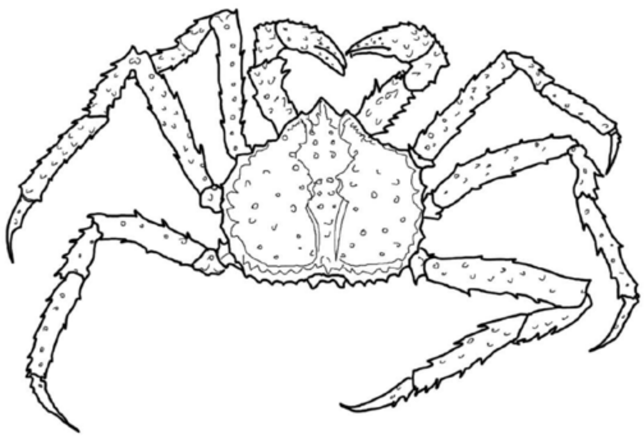
INITIAL REVIEW DRAFT

Environmental Assessment for Proposed Amendment to the Fishery Management Plan For The Bering Sea And Aleutian Islands King And Tanner Crabs

Rebuilding Plan for Saint Matthew Island blue king crab

December 2019



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Abstract: This environmental assessment analyses an action to prepare and implement an amendment to the BSAI Crab FMP to rebuild the Saint Matthew Island blue king crab stock in compliance with section 304(e)(3) of the Magnuson-Stevens Act. A range of alternative rebuilding time frames is considered based on whether or not directed fishing is permitted during stock recovery. The impacts of the alternatives considered under the action upon crab resources, fishery participants, habitat, and other components of the human environment are discussed in the analysis.

List of Acronyms and Abbreviation

Acronym or Abbreviation	Meaning
AAC	Alaska Administrative Code
ABC	Acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
AIGKC	Aleutian Is. golden king crab
AKFIN	Alaska Fisheries Information Network
BBRKC	Bristol Bay red king crab
B_{MSY}	Biomass corresponding to MSY
BSAI	Bering Sea and Aleutian Islands
CAS	Catch Accounting System
CEQ	Council on Environmental Quality
CFEC	Commercial Fisheries Entry Commission
CFR	Code of Federal Regulations
CL	Carapace length
Council	North Pacific Fishery Management Council
CP	Catcher/processor
CPUE	Catch per unit effort
CPT	Crab Plan Team
CSA	Catch survey analysis
CV	Catcher vessel
DPS	Distinct population segment
E.O.	Executive Order
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESP	Ecosystem and Socio-economic Profile
ESU	Endangered species unit
F	Fishing mortality rate
FMA	Fisheries Monitoring and Analysis
FMP	Fishery management plan
FONSI	Finding of No Significant Impact
FR	Federal Register
FRFA	Final Regulatory Flexibility Analysis
ft	Foot or feet
GHL	Guideline harvest level
GOA	Gulf of Alaska
IRFA	Initial Regulatory Flexibility Analysis
IPA	Incentive Plan Agreement
lb(s)	Pound(s)
LLP	License limitation program
LOA	Length overall
m	Meter or meters
M	Natural mortality rate
MFMT	Maximum fishing mortality threshold
MMB	Mature male biomass

Acronym or Abbreviation	Meaning
MSST	Minimum stock size threshold
MSY	Maximum sustainable yield
t	Tonne, or metric ton
NAICS	North American Industry Classification System
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPPSD	North Pacific Pelagic Seabird Database
NS1	National Standard 1
NSRKC	Norton Sound red king crab
Observer Program	North Pacific Groundfish and Halibut Observer Program
OFL	Overfishing level
OMB	Office of Management and Budget
OY	Optimum yield
PBR	Potential biological removal
PIBKC	Pribilof Is. blue king crab
PIGKC	Pribilof Is. golden king crab
PIRKC	Pribilof Is. red king crab
PSC	Prohibited species catch
PRA	Paperwork Reduction Act
PSEIS	Programmatic Supplemental Environmental Impact Statement
RFA	Regulatory Flexibility Act
RFFA	Reasonably foreseeable future action
RIR	Regulatory Impact Review
RPA	Reasonable and prudent alternative
S-R	Stock-recruitment
SAFE	Stock Assessment and Fishery Evaluation
SBA	Small Business Act
Secretary	Secretary of Commerce
SMBKC	Saint Matthew Island blue king crab
SMIHCA	Saint Matthew Island Habitat Conservation Area
SSC	Scientific and Statistical Committee
TAC	Total allowable catch
T_{min}	Minimum time to rebuild
T_{max}	Maximum time to rebuild
U.S.	United States
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WAIRKC	Western Aleutian Is. red king crab

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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 off Alaska are managed under the Fishery Management Plan for Bering Sea / 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.

On October 22, 2018, the NMFS Alaska Region notified the Council that a rebuilding plan must be developed for the St Matthew Island blue king crab stock and be implemented within two years of the notification. The action must be implemented before the start of the 2020/21 crab fishing year. The Council is considering action to implement a rebuilding plan that will maintain existing low levels of fishing mortality on this stock, so that it will rebuild.

The St. Matthew Island blue king crab directed fishery has been closed since the 2016/2017 season. The St. Matthew Island Habitat Conservation Area (SMIHCA) was created in 2008 and expanded through Amendment 94 to the BSAI Groundfish FMP (NPFMC 2009) to protect blue king crab habitat; vessels fishing with non-pelagic trawl gear are prohibited from fishing in the SMIHCA. Other fishery closure areas include a 20 nm Steller sea lion closure around the southern tip of Hall Island (NMFS 2001) to trawling, hook-and-line, and pot fisheries for pollock, Pacific cod, and Atka mackerel. In addition, State jurisdictional waters (0 to 3 nm from shore) surrounding St. Matthew, Hall, and Pinnacle Islands are closed to the taking of king and Tanner crab and to commercial groundfish fishing.

Based on the best available information on the biology of the St Matthew Island blue king crab stock and environmental conditions, the time period to rebuild the stock will exceed 10 years, as considered under section 304(e)(4)(A)(ii) of the Magnuson-Stevens Act. The fishery has been closed since 2016, and analyses indicate that rebuilding time is insensitive to average recent bycatch and only minimally affected by bycatch mortality at maximum historical levels. The stock appears to have been in a low productivity phase since 1996, and the timing of population recovery is expected to be constrained by environmental conditions that affect recruitment.

Options for the implementation of a rebuilding plan for St Matthew Island blue king crab are being considered that would prohibit directed harvest throughout rebuilding (Alternative 2 / Option 1) or allow direct harvest during rebuilding under conditions consistent with the State of Alaska's harvest strategy, as currently described in State regulations (Alternative 2 / Option 2).

Under any alternative, the stock would be considered "rebuilt" the year that it is estimated to have reached B_{MSY}. In other words, the stock does not have to remain at or above B_{MSY} for a period of years in order to be declared rebuilt. Based on projections described in section 3.2.5.2, the time with a greater than 50% probability of rebuilding to B_{MSY} at F=0 **(T_{min}) is 14.5 years**. Because T_{min} > 10 years, the designation of the rebuilding time is based on T_{max} under the definition provided in the NS1 Guideline as "T_{min} plus the length of time associated with one generation time for that stock or stock complex." The estimated generation time for SMBKC is approximately 14 years, and therefore **T_{max} is 28.5 years** ([T_{min}] + 14 years).

No alternatives propose management measures to reduce bycatch of SMBKC in the groundfish fisheries. The impacts of SMBKC bycatch in groundfish fisheries was thoroughly considered as a potential factor on stock recovery in the rebuilding analyses included in the 2019 BSAI Crab SAFE. Additionally, all of the analyses of rebuilding times under the alternatives (Section 3.2.3) factor in bycatch by groundfish fisheries at recent average levels as well as the maximum level observed. In projections that apply average bycatch in each rebuilding year, the time for stock recovery is not differentiable from the "no bycatch" scenario. In projections that assume the maximum observed bycatch occurs in every year of rebuilding, the time for stock recovery is minimally affected.

Projections estimate the amount of time it will take for the stock to reach the B_{MSY} rebuilding target (3.484 kt), defined as the average of mature male biomass estimates from the 1978-2018 assessment period. Because the stock appears to be in a low productivity phase, currently, the projections incorporate near-term (ecosystem) constraints on productivity by forecasting recruitment as a function of stock size using Ricker stock-recruitment model parameters. The estimated times for rebuilding under the alternatives are >40 years (Alternative 1), 14.5 years (Alternative 2, Option 1), and 25.5 years (Alternative 2, Option 2). Only Alternative 2 accomplishes rebuilding within the NS1 definition of T_{max} (28.5 years) according to the projections.

Given the intermittent openings and decreasing TACs of the targeted SMBKC fishery over the last 20 years, vessel and community dependence on SMBKC is relatively low. Under Option 1, the fishery would remain closed longer, but rebuilding (and a fully open directed fishery) would likely occur sooner. Under Option 2, the State harvest strategy may open some fishing earlier, this would increase the timeline for full rebuilding of the fishery.

1. Introduction

1.1. Purpose and Need

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 a rebuilding plan to prevent overfishing and to rebuild the Saint Matthew Island blue king crab (SMBKC) stock. Rebuilding should take place in as short a time as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem.

The SMBKC stock was declared overfished on October 22, 2018, because the estimated spawning biomass was below the minimum stock size threshold specified in the crab FMP. In order to comply with provisions of the Magnuson-Stevens Fishery Conservation and Management Act, a rebuilding plan must be implemented prior to the start of the 2020/2021 fishing season.

The St. Matthew Island blue king crab directed fishery has been closed since the 2016/2017 season. The St. Matthew Island Habitat Conservation Area (SMIHCA) was created in 2008 and expanded through Amendment 94 to the BSAI Groundfish FMP (NPFMC 2009) to protect blue king crab habitat; vessels fishing with non-pelagic trawl gear are prohibited from fishing in the SMIHCA. Other fishery closure areas include a 20 nm Steller sea lion closure around the southern tip of Hall Island (NMFS 2001) to trawling, hook-and-line, and pot fisheries for pollock, Pacific cod, and Atka mackerel. In addition, State jurisdictional waters (0 to 3 nm from shore) surrounding St. Matthew, Hall, and Pinnacle Islands are closed to the taking of king and Tanner crab and to commercial groundfish fishing.

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

1.2. Requirements of the Magnuson-Stevens Act and National Standard Guidelines

The Magnuson-Stevens Act sets forth ten national standards for fishery conservation and management. National Standard 1 states, “Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the U.S. fishing industry.” The specification of OY and the conservation and management measures to achieve it must prevent overfishing. NMFS published National Standard Guidelines (50 CFR 600.310 through 600.355) to provide comprehensive guidance for the development of FMPs and FMP amendments that comply with the Magnuson-Stevens Act National Standards. The Guidelines provide guidance for status determination criteria and rebuilding overfished stocks, including specifying the time period for rebuilding.

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

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

1.2.1. Magnuson-Stevens Act Language on Rebuilding Overfished Stocks

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

(e) REBUILDING OVERFISHED FISHERIES--

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.2.2. National Standard 1 Guidelines

Further clarification on stock rebuilding under the Magnuson-Stevens Act for National Standard 1 is provided in the excerpt below from the Final Rule on National Standard Guidelines published in the Federal Register on October 18, 2016 (81 FR 71858) and available on the NOAA Fisheries website: https://www.fisheries.noaa.gov/national/laws-and-policies/national-standard-guidelines

Sec. 600.310 National Standard 1— Optimum Yield.

(j) *Council actions to address overfishing and rebuilding for stocks and stock complexes*—

(1) *Notification.* The Secretary will immediately notify in writing a Regional Fishery Management Council whenever the Secretary determines that:

(i) Overfishing is occurring;

(ii) A stock or stock complex is overfished;

(iii) A stock or stock complex is approaching an overfished condition; or

(iv) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress (*see* MSA section 304(e)).

(2) *Timing of actions*—(i) *If a stock or stock complex is undergoing overfishing.* Upon notification that a stock or stock complex is undergoing overfishing, a Council should immediately begin working with its SSC (or agency scientists or peer review processes in the case of Secretarially-managed fisheries) to ensure that the ABC is set appropriately to end overfishing. Councils should evaluate the cause of

overfishing, address the issue that caused overfishing, and reevaluate their ACLs and AMs to make sure they are adequate.

(ii) *If a stock or stock complex is overfished or approaching an overfished condition.* Upon notification that a stock or stock complex is overfished or approaching an overfished condition, a Council must prepare and implement an FMP, FMP amendment, or proposed regulations within two years of notification, consistent with the requirements of section 304(e)(3) of the Magnuson-Stevens Act. Council actions should be submitted to NMFS within 15 months of notification to ensure sufficient time for the Secretary to implement the measures, if approved.

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

(A) *The minimum time for rebuilding a stock (T_{min}).* T_{min} means the amount of time the stock or stock complex is expected to take to rebuild to its MSY biomass level in the absence of any fishing mortality. In this context, the term “expected” means to have at least a 50 percent probability of attaining the B_{msy}, where such probabilities can be calculated. The starting year for the T_{min} calculation should be the first year that the rebuilding plan is expected to be implemented.

(B) *The maximum time for rebuilding a stock or stock complex to its B_{msy} (T_{max}).*

(*1*) If T_{min} for the stock or stock complex is 10 years or less, then T_{max} is 10 years.

(*2*) If T_{min} for the stock or stock complex exceeds 10 years, then one of the following methods can be used to determine T_{max}:

(*i*) T_{min} plus the length of time associated with one generation time for that stock or stock complex. “Generation time” is the average length of time between when an individual is born and the birth of its offspring,

(*ii*) The amount of time the stock or stock complex is expected to take to rebuild to B_{msy} if fished at 75 percent of MFMT, or

(*iii*) T_{min} multiplied by two.

(*3*) In situations where T_{min} exceeds 10 years, T_{max} establishes a maximum time for rebuilding that is linked to the biology of the stock. When selecting a method for determining T_{max}, a Council, in consultation with its SSC, should consider the relevant biological data and scientific uncertainty of that data, and must provide a rationale for its decision based on the best scientific information available. One of the methods listed in subparagraphs (j)(3)(i)(B)(*2*)(*ii*) and (*iii*) may be appropriate, for example, if given data availability and the life history characteristics of the stock, there is high uncertainty in the estimate of generation time, or if generation time does not accurately reflect the productivity of the stock.

(C) *Target time to rebuilding a stock or stock complex (T_{target}).* T_{target} is the specified time period for rebuilding a stock that is considered to be as short a time as possible, taking into account the factors described in paragraph (j)(3)(i) of this section. T_{target} shall not exceed T_{max}, and the fishing mortality associated with achieving T_{target} is referred to as $F_{rebuild}$.

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

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

(iv) *Adequate Progress.* The Secretary shall review rebuilding plans at routine intervals that may not exceed two years to determine whether the plans have resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks (MSA section 304(e)(7)). Such reviews could include the review of recent stock assessments, comparisons of catches to the ACL, or other appropriate performance measures. The Secretary may find that adequate progress is not being made if $F_{rebuild}$ or the ACL associated with $F_{rebuild}$ is exceeded, and AMs are not correcting the operational issue that caused the overage, nor addressing any biological consequences to the stock or stock complex resulting from the overage when it is known (*see* paragraph (g)(3) of this section). A lack of adequate progress may also be found when the rebuilding expectations of a stock or stock complex are significantly changed due to new and unexpected information about the status of the stock. If a determination is made under this provision, the Secretary will notify the appropriate Council and recommend further conservation and management measures, and the Council must develop and implement a new or revised rebuilding plan within two years (*see* MSA sections 304(e)(3) and (e)(7)(B)). For Secretarially-managed fisheries, the Secretary would take immediate action necessary to achieve adequate progress toward rebuilding and ending overfishing.

(v) While a stock or stock complex is rebuilding, revising rebuilding timeframes (*i.e.*, T_{target} and T_{max}) or $F_{rebuild}$ is not necessary, unless the Secretary finds that adequate progress is not being made.

(vi) If a stock or stock complex has not rebuilt by T_{max}, then the fishing mortality rate should be maintained at its current $F_{rebuild}$ or 75 percent of the MFMT, whichever is less, until the stock or stock complex is rebuilt or the fishing mortality rate is changed as a result of the Secretary finding that adequate progress is not being made.

(4) *Emergency actions and interim measures.* If a Council is developing a rebuilding plan or revising an existing rebuilding plan due to a lack of adequate progress (*see* MSA section 304(e)(7)), the Secretary may, in response to a Council request, implement interim measures that reduce, but do not necessarily end, overfishing (*see* MSA section 304(e)(6)) if all of the following criteria are met:

(i) The interim measures are needed to address an unanticipated and significantly changed understanding of the status of the stock or stock complex;

(ii) Ending overfishing immediately is expected to result in severe social and/or economic impacts to a fishery; and

(iii) The interim measures will ensure that the stock or stock complex will increase its current biomass through the duration of the interim measures.

(5) *Discontinuing a rebuilding plan based on new scientific information.* A Council may discontinue a rebuilding plan for a stock or stock complex before it reaches B_{msy} if the Secretary determines that the stock was not overfished in the year that the overfished determination (*see* MSA section 304(e)(3)) was based on and has never been overfished in any subsequent year including the current year.

(k) *International overfishing.* If the Secretary determines that a fishery is overfished or approaching a condition of being overfished due to excessive international fishing pressure, and for which there are no management measures (or no effective measures) to end overfishing under an international agreement to which the United States is a party, then the Secretary and/or the appropriate Council shall take certain actions as provided under Magnuson-Stevens Act section 304(i). The Secretary, in cooperation with the Secretary of State, must immediately take appropriate action at the international level to end the overfishing. In addition, within one year after the determination, the Secretary and/or appropriate Council shall:

(1) Develop recommendations for domestic regulations to address the relative impact of the U.S. fishing vessels on the stock. Council recommendations should be submitted to the Secretary.

(2) Develop and submit recommendations to the Secretary of State, and to the Congress, for international actions that will end overfishing in the fishery and rebuild the affected stocks, taking into account the relative impact of vessels of other nations and vessels of the United States on the relevant stock. Councils should, in consultation with the Secretary, develop recommendations that take into consideration relevant provisions of the Magnuson-Stevens Act and NS1 guidelines, including section 304(e) of the Magnuson-Stevens Act and paragraph (j)(3)(iii) of this section, and other applicable laws. For highly migratory species in the Pacific, recommendations from the Western Pacific, North Pacific, or Pacific Councils must be developed and submitted consistent with Magnuson-Stevens Reauthorization Act section 503(f), as appropriate.

(3) *Considerations for assessing "relative impact."* "Relative impact" under paragraphs (k)(1) and (2) of this section may include consideration of factors that include, but are not limited to: Domestic and international management measures already in place, management history of a given nation, estimates of a nation's landings or catch (including bycatch) in a given fishery, and estimates of a nation's mortality contributions in a given fishery. Information used to determine relative impact must be based upon the best available scientific information.

(l) *Exceptions to requirements to prevent overfishing.* Exceptions to the requirement to prevent overfishing could apply under certain limited circumstances. Harvesting one stock at its optimum level may result in overfishing of another stock when the two stocks tend to be caught together (This can occur when the two stocks are part of the same fishery or if one is bycatch in the other's fishery). Before a Council may decide to allow this type of overfishing, an analysis must be performed and the analysis must contain a justification in terms of overall benefits, including a comparison of benefits under alternative management measures, and an analysis of the risk of any stock or stock complex falling below its MSST. The Council may decide to allow this type of overfishing if the fishery is not overfished and the analysis demonstrates that all of the following conditions are satisfied:

(1) Such action will result in long-term net benefits to the Nation;

(2) Mitigating measures have been considered and it has been demonstrated that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/configuration, or other technical characteristics in a manner such that no overfishing would occur; and

(3) The resulting rate of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50 percent of the time in the long term, although it is recognized that persistent overfishing is expected to cause the affected stock to fall below its B_{msy} more than 50 percent of the time in the long term.

1.2.3. Process for Determining Status of BSAI Crab Stocks

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

For crab stocks, OFL equals the maximum sustainable yield (MSY) and overfishing is determined by comparing the OFL with the catch estimates for that crab fishing year. Catch includes all fishery removals, including retained catch and discard mortality. Discard mortality is determined by multiplying the appropriate handling mortality rate by observer-based estimates of discards.

Annually, the NPFMC, SSC, and CPT review (1) the stock assessment documents, (2) the OFLs and ABCs, (3) whether overfishing occurred in the previous crab fishing year, (4) whether any stocks are overfished and (5) whether catch exceeded the ACL in the previous crab fishing year. If overfishing occurred or the stock is overfished, the Magnuson-Stevens Act, requires the NPFMC to immediately end overfishing and/or develop a plan to rebuild affected stocks.

The OFL and ABC for each stock are estimated for the upcoming crab fishing year using a five-tier system, detailed in Table 1 and Table 2. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the CPT process to the SSC. The SSC recommends tier assignments, stock assessment and model structure, and parameter choices, including whether the information is "reliable," for the assessment authors to use for calculating OFL and ABC.

For Tiers 1 through 4, once a stock is assigned to a tier (SMBKC is in Tier 4), the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation (Table 1) used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" and the F_{MSY} control rule assigns F_{OFL} according to stock status level (Table 1). At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β). In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β. At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. *The SMBKC stock is in need of a rebuilding plan, however, B_{2019}/B_{msy} is 31% (stock status "b") according to the approved 2019 BSAI Crab SAFE, and so directed fishing is permitted during rebuilding.*

1.2.4. Status Determination for Tier 4 Crab Stocks

Tier 4 is for stocks like SMBKC for which essential life-history, recruitment information, and understanding are insufficient to achieve Tier 3. However, there is sufficient information for modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as γ.

Explicit to Tier 4 are reliable estimates of biomass and natural mortality (M), and F_{OFL} is calculated as the product of M and a scalar, γ, such that γ can be adjusted to account for differences in biomass measures. The proxy for B_{MSY} under Tier 4 is the average biomass over a specified time period, with the understanding that the Council's SSC may recommend a different value for a specific stock or stock complex to reflect the best available scientific information. *For SMBKC $B_{MSY\ PROXY}$ is the average model estimate of mature male blue king crab biomass for the entire assessment period,1978-2018 in the 2019 BSAI Crab SAFE.*

If the information necessary to determine total catch is not available for a Tier 4 stock, then OFL and ACL are determined for retained catch. However for SMBKC, where all catch components are available, total catch is (1) non-directed discard mortalities; (2) directed fishery discard mortalities; and (3) directed fishery retained catch. In the future, as information improves, selectivity curves could be estimated for discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models.

Table 1. Five-Tier System for setting overfishing limits (OFLs) and Acceptable Biological Catches (ABCs) for crab stocks. The tiers are listed in descending order of information availability.

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

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

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

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

1.3. Scope of the Analysis

This EA relies heavily on the information and analysis contained in previous NEPA documents and Stock Assessment and Fishery Evaluation (SAFE) Reports. Relevant information from these documents are summarized in the appropriate chapters.

This EA also incorporates information from Amendment 94 to the BSAI groundfish FMP (NPFMC 2009), which established the current boundaries for the year-round non-pelagic trawl SMIHCA.

This analysis further incorporates information contained in the Bering Sea Aleutian Islands Crab Fisheries Final Environmental Impact Statement/Regulatory Impact Review/Initial Regulatory Flexibility Analysis/Social Impact Assessment (Crab EIS) (NMFS 2004) by reference.

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

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

This EA also relies heavily on the information and analysis contained in the Council's 2019 BSAI Crab SAFE Report (NPFMC 2019), attached as an Appendix, and available from the Council web site at:

https://www.npfmc.org/fishery-management-plan-team/bsai-crab-plan-team/#currentcrab

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

The preparation of a Regulatory Impact Review (RIR) is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735, September 30, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

> In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and Benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

Because neither alternative would involve any changes to federal regulations, the preparation of an RIR is not necessary and is not a part of this analysis.

1.4. SMBKC Management Area

The analyses presented here take into account the activities of directed SMBKC fisheries as well as other fisheries and non-fishing activities with the potential to impact the SMBKC stock. None of the actions to rebuild the SMBKC stock would redefine the fishery management unit in the FMP or introduce new or modified spatial management measures affecting SMBKC. Gear restrictions and prohibitions exist within the SMBKC stock area and are described in section 3.2.3.

The FMP authorizes the State of Alaska to define spatial management boundaries for crab stocks within the management unit. Under the State of Alaska's spatial management scheme, the St. Matthew Island Section for blue king crab is the Northern District of Bering Sea king crab Registration Area Q (Figure 1), which includes the waters north of Cape Newenham (58°39' N. lat.) and south of Cape Romanzof (61°49' N. lat.).

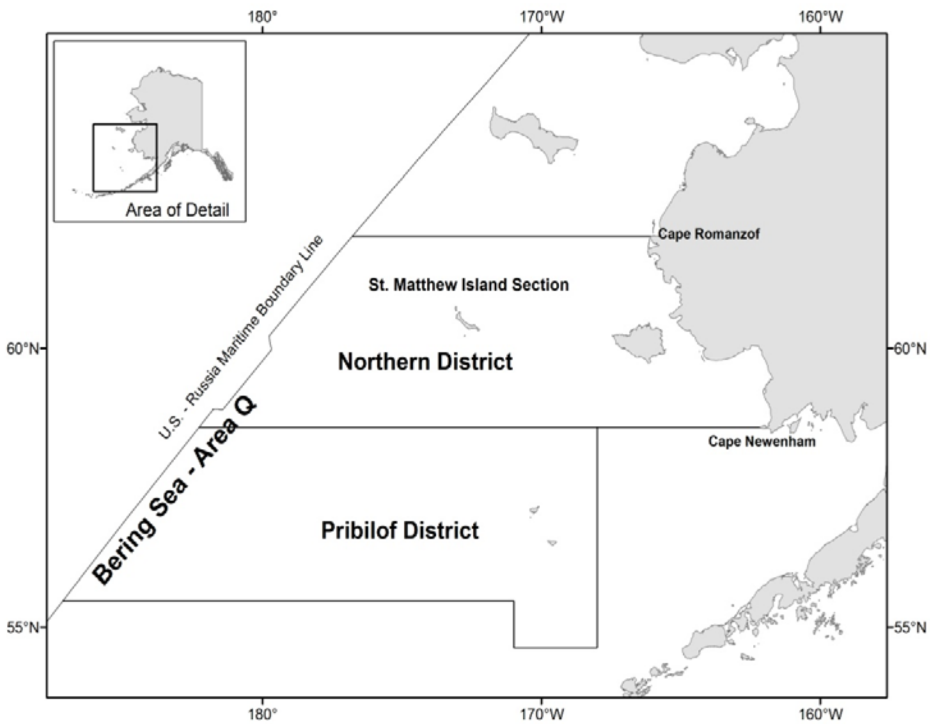

Figure 1. State of Alaska Bering Sea king crab Registration Area Q, which includes the Northern District and St. Matthew Island Section.

2. Description of Alternatives

Under any alternative, the stock would be considered "rebuilt" the year that it is estimated to have reached B_{MSY}. In other words, the stock does not have to remain at or above B_{MSY} for a period of years in order to be declared rebuilt. Based on projections described in section 3.2.5.3, the time with a greater than 50% probability of rebuilding to B_{MSY} at F=0 **(T_{min}) is 14.5 years**. Because T_{min} > 10 years, the designation of the rebuilding time is based on T_{max} under the definition provided in the NS1 Guideline as "T_{min} plus the length of time associated with one generation time for that stock or stock complex." The estimated generation time for SMBKC is approximately 14 years, and therefore **T_{max} is 28.5 years** ([T_{min}] + 14 years).

Under any alternative or option, all of the existing area closures and gear restrictions (section 3.2.3) that reduce fishery impacts on SMBKC would be expected to be maintained throughout rebuilding since none are associated with sunset dates.

No alternatives propose management measures to reduce bycatch of SMBKC in the groundfish fisheries. The impacts of SMBKC bycatch in groundfish fisheries was thoroughly considered as a potential factor on stock recovery in the rebuilding analyses included in the 2019 BSAI Crab SAFE. Additionally, all of the analyses of rebuilding times under the alternatives (section 3.2.3) factor in bycatch by groundfish fisheries at recent average levels as well as the maximum level observed. In projections that apply average bycatch in each rebuilding year, the time for stock recovery is not differentiable from the "no bycatch" scenario. In projections that assume the maximum observed bycatch occurs in every year of rebuilding, the time for stock recovery is minimally affected.

2.1. Alternative 1, No Action

Under Alternative 1, the Council would not develop a rebuilding plan, and thus constraints on fishing mortality needed for stock recovery would not be imposed. Importantly, taking no action to establish a rebuilding plan for an overfished stock would be a violation of the MSA. The stae Alternative 1 is a hypothetical scenario and projections to estimate rebuilding times under Alternative 1 (no rebuilding) allow fishing mortality to fully achieve ABC calculations in each rebuilding year in order to provide a contrasting reference for stock trajectories under more realistic management scenarios in the action alternative (Alternative 2).

2.2. Alternative 2, Establish a Rebuilding Plan

Under Alternative 2, a rebuilding plan would be established that would have greater than a 50% probability of rebuilding the SMBKC stock to B_{MSY} within a timeframe based on NS1 Guidelines. Ideally, under the Guidelines, rebuilding would be achieved in less than 10 years. If, however, the "biology of the stock, other environmental conditions, or management measures under an international agreement to which the U.S. participates, dictate otherwise" rebuilding can take more than 10 years. The fastest rebuilding time (T_{min}), is calculated based on F=0. If T_{min} > 10 years, then the NS1 Guidelines provide for an alternative rebuilding time, (i.e., T_{max}).

There are two options under Alternative 2 that consider alternative harvest scenarios during rebuilding:

Option 1: No directed fishing until the stock is rebuilt.

Option 2: Allow the directed fishery to open based on the state harvest strategy while the stock is rebuilding.

At stock status level "c," ($B/B_{msy} \leq 25\%$; Table 1) directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. Although the SMBKC stock is in need of a rebuilding plan, B_{2019}/B_{msy} is 31% (stock status "b") according to the approved 2019 BSAI Crab SAFE, and so directed fishing is permitted during rebuilding and Alternative 2 / Option 2 is a viable option.

A federal rebuilding plan for SMBKC will be incorporated into the BSAI King and Tanner Crab FMP by amending the FMP language to reflect the approved rebuilding alternative. The FMP authorizes the State to set preseason TACs and GHLs under State regulations, and seasons or areas are closed when the TAC or GHL is reached. The State must take into account the following factors, to the extent information is available, in developing harvest strategies or setting TACs and GHLs: (1) whether the ACL for that stock was exceeded in the previous year; (2) stock status relative to the OFL and ACL; (3) estimates of exploitable biomass; (4) estimates of recruitment; (5) estimates of thresholds; (6) market and other economic considerations; (7) additional uncertainty; and (8) any additional factors pertaining to the health and status of the stock or the marine ecosystem.

Under approval of Alternative 2/Option 1, the FMP language would be amended to reflect a prohibition on harvest of SMBKC until the stock is declared rebuilt, and this would prohibit the State from setting a TAC or GHL that allows for directed harvest. Under Alternative 2/Option 2, the amended FMP language could either include the specific formulae for opening the SMBKC fishery provided in the current State harvest strategy or could state that no change in the harvest strategy should occur that would contribute to departure from the Council's intended rebuilding timeline.

For Option 2, the State of Alaska's Saint Matthew Island Section blue king crab harvest strategy (referred to hereafter as the "State harvest strategy" and provided in the Alaska Administrative Code at 5 AAC 34.917**)** is provided below and illustrated in Figure 2.

5 AAC 34.917. Saint Matthew Island Section blue king crab harvest strategy.

> (a) In the Saint Matthew Island Section, the commissioner may, by emergency order, open the blue king crab fishery only if the department's preseason survey estimate of mature male blue king crab equals at least 50 percent of the 1978–2012 average survey estimate of mature males.
>
> (b) If the commercial blue king crab fishery is open under (a) of this section, and the preseason survey estimate of mature males is
>
>> (1) at least 50 percent but less than 100 percent of the 1978–2012 average survey estimate of mature males, the number of legal males available for harvest will be no more than 0.1 x M x ($M/M_{1978\text{-}2012}$), where M = the current year preseason survey estimate of mature males, and $M_{1978\text{-}2012}$ = the 1978 – 2012 average survey estimate of mature males, or 25 percent of the preseason survey estimate of legal males, whichever is less;
>>
>> (2) equal to or greater than the 1978–2012 average survey estimate of mature males, the number of legal males available for harvest will be no more than 10 percent of the preseason survey estimate of mature males or 25 percent of the preseason survey estimate of legal males, whichever is less.
>
> (c) In implementing this harvest strategy, the Alaska Board of Fisheries directs the department to use the best scientific information available and to consider the reliability of estimates of blue king crab, the manageability of the fishery, and any other factors it determines necessary to be consistent with sustained yield principles.
>
> (d) For the purposes of this section,
>
>> (1) "preseason survey estimate" means the
>>
>>> (A) population number present at the time of the preseason survey as estimated directly by the area-swept method from annual trawl survey data, if a stock-assessment model is not used for abundance estimation;

(B) model-estimated population number present at the time of the preseason survey times the estimated survey selectivity and catchability, if a stock-assessment model is used for abundance estimation;

(2) "legal males" means all male blue king crab at least

(A) 5.5 inches in width of shell; or

(B) 120 millimeters in length of shell, if only shell length measurements are available in the preseason survey data;

(3) "mature males" means all male blue king crab at least 105 millimeters in length of shell.

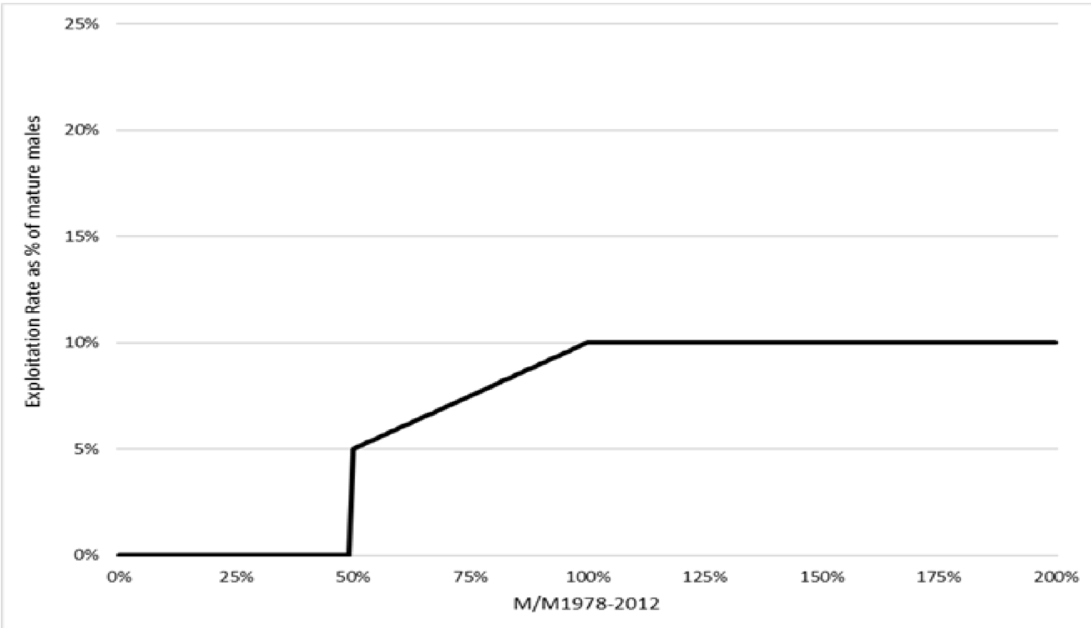

Figure 2. State harvest strategy for SMBKC, i.e., 0.1 x B x ($B/B_{1978\text{-}2012}$) for 50%<$B/B_{1978\text{-}2012}$ <100% and 0.1 x B for $B/B_{1978\text{-}2012}$> 100%.

2.3. Monitoring Progress of the Rebuilding Plan

The NMFS eastern Bering Sea bottom-trawl survey provides data for annual assessment of the status of crab stocks in the BSAI, including SMBKC, and would continue throughout rebuilding. The BSAI Crab Plan Team would report stock status and progress towards the rebuilt level in the Stock Assessment and Fishery Evaluation (SAFE) Report for the king and Tanner crab fisheries of the BSAI.

Additionally, ADF&G and NMFS will monitor directed fishery catch (allowable only under Alternative 2/Option 2) and bycatch of blue king crabs in other fisheries (under any alternative). ADF&G currently has a dockside sampling program for monitoring landings during the commercial fishery to shoreside processors and an observer program for monitoring landings by catcher-processor vessels. ADF&G reports the total harvest from the commercial fishery and that report will be included annually in the SAFE.

State and federal observer programs monitor bycatch with State coverage of the crab fisheries and federal monitoring of the groundfish trawl, pot and longline fisheries Estimates of crab bycatch from all commercial fisheries will be reported annually in the SAFE and the BSAI Crab Plan Team will assess that bycatch relative to the expectations and assumptions of the rebuilding plan.

Programs also exist within ADF&G and NMFS to contain levels of catch and bycatch at those prescribed in the rebuilding plan. If the combination of catch and bycatch were to approach the maximum level within any given year under the rebuilding plan, harvest can be capped through closure of directed harvest and area restrictions, if necessary for reducing bycatch.

3. Environmental Assessment

There are four required components for an environmental assessment. The need for the proposal is described in Chapter 1, and the alternatives in Chapter 2. This chapter addresses the probable environmental impacts of the proposed action and alternatives. A list of agencies and persons consulted is included in Chapter 6.

This chapter evaluates the direct, indirect, and cumulative impacts of the alternatives and options on the various resource components. The socio-economic impacts of this action are described in detail in section 3.3 of this analysis.

Recent and relevant information, necessary to understand the affected environment for each resource component, is summarized in the relevant section. For each resource component, the analysis identifies the potential impacts of each alternative, and uses criteria to evaluate the significance of these impacts. If significant impacts are likely to occur, preparation of an EIS is required. Although an EA should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

An environmental assessment must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative effects as:

"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the Council on Environmental Quality (CEQ) guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful.

3.1. Methods

3.1.1. Resource Components Addressed in the Analysis

The proposed action is to establish a rebuilding plan for St. Matthew Island blue king crab. Extensive environmental analysis on all resource components is not needed in this document because the proposed action is not anticipated to have environmental impacts on all resource components. The fishery has been closed since 2016 and would remain closed for several years under the proposed action, therefore there is no change anticipated to non-target species interactions, marine mammals, seabirds, or habitat. Table 3 identifies the components of the human environment that would be affected by establishing a rebuilding plan.

Table 3. Resources potentially affected by the proposed action and alternatives.

Potentially affected resource component					
Saint Matthew Island blue King Crab Stock	**Non-Target Species**	**Marine Mammals**	**Seabirds**	**Habitat**	**Social and Economic**
Y	N	N	N	N	Y

N = no impact anticipated by each alternative on the component.
Y = an impact is possible if each alternative is implemented.

3.1.2. Cumulative Effects Analysis

Council on Environmental Quality 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. Cumulative effects are those combined effects on the quality of the human environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such other actions (40 CFR 1508.7). A discussion of the cumulative effects of the crab fisheries is provided in the Bering Sea Aleutian Islands Crab Fisheries Final Environmental Impact Statement/Regulatory Impact Review/Initial Regulatory Flexibility Analysis/Social Impact Assessment (Crab EIS) (NMFS 2004a). The past and current cumulative effects are discussed in the Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement (NMFS 2004a). Both of these discussions are incorporated by reference.

This analysis discusses the cumulative effects of the following categories of reasonably foreseeable future actions identified for this action may have a continuing, additive, and meaningful relationship to the direct and indirect effects of the alternatives —

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

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 minimum stock size threshold (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 2004b) and Amendment 24 to the Crab FMP (NPFMC 2008a) incorporated into this analysis by reference assess the potential direct and indirect effects of crab fishery harvest levels in combination with other factors that affect physical and biological resource components of the Bering Sea and Aleutian Islands (BSAI) environment.

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

Accountability measures (AMs) are a required provision of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (Public Law 109-479) in conjunction with provisions for ACL requirements. The 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.

Crab bycatch in the groundfish fisheries is not constraining for SMBKC stock recovery but will continue to be monitored. The Council is not considering management measures for further addressing bycatch in the groundfish fisheries such as additional time/area closures or hard caps on groundfish fisheries. If management measures are implemented in the future to reduce crab bycatch further, this could have an impact on groundfish fleet effort and distribution.

Other government actions

The Bureau of Ocean Energy Management, Regulation, and Enforcement expects that reasonably foreseeable future activities include development of oil and gas deposits over the next 15 to 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 under traditional management tools.

While hatchery efforts for blue king crab are not currently active in the Saint Matthew Island region, there has been an 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 Bering Sea.

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 action.

3.2. Saint Matthew Island blue king crab

Blue king crab, *Paralithodes platypus* (Figure 3), are distributed in several disjunct locations of the North Pacific from Hokkaido, Japan, to southeastern Alaska (Figure 4). In the eastern Bering Sea, small populations are distributed around St. Matthew Island, the Pribilof Islands, St. Lawrence Island, and Nunivak Island. The State of Alaska divides the Bering Sea king crab Registration Area into the Pribilof Islands District and the Northern District. The St. Matthew Island Section for blue king crab in the Northern District of Bering Sea king crab Registration Area Q defines the spatial extent of the SMBKC stock, which includes the waters north of Cape Newenham (58°39' N. lat.) and south of Cape Romanzof (61°49' N. lat.) (Figure 1).

The blue king crab is a shallow water species with adults found at an average depth of 70 m (NPFMC 2011). The reproductive cycle appears to be annual for the first two years and biennial thereafter (Jensen and Armstrong 1989), and mature crab migrate inshore seasonally where they molt and mate. Somerton and MacIntosh (1983) estimated SMBKC male size at the advent of sexual maturity to be 77 mm carapace length (CL), and the State of Alaska defines the lower size bound of functionally mature male SMBKC as ≥105 mm CL (Pengilly and Schmidt 1995). Otto and Cummiskey (1990) report an average growth increment of 14.1 mm CL for adult SMBKC males. Unlike red king crab, juvenile blue king crab do not form pods for protection from predators, but instead rely on cryptic coloration and suitable habitat such as cobble and shell hash.

Figure 3. Blue king crab (*Paralithodes platypus*) on a 1 inch square (2.54 cm2) background. Source ADF&G.

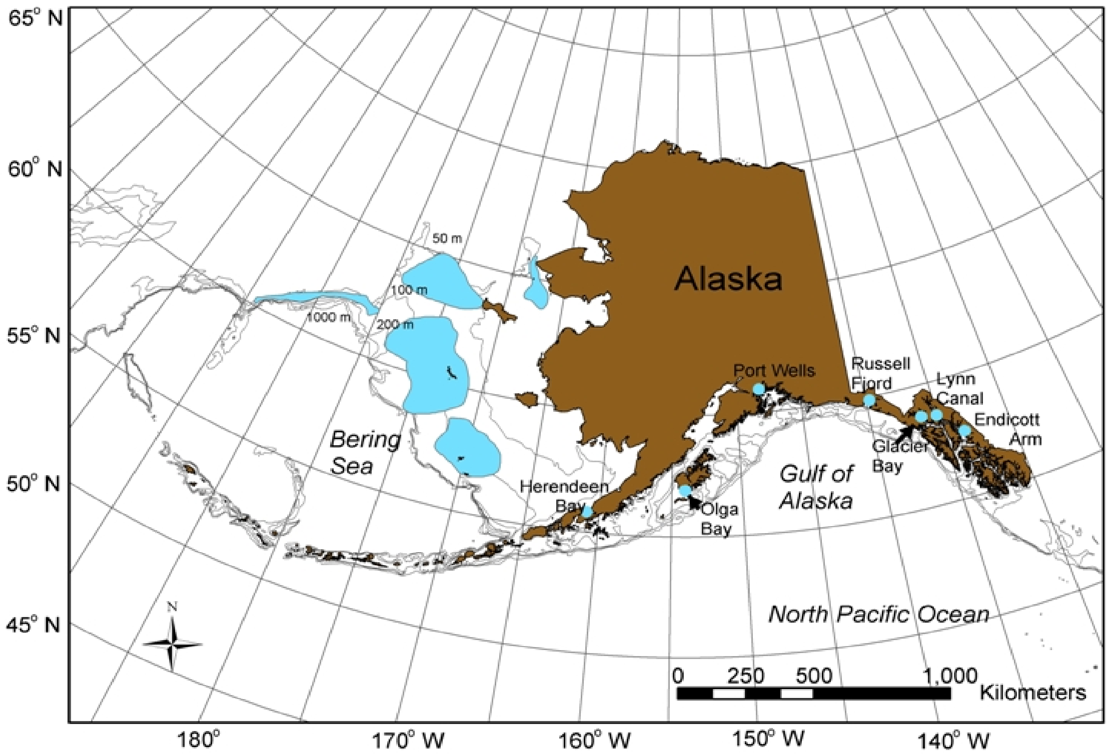

Figure 4. Distribution of blue king crab (*Paralithodes platypus*) in the Gulf of Alaska, Bering Sea, and Aleutian Islands waters (shown in blue).

3.2.1. SMBKC Fishery Catches and Stock Biomass

The purpose of this section is to provide a discussion of the history of directed harvest levels, given in Table 4 for the entire assessment period (1978-2019), while fleet and processor characteristics for the SMBKC fishery are provided in section 3.3.1.

The SMBKC fishery originally developed when ecological studies supporting oil exploration in the 1970s revealed the presence of crab in the area (Otto 1990). Ten U.S. vessels harvested 545 t in 1977, and harvests peaked in 1983 when 164 vessels landed 4,288 t (Fitch et al. 2012). The fishing seasons were generally short, early on, often lasting only a few days.

Directed fishery was prosecuted from 1977 to 1998, and harvest was fairly stable from 1986 to 1991, averaging 568 t annually. Harvest increased to a mean catch of 1,496 t during the 1991 to 1998 seasons until the fishery was declared overfished and closed in 1999 when the stock size estimate was below the MSST of 4,990 t.

Zheng and Kruse (2002) hypothesized a high level of SMBKC natural mortality from 1998 to 1999 as an explanation for the low catch per unit effort (CPUE) in the 1998 commercial fishery and 1999 to 2005 eastern Bering Sea trawl survey. In November 2000, Amendment 15 to the FMP for Bering Sea/Aleutian Islands king and Tanner crabs was approved to implement a rebuilding plan for the SMBKC stock (NPFMC 2000). The rebuilding plan included a State harvest strategy (*5 AAC 34.917)*, area closures, and gear modifications. In addition, commercial crab fisheries near St. Matthew Island were restricted to fall and early winter to reduce the potential for bycatch mortality of vulnerable molting and mating crab.

After a 10-year closure, NMFS declared the stock rebuilt in September 2009, and the fishery was reopened the next month with a TAC of 529 t. In that fishing season, seven vessels landed 209 t. The fishery remained open for the next three years with modest harvests but declines in the NMFS trawl-survey estimate of stock abundance raised concerns, which prompted ADF&G to close the fishery again for the 2013/14 season. The fishery was reopened for the 2014/15 season with a low TAC of 297 t. In 2015/16, the TAC was further reduced to 186 t and then completely closed the 2016/17 season, although the MMB estimate of 2.23 t, at the time, was above MSST (1.84 t). Fishery closures have been in place since the 2016/2017 crab fishing season.

Table 4. St. Matthew Island directed blue king crab pot fishery characteristics from 1978/79 to 2018/19. The Guideline Harvest Level and Total Allowable Catch (GHL/TAC) are equivalent and are in millions of pounds.

			Harvest		
Year	Opening Dates	GHL/TAC	Number of Crab	Pounds	Metric tons
1978/79	07/15 - 09/03		436,126	1,984,251	900
1979/80	07/15 - 08/24		52,966	210,819	96
1980/81	07/15 - 09/03		CONFIDENTIAL		
1981/82	07/15 - 08/21		1,045,619	4,627,761	2,099
1982/83	08/01 - 08/16		1,935,886	8,844,789	4,012
1983/84	08/20 - 09/06	8.0	1,931,990	9,454,323	4,288
1984/85	09/01 - 09/08	2.0-4.0	841,017	3,764,592	1,708
1985/86	09/01 - 09/06	0.9-1.9	436,021	2,175,087	987
1986/87	09/01 - 09/06	0.2-0.5	219,548	1,003,162	455
1987/88	09/01 - 09/05	0.6-1.3	227,447	1,039,779	472
1988/89	09/01 - 09/05	0.7-1.5	280,401	1,236,462	561
1989/90	09/01 - 09/04	1.7	247,641	1,166,258	529
1990/91	09/01 - 09/07	1.9	391,405	1,725,349	783
1991/92	09/16 - 09/20	3.2	726,519	3,372,066	1,530
1992/93	09/04 - 09/07	3.1	545,222	2,475,916	1,123
1993/94	09/15 - 09/21	4.4	630,353	3,003,089	1,362
1994/95	09/15 - 09/22	3.0	827,015	3,764,262	1,707
1995/96	09/15 - 09/20	2.4	666,905	3,166,093	1,436
1996/97	09/15 - 09/23	4.3	660,665	3,078,959	1,397
1997/98	09/15 - 09/22	5.0	939,822	4,649,660	2,109
1998/99	09/15 - 09/26	4.0	635,370	2,968,573	1,347
1999/00			FISHERY CLOSED		
2000/01			FISHERY CLOSED		
2001/02			FISHERY CLOSED		
2002/03			FISHERY CLOSED		
2003/04			FISHERY CLOSED		
2004/05			FISHERY CLOSED		
2005/06			FISHERY CLOSED		
2006/07			FISHERY CLOSED		
2007/08			FISHERY CLOSED		
2008/09			FISHERY CLOSED		
2009/10	10/15 - 02/01	1.17	103,376	460,859	209
2010/11	10/15 - 02/01	1.60	298,669	1,263,982	573
2011/12	10/15 - 02/01	2.54	437,862	1,881,322	853
2012/13	10/15 - 02/01	1.63	379,386	1,616,054	733
2013/14	10/15 - 02/01		FISHERY CLOSED		
2014/15	10/15 - 02/01	0.66	69,109	308,582	140
2015/16	10/19 - 11/28	0.41	24,076	105,010	48
2016/17			FISHERY CLOSED		
2017/18			FISHERY CLOSED		
2018/19			FISHERY CLOSED		

Based on the 2019 BSAI Crab SAFE, the model estimate of mature male biomass for the 2018/19 fishing season (1.15 kt) is below the minimum stock-size threshold (MSST; 1.74 kt), and so the stock is still "overfished". Figure 5shows annual mature male biomass estimates relative to annual MSST estimates from 2010-2019 based on the BSAI Crab SAFE. Note that values are based on historical assessments and not updated through the 2019 assessment.

Fishery closures, in combination with very low bycatch levels, have constrained removals of SMBKC below OFL, and so "overfishing" has not been occurring. Nevertheless, the 2019 BSAI Crab SAFE suggests that current spawning stock biomass is 52% of hypothetical biomass in the absence of fishing, which suggests that the impact of fishing is not insignificant.

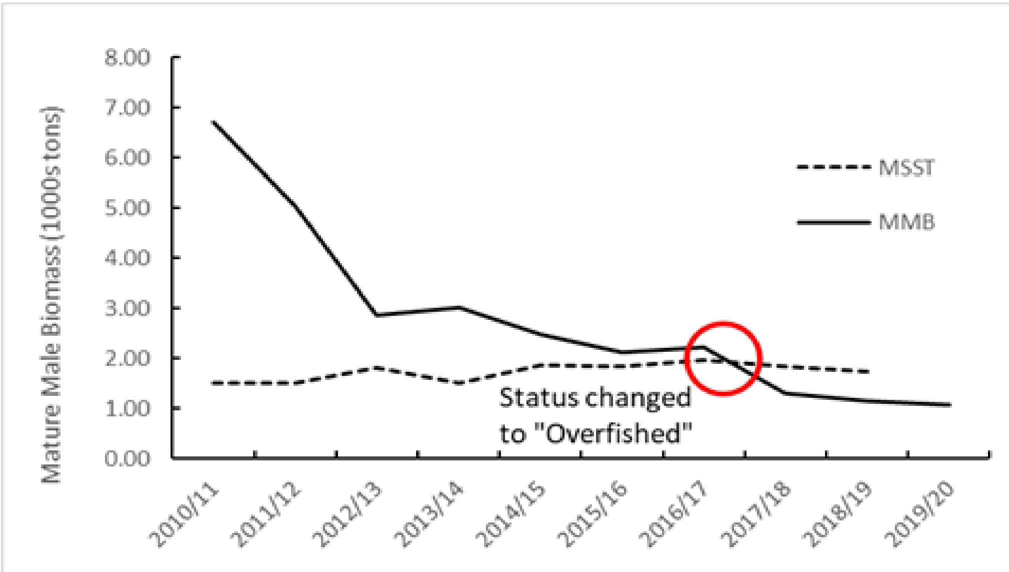

Figure 5. Annual mature male biomass (MMB) estimates relative to annual MSST estimates from 2010-2019 based on the BSAI Crab SAFE. Note that values are based on historical assessments and not the re-estimated MMB time series from the 2019 assessment.

3.2.2. Bycatch of SMBKC in other fisheries

Incidental catch of SMBKC has occurred in eastern Bering Sea groundfish fisheries and some other directed crab fisheries. The NMFS observer data suggest that variable, limited SMBKC bycatch has occurred in the eastern Bering Sea groundfish fisheries. Table 5 from the 2019 BSAI Crab SAFE and provided below provides the range of groundfish fishery bycatch estimates of male BKC from 1978-2018 by gear category. A noteworthy fixed gear bycatch estimate of 69.7t occurred during a fishery closure in 2007, however, non-target bycatch of males SMBKC has generally been less than 5 t, since 1991, compared to directed harvest of just over 1,000 t.

Explorations of SMBKC bycatch in the groundfish fisheries was conducted that directly addresses the potential for groundfish bycatch to constrain stock rebuilding. The analyses reviewed the spatial extent and of blue king crab groundfish bycatch. Figure 6 provides a map of the St. Matthews Island area split into its different ADF&G statistical areas. In each statistical area, the amount of observed blue king crab bycatch in the groundfish fisheries is illustrated using bar charts, such that the different colored bars represent historical (1996-2018) and recent (2014-2018) fixed gear bycatch of SMBKC as well as historic and recent trawl bycatch. Historic fixed gear bycatch has occurred in areas within the SMIHCA, but have generally been reduced in the recent period. Low level historical trawl bycatch and limited recent trawl bycatch occurred in the total stock area that extends beyond the SMIHCA.

Bycatch of blue king crab has been observed historically in the eastern Bering Sea snow crab fishery, but in recent years it has generally been negligible. The St. Matthew Island golden king crab fishery, the only other commercial crab fishery in the area, occurs at depths that generally precludes blue king crab catch.

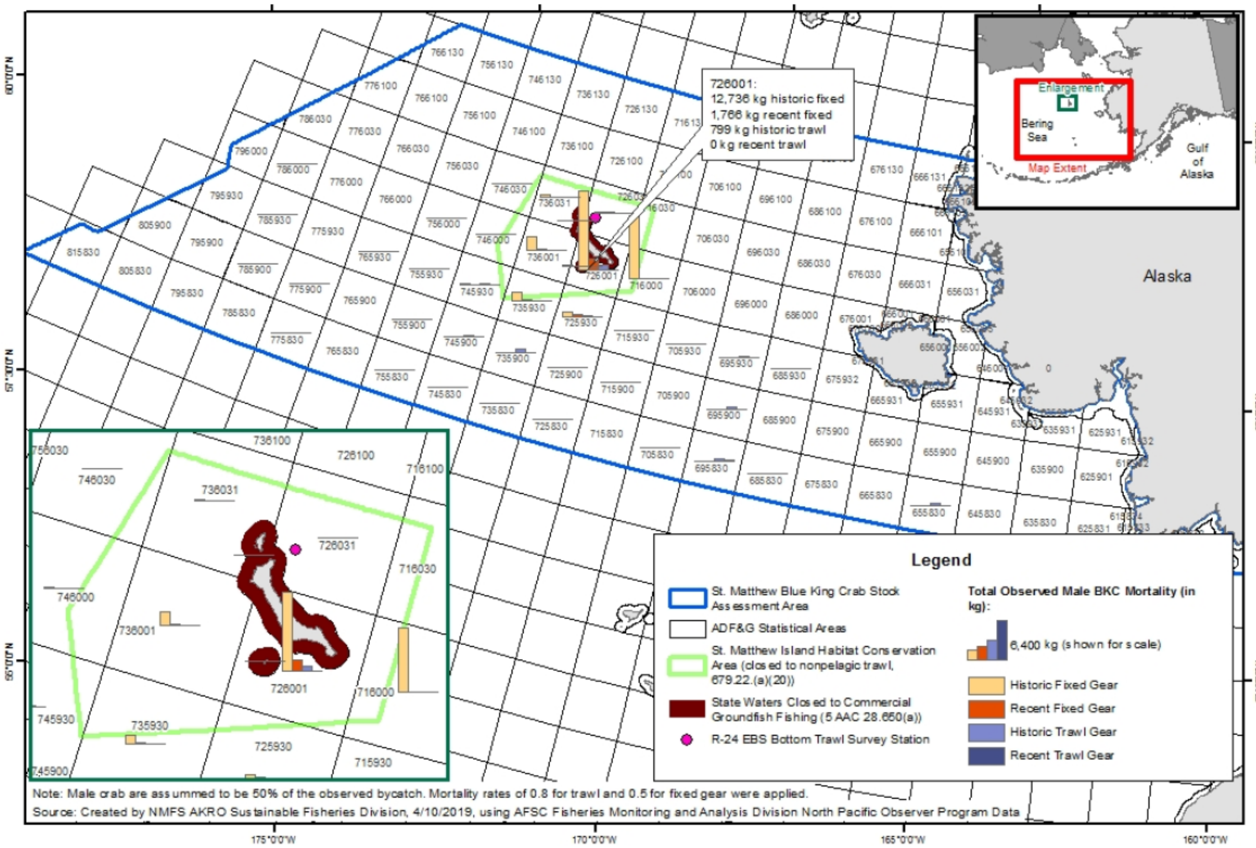

Figure 6. Comparison of spatial extent of historical (1996-2018) and recent (2014-2018, a subset of historical data) male SMBKC bycatch mortality in the groundfish fisheries in the St Matthew BKC stock area.

Table 5. Groundfish SMBKC male bycatch biomass (t) estimates. Trawl includes pelagic trawl and non-pelagic trawl types. Source: J. Zheng, ADF&G, and author estimates based on data from R. Foy, NMFS. Estimates used after 2008/09 are from NMFS Alaska Regional Office.

Year	Trawl bycatch	Fixed gear bycatch
1978	0.000	0.000
1979	0.000	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000
1985	0.000	0.000
1986	0.000	0.000
1987	0.000	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	3.538	0.045
1992	1.996	2.268
1993	1.542	0.500
1994	0.318	0.091
1995	0.635	0.136
1996	0.500	0.045
1997	0.500	0.181
1998	0.500	0.907
1999	0.500	1.361
2000	0.500	0.500
2001	0.500	0.862
2002	0.726	0.408
2003	0.998	1.134
2004	0.091	0.635
2005	0.500	0.590
2006	2.812	1.451
2007	0.045	69.717
2008	0.272	6.622
2009	0.638	7.522
2010	0.360	9.564
2011	0.170	0.796
2012	0.011	0.739
2013	0.163	0.341
2014	0.010	0.490
2015	0.010	0.711
2016	0.229	1.633
2017	0.052	6.032
2018	0.001	1.281

3.2.3. Existing Protections to SMBKC and SMBKC Habitat

The SMBKC directed fishery has been closed since the 2016/2017 season. The St. Matthew Island Habitat Conservation Area (SMIHCA; Figure 7) was created in 2008 and expanded through Amendment 94 to the BSAI Groundfish FMP (NPFMC 2009) to protect blue king crab habitat. Vessels fishing with non-pelagic trawl gear are prohibited from fishing in the SMIHCA.

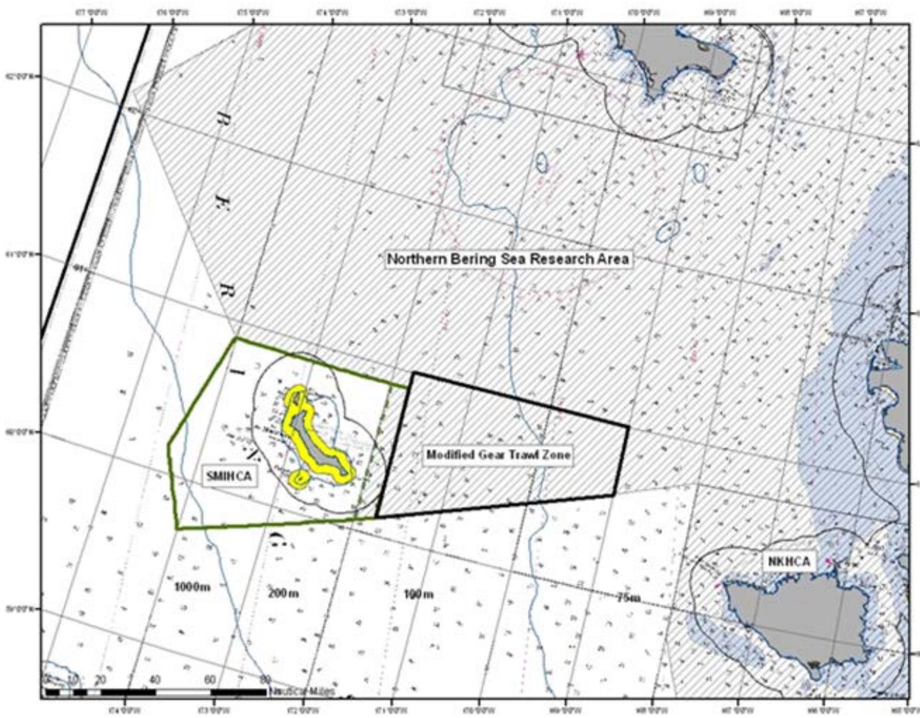

Figure 7. St. Matthew Island Habitat Conservation Area including the expansion of eastern boundary from Groundfish Amendment 94 in 2010. The Modified Gear Trawl Zone to the east of the SMIHCA was also established through Amendment 94 to reduce the impacts of non-pelagic trawl gear on crab habitat.

Other fishery closure areas include a 20nm Steller sea lion closure around the southern tip of Hall Island (NPFMC 2001; Figure 7) to trawling, hook-and-line, and pot fisheries for pollock, Pacific cod, and Atka mackerel. In addition, State jurisdictional waters (0 to 3 nm from shore) surrounding St. Matthew, Hall, and Pinnacle Islands are closed to the taking of king and Tanner crab and to commercial groundfish fishing.

It is challenging to quantitatively measure protections gained from fishery gear restricted areas, for example, estimating the magnitude of SMBKC biomass loss compared to current biomass if the closure areas had not been put in place. Analyses provided in Groundfish Amendment 94 suggest important prevention of red king crab mortality following trawl gear modifications (Figure 8), which may also benefit blue king crab, and the SMIHCA will continue to prohibit non-pelagic trawl gear throughout rebuilding.

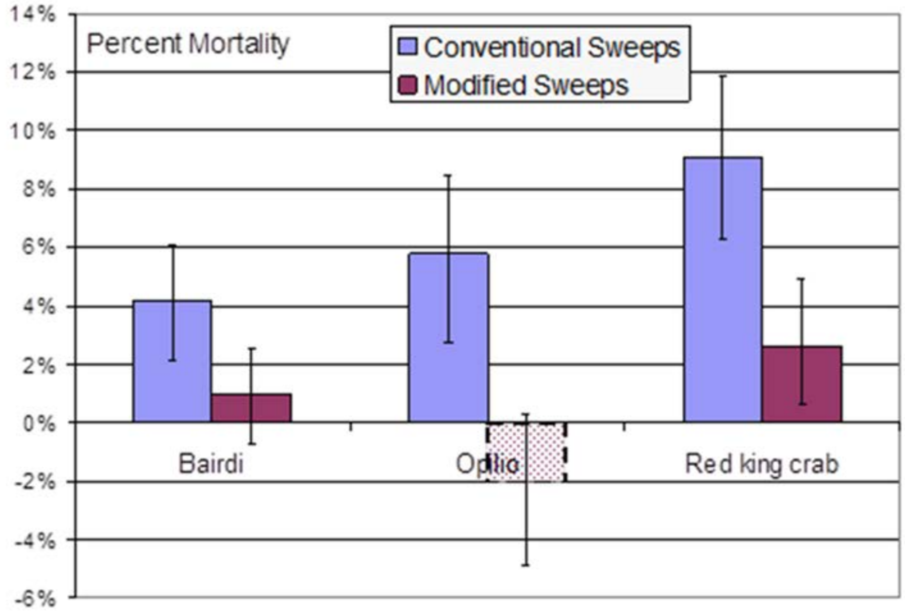

Figure 8. Estimated mortalities of Chionoecetes opilio, C. bairdi, and red king crab after contact with conventional and modified sweeps. Rates have been adjusted for handling mortality based on mortality estimates from a control net. (Apparent negative mortality is a non-significant artifact of the control adjustment). From Amendment 94 EA-RIR-IRFA (NPFMC 2009)

3.2.4. Prevailing Ecosystem Conditions

SMBKC rebuilding will occur within the context of prevailing ecosystem conditions, which are characterized in a recent “Ecosystem and Socioeconomic Profile” (ESP) that was included in the SMBKC chapter of the 2019 BSAI Crab SAFE. The ESP uses data collected from a variety of sources to generate ecosystem and socioeconomic indicators that may help explain trends for a given stock. The ESP process and products have been recommended by the CPT and SSC.

Five ecosystem indicators listed below were developed for SMBKC, and trends for these from 1980-present are illustrated in Figure 9. The indicators could be useful for informing progress during the rebuilding process.

1. Pre-recruit biomass
2. Bottom temperature
3. Cold pool extent
4. Benthic invertebrate biomass
5. Benthic predator biomass.

Pre-recruit biomass can be an indicator of future changes in mature male biomass and may also be useful as an early indicator of progress on stock recovery for the SMBKC. Bottom temperature peaked in 2018-2019, and there was also a low in cold pool extent. Bottom temperatures that exceed thermal optima for SMBKC could potentially induce movement to less favorable habitat. Invertebrate biomass and predator fish indicators peaked in 2016, and the peak in predators was dominated by Pacific cod.

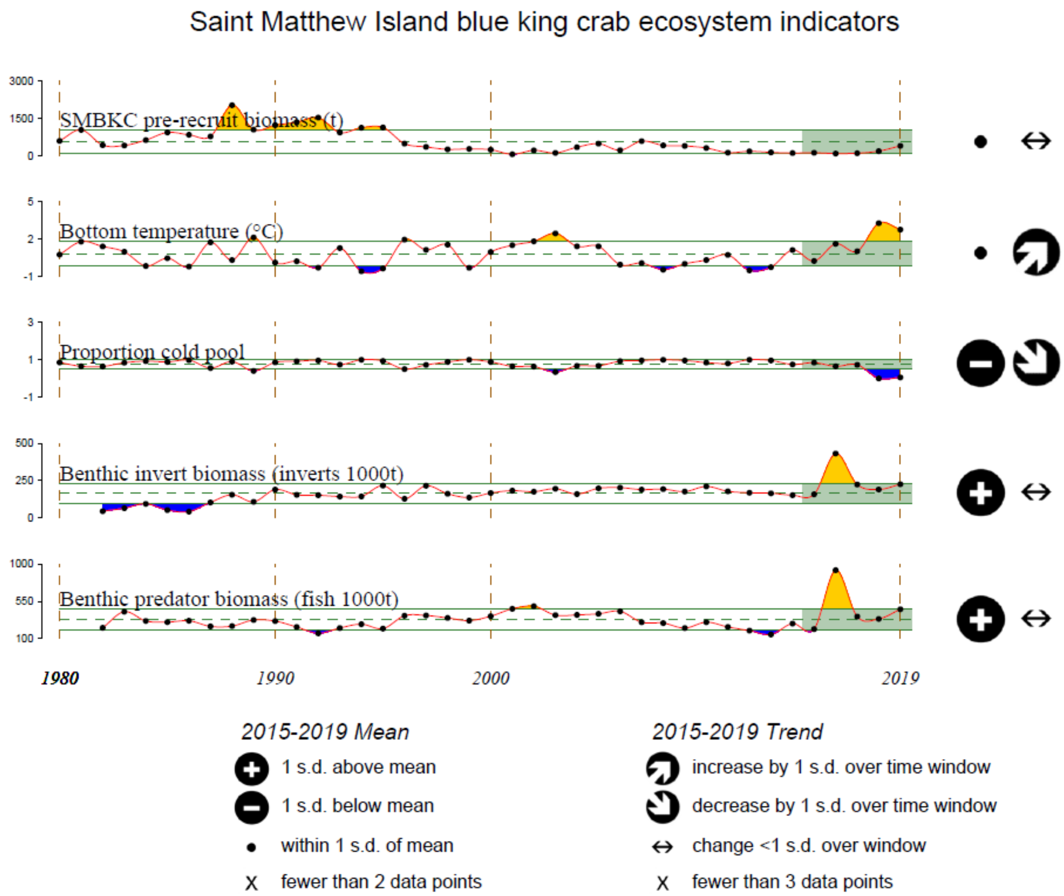

Figure 9. Selected ecosystem indicators for SMBKC with time series ranging from 1980 – 2019. Upper and lower solid green horizontal lines are 90th and 10th percentiles of time series. Dashed horizontal line is the mean of the time series. The light green shaded area represents the most recent five years for mean and trend analysis. Source: 2019 BSAI Crab SAFE.

3.2.5. SMBKC ESP Conclusions/Recommendations

Projections used for the SMBKC rebuilding plan indicate that recruitment appears to drive recovery time. A better understanding, therefore, of early life history processes and the continued development of indicators relevant to larval and juvenile SMBKC is needed. Developing an EFH habitat indicator for SMBKC should also be considered, since the ESP results highlighted several vulnerabilities related to habitat. The following set of additional considerations is provided in the 2019 ESP:

- Despite repeated fishery closures, SMBKC mature male biomass and recruitment estimates remain below-average following a 1989 regime shift in the Bering Sea, suggesting that environmental factors may be impeding recruitment success and stock recovery.
- Highly specific thermal optimums and habitat requirements of SMBKC likely limit mobility in response to warmer than average bottom temperatures and shifting predator distributions in the Bering Sea.
- Large catches of Pacific cod in the St. Matthew Island management boundary in 2016 preceded declines in BKC recruitment and the overfished declaration in 2018.

- Trend modeling for ecosystem indicators revealed poor conditions for SMBKC in recent years, attributed to above average bottom temperatures, a reduction in the cold pool extent, and an increase in mean benthic predator biomass in the St. Matthew Island management boundary.

The ESP also recommends additional data gathering and research initiatives to address life history characteristics (i.e. growth-per-molt data and molting probabilities) as well as estimates for natural mortality would aide in a better understanding of stage-specific vulnerabilities. In addition, process-based studies would identify links between larval survival, recruitment and environmental factors. Examining larval drift patterns and spatial distributions of mature BKC around St. Matthew Island in relation to habitat characteristics will help to inform essential fish habitat models and the development of a larval retention indicator. Furthermore, additional groundfish stomach data outside of the summer survey time series would help to refine our understanding of predation pressure across life history stages of SMBKC. Likewise, spring bottom temperatures prior to the summer bottom trawl survey may help to explain SMBKC distribution in relation to survey catchability.

3.2.6. Effects of the Alternatives

The focus of this section is to describe and interpret rebuilding projections that allow for comparison of the time frames for rebuilding the SMBKC stock under the alternatives. Measures of ecosystem conditions, quantified in section 3.2.4 above, are not directly integrated into projections, however, the constraining effects of prevailing ecosystem conditions on stock rebuilding are addressed through analytical choices regarding stock productivity (section 3.2.5.2 below). The impacts of the alternatives on the SMBKC stock are, very briefly, increasingly positive as rebuilding times are reduced, and so Alternative 1 / Option 1, which would prohibit directed fishing would be expected to contribute the most to rapid rebuilding, while Alternative 1, no action, is associated with the longest recovery time and the most negative impacts to the stock.

3.2.7. Starting conditions for rebuilding projections

The relevant projections are similar with regard to starting population conditions and the end point for rebuilding, i.e., the measure of biomass that defines a rebuilt stock, once achieved. Population quantities and parameter values (Table 6) were based on the accepted 2019 stock assessment for SMBKC (Appendix). The assessment uses is a three-stage Catch-Survey-Analysis (CSA) model configured within the Gmacs framework (Webber et al. 2016) in order to facilitate an evaluation of model assumptions. The model estimates abundances of male SMBKC with carapace lengths (CLs) greater than 90 mm within three length stages: stage 1: 90-104 mm CL; stage 2: 105-119 mm CL; and stage 3: CL $\geq$ 120 mm. The stage definitions are based on size at maturity - stage 2 (105 mm CL) and size at harvest - stage 3 (~120 mm or approximately 5.5 in CL). Additionally, the stages are consistent with the average growth increment of about 14 mm per molt (Otto and Cummiskey 1990).

Within the model, the beginning of the crab year is assumed to occur with the NMFS trawl survey, nominally assigned a date of July 1 and MMB is estimated for February 15, which is the federal management reference date for biomass. Each model year is split into five seasons and a scaled proportion of the natural mortality, is applied in each. The seasons differ in terms of events and processes: season 1 (survey period), season 2 (natural mortality until pulse fishery), season 3 (pulse fishery), season 4 (natural mortality until spawning), and season 5 (natural mortality and somatic growth until June 30th). The timeframes for specific data inputs vary according to when data collection was initiated (observer data and pot surveys), or whether the fishery was open (fish tickets, trawl survey). Major data sources used in this assessment include annual directed-fishery retained-catch statistics from fish tickets; the annual NMFS eastern Bering Sea trawl survey; the ADF&G SMBKC pot survey; mean somatic mass given length category by year; size-frequency information from ADF&G crab-observer pot-lift sampling; and the NMFS groundfish-observer bycatch biomass estimates.

Figure 10 shows stations from which SMBKC trawl-survey and pot-survey data were obtained. Further information concerning the NMFS trawl survey as it relates to commercial crab species is available in Daly et al. (2014); see Gish et al. (2012) for a description of ADF&G SMBKC pot-survey methods. Note that the surveys cover different geographic regions and each has, in some years, encountered proportionally large numbers of male blue king crab in areas not covered by the other survey.

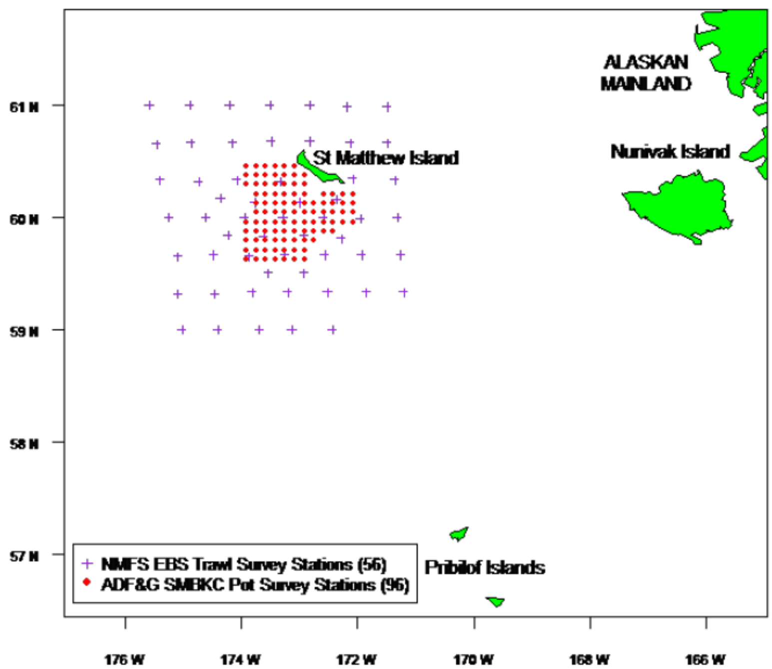

Figure 10. Trawl and pot-survey stations used in the SMBKC stock assessment.

From the assessment, the overfishing level (OFL) is the fishery-related mortality biomass associated with fishing mortality F_{OFL}. The SMBKC stock is currently managed as Tier 4, and only a Tier 4 analysis is presented here. Thus, given stock estimates or suitable proxy values of B_{MSY} and F_{MSY} , along with two additional parameters α and β, F_{OFL} is determined by the control rule:

$$F_{OFL} = \begin{cases} F_{MSY}, & \text{when } B/B_{MSY} > 1 \\ F_{MSY}\frac{(B/B_{MSY}-\alpha)}{(1-\alpha)}, & \text{when } \beta < B/B_{MSY} \leq 1 \end{cases}$$

$$F_{OFL} < F_{MSY} \text{ with directed fishery } F = 0 \text{ when } B/B_{MSY} \leq \beta$$

where *B* is quantified as mature-male biomass (MMB) at mating with time of mating assigned a nominal date of 15 February. Note that as *B* itself is a function of the fishing mortality F_{OFL} (therefore numerical approximation of F_{OFL} is required). F_{OFL} is taken to be full-selection fishing mortality in the directed pot fishery and groundfish trawl and fixed-gear fishing mortalities set at their model geometric mean values over the years for which there are data-based estimates of bycatch-mortality biomass.

The recommended Tier 4 convention is to use the full assessment period, currently 1978- 2018, to define a B_{MSY} proxy in terms of average estimated MMB and to set λ= 1.0 with assumed stock natural mortality M = 0.18 yr^{-1} in setting the F_{MSY} proxy value λM . The parameters α and β are assigned their default values $\alpha = 0.10$ and $\beta = 0.25$. The F_{OFL}, OFL, ABC, and MMB in 2019 for all scenarios are summarized in Table 6.

Table 6. Tier 4 B_{MSY} proxy (rebuilding target) from the accepted SMBKC assessment model in the 2019 BSAI Crab SAFE.

Year	Basis for B_{MSY} proxy	B_{MSY} proxy	MSST	B_{2019}	B/B_{MSY}	F_{OFL}	M
2019/20	Ave. Annual MMB from 1978-2018	3.484 kt MMB	1.742 kt MMB	1.081 kt MMB	0.31	0.042	0.18

Bycatch in Groundfish fisheries. Table 5 in section 3.2.2 provides estimates of bycatch throughout the assessment period. Although a remarkable bycatch estimate of 69.7 t during a fishery closure in 2007, non-target bycatch of males SMBKC has generally been less than 5 t, since 1991, compared to directed harvest of just over 1,000 t.

Projections including bycatch were performed to determine their effect on time to recovery including sensitivity to large increases (using maximum observed bycatch in 2007). Rebuilding times were completely unaffected by recent average (2014 - 2018) bycatch values. A depiction of "probability of recovery" over time is provided in Figure 11, however, the rebuilding curves are indistinguishable with respect to inclusion of bycatch.

Recruitment. For all of the alternatives, a Ricker stock-recruit relationship was used since it incorporates stock status into the recruitment inputs and avoids choosing a time frame for random recruitment draws. This avoids conflict with the existing B_{MSY} proxy reference period, while also incorporating near-term ecosystem constraints on productivity. For estimating rebuilding times under the alternatives, it is considered unreasonable to use randomization that includes recruitment in the near future at levels seen prior to 1996. On the other hand, confining recruitment to the recent time frame can generate an unrealistically long rebuilding period.

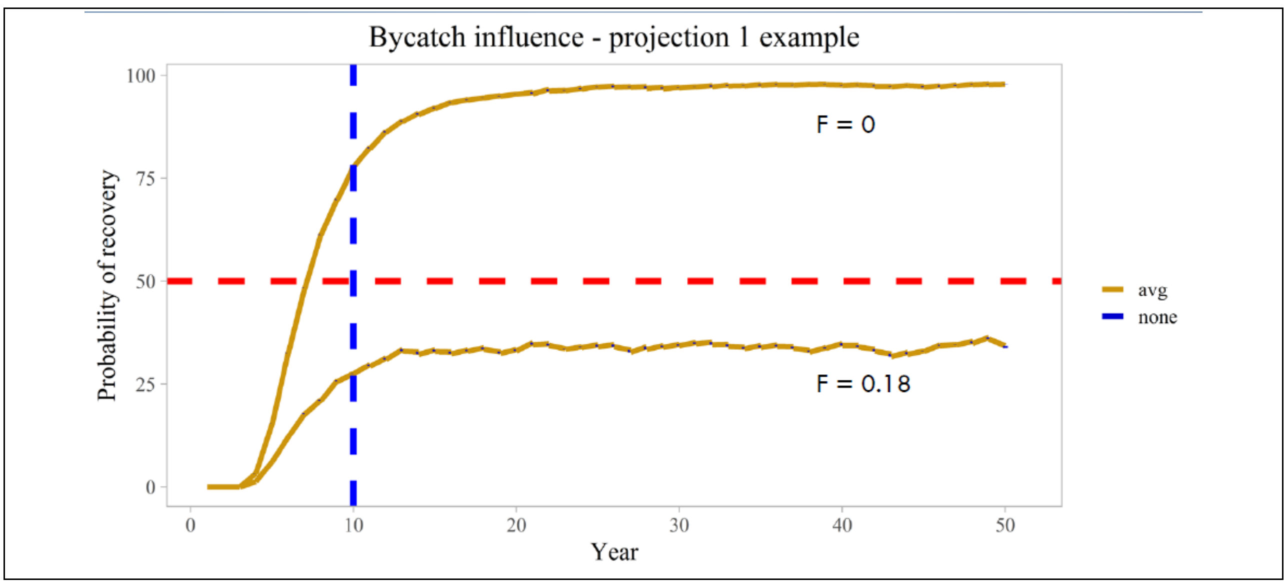

Figure 11. Comparison of probabilities of recovery under two direct harvest scenarios and two bycatch scenarios. Direct harvest is either eliminated (F=0) or is set at maximum F scenario where F=M=0.18. Bycatch is also set at either "none" or the recent (2014-2018) average.

3.2.8. Breakpoint Analysis

A breakpoint analysis (Appendix D in the SAFE chapter) explored the potential for historical changes in productivity that could have implications for the reference period for Bmsy as well as recruitment inputs in projections (See Figure 12). Methods involved Ricker and Beverton-Holt S-R parameters and were similar to those used for Bristol Bay red king crab in 2017 (Zheng et al. 2017) and eastern Bering Sea Tanner crab in 2013 (Stockhausen 2013). Additionally, a “Sequential t-Test Analysis of Regime Shifts (STARS)” method was explored since it can be performed on any time series and does not rely on a stock recruitment relationship.

The two analyses converged on a breakpoint year of 1989 (Figure 13), which would produce a break in recruitment in 1996 and is consistent with characterizations of wide-scale changes in Bering Sea ecosystem conditions in 1989 (e.g., Overland *et al.*, 2008). Recruitment success for SMBKC, as with many crab species, is driven by environmental conditions. In the Bering Sea, recent environmental conditions appear to be unfavorable for recruitment success for this stock, which may be due to a longer larval episode for blue king crab.

Although evidence clearly exists for a regime shift, redefining the Bmsy reference point was not done for assessing impacts to the alternatives. Using Tier 4 definitions based on a revised (1996-2018) reference period, may ignore the influence of fishing mortality in the history of the stock, and is suggestive of “shifting baselines” according to discussions at the September 2019 CPT meeting. The current Tier 4 definition of Bmsy based on 1978-2018 MMB is the effective rebuilding target since it represents the Bmsy proxy in the approved 2019 BSAI Crab SAFE.

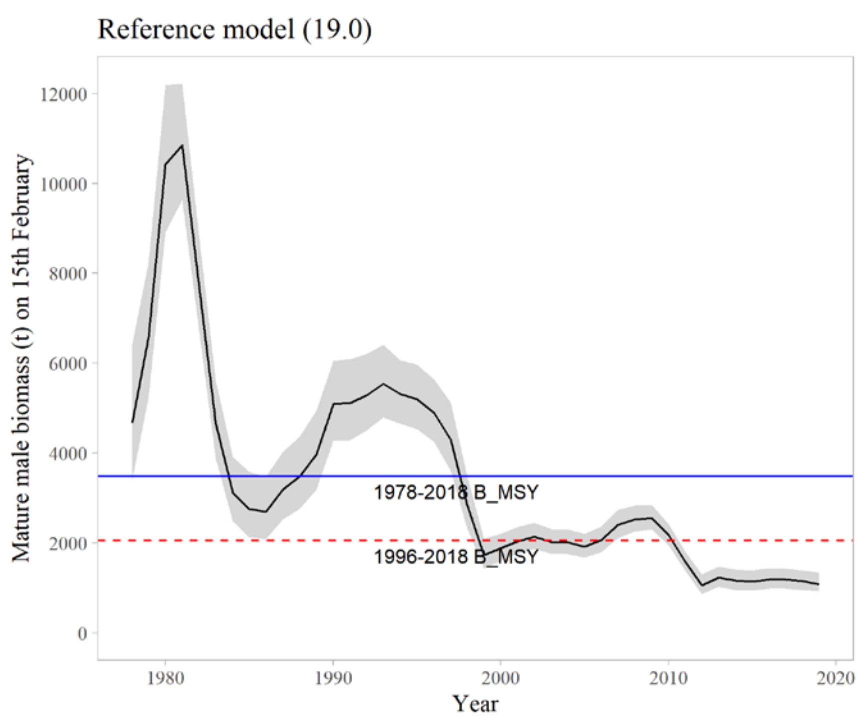

Figure 12. Computed BMSY proxy (average mature male biomass) for the corresponding year ranges based on the 2019 assessment model with GMACS code updates.

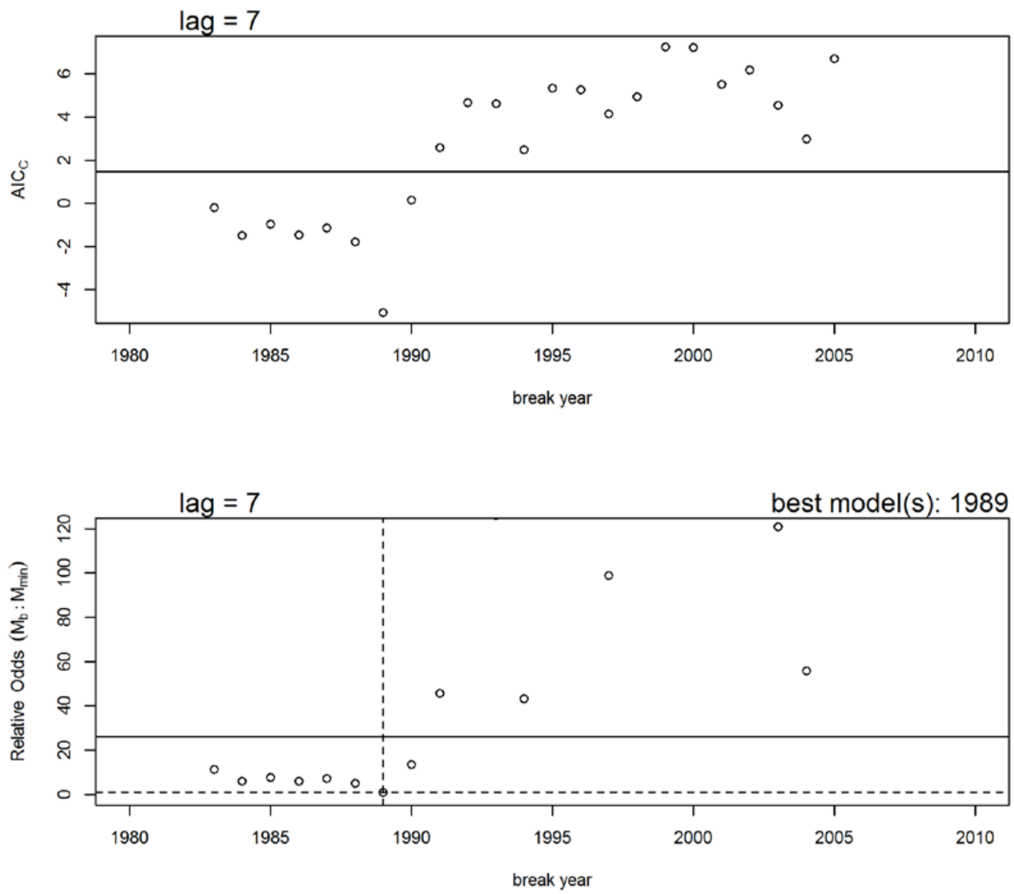

Figure 13. Results from the Ricker stock-recruit breakpoint analysis. Upper graph: AICc vs. year of breakpoint for the 1-breakpoint models (circles) and AICc for the model with no breakpoint (horizontal line). Lower graph: probabilistic odds for all 1-breakpoint models (circles) and the no breakpoint model (horizontal solid line) relative to the model with the smallest AICc score. The dashed lines indicate the value for the model with the lowest AICc score (breakpoint in 1989).

3.2.9. Summary of Impacts to SMBKC

Several rebuilding scenarios were reported in the 2019 BSAI Crab SAFE that explore either randomized draws or S-R model based recruitment, with randomization being based on two ecosystem/productivity regimes (Table 7). The above considerations limit the rebuilding projections to scenarios, provided in Table 8, that are consistent in regard to recruitment and B_{msy}, but differ in their potential for directed harvest under the alternatives, and also with regard to bycatch. For the Alternative 1 scenarios in which no rebuilding plan is established, catch achieves ABC in every projection year in order to provide a hypothetical time frame in which fishing mortality is essentially not controlled to allow for rebuilding. For Alternative 2/Option 1, no directed catch is allowed, so only average and maximum bycatch scenarios apply. Alternative 2/Option 2 includes directed catch based on the State harvest strategy as well as average and maximum bycatch scenarios. In the projections, harvest under the State harvest strategy does not occur until biomass reaches the minimum necessary to trigger an opening. Trawl survey catches or estimated biomass can be used to trigger an opening of the fishery under the Policy, however, the trawl survey catches were not modeled. Instead, the fishery did not open until the projected biomass reached a level analogous to the minimum survey catch threshold (50% of the long term average from 1978 to 2012 per regulation). For this reason, at least in the projections, Alternative 2 Options 1 and 2 are not differentiable for the first 5-6 years of rebuilding.

Table 7. Range of input scenarios explored in the SMBKC SAFE Chapter Appendix on stock rebuilding.

B_{MSY} proxy options for 2018 model 3, all Tier 4b.

Year	Basis for B_{MSY}	B_{MSY} proxy	MSST	Biomass(MMB_{mating})	B/B_{MSY}	F_{OFL}	M
2019/20	1978-2018	3.48	1.74	1.08	0.31	0.042	0.18
2019/20	1996-2018	2.05	1.025	1.04	0.51	0.082	0.18

T_{min} for each projection version d with no directed fishing (F=0) and average recent bycatch.

Projection	recruitment	B_{MSY} proxy	recruitment yrs	T_{min}
1	random recruitment	1978-2018	1978-2018	6.05 years
2	ricker	1978-2018	1978-2018	14.5 years
4	random recruitment	1978-2018	1996-2018	>100 years
5	random recruitment	1996-2018	1996-2018	9.0 years

T_{min} for each projection version aa with maximum observed bycatch.

Projection	recruitment	B_{MSY} proxy	recruitment yrs	F level	T_{min}
1	random recruitment	1978-2018	1978-2018	F = 0	6.5 years
1	random recruitment	1978-2018	1978-2018	F = SHR	11.0 years
5	random recruitment	1996-2018	1996-2018	F = 0	11.25 years
5	random recruitment	1996-2018	1996-2018	F = SHR	13.0 years

Table 8. Projection scenarios for SMBKC rebuilding that consider a range of bycatch and directed harvest levels throughout the rebuilding period. All of the projections apply Ricker S-R for recruitment inputs.

Scenario	Bycatch	Directed Fishing
Alt 1	recent (2014-2018)	F = ABC
Alt 2 Option 1	recent (2014-2018)	none
Alt 2 Option 1	max	none
Alt 2 Option 2	recent (2014-2018)	SOA harvest strategy
Alt 2 Option 2	max	SOA harvest strategy

All of the rebuilding projections were performed using a projection module coded into Gmacs in early 2019 (A. Punt per Comm). For each range of assumptions on F level and bycatch mortality a distribution of possible projections into the future was created (a minimum of 2,000 iterations). The resulting probability of recovery corresponds to the percentage of this distribution that results in a rebuilt stock (achieving a stock size equal to the B_{MSY} proxy in Table 6).

Rebuilding times under each of the projection combinations are provided in Table 9 relative to the minimum and maximum rebuilding periods as defined using the NS1 guidelines and are illustrated in Figure 14.

Alternative 1 is associated with the greatest potential for long term negative effects on the SMBKC stock and the time to rebuild is beyond the maximum time contemplated under NS1 (T_{max} = 28.5 years), and could be greater than 40 years under an assumed harvest at ABC each year in the projections (Figure 14) Although rebuilding does not occur under Alternative 1, that outcome is a product of the assumed level of harvest in the projection which is maximized at harvest equal to ABC each year to frame the upper range of rebuilding timelines.

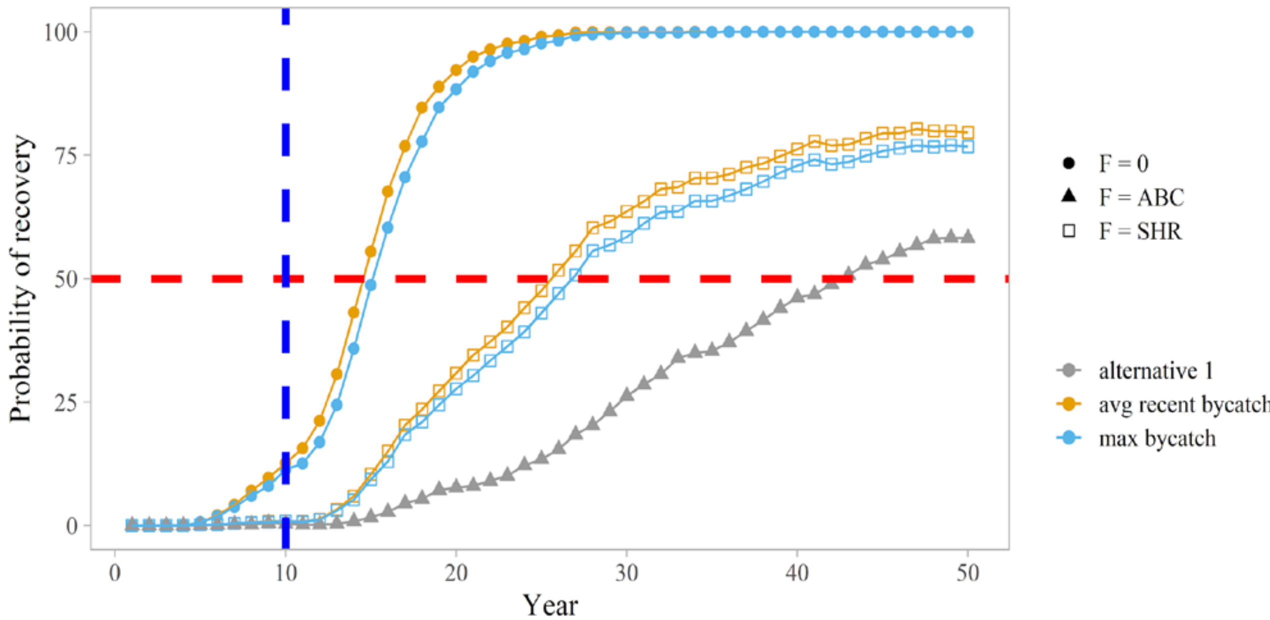

Figure 14. Comparisons of probability of recovery with Ricker S-R relationship using the entire time series (1978-2018) under different bycatch scenarios and both F = 0 (T_{min}) and F equivalent to the state harvest rate (SHR). From the 2019 BSAI Crab SAFE.

Under Alternative 1 and Alternative 2/Option 2, any year when the State harvest strategy is not triggered by threshold survey catches, the fishery would not open. Additionally, under any alternative or option, all of the existing area closures and gear restrictions that reduce fishery impacts on SMBKC would be expected to be maintained throughout rebuilding since none are associated with sunset dates. For these reasons, the fishing mortality applied under Alternative 1 may be unrealistic.

For Alternative 2, Option 1 the time to achieve a 50% probability of rebuilding is estimated to be 14.5 years under either bycatch scenario (Table 9), which is equivalent to T_{min} (F=0) and illustrates the absence of a constraining impact on rebuilding from potential groundfish bycatch. The time to rebuild under Alternative 2/Option 2 is estimated to be 25.5 years, which is three years less than the estimate of T_{max}. Similar to Alternative 1, this Option would allow for directed harvest under the State harvest strategy, however, because a rebuilding plan would be in place, constraints on fishing mortality in the projections prevent it from increasing to force harvest at ABC.

Under Option 2, the State harvest strategy would prohibit fishing unless the preseason survey estimate of mature male blue king crab is at least 50 percent of the 1978–2012 average survey estimate of mature males. In the harvest strategy at 5 AAC 34.917(d)(1) (A) and (B), the preseason survey estimate is defined as either the assessment model biomass estimate or, if an assessment model isn't used, the EBS swept area trawl survey biomass estimate. Since an assessment model is used for estimating SMBKC MMB, annual updates of the stock assessment for determination of stock status (B_y/B_{msy}) under the

Council process would also be used for updating $B_y/B_{1978\text{-}2012}$ to determine openings under the State harvest strategy.

The State harvest strategy can be thought of as conservative compared to the threshold for allowing harvest under the existing federal control rule parameters for SMBKC. Directed fishing is prohibited under the Council's F_{OFL} control rule at $B/B_{msy} = \beta = 25\%$ (2019 BSAI Crab SAFE), while the State harvest strategy prohibits fishing at biomass levels below $B_y/B_{1978\text{-}2012} = 50\%$.

Additionally, the values of biomass estimated for each year in the assessment period are susceptible to adjustment as the assessment is updated with new catch data, so that new ratios of terminal year biomass (B) and biomass from the State and federal reference time frames ($B_{1978\text{-}2012}$ or B_{msy}) would be generated. In the current assessment, the value for the State basis, $B_{1978\text{-}2012}$, is 3,880 t compared to the B_{MSY} = 3,484 t. In the last four assessment updates (2016-2019), $B_{1978\text{-}2012}$ has been greater than B_{MSY} (range +4% in 2016 to +10% in 2019).

When the fishery does open under the State harvest strategy, harvest from the sloping portion of the State control rule is less than under the current parameter values for calculating ABC as a function of the federal F_{OFL} control rule. A larger denominator (for the time being) and threshold for opening would tend to delay directed fishing under the State harvest strategy relative to the Federal control rule and contributed to the State closure of directed fishing since 2016. Delays in stock growth following closure of the fishery are illustrated in the rebuilding projections (Figure 14) and are likely related to delays in the onset of increases in recruitment. The age of recruitment of male crab to the mature male stock is 7 years (citation). Increases in MMB in the F=0 projections does not occur until 5-6 years out, while under Option 2, MMB does not begin to slope upward for 13-14 years.

Table 9. Times to rebuild under Alternative 2 Options 1 and 2 based on projections using Tier 4 Bmsy proxy from the entire 1978-2018 time frame and Ricker stock-recruit relationship.

Alternative	Time for 50% Prob of Rebuilt	Fishing mortality	Diff from T_{min} (14.5 years)	Diff from T_{max} (28.5 years)
Alt 1	>50 years	F = M (0.18)	>+29 years	>+15 years
Alt 2, Option 1	14.5 years	zero	$=T_{min}$	-17 years
Alt 2, Option 2	25.5 years	State harvest strategy	+11 years	-3 years

If the speed of recovery is the primary metric for benefits to the SMBKC stock, Alternative 2 / Option 1 is the most beneficial to the stock. Nevertheless, a protracted rebuilding period is expected even under a prohibition of directed fishing. No additional measures, such as reducing bycatch mortality (section 3.2.2) appear promising to accelerate rebuilding. Ecosystem conditions (section 3.2.4) may improve that would result in reduced natural mortality and increased production but are addressed during rebuilding through continued monitoring of ecosystem indicators. The allowance, in the projections, for recruitment to eventually increase and contribute to stock growth assumes that existing ecosystem conditions or other constraints on production will not continue indefinitely.

3.3. Economic and Social Effects

This section provides background information on the fishery as well as the economic and social impacts of the alternatives including identification of the individuals or groups that may be affected by the action, and the nature, direction and magnitude of impacts if possible. The objective of this amendment is to rebuild the St. Matthew blue king crab stock to sustainable levels. The alternatives were discussed in section 2.

3.3.1. Description of the Fishery

The St. Matthew Island blue king crab fishery occurs in that portion of the Bering Sea north of the latitude of Cape Newenham at 58° 39' N. lat. and south of the latitude of Cape Romanzof at 61° 49' N. lat. This area, along with the rest of the Bering Sea, was fished by Japanese, Russian and other foreign vessels beginning in 1930. The last foreign fishing operations in this area concluded in 1974. The St. Matthew area was first exploited commercially by domestic fishers in 1977, when 10 vessels harvested 590 t. Catch and effort continued to increase with a peak harvest of 4,012 t taken in 1983 by 164 vessels. The annual harvest since that time has only exceeded 2,000 t once, in 1997. In 1998 the harvest was 1,347 t taken by 131 vessels. Significant declines in all components of the stock, including legal males, which fell below the minimum stock size threshold, prompted a complete fishery closure for the 1999 season.

In November 2000, Amendment 15 to the FMP for Bering Sea/Aleutian Islands king and Tanner crabs was approved to implement a rebuilding plan for the SMBKC stock (NPFMC 2000). After a closure for ten years while under the rebuilding plan, the St. Matthew Island blue king crab stock was declared rebuilt in 2009 and the fishery was opened for the 2009/10 season, landing over 209 t worth almost $1 million. The fishery increased substantially for the next three years, landing 573-853 t annually worth between $6.2-8.7 million. Due to low area-swept survey results in 2013, the fishery was closed for the 2013/14 season, but was subsequently reopened for 2014/15 and 2015/16. The fishery was substantially smaller during these years, landing just over 140 t and 48 t respectively. Dollar value of the fishery cannot be reported for these years due to confidentiality. Low survey abundance since 2016 has led to fishery closures for the past three years (the 2016/17, 2017/18, and 2018/19 seasons) (Table 10).

Table 10. Fishery characteristics for the directed St. Matthew Island blue king crab pot fishery. Source: 2019 SAFE (GHL/TAC) and Comprehensive fish tickets sourced through AKFIN. *Data are not reported due to confidentiality.

Fishing Year	GHL/TAC (mil lbs)	Crab	Pounds	Value	Pot lifts	CPUE	CVs	Landings	Trips
1999/00 - 2008/09				FISHERY CLOSED					
2009/10	1.17	101,074	460,857	986,770	10,697	9	7	21	16
2010/11	1.6	296,183	1,263,974	6,225,905	29,346	10.1	11	47	39
2011/12	2.54	430,813	1,880,606	8,695,968	48,554	8.9	18	61	58
2012/13	1.63	374,278	1,616,048	6,966,710	37,065	10.1	17	54	46
2013/14				FISHERY CLOSED					
2014/15	0.66	67,872	308,581	*	10,133	6.7	4	18	14
2015/16	0.41	24,045	106,422	*	5,475	4.4	3	6	6
2016/17 - 2018/19				FISHERY CLOSED					

Season timing and duration have varied through the years based on catch limits and management changes. Over the 1977 to 1998 period, the SMBKC fishery was prosecuted during open seasons that varied in length and timing, with the earliest opening on June 7 in 1977, growing later over subsequent seasons to August 1 in 1982, September 1 in 1985, and September 16 in 1991, and September 15 from 1993 through 1998. Prior to 1982, SMBKC openings ranged from approximately 5 to 9 weeks, with the latest closing on September 3 after 19 days in both 1978 and 1980. Over subsequent years (when the fishery was open) prior to the crab rationalization program (implemented in 2005), openings in the fishery were limited to shorter spans of 1 to 11 days, with the latest closing in 1998 on September 26. With the implementation of the crab rationalization program, the regulatory season for SMBKC was shifted to October 15 through February 1, with active fishing typically during years when the fishery opened occurring within a period of 4-5 weeks beginning October 15, with final landings for the respective seasons occurring during early- to mid-November.

Since the 2009/10 season when the fishery reopened after the 10-year closure all participating vessels have been catcher vessels (no catcher processors have participated in the fishery). Participation increased from seven CVs in the 2009/10 season to 18 in the 2011/2 season. Participation dropped substantially after the 2013/14 closure with only four CVs participating in the 2014/15 season and three in the 2015/16 season (Table 11). Vessels that have participated in the SMBKC fishery are primarily owned in communities in Washington and Alaska with a few vessels also participating from Oregon (Table 11). A majority of the revenues from the SMBKC fishery over the past ten years have gone to vessels from Oregon and Washington while only 28% of annual average revenues from 2010-2012 was landed by vessels owned in Alaska (Table 12).

Table 11. Vessels Participating in the Saint Matthew Island blue king crab, 2010-2015 (number of vessels)

Geography	2010	2011	2012	2013	2014	2015	Annual Average 2010-2015 (number)	Annual Average 2010-2015 (percent)	Total Unique CVs 2010-2015 (number)
Anchorage	3	4	3	Fishery closed	0	0	2.0	18.87%	7
Homer	0	0	2		0	0	0.4	3.77%	2
Kenai	0	0	0		0	1	0.2	1.89%	1
Kodiak	1	2	1		0	1	1.0	9.43%	3
Alaska Total	4	6	6		0	1	3.4	32.08%	12
Milton Freewater	1	1	1		0	0	0.6	5.66%	1
Newport	0	1	0		0	0	0.2	1.89%	1
Cascade Locks	1	1	1		1	1	1.0	9.43%	1
Oregon Total	2	3	2		1	1	1.8	16.98%	3
Seattle	5	8	8		3	1	5.0	47.17%	10
Greenbank	0	1	1		0	0	0.4	3.77%	1
Washington Total	5	9	9		3	1	5.4	50.94%	11
Grand Total	11	18	17		4	3	10.6	100.00%	26

*Seattle MSA includes all communities in King, Pierce, and Snohomish counties.
Note: Due to ownership movement between communities over the years shown, total unique vessels per community may not sum to state or grand totals.
Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

Table 12. Revenue for Vessels Participating in the Saint Matthew Island blue king crab fishery, 2010-2015 (millions of 2018 real dollars).

Geography	2010	2011	2012	2013	2014	2015	Annual Average 2010-2012 ($ millions)	Annual Average 2010-2012 (percent)
Alaska Total	$2.11	$2.45	$2.33	Fishery Closed	*	*	$2.30	27.99%
WA, OR Total	$5.04	$7.33	$5.35		*	*	$5.91	72.01%
Grand Total	$7.15	$9.78	$7.69		*	*	$8.21	100.00%

* Data not reported due to confidentiality restrictions

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

The vessels participating in the SMBKC fishery since 2010, on average, receive a fairly low percentage of their total revenues from the SMBKC fishery. Given fishery closures and data confidentiality requirements, reportable revenue information is only available for a few of the past 20 years. From 2010-2012 vessel dependence on SMBKC revenues was around 15% of annual average revenues (Table 13). Figure 15 displays the percentage of average revenue over 2010-2015 (excluding 2014 when the fishery was closed), by fishery for SMBKC vessels based on their relative dependence on SMBKC. Vessels are grouped into quartiles based on the percentage of their revenue from 2010-13 and 2015 that they receive from SMBKC. Vessels that participate in the SMBKC fishery generally participate in other crab fisheries, mainly the Bristol Bay red king crab and Bering Sea snow crab and to a lesser extent, Bering Sea Tanner crab East and West as well as groundfish. Those vessels with higher relative dependence on SMBKC generally have more evenly distributed portfolio of landings revenues, while those with lower SMBKC dependence are more heavily reliant on Bristol Bay red king crab and Bering Sea snow crab.

Table 13. Vessels Revenue Dependence on the Saint Matthew Island blue king crab fishery, 2010-2012 (millions of 2018 real dollars).

Geography	Annual Average Number of Vessels	Annual Average Ex-Vessel Gross Revenues	Annual Average Total Ex-Vessel Gross Revenues	Ex-Vessel Value as a Percentage of Total Ex-Vessel Gross Revenue
Alaska Total	5.3	$2.30	$18.90	12.15%
WA and OR	10.0	$5.91	$36.10	16.37%
Grand Total	15.3	$8.21	$55.00	14.92%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

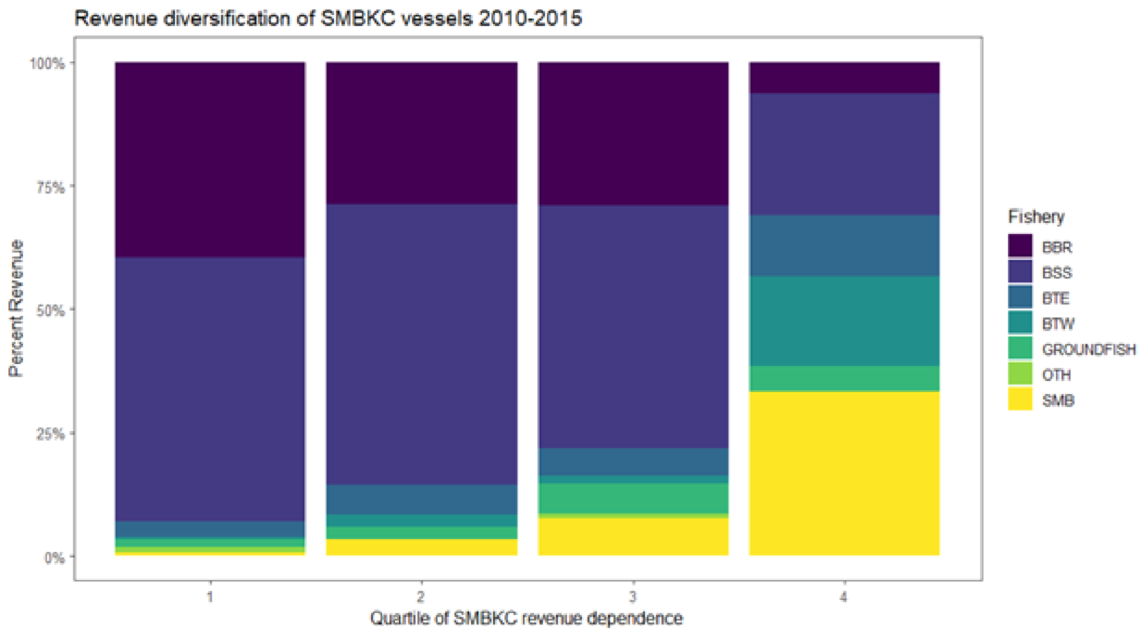

Figure 15. Percentage of average revenue 2010-2015 (excluding 2014 when fishery was closed), by fishery for SMBKC vessels based on their relative dependence on SMBKC. Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

Table 14 provides information on ex-vessel gross revenue from the SMBKC fishery relative to total ex-vessel gross revenue from all areas, gears, and fisheries by community. Communities are identified by the historical ownership address for the vessels that participated in the SMBKC fishery from 2010 through 2012. Within these communities, both the number of vessels and the amount of revenue derived from SMBKC represent a relatively small pro portion of the overall community fishing effort and participation. Of over 1,100 vessels that participate in commercial fishing in these communities, only 15 participate in the SMBKC fishery (Table 14). Ex-vessel revenue from the SMBKC fishery accounts for less than one percent of total ex-vessel revenues in these communities (Table 14).

Table 14. Community Fishery Revenue Dependence on the Saint Matthew Island blue king crab fishery, 2010-2012 (millions of 2018 real dollars).

Geography	Annual Average Number of Vessels	Annual Average Number of Commercial Fishing CVs in those Same Communities	Annual Average Ex-Vessel Gross Revenues from SMB Fishery	Annual Average Total Ex-Vessel Gross Revenues from All Areas, Gears, and Species Fisheries by Community	Annual Average Saint Matthews Blue King Crab Ex-Vessel Revenue as a Percentage of Total Ex-Vessel Revenue
Alaska Total	5.3	866	$2.30	$270.65	0.85%
WA and OR	10.0	298	$5.91	$608.16	0.97%
Grand Total	15.3	1,164	$8.21	$878.81	0.93%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

Declines in participation over the past 10 years were also reflected in the processing sector. From 2009-2012, the communities of Dutch Harbor/Unalaska, St. Paul, and Akutan operated plants that received landings of SMBKC. Since the 2013/14 closure St. Paul is the only community that has received landings (Table 15). Between 2010 and 2012 the overall community processing dependence as measured by the amount of ex-vessel value processed in each community that is from the SMBKC fishery is just over 1.3% (Table 16).

Table 15. Shore-Based Processors in Alaska Accepting Saint Matthew Island blue king crab Deliveries, 2010-2015 (number of processors).

Geography	2010	2011	2012	2013	2014	2015	Annual Average 2010-2015 (number)	Annual Average 2010-2015 (percent)	Total Unique SBPRs 2010-2015 (number)
Akutan	1	1	1	Fishery Closed	0	0	0.6	21.43%	1
Unalaska/Dutch Harbor	2	2	2		0	0	1.2	42.86%	3
St Paul	1	1	1		1	1	1.0	35.71%	1
Total	4	4	4		1	1	2.8	100.00%	5

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

Table 16. Processors Ex-Vessel Values From Saint Matthew Island blue king crab, 2010-2015 (millions of 2018 real dollars).

	2010	2011	2012	2013	2014	2015	Annual Average 2010-2012 ($ millions)	Processor Dependence 2010-2012 (percent)	Community Processing Dependence 2010-2012 (percent)
Shore-Based Processors	$7.15	$9.78	$7.69	NA	*	*	$8.21	1.38%	1.35%

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive FT

Socioeconomic indicators

Socioeconomic indicators tracked in the Ecosystem and Socioeconomic Profile of the St. Matthew Blue King Crab stock in the Bering Sea (Fedewa et al. 2019) demonstrate a decline in most metrics of commercial value, constituent demand, community dependence and relative quantity and efficiency of fishing effort (Figure 16). It should be noted that the intermittent opening of the targeted SMBKC fishery over the last 20 years, creates substantial gaps in the time-series. Most socioeconomic indicators indicate zero (0) values when no fishery occurred, and the small number of vessels or processors participating in the fishery during some recent openings prevents reporting the value of some indicators for those years to protect confidentiality of associated landings and/or catch and effort data. Additionally, discontinuities in some data series due to changes in data collection methods limit reporting of indicator values to 1991 and later (Fedewa et al. 2019).

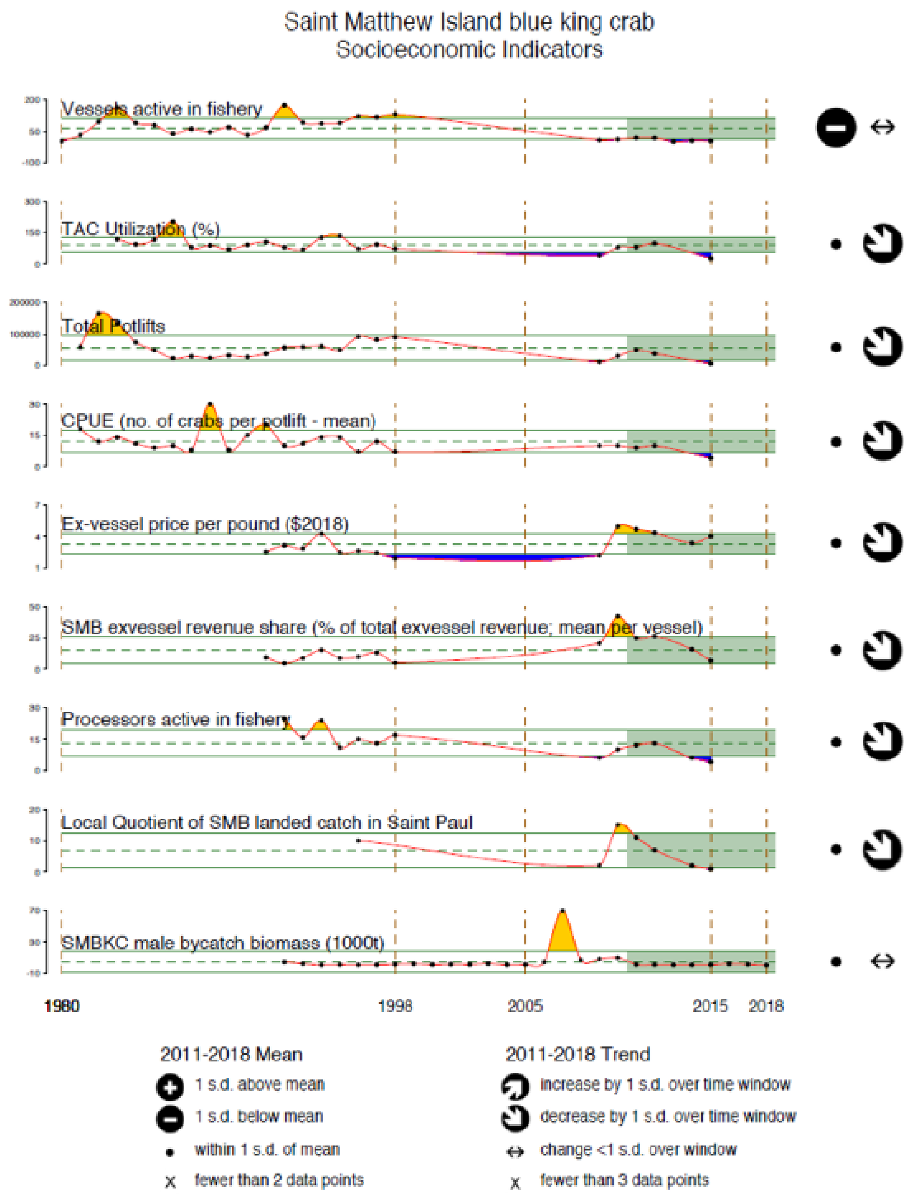

Figure 16. Selected ecosystem indicators for SMBKC with time series ranging from 1980 – 2019. Upper and lower solid green horizontal lines are 90th and 10th percentiles of time series. Dotted green horizontal line is the mean of time series. Light green shaded area represents the most recent five years for mean and trend analysis. Source: Ecosystem and Socioeconomic Profile of the Saint Matthew Blue King Crab stock in the Bering Sea 2019.

3.3.2. Expected Effects of the Alternatives

The Alternatives are described in detail in section 2. Alternative 1 would fail to implement a rebuilding plan. This would be a direct violation of the MSA, thus the effects of Alternative 1 are not analyzed further.

Alternative 2 would implement a rebuilding plan. Within Alternative 2, Option 1 would prohibit directed harvest throughout the rebuilding period. Option 2 would allow for directed harvest under the State of Alaska SMBKC harvest strategy. That strategy would prohibit directed harvest at any point during rebuilding when the State's preseason survey estimate of mature male blue king crab is less than 50 percent of the 1978–2012 average survey estimate of mature males. If the preseason survey estimate allowed for a directed fishery, it would be subject to harvest control rules as described in section 2.2.

In the projection scenarios, the minimum time to reach a greater than 50% probability of rebuilding was 14.5 years under Option 1 and 25.5 years under Option 2 (Table 9). Therefore it is likely that under Alternative 2, Option 1, the directed SMBKC fishery would be closed for the next 14.5 years; while under Option 2, the fishery would likely open sooner (subject to the State harvest strategy) but would take 11 years longer to rebuild. No specific analysis was done to estimate how many years into the future the State harvest strategy would allow direct harvest under Option 2 (when the State's preseason survey estimate of mature male blue king crab is projected to be at least 50 percent of the 1978–2012 average survey estimate of mature males). However, according to the recovery probability analysis, the fishing mortality under Option 1 (F=0) and Option 2 (F=SHR) begin to diverge at year five (Figure 14). Therefore, under Option 2 the fishery would likely be closed for the next five years. It is important to note that the purpose of the recovery probability analysis was not to estimate when the State harvest strategy would allow a directed fishery to open but rather to compare the probability of stock recovery under different recruitment scenarios and differing levels of bycatch. Under these different recruitment and bycatch scenarios the year in which F=0 and F=SHR begin to diverge varies from year 3 to year 8. Therefore according to this analysis, under Alternative 2, Option 2, the fishery could be closed for the next three to eight years.

In either option under Alternative 2 there would be no directed SMBKC fishery in the near future, likely for three to eight years under Option 2 and longer under Option 1. Given that the fishery was last open in the 2015 season, Alternative 2 represents a continuation of status quo. The direct social and economic impacts associated with closing the directed fishery have already occurred, therefore the short-term impacts of Alternative 2 are negligible. Inconsistent openings and reduced TACs over the last few years the fishery was open led to consolidation in participation at the vessel and processing level. Only three vessels participated during the last year the fishery was open (2015/16), a substantial decline from the 18 vessels operating in 2011/12 (the peak participation since the 2009/10 season when the fishery reopened after the 10-year closure). Additionally, processing participation declined such that St. Paul is the only community that has processed SMBKC landings since 2013.

Given the intermittent openings and decreasing TACs of the targeted SMBKC fishery over the last 20 years, vessel and community dependence on SMBKC is relatively low (as described in section 3.3.1). Saint Paul is the only community that received landings since 2013. According to the Ecosystem and Socioeconomic Profile of the fishery (Fedawa et al 2019) the ex-vessel revenue share and the Local Quotient for Saint Paul both reached high values during 2010, concurrent with a peak in ex-vessel price. Large declines in both metrics over the subsequent open seasons, despite relatively high ex-vessel prices during the next four open SMBKC seasons indicate that both vessels and processors active during those years have shifted into other fisheries (Fedawa et al. 2019).

Long term social and economic effects of Alternative 2 are likely to be positive if the fishery rebuilds and can support a directed fishery. While the effects are similar under Option 1 and 2, the timeline of these effects may vary based on which Option is selected. Under Option 1, the fishery would remain closed longer, but rebuilding (and a fully open directed fishery) would likely occur sooner. Under Option 2, the State harvest strategy may open some fishing earlier, this would increase the timeline for full rebuilding of the fishery (Table 9). Given that the fishery has been prosecuted after previous closed periods and TAC reductions, it is likely that some vessels would re-enter the fishery if rebuilding occurs. If future patterns of participation are consistent with those of previous years, benefits of rebuilding would likely accrue to Alaska, Washington and Oregon communities associated with vessels as identified in section 3.3.1 and the processing sector in St. Paul, AK. Detailed information about these communities is provided in NOAA Fisheries Fishing Community Profiles.

3.4. NEPA Summary

To be completed for final review

4. Magnuson-Stevens Act and FMP Considerations

4.1. Magnuson-Stevens Act National Standards

Consistency with the MSA is also addressed in section 1.2, above. Rebuilding overfished stocks is required by the Magnuson-Stevens Act, section 304(e), and therefore, this action is directly responsive to the MSA mandates.

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), and a brief discussion of how each alternative is consistent with the National Standards, where applicable. In recommending a preferred alternative, the Council must consider how to balance the national standards.

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

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

> (A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
>
> (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and
>
> (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

The action alternative prevents overfishing of Saint Matthew Island blue king crab (SMBKC) by establishing a rebuilding plan that identifies catch levels that will rebuild the stock.

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

Information in this analysis represents the most current, comprehensive set of information available to the North Pacific Fishery Management Council (Council), recognizing that some information (such as operational costs) is unavailable.

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

This stock is managed as a single unit within the area defined as the stock boundary, and the rebuilding plan would be in effect throughout the management unit.

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

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

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

The wording of this standard was changed in the 2006 Magnuson-Stevens Act authorization, to consider rather than promote efficiency. Efficiency in the context of this change refers to economic efficiency, and the reason for the change, essentially, is to de-emphasize to some degree the importance of economics relative to other considerations (Senate Report of the Committee on Commerce, Science, and Transportation on S. 39, the Sustainable Fisheries Act, 1996). The analysis presents information relative to these perspectives and provides information on the economic risks associated with the proposed rebuilding plan.

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

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

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

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

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of National Standard 2, in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

A summary of the level of fishery engagement and dependence in communities with regard to SMBKC fishing is provided in section 3.3. Between 2010 and 2012 the overall community processing dependence as measured by the amount of ex-vessel value processed in each community that is from the SMBKC fishery is just over 1.3%. The sustained participation of the identified fishing communities is not put at risk by any of the alternatives being considered.

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

The proposed action is specifically intended to control SMBKC catches through rebuilding. The practicability of the alternatives is demonstrated through existing fishery closures and mechanisms for establishing harvest limits.

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

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

4.2. Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP or FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA. The effects on participants in the fisheries and fishing communities are analyzed in section 3.3 No effects of the proposed action on safety of human life at sea are anticipated since no changes in fishery management measures are proposed. Based on the information reported in this section, there is no need to update the Fishery Impact Statement included in the FMP.

The proposed action affects the Saint Matthew Island blue king crab fishery in the EEZ off Alaska, which is under the jurisdiction of the North Pacific Fishery Management Council and the State of Alaska. Impacts on participants in fisheries conducted in adjacent areas under the jurisdiction of other Councils are not anticipated as a result of this action.

4.3. Council's Ecosystem Vision Statement

In February 2014, the Council adopted, as Council policy, the following:

Ecosystem Approach for the North Pacific Fishery Management Council

Value Statement

The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.

Vision Statement

The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.

Implementation Strategy

The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.

The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

In considering this action, the Council is being consistent with its ecosystem approach policy. This action establishes a plan for rebuilding the Saint Matthew blue king crab stock, taking into account the biology of the stock and prevailing ecosystem conditions. This is supportive of the Council's intention to prevent overfishing and to adjust catch levels as necessary to account for uncertainty and ecosystem factors.

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6. References

Daly, B., R. Foy, and C. Armistead. 2014. The 2013 eastern Bering Sea continental shelf bottom trawl survey: results for commercial crab species. NOAA Technical Memorandum295, NMFS-AFSC.

Fedawa, E., Garber-Yonts, B., Shotwell, K., and Palof, K. Ecosystem and Socioeconomic Profile of the Saint Matthew Blue King Crab stock in the Bering Sea 2019.

Fitch, H., M. Deiman, J. Shaishnikoff, and K. Herring. 2012. Annual management report for the commercial and subsistence shellfish fisheries of the Bering Sea, 2010] Fitch, H., M. Schwenzfeier, B. Baechler, T. Hartill, M. Salmon, and M. Deiman, E.

Garber-Yonts, B., and J. Lee.,. Stock Assessment and Fishery Evaluation Report for King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions: Economic Status of the BSAI Crab Fisheries, 2018. http://www.afsc.noaa.gov/refm/Socioeconomics/SAFE/default.php

Gish, R.K., V.A. Vanek, and D. Pengilly. 2012. Results of the 2010 triennial St. Matthew Island blue king crab pot survey and 2010/11 t of Fish and Game, Fishery Management Report No. 12-24, Anchorage.

Jensen, G.C., and D.A. Armstrong. 1989. Biennial reproductive cycle of blue king crab, *Paralithodes platypus*, at the Pribilof a congener, P. camtschatica. Can. J. Fish. Aquat. Sci. 46: 932-940.

NMFS. 2001. Final Supplemental Environmental Impact Statement. Steller sea lion protection measures. NMFS, Juneau, AK.

NMFS. 2004. Final Environmental Impact Statement/Regulatory Impact Review/Initial Regulatory Flexibility Analysis/Social Impact Assessment for Bering Sea and Aleutian Islands Crab Fisheries. NMFS, Juneau, AK.

NOAA Fisheries Fishing Community Profiles. https://www.fisheries.noaa.gov/national/socioeconomics/fishing-community-profiles

NPFMC. 2000. Environmental assessment/regulatory impact review/initial regulatory flexibility analysis for proposed Amendment 15 to the Fishery Management Plan for king and Tanner crab fisheries in the Bering Sea/Aleutian Islands and regulatory amendment to the Fishery Management Plan for the groundfish fishery of the Bering Sea and Aleutian Islands area: A rebuilding plan for the Pacific Fishery Management Council, Anchorage. Draft report.

NPFMC. 2009. Amendment 94 to the Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands to Require Trawl Sweep Modification in the Bering Sea Flatfish Fishery, Establish a Modified Gear Trawl Zone, and Revise Boundaries of the Northern Bering Sea Research Area and Saint Matthew Island Habitat Conservation Area. North Pacific Fishery Management Council, 605 West 4th Ave, Anchorage, AK. 99501.

NPFMC. 2011. Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. NPFMC, Anchorage, AK.

NPFMC. 2019. Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions. NPFMC, Anchorage, AK.

Otto, R.S. 1990. An overview of eastern Bering Sea king and Tanner crab fisheries. Pages 9-26 [In] Proceedings of the international symposium on king and Tanner crabs University of Alaska Fairbanks, Alaska Sea Grant Program Report 90-4, Fairbanks.

Otto, R.S., and P.A. Cummiskey. 1990. Growth of adult male blue king crab (*Paralithodes platypus*). Pages 245-258 [In] Proceedings of the international symposium on king and Tanner crabs. University of Alaska Fairbanks, Alaska Sea Grant Report 90-4, Fairbanks.

Overland, J. E., S. Rodionov, S. Minobe, and N. Bond, 2008: North Pacific regime shifts: Definitions, issues, and recent transitions. Prog. Oceanogr., 77, 92–102.

Pengilly, D. and D. Schmidt. 1995. Harvest Strategy for Kodiak and Bristol Bay red king crab and St. Matthew Island and Pribilof blue king crab. Alaska Department of Fish and Game Commercial Fisheries Management and Development Division, Special Publication Number 7, Juneau.

Somerton, D.A., and R.A. MacIntosh. 1983. The of blue king crab, *Paralithodes platypus*, in Alaska. Fishery Bulletin 81: 621-828.

Webber, D., J. Zheng, and J. Ianelli, 2016. Stock assessment of Saint Matthews Island Blue King Crab. North Pacific Fishery Management Council. Anchorage AK.

Zheng, J., and G.H. Kruse. 2002. Assessment and management of crab stocks under uncertainty of massive die-offs and rapid changes in survey catchability. Pages 367-384 [In] A.J. Paul, E.G. Dawe, R. Elner, G.S. Jamieson, G.H. Kruse, R.S. Otto, B. Sainte-Marie, T.C. Shirley, and D. Woodby (eds.). Crabs in Cold Water Regions: Biology, University of Alaska Fairbanks, Alaska Sea Grant Report 02-01, Fairbanks.