2013 Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands

Introduction

The annual stock assessment and fishery evaluation (SAFE) report is a requirement of the North Pacific Fishery Management Council's *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP)*, and a federal requirement [50 CFR Section 602.12(e)]. The SAFE report summarizes the current biological and economic status of fisheries, total allowable catch (TAC) or Guideline Harvest Level (GHL), and analytical information used for management decisions. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the NMFS web page at http://www.fakr.noaa.gov and the Alaska Department of Fish and Game (ADF&G) Westward Region Shellfish web page at: http://www.cf.adfg.state.ak.us/region4/shellfsh/shelhom4.php.

This FMP applies to 10 crab stocks in the BSAI: 4 red king crab, *Paralithodes camtschaticus*, stocks (Bristol Bay, Pribilof Islands, Norton Sound and Adak), 2 blue king crab, *Paralithodes platypus,* stocks (Pribilof District and St Matthew Island), 2 golden (or brown) king crab, *Lithodes aequispinus,* stocks (Aleutian Island and Pribilof Islands), EBS Tanner crab *Chionoecetes bairdi*, and EBS snow crab *Chionoecetes opilio*. All other BSAI crab stocks are exclusively managed by the State of Alaska.

The Crab Plan Team (CPT) annually assembles the SAFE report with contributions from ADF&G and the National Marine Fisheries Service (NMFS). This SAFE report is presented to the North Pacific Fishery Management Council (NPFMC) and is available to the public on the NPFMC web page at: http://fakr.noaa.gov/npfmc/membership/plan_teams/CRAB_team.htm. Under a process approved in 2008 for revised overfishing level (OFL) determinations, and new ACL requirements in 2011, the Crab Plan Team reviews three assessments in May to provide recommendations on OFL, ABC and stock status specifications for review by the Council's Science and Statistical Committee (SSC) in June. In September, the CPT reviews the remaining assessments and provides final OFL and ABC recommendations and stock status determinations. Additional information on the OFL and ABC determination process is contained in this report.

The Crab Plan Team met from September 17-20, 2013 in Seattle, WA to review the final stock assessments as well as additional related issues, in order to provide the recommendations and status determinations contained in this SAFE report. This final 2013 Crab SAFE report contains all recommendations for all 10 stocks including those whose OFL and ABC were determined in June 2013. This SAFE report will be presented to the Council in October for their annual review of the status of BSAI Crab stocks. Members of the team who participated in this review include the following: Bob (Chair), Karla Bush (Vice-Chair), Wayne Donaldson, Heather Fitch, Brian Garber-Yonts, Jason Gasper, Ginny Eckert, Doug Pengilly André Punt, Buck Stockhausen, Martin Dorn, Shareef Siddeek, Jack Turnock and Diana Stram.

Stock Status Definitions

The FMP (incorporating all changes made following adoption of Amendment 24) contains the following stock status definitions:

Acceptable biological catch (ABC) is a level of annual catch of a stock that accounts for the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty and is set to prevent, with a greater than 50 percent probability, the OFL from being exceeded. The ABC is set below the OFL.

ABC Control Rule is the specified approach in the five-tier system for setting the maximum permissible ABC for each stock as a function of the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For crab stocks, the ACL will be set at the ABC.

Total allowable catch (TAC) is the annual catch target for the directed fishery for a stock, set to prevent exceeding the ACL for that stock and in accordance with section 8.2.2 of the FMP.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available.

F_{MSY} control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B_{MSY} stock size is the biomass that results from fishing at constant F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Maximum fishing mortality threshold (MFMT) is defined by the F_{OFL} control rule, and is expressed as the fishing mortality rate.

Minimum stock size threshold (MSST) is one half the B_{MSY} stock size.

Overfished is determined by comparing annual biomass estimates to the established MSST. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished.

Overfishing is defined as any amount of catch in excess of the overfishing level (OFL).   The OFL is calculated by applying the F_{OFL} control rule annually estimated using the tier system in Chapter 6.0 to abundance estimates.

Status Determination Criteria

The FMP defines the following status determination criteria and the process by which these are defined following adoption of amendment 24 and 38.

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criteria and acceptable biological catch (ABC) levels are annually formulated. The annual catch limit (ACL) for each stock equals the ABC 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, the overfishing level (OFL) equals maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system.   Overfishing is

determined by comparing the OFL with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. For the previous crab fishing year, NMFS will also determine whether the ACL was exceeded by comparing the ACL with the catch estimates for that crab fishing year. Catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL and ACL will be set for and compared to the retained catch.

NMFS will determine whether a stock is in an overfished condition by comparing annual biomass estimates to the established MSST, defined as ½ B_{MSY}. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the Council to immediately end overfishing and rebuild affected stocks.

The Magnuson-Stevens Act requires that FMPs include accountability measures to prevent ACLs from being exceeded and to correct overages of the ACL if they do occur. Accountability measures to prevent TACs and GHLs from being exceeded have been used under this FMP for the management of the BSAI crab fisheries and will continue to be used to prevent ACLs from being exceeded. These include: individual fishing quotas and the measures to ensure that individual fishing quotas are not exceeded, measures to minimize crab bycatch in directed crab fisheries, and monitoring and catch accounting measures. Accountability measures in the harvest specification process include downward adjustments to the ACL and TAC in the fishing year after an ACL has been exceeded.

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

Optimum yield is defined in the FMP Chapter 4. Information pertaining to economic, social and ecological factors relevant to the determination of optimum yield is provided in several sections of the FMP, including sections 7.2 (Management Objectives), Chapter 11, Appendix D (Biological and Environmental Characteristics of the Resource), and Appendix H (Community Profiles).

For each crab fishery, the optimum yield range is 0 to < OFL catch. For crab stocks, the OFL is the annualized maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Recognizing the relatively volatile reproductive potential of crab stocks, the cooperative management structure of the FMP, and the past practice of restricting or even prohibiting directed harvests of some stocks out of ecological considerations, this optimum yield range is intended to facilitate the achievement of the biological objectives and economic and social objectives of the FMP (see sections 7.2.1 and 7.2.2) under a variety of future biological and ecological conditions. It enables the State to determine the appropriate TAC levels below the OFL to prevent overfishing or address other biological concerns that may affect the reproductive potential of a stock but that are not reflected in the OFL itself. Under FMP section 8.2.2, the State establishes TACs at levels that maximize harvests, and associated economic and social benefits, when biological and ecological conditions warrant doing so.

<u>Five-Tier System</u>

The OFL and ABC for each stock are annually estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 6-1 and 6-2. 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 Crab Plan Team process to the Council's Scientific and Statistical Committee. The Council's Scientific and Statistical Committee recommends tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the proposed OFLs and ABCs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 6-1). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β).

In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β. At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST.

For Tiers 1 through 3, the coefficient α is set at a default value of 0.1, and β set at a default value of 0.25, with the understanding that the Scientific and Statistical Committee may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}.

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

Second, the assessment author prepares the stock assessment and calculates the proposed OFLs by applying the F_{OFL} and using the most recent abundance estimates. The assessment authors calculate the proposed ABCs by applying the ABC control rule to the proposed OFL.

Stock assessment documents shall:
- use risk-neutral assumptions;
- specify how the probability distribution of the OFL used in the ABC control rule is calculated for each stock; and
- specify the factors influencing scientific uncertainty that are accounted for in calculation of the probability distribution of the OFL.

Second, the Crab Plan Team annually reviews stock assessment documents, the most recent abundance estimates, the proposed OFLs and ABCs, and complies the Stock Assessment and Fishery Evaluation Report. The Crab Plan Team then makes recommendations to the Scientific and Statistical Committee on the OFLs, ABCs, and any other issues related to the crab stocks.

Third, the Scientific and Statistical Committee annually reviews the Stock Assessment and Fishery Evaluation Report, including the stock assessment documents, recommendations from the Crab Plan Team, and the methods to address scientific uncertainty.

In reviewing the Stock Assessment and Fishery Evaluation Report, the Crab Plan Team and the Scientific and Statistical Committee shall evaluate and make recommendations, as necessary, on:
- the assumptions made for stock assessment models and estimation of OFLs;
- the specifications of the probability distribution of the OFL;
- the methods to appropriately quantify uncertainty in the ABC control rule; and
- the factors influencing scientific uncertainty that the State has accounted for and will account for on an annual basis in TAC setting.

The Scientific and Statistical Committee will then set the final OFLs and ABCs for the upcoming crab fishing year. The Scientific and Statistical Committee may set an ABC lower than the result of the ABC control rule, but it must provide an explanation for setting the ABC less that the maximum ABC.

As an accountability measure, the total catch estimate used in the stock assessment will include any amount of harvest that may have exceeded the ACL in the previous fishing season. For stocks managed under Tiers 1 through 4, this would result in a lower maximum ABC in the subsequent year, all else being equal, because maximum ABC varies directly with biomass. For Tier 5 stocks, the information used to establish the ABC is insufficient to reliably estimate abundance or discern the existence or extent of biological consequences caused by an overage in the preceding year. Consequently, the subsequent year's maximum ABC will not automatically decrease. However, when the ACL for a Tier 5 stock has been exceeded, the Scientific and Statistical Committee may decrease the ABC for the subsequent fishing season as an accountability measure.

Tiers 1 through 3

For Tiers 1 through 3, reliable estimates of B, B_{MSY}, and F_{MSY}, or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points B_{MSY} and F_{MSY}.

- Tier 1 is for stocks with assessment models in which the probability density function (pdf) of F_{MSY} is estimated.
- Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of F_{MSY} is made.
- Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for F_{MSY} and B_{MSY} can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form "F_X" refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy such as mature male biomass at mating) per recruit equal to X% of the equilibrium level in the absence of any fishing.

The OFL and ABC calculation accounts for all losses to the stock not attributable to natural mortality. The OFL and ACL are total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are insufficient to achieve Tier 3. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation 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.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}. Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous M. The proxy B_{MSY} is the average biomass over a specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar, γ, is multiplied by M to estimate the F_{OFL} for stocks at status levels **"a"** and **"b,"** and γ is allowed to be less than or greater than unity. Use of the scalar γ is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of γ is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

If the information necessary to determine total catch OFLs and ACLs is available for a Tier 4 stock, then the OFL and ACL will be total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. If the information necessary to determine total catch OFLs and ACLs is not available for a Tier 4 stock, then the OFL and ACL are determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL and ACL from this approach, therefore, would be the total catch OFL and ACL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass and only historical catch data is available. For Tier 5 stocks, the OFL is set equal to the average catch from a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information. The ABC control rule sets the maximum ABC at less than or equal to 90 percent of the OFL and the ACL equals the ABC.

For Tier 5 stocks where only retained catch information is available, the OFL and ACL will be set for the retained catch portion only, with the corresponding limits applying to the retained catch only. For Tier 5 stocks where information on bycatch mortality is available, the OFL and ACL calculations could include discard losses, at which point the OFL and ACL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.
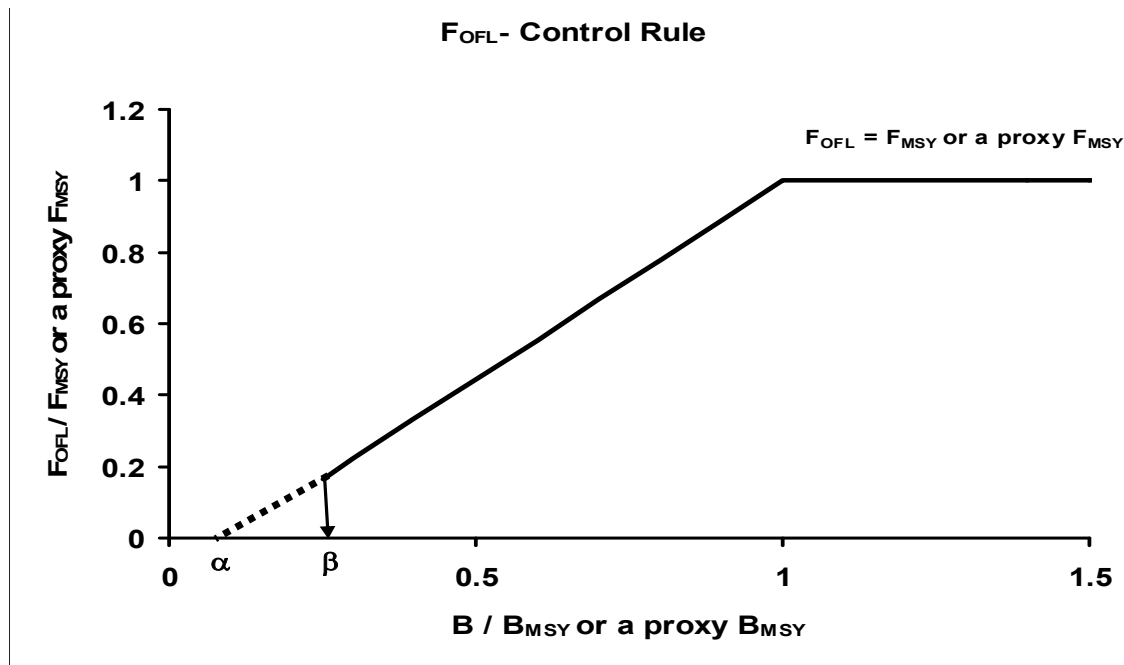
Figure 1. Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below β.

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. Table 2 contains a guide for understanding the five-tier system.**

Information available	Tier	Stock status level	F_{OFL}	ABC control rule
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\dfrac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf	
		b. $\beta < \dfrac{B}{B_{msy}} \le 1$	$F_{OFL} = \mu_A \dfrac{B/B_{msy} - \alpha}{1 - \alpha}$	ABC≤(1-b$_y$) * OFL
		c. $\dfrac{B}{B_{msy}} \le \beta$	Directed fishery F = 0 $F_{OFL} \le F_{MSY}$[†]	
B, B_{MSY}, F_{MSY}	2	a. $\dfrac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$	
		b. $\beta < \dfrac{B}{B_{msy}} \le 1$	$F_{OFL} = F_{msy} \dfrac{B/B_{msy} - \alpha}{1 - \alpha}$	ABC≤(1-b$_y$) * OFL
		c. $\dfrac{B}{B_{msy}} \le \beta$	Directed fishery F = 0 $F_{OFL} \le F_{MSY}$[†]	
B, $F_{35\%}{}^*$, $B_{35\%}{}^*$	3	a. $\dfrac{B}{B_{35\%*}} > 1$	$F_{OFL} = F_{35\%}{}^*$	
		b. $\beta < \dfrac{B}{B_{35\%}{}^*} \le 1$	$F_{OFL} = F^*_{35\%} \dfrac{\dfrac{B}{B^*_{35\%}} - \alpha}{1 - \alpha}$	ABC≤(1-b$_y$) * OFL
		c. $\dfrac{B}{B_{35\%}{}^*} \le \beta$	Directed fishery F = 0 $F_{OFL} \le F_{MSY}$[†]	
B, M, $B_{msy^{prox}}$	4	a. $\dfrac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$	
		b. $\beta < \dfrac{B}{B_{msy^{prox}}} \le 1$	$F_{OFL} = \gamma M \dfrac{B/B_{msy^{prox}} - \alpha}{1 - \alpha}$	ABC≤(1-b$_y$) * OFL
		c. $\dfrac{B}{B_{msy^{prox}}} \le \beta$	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')).

Crab Plan Team Recommendations

Table 3 lists the team's recommendations for 2013/2014 on Tier assignments, model parameterizations, time periods for reference biomass estimation or appropriate catch averages, OFLs and ABCs. The team recommends three stocks be placed in Tier 3 (EBS snow crab, Bristol Bay red king crab and EBS Tanner crab), four stocks in Tier 4 (St. Matthew blue king crab, Pribilof Island blue king crab, Pribilof Island red king crab and Norton Sound red king crab) and three stocks in Tier 5 (AI golden king crab, Pribilof Island golden king crab and Adak red king crab). Table 4 lists those stocks for which the team recommends an ABC less than the maximum permissible ABC for 2013/14. Stock status in relation to status determination criteria are evaluated in this report (Table 5).

The team has general recommendations for all assessments and specific comments related to individual assessments. All recommendations are for consideration for the 2014 assessment. The general comments are listed below while the comments related to individual assessments are contained within the summary

of plan team deliberations and recommendations contained in the stock specific summary section. Additional details regarding recommendations are contained in the Crab Plan Team Report (September 2013 CPT Report).

General recommendations for all assessments

1. The team recommends that all assessment authors document assumptions and simulate data under those assumptions to test the ability of the model to estimate key parameters in an unbiased manner. These simulations would be used to demonstrate precision and bias in estimated model parameters.
2. The CPT recommends that weighting factors be expressed as sigmas or CVs or effective sample sizes. The team requests all authors to follow the Guidelines for SAFE preparation and to follow the Terms of Reference as listed therein as applicable by individual assessment for both content and diagnostics.
3. Authors should focus on displaying information on revised models as compared to last year's model rather than focusing on aspects of the assessment that have not changed from the previous year.
4. The team recommends supporting the recruitment and survey average workgroup recommendations for crab assessments as well as groundfish
5. The current approach for fitting length-composition data accounts for sampling error but ignores the fact that selectivity among size classes is not constant within years; a small change in the selectivity on small animals could lead to a very large change in the catch of such animals (as may have happened for NSRKC). Authors are encouraged to develop approaches for accounting for this source of process error. This issue is generic to assessments of crab and groundfish stocks Authors are reminded that assessments should include the time series of stock estimates at the time of survey for at least the author's recommended model in that year.

By convention the CPT used the following conversions to include tables in both lbs and t in the status status summary sections:
- lbs to t [/2.204624]
- t to lbs [x 0.453592]

Economic SAFE overview

The economic status chapter is delayed pending completion of 2012 EDR data processing, and will be forwarded to Council with the Groundfish Economic SAFE report for December. A summary of economic indicators is included as a brief appendix to the SAFE report; key points are as follows:

2012 Production and Y/Y Change 2011-2012
- total volume of ex-vessel landings: 104 million pounds, +48%
- finished production volume: 67 million, +39%
- total gross ex-vessel revenues: $253 million, -2%
- total first wholesale revenues: $392 million, +8%
- All directed catch allocations > 98% exploited, including SMB

2012 Prices: returned to 2010 levels
- AIG Ex-Vessel: $3.51   WS: $8.37
- BBR Ex-Vessel: $7.27 WS: $15.09
- BSS Ex-Vessel: $1.89   WS: $4.72
- SMB Ex-Vessel: $3.77 WS: $12.45

2013 Wholesale Price Forecasts: return to 2011 levels
- Median, 90%CI
- AIG $10.24 ±1.07
- BSS $5.48   ±0.3
- BBR $18.38 ±2.48

Crew and processors employment and income indicators: limited information available pending completion of EDR data analysis and resolution of confidentiality limitations

Stock Status Summaries

1   Eastern Bering Sea Snow crab

Fishery information relative to OFL setting

The total catch in the 2012/13 fishery was estimated at 32,400 t (including model estimated bycatch) and the retained catch in the directed fishery was 30,100 t. This is below the 2012/13 OFL of 67,800 t. Snow crab bycatch occurs in the directed fishery and to a lesser extent in the groundfish trawl fisheries. The estimate of discard mortality rate for bycatch in the directed fishery was updated to 30% from 50% during 2013 based on data collected from the fishery and experimental results. The estimates of trawl bycatch in recent years are less than 1% of the total snow crab catch. Estimates of stock status have been above $B_{35\%}$(currently estimated to be 154,170 t) since 2010/11.

Data and assessment methodology

The stock assessment is based on a size- and sex-structured model in which crabs are categorized into immature, mature, new and old shell. The growth transition matrix is based on a linear growth function with the transition probability based on a gamma distribution where the variance term for the growth increment is pre-specified. The model is fitted to abundance and size frequency data from the NMFS trawl survey, total catch data from the directed fishery, bycatch data from the trawl fishery, and size frequency data for male retained catch in the directed fishery, and male and female bycatch in the directed fishery and trawl fishery. The model is also fitted to the 2009 and 2010 BSFRF study area biomass estimates and size frequency data. Unlike the model on which the 2012 assessment was based, the model on which the 2013 assessment is based fitted new data on growth increments and did not impose a prior on the parameters of the growth curve. The 2013 model assumed that the discard mortality in the directed fishery was 30% rather than 50%. The 2013 model also used updated bycatch data for the 2009/10 – 2011/12 trawl fishery and 2013 survey and 2012/13 fishery data.

The assessment author presented three variants of the base model. These variants explored the impacts of assuming a discard mortality rate of 50% and not making use of the new growth data. The estimates of biomass were relatively insensitive to these changes, but the estimate of $F_{35\%}$ and hence the OFL for the 2013/14 fishery were sensitive to the assumed discard mortality rate. For example, scenario 2, which was the same as the base model except it assumed that the discard mortality rate was 50%, led to an OFL which was 9,000 t lower than that from the base model. All of the models considered led to estimates of survey catchability (Q) (~ 0.55) which were lower than the estimate from the 2012 base model.

Stock biomass and recruitment trends

Observed survey mature male biomass decreased from 167,400 t in 2011 to 120,800 t in 2012 and to 96,100 t in 2013. Observed survey mature female biomass also decreased in the last three surveys: from 280,000 t in 2011 to 220,600 t in 2012 and to 195,100 t in 2013. The 2013 model, however, estimates that mature male biomass increased between 2012 and 2013, almost returning to the 2011 level. While the model-predicted survey mature male biomass for 2012 (127,900 t) is close to the observed value, the model-predicted mature male biomass for 2013 (142,300 t) is 1.5 times higher than the observed value. Fits by the 2013 model to the size frequency data from recent surveys, particularly from the 2013 survey, are poor; fitted size frequencies are lower than observed for females and higher than observed for males. The model is apparently "carrying forward" a relatively high abundance of small (~50 mm CW) males observed in the 2010 survey into the mature and harvested sizes in 2013 at higher than observed abundances.

Tier determination/Plan Team discussion and resulting OFL/ABC determination Status and catch specifications

The CPT recommends that the EBS snow crab is a Tier 3 stock so the OFL will be determined by the $F_{35\%}$

control rule. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating based on average recruitment over 1979 to present (154,170 t), and hence the minimum stock size threshold (MSST) is 77,100 t. The CPT recommends that the ABC be less than maximum permissible ABC, and concurs with the authors' recommendation to use a default 10% buffer for setting the ABC.

Historical status and catch specifications for snow crab (thousand t).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	66.6	127.7[A]	21.8	21.8	23.9	33.1	
2010/11	73.7	196.6[A]	24.6	24.7	26.7	44.4	
2011/12	77.3	165.2[A]	40.3	40.5	44.7	73.5	66.2
2012/13	77.1	170.1[A]	30.1	30.1	32.4	67.8	61.0
2013/14		157.6[B]				78.1	70.3

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

Historical status and catch specifications for snow crab (millions of lb.).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	146.8	281.5[A]	48.1	48.1	52.7	73.0	
2010/11	162.5	433.4[A]	54.2	54.5	58.9	97.9	
2011/12	170.4	364.2[A]	88.8	89.3	98.5	162.0	145.8
2012/13	169.9	374.9[A]	66.3	66.3	71.4	149.5	134.5
2013/14		347.4[B]				172.1	154.9

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

Additional Plan Team recommendations

The CPT identified several additional model runs for the May 2014 CPT. These runs further explore the use of growth increment data in the assessment

2   Bristol Bay Red King Crab

Fishery information relative to OFL setting.
The commercial harvest of Bristol Bay red king crab (BBRKC) dates to the 1930s, initially prosecuted mostly by foreign fleets but shifting to a largely domestic fishery in the early 1970s. Retained catch peaked in 1980 at 129.9 million lb (58.9 thousand t), but harvests dropped sharply in the early 1980s, and population abundance has remained at relatively low levels over the last two decades compared to those seen in the 1970s. The fishery is managed for a total allowable catch (TAC) coupled with restrictions for size ($\geq$ 135.1mm (6.5-in) carapace length), sex (male only), and season (no fishing during mating/molting periods).

The current State harvest strategy allows a maximum harvest rate of 15% of mature males, but also incorporates a maximum harvest rate of 50% of legal males, a threshold of 14.5 million lb (6.6 thousand t) of effective spawning biomass (ESB), to prosecute a fishery. The TAC increased from 15.5 million lb (34.2 thousand t) for the 2006/07 season to 20.4 million lb (45.0 thousand t) for the 2007/08 and 2008/09 seasons, and then declined through the next two seasons to 14.9 million lb (32.8 thousand t) for 2010/2011. Annual non-retained catch of female and sublegal male RKC during the fishery averaged less than 3.9 million lb (8.6 thousand t) since data collection began in 1990. Estimated fishing mortality ranged from 0.3 to 0.4 yr^{-1} following implementation of crab rationalization. Total catch (retained and bycatch mortality) increased from 16.9 million lb (7.6 thousand t) in 2005/06 to 23.4 million lb (10.6 thousand t) in 2007/08, but has decreased each season since then; total retained catch in 2012/13 was 8.59 million lb (3.90 thousand t).

Data and assessment methodology
The stock assessment model is based on a sex- and size-structured population dynamics model incorporating data from the NMFS eastern Bering Sea trawl survey, the Bering Sea Fisheries Research Foundation (BSFRF) trawl survey, commercial catch, and at-sea observer data program. In the model recommended by the CPT, annual stock abundance was estimated for male and female crabs $\geq$ 65-mm carapace length from 1975 to the time of the 2013 survey and mature male biomass was projected to 15 February 2014. Catch data (retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date) from the directed fishery, which targets males $\geq$ 135mm (6.5 in. carapace length), were obtained from ADF&G fish tickets and reports, red king crab and Tanner crab fisheries bycatch data from the ADF&G observer database, and groundfish trawl bycatch data from the NMFS trawl observer database. Catch and bycatch data were updated with data from the 2012/13 crab fishery year.

Six alternative models were evaluated in the 2013, including a base model based on the accepted model from the 2012 assessment. The author presented results from all six alternatives and discussed his reasons for preferring two of them, Models 1 and 4 as identified in the SAFE chapter. After discussion, the CPT selected Model 4 as its recommended model to proceed with status determination and OFL setting. Unlike the base model (2012 assessment model), this model begins in 1975 and consequently does not incorporate data from the NMFS trawl survey prior to 1975 that both the author and the CPT found to be problematic due to changes in survey timing, coverage and gear prior to 1975. It also differs from the base model in computing effective sample sizes more simply, it combines new shell and old shell males in the likelihood rather than separating them, it estimates molting probabilities for two time periods rather than three, and it incorporates sex/length compositions and survey biomass from the BSFRF trawl surveys into the likelihood rather than mature male abundances. It is similar to the base model in that it uses a constant natural mortality of M = 0.18yr^{-1}, but with additional natural mortality for males and females during 1980−1984 and for females during the "split period" 1976−1979 and 1985−1993, it estimates initial proportions-at-size, and (with respect to the "Bristol Bay retow data") it uses only the standard survey data for males and uses the re-tow data for females.

Stock biomass and recruitment trends
Model estimates of total survey biomass increased from 254.5 thousand t in 1975 to 301.9 thousand t in 1978, fell to 37.3 thousand t in 1985, generally increased to 91.5 thousand t in 2007, and subsequently declined to 74.2 thousand t in 2013. Estimated recruitment was high during the 1970s and early 1980s and has been generally low since 1985. The near-term outlook for this stock is a continued declining trend. Recruitment has been poor (less than the mean from 1984-2013) since 2006. The 2011 survey produced a high catch of juvenile males and females <65 mm CL in one survey tow but that catch did not track into the 2012 or 2013 surveys.

Tier determination/Plan Team discussion and resulting OFL and ABC determination
The CPT supports the use of Model 4 for the 2013 assessment for stock status determination.

Bristol Bay red king crab is a Tier 3 stock. The proxy of B_{MSY} ($B_{35\%}$) for a Tier 3 stock is based on mature male biomass at mating (MMB) and is computed as the average recruitment over some time period multiplied by the mature male biomass-per-recruit corresponding to $F_{35\%}$ less the mature male catch under an $F_{35\%}$ harvest strategy. Based on the author's discussion regarding an apparent reduction in stock productivity associated with the well-known 1976/77 climate regime shift in the EBS, the CPT continues to recommend computing average recruitment based on model recruitment using the time period 1984 (corresponding to fertilization in 1977) to the last year of the assessment. The estimated $B_{35\%}$ is 58.2 million lb (26.4 thousand t). MMB for 2012/13 is estimated at 55.0 million lb (25.0 thousand t), slightly less than $B_{35\%}$. Consequently, the Tier level for the BBRKC stock is 3b.

The team recommends that the OFL for 2013/14 be set according to Model 4, for which the calculated OFL is 15.58 million lb (7.07 thousand t). The team recommends that the ABC for 2013/14 be set below the maximum permissible ABC. The team recommends that a 10% buffer from the OFL be used to set the ABC at 14.02 million lb (6.36 thousand t).

The stock is estimated to have been above MSST in 2012/13, hence the stock was not overfished in 2012/13. The total catch in 2012/13 was less than the OFL, so overfishing did not occur in 2012/13. The stock at 2013/14 time of mating is projected to be 55.0 million lb (24.95 thousand t), which is above the MSST and 95% of the B_{MSY} calculated from the 2013 assessment. Hence the stock is not projected to be in overfished condition in 2013/14.

Status and catch specifications (millions of lb) for Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	31.3	89.0 [A]	16.00	16.03	18.32	22.56	
2010/11	30.0	72.0 [A]	14.84	14.91	17.00	23.52	
2011/12	30.4	68.1 [A]	7.83	7.95	9.01	19.39	17.46
2012/13	29.1	64.0 [A]	7.85	7.98	8.59	17.55	15.80
2013/14		55.0 [B]				15.58	14.02

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

Status and catch specifications (thousand t) for Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	14.22	40.37[A]	7.26	7.27	8.31	10.23	
2010/11	13.63	32.64[A]	6.73	6.76	7.71	10.66	
2011/12	13.77	30.88[A]	3.55	3.61[C]	4.09	8.80	7.92
2012/13	13.19	29.05[A]	3.56	3.62[C]	3.90	7.96	7.17
2013/14		24.95[B]				7.07	6.36

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.
C- Catch > TAC represents cost recovery catch in that year

Additional Plan Team comments
The CPT noted that Model 4, the model the CPT selected as its preferred model for status determination and OFL setting, was the result of a previous CPT request to the author to incorporate length compositions and abundance data from the BSFRF trawl surveys into the assessment model. As part of that request, the CPT intended that the model would also fix catchability for the BSFRF trawl surveys to 1 and estimate catchability for the NMFS trawl surveys. Model 4, however, fixes catchability for both surveys. The CPT thus requests that the author evaluate an alternative model, using Model 4 as the new base model, which estimates catchability for the NMFS trawl surveys and present the results of this evaluation to the CPT at its May 2014 meeting.

The CPT also noted that the results from Model 7, a diagnostic model in which natural mortality was allowed to vary in an autoregressive manner, appeared to provide support for the use of higher natural mortality rates in the late 1970's-early 1980's in the CPT's recommended model. These results also suggested that natural mortality may have been high in a more recent time period (mid-to-late 2000's), as well. The CPT requests that the author explore the use of an additional "recent" period of higher natural mortality, using Model 4 as the base model.

3 Eastern Bering Sea Tanner crab

Fishery information relative to OFL setting.
Eastern Bering Sea (EBS) Tanner crabs are caught in a directed Tanner crab fishery, and as bycatch in the groundfish fisheries, scallop fisheries, in the directed Tanner crab fishery (principally as non-retained females and sublegal males), and in other crab fisheries (notably, eastern Bering Sea snow crab and to a lesser extent in the fishery for Bristol Bay red king crab). A single OFL is set for Tanner crab in the EBS. Under the Crab Rationalization Program, ADF&G sets separate TACs for two directed fisheries, one east and one west of 166° W longitude. NMFS declared this stock overfished in 1999 and the Council developed a rebuilding plan. Both fisheries were closed from 1997 to 2004 due to low abundance. In 2005/06, abundance increased to a level to support a fishery in the area west of 166° W. longitude. ADF&G opened both fisheries for the 2006/07 to 2008/09 crab fishing years, and to the area east of 166° W longitude only in 2009/10. In 2007, NMFS determined the stock was rebuilt because spawning biomass was above the proxy for B_{MSY} for two consecutive years. The mature male biomass was, however, estimated to be below the Minimum Stock Size Threshold ($0.5B_{MSY}$) in February 2010 (the assumed time of mating) based on trends in mature male biomass from the survey, and NMFS declared the stock overfished in September 2010. The directed fisheries were closed again in 2010/11 and 2011/12 crab fishery years, and remained closed in the 2012/13 crab fishery year. NMFS determined the stock was not overfished in 2012 based on a new assessment model with a revised estimate of B_{MSY}.

Data and assessment methodology
A stock assessment model is used for EBS Tanner crab. The SSC accepted the model for use in harvest specifications in 2012 and classified it as a Tier 3 stock. The model is structured by size, sex, shell condition, and maturity state. It uses available information on the magnitude and size-composition of the landings and discards by the directed fishery, and bycatch in the Bristol Bay red king crab, EBS snow crab, and groundfish fisheries. It also uses index and size-composition data from the NMFS trawl survey. The model includes prior distributions on parameters related to natural mortality and catchability, and includes penalties on changes in recruitment and in the proportion maturing. The current model is unchanged from the model that was used last year, except for the correction of several minor coding errors. New input data include the 2013 NMFS bottom trawl survey results (abundance and size composition), and discard (biomass, size composition) from the 2012/13 snow crab fishery, Bristol Bay red king crab fishery, and the EBS groundfish fishery.

Stock biomass and recruitment trends
The MMB peaked in the mid-1970s and early 1990s; MMB at the time of mating was highest early in the modeled period (February 1972; 352.5 thousand t), with secondary peaks in February 1989 (70.6 thousand t) and February 2009 (71.6 thousand t). MMB has subsequently declined. The MMB in February 2013 is estimated to be 59.4 thousand t compared to 59.3 thousand t in February 2012. Recruitment is estimated to have peaked before 1974, the first year for which survey data are included in the assessment. Subsequent peaks in recruitment occurred during 1985 through1987 and 2009 through 2010.

Tier determination/Plan Team discussion and resulting OFL and ABC determination
The team recommends the OFL for this stock be based on the Tier 3 control rule. Application of the Tier 3 control rule requires a set of years for defining the mean recruitment corresponding to B_{MSY}($\bar{R}_{MSY}$),which should reflect mean recruitment under prevailing environmental conditions. Last year, the CPT recommended that $\bar{R}_{MSY}$ be set to the mean recruitment from 1990 onwards based on an analysis of the relationship between log(R/MMB) and MMB that identified a change in this relationship in 1985 (1990 year of recruitment to the model). The SSC subsequently recommended that the years from 1982 onwards be used, corresponding to a change in 1977. This recommendation was based on various considerations,

including the reliability of the earlier recruitment estimates, and the identification of the late 1970s as a period of rapid ecological change in the EBS.

An appendix to the Tanner crab assessment includes a more extensive change point analysis of the relationship between log(R/MMB) and MMB (note that this analysis is equivalent to fitting a Ricker stock-recruit relationship). Two candidate periods for a change in the relationship of log(R/MMB) and MMB were identified, 1974-75 and 1983-1987. The 1974-75 change point models indicate that primary difference between the two periods is a decrease in overall productivity at all stock sizes (i.e., a change in the intercept parameter), whereas the 1983-1987 models indicate an increase in density dependent mortality (i.e., a change in the slope parameter). The CPT considered the 1974-75 change point models to be more consistent with what is generally understood as a change in stock productivity. An increase in density-dependent mortality was considered less plausible by the CPT, though the assessment author suggested a scenario in which reductions in habitat available for settlement due to changes in the cold pool could lead to greater competition at the early life history stages of Tanner crab. A change point in 1974 implies use of recruitments from 1979 onwards to estimate $\overline{R}_{MSY}$. However, this is reasonably close to the SSC recommendation to use recruitments from 1982 onwards, and the CPT found no compelling reason to deviate from the SSC's recommendation.

Based on the estimated biomass at 15 February 2014, the stock is at Tier 3 level a. The F_{MSY} proxy ($F_{35\%}$) is 0.73 yr^{-1} (note an increase from 0.61 last year), and the 2013/14 is F_{OFL}=0.73 yr^{-1} under the Tier 3 OFL Control Rule, which results in a total male and female catch of 25.35 thousand t.

Last year, the team recommended that the ABC be adjusted over three year period due to the major change in stock status, and concern about the stability of assessment model and the uncertainty of the OFL estimate. The NMFS bottom trawl survey showed a modest increase in both female and male mature biomass in 2013. Therefore the team considered it appropriate to make the next incremental adjustment to the ABC. The calculation of the ABC is as follows:
2011/12 OFL = 2.75 thousand t
2013/14 OFL = 25.35 thousand t
2013/14 ABC = (2/3) X (25.35 thousand t– 2.75 thousand t) + 2.75 thousand t = 17.82 thousand t.

The CPT remains concerned about the uncertainty of the assessment and the estimates of stock status and will consider making a final adjustment to ABC next year.

Historical status and catch specifications (million lb) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2009/10	92.37[c/]	62.70[c/A]	1.34[a/]	1.32	3.62	5.00	
2010/11	91.87[c/]	58.93[c/B]	0.00	0.00	1.92	3.20	
2011/12	25.13[C]	129.17[C]	0.00	0.00	2.73	6.06	5.47
2012/13	36.97[D]	130.84[D]	0.00	0.00	1.57	41.93[C]	18.01[C]
2013/14		117.07[b/D]				55.89[D]	39.29[D]

(b) Historical status and catch specifications (thousand t) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2009/10	41.90[1/]	28.44[c/A]	0.61[a/]	0.60	1.64	2.27	
2010/11	41.67[2/]	26.73[c/A]	0.00	0.00	0.87	1.45	
2011/12	11.40	58.59[A]	0.00	0.00	1.24	2.75	2.48
2012/13	16.77	59.35[A]	0.00	0.00	0.71	19.02	8.17
2013/14		53.1[B]				25.35	17.82

1/ Projected 2012/13 MMB at time of mating after extraction of the estimated total catch OFL.

2/ Based on mature male biomass at the time of mating inferred from the NMFS survey under the assumption Q=1

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.

B - Projected biomass from the current stock assessment. This value will be updated next year.

EBS Tanner crab MMB was above B_{MSY} at the time of mating in mid-February 2013. Overfishing did not occur during the 2012/13 fishing year because total catch removals (0.71 thousand t) did not exceed the total catch OFL (19.02 thousand t).

4   Pribilof Islands red king crab

Fishery information relative to OFL setting

The Pribilof Islands red king crab fisherybegan in 1973 as bycatch during the blue king crab fishery. The directed red king crab fishery opened with a specified GHL for the first time in September 1993. Beginning in 1995, combined Pribilof Islands red and blue king crab GHLs were established. Declines in crab abundance of both king crab stocks from 1996 to 1998 resulted in poor fishery performance during those seasons with annual harvest levels below the GHLs. The Pribilof red king crab fishery was closed from 1999 through 2011/12 due to uncertainty in estimated red king crab survey abundance and concerns for incidental catch and mortality of Pribilof blue king crab which was an overfished and severely depressed stock. Prior to the closure, the 1998/99 harvest was 246.9 t (0.544 million lb). The non-retained catches, with application of bycatch mortality rates, from pot and groundfish bycatch estimates of red king crab ranged from 2.8 t (0.001 million lb) to 192.1 t (0.424 million lb) during 1991/92 to 2011/12.

Data and assessment methodology

There is no stock assessment model for Pribilof Island red king crab. The 2013 assessment is based on trends in male mature biomass (MMB) at the time of mating inferred from NMFS bottom trawl survey from 1975-2013 and commercial catch and observer data from 1973/74 to 2012/13. The revised time-series of historical NMFS trawl survey abundance estimates were used in this assessment. The 2012/13 non-retained catch from all non-directed pot and groundfish fisheries were included in the SAFE report, incorporating a new data set for observed groundfish fisheries which aggregates data on crab catch by species to the level of the respective stock area; prior to 2009, bycatch data are aggregated over all crab species by federal reporting area. An F_{OFL} for 2012/13 was determined using a mean MMB at the time of mating, the default γ value of 1.0 and an M of 0.18yr^{-1}. As recommended by the CPT (September 2011) and SSC (October 2011), the annual index of MMB for this stock was derived as the 3-yr running average centered on the current year MMB and weighted by the inverse variance. The $B_{MSY\ proxy}$ was calculated using the unweighted observed survey MMBs from 1991-2013.

Stock biomass and recruitment trends

The stock exhibited widely varying mature male and female abundances during 1975-2013. The average MMB estimated for 2013 was 4,679 t (10.32 million lb). Retained catches have not occurred since the 1998/99 season. Non-directed discard losses in the pot fisheries decreased in recent years, and there are no discard losses in the current year. Mature stock biomass declined in 2008/09 and 2009/10 followed by increases in MMB in 2010/11 through 2012/13. The estimated biomass of pre-recruit size crab remained relatively constant over the past decade although pre-recruit sized crab may not be well sampled by the NMFS survey. Bycatch losses resulting from the fixed gear groundfish fleet using the new dataset decreased from 2011/12 to 2012/13, while losses resulting from discards in the groundfish trawl fleet increased from 4,470 t (9.85 million lb) to 12,980 t (28.62 million lb) between 2011/12 to 2012/13. In 2013, estimates of legal male biomass and mature male biomass increased substantially relative to 2012, whereas mature female biomass decreased substantially from 663 t to 169 t.

In 2012/2013, using the new database estimation, 16.46 t of male and female red king crab were caught in fixed gear (0.24 t) and trawl gear (16.23 t) groundfish fisheries which is 51% greater than was caught in 2011/2012 pot, trawl, and hook and line groundfish fisheries. The catch was mostly in non-pelagic trawls (99%) followed by longline (1%), and pot (<1%) fisheries (Table 4). The targeted species in these fisheries were Pacific cod (3%), flathead sole (18%), yellowfin sole (77%), and traces <1% found in the rockfish fisheries (Table 5). Unlike previous years no bycatch was observed in Alaska plaice fisheries in

2011/2012 or 2012/2013.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

Based on available data, the author recommended classification for this stock is Tier 4 for stock status level determination. For 2012/13 the $B_{MSY\ proxy}$ = 5,164 t of MMB_{mating} derived as the mean of 1991/92 to 2012/13. MMB varied considerably during these periods likely leading to varying estimates of B_{MSY}. Male mature biomass at the time of mating for 2012/13 was estimated at 4,679 t. The $B/B_{MSY\ Proxy}$ =0.91 and F_{OFL}=0.16. $B/B_{MSY\ Proxy}$ is < 1, therefore the stock status level is *b*. For the 2013/2014 fishery, the OFL was estimated at 903 t of crab. The projected exploitation rates based on full retained catches up to the OFL is 0.17 for both LMB and $MMB_{fishery}$

. The CPT concurred with the author's recommendation to set the ABC below the maximum permissible, given the relative amount of information available for Pribilof Island red king crab. For 2013/14 using the recommended $B_{MSYprox}$, the multiplier equivalent to a P* of 0.49 was 0.84. The maxABC was thus estimated to be 759 t. Incorporating additional uncertainty by applying a σ_b of 0.40 resulted in a multiplier of 0.80 and a recommended ABC of 718 t (1.58 million lb).

Historical status and catch specifications (million lb) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	4.22	4.80[A]	0	0	0.006	0.50	
2010/11	4.97	6.07[A]	0	0	0.009	0.77	
2011/12	5.67	6.12[A]	0	0	0.011	0.87	0.68
2012/13	5.75	8.87[A]	0	0	0.029	1.25	1.00
2013/14		10.32[B]				1.99	1.58

Historical status and catch specifications (t) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	1,914	2,175[A]	0	0	2.7	227	
2010/11	2,255	2,754[A]	0	0	4.2	349	
2011/12	2,571	2,775[A]	0	0	5.4	393	307
2012/13	2,609	4,025[A]	0	0	13.1	569	455
2013/14		4,679[B]				903	718

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

The stock was above MSST in 2012/2013 and is hence not overfished. Overfishing did not occur during the 2012/2013 fishing year.

5 Pribilof Islands blue king crab

Fishery information relative to OFL setting.

The Pribilof blue king crab fishery began in 1973, with peak landings of 11.0 million lb during the 1980/81 season. A steep decline in landings occurred after the 1980/81 season. Directed fishery harvest from 1984/85 until 1987/88 was annually less than 1.0 million lb with low CPUE. The fishery was closed from 1988/89 through 1994/95 fishing seasons. The fishery reopened from 1995/96 to 1998/99 seasons. Fishery harvests during this period ranged from 1.3 to 2.5 million lb. The fishery closed again for the 1999/00 due to declining stock abundance and has remained closed through the 2012/13 season. The stock was declared overfished in 2002.

A revised rebuilding plan has been submitted for review by the Secretary of Commerce in 2013 as NMFS determined that the stock was not rebuilding in a timely manner and would not meet the rebuilding horizon of 2014. This rebuilding plan closes the Pribilof Island Habitat Conservation Zone to Pacific cod pot fishing, which comprises the highest historical rates of bycatch of this stock. This area is already closed to groundfish trawl fishing.

Data and assessment methodology

NMFS conducts an annual trawl survey that is used to produce area-swept abundance estimates. The CPT has discussed the history of the fishery and the rapid decline in abundance. It is clear that the stock has collapsed, although the annual area-swept abundance estimates are imprecise.

The 2013/14 survey biomass time series uses the area definition established in 2012/13 that includes an additional 20 nm strip east of the Pribilof District. MMB was estimated using a three-year running average centered on the current year weighted by the inverse variance of the area-swept estimate. Groundfish bycatch was recalculated for 2009/10 – 2012/13 using State of Alaska statistical areas. The new time series in the newly defined Pribilof stock area resulted in significantly different estimates of blue king crab bycatch biomass in 2009/2010-2012/2013. In 2012/2013, using the new estimation method, 0.82 t of male and female blue king crab were caught in fixed gear (0.16 t) and trawl (0.67 t) gear groundfish fisheries. The targeted species in these fisheries were Pacific cod (19%), yellowfin sole (78%), and flathead sole (3%) fisheries. The catch was in non-pelagic trawls (81%) and longline (19%) fisheries. There was no bycatch attributed to pot fisheries. The discrepancy between the old and new methods highlights the problems attributing non –observed vessels from outside the stock boundaries. The analyses in this document use only the new method for 2009/2010 through 2012/2013 catch data.

Stock biomass and recruitment trends

The estimated mature-male biomass increased to 579 t in 2012/13 from 365 t in 2011/12. The 2013/14 MMB at mating is projected to be 278 t, which is 7% of the proxy for B_{MSY}. The Pribilof blue king crab stock biomass continues to be low. From recent surveys there is no indication of recruitment.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

This stock is recommended for placement into Tier 4. B_{MSY} was estimated using the time periods 1980/81 -1984/85 and 1990/91-1997/98. This range was chosen because it eliminates periods of extremely low abundance that may not be representative of the production potential of the stock. B_{MSY} is estimated at 3,988 t (8.70 million pounds).

Because the projected 2013/14 estimate of MMB is less than 25% B_{MSY}, the stock is in stock status c and the directed fishery F is 0 However, an F_{OFL} must be determined for the non-directed catch. Ideally this should be based on the rebuilding strategy. For this stock the F_{OFL} is based on average groundfish

bycatch between 1999/00 and 2005/06. The recommended OFL for 2013/14 is 1.16 t (0.003 million lb). The CPT concurred with the author's recommendation to set ABC less than the maximum permissible by employing a 10% buffer consistent with a Tier 5 average catch calculation, as was used in 2012/13. The ABC was estimated at 1.04 t (0.002 million lb.). The CPT did not see justification to change ABC from status quo.

Historical status and catch specifications (t.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	2,105[A]	401[A]	closed	0	0.5	1.81	
2010/11	2,105[B]	286[A]	closed	0	0.18	1.81	
2011/12	2,247[C]	365[A]	closed	0	0.36	1.16	1.04
2012/13	1,994[D]	579[A]	closed	0	0.61	1.16	1.04
2013/14		278[B]				1.16	1.04

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

Historical status and catch specifications (million lb.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	4.64[A]	0.88[A]	closed	0	0.001	0.004	
2010/11	4.64[B]	0.63[A]	closed	0	0.0004	0.004	
2011/12	4.95[C]	0.80[A]	closed	0	0.0008	0.003	0.002
2012/13	4.39[D]	1.28[A]	closed	0	0.0013	0.003	0.002
2013/14		0.61[B]				0.003	0.002

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

The total catch for 2012/13 (0.61 t, 0.0013 million lb) was less than the 2012/13 OFL (1.16 t, 0.003 million lb) so overfishing did not occur during 2012/13. The 2013/14 projected MMB estimate of 278 t (0.61 million lb) is below the proxy for MSST (MMB/B_{MSY} = 0.07) so the stock continues to be in an overfished condition and failed to rebuild within the maximum required rebuilding time.

Additional Plan Team comments

None.

6   St. Matthew blue king crab

Fishery information relative to OFL setting

The fishery was prosecuted as a directed fishery from 1977 to 1998. Harvests peaked in 1983/84 when 9.454 million lb. were landed by 164 vessels. Harvest was fairly stable from 1986/87 to 1990/91, averaging 1.252 million lb. annually. Harvest increased to a mean catch of 3.297 million lb. during the 1991/92 to 1998/99 seasons until the fishery was declared overfished and closed in 1999 when the stock size estimate was below the MSST. In November of 2000, Amendment 15 to the FMP was approved to implement a rebuilding plan for the St. Matthew Island blue king crab stock. The rebuilding plan included a harvest strategy established in regulation by the Alaska Board of Fisheries, an area closure to control bycatch, and gear modifications. In 2008/09 and 2009/10, the MMB was estimated to be above B_{MSY} for two years and the stock declared rebuilt in 2009.

The fishery re-opened in 2009/10 with a TAC of 1.167 million lb. and 0.461 million lb. of retained catch were harvested. The 2010/11 TAC was 1.600 million lb. and the fishery reported a retained catch of 1.264 million lb. The 2011/12 harvest of 1.88 million lb. represented 80% of 2.36 million lb. TAC. In 2012/13, by contrast, harvesters landed 99% of a reduced TAC of 1.630 million lb., though fishery efficiency, at about 10 crab per pot, was little changed from what it had been in each of the previous three years. Bycatch of non-retained blue king crab has been observed in the St. Matthew blue king crab fishery, the eastern Bering Sea snow crab fishery, and trawl and fixed-gear groundfish fisheries. Based on limited observer data, bycatch of sublegal male and female crabs in the directed blue king crab fishery off St. Matthew Island was relatively high when the fishery was prosecuted in the 1990s, and total bycatch (in terms of number of crabs captured) was often twice as high or higher than total catch of legal crabs.

Data and assessment methodology

A three-stage catch-survey analysis (CSA) is used to assess the male crab ≥90 mm CL. The three size categories are: 90–104 mm CL; 105–119 mm CL; and ≥120 mm CL. Males ≥ 105 are used as a proxy to identify mature males, and males ≥ 120 mm CL are used as a proxy to identify legal males. The CSA incorporates the following data: (1) commercial catch data from 1978/79 -1998/99, 2009/10- 2012/13; (2) annual trawl survey data from 1978 to 2013; (3) triennial pot survey data from 1995 to 2010; (4) bycatch data in the groundfish trawl and groundfish fixed-gear fisheries from 1991 to 2013; and (5) ADF&G crab-observer composition data for the years 1990/91−1998/99, 2009/10−2012/13. Trawl survey data are from summer trawl survey for stations within the St. Matthew Section. Trawl survey data provided estimates of density (number/nm^2) at each station for males in the three size categories. The pot survey data originate from the ADF&G triennial pot surveys that occurred during July and August in 1995, 1998, 2001, 2004, 2007, and 2010. The pot survey samples areas of high-relief habitat important to blue king crab (particularly females) that the NMFS trawl survey cannot sample. Data used are from only the 96 stations fished in common during each of the five pot survey years. The CPUE (catch per pot lift) indices from those 96 stations for the male categories listed above were used in the assessment.

Groundfish discard information for trawl and fixed gear is estimated from NMFS observer data. Bycatch composition data were not available so total biomass caught as bycatch was estimated by summing blue king crab biomass from federal reporting areas 524 and 521 according to gear type.

Stock biomass and recruitment trends

The 2013 assessment estimates that the stock is currently below the proxy for B_{MSY} even though previous assessments estimated that the stock was above B_{MSY}. The MMB has fluctuated substantially over three periods, increasing during 1978 to 1981 of the first period from 7.6 million lb. to 17.6 million lb.,

followed by a steady decrease to 2.9 million lb. in 1985. The second period had a steady increase from 1986 to 13.3 million lb. in 1997 followed by a rapid decline to 2.8 million lb. in 1999. The third period starting in 2000 had a steady increase in all size classes and peaked at 15.80 million lb. in 2011/2012 before declining to 6.64 million pounds in 2012/2013. The low 2013 survey estimate of stock biomass along with declining trends in model recruitment raises concern that the stock maybe approaching and overfished condition.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT agrees with the author recommended base model, which results in a Tier 4b specification. The recommended model follows past CPT and SSC guidance. The model uses the full assessment period (1978/79-2012/13) to define the proxy for B_{MSY} in terms of average estimated MMB_{mating} with gamma (γ)=1 and an instantaneous natural mortality = 0.18^{-1} year. The MMB estimated for 2012/13 under the recommended model is 6.76 million lb (3,060 t) and the F_{MSY} proxy is taken equal to the assumed instantaneous natural mortality rate (0.18^{-1} year), resulting in a mature male biomass OFL = 1.24 million lb (1.02 t). The maxABC based on a P* = 0.49 is 1.23 million lb. However, the CPT had strong concerns about the declining trends of abundance in recent years and historical "boom and bust" patterns in the trawl survey indices.. The team noted a downward trend in most-recent biomass estimates in the retrospective assessment analysis, giving rise to concerns that the 2013 MMB may be over-estimated. Due to this retrospective patterns, the estimate of F was greater than the estimated F_{MSY} in each of these years. These concerns highlighted the large amount of uncertainty and the need to be precautionary in setting the ABC. The CPT therefore recommended a 20% buffer (1.24 *0.80) for an ABC of 0.99 million lb. (453 t).

Historical status and catch specifications (millions lb.) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL*	ABC
2009/10	3.4	12.76[A]	1.17	0.46	0.53	1.72	
2010/11	3.4	14.77[A]	1.60	1.26	1.41	2.29	
2011/12	3.4	11.09[A]	2.54	1.88	2.10	3.31	3.40
2012/13	4.0	6.29[A]	1.63	1.62	1.81	2.24	2.02
2013/14		6.64[B]				1.24	0.99

Historical status and catch specifications (kt) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL*	ABC
2009/10	1.5	5.79[A]	0.53	0.21	0.24	0.78	
2010/11	1.5	6.70[A]	0.73	0.57	0.64	1.04	
2011/12	1.5	5.03[A]	1.15	0.85	0.95	1.70	1.50
2012/13	1.8	2.85[A]	0.74	0.73	0.82	1.02	0.92
2013/14		3.01[B]				0.56	0.45

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Projected biomass from the current stock assessment. This value will be updated next year.

The total male catch for 2012/13 (1.8 million lb.) was less than the 2012/13 OFL (2.24 million lb.) so overfishing did not occur during 2012/13. Likewise, the 2012/13 MMB (6.29 million lb.) is above the MSST (4.0 million lb.) so the stock is not in an overfished condition.

Additional Plan Team recommendations

The author presented preliminary models (Tbase and TC) incorporating alternative stage-transition matrix motivated by the work by Otto and Cummiskey (1990). The CPT recommended further development of this transition matrix using pertinent biological information such as molting and growth. A biologically defensible transition matrix would improve model structure and may also improve trawl selectivity estimates.

7   Norton Sound Red King Crab

Fishery information relative to OFL setting

This stock supports three main fisheries: summer commercial, winter commercial, and winter subsistence. The summer commercial fishery, which accounts for the majority of the catch, reached a peak in the late 1970s at a little over 2.9 million lbs retained catch. Retained catches since 1982 have been below 0.5 million lbs, averaging 275,000 lbs, including several low years in the 1990s. Retained catches in the past four years have been about 400,000 lbs.

Data and assessment methodology

Four types of surveys have been conducted during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot, but none of these surveys have been conducted every year. The 1976-1991 NMFS trawl survey data were revised during the last year and were included in the May 2013 assessment. A length-based model of male crab abundance was developed that combines multiple sources of data, and estimates abundance, recruitment, and selectivity and catchability of the commercial pot gear. The model has been updated using data from the 2012/13 winter pot survey, the 2012 summer commercial fishery, the 2012 summer trawl survey, the finalized catches for the 2011/12 winter commercial and subsistence fisheries, and the most up-to-date 2012/13 winter commercial and subsistence catches. The model assumes M=0.18yr^{-1} for all length classes. The assessment author revised the model based on the recommendations from the January 2013 crab model workshop and the May 2013 CPT meeting recommendations. This assessment was reviewed in September 2013 due to the change in the assessment timing from July-June to October-September so that harvest specifications can be set in a timely manner for the summer fishery. Harvest specifications for this stock will now be made each year in September.

Stock biomass and recruitment trends

Mature male biomass (MMB) showed an increasing trend since 1997, following a substantial decline in abundance from the peak in 1977 to 1982. However, uncertainty in historical biomass is considerable, which is in part a result of infrequent trawl surveys and a limited winter pot survey. Estimated recruitment has been highly variable, but there is an increasing trend in recruitment over recent years.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The team was concerned regarding the outcomes of the assessment when the length-frequency data from observer sampling during 2013 was included in the assessment (the "full" model). The abundance of crab in the smallest size-class was very high in the 2013 observer data, which the model interpreted as the largest year-class ever given there is no other information about the associated year-class. Most stock assessments impose a penalty on the extent of variation in recruitment about mean recruitment but this penalty is very weak in the current assessment. The high estimate of recruitment contributes to the OFL for the "full" model because this year class is assumed to growth into a size-class which is assumed to be mature but not retained. The CPT acknowledges that there are data indicating a strong recruitment event, but that substantial uncertainty surrounds this estimate which is not appropriately treated within the current model formulation. Given these concerns the CPT recommends the model without the 2013 data point for use in setting harvest specifications for 2013/14.

The team continues to recommend Tier 4 stock status for Norton Sound red king crab. The estimated legal biomass in 2014 based on "no observed data" model is 2.83 million lb (SD 1.18 million lb) while the estimated mature male biomass in 2014 is 3.72 million lb (SD 4.37 million lb). The average mature male

biomasses during 1980-2014 (4.36 million lb) was used as the proxy for B_{MSY}. The F_{MSY} proxy is M (0.18 yr^{-1}) and F_{OFL} is F_{OFL}=0.15 yr^{-1} because the 2014 mature male biomass is less than the proxy for B_{MSY}.

The maximum permissible ABC in 2014 is 0.39 million lb. The CPT recommended an ABC less than the maximum permissible due to potential concerns with model specification, as well as issues noted with the M employed for the largest length group. The CPT recommended an ABC = 90% of the OFL (10% buffer) of 0.36 million pounds.

Status and catch specifications (million lbs.)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2009/10	1.54	5.83[A]	0.38	0.40	0.43	0.71	
2010/11	1.56	5.44[A]	0.40	0.42	0.46	0.73	
2011/12	1.56	4.70[A]	0.36	0.40	0.43	0.66	0.59
2012/13	1.78	4.59[A]	0.47	0.47	0.47	0.53	0.48
2013	2.06[B]	5.00[B]	0.50	0.35	0.35	0.58[B]	0.52[B]
2013/14	2.18[C]	3.72[C]				0.39[C]	0.36[C]

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Calculated from the assessment reviewed by the Crab Plan Team in Sep 2013 for the 2013/14 winter fishery and the 2014 summer fishery. This represents projected biomass from the current stock assessment. This value will be updated next year.
C-Calculated from the assessment reviewed by the Crab Plan Team in May 2013 for fishery of the 2013 summer fishery and the 2013/14 Winter fishery

Status and catch specifications (thousand t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2009/10	0.70	2.64[A]	0.17	0.18	0.22	0.32	
2010/11	0.71	2.47[A]	0.18	0.19	0.21	0.33	
2011/12	0.71	2.13[A]	0.16	0.18	0.20	0.30	0.27
2012/13	0.80	2.08[A]	0.21	0.21	0.21	0.24	0.22
2013	0.62[B]	2.16[B]	0.23	0.16	0.16	0.26[B]	0.24[B]
2013/14	0.99[C]	1.69[C]				0.18[C]	0.16[C]

A - Estimated biomass at the time of mating for the year concerned. Note this represents a revised estimate from the projection the previous year.
B - Calculated from the assessment reviewed by the Crab Plan Team in Sep 2013 for fishery of 2013/2014 (Winter fishery and 2014 Summer fishery). This represents projected biomass from the current stock assessment. This value will be updated next year.
C-Calculated from the assessment reviewed by the Crab Plan Team in May 2013 for fishery of 2013 Summer fishery and 2013/2014 Winter fishery

Total catch in 2012/13 did not exceed the OFL for this stock thus overfishing is not occurring. Stock biomass is above MSST; thus the stock is not overfished.

Additional Plan Team recommendations

The CPT has the following recommends for the next assessment:
- include a much stronger penalty on the extent to which recruitment can vary among years (e.g. by increasing the "lambda" on the recruitment penalty from 0.01 to 0.5;

- construct a likelihood profile for M;
- the assessment should report the OFL and report how much of this OFL is predicted to be retained and to be discarded; and
- evaluate whether selectivity should be assumed to differ for the NMFS and ADFG trawl surveys.

8   Aleutian Islands golden king crab

Fishery information relative to OFL setting

The directed fishery has been prosecuted annually since the 1981/82 season. Retained catch peaked in 1986/87 at 14.7 million lb and averaged 11.9 million lb over the 1985/86-1989/90 seasons. Average harvests dropped sharply from 1989/90 to 1990/91 to a level of 6.9 million lb for the period 1990/91–1995/96. Management based on a formally established GHL began with the 1996/97 season. The 5.9 million lb GHL established for the 1996/97 season, which was based on the previous five-year average catch, was subsequently reduced to 5.7 million lb beginning in 1998/99. The GHL (or TAC, since 2005/06) remained at 5.7 million lb for 2007/08, but was increased to 6.0 million lb for the 2008/09-2011/12 seasons, and to 6.3 million lb for the 2012/13 season. Average retained catch for the period 1996/97–2007/08 was 5.6 million lb, and 5.8 million lb for the period 2008/09-2010/11. The retained catch for 2011/12 was 6.0 million lb. This fishery is rationalized under the Crab Rationalization Program. The 2012/13 season remains open until 15 May 2013.

Non-retained bycatch occurs mainly in the directed fishery, and to a minor extent in other crab fisheries. Bycatch also occurs in fixed-gear and trawl groundfish fisheries although that bycatch is low relative to the weight of bycatch in the directed fishery. Total annual non-retained catch of golden king crab during crab fisheries has decreased relative to the retained catch since the 1990s. It decreased from 13.8 million lb in 1990/91 (199% of the retained catch) to 9.1 million lb in 1996/97 (156% of the retained catch), and to 4.3 million lb in the 2004/05 season (78% of the retained catch). Bycatch has ranged from 2.5 million lb in 2005/06 (46% of the retained catch) to 3.0 million lb for 2007/08 (55% of the retained catch) during the seven seasons prosecuted as rationalized fisheries (2005/06–2011/12). Bycatch mortality has correspondingly decreased since 1996/97 both in absolute weight and relative to the retained catch weight. Estimated total mortality (retained catch plus bycatch in crab and groundfish fisheries) ranged from 5.8-9.4 million lb over 1995/96–2011/12. Estimated total mortality in 2011/12 was 6.5 million lb.

Data and assessment methodology

Available data are from ADF&G fish tickets (retained catch numbers, retained catch weight, and pot lifts by ADF&G statistical area and landing date), size-frequencies from samples of landed crabs, at-sea observations from pot lifts sampled during the fishery (date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc.), triennial pot surveys in the Yunaska-Amukta Island area of the Aleutian Islands approximately 171° W longitude, tag recoveries from crabs released during the triennial pot surveys, and bycatch from the groundfish fisheries. These data are available through the 2011/12 season and the 2006 triennial pot survey. Most of the available data were obtained from the fishery which targets legal-size (≥6-inch CW) males and trends in the data can be affected by changes in both fishery practices and the stock. The triennial survey is too limited in geographic scope and too infrequent to provide a reliable index of abundance for the Aleutian Islands area. An assessment model is currently being developed for this stock.

Stock biomass and recruitment trends

Although a stock assessment is in development, it has not yet been accepted for use in management. There are consequently no estimates of stock biomass. Estimates of recruitment

trends and current levels relative to virgin or historic levels are also not available.

Summary of major changes

Fishery data have been updated with the results for 2011/12: retained catch for the directed fishery and bycatch estimates for the directed fishery, non-directed crab fisheries, and groundfish fisheries.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock be managed as a Tier 5 stock in 2013/14. B_{MSY} and MSST are not estimated for this stock. Observer data on bycatch from the directed fishery and groundfish fisheries provides the estimate of total bycatch mortality. Bycatch data from the directed fishery for years after the 1990/91 season (excluding 1993/94 and 1994/95 seasons due to insufficient data) and from the groundfish fisheries since the 1993/94 season were used. There are no directed fishery observer data prior to the 1988/89 season and observer data are lacking or confidential for four seasons in at least one management area in the Aleutian Islands during 1988/89–1994/95.

This assessment author recommended using the same approach for determining the 2013/14 total catch OFL as was used to determine the 2012/13 total catch OFL. This approach uses data for 1985/86–1995/96 to estimate the mean retained catch in the crab fisheries, and bycatch data for 1990/91-95/96 to estimate the mean bycatch rate (0.363):

$$\text{OFL}_{2013/14} = (1+R_{90/91\text{-}95/96})\bullet \text{RET}_{85/86\text{-}95/96} + \text{BM}_{GF,93/94\text{-}08/09} = 12,537,757 \text{ lb}$$

where,

- $R_{90/91\text{-}95/96}$ is the average of the annual ratios of bycatch mortality due to crab fisheries to retained catch in pounds over the period of the subscripted years, excluding 1993/94–1994/95 due to data confidentiality and lack of data,
- $\text{RET}_{85/86\text{-}95/96}$ is the average annual retained catch in the directed crab fishery over the period 1985/86-1995/96), and
- $\text{BM}_{GF,93/94\text{-}08/09}$ is the average of the annual estimates of bycatch mortality due to groundfish fisheries over the period 1993/94-2008/09.

The team concurred with the author's recommendation to set the ABC based on the maximum permissible from the ABC control rule which specifies an ABC based on a 10% buffer on the OFL. The recommended ABC is 11,283,981 lb.

Historical status and catch specifications (millions lb.) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	NA	NA	5.99	5.91	6.51	9.18 [A]	
2010/11	NA	NA	5.99	5.97	6.56	11.06	
2011/12	NA	NA	5.99	5.96	6.51	11.40	10.26
2012/13	NA	NA	6.29	6.27	6.87	12.54	11.28
2013/14	NA	NA	6.29			12.54	11.28

A – retained catch

Historical status and catch specifications (thousand t) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	NA	NA	2.72	2.68	2.95	4.16 [A]	
2010/11	NA	NA	2.72	2.71	2.98	5.02	
2011/12	NA	NA	2.72	2.71	2.95	5.17	4.66
2012/13	NA	NA	2.85	2.84	3.12	5.69	5.12
2013/14	NA	NA	2.85			5.69	5.12

A – retained catch

No overfished determination is possible for this stock given the lack of biomass information. Catch in 2012/13 was below the OFL therefore overfishing did not occur..

Additional Plan Team recommendations

The CPT has reviewed draft versions of a developing stock assessment model for this stock. The most recent version of the model, along with the method for standardizing the CPUE data was reviewed at the February 2013 Crab Modeling Workshop. The team reviewed progress on standardizing the CPUE data in response to the suggestions from the February 2013 Workshop. The assessment author will further update the CPUE standardization and provide additional results and a revised assessment to the CPT in September 2013. The CPT also heard a presentation on a pilot study in which research pots were fished alongside commercial pots to assess differences in fishery selectivity and population structure in fished areas. The CPT noted the value of these data to confirm that small crab are present where the fishery is prosecuted and that the estimated retention function matches the selectivity patterns for the commercial fishery from the two most recent versions of the assessment model that is under development.

9   Pribilof District Golden King Crab

Fishery information relative to OFL setting

The Pribilof District fishery for male golden king crab $\geq$ 5.5 in carapace width ($\geq$ 124 mm carapace length) developed in the 1981/82 season. The directed fishery mainly occurs in Pribilof Canyon of the continental slope. Peak directed harvest is 856-thousand lb during the 1983/84 season. Historical fishery participation has been sporadic and retained catches variable. The current fishing season is based on a calendar year. Since 2000, the fishery was managed for a guideline harvest level (GHL) of 150-thousand lb. Non-retained bycatch occurs in the directed fishery, Bering Sea snow crab, Bering Sea groundfish, and historical grooved Tanner crab fisheries. Estimated total fishing mortality in crab fisheries averages 78-thousand lb (2001-2011). Crab mortality in groundfish fisheries (July 1–June 30, 1991/92–2011/12) averages 6-thousand lb. There was no participation in the directed fishery from 2006-2009; two vessels participated in 2011 and 1 vessel in 2012. Pribilof District golden king crab is not included in the Crab Rationalization Program.

Data and assessment methodology

Total golden king crab biomass has been estimated during the NMFS upper-continental-slope trawl surveys in 2002, 2004, 2008, 2010 and 2012. There is no assessment model for this stock. Fish ticket and observer data are available (including retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date), size-frequency data from samples of landed crabs, and pot lifts sampled during the fishery (including date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc.), and from the groundfish fisheries. Much of the directed fishery data are confidential due to low number of participants.

Stock biomass and recruitment trends

Estimates of stock biomass (all sizes, both sexes) were provided for the Pribilof Canyon. A separate report by W. Gaeuman on a proposed tier 4 analysis has a discussion of survey biomass estimates and is appended to the SAFE chapter.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The Team recommends this stock be managed under Tier 5 in 2014.

The assessment author presented two alternatives for establishing the OFL. The Team concurs with the author's recommendation for the 2014 OFL based on the same analysis as the 2013 OFL of 0.2 million lb and the maximum permissible ABC of 0.18 million lb. The ABC was derived by applying the Tier 5 control rule a 10% buffer of the OFL, ABC = 0.9 * OFL. The OFL was derived based on the following data:

$$\text{OFL}_{\text{TOT,2013}} = (1+R_{2001\text{-}2010}) * \text{RET}_{1993\text{-}1998} + \text{BM}_{\text{NC,1994-1998}} + \text{BM}_{\text{GF,92/93-98/99}}$$

- $R_{2001–2010}$ is the average of the estimated average annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010.
- $\text{RET}_{1993\text{-}1998}$ is the average annual retained catch in the directed crab fishery during 1993–1998 (period of unconstrained catch).
- $\text{BM}_{\text{NC,1994-1998}}$ is the estimated average annual bycatch mortality in non-directed crab fisheries during 1994–1998.
- $\text{BM}_{\text{GF,1992/93–1998/99}}$ is the estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99.

The average of the estimated annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010 is used to estimate bycatch mortality in the directed fishery during 1993–1998 because, whereas there are no data on bycatch for the directed fishery during 1993–1998,

there are such data from the directed fishery during 2001–2010 (excluding 2006–2009, when there was no fishery effort).

The estimated average annual bycatch mortality in non-directed fisheries during 1994–1998 is used to estimate the average annual bycatch mortality in non-directed fisheries during 1993–1998 because there is no bycatch data available for the non-directed fisheries during 1993.

The estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99 is used to estimate the average annual bycatch mortality in groundfish fisheries during 1993-1998 because 1992/93–1998/99 is the shortest time period of crab fishery years that encompasses calendar years 1993–1998.

Status and catch specifications (millions lb)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2010	N/A	N/A	0.15	Conf.	Conf.	0.17[A]	
2011	N/A	N/A	0.15	Conf.	Conf.	0.18	
2012	N/A	N/A	0.15	Conf.	Conf.	0.20	0.18
2013	N/A	N/A	0.15			0.20	0.18
2014	N/A	N/A	0.15			0.20	0.18

A= Retained-catch OFL
Conf. = confidential

Status and catch specifications (t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2010	N/A	N/A	68	Conf.	Conf.	77.1[A]	
2011	N/A	N/A	68	Conf.	Conf.	81.6	
2012	N/A	N/A	68	Conf.	Conf.	90.7	81.6
2013	N/A	N/A	68			90.7	81.6
2014	N/A	N/A	68			90.7	81.6

A= Retained-catch OFL
Conf. = confidential

No overfished determination is possible for this stock given the lack of biomass information. Although catch information is confidential under Alaska statute (AS 16.05.815) the assessment author indicated that the total catch did not exceed the OFL of 0.20 million lb therefore overfishing did not occur. The 2013 fishery is ongoing until the GHL is achieved or until December 31.

Additional Plan Team recommendations

The team reviewed the appendix on a proposed Tier 4 biomass calculation for catch specifications in September 2013. The team recommends that alternative OFL and ABC specifications based on this approach be included in the 2014 assessment. Additional recommendations are contained in the Crab Plan Team report.

10   Adak red king crab, Aleutian Islands

Fishery information relative to OFL and ABC setting

The domestic fishery has been prosecuted since 1960/61 and was opened every season through the 1995/96 season. Since 1995/96, the fishery was opened only in 1998/99, and from 2000/01-2003/04. Peak harvest occurred during the 1964/65 season with a retained catch of 21.19 million lb. During the early years of the fishery through the late 1970s, most or all of the retained catch was harvested in the area between 172° W longitude and 179° 15' W longitude. As the annual retained catch decreased into the mid-1970s and the early-1980s, a large portion of the retained catch came from the area west of 179° 15' W longitude.

Retained catch during the 10-year period, 1985/86 through 1994/95, averaged 0.94 million lb, but the retained catch during the 1995/96 season was low, only 0.04 million lb. There was an exploratory fishery with a low guideline harvest level (GHL) in 1998/99; three Commissioner's permit fisheries in limited areas during 2000/01 and 2002/03 to allow for ADF&G-Industry surveys, and two commercial fisheries with a GHL of 0.50 million lb. during the 2002/03 and 2003/04 seasons. Most of the catch since the 1990/91 season was harvested in the Petrel Bank area (between 179° W longitude and 179° E longitude) and the last two commercial fishery seasons (2002/03 and 2003/04) were opened only in the Petrel Bank area. Retained catches in those two seasons were 0.51 million lb (2002/03) and 0.48 million lb (2003/04). The fishery has been closed since the end of the 2003/04 season.

Non-retained catch of red king crabs occurs in both the directed red king crab fishery (when prosecuted), in the Aleutian Islands golden king crab fishery, and in groundfish fisheries. Estimated bycatch mortality during the 1995/96-2011/12 seasons averaged 0.002 million lb in crab fisheries and 0.020 million lb in groundfish fisheries. Estimated annual total fishing mortality (in terms of total crab removal) during 1995/96-2011/12 averaged 0.095 million lb. The average retained catch during that period was 0.074 million lb. This fishery is rationalized under the Crab Rationalization Program only for the area west of 179° W longitude.

Data and assessment methodology

The 1960/61-2007/08 time series of retained catch (number and pounds of crabs), effort (vessels, landings and pot lifts), average weight and average carapace length of landed crabs, and catch-per-unit effort (number of crabs per pot lift) are available. Bycatch from crab fisheries during 1995/96-2011/12 and from groundfish fisheries during 1993/94-2011/12 are available. There is no assessment model for this stock. The standardized surveys of the Petrel Bank area conducted by ADF&G in 2006 and 2009 and the ADF&G-Industry Petrel Bank surveys conducted in 2001 have been too limited in geographic scope and too infrequent for reliable estimation of abundance for the entire western Aleutian Islands area.

Stock biomass and recruitment trends

Estimates of stock biomass are not available for this stock. Estimates of recruitment trends and current levels relative to virgin or historic levels are not available. The fishery has been closed since the end of 2003/04 season due to apparent poor recruitment. An ADF&G-Industry survey was conducted as a commissioner's permit fishery in the Adak-Atka-Amlia Islands area in November 2002 and provided no evidence of recruitment sufficient to support a commercial fishery. A pot survey conducted by ADF&G in the Petrel Bank area in 2006 provided no evidence of strong recruitment. A 2009 survey conducted by ADF&G in the Petrel Bank area encountered a smaller, ageing population with the catch of legal male crab occurring in a more limited area and at lower densities than were found in the 2006 survey and

provided no expectations for recruitment. A test fishery conducted by a commercial vessel during October-December 2009 in the area west of Petrel Bank yielded only one legal male red king crab.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock be managed under Tier 5 for the 2013/14 season. The CPT concurs with the assessment author's recommendation of an OFL based on the 1995/96–2007/08 average total catch following the recommendation of the SSC in June 2010 to freeze the time period for computing the OFL at 1995/96–2007/08. The CPT recommends an OFL for 2013/14 of 0.12 million lb.

The Team continues to have concerns regarding the depleted status of this stock. Groundfish bycatch in recent years has accounted for the majority of the catch of this stock. The maximum permissible ABC is 0.11 million lb based on the Tier 5 control rule of a 10% buffer on the OFL.

The CPT recommends an ABC of 0.074 million lb for 2013/14, which is below the maximum permissible ABC (maxABC = 0.11 million lb). Industry has expressed interest in an exploratory fishery around the Adak area based on anecdotal information that there may be legal crab available in this stock.

Status and catch specifications (millions of lb) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	NA	NA	Closed	0	0.012	0.50[A]	
2010/11	NA	NA	Closed	0	0.004	0.12	
2011/12	NA	NA	Closed	0	0.002	0.12	0.03
2012/13	NA	NA	Closed	0	<0.001	0.12	0.07
2013/14	NA	NA	Closed			0.12	0.07

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch

Status and catch specifications (t) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2009/10	NA	NA	Closed	0	5.44	226.8[A]	
2010/11	NA	NA	Closed	0	1.81	54.43	
2011/12	NA	NA	Closed	0	1.0	54.43	12.0
2012/13	NA	NA	Closed	0	<1.0	54.43	33.57
2013/14	NA	NA	Closed			54.43	33.57

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch

No overfished determination is possible for this stock given the lack of biomass information. Catch in 2012/13 was below the OFL therefore overfishing did not occur..

Additional Plan Team discussion
The team reviewed a request from the ACDC regarding the ability to remove the eastern portion of the stock (east of 179 W) from the FMP. See the Crab Plan Team Report for additional discussion and recommendations.

Table 3 Crab Plan Team recommendations for September 2013 (stocks 1-7). Note that recommendations for stocks 6-10 represent those final values recommended by the SSC in June 2013. Note diagonal fill indicates parameters are not applicable for that tier level. Values in thousand metric tons (t).

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2013/14[2][3] MMB	2013 MMB / MMB_{MSY}	γ	Mortality (M)	2013/14 OFL	2013/14 ABC
1	EBS snow crab	3	a	1.58	154.2	1979-current [recruitment]	157.6	1.02		0.23(females) 0.386 (imm) 0.2613 (mat males)	78.1	70.3
2	BB red king crab	3	b	0.29	26.4	1984-current [recruitment]	25.0	0.95		0.18 default Estimated[4]	7.07	6.36
3	EBS Tanner crab	3	a	0.73	33.54	1982-current [recruitment]	59.4	1.77		0.34 (females), 0.25 (mat male), 0.247 (imm males and females)	25.35	17.82
4	Pribilof Islands red king crab	4	b	0.16	5.16	1991-current	4.68	0.91	1.0	0.18	0.90	0.72
5	Pribilof Islands blue king crab	4	c	0	3.99	1980-1984 1990-1997	0.28	0.07	1.0	0.18	0.00116	0.00104
6	St. Matthew Island blue king crab	4	b	0.18	3.1	1978-current	3.01	0.98	1.0	0.18	0.56 [total male catch]	0.45 [total male catch]
7	Norton Sound red king crab	4	a	0.15	2.00	1980-current [model estimate]	1.69	0.9	1.0	0.18 0.68 (>123 mm)	0.18 [total male]	0.16 [total male]
8	AI golden king crab	5				See intro chapter					5.69	5.12
9	Pribilof Island golden king crab	5				See intro chapter					0.09	0.08
10	Adak red king crab	5				1995/96–2007/08					0.05	0.03

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1 For Tiers 3 and 4 where B_{MSY} or $B_{MSYproxy}$ is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years upon which the catch average for OFL is obtained.
2 MMB as projected for 2/15/2014 at time of mating.
3 Model mature biomass on 7/1/2013
4 Additional mortality males: two periods-1980-1985; 1968-1979 and 1986-2013. Females three periods: 1980-1984; 1976-1979; 1985 to 1993 and 1968-1975; 1994-2013. See assessment for mortality rates associated with these time periods.

Table 4 Maximum permissible ABCs for 2013/14 and Crab Plan Team recommended ABCs for those stocks where the Plan Team recommendation is below the maximum permissible ABC as defined by Amendment 38 to the Crab FMP. Note that the rationale is provided in the individual introduction chapters for recommending an ABC less than the maximum permissible for these stocks. Values are in 1000 t. Note that recommendations for Adak red king crab represent the final values recommended by the SSC in June 2013.

Stock	Tier	2013/14 *Max*ABC	2013/14 ABC
EBS Snow Crab	3a	78.03	70.30
BBRKC	3b	7.07	6.36
Tanner Crab	3a	25.31	17.82
PIRKC	4b	0.759	0.718
PIBKC	4c	0.00116	0.00104
SMBKC	4b	1.23	0.45
Norton Sound RKC	4a	0.18	0.16
Adak red king crab	5	0.05	0.03

Table 5. Stock status in relation to status determination criteria 2012/13. (Note diagonal fill indicates parameters not applicable for this tier level)

Chapter	Stock	Tier	MSST	B_{MSY} or $B_{MSYproxy}$	2012/13 MMB	2012/13 MMB / MMB_{MSY}	2012/13 OFL 1000 t	2012/13 Total catch	Rebuilding Status
1	EBS snow crab	3	77.1	154.2	170.1	1.10	67.8	32.4	
2	BB red king crab	3	13.19	26.4	29.05	1.10	7.96	3.90	
3	EBS Tanner crab	3	16.77	33.54	59.35	1.77	19.02	0.71	
4	Pribilof Islands red king crab	4	2.61	5.22	4.03	0.77	0.90	0.013	
5	Pribilof Islands blue king crab	4	1.99	3.98	0.58	0.15	0.00116	0.00061	overfished
6	St. Matthew Island blue king crab	4	1.8	3.6	2.85	0.79	1.02 [total male catch]	0.82 [total male catch]	
7	Norton Sound red king crab	4	0.80	1.6	2.08	1.30	0.24	0.21	
8	AI golden king crab	5					5.69	3.12	
9	Pribilof Island golden king crab	5					0.09	Conf.	
10	Adak red king crab	5					0.054	0.001	

MMB as estimated during this assessment for 2002/13 as of 2/15/2013.