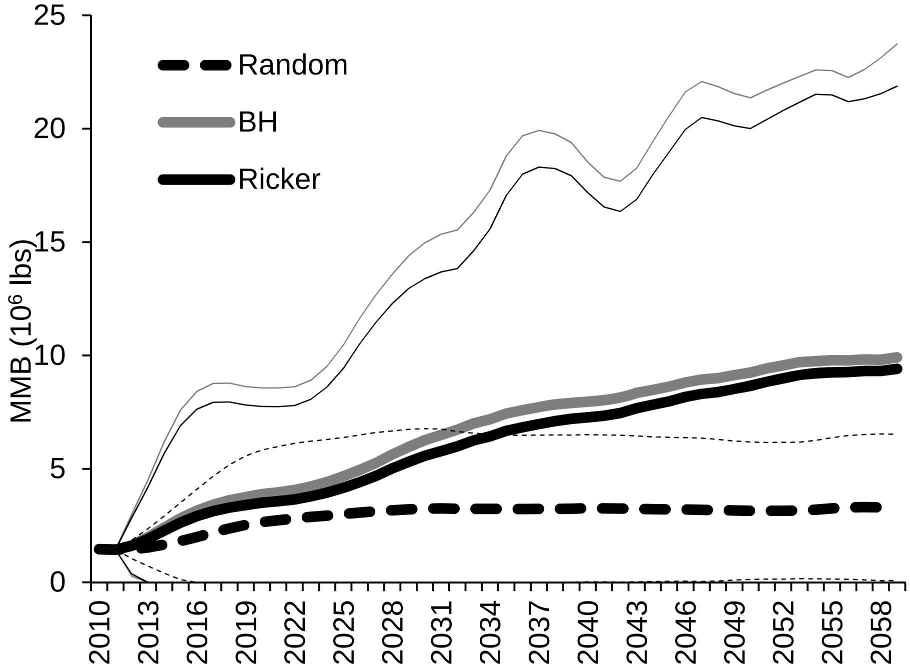


Figure 10-39 Projection estimates (± CI) of mature male biomass (MMB) based on random, Ricker, and Beverton-Holt (BH) recruitment models for the status quo reduction in groundfish bycatch of Pribilof Islands blue king crab.

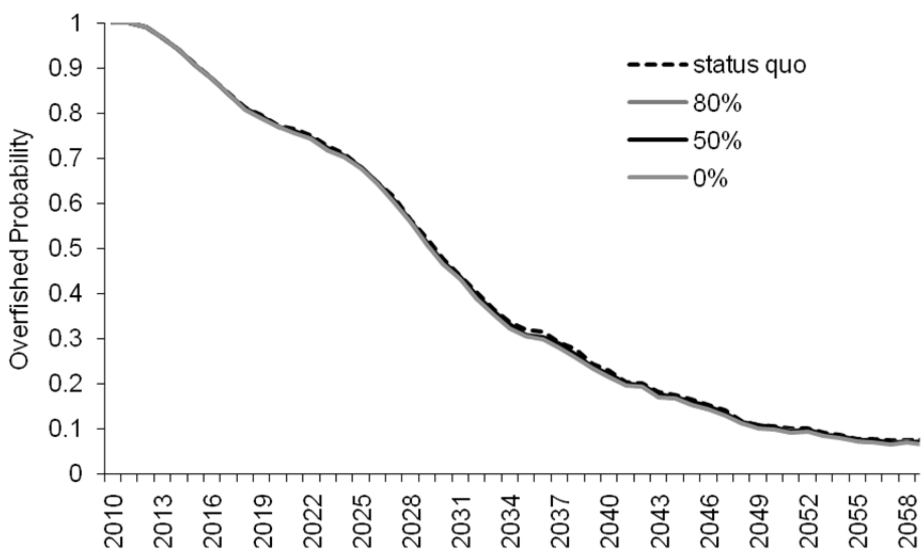


Figure 10-40 Projection estimates of the probability of overfishing based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option a for all groundfish fisheries.

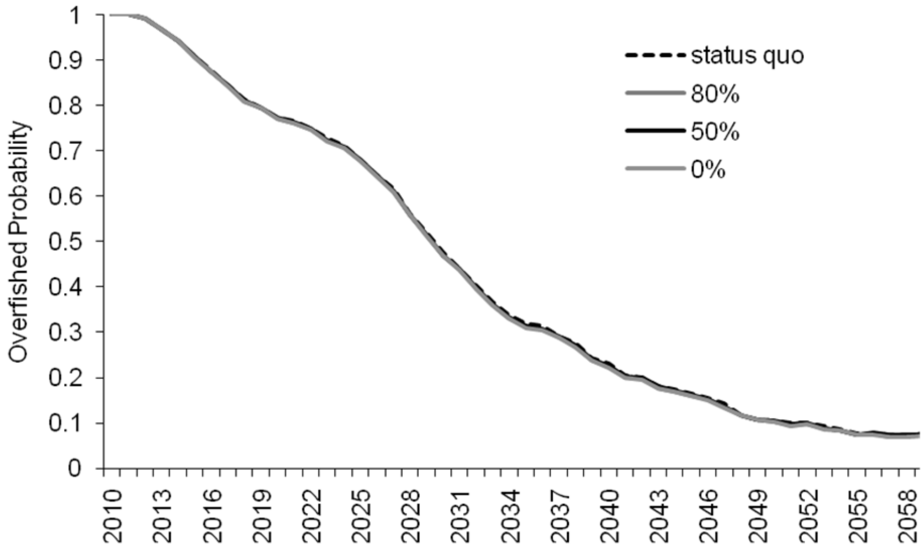


Figure 10-41 **Projection estimates of the probability of overfishing based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option b for Pacific cod pot fisheries.**

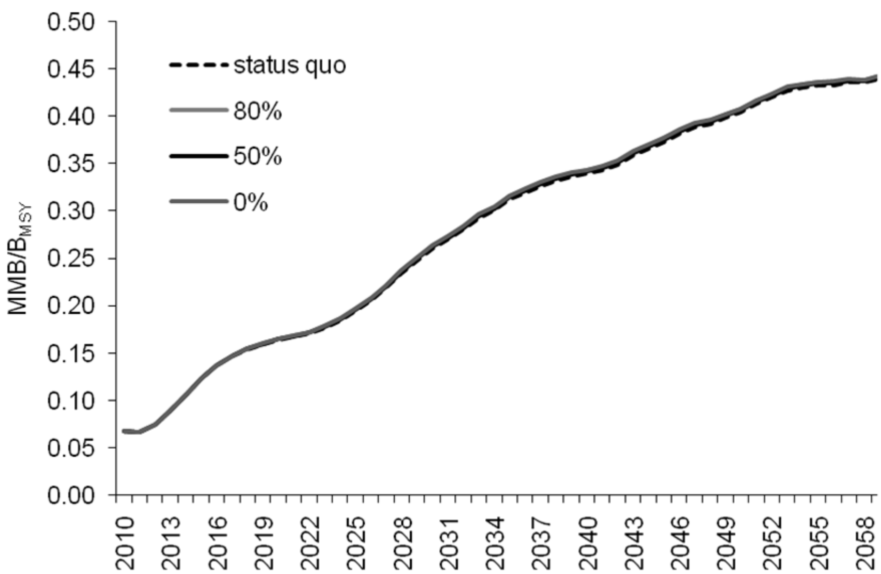


Figure 10-42 **Projection estimates of MMB relative to B_{MSY} based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option a for all groundfish fisheries.**

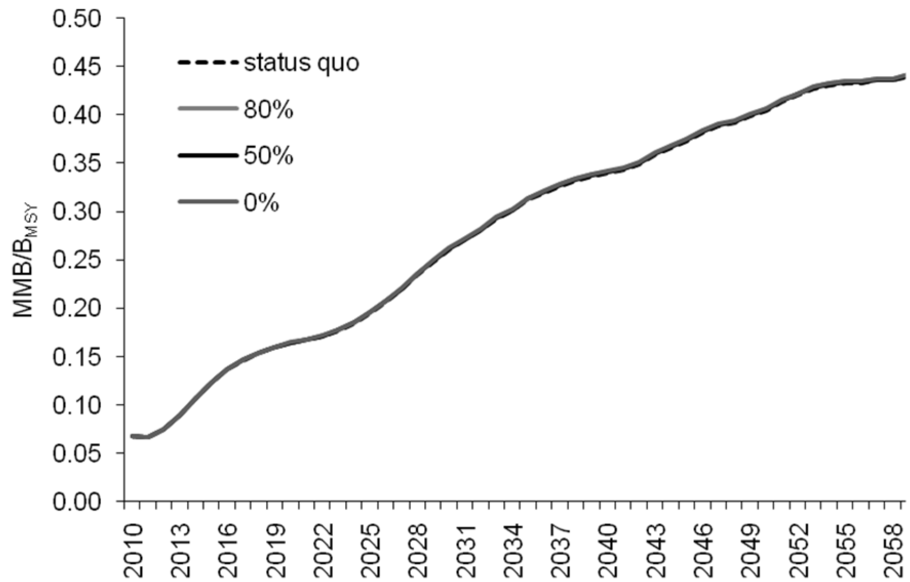


Figure 10-43 **Projection estimates of mature male biomass (MMB) relative to B_{MSY} based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option b for Pacific cod pot fisheries.**

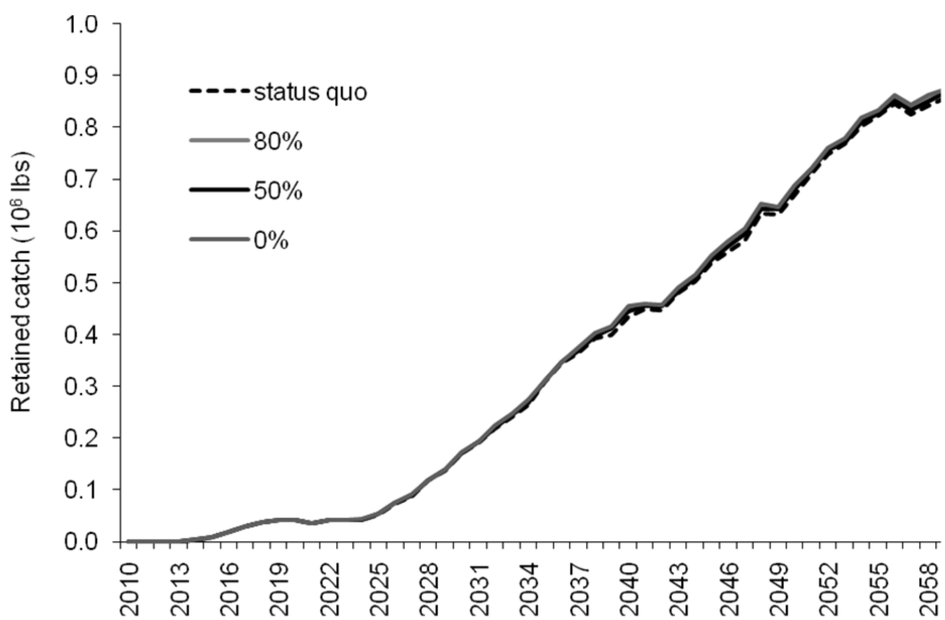


Figure 10-44 **Projection estimates of retained catch based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option a for all groundfish fisheries.**

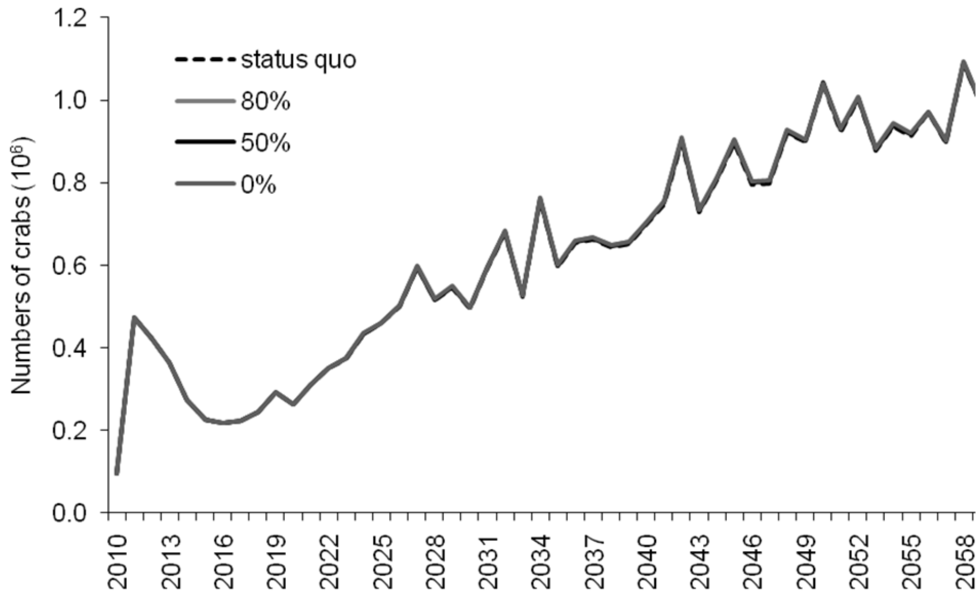


Figure 10-45 **Projection estimates of recruitment based on a Ricker recruitment function for each groundfish reduction of Pribilof Islands blue king crab bycatch scenario under option a for all groundfish fisheries.**

11 Tables

Table 11-1 List of fisheries and gear types with recorded bycatch of Pribilof Islands blue king crab in the area shown in Figure 10-15, 2003-2010 by threshold option as described in Section 3.2 (as of 12/15/2010).

The records column indicates the datasource where a record of bycatch since 2003 was used. PSC = NMFS RO estimates (from CAS in area 513 only), OBS = Observer data and FT = Fishticket from Alaska Department of Fish and Game Stat areas used to define the Pribilof area.

Target	Gear	Records	Threshold option (a,b)
Pacific cod	Pot	PSC, FT, OBS	a
	Hook and Line	PSC, FT, OBS	a
Rock Sole	Trawl	PSC	a,b
Yellowfin sole	Trawl	PSC, OBS	a
Other Flatfish	Trawl	OBS	a

Table 11-2 **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.

Table 11-3 Comparison of bycatch in numbers from Area 513 (only) compared with bycatch in numbers for the entire Pribilof District (as shown in Figure 10-13). The PI District numbers use the CIA database to calculate PSC on smaller grid sizes than the NMFS reporting areas from the AKRO estimates. Pribliof District numbers

	Area 513	Pribilof District
2003/04	491	240
2004/05	210	745
2005/06	552	576
2006/07	987	806
2007/08	5,376	5,679
2008/09	580	329
2009/10	604	762

Table 11-4 Comparison of bycatch in numbers for the non-pelagic trawl flatfish fishery (note Pacific cod fishery could not be displayed due to confidentiality) for Area 513 (only) compared with bycatch in numbers for the entire Pribilof District (as shown in Figure 10-13). The PI District numbers use the CIA database to calculate PSC on smaller grid sizes than the NMFS reporting areas from the AKRO estimates.

Year	Gear	Area 513 (PSC)[1]	PI District (CIA)[2]
2003	NPT	384	112
2004	NPT	0	4
2005	NPT	18	24
2006	NPT	780	8
2007	NPT	79	145
2008	NPT	454	198
2009	NPT	320	84
2010	NPT	154	15

[1]-combined flatfish target here includes: AK Plaice, Arrowtooth, Flathead sole, Greenland turbot, Kamchatka flounder, other flatfish, Yellowfin sole
[2]-combined flatfish target here includes: all above with the exception of flathead sole

Table 11-5 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

Table 11-6 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

Table 11-7 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).

Crab fishing season	Yellowfin sole %	Pacific cod %	Flathead sole %	Rocksole %	Total Mortality million lbs	TOTAL (# 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] Here 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 11-8 Proportion of the Pribilof Islands blue king crab bycatch (Area 513 only) among gear types 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).

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] Here 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 11-9 Pacific halibut catch from 2004 to 2008 in International Pacific Halibut Commission areas that overlap with Pribilof Islands blue king crab 1975-1984 distribution area.

Year	Log Data			Ticket Data	
	Net wt (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 11-10 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 Table A1.

Species	2003	2004	2005	2006	2007	2008	2009
AKPL	49.15	2.12	2.8	27.22	46.42	16.35	2.71
AMCK	0.01	7.65	0.11	0.01	0.06	0.15	0.04
ARTH	92.3	67.78	26.74	46.07	192.3	27.17	33.38
DEM1	3.53						
DFL4	0.27						
FLO5	3.48	16.08	4.35	2.25	8.43	0.92	0.37
FSOL	313.46	153.58	55	102.19	293.59	173.25	139.15
GTRB	0.75	0.16	0.15	0.79	0.18	0.04	0.30
NORK	0.13	0.28	0.2	0.08	0.03	0.07	0.10
OTHR	429.03	580.7	818.82	503.51	519.74	278.65	233.74
PCOD	3392.04	5847.39	7833.58	4640.75	4083.36	2563.44	1295.97
PEL7	0.04						
PLCK	2742.45	6540.28	2554.52	1315.92	736.78	339.29	
POPA	0.22	0.02	C	0.02	1.03		0.07
REYE		0.02	C			0.01	C
ROCK	0.58	0.99	0.34	0.05	0.06	0.12	0.10
RSOL	57.52	44.12	31.23	53.55	155.21	57.94	25.61
SABL	109.24	C	0.32	C	C	0.03	C
SFL1	0.38						C
SQID	0.15	0.12	0.09	C	C	C	0.21
SRKR		0.43	C	C		0.08	
SRRE	4.78						
THDS	6.11						
USKT			C				
YSOL	144.93	19.41	37.53	97.06	270.67	54.41	26.33

Table 11-11 Bycatch mortality by fishery 2003/04-2009/10

Crab fishing season	yellowfin sole	pacific cod	flathead sole	rocksole	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

Table 11-12 Bycatch mortality by gear type 2003/04-2009/10

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] Here 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 11-13 Impacts of alternative closures on estimated PIBKC bycatch by the Pacific cod fishery (Note the majority of the catch is from pot gear) 2003-2010. Reprojection estimate using CIA database.

Closure	YEAR	Closed	reproject	Ratio outside/inside
Current	2003	40	31	0.780
	2004	34	31	0.932
	2005	451	429	0.953
	2006	51	35	0.698
	2007	8,000	17,512	2.189
	2008	35	26	0.733
	2009	201	118	0.588
	2010	220	89	0.405
ADFG	2003	4	4	1.036
	2004	12	17	1.437
	2005	112	112	1.000
	2006	40	20	0.492
	2007	4,597	7,369	1.603
	2008	8	6	0.702
	2009	31	28	0.913
	2010	0	0	1.038
PSC 75	2003	182	102	0.561
	2004	439	274	0.624
	2005	578	213	0.369
	2006	199	200	1.006
	2007	9,490	19,210	2.024
	2008	332	130	0.391
	2009	423	315	0.744
	2010	323	39	0.121
PSC 84	2003	86	75	0.874
	2004	142	85	0.597
	2005	527	135	0.255
	2006	127	92	0.724
	2007	8,658	18,514	2.138
	2008	127	61	0.484
	2009	373	217	0.582
	2010	286	20	0.068

Table 11-14 Impacts of alternative closures on estimated PIBKC bycatch by the flatfish target fishery (Note the majority of this catch is using trawl gear) 2003-2010. Reprojection estimate using CIA database.

Closure	YEAR	Closed	reproject	Ratio outside/inside
Current	2003	0	0	0.883
	2004	0	0	
	2005	0	0	
	2006	0	2	6.972
	2007	0	0	0.905
	2008	1	8	16.532
	2009	0	0	1.000
	2010	0	0	
ADFG	2003	39	25	0.656
	2004	0	0	
	2005	0	1	85.229
	2006	1	1	0.984
	2007	0	5	
	2008	36	30	0.840
	2009	0	0	
	2010	0	0	1.000
PSC 75	2003	76	144	1.881
	2004	2	2	0.675
	2005	44	0	0.003
	2006	53	102	1.909
	2007	82	18	0.219
	2008	84	109	1.298
	2009	54	3	0.052
	2010	6	5	0.925
PSC 84	2003	75	81	1.083
	2004	1	1	0.996
	2005	44	0	0.004
	2006	52	59	1.127
	2007	15	16	1.051
	2008	81	95	1.165
	2009	24	23	0.960
	2010	6	5	0.925

Table 11-15 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
ADFG	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

Table 11-16 Prohibited species catch (Chinook, non-Chinook, 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	#DIV/0!	1,910
		ADFG	0	0	#DIV/0!	838
		PSC_75	0	0	#DIV/0!	2,918
		PSC_84	0	0	#DIV/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

Table 11-17 The count and mean length of observed Pribilof Islands blue king crab catches by sex for each alternative proposed closure area between 2003 and 2007.

		2003		2004		2005		2006		2007	
Alternative		count	mean length	count	mean length	count	mean length	count	mean length	count	mean length
	Female	24	130.1	18	143.3	38	140.3	17	147.4	19	125.5
1 & 2	Male	7	163.7	5	167.0	17	180.7	4	153.0	5	128.0
	Total	31	139.2	23	149.0	55	155.1	21	148.5	24	126.1
	Female	0		4	124.3	38	140.3	15	146.9	19	125.5
3	Male	0		1	158.0	17	180.7	4	153.0	5	128.0
	Total	0		5	131.0	55	155.1	19	148.3	24	126.1
	Female	25	126.0	18	143.3	39	139.5	17	147.4	19	125.5
4	Male	7	163.7	6	171.3	17	180.7	5	164.0	5	128.0
(1984-2009)	Total	32	135.8	24	151.0	56	154.2	22	151.3	24	126.1
	Female	25	126.0	18	143.3	39	139.5	18	144.5	19	125.5
4	Male	7	163.7	6	171.3	18	182.1	6	163.0	5	128.0
(1975-2009)	Total	32	135.8	24	151.0	57	155.3	24	149.3	24	126.1

Table 11-18 Non-retained total catch mortalities from directed and non-directed fisheries for Pribilof Islands District blue king crab.

Handling mortalities (pot and hook/line= 0.5, trawl = 0.8) were applied to the catches. (Bowers et al. 2008; D. Pengilly, ADF&G; J. Mondragon, NMFS). NMFS Area 513 only.

	Crab Pot Fisheries			Groundfish Fisheries	
	Legal non-retained 10^6 lbs	Sublegal male 10^6 lbs	All Female 10^6 lbs	All Pot 10^6 lbs	All Trawl 10^6 lbs
1991	0	0	0	0.0001	0.0109
1992	0	0	0	0.0010	0.1072
1993	0	0	0	<0.0001	0.0604
1994	0	0	0	<0.0001	0.0121
1995	0	0	0	0.0001	0.0023
1996	0	0.001	0	<0.0001	0.0001
1997	0	0	0	0.0016	0.0002
1998	0.003	0.001	0.004	0.0218	0.0001
1999	0.004	0.005	0.002	0.0009	<0.0001
2000	0	0	0	0.0001	<0.0001
2001	0	0	0	0.0009	0.0001
2002	0	0	0	0.0001	0.0005
2003	0	0	0	0.0004	0.0004
2004	0	0	0	0.0009	<0.0001
2005	0	0	0.0001	0.0004	0.0024
2006	0	0	0.0001	0.0002	0.0001
2007	0	0	0.0001	0.0044	0.0002
2008	0	0	0	0.0002	0.0008

Table 11-19 Preliminary assessment of the potential relationship between blue king crab in the Pribilof Islands and St. Matthew. Factors and criterion were based on information contained in Spencer et al. (In Prep).

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 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 << management areas)	Harvests in the St. Matthew stock are concentrated south of St. Matthew likely due to the accessibility of the stock. Since much of the stock biomass is north of St. Matthew 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 LAA, WAA, or LW 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 (<<Management areas)	Not available
Pairwise genetic differences (Significant differences between geographically distinct collections)	TBD

12 Appendix: 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 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 1984 distribution area (Alternative 4) between 2003 and 2009. C represents a confidential value. Species code names found in Appendix Table A1.

Table A4 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. Species code names found in Appendix 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. CDQ=Community Development Quota, OA=Open Access, IFQ=Individual Fishing Quota. CV=catcher vessel, and CP=catcher processor.

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	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: C= Pacific cod, I=halibut, K=rockfish, S=sablefish, and W=arrowtooth flounder. CDQ=Community Development Quota, OA=Open Access, IFQ=Individual Fishing Quota. CV=catcher vessel, and CP=catcher processor.

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.

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.

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
S	IFQ	CV	POT	C		C	C		C	
S	OA	CP	HAL	C				C		
S	OA	CV	HAL	75.44						

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
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	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
POT	AKPL	C						

Gear	Species	2003	2004	2005	2006	2007	2008	2009
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.

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
R	CDQ	CP	NPT		C	C	C	C		C

Target	Program	Sector	Gear	2003	2004	2005	2006	2007	2008	2009
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.

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
NPT	SABL	0.78	C	0.93	C			

Gear	Species	2003	2004	2005	2006	2007	2008	2009
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