AGENDA C-4(e,f)
OCTOBER 2009

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Chris Oliver for
Executive Director

DATE: September 21, 2009

SUBJECT: BSAI Crab Issues

ESTIMATED TIME
10 HOURS
All C-4 Items

ACTION REQUIRED

(e) Approve BSAI Crab SAFE report and OFLs; receive discussion paper on crab bycatch and PSC limits

(f) Review status of St. Matthew and Pribilof blue king crab and snow crab rebuilding plans

BACKGROUND

(e) Approve BSAI Crab SAFE report and OFLs; receive discussion paper on crab bycatch and PSC limits

The Crab Plan Team met at the Alaska Fisheries Science Center from September 14-16, 2009 to review the status of stocks and to compile the annual Stock Assessment and Fishery Evaluation (SAFE) report. The Crab SAFE report was mailed to you September 22nd. This is the second year of the new process for annual determination of Crab OFLs and the Crab Plan Team is part of the newly established review process for BSAI crab assessments. There are 10 crab stocks in the BSAI Crab FMP and all 10 must have annually established OFLs. Six of the ten stocks have OFLs, established following the summer survey information availability. Two of the ten stocks (Norton Sound red king crab and AI golden king crab) have OFLs that were established following review and recommendations by the CPT and SSC in the spring of 2009 in order to allow for the summer fisheries for these stocks. The remaining two stocks (Adak red king crab and Pribilof Islands golden king crab) have OFLs recommended based on Tier 5 formulation (average catch). The CPT compiles the introduction to the SAFE Report and provides stock assessment and OFL recommendations within it with additional recommendations and discussions included in the CPT Report. The introduction to the SAFE Report is attached as Item C-4(e)(1). The Crab Plan Team Report will be made available at the meeting.

Following approval of Amendment 24 to the BSAI Crab FMP, all ten crab stocks have annually-specified overfishing limits (OFLs). For all stocks for which information is available, these OFLs are intended to cover total removals from the stock, including bycatch in groundfish and scallop fisheries. Additional requirements for catch removals for crab stocks will be necessary to comply with ACLs. The Crab Plan Team discussed relative bycatch management measures in groundfish and scallop fisheries at the May 2009 meeting. The Team recommended further consideration of bycatch in groundfish fisheries by the Council. In June, the Council tasked staff to prepare a discussion paper summarizing the current bycatch by crab stock in groundfish fisheries as well as the current measures under the BSAI groundfish FMP to control crab bycatch. This discussion paper was mailed to you on September 22nd and is attached as Item C-4(e)(2). At this meeting, the Council will review the current management measures for crab bycatch in the BSAI groundfish FMP, the overall stock-specific removals as they relate to new OFLs by crab

species under the Crab FMP, the data on crab bycatch in groundfish fisheries and the potential issues as noted in the discussion paper and discuss a direction for revising crab bycatch management measures in the groundfish fisheries.

(f) Review status of St. Matthew and Pribilof blue king crab and snow crab rebuilding plans

BSAI crab stock status in relation to status determination criteria are on an annual basis at this meeting. No crab stocks were subject to overfishing in 2008/09. Two stocks remain under rebuilding plans: EBS snow crab and Pribilof Islands blue king crab. Of these, the Pribilof Islands blue king crab estimated biomass remains below its MSST and is still considered in an overfished state. For EBS snow crab, estimated biomass is above the MSST but below its B_{MSY} proxy level and thus this stock will not be rebuilt within its rebuilding period. Rebuilding plans for EBS snow crab and Pribilof Islands blue king crab are to be revised for implementation by the 2011/12 fishing year. St. Matthew blue king crab estimated biomass is above B_{MSY} for the second consecutive year and may now be considered rebuilt. EBS Tanner crab estimated biomass for 2009/10 is projected to be below its MSST and considered to be approaching an overfished condition. A new rebuilding plan to EBS Tanner crab will be developed for implementation by the 2011/12 fishing year.

A letter from NMFS regarding these status determinations and the necessity of revising existing rebuilding plans is attached as Item C-4(f)(1).

2009 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, the Crab Plan Team reviews draft assessments in May to provide recommendations in a draft SAFE report for review by the Council's Science and Statistical Committee (SSC) in June. In September, the CPT reviews final assessments and provides final OFL recommendations and stock status determinations. Additional information on the new OFL determination process is contained in this report.

The Crab Plan Team met from September 14-15, 2009 at the Alaska Fisheries Science Center in Seattle WA to review the draft stock assessments and survey and bycatch data issues, in order to provide the recommendations and status determinations contained in this report. Members of the team who participated in this review include the following: Forrest Bowers (Chair), Ginny Eckert (Vice-Chair), André Punt, Jack Turnock, Shareef Siddeek, Bill Bechtol, Herman Savikko, Brian Garber-Yonts, Gretchen Harrington, Doug Pengilly, Bob Foy, Lou Rugolo, Wayne Donaldson, and Diana Stram. This report builds upon recommendations contained in the May 2009 report.

The CPT participated in the Alaska Crab Stock Assessment Workshop on May 13 and 14. The goal of the workshop was to establish a set of standards for use in all modeling efforts and resolve issues related to the weighting of data sources, such as appropriate weights for different likelihood components and the most appropriate ways to estimate effective sample sizes for length and size composition data. A workshop report is appended to this SAFE report. This report is prescriptive, provides guidance to assessment authors, and ensures that the stock assessments approach these issues in a similar way. Guidance in the report is intended to inform the models for the 2010/11 assessment cycle.

Stock Status Definitions

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

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.

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 criterion are annually formulated and assessed to determine the status of the crab stocks and whether (1) overfishing is occurring or the rate or level of fishing mortality for a stock or stock complex is approaching overfishing, and (2) a stock or stock complex is overfished or a stock or stock complex is approaching an overfished condition.

Overfishing is determined by comparing the overfishing level (OFL), as calculated in the five-tier system for the crab fishing year, 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. This 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 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.

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

Five-Tier System

The OFL for each stock is 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 will recommend tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the OFLs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the stock status level is determined 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).

Lastly, in stock status level "c," current biomass is below β * (B_{MSY} or a proxy for B_{MSY}). 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.

OFLs will be calculated by applying the F_{OFL} and using the most recent abundance estimates. The Crab Plan Team will review stock assessment documents, the most recent abundance estimates, and the proposed OFLs. The Alaska Fisheries Science Center will set the OFLs consistent with this FMP and forward OFLs for each stock to the State of Alaska prior to its setting the total allowable catch or guideline harvest level for that stock's upcoming crab fishing season.

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) per recruit equal to X% of the equilibrium level in the absence of any fishing.

The OFL calculation accounts for all losses to the stock not attributable to natural mortality. The OFL is the total catch limit 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 lacking. 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 is not available for a Tier 4 stock, then the OFL is 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 from this approach,

therefore, would be the total catch OFL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass or M and only historical data of retained catch is available. For Tier 5 stocks, the historical performance of the fishery is used to set OFLs in terms of retained catch. The OFL represents the average retained catch from a time period determined to be representative of the production potential of the stock. The time period selected for computing the average catch, hence the OFL, would be based on the best scientific information available and provide the appropriate risk aversion for stock conservation and utilization goals. In Tier 5, the OFL is specified in terms of an average catch value over 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.

For most Tier 5 stocks, only retained catch information is available so the OFL will be estimated for the retained catch portion only, with the corresponding overfishing comparison on the retained catch only. In the future, as information improves, the OFL calculation could include discard losses, at which point the OFL 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.

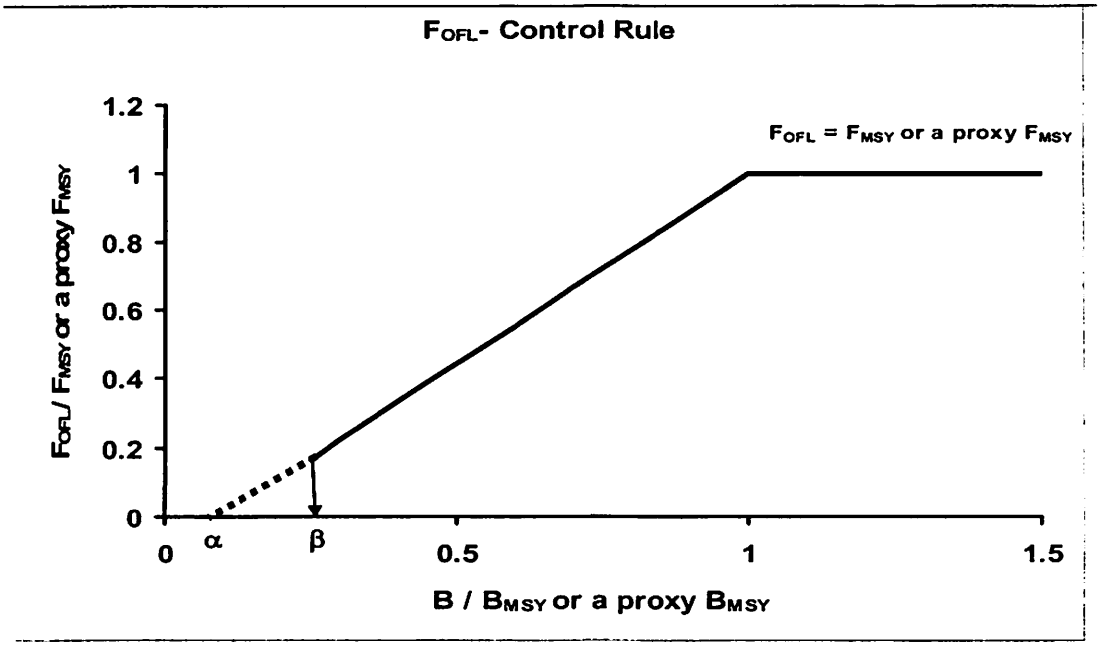

Table 1 Five-Tier System for setting overfishing limits for crab stocks. The tiers are listed in descending order of information availability. Table 6-2 contains a guide for understanding the five-tier system.

Information available	Tier	Stock status level	F_{OFL}
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$†
B, B_{MSY}, F_{MSY}	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$†
B, $F_{35\%}^{*}$, $B_{35\%}^{*}$	3	a. $\frac{B}{B_{35\%}^{*}} > 1$	$F_{OFL} = F_{35\%}$ *
		b. $\beta < \frac{B}{B_{35\%}^{*}} \leq 1$	$F_{OFL} = F^{*}_{35\%} \frac{\frac{B}{B^{*}_{35\%}} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{35\%}^{*}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$†
B, M, $B_{msy^{prox}}$	4	a. $\frac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$
		b. $\beta < \frac{B}{B_{msy^{prox}}} \leq 1$	$F_{OFL} = \gamma M \frac{B/B_{msy^{prox}} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy^{prox}}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$†
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.

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.

† An $F_{OFL} \leq F_{MSY}$ will be determined in the development of the rebuilding plan for that 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 $\beta \cdot B_{MSY} < B \leq B_{MSY}$.

Overview of changes to the EBS bottom trawl survey timeseries

The EBS bottom trawl time series for crab has been revised from 1975 to 2008. Changes include error fixes and the inclusion of recalculated area swept estimates with net width estimated from net mensuration data instead of a fixed value. Thirty nine individual crab data points affecting abundance estimates in 19 different years were amended after transcription errors were found in the database. The error fixes resulted in minor survey catch count changes in 34 of the data records. Five fixes, however, resulted in increases or decreases in the survey catch count between 1000 and 2000 crabs/nm^2 affecting mostly snow crab and Tanner crab. Using net width estimated from net mensuration data resulted in changes to all haul records from 1981 to 2009. The range of average net widths estimated in the revised time series was 14.9 to 17.4 m effectively increasing the area swept from a fixed net width of 15.24 m which was used previously. This revised time series was used for the 2009/2010 assessments for Bristol Bay red king crab, Pribilof Islands red king crab, Pribilof Islands blue king crab, and Saint Matthews blue king crab. The revised time series was not used for assessment purposes in the assessments of Eastern Bering Sea snow crab and Eastern Bering Sea Tanner crab in the 2009/2010 assessment cycle. Regardless of whether the revised data set was used for OFL specification purposes, the individual stock assessments contain a comparison of the assessment results using both trawl survey datasets. A technical paper containing the information on the revisions to the data set in addition to changes to the survey strata and subsequent variance calculations will be available in May 2010. All stocks assessments employing the trawl survey time series data will use the revised dataset in the 2010/2011 assessment cycle.

Crab Plan Team Recommendations

Table 3 lists the team's final recommendations for 2009/2010 on Tier assignments, model parameterizations, time periods for reference biomass estimation or appropriate catch averages, OFLs, and whether an OFL is applied to retained catch only or to all catch. The team recommends two stocks be placed in Tier 3 (EBS snow crab and Bristol Bay red king crab), five stocks in Tier 4 (EBS Tanner crab, 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).

Stock status in relation to status determination criteria are evaluated in this report (Table 3, Table 4). No crab stocks were subject to overfishing in 2008/09. In 2008/09, three stocks (Bristol Bay red king crab, Pribilof Islands red king crab and St. Matthew Islands blue king crab) had estimated biomass above the B_{MSY} proxy level. Two stocks remain under rebuilding plans: EBS snow crab and Pribilof Islands blue king crab. Of these, the Pribilof Islands blue king crab estimated biomass remains below its MSST and is still considered overfished. For EBS snow crab, estimated biomass is above the MSST but below its B_{MSY} proxy level and thus this stock will not be rebuilt within its rebuilding period. Rebuilding plans for EBS snow crab and Pribilof Islands blue king crab are to be revised for implementation by the 2011/12 fishing year. St. Matthew blue king crab estimated biomass is above B_{MSY} for the second consecutive year and may now be considered rebuilt.

Projections for 2009/10 indicate that two stocks (Bristol Bay red king crab and St. Matthew islands blue king crab) will have estimated biomass above the B_{MSY} proxy level. EBS Tanner crab estimated biomass for 2009/10 is projected to be below its MSST and considered to be approaching an overfished condition. A new rebuilding plan to EBS Tanner crab will be developed for implementation by the 2011/12 fishing year. Pribilof Islands red king crab biomass is estimated to drop substantially in the 2009/10 assessment year and is close to its MSST.

The team has general recommendations for all assessments and specific comments related to individual assessments. All recommendations are for consideration for the 2010 assessment cycle unless indicated otherwise. 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 Reports (May and September 2009 CPT Reports). Terms of reference and further guidelines for Crab Stock assessments following the April 2009 crab stock assessment workshop are appended to this report. This report contains information guidelines for the material to be included in all subsequent assessments.

General recommendations for all assessments

- All assessments should use the most recent data available, including revised survey data.
- All assessment should closely follow the guidelines in the Report of the Alaska Crab Stock Assessment Workshop (Appendix 1).
- The assessments should provide complete documentation on model formulation, assumptions, data sources and all calculations used when computing the OFL.
- Any tables depicting commercial fishery harvest or performance should be updated to include the most current information available.
- If the fishery year does not correspond to a calendar year then the fishery year notation should be used (e.g., 2007/08)

- The assessments must include consistent key management-related stock status information
- The assessments should include results based on the modeling approach used in the previous years to allow comparisons to be made with the proposed modeling approach for the current year.
- Estimates of precision for the survey data should be included in all assessments.
- Data (e.g. bycatch, survey) used in the assessment should be included in documentation.
- Table headings should clearly and accurately describe the data, including indicating when the values include a handling mortality assumption and the assumption used.
- Responses to all comments by the SSC and CPT on the September and May drafts of the stock assessment should be clearly addressed and responded to in the assessment.
- Research on handling mortality rates needs to be performed to better specify handling mortality rates used in the analyses.

Stock Status Summaries

1 Eastern Bering Sea Snow Crab

Fishery information relative to OFL setting.

The snow crab fishery has been opened, and harvest reported, every year since the 1960s. Prior to 2000, the GHL was 58% of abundance of male crab over 101 mm CW, estimated from the survey. The target harvest rate was reduced to 20% following the declaration of the stock as overfished in 1999, and the GHL/TAC since 2000 has been based on a harvest strategy that aims to allow recovery to the proxy for B_{MSY}.

Data and assessment methodology

The assessment is based on a size-structured population dynamics model in which crabs are categorized into mature, immature, new shell and old shell crabs by sex. The model is fitted to data on historical catches (landed and discard), survey estimates of biomass, and fishery, discard and survey size-composition data. It covers the 1978-2009 seasons and estimates abundance from 25-29mm to 130-135mm using 5mm size bins. The results of the annual Bering Sea bottom trawl survey are analyzed in three periods: before 1982, 1982-88, and 1989 onwards, with different selectivity and catchability parameters for each period. The model is based on the assumption of a terminal molt at maturity. The 2009 assessment is based on the same model and estimation framework as the 2008 assessment. Research is currently underway to evaluate the performance of the assessment method using the Management Strategy Evaluation approach, and to explore spatial structure and spatially-structured population dynamics models for snow crab. The impact of the BSFRF data regarding survey selectivity will be analyzed for the May 2010 CPT meeting.

Compared with the assessment presented to the CPT in May 2009, the final assessment uses catch and fishery length-frequency data for the 2008/09 season as well as survey abundance and length-frequency data for 2009. The 2009 assessment examines the sensitivity of the results to the use of survey data based on a variable net width.

Stock biomass and recruitment trends

Mature male biomass (at the time of mating) peaked between the late-1980s and mid-1990s, declined to a minimum in 2002 and has increased thereafter. However, the estimate of mature male biomass has not

recovered as much as expected from the 2008 assessment. This reflects a continuing retrospective pattern in that biomass estimates are revised downwards with additional data. Recruitment has varied considerably over the period 1979-2009, with the recruitment (at 25mm) in 1986 the highest on record.

Tier determination/Plan Team discussion and resulting OFL determination

The CPT recommends that snow crab be in Tier 3 (stock status b), so the OFL is based on the $F_{35\%}$ control rule. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating, computed as the average recruitment from 1979 to the last year of the assessment multiplied by the mature male biomass-per-recruit corresponding to $F_{35\%}$ less the mature male catch under an $F_{35\%}$ harvest strategy. The estimate of B_{MSY} from the 2009 assessment is 326.7 million lbs. The MSST is defined as half of the proxy for B_{MSY} (163.4 million lbs).

Status and catch specifications (millions lbs.) of snow crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		N/A	36.9	37.0	42.9	
2006/07		N/A	36.2	36.4	44.9	
2007/08	158.9	218	63.0	63.0	77.1	
2008/09	163.4	241	58.6	58.5	69.5	77.3
2009/10		251*				73.0

* Model forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The 2008/09 MMB (241 million lb) exceeds the proxy for MSST (163.4 million lbs) so the stock is not currently overfished. The total catch for 2008/09 (69.5 million lbs) was less than the 2008/09 OFL (77.3 million lbs) so overfishing did not occur during 2008/09.

The CPT notes that compared to the distribution from surveys, the catch is highly concentrated spatially. This could lead to exploitation rates in the south that exceed the desired rate. In principle, an OFL could be computed for the area in which the fishery operates, for example by applying OFL control rule to the estimated fraction of the population in that area. However, it is not clear how concentrated the stock is at the time of the fishery compared to when the survey takes place.

The OFL is uncertain (95% confidence interval of 20-113 million lbs). The uncertainty in the assessment is also reflected in terms of the relationship between the annual fishing mortality rate and that expected under the OFL control rule. For example, the TAC for 2008/09 was set less than the OFL, but the fishing mortality for 2008/09 equaled the value expected under the OFL control rule.

Rebuilding analysis

Under the current rebuilding plan, this stock had to recover to the B_{MSY} proxy in 2008/09 and 2009/10 to be defined as rebuilt. As the 2008/09 mature male biomass was smaller than B_{MSY}, the stock will fail to recover as planned. To assist the Council in amending the rebuilding plan for this stock, an approach to evaluate the trade-off between the rate of recovery to the B_{MSY} proxy and the catch during the period of recovery using projections based on the stock assessment has been developed. The assessment reports results for three candidate rebuilding harvest strategies which cover the range from closing the fishery to setting the fishing mortality to maximum permitted under the revised National Standard 1 Guidelines (75% of the F_{OFL}). It also reports some preliminary economic analyses of these rebuilding strategies. The assessment authors recommend an interim rebuilding strategy of 55% $F_{35\%}$ for the 2009/10 fishing season. The CPT did not

evaluate the trade-offs among the various rebuilding strategies and hence does not have a recommendation for an interim harvest for 2009/10. The development of a revised rebuilding plan should also consider catches of snow crab in other fisheries, including groundfish fisheries.

Additional Plan Team recommendations

The next assessment should: (a) further justify the values chosen for the weighting factors (the lambdas) and explore sensitivity to alternative weights, as outlined in the report of the 13-14 May 2009 stock assessment workshop, (b) re-run the model setting the lambda on the survey data to unity and adjusting the remaining lambdas – this will not change the point estimates of the model outputs but should widen the confidence intervals, (c) include the predictions from the May version of the model in the September assessment to evaluate how well the model forecasts biomass, (d) use the revised trawl survey data and, (e) include a sensitivity test taking account of the 2009 data from the NMFS/BSFRF survey.

The next assessment should consider: (a) imposing a penalty to prevent the probability of maturity declining with increasing size if maturity is estimated within the model, (b) setting the effective sample sizes for the length-frequency data based on the effective sample sizes estimated from the fit of the model, (c) exploring whether it is possible to improve the residual patterns for the length-frequency data by modifying how maturity, growth and natural mortality are modeled and the implications of the change in distribution of the population over time, (d) reducing the number of size classes for females, and (e) fitting to the discard length-frequency data for males rather than to the total length-frequency data for males (to avoid fitting to the retained length-frequency data twice).

The CPT continues to support development of a spatially-structured stock assessment model so that the implications of differences in where the catch is taken and where the survey finds snow crab can be evaluated.

Ecosystem Considerations summary

No additional ecosystem considerations were included in the assessment at this time.

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 lbs, but harvests dropped sharply in the early 1980s, and population abundance has remained at relatively low levels over the last two decades compared to that seen in the 1970s. The fishery is managed for a total allowable catch (TAC) coupled with restrictions for size (≥ 6.5-in carapace width), sex (male only), and season (no fishing during mating/molting periods). Prior to 1990, the harvest rate was based on estimated population size and prerecruit and postrecruit abundances, and varied from 20% to 60% of legal males. In 1990, the harvest strategy became 20% of the mature male (≥120-mm CL) abundance, with a maximum of 60% on legal males, and a threshold abundance of 8.4 million mature females. The current stepped 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 lbs of effective spawning biomass (ESB), and a minimum GHL of 4.0 million lbs to prosecute a fishery. The TAC increased from 15.5 million lbs for the 2006/07 season 20.4 and 20.3 million lbs for the 2007/08 and 2008/09 seasons, respectively. Catch of legal males per pot lift was relatively high in the 1970s, low in the 1980s to mid-1990's, and increased to an average of 27.0 crab/pot lift over the last three years; CPUE increased markedly with the implementation of the crab rationalization program in 2005. Annual non-retained catch of female and sublegal male RKC during the fishery averaged less than 3.9 million lbs since data collection began in 1990. Estimates of fishing mortality ranged from 0.28 to 0.38yr^{-1} following implementation of crab rationalization. Total catch (retained and bycatch mortality) increased from 17.2 million lbs in 2006/07 to 23.2 million lbs in 2007/08 and 23.1

million lbs in 2008/09. Retained catch was 20.3 million lbs in the 2008/09 fishery.

Data and assessment methodology

The stock assessment model is based on a length-structured population dynamics model incorporating data from the eastern Bering Sea trawl survey, commercial catch, and at-sea observer data program. Stock abundance is estimated for male and female crabs ≥ 65-mm carapace length during 1968-2009, an extension from the previous assessment which considered the years 1985-2008. Catch data (retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date from the fishery which targets males ≥6.5" carapace width) 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. Several other changes to the assessment, included re-analysis of the trawl survey data based on revised estimates of the area-swept from 1975 to 2009, and allowances for changes over time in the size at maturity for females, and mortality. The author evaluated three model scenarios: (1) a constant natural mortality ($0.18yr^{-1}$) with additional "unexplained" mortality for males and females, and incorporating Bering Sea Fisheries Research Foundation (BSFRF) survey data for 2007 and 2008; (2) constant $M = 0.18yr^{-1}$ with BSFRF 2008 survey data; and (3) similar to scenario 1, but without BSFRF data.

Stock biomass and recruitment trends

Estimates of total survey biomass increased from 177.2 million lbs in 1968 to 721.1 million lbs in 1978, decreased sharply to a low of 66.3 million lbs in 1985, then generally increased to 196.5 million lbs in 2009. Recent above-average year classes have largely recruited into the fished population with no evidence of new strong recruitment for the past three years. Mature male biomass at mating increased from 76.4 million lbs in 2007 to 95.2 million lbs in 2009.

Spatial aspects of red king crab distribution were identified as needing further exploration. For example, female survey abundance has increased in southwestern Bristol Bay, an area that also encounters extensive groundfish trawling. The distribution of this stock relative to the boundaries between the Bristol Bay management unit and the Northern District management unit warrants further examination.

Tier determination/Plan Team discussion and resulting OFL determination

All data used in the model need to be tabulated in the document and fits to all data components shown in figures. For example, model estimates of pot discard mortality and total catch from all sources should be included in the catch table for all years (1968 to present) and the BSFRF survey indices should be tabulated and the fit to them shown.

The team noted that the use of the NMFS survey data to set a prior for estimation of Q for the BSFRF survey is not appropriate as this uses the data twice.

Additional mortality for 1976-1993 is estimated in the model and referred to as natural mortality. The CPT recommends this additional mortality be referred to as unknown mortality, which could be fishing mortality or natural mortality. The CPT also requests better justification for the time periods used for unknown mortality estimation and exploration of alternative periods.

In May, the CPT considered four time periods for estimation of $B_{35\%}$ including: (1) adopt the author's recommendation using recruitment from 1995 to present; (2) 1985 to present, (3) all years, 1968 to present, and (4) pre-collapse years, 1968 to 1980. The team discussed whether changes in stock production have occurred over period 1968 to present. The team recommended, and the SSC concurred with, the author's suggested time period of 1995-current for estimation of $B_{35\%}$. For the May 2010 meeting, the team recommends additional analyses into whether stock production has changed over time, including a discussion

on regime shifts in the Bering Sea and possible mechanisms for effects on red king crab recruitment.

In May, the CPT recommended model scenario 3, in particular because, the team did not have sufficient information regarding the BSFRF survey results, and in any case, not all of the BRFRF data were included in the assessment to recommend a model scenario which incorporates these data.

The Plan Team recommends Bristol Bay red king crab in Tier 3, stock status a. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating, computed as the average recruitment from 1995 to the last year of the assessment multiplied by the mature male biomass-per-recruit corresponding to $F_{35\%}$ less the mature male catch under an $F_{35\%}$ harvest strategy. Estimated $B_{35\%}$ is 68.5 million lbs. Total catch includes retained male catch and all other bycatch sources.

Status and catch specifications (millions lbs.) of Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		NA	18.33	18.52	22.72	
2006/07		NA	15.53	15.75	17.22	
2007/08	44.8	85.9	20.38	20.51	23.23	
2008/09	37.6	87.8	20.37	20.32	23.10	24.20
2009/10		95.2*				22.56

* Model forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The 2008/09 MMB exceeds the B_{MSY} proxy of $B_{35\%}$ so the stock is not currently overfished. The total catch for 2008/09 (23.1 million lbs) was less than the 2008/09 OFL (24.2 million lbs) so overfishing did not occur during 2008/09.

Additional Plan Team recommendations

For the May 2010 assessment, the CPT requests that model scenarios 1, 2 and 3 be reexamined. The Plan Team identified the need for all model input data to be tabulated.

The CPT appreciates the preliminary analysis of model sensitivity to different weightings (lambdas). The magnitudes of lambdas have a direct affect on projected biomass and likelihood profiles because increasing lambdas impact the widths of the profiles. In terms of evaluating uncertainty in some of the forcing parameters, the team recommends that the authors provide a plot of a likelihood profile for some of the parameters such as trawl survey catchability and M. It was also recommended that the author consider parameter estimation in a fully Bayesian context. Figures of standardized residuals were provided in the current assessment and the CPT encourages further analysis of some of the residual patterns for possible cohort or growth effects. The team also requested clarification of the effect of aging errors on molt probability.

Ecosystem Considerations summary

A variety of ecological factors likely affect BBRKC recruitment and growth, although the mechanisms are unclear. For example, previous research suggested BBRKC recruitment trends may partly relate to decadal shifts in physical oceanography. Recruitment may also relate to spatial and temporal patterns in groundfish distributions. Finally, spatial distributions of red king crab females have likely shifted in response to changes in near bottom temperatures.

3 Eastern Bering Sea Tanner crab

Fishery information relative to OFL setting.

Two fisheries, one east and one west of 166° W. longitude, harvest eastern Bering Sea (EBS) Tanner crab. Under the Crab Rationalization Program, ADF&G sets separate TACs and NMFS issues separate individual fishing quota (IFQ) for these two fisheries. However, one OFL is set for the EBS Tanner crab because evidence indicates that the EBS Tanner crab is one stock. Both fisheries were closed from 1997 to 2005 due to low abundance. NMFS declared this stock overfished in 1999 and the Council developed a rebuilding plan. In 2005, 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. In 2007, NMFS determined the stock was rebuilt because spawning biomass was above B_{MSY} for two consecutive years.

Tanner crab are caught as bycatch in the groundfish 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 the Bristol Bay red king crab).

Data and assessment methodology

This stock is surveyed annually by the NMFS EBS trawl survey. Although a stock assessment model has been developed for the eastern portion of the stock, this model is not employed to assess the stock because it does not cover the entire EBS. Area-swept estimates of biomass from the EBS trawl survey are used to estimate biomass of stock components: mature male biomass (MMB), legal male biomass (LMB), and females. Fish ticket data are used for computing retained catch and observer data from the crab, and groundfish fisheries are used to estimate the non-retained catch; assumed handling mortality rates for fishery components are used to estimate the discard mortality.

Although the status determinations are based upon the original NMFS trawl survey data, the 2009 stock assessment contains an Appendix B that calculates stock status and overfishing levels using the revised NMFS bottom trawl survey data in response to an SSC request. The CPT notes that the May 2010 stock assessment will use the revised survey data.

Stock biomass and recruitment trends

MMB and LMB showed peaks in the mid-1970s and early 1990s. MMB at the survey revealed an all-time high of 623.9 million pounds in 1975, and a second peak of 255.7 million pounds in 1991. From late-1990s through 2007, MMB has risen at a moderate rate from a low of 25.1 million pounds in 1997. Post-1997, MMB at the time of survey increased to 185.2 million pounds in 2007 and subsequently decreased to 143.1 million pounds in 2008. In the 2008 survey, estimated abundance of legal males increased over the 2007 abundance estimate by 9%; however, the 2008 survey showed a marked decline in estimated abundance across all other size classes of males and females. In the 2009 survey, the MMB at the time of survey decreased to 86.6 million pounds, a 36.8% decrease from 2008. Most other size classes of males and females also showed a decline in estimated abundance, except for small females (see Figure 9 in the stock assessment).

Tier determination/Plan Team discussion and resulting OFL determination

The team recommends the OFL for this stock be based on the Tier 4 control rule because no stock assessment model has been developed for the entire EBS stock. Based on the estimated biomass, the stock is at stock status level b. The team recommends that B_{MSY} is based on the average MMB for the years 1969-1980, discounted by fishery removals (retained and non-retained mortalities) and natural mortality between the time of survey and the time of mating. This time period is thought to represent the reproductive potential of the stock because it encompasses periods of both high and low stock status equivalently. This equates to a B_{MSY} of 189.76 MMB. The team recommends that gamma (γ) be set to γ=1.0.

Historical status and catch specifications (millions lbs) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL
2005/06		86.24	1.6	0.95	4.19	
2006/07		126.58	2.97	2.12	11.95	
2007/08	94.8	150.74	5.62	2.11	8.80	
2008/09	94.8	118.23	4.3	1.94	4.96	15.52
2009/10		70.16*				5.57

* Forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The total catch for 2008/09 (4.96 million lbs) was less than the 2008/09 OFL (15.52 million lbs) so overfishing did not occur during 2008/09. Based on the stock assessment, the Tanner crab stock was not overfished in 2008/09. However, based on the survey for 2009, irrespective of the catch during 2010, MMB is projected to be below MSST on February 15, 2010, i.e. the stock is approaching an overfished condition.

Ecosystem Considerations summary

Ecosystem considerations for this stock were not discussed by the CPT.

4 Pribilof Islands red king crab

Fishery information relative to OFL setting

There is no harvest strategy for this fishery in State regulation. The fishery began as bycatch in 1973 during the blue king crab fishery. A red king crab fishery opened with a specified GHL for the first time in September 1993. The 1993/94 fishery yielded 2.6 million pounds under a 3.4 million pound GHL, with the highest catches occurred east of St. Paul Island, but harvests also south, southwest, west, and northeast of St. Paul Island. The 1994 fishery was also prosecuted with a specified red king crab GHL. Since 1995, a combined GHL for red and blue king crabs was set and ranged from 1.25 to 2.5 million pounds. The fishery has remained closed since 1999 because of uncertainty with estimated red king crab survey abundance and concerns for incidental catch and mortality of blue king crab, an overfished and very depressed stock. Prior to the closure, the CDQ harvest (3.5%) in 1998/99 was 35,958 pounds. The non-retained catches (without application of bycatch mortality rate) from pot and groundfish bycatch estimates of red king crab ranged from 0.11 to 0.19 million pounds during 1991/92 – 2008/09.

Data and assessment methodology

Although a catch survey analysis has been used for assessing the stock in the past, which incorporated data from the eastern Bering Sea trawl survey, commercial catch, pot survey, and at-sea observer data; for this assessment, trends in MMB at mating are based on NMFS annual trawl survey estimates for 1980-2009 and incorporated commercial catch and observer data. The revised NMFS trawl survey historical abundance estimates were used in this assessment. For 2009 reference points' estimation, an F_{OFL} is determined using a mean mature male biomass (MMB) at the time of mating (projected to mating time), the default γ value of 1, and an M value of $0.18yr^{-1}$. The stock assessment analyzes two time period options for estimating mean MMB as a proxy B_{MSY}, 1991-2009 and 1980-2009. This F_{OFL} is applied to the projected legal male biomass at the time of the fishery to determine the catch OFL. Total crab removal (retained, and directed and non-directed bycatch losses) with legal male biomass and MMB are used to estimate the exploitation rates on legal male and mature male biomasses, respectively, at the time of the fishery.

Stock biomass and recruitment trends

The stock exhibited widely varying mature male and female abundances during 1980-2009. The estimate of MMB from the 2009 survey was 4.46 million pounds. Recruitment indices are not well understood for Pribilof red king crab. Pre-recruitment have remained relatively consistent in the past 10 years, although may not be well assessed with the survey. Stock biomass in recent years has decreased since the 2007 survey with a substantial decrease in all size classes in 2009. Red king crabs have been historically harvested with blue king crabs and are currently the dominant of the two species in this area.

Tier determination/Plan Team discussion and resulting OFL determination

This stock is recommended to be in Tier 4, stock status b. For the 2009/2010 fishery, the CPT recommends using the period 1991-2009 to determine mean MMB at mating time as a proxy B_{MSY}. The estimated proxy B_{MSY} is 8.78 million pounds. The team recommends that γ be set to 1.0.

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

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		2.59	Closed	0	0.064	
2006/07		13.87	Closed	0	0.024	
2007/08	4.33	14.70	Closed	0	0.008	
2008/09	4.39	11.06	Closed	0	0.021	3.32
2009/10		4.46*				0.50

* Forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The total catch for 2008/09 (0.021 million lbs) was less than the 2008/09 OFL (3.32 million lbs) so overfishing did not occur during 2008/09. The 2009 MMB estimate of 11.06 was above MSST in 2008/09 and therefore is not overfished.

Additional plan team recommendations

The CPT looks forward to an update on the catch survey model for May 2010.

Ecosystem Considerations summary

There have been no direct studies of the prey of Pribilof Islands red king crab. Studies in other areas indicate that red king crab diet varies with life stage and that red king crabs are opportunistic omnivorous feeders, eating a wide variety of microscopic and macroscopic plants and animals. Pacific cod is the major predator of red king crab in the eastern Bering Sea. Recruitment trends for red king crab in the eastern Bering Sea may be partly related to decadal shifts in climate and physical oceanography. Strong year classes were observed when temperatures were low and weak year classes were observed when temperatures were high, but temperature alone cannot explain year class strength trend. The lack of king crab recruitment in the Pribilof Islands area may be the result of a large-scale environmental event affecting abundance and distribution. Seasonal ice cover has an effect on primary productivity and hence crab recruitment, but the effect of changes in ice cover on benthic communities of the Pribilof Islands are not well known. The trawl fishery ban around the Pribilof Islands protects red king crab critical habitat in this area. The extent that pot gear impacts benthic habitat is not well known and most likely depends on the substrate.

5 Pribilof District blue king crab

Fishery information relative to OFL setting.

The Pribilof blue king crab fishery began in 1973, with peak landing of 11.0 million lbs in the 1980/81 season. A steep decline in landings occurred after the 1980/81 season. Directed fishery harvest from 1983 until 1987 was annually less than 1.0 million lbs with low CPUE. The fishery was closed in 1988 until 1995. The fishery reopened from 1995 to 1998. Fishery harvests during this period ranged from 1.3 to 0.5 million lbs. The fishery closed again in 1999 due to declining stock abundance and has remained closed through the 2008/09 season. The stock was declared overfished in 2002.

Data and assessment methodology

The NMFS conducts an annual trawl survey that is used to produce area-swept abundance estimates. In 2009 NMFS updated the trawl survey time series resulting in a minor adjustment in current and historical survey biomass and a minor adjustment in the B_{MSY} calculation. This assessment uses the new survey data series with measured net widths. The CPT discussed the history of the fishery and the rapid decline in landings. It is clear that the stock has collapsed, although the annual area-swept abundance estimates are imprecise.

Stock biomass and recruitment trends

Based on 2009 NMFS bottom-trawl survey, the estimated total mature-male biomass increased to 1.28 million lbs from 0.29 million lbs in 2008. However, the 2009/10 MMB at mating is projected to be 1.13 million lbs which is about 12% of 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 determination

This stock is recommended for placement into Tier 4, stock status level c. The time period for B_{MSY} is 1980/81-1984/85 plus 1990/1991-1997/1998, excluding the period 1985/1986-1989/1990. 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 as 9.28 million pounds. The retained catch OFL is 0 because the 2009/10 estimate of MMB is less than 25% B_{MSY}. Due to the Tier level and stock status an F_{OFL} must be determined for the non-directed catch. Ideally this should be based on the rebuilding strategy, however the rebuilding plan needs to be revised due to inadequate progress towards rebuilding.

The OFL for 2008/09 was set at 0.004 million lbs, the average catch mortality between 1999/00 and 2005/06. The CPT recommends an OFL for 2009/10 at 0.004 million lbs, equal to the total catch OFL for 2008/09.

The CPT recommended $\gamma = 1$, given the absence of information presented to establish an alternate value at this time. Natural mortality was $M=0.18yr^{-1}$.

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

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		0.68	closed	0	0.002	
2006/07		0.33	closed	0	0.0004	
2007/08		0.66	closed	0	0.005	
2008/09	4.64	0.25	closed	0	0.001	0.004
2009/10	4.64	1.13*	closed	0		0.004

* Forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The total catch for 2008/09 (0.001 million lbs) was less than the 2008/09 OFL (0.004 million lbs) so overfishing did not occur during 2008/09. The 2009/10 projected MMB estimate of 1.13 million lbs is below the proxy for MSST so the stock continues to be in an overfished condition.

Additional Plan Team recommendations

The rebuilding plan needs to be revised given inadequate progress towards rebuilding. Management options for revising the rebuilding plan are contained in the Crab Plan Team minutes (May 2009).

6 St. Matthew blue king crab

Fishery information relative to OFL setting

The fishery was prosecuted as a directed fishery from 1977 to 1998. The stock was declared overfished and closed in 1999, and was under a rebuilding plan until 2008/2009. The MMB has been over B_{MSY} for two years and is now rebuilt. The fishery has remained closed since 1999.

Data and assessment methodology

A four-stage catch survey analysis that incorporates annual trawl survey data from 1978 to present, triennial pot survey data from 1995 to 2007, and commercial catch data from 1978 to 2008, and uses a maximum likelihood approach to estimate male crab biomass and abundance forms the basis for the assessment. The model links crab abundance in four crab stages based on a growth matrix, estimated mortalities, and molting probabilities. The four stages are prerecruit-2s (90-104 mm CL), prerecruit-1s (105-119 mm CL), recruits (newshell 120-133 mm CL), and postrecruits (oldshell $\geq$ 120 mm CL and newshell $\geq$ 134 mm CL). The assessment considered five scenarios to related natural mortality (M) or survey catchability (Q). The first three scenarios include estimated M for one year (1999), while the other two assume that M was constant over time. The scenario with q and M fixed (with estimating M in 1999) was selected by the CPT because of the uncertainty in parameter estimation.

Stock biomass and recruitment trends

MMB has fluctuated greatly in three periods. The first period increased from 7.6 to over 17.6 million lbs from 1978 to 1981, followed by a steady decrease to 2.9 million lbs. in 1985. The second period had a steady increase from the low in 1985 to 13.3 million lbs. in 1997 followed by a rapid decrease to 2.8 million lbs. in 1999. The third period had a steady increase from the low in 1999 to it present high of over 10.7 million lbs. in 2008.

Tier determination/Plan Team discussion and resulting OFL determination

St. Matthew blue king crab is recommended as a Tier 4 stock. The $B_{MSYproxy}$ varies as a function of years used

to calculate average MMB. The time period selected by CPT for estimating $B_{MSYproxy}$ was 1989 to current. This because the stock was harvested at extremely high rates before 1986 and this time period incorporates stock rebuilding several years after the stock crash. $B_{MSYproxy}$ during this time period is 7.99 million lbs. and γ =1.

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

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		5.3	closed	closed	0.47	
2006/07		7.1	closed	closed	0.67	
2007/08		9.7	closed	closed	0.35	
2008/09	4.0	10.74	closed	0.20	0.20	1.63 [retained]
2009/10	4.0	12.47*				1.72 total male catch

* Model forecast based on the 2009 assessment under the assumption that the 2009/10 catch equals to the OFL. This value will be updated during the September 2010 assessment when the 2010 survey data and the 2009/10 catch data become available.

The retained catch for 2008/09 (0.20 million lbs) was less than the 2008/09 OFL (1.63 million lbs) so overfishing did not occur during 2008/09. The stock is considered rebuilt after two years of estimated MMB biomass above the $B_{MSYproxy}$. The MMB has been over $B_{MSYproxy}$ for two years and is now rebuilt. The 2009/10 projected MMB estimate of 12.47 million lbs is also above the $B_{MSYproxy}$.

Additional Plan Team recommendations

1) The model should continue to be refined for review at the May 2010 CPT meeting to allow this stock to be considered for Tier 3.
2) Bycatch data in all fisheries must be compiled to generate a total catch OFL. Note this was only done for total (male) catch OFL in the 2009/10 fishery. The model should be modified in the future to allow for the total catch OFL to include both males and females.

Ecosystem Considerations summary

Information on habitat, prey availability and predator trends are needed with greater spatial and temporal resolution in order to better understand how they may vary with St. Matthew blue king crab abundance.

7 Norton Sound Red King Crab

Fishery information relative to OFL-setting

Norton Sound red king crab harvest occurs in three fisheries: summer commercial, winter commercial, and winter subsistence fishery. The summer commercial fishery is the major fishery. Commercial fishing started in 1977 and, since 1994, commercial vessels were restricted harvesting Norton Sound red king crab only. In 1998, Community Development Quota groups were allocated a portion of the summer fishery quota. The winter commercial fishery is relatively small averaging 2,400 crabs annually during 1997-2007. The subsistence fishery, which averaged 5,300 crabs during 1978-2007, occurs mainly during the winter via hand lines and pots deployed through the near shore ice.

The management strategy for Norton Sound red king crab involves a stepped harvest rate (HR). The guideline harvest level for the summer fishery is established at three levels based on estimated legal biomass (ELB): (1) HR = 0% for ELB < 1.5 million lbs; (2) HR ≤ 5% for ELB from 1.5 to 2.5 million lbs; and (3) HR ≤ 10% for ELB > 2.5 million pounds.

Data and assessment methodology
Fishery-dependent data are available for the three fisheries. Fishery-independent data are available through four surveys: summer trawl, summer pot, winter pot, and a preseason pot survey. Surveys are conducted periodically with no survey being conducted on an annual basis. No observer program-based bycatch or discard data is available for the fisheries. A length-based stock model was developed to estimate annual stock abundance for the period 1976-2007. Summer commercial fishery data are available from 1977. The current 2009 stock assessment was updated with data from the 2008 fall trawl survey, 2008 winter pot survey, and the 2008 summer commercial fishery. The 2008/09 retained fishery catch data used in the analysis are incomplete. No directed fishery discard losses, or stock losses resulting from non-directed fishery bycatch were included in this 2009 assessment.

Stock biomass and recruitment trends

Estimated legal stock abundance was high during the 1970s, low in the early 1980s and mid 1990s, and has gradually trended upward since 1996. Estimated recruitment was low in the late 1970s and early and late 1990s, and higher in the early 1980s, mid 1990s, and early 2000s, with a generally upward trend in the most recent seasons.

Tier determination, Plan Team discussion and OFL determination

The Crab Plan Team discussed the current stock assessment model. The CPT had major concerns about the suitability of the model presented for OFL-setting, and offered several recommendations and requests of the authors:

1. The team requested that the assessment model from the previous year be included in the current assessment in order to evaluate the impact of changes made to the model, and to have those results as a fall-back option if the current model is unsuitable and rejected for OFL-determination.

2. In this assessment, stock losses due to natural morality and only retained catch are considered. Mortalities due to directed fishery discards and non-directed bycatch are not included; thus, handling mortality is explicitly set equal to zero. The team discussed the justification for a zero handling morality rate assumption and questioned the justification as described in the assessment.

   The author justified this rate based on the absence of observer data. The author also justified the lack of discard and bycatch mortality as the only source of such mortality is temperature (i.e. freezing) induced and this is not significant due to the timing of the fishery. This justification was considered inadequate by the team and the assumption of zero non-retained morality to be implausible. The team noted other sources of potential mortality such as that resulting from handling stress and physical damage of non-retained crab. The team recommended that in the absence of observer data on discards and bycatch, the assessment should include a sensitivity analysis as to a plausible range of non-retained mortalities. The team also suggested that the approach used in the Bristol Bay red king crab assessment for estimating discard catch in the directed fishery be used as a benchmark, and that these results be compared to those resulting from the zero non-retained mortality assumption.

3. The team did not approve the model scenario which included a naturally mortality rate = 0.3 and requested instead the use of 0.18. The team discussed the likelihood profiles of M presented in the assessment (Chapter 7, Figure 2) and did not consider the rate of 0.30 to be adequately supported by either profile. The team also did not support natural mortality arguments based on longevity as presented in the assessment.

4. The team had major concerns about the use of $\gamma = 0.6$ in the 2009 OFL analysis and requested that the model be revaluated with a $\gamma = 1$ as their preferred alternative. The assessment was modified to include this.

5. The team requests that the assessment be updated for September 2009 with the 2008/09 retained catch included in order to determine if overfishing was occurring in 2008/09.

6. The team requests further analysis of the retrospective pattern in the assessment given concerns regarding the consistent pattern indicating an overestimate of biomass compared to the trawl survey.

7. The team approved the authors' recommendation of the use of 1983-2009 to estimate the B_{MSY} proxy which excludes the 1976-1982 period due to uncertainty in biomass estimates, however the team requests that author provide a more complete rationale for choice of range of years in future assessments.

8. The team recommended inclusion of an assumed bycatch and discard mortality for the subsequent assessments.

9. The team requested that the subsequent assessment also include a Tier-5 calculation.

The team recommended Tier 4 stock status for a 2009/10 retained catch OFL of 0.7125 million pounds. The $B_{MSYproxy}$ is 3.07 million lbs, $F_{MSYproxy} = 0.18$, MMB in 2009 = 5.83 million lbs. This OFL is established in June 2009 in order to allow for the summer fishery.

Historical status and catch specifications (million lbs.) of Norton Sound red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06		3.89	0.37	0.40		
2006/07		3.62	0.45	0.45	0.48	
2007/08		4.40	0.32	0.31*	0.35	
2008/09	1.55	5.24	0.41	0.39*	0.42	0.68 [retained]
2009/10	1.55	5.83	0.37			0.71 [retained]

*Summer fishery only. Small winter and subsistence fisheries not included.

The retained catch for 2008/09 (0.39 million lbs) was less than the 2008/09 OFL (0.68 million lbs) so overfishing did not occur during 2008/09. The 2009 MMB estimate of 5.83 was above MSST in 2009 and therefore is not overfished.

Additional Plan Team recommendations

The team also recommended that the summary fishery performance table include the most recent year's catch, the corresponding estimated catch used in the stock assessment model and the OFL. Finally, figures should be clearly configured for ease of interpretation (e.g., X-axes offset in the comparison of observed and estimated abundances, and the most recent observations clearly marked showing the relationship between harvest rates and mature male biomass).

The team reiterated the ongoing request that that the assessment show results of sensitivity analyses for key model parameters to assist in evaluating alternative model specifications.

8 Aleutian Islands golden king crab

Fishery information relative to OFL setting

The fishery has been prosecuted as a directed fishery since the 1981/82 season and has been open every season since then. Retained catch peaked during the 1985/86–1989/90 seasons (average catch of 11.9 million lbs), but average harvests dropped sharply from the 1989/90 to 1990/91 season and the average harvest for the period 1990/91–1995/96 was 6.9 million lbs. Management for a formally established GHL was first introduced with a 5.9-million lb GHL in the 1996/97 season, subsequently reduced to 5.7-million lbs beginning with the 1998/99 season. The GHL (or TAC, since the 2005/06 season) remained at 5.7 million lbs through the 2007/08 season. In March 2008 the Alaska Board of Fisheries set the TAC for this stock in regulation at 5.985 million pounds. Average retained catch for the period 1996/97–2007/08 was 5.6 million lbs, including 5.5 million lbs in the 2007/08 season. This fishery is rationalized under the Crab Rationalization Program.

Data and assessment methodology

There is no assessment model in use for this stock. 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-frequency data from samples of landed crabs, at-sea observer data from pot lifts sampled during the fishery (date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc), data from a triennial pot survey in the Yunaska-Amukta Island area of the Aleutian Islands (approximately 171° W longitude), recovery data from tagged crabs released during the triennial pot surveys and bycatch data from the groundfish fisheries. These data are available through the 2007/08 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. A triennial survey was scheduled for 2009, but was cancelled.

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. However, there is good evidence that the sharp increase in CPUE of retained legal males during recent fishery seasons was not due to a sharp increase in recruitment of legal-size males.

Tier determination/Plan Team discussion and resulting OFL determination

AIGKC is recommended for Tier 5 stock in 2009/2010. B_{MSY} and MSST are not estimated for this stock. Observer data on bycatch from the directed fishery is too incomplete to provide estimates of total catch for the time periods under consideration; there is no observer data from the directed fishery prior to the 1988/89 season and observer data are lacking or confidential for at least one management area in the Aleutian Islands for four seasons of seven seasons during 1988/89–1994/95. Hence, OFL was recommended for this year as a retained catch OFL. The time period for calculating average catch was selected as 1990/1991 to 1995/1996 because before 1990, during a period of unconstrained harvest, there were indications (declining CPUE and catch) that large catches prior to 1990 were not sustainable. Post 1996 harvests were constrained by a constant GHL/TAC and therefore may not be representative of true production potential. The CPT believes that the 1990/1991 to 1995/1996 time period best represents the sustainable, long-term production potential of the stock. This recommendation differs with the approach taken by the SSC in June 2008. However the reasons for recommending the year period 1990/1991 - 1995/1996 to calculate the OFL persist from the prior year's assessment.

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

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL (retained)
2005/06	NA	NA	5.70	5.52	6.0	
2006/07	NA	NA	5.70	5.22	5.8	
2007/08	NA	NA	5.70	5.51	6.2	
2008/09	NA	NA	5.99	5.68	6.3	9.18 [retained]
2009/10	NA	NA	5.99			6.93 [retained]

No overfished determination is possible for this stock given the lack of biomass information. Retained catch in 2008/09 (5.68 million pounds) was less than the retained catch OFL for this stock in 2008/09 therefore overfishing did not occur.

Additional Plan Team recommendations

In May 2009, the plan team reviewed a new stock assessment model for Aleutian Islands golden king crab (Chapter 8b, Draft May Crab SAFE report). Use of an assessment model could allow for this stock to be moved to Tier 4 and would provide focus for establishing research and data collection priorities. The team believes that the model has been improved greatly from the 2008 iteration. The team recommends incorporation of plan team comments into the model for the September 2009 plan team meeting but did not recommend adopting the model for OFL determination in this year. Specific comments on model suggestions are contained in the May Crab Plan Team report.

Ecosystem Considerations summary

The assessment author should reference the Aleutian Islands Fishery Ecosystem Plan in future assessment reports. The author reviewed the June 2008 SSC comments on ecosystem considerations for this stock. However an ecosystem discussion was not included in the assessment. The specific SSC comments regarding sea bird predation on larval crabs may be difficult to address for this stock.

9 Pribilof Islands golden king crab

Fishery information relative to OFL setting

The domestic fishery around the Pribilof Islands for male golden king crab ≥5.5 in. CW (≥124 mm. CL) developed in 1982. Since then, fishery participation has been sporadic and retained catches variable. The fishery has been managed for a GHL of 0.15 million lbs since 2000. Non-retained bycatch occurs in the directed fishery as well as in the Bering Sea snow crab and grooved Tanner crab fisheries. This fishery was not included in the Crab Rationalization Program. This fishery is the only fishery considered here in which the fishery year corresponds with the calendar year; the fishery opens on January 1 and is open year round operating under an ADF&G commissioner's permit. No permits have been issued since 2005 for this fishery.

Data and assessment methodology

There is no survey and no assessment model in use for this stock. Available data are from fish tickets (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 at-sea observer data from 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 is confidential due to low numbers of participating vessels or processors.

Stock biomass and recruitment trends

Estimates of stock biomass are not available. Between 2002 and 2005, the average size of legal male golden king crab taken in the commercial fishery decreased while CPUE increased, which may suggest some recruitment to the legal male portion of the stock during that period.

Tier determination/Plan Team discussion and resulting OFL determination

The team recommends that this stock be assigned to Tier 5 due to the lack of available biomass information. Options for time periods and for considering a total catch OFL were presented. Due to either confidentiality of retained catch data or lack of observer data a total catch OFL can only be computed from the average of the 2001 and 2002 seasons, both of which were fished under the constraint of a 150,000 pound GHL. Hence it is recommended that the 2010 OFL for fishery be established as a retained catch OFL. The team recommended that the time period for the average catch calculation be 1993-1998 as this time frame contains average catch over a time period where catch is neither confidential nor constrained by a GHL.

Status and catch specifications (million lbs.) of Pribilof Islands golden king crab

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Catch (non retained all fisheries)*	OFL
2006	NA	NA	0.15	0		
2007	NA	NA	0.15	0		
2008	NA	NA	0.15	0		
2009	NA	NA	0.15	0	0.001	0.17 [retained]
2010	NA	NA				0.17 [retained]

*catch data for crab fisheries only

No overfished determination is possible for this stock given the lack of biomass information. Retained catch in 2009 did not exceed the retained catch OFL therefore overfishing did not occur in 2009.

Additional Plan Team recommendations

The team recommends the assessment author further evaluate all sources of mortality in order to present alternative total catch OFL options for the 2011 assessment (May 2010). The team encourages inclusion of further information on the slope survey to the extent possible to consider whether or not information may be sufficient to move this assessment up to tier 4 in future years.

10 Adak red king crab, Aleutian Islands

Fishery information relative to OFL 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 occasionally, 1998/99, 2000/01-2003/04. Peak harvest occurred during the 1964/65 season with a retained catch of 21 million pounds. 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, the area west of 179° 15' W longitude began to account for a larger portion of the retained catch

Retained catch during the 10-year period, 1985/86 through 1994/95, averaged 0.943 million pounds, but the retained catch during the 1995/96 season was low, only 0.039 million pounds. 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 0.5 million pounds 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 0.506 million pounds (2002/03) and 0.479 million pounds (2003/04). The fishery has been closed through the 2008/09 season 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 1995/96-2008/09 seasons averaged 0.003 million pound in crab fisheries and 0.024 million pounds in groundfish fisheries. Estimated annual total fishing mortality (in terms of total crab removal) during 1995/96-2008/09 averaged 0.116 million pounds. The average retained catch during that period was 0.09 thousand pounds. This fishery is rationalized under the Crab Rationalization Program only for the area west of 179° W longitude.

Data and assessment methodology

The 1960/61-2008/09 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 1995/96-2008/09 and from groundfish fisheries during 1992/93-2008/09 are available. There is no assessment model in use for this stock. The standardized surveys by ADF&G have been too limited in geographic scope and too infrequent for reliable estimation of abundance for the Aleutian Islands area. Prior to the 2006 survey, the last one conducted was in 2001, performed with industry participation under provisions of a commissioner's permit. The department attempted to do another systematic pot survey in 2007, but did not receive any bids for a charter vessel. The department plans to conduct a survey in the Petrol Bank area in November 2009 using a chartered crab pot vessel. Future pot surveys will be dependent upon the department's ability to secure bids for charter work. The department has also been in discussion with industry representatives concerning their desire for departmental review of future collaboration for survey work in this 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. A pot survey conducted by ADF&G in the Petrol Bank area in 2006 provided no evidence of strong recruitment.

Tier determination/Plan Team discussion and resulting OFL determination

The CPT recommends this as a Tier 5 stock for the 2009/10 season. The team discussed at length whether to compute the OFL as total catch or only retained catch. The author suggested using the retained catch OFL because there would be errors in estimating bycatch during initial years of the fishery when it was developing. The CPT agrees with the author's suggestion. The author provided three model alternatives (Alt.) with different time periods in addition to the "Base" that was used to determine the OFL for 2008/09 (Base:

1985/886-2007/08; Alt.1: 1984/85-2007/08; Alt.2: 1977/78-2007/08; and Alt.3: 1960/61-2007/08) to compute the average retained catch as OFL. Agreeing with SSC's recommendations the CPT recommends alternative 1 for the OFL calculation. The retained catch OFL for this period (1984/85-2007/08) is 0.50 million pounds. The CPT also recommends freezing the final fishing season for OFL calculation at 2007/08.

Status and catch specifications (millions of lbs) of Adak red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL
2005/06	NA	NA	Closed	0	0.004	
2006/07	NA	NA	Closed	0	0.004	
2007/08	NA	NA	Closed	0	0.011	
2008/09	NA	NA	Closed	0	0.014	0.46[a] [retained]
2009/10	NA	NA	Closed	0		0.50[b] [retained]

a based on 1984/85-07/08 mean retained catch
b based on 1984/85-07/08 mean retained catch

No overfished determination is possible for this stock given the lack of biomass information. Retained catch in 2009 did not exceed the retained catch OFL therefore overfishing did not occur in 2009.

Additional Plan Team recommendations

For the May 2010 CPT meeting, the CPT requested the author to provide an analysis applying the available information on bycatch to time periods for which bycatch data are lacking to obtain an estimate of a total-catch OFL and to provide the CPT with total-catch OFLs options to consider for 2010/11.

Ecosystem Considerations summary

This stock is unsurveyed, remote, and data-poor. Since the fishery is sporadic and restricted to a limited area (Petrol Bank), fishery specific effects on target size crab, discards, age at maturity, EFH non-living substrate appears minimal.

Table 3 Crab Plan Team recommendations September 2009
(Note diagonal fill indicates parameters not applicable for that tier level)

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2009/10[2 3] MMB	2009/10 MMB / MMB_{MSY}	γ	Mortality (M)	2009/10 OFL mill lbs [retained]
1	EBS snow crab	3	b	0.52	326.7	1979-current [recruitment]	251	0.77		0.23 (males, immat.) 0.29 (mature females)	73.0
2	BB red king crab	3	a	0.32	68.5	1995-current [recruitment][5]	95.17	1.08		0.18 default, estimated otherwise[4]	22.56
3	EBS Tanner crab	4	b	0.07	189.76	1969-1980 [survey]	70.2	0.37	1.0	0.23	5.57
4	Pribilof Islands red king crab	4	b	0.08	8.78	1991-current [survey][5]	4.46	0.51	1.0	0.18	0.50
5	Pribilof Islands blue king crab	4	c	0	9.01	1980-1984; 1990-1997 [survey][5]	1.13	0.13	1.0	0.18	0.004
6	St. Matthew Island blue king crab	4	a	0.18	7.99	1989-current [model estimate][5]	12.47	1.56	1.0	0.18 (1978-98, 2000-08); 1.8 (1999)	1.723 total male catch
7	Norton Sound red king crab	4	a	0.18	3.07	1983-current [model estimate]	5.83	1.9	1.0	0.18	0.7125 [retained]
8	AI golden king crab	5				1990/91-1995/96 [retained catch]					6.93 [retained]
9	Pribilof Island golden king crab	5				1993-1998 [retained catch]					0.176 [retained]
10	Adak red king crab	5				1984/85-2007/08 [retained catch]					0.50 [retained]

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 2/15/2010 at time of mating.
3 Model mature biomass
4 Additional mortality males: two periods-1980-1985; 1968-1979 and 1986-2008. Females three periods: 1980-1984; 1976-1979; 1985 to 1993 and 1968-1975; 1994-2008. See assessment for mortality rates associated with these time periods.
5 Revised EBS trawl survey timeseries data used
6 For calendar year 2010

Table 4 Stock status in relation to status determination criteria 2008/09
(Note diagonal fill indicates parameters not applicable for that tier level)

Chapter	Stock	Tier	MSST	B_{MSY} or $B_{MSYproxy}$	2008/2009[7] MMB	2008/2009 MMB / MMB_{MSY}	2008/09 OFL mill lbs [retained]	2008/09 Total catch
1	EBS snow crab	3	163.4	326.7	241	0.74	77.3	69.5
2	BB red king crab	3	34.3	68.5	87.8	1.28	24.2	23.1
3	EBS Tanner crab	4	94.9	189.76	118.0	0.62	15.52	4.96
4	Pribilof Islands red king crab	4	4.39	8.78	11.06	1.28	3.32	0.021
5	Pribilof Islands blue king crab	4	4.5	9.01	0.24	0.03	0.004	0.001
6	St. Matthew Island blue king crab	4	4.0	7.99	10.74	1.34	1.63 [retained]	0.20
7	Norton Sound red king crab	4	1.55	3.07	5.83	1.9	0.7125 [retained]	0.42
8	AI golden king crab	5					6.93 [retained]	6.3
9	Pribilof Island golden king crab	5					0.17 [retained]	0.001
10	Adak red king crab	5					0.46 [retained]	0.014

7 MMB as estimated during this assessment for 2008/09 as of 2/15/2009.

Crab bycatch in BSAI groundfish fisheries

Staff Discussion paper

The BSAI Crab FMP applies to 10 crab stocks in the BSAI: 4 red king crab, *Paralithodes camtschaticus*,(Bristol Bay, Pribilof Islands, Norton Sound and Adak), 2 blue king crab, *Paralithodes platypus* (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 *C. opilio*. All other BSAI crab stocks are exclusively managed by the State of Alaska. Following approval of amendment 24 to the BSAI Crab FMP, these stocks now have annually-specified overfishing limits (OFLs). For all stocks for which information is available, these OFLs are intended to cover total removals from the stock, including bycatch in groundfish and scallop fisheries. Additional requirements for catch removals for crab stocks will be necessary to comply with ACLs. The Crab Plan Team discussed relative bycatch management measures in groundfish and scallop fisheries at the May 2009 meeting (CPT minutes on this attached as Appendix A). The Team recommended further consideration of bycatch in groundfish fisheries by the Council. The Team reiterated this request and discussed specific bycatch concerns related to individual stocks at their recent September 2009 meeting (see draft CPT report under agenda item C-4e to be made available at the Council meeting). At the June 2009 meeting, the Council recommended that staff prepare a discussion paper summarizing the current bycatch by crab stock in groundfish fisheries as well as the current measures under the BSAI groundfish FMP to control crab bycatch.

1. Current crab bycatch measures in BSAI groundfish fisheries

The BSAI groundfish FMP specifies crab bycatch management measures for protection of Bristol Bay red king crab, EBS Tanner crab, EBS snow crab, Pribilof blue king crab and St. Matthew blue king crab stocks (Table 1). These measures consist of triggered or fixed time and area closures for trawl fisheries. No measures are currently in place for any fixed gear fisheries nor are overall limits placed on bycatch of any crab species. Bycatch management measures are not linked to new BSAI crab FMP requirements to account for total removals from all fisheries under new OFLs.

The sections below describe the individual existing time and area closures in more detail for those crab stocks and where applicable the limits that trigger the closure (using 2009 as an example where limits are annually varying). Information on relative bycatch levels for each stock is then summarized in the subsequent section by gear type and where available (2008/09 data) by fishery.

Table 1 Summary of groundfish management measures to address crab bycatch in the trawl fisheries

Stock	Area	Gear type	Timing	For trigger closures		
				Allocation by sector or target fishery in 2009	How catch accrues	2009 PSC limit
Bristol Bay red king crab	Red King Crab Savings Area	nonpelagic trawl	closed year-round, except subarea			
	Nearshore Bristol Bay Trawl Closure	nonpelagic trawl	closed year-round, except Togiak subarea open 4/15-6/15			
	Zone 1	all trawl	when limit is reached, area closes to target fishery	Amd 80 sector yellowfin sole Pacific cod pollock/mackerel/ other species	RKC bycatch in Zone 1, by fishery	197,000 allocated among target fisheries
EBS Tanner crab	Zone 1	all trawl	when limit is reached, area closes to target fishery	Amd 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Tanner crab bycatch in Zone 1, by fishery	980,000 allocated among target fisheries
	Zone 2	all trawl	when limit is reached, area closes to target fishery	Amd 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Tanner crab bycatch in Zone 2, by fishery	2,970,000 allocated among target fisheries
Pribilof Islands blue king crab	Pribilof Islands Habitat Conservation Area	all trawl	year-round			
EBS snow crab	*C. opilio* Bycatch Limitation Zone (COBLZ)	all trawl	when limit is reached, area closes to target fishery	Amd 80 sector yellowfin sole rockfish Pacific cod pollock/mackerel/ other species	Snow crab bycatch in the COBLZ, by fishery	4,350,000 allocated among target fisheries
	Northern Bering Sea Research Area	nonpelagic trawl	currently year-round; fishing may resume in future under a research plan			
St Matthew blue king crab	St Matthew Island Habitat Conservation Area	nonpelagic trawl	year-round			

1.1. Bristol Bay red king crab measures

Fixed closures and a triggered time/area closure close to trawling to protect Bristol Bay red king crab stocks and habitat.

1.1.1. Red King Crab Savings Area

Non-pelagic trawling is prohibited year round within the area indicated in Figure 1**Error! Reference source not found.** with the exception that a subarea of the Red King Crab Savings Area between 56°00' N. and 56°10' N. latitude and 162° W. and 164° W. longitude may be opened to non-pelagic by the Regional Administrator in consultation with the Council. This is done during the annual specifications process by the Council in December 2009.

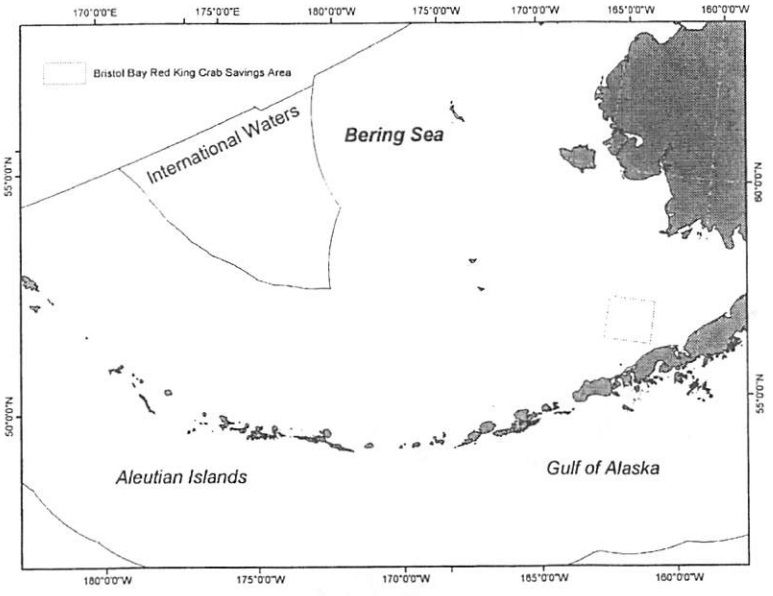

Figure 1 Bristol Bay red king crab savings area.

1.1.2. Nearshore Bristol Bay Trawl Closure

All trawling is prohibited year round in Bristol Bay east of 162° W. longitude, except the subarea that is open to trawling during the period April 1 to June 15 each year (Figure 2).

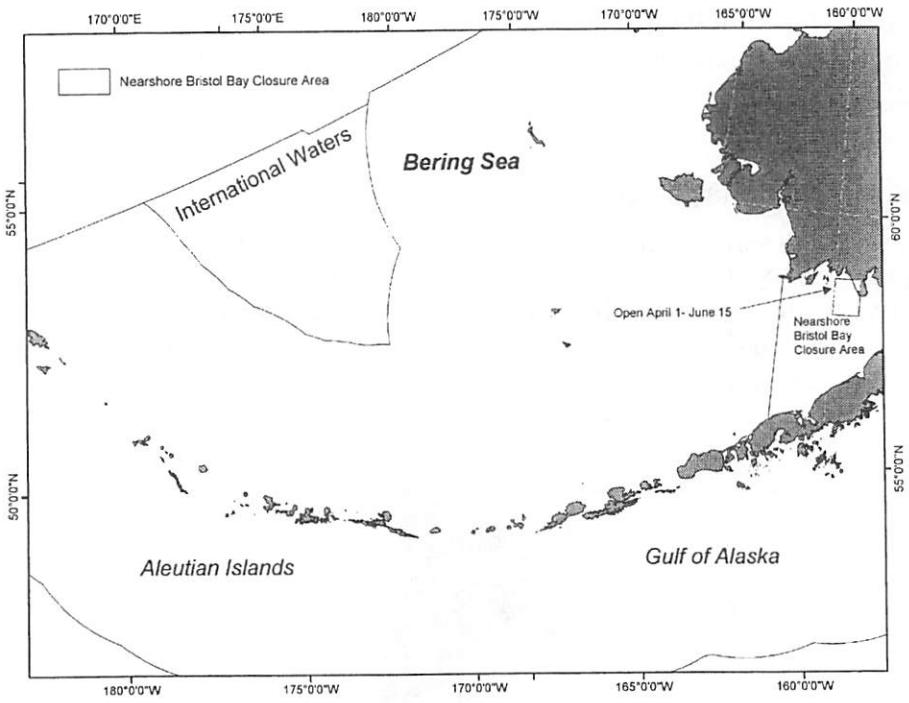

Figure 2 Nearshore Bristol Bay trawl closure

1.1.3. Zones 1 and 2

Zones 1 and 2 are closed to directed fishing when the crab bycatch caps (red king crab and EBS Tanner crab) are attained in specified fisheries (Figure 3). Species-specific caps are described below.

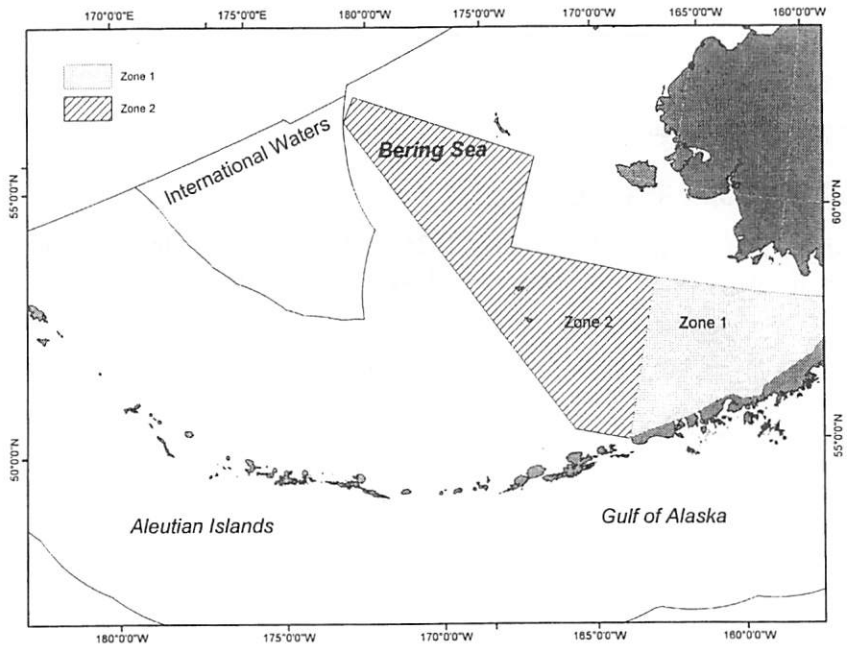

Figure 3 Zones 1 and 2 area for closures (Bristol Bay red king crab and EBS Tanner crab)

Table 2 PSC limits for red king crab

PSC limits for Zone 1 red king crab (No Zone 2 RKC)	
Abundance	**PSC Limit**
Below threshold or 14.5 million lbs of effective spawning biomass (ESB)	33,000 crabs
Above threshold, but below 55 million lbs of ESB	97,000 crabs
Above 55 million lbs of ESB	197,000 crabs

The stair step procedure for determining PSC limits for red king crab taken in Zone 1 trawl fisheries is based on abundance of Bristol Bay red king crab (Table 2). Based on the 2008 estimate of effective spawning biomass of 75 million pounds, the PSC limit for 2009 is 197,000 red king crabs. Up to 25% of the red king crab PSC limit can be used in the 56° - 56°10'N strip of the Red King Crab Savings Area. The red king crab cap has generally been allocated among the pollock/mackerel/other species, Pacific cod, rock sole, and yellowfin sole fisheries.

1.2. EBS Tanner crab management measures

PSC limits for C. *bairdi* (EBS Tanner crab) in Zones 1 and 2 have been based on total abundance of *bairdi* crab as indicated by the NMFS trawl survey (Table 3). Based on 2008 abundance (435 million crab), and an additional reduction implemented in 1999, the PSC limit in 2009 for *C. bairdi* is 980,000 (1,000,000 minus 20,000) *bairdi* crab in Zone 1 and 2,970,000 (3,000,000 minus 30,000) crab in Zone 2.

Table 3 PSC limits for EBS Tanner crab

PSC limits for *bairdi* Tanner crab: Zone 1 and 2		
Zone	**Abundance**	**PSC Limit**
Zone 1	0-150 million crabs	0.5% of abundance
	150-270 million crabs	750,000
	270-400 million crabs	850,000
	over 400 million crabs	1,000,000
Zone 2	0-175 million crabs	1.2% of abundance
	175-290 million crabs	2,100,000
	290-400 million crabs	2,550,000
	over 400 million crabs	3,000,000

1.3. Pribilof Islands blue king crab management measures

Amendment 21a to the BSAI groundfish FMP established the Pribilof Islands Habitat Conservation Area, effective January 20, 1995 (Figure 4). This amendment prohibits the use of trawl gear in a specified area around the Pribilof Islands year-round. The intent of this closure was to protect the unique habitat and ecosystem surrounding the Pribilof Islands so that it could contribute long term benefits to the fisheries surrounding the waters of the Pribilof Islands area (NPFMC, 1994). The Pribilof Islands area provides habitat for commercially important groundfish species, blue king crab, red king crab, Tanner crab, snow crab, juvenile groundfish,

Korean hair crab, marine mammals, seabirds and their prey species. This area was established based upon the distribution and habitat of the blue king crab in the NMFS annual trawl surveys and based on observer data (NPFMC, 1994).

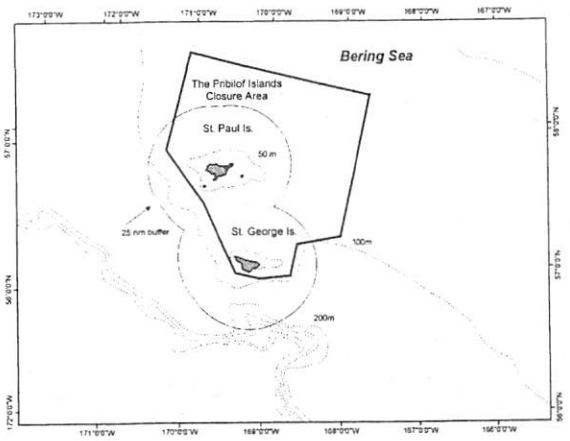

Figure 4 Pribilof Islands Habitat Conservation Zone

1.4. EBS Snow crab management measures

A triggered time/area closure (described below) closes to trawling to protect snow crab stocks and habitat.

1.4.1. *C. Opilio* Bycatch Limitation Zone (COBLZ)

A closure for EBS snow crab (*C. opilio*) is triggered if the limit (as described below) is reached in specified fisheries. The limit accrues for bycatch taken within the *C. opilio* Bycatch Limitation Zone (COBLZ) and that area then closes for the fishery that reaches its specified limit. (Figure 5).

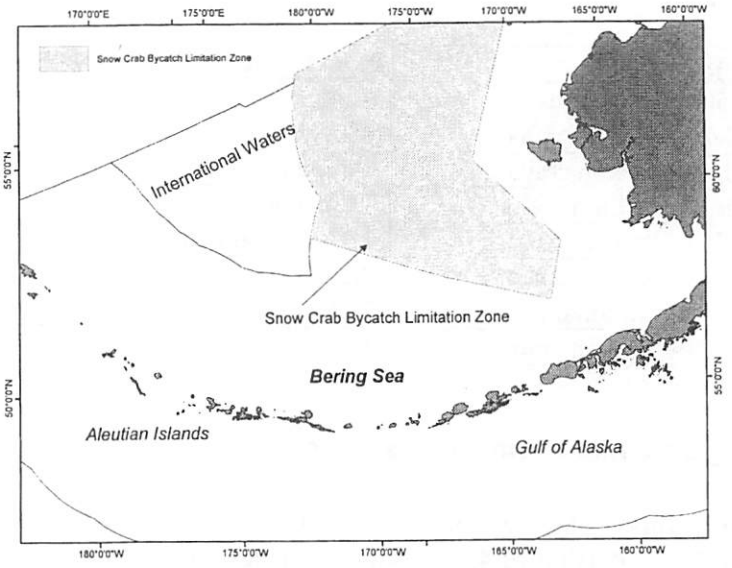

Figure 5 *C. opilio* Bycatch Limitation Zone (COBLZ)

EBS snow crab PSC limits are based on total abundance of snow crab as indicated by the NMFS standard trawl survey. The cap is set at 0.1133% of snow crab abundance index, with a minimum

of 4.5 million snow crab and a maximum of 13 million snow crab; the cap is further reduced by 150,000 crab. The 2008 survey estimate of 2.60 billion crabs resulted in a 2009 snow crab PSC limit of 2,943,421 crabs, if left unadjusted. However, the BSAI groundfish FMP mandates a minimum of 4,350,000 snow crab. Only snow crab taken within the COBLZ accrue toward the PSC limits established for individual trawl fisheries.

1.5. St. Matthew blue king crab management measures

A fixed closure (described below) prohibits bottom trawling in the vicinity of St. Matthew Island to protect blue king crab stocks and habitat. Additional habitat conservation area closures are also closed to bottom trawling as described below.

1.5.1. Habitat Conservation Areas

Non-pelagic trawl gear fishing is prohibited in St. Matthew Island Habitat Conservation Area, St. Lawrence Habitat Conservation Area, Nunivin, Kuskokwim, Etolin Habitat Conservation areas and the Bering Sea Habitat Conservation Area (Figure 6). Trawling is currently prohibited in the Northern Bering Sea Research Area, but sections of that region may open to trawling for research purposes in the future.

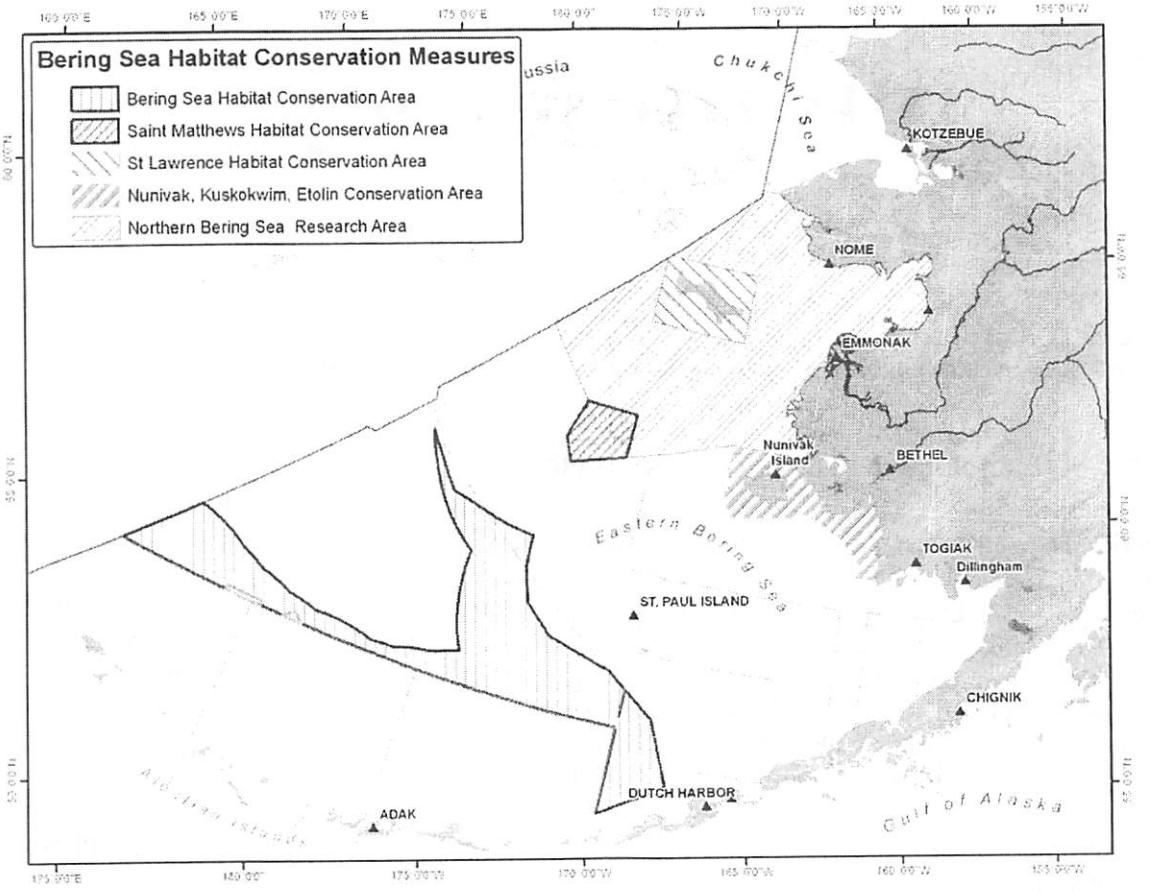

Figure 6 Bering Sea Habitat Conservation measures closure areas.

2. *Groundfish bycatch by crab stock*

Overall bycatch by species since 1991 is show in Figure 7. Here bycatch is listed in number of crab with no mortality rates applied by gear type. Once annual bycatch numbers by crab species are tabulated, they must be delineated by area (for stock-specific bycatch) and converted to a weight. Stock-specific boundaries are still being developed (for smaller scale bycatch accounting) thus currently delineations are by Federal reporting area distribution by stock. There is not perfect alignment between Federal reporting areas and crab management units thus smaller scale management units using ADF&G statistical areas are being developed for groundfish bycatch accounting in the future.

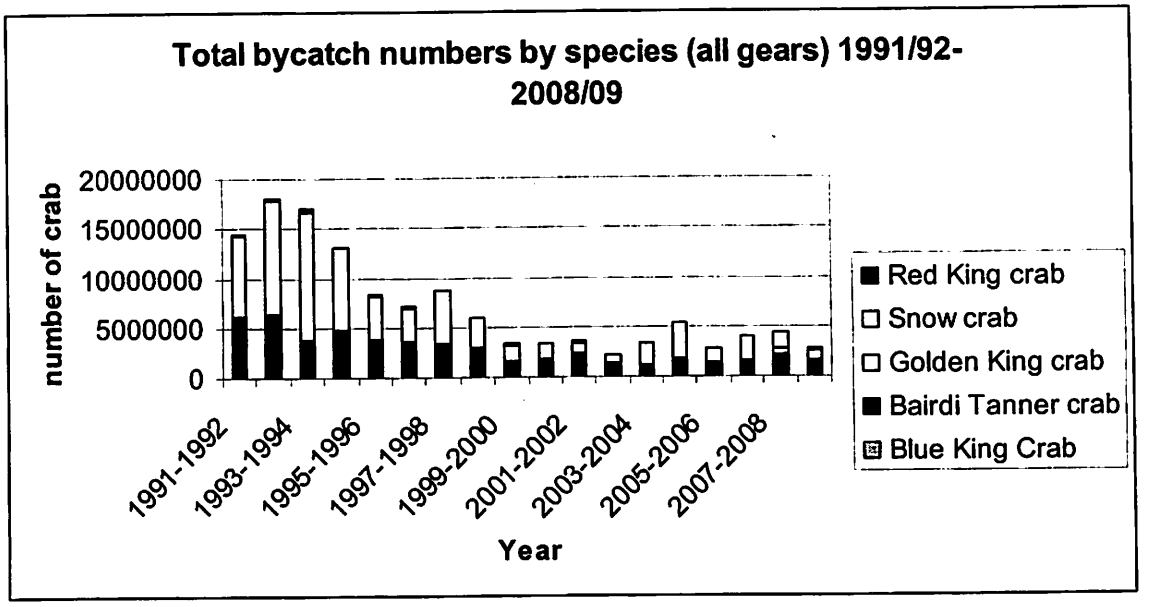

Figure 7 Total bycatch numbers by species (all gears). Numbers not adjusted for mortality.

2.1. Methodology to estimate crab mortality

In groundfish fisheries, crab bycatch is currently tabulated by number of crab, however in crab fisheries the overall weight of crab (in kilograms and lbs) is tabulated. For purposes of accruing against the stock-specific OFLs, the weight is the important measure. A procedure was developed by NMFS catch accounting for applying average crab weights by year against the extrapolated numbers of crab in the observer database. A general description of the procedure of moving from extrapolated numbers of crab to weight of crab for purposes of accruing against stock-specific OFLs is described below (excerpted from Gasper et al. 2009). Data have been compiled by stock from 1991/92-2008/09 crab fishing years. These data are now used in all assessments for which a total catch OFL is specified.

Observer information must be used to infer the total of weight of crabs because both the blend and catch accounting systems (CAS) only estimate the number of crabs. Observer data was obtained from the AFSC for each crab year between 1991 and 2009. The observer data consists of random samples taken within a haul on a vessel. These random samples contain the total weight of crabs and the number of crabs contained in a sample.

To calculate an average weight per crab, the number and total weight of crabs in observer samples were summed across gear types and averaged by year. Thus a nominal average by year

and crab species was used. This may not be the ideal method given potential gear selectivity for crab size/condition and differences in sample sizes between gear types. The distribution of sampled crab was unevenly divided, with trawl samples accounting for approximately 45 percent of the total sample weight and 35 percent of the total number of crab sampled across all years. In addition, the accuracy of crab weights representing whole crabs caught in trawl gear is largely unknown because these crabs may be crushed or incomplete due to missing body parts. Crab weights caught using fixed gear is likely generally whole crabs due to the nature of the gear used.

Once these estimates of total weights of crab are provided to stock assessment authors, authors apply a mortality rate by gear type to discount for handling mortality prior to inclusion in the assessment. Generally authors apply a 50% handling mortality for fixed gear and an 80% handling mortality for trawl gear (NPFMC 2009). Previously handling mortality rates used to estimate mortality in groundfish fisheries in conjunction with annual estimates of bycatch mortality by crab stock were 80% for groundfish trawl gear and 20% for groundfish fixed gear (NPFMC 2007). These are the rates employed by gear type in this summary paper thus they may underestimate fixed gear bycatch mortality in comparison to stock assessment chapters and actual accrual towards the crab stock specific OFL. Total mortality by species for the same time period is shown in Figure 8.

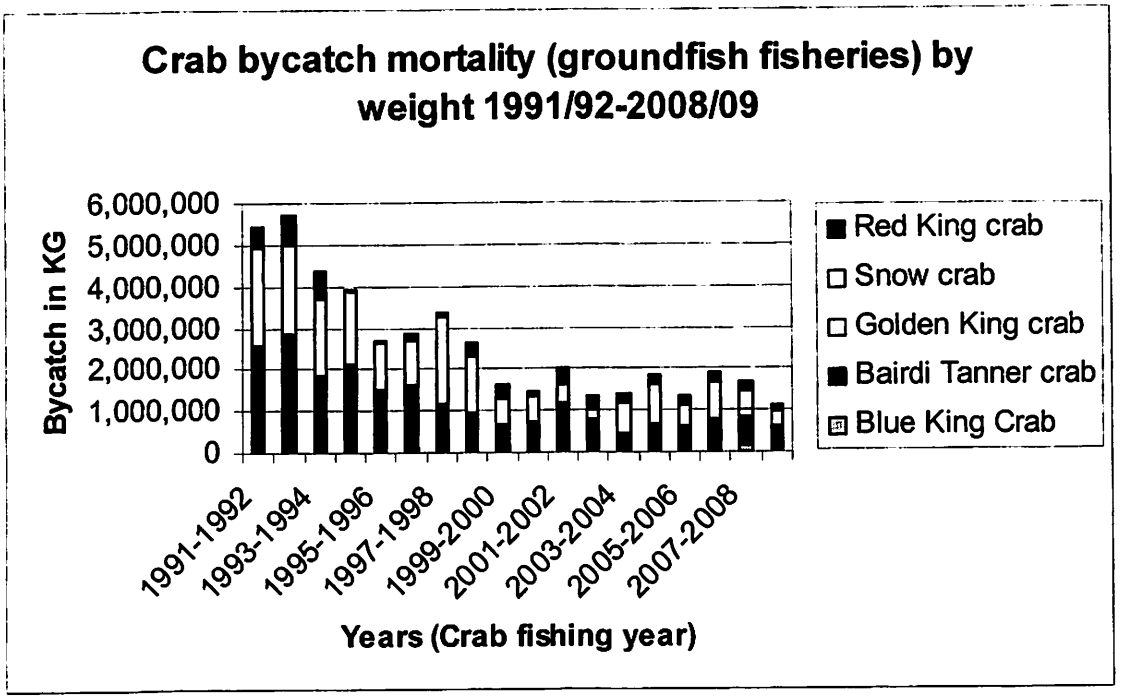

Figure 8 BSAI crab bycatch mortality (KG) 1991/92-2008/09 all species.

2.2. Relationship of BSAI Crab FMP to BSAI Groundfish FMP

Under the annual OFLs established by amendment 24 to the BSAI Crab FMP, all crab bycatch in groundfish (and scallop) fisheries counts against the OFL for each stock. There is no explicit linkage between the BSAI Crab FMP and the BSAI Groundfish FMP or Alaskan Scallop FMP. Scallop bycatch is almost entirely Tanner crab and at very low levels. Limits do exist in the Scallop fishery for Tanner crab and are based on abundance thresholds in relation to the Tanner crab stock status. Tanner crab removals by the scallop fishery will be explicitly considered in the

next EBS Tanner crab assessment but represent a very low ratio of total removals. Following Crab Plan Team discussion of the relative removals from the scallop fishery as compared with the groundfish fishery, the CPT recommended that examination of limits and bycatch by stock in the groundfish fisheries were a high priority and removals from the scallop fishery were minimal (see attached minutes from CPT meeting May 2009).

Absent any additional measures to establish limits and linkages between the Groundfish FMP and Crab FMP, if conservation concerns arise for these crab stocks, any resulting catch limitation can only come from the directed crab fishery. The EA for amendment 24 to the BSAI Crab FMP specifically noted that there is no link currently between the FMPs and highlighted the concern that this could pose in the case of an overfishing determination. As noted in the EA (NPFMC, 2008).

If an OFL for a crab species is exceeded in a given year, an overfishing determination will be found at the end of the crab fishing year, and a corresponding reduction in the harvest will be taken the following year so as to avoid a subsequent overfishing determination (see section 2.4 for more details). Amendment 24 does not provide an in-season mechanism for determining if overfishing is occurring or a response for management measures in the directed crab fisheries. Overfishing is prevented by setting the OFLs prior to the State setting the TAC for the up coming crab fishing year. The TAC is constrained by the OFLs. The State is not mandated to close directed crab fisheries for exceeding the OFL in-season. This is distinctly different from Federal groundfish fisheries management.

However, regardless of having an overfishing determination the following season, there are currently no corresponding management measures which occur in the groundfish or scallop fisheries to further limit crab bycatch. Crab catch in these fisheries is solely regulated by the bycatch limits as described in sections 10.1 – 10.4. Under all alternatives, regulations to reduce the bycatch of crab in groundfish and scallop fisheries would be considered when a crab stock becomes overfished and necessitates a rebuilding plan (or revisions to an existing rebuilding plan). Or, if the Council determines measure are necessary to end overfishing. In order for there to be any further feedback management mechanism in either the groundfish fisheries or scallop fisheries in the case that the catch of a particular crab stock exceeded its OFL, the respective BSAI groundfish FMP and Scallop FMP would need to be amended. Should a crab stock become overfished and necessitate the creation of a rebuilding plan (or revisions to an existing rebuilding plan), regulations on the bycatch of crab in groundfish and scallop fisheries would be considered again at that time and additional regulations under those FMPs may be considered in a new (or revised) rebuilding plan (pages 141-142 of the EA for Amendment 24 to the BSAI King and Tanner Crab FMP, NPFMC, 2008).

2.3. Bycatch by Crab Stock

The following sections provide an overview of groundfish bycatch by gear type from 1991/92 through 2008/09. Bycatch is listed by crab fishing year (July through the following June) consistent with the time period over which removals accrue against the OFL for crab stocks. All crab bycatch data are from the NMFS catch accounting and are consistent with the information provided to crab stock assessment authors for use in their most recent stock assessments. The dataset used to estimate crab bycatch consisted of Blend data and estimates generated from the Catch Accounting System for the BSAI. Blend data were used for the time period between 1991 and 2003, with CDQ data originated from a separate table for 1998. The catch accounting system estimates were used for 2003-2009. Crab estimates for 2003 were a combination of blend and catch accounting estimates (for more information see Gasper et al., 2009).

In addition to general trends from 1991/92-2008/09 for each stock, bycatch for 2008/09 by groundfish fishery is also summarized. This provides only a snapshot of the removals by fishery under the first year that these removals accrued against the OFL for crab stocks. Further investigation would need to be done of trends by fishery over time in order to determine if the single year is representative of trends in fishery removals by stocks. Nonetheless it does provide some indication of which fisheries are most likely to be affected by any subsequent limitation of crab bycatch by stock should the Council move forward with an analysis of additional crab bycatch measures.

Bycatch for stocks under a total catch OFL are all summarized here. Not all crab stocks have a total catch OFL at this time. Crab stocks which are currently managed (through the 2009/10 crab fishing year) under a retained catch OFL include the Aleutian Islands golden king crab (AIGKC), Pribilof Islands golden king crab and Adak red king crab stocks. Bycatch information for Aleutian Islands golden king crab and Adak red king crab are nonetheless summarized in this paper as AIGKC is likely to move to a total catch OFL in the subsequent assessment cycle (whereby all removals would accrue against the OFL) and Adak red king crab is an extremely depressed, information-poor stock where bycatch in other fisheries may be contributing to its inability to recover to historical levels.

Bycatch data are summarized by removals in kilograms (with mortality applied as 20% for fixed gear and 80% for trawl gear) as well as in overall numbers of crab (no mortality applied). Fisheries accounting for the majority of removals in 2008/09 are noted and timing of bycatch by fishery over the crab fishing year is shown for some fisheries. Groundfish fishing patterns in 2008/09 changed as a result of the implementation of amendment 80 which created sector allocations and cooperatives for the head and gut trawl catcher/processor fleet for the following five species: Atka mackerel, Pacific ocean perch, yellowfin sole, flathead sole and rocksole. Additionally, 2008/09 is the first year of implementation of amendment 24 to the Crab FMP whereby all crab removals from groundfish, crab and scallop fisheries accrue against stock-specific OFLs. In each section below, a single comparison is made for stocks indicating what percentage the total catch in 2008/09 in groundfish fisheries was compared to the OFL for that stock.

2.3.1. Aleutian Islands Golden King Crab

Bycatch mortality of AIGKC by year and gear type are shown in Figure 9 and Figure 10. Fishery-specific bycatch (screened for confidentiality) for 2008/09 is shown in Table 4.

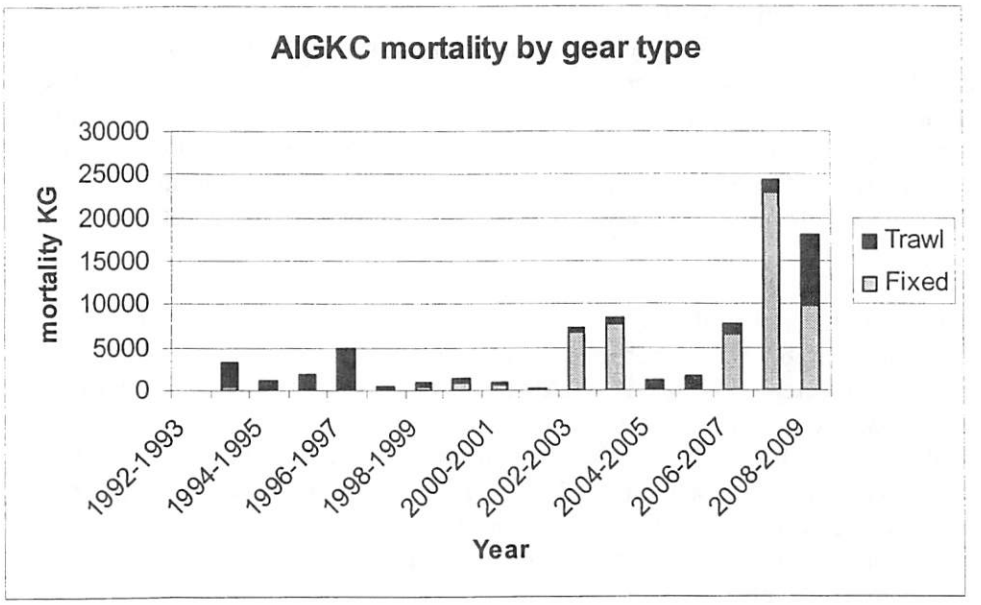

Figure 9 Bycatch mortality for Aleutian Islands golden king crab, all gears

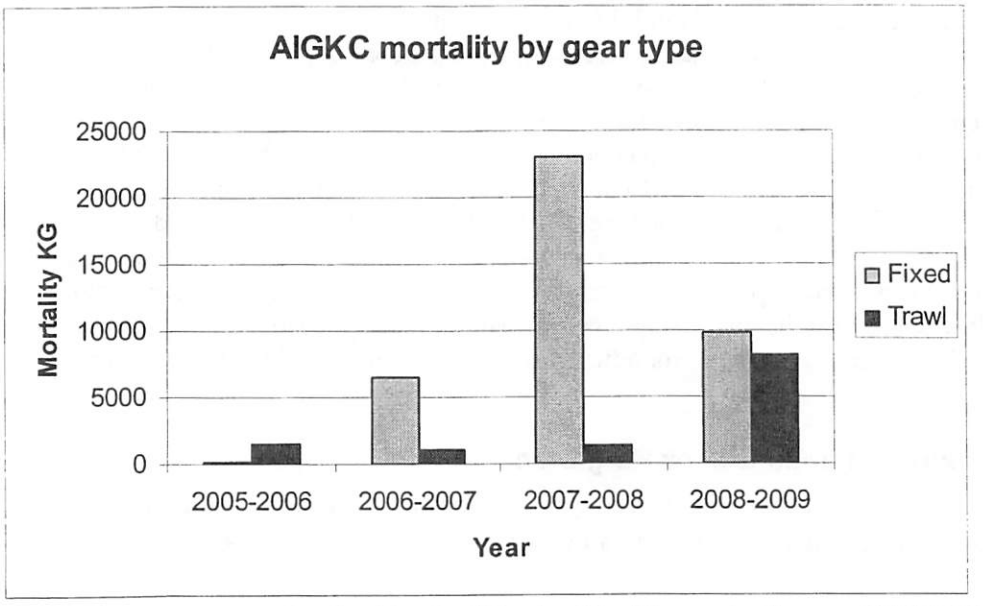

Figure 10 Bycatch mortality for Aleutian Island golden king crab all gears, 2005/06-2008/09

Table 4 Bycatch mortality by fishery and gear type and overall bycatch numbers (no mortality applied) for Aleutian Islands golden king crab 2008/09

2008/09 AIGKC mortality by fishery

Fishery	HAL	NPT	POT	Total mortality KG	Total # crab
Sablefish	**24**		**9,787**	**9,811**	**128,372**
Atka mackerel		**6,684**		**6,684**	**21,864**
arrowtooth flounder		356		356	1,166
Greenland turbot		249		249	814
Pacific cod	34	24		58	529
Rockfish		928		928	3,037
Shallow-water flatfish	14			14	186
Grand Total	73	8,242	9,787	18,101	155,968

Aleutian Islands golden king crab in 2008/09 crab fishing year operated under a retained catch OFL of 9.18 million pounds. For comparison against this amount, the total groundfish crab bycatch mortality in 2008/09 was approximately 39,906 lbs or 0.4% of the retained catch OFL. The highest mortality occurred in the sablefish pot fishery, followed by the Atka mackerel trawl fishery. Bycatch by month in numbers of crab (not discounted for mortality) in the sablefish pot fishery indicated the highest bycatch in May (Figure 11). Bycatch was primarily taken in Area 541. In contrast, bycatch in the Atka mackerel trawl fishery in 2008/09 was highest in September/October. Observer coverage in the sablefish pot fishery is low. Relative levels of observed catch from 2004 to 2007 indicate that 28-59% of the catch was observed in the sablefish pot fishery (http://www.fakr.noaa.gov/npfmc/current_issues/observer/percent_observed.pdf). Sablefish pot fishing has increased dramatically in the Aleutian Islands and the Bering Sea since 1999. In 2007, pot gear accounted for 81% of the Bering Sea fixed gear IFQ catch and 56% of the catch in the Aleutians (Hanselman et al, 2008). The atka mackerel trawl fishery has high observer coverage (100% over the time frame 2004-2007) given that it is mainly prosecuted by vessels >125'.

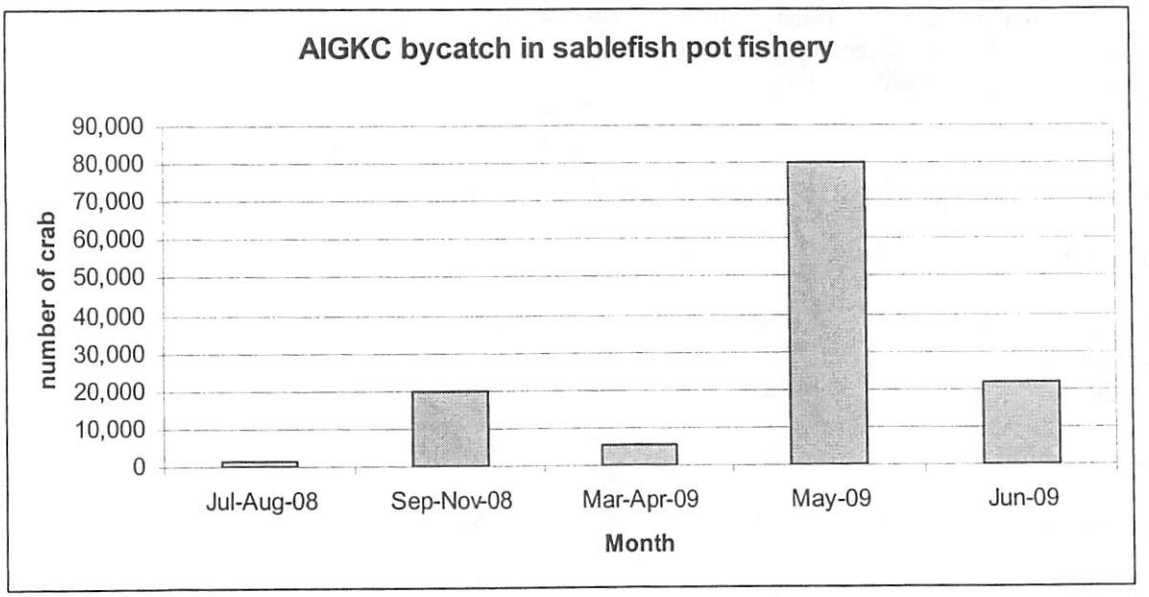

Figure 11 Bycatch of AIGKC in the sablefish pot fishery (numbers of crab, not discounted for mortality) 2008/09 crab fishing year.

2.3.2. EBS snow crab

Bycatch mortality from groundfish fisheries by gear type from 1991/92 to 2008/09 is shown in Figure 12 with the most recent 5 years shown in Figure 13. Fishery-specific bycatch (screened for confidentiality) for 2008/09 is shown in Table 5

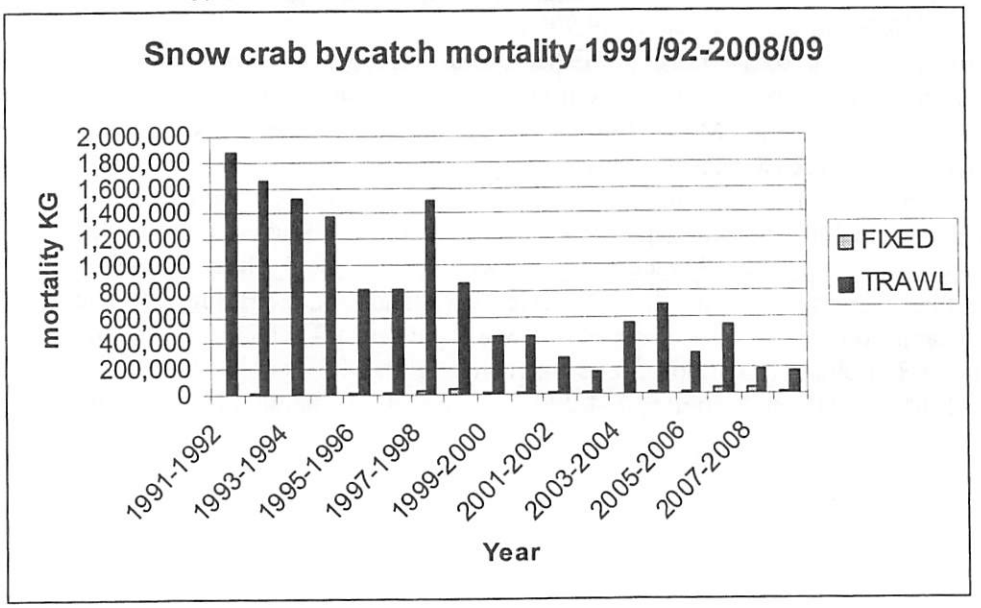

Figure 12 Bycatch mortality (KG) by gear type for EBS snow crab

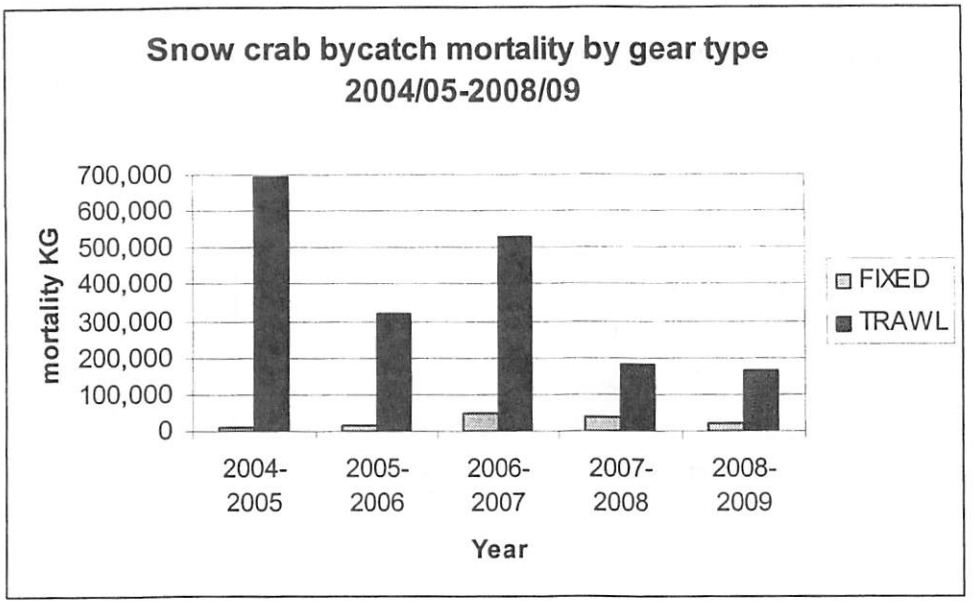

Figure 13 Bycatch mortality by gear type for EBS snow crab, most recent 5 years (2005/06-2008/09)

Table 5 Bycatch mortality by fishery and gear type and overall bycatch numbers for EBS snow crab 2008/09.

2008/09 Snow crab mortality by fishery

Fishery	HAL	NPT	POT	PTR	Total mortality	Total # crab
arrowtooth flounder	0	2,190			2,190	9,531
Deepwater Flat		86			86	374
Flathead sole		**44,595**			**44,595**	**194,115**
Greenland turbot	2	0			2	30
Other Flatfish		18			18	79
Pacific cod	**4,963**	**3,449**	**16,828**		**25,239**	**394,409**
Pollock	0	0		1,300	1,300	5,664
Rock sole		3,027		0	3,027	13,175
Sablefish	0	0	12		12	207
yellowfin sole		**109,614**			**109,614**	**477,127**
Total	4,966	162,980	16,839	1,300	186,085	1,094,727
COBLZ limit = 4,350,000					COBLZ catch	677,169

The 2008/09 OFL for EBS snow crab was 77.30 million pounds. Total groundfish fishery mortality of snow crab in 2008/09 was approximately 410,240 lbs or approximately 0.5% of the OFL. Mortality occurred primarily in the yellowfin sole trawl fishery, with lesser amounts in the flathead sole trawl fishery and the Pacific cod pot fishery. Timing of bycatch in 2008/09 (aggregated by month) in the yellowfin sole fishery indicates the majority of the bycatch occurs between August and November with additional high numbers in April (Figure 14).

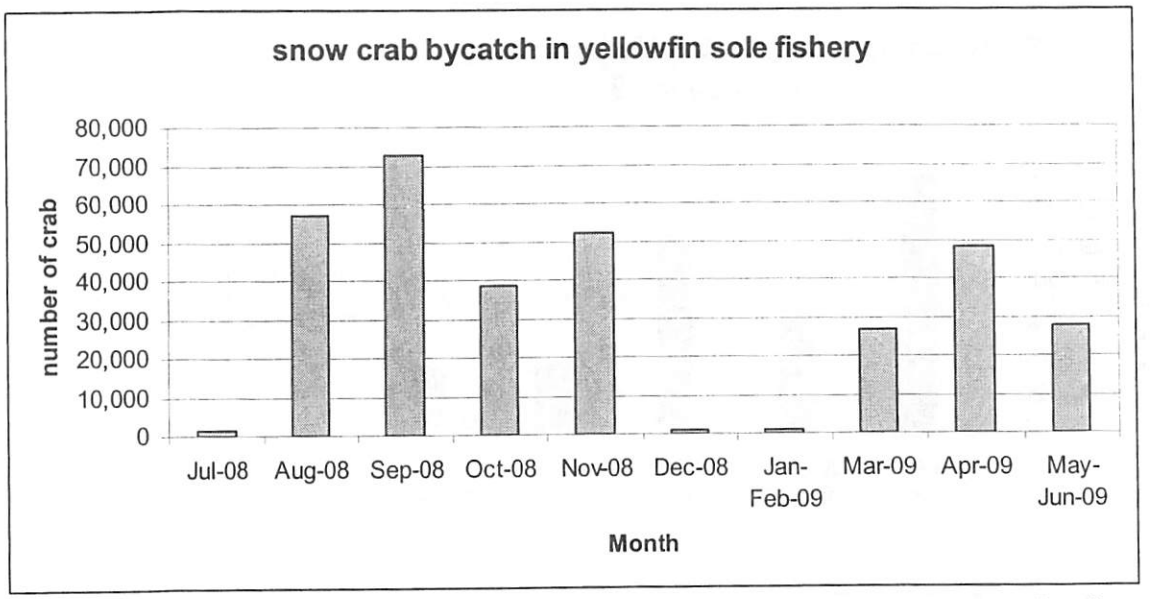

Figure 14 Bycatch by month (numbers of crab, no mortality applied) of snow crab in the yellowfin sole fishery 2008/09 (crab fishing year).

2.3.3. Bristol Bay red king crab

Bycatch mortality from groundfish fisheries by gear type from 1991/92 to 2008/09 is shown in Figure 15 with the most recent 5 years shown in Figure 16.

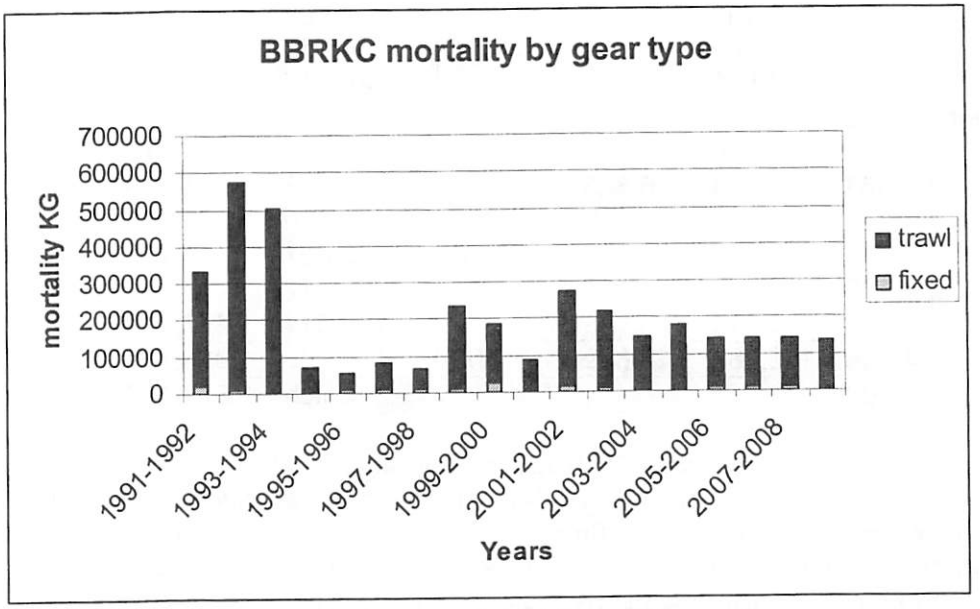

Figure 15 Bycatch mortality by gear type Bristol Bay red king crab

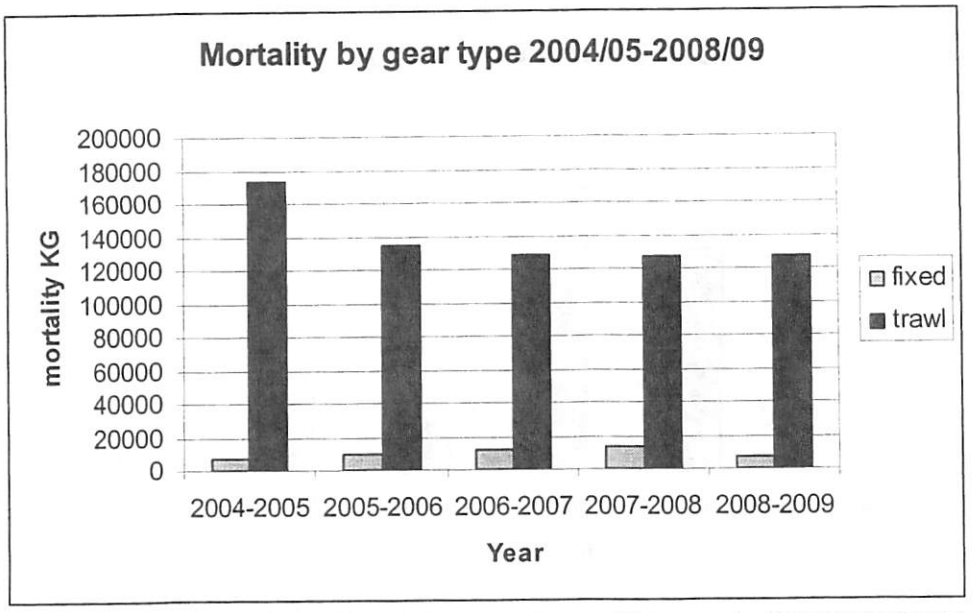

Figure 16 Bycatch mortality by gear type, most recent 5 year years (2005/06-2008/09)

Table 6 Bycatch mortality by fishery and gear type and overall bycatch numbers for Bristol Bay red king crab 2008/09.

2008/09 mortality of BBRKC by fishery

Fishery	HAL	NPT	POT	PTR	Total mortality	Total # crab
Arrowtooth flounder		460			460	300
Atka mackerel		2,578			2,578	1,680
Flathead sole		6,310			6,310	4,112
Other Flatfish		132			132	86
Pacific cod	2,572	2,843	5,125		10,540	21,914
Pollock				41	41	27
Rock sole		**78,733**			**78,733**	**51,305**
Rockfish		364			364	237
Sablefish	9		24		33	85
yellowfin sole		**35,828**			**35,828**	**23,347**
Grand Total	2,582	127,249	5,149	41	135,020	103,096

The Bristol Bay red king crab OFL in 2008/09 was 24.20 million lbs. Groundfish bycatch over this time period accruing towards the OFL was approximately 297,670 lbs or approximately 1.2% of the OFL. The highest source of mortality by fishery was in the rocksole trawl fishery, followed by the yellowfin sole trawl fishery and the Pacific cod fisheries (fixed gear and trawl) (Table 6). Bycatch by month for July 2008-June 2009 (crab fishing year) in the rock sole trawl fishery indicates the majority of bycatch was taken in January and February (Figure 17)

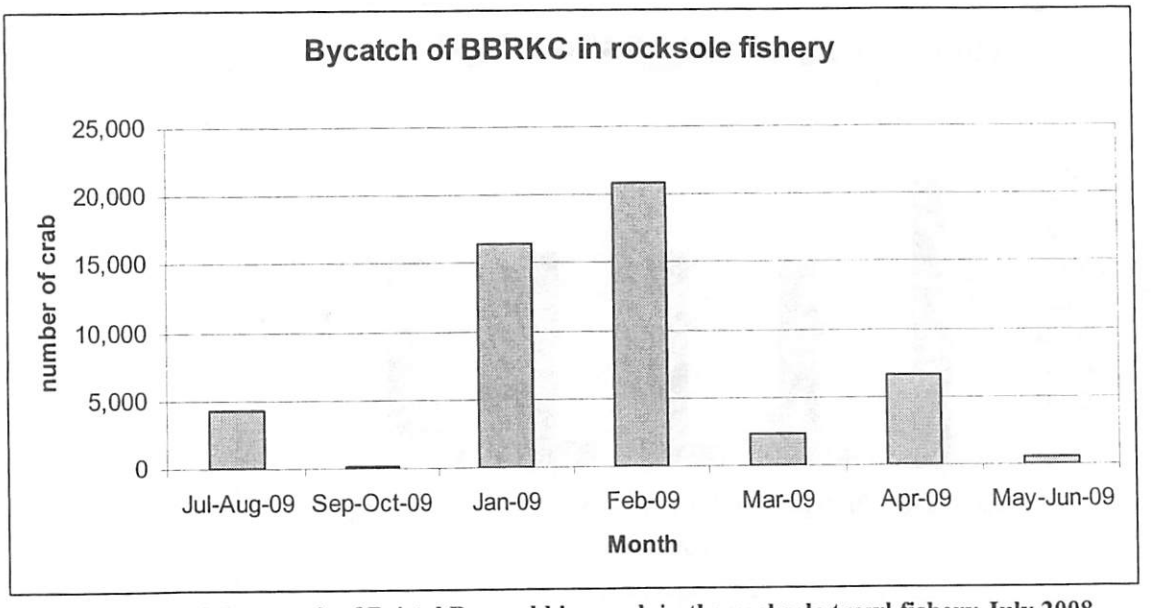

Figure 17 Bycatch by month of Bristol Bay red king crab in the rocksole trawl fishery July 2008-June 2009 (Crab fishing year). Numbers of crab aggregated by month (not discounted for mortality).

2.3.4. EBS Tanner crab

Bycatch mortality from groundfish fisheries by gear type from 1991/92 to 2008/09 is shown in Figure 18 with the most recent 5 years shown in Figure 19.

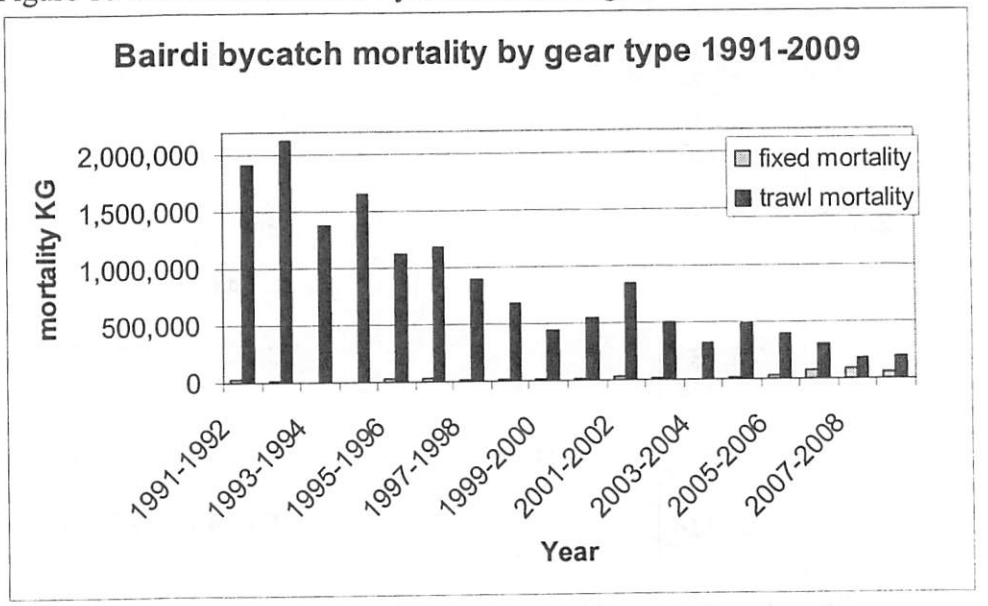

Figure 18 Bycatch mortality by gear type for EBS Tanner crab

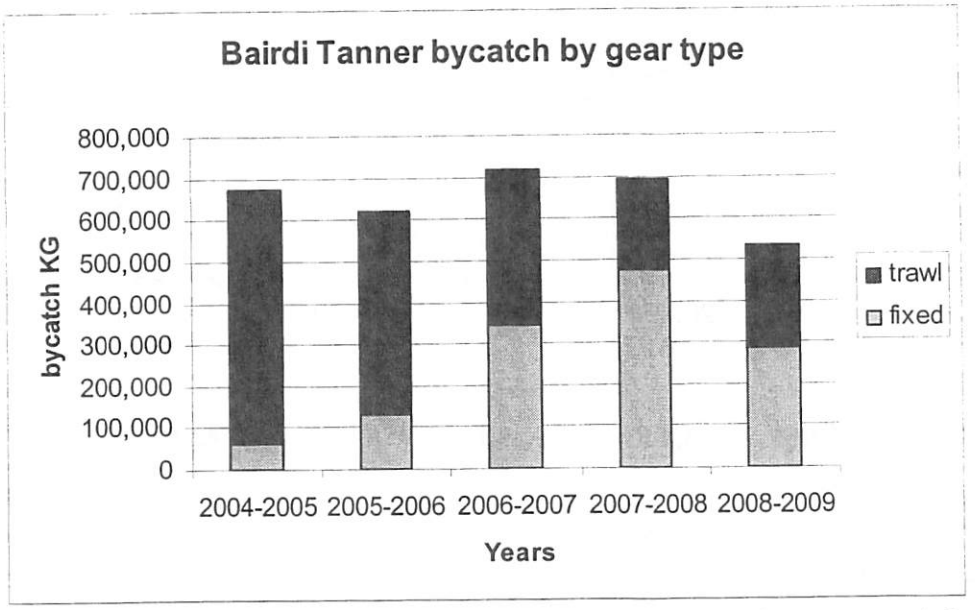

Figure 19 Bycatch mortality by gear type for EBS Tanner crab, most recent 5 years (2005/06-2008/09)

The 2008/09 OFL for EBS Tanner crab was 15.52 million pounds. Total groundfish fishery bycatch over this time period was approximately 559,440 lbs or 3.6% of the OFL. Bycatch mortality was primarily in the yellowfin sole trawl fishery, the Pacific cod pot fishery and the rocksole trawl fishery. Here the mortality assumption of 20% for the Pacific cod pot fishery may be an underestimate of the actual mortality accruing against the OFL (the 2009/10 crab assessments use 50% for all pot gear), thus mortality as represented in this paper for fixed gear may be an underestimate of the actual mortality accruing against the OFL for crab stocks.

Table 7 Bycatch mortality by fishery and gear type and overall bycatch numbers for EBS Tanner crab 2008/09.

2008/09 EBS Tanner crab mortality by fishery

Fishery	HAL	NPT	POT	PTR	Total mortality	Total # crab
arrowtooth flounder		11,192			11,192	35,584
Deepwater Flat		79			79	250
Flathead sole		26,498			26,498	84,240
Other Flatfish		319			319	1,014
Pacific cod	**2,955**	**4,445**	**36,183**		**43,584**	**511,844**
Pollock	*			342	*	*
Rock sole		30,427			30,427	96,731
Rockfish/other species/ sablefish/ Shallow-water flatfish/Greenland turbot	31	16			46	445
yellowfin sole		**122,369**			**122,369**	**389,028**
Total		195,343	36,184	342		1,120,234

*confidential

Bycatch by month in the yellowfin sole fishery from July 2008-June 2009 shows that the highest bycatch was taken in the spring from March –May 2009 (Figure 20). Bycatch was also taken in this fishery in the fall between September and November 2008. This is the first year of rationalized flatfish fisheries (under amendment 80) thus for these fisheries the snapshot of bycatch (timing and amounts) may be representative of future conditions given the transition form open-access to rationalization in these fisheries. Observer coverage is also increased as a result of implementation of amendment 80. Bycatch in the Pacific cod pot fishery was highest in January 2009, with bycatch also taken in high numbers in September and October of 2008 (Figure 21). Observer coverage in the Pacific cod pot fishery is variable (http://www.fakr.noaa.gov/npfmc/current_issues/observer/percent_observed.pdf) but much of the catch is taken in the shoreside sector with lower observer coverage. The observed catch percentages from 2004-2007 in the shoreside sector for Pacific cod pot fishery ranged from 0-41% of the catch observed depending upon vessel size (0% in the <60' and a high of 41% observed catch in 2007 in the >125' class in 2007.

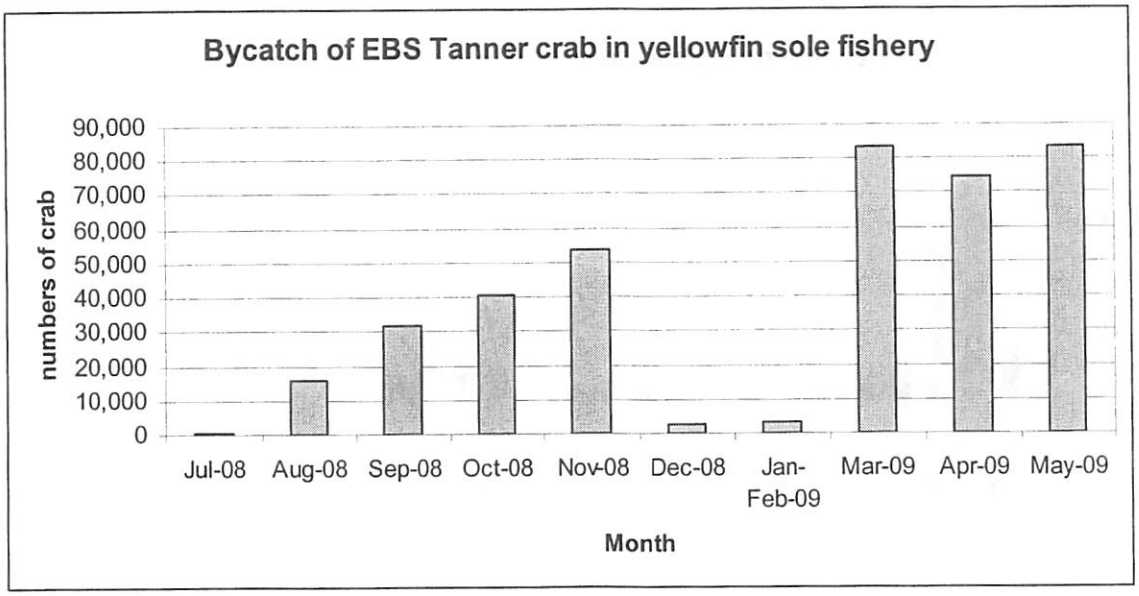

Figure 20 Bycatch of EBS Tanner crab in the Yellowfin sole fishery from July 2008-June 2009 (crab fishing year). Numbers of crab, not discounted for mortality.

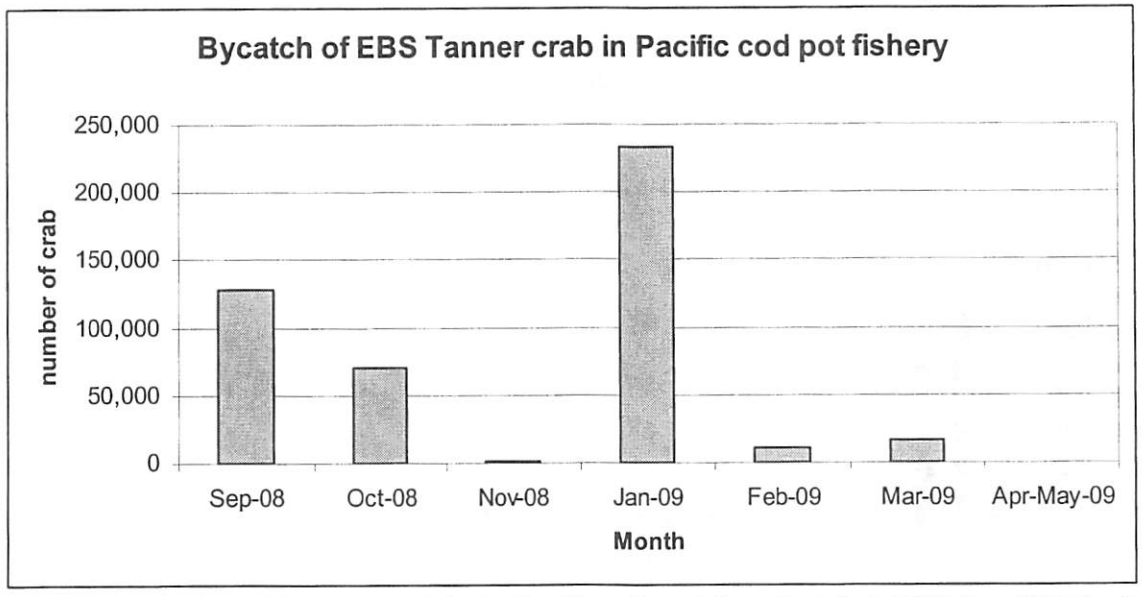

Figure 21 Bycatch of EBS Tanner crab in the Pacific cod pot fishery from July 2008-June 2009 (crab fishing year). Numbers of crab, not discounted for mortality.

2.3.5. Pribilof Island blue king crab

Bycatch mortality of Pribilof Island blue king crab 1991/92-2008/09 are shown in Figure 22. Additional discussion of fisheries contributing to this bycatch and alternatives for consideration in a revised rebuilding plan are contained in the stock assessment and not repeated here. The majority of the bycatch in 2008/09 occurred in the Pacific cod hook and line fisheries, and flatfish trawl fisheries.

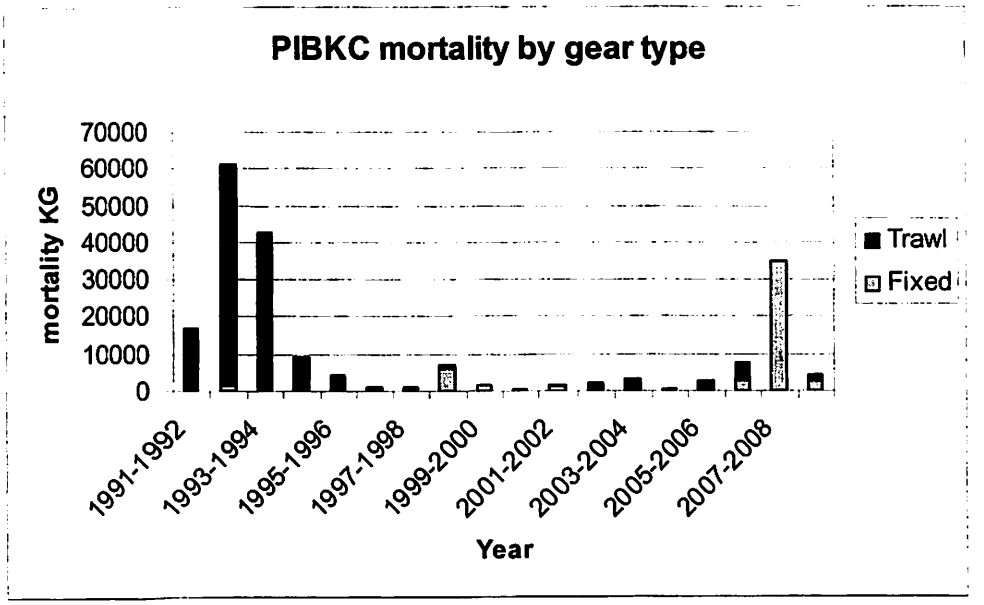

Figure 22 Bycatch mortality by gear type for Pribilof Island blue king crab

2.3.6. Pribilof Island red king crab

Bycatch mortality from groundfish fisheries by gear type from 1991/92 to 2008/09 is shown in Figure 23.

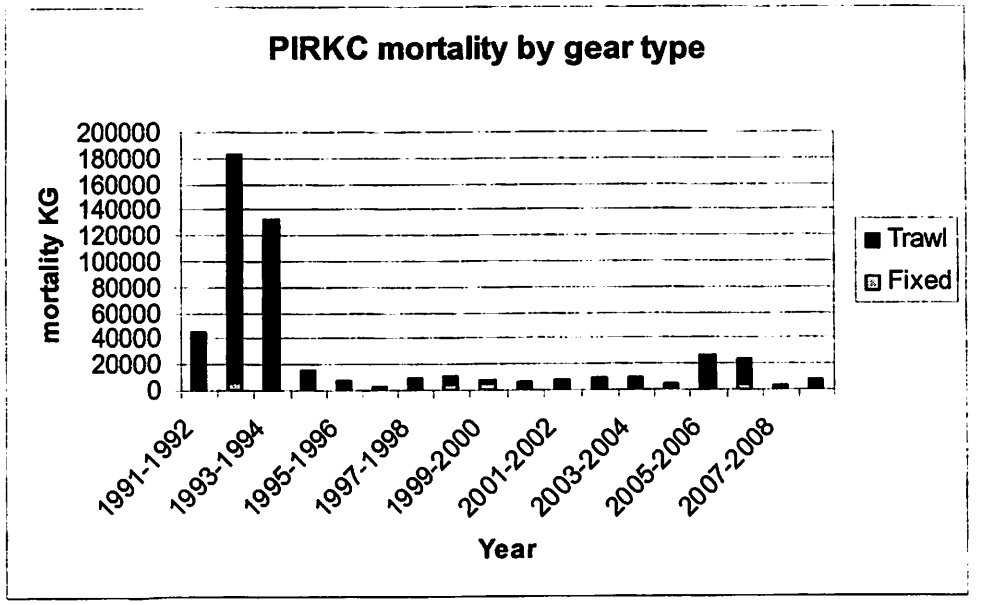

Figure 23 Bycatch mortality by gear type for Pribilof Islands red king crab

The 2008/09 OFL for Pribilof Islands red king crab was 3.32 million pounds. The total mortality from bycatch in groundfish fisheries applied towards this OFL is approximately 16,750 lbs or 0.5% of the OFL. Given the observed decrease in biomass for this stock, the recommended 2009/10 OFL is 0.50 million pounds (NPFMC 2009) and similar groundfish bycatch levels would represent a greater portion of the OFL in the 2009/10 assessment cycle.

Table 8 Bycatch mortality by fishery and gear type and overall bycatch numbers for Pribilof Islands red king crab 2008/09.

2008/09 mortality of PIRKC fishery					
Fishery	HAL	NPT	POT	Total mortality	Total # crab
Flathead sole		**1,577**		**1,577**	**1,028**
Pacific cod	**98**	**655**	**557**	**1,310**	**2,134**
Rock sole		864		864	563
yellowfin sole		**3,843**		**3,843**	**2,505**
Total	100	6,940	557	7,597	6,234

2.3.7. St. Matthew blue king crab

Bycatch mortality from groundfish fisheries by gear type from 1991/92 to 2008/09 is shown in Figure 24 with the most recent 5 years shown in Figure 25.

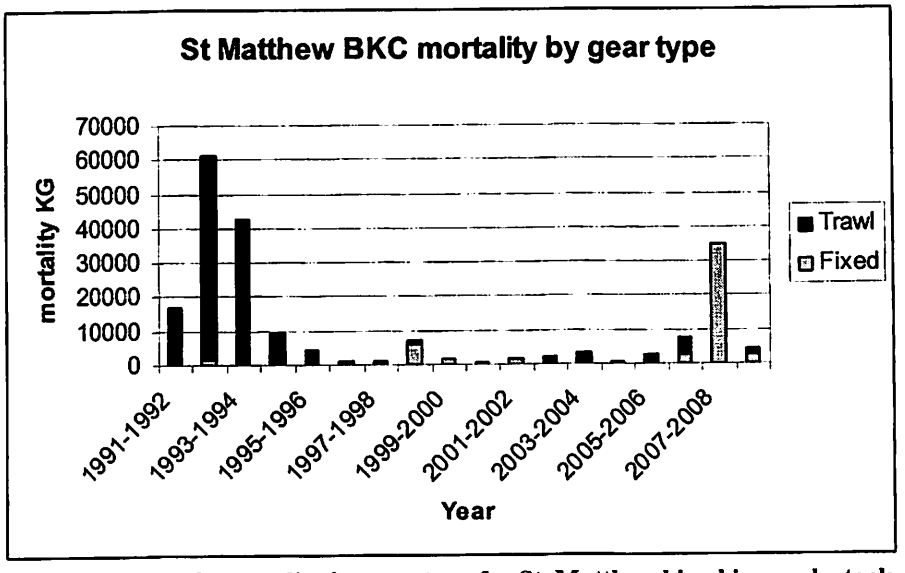

Figure 24 Bycatch mortality by gear type for St. Matthew blue king crab stock

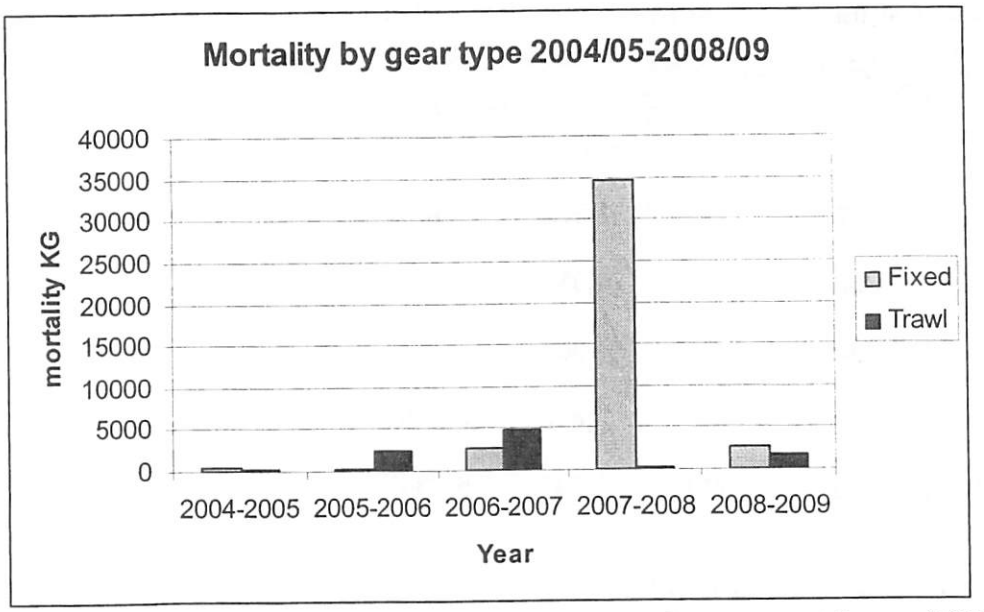

Figure 25 Bycatch mortality for St. Matthew blue king crab, most recent 5 years (2005/06-2008/09)

The retained catch OFL for St. Matthew blue king crab in 2008/09 was 1.63 million pounds. For comparison the total bycatch mortality in the groundfish fisheries for 2008/09 was approximately 6,885 lbs or 0.4% of the OFL. This was primarily from the Pacific cod fishery. This amount did not accrue towards the OFL however as the OFL for that year was retained-catch only. In 2009/10 it is anticipated the OFL would be for all catch. For comparison the previous year (where the bycatch in groundfish fisheries, especially fixed gear, was quite high) the total catch was approximately 77,200 lbs (which when compared against an OFL of 1.63 million pounds would have represented approximately 4.7% of the OFL).

Table 9 Bycatch mortality by fishery and gear type and overall bycatch numbers for St. Matthew blue king crab 2008/09.

2008/09 St. Matthew blue king crab mortality by fishery

Fishery	HAL	NPT	POT	PTR	Total mortality	Total # crab
arrowtooth flounder		106			106	85
Flathead sole		49			49	39
Pacific cod	**2,677**	**184**	**0**		**2,861**	**8,748**
Pollock				10	10	8
yellowfin sole		97			97	78
Grand Total	2,677	436	0	10	3,123	8,958

2.3.8. Adak red king crab

Adak red king crab are a Tier 5 stock and thus have a retained catch OFL only. However, given conservation concerns regarding this stock, bycatch from the groundfish fisheries of Adak red king crab is summarized below by number (no mortality applied, Figure 26) and mortality by gear type (Figure 27).

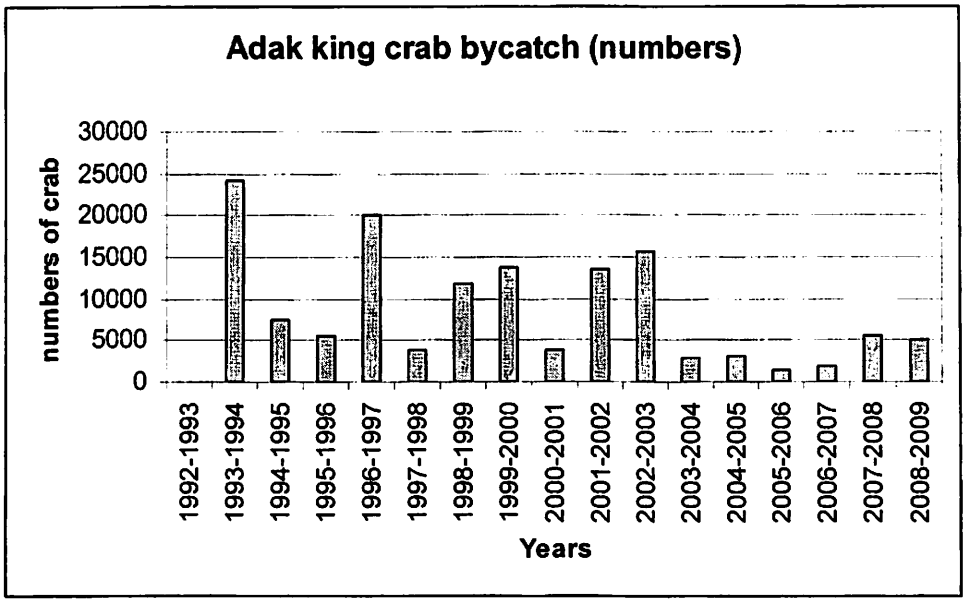

Figure 26 Total groundfish bycatch numbers (no mortality applied) all gear types for Adak red king crab

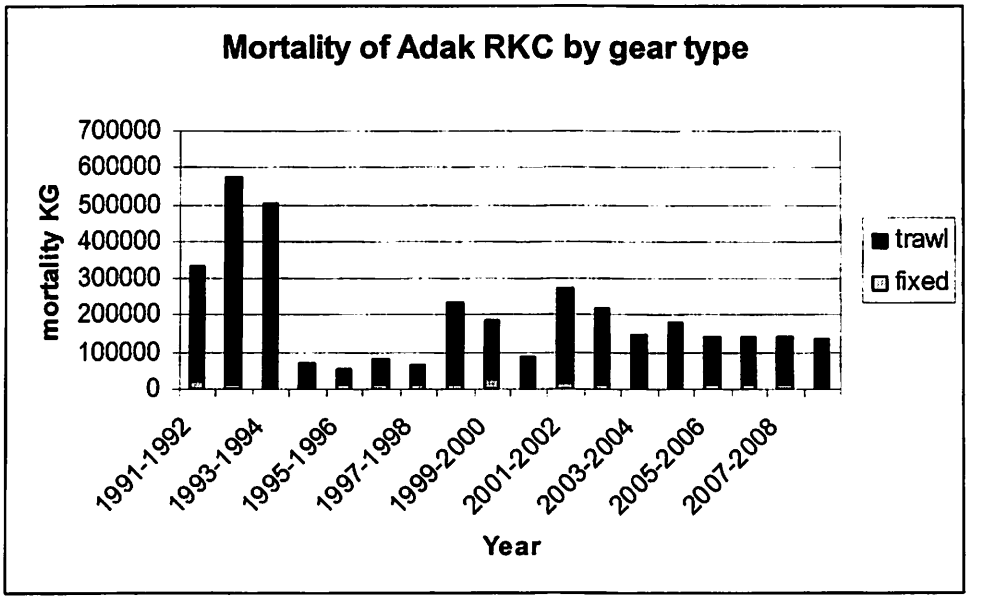

Figure 27 Bycatch mortality by gear type, Adak red king crab

In 2008/09 mortality of Adak red king crab was primarily in the atka mackerel fishery, followed by the Pacific cod fishery.

Table 10 Bycatch mortality by fishery and gear type and overall bycatch numbers for Adak red king king crab 2008/09.

2008/09 mortality of Adak red king crab by fishery					
Fishery	HAL	NPT	POT	Total mortality	Total # crab
Atka mackerel		**2,578**		**2,578**	**1,680**
Pacific cod	25	792	946	1,763	3,047
Rockfish		364		364	237
Sablefish	7			7	18
Grand Total	32	3,734	946	4,712	4,982

2.3.9. Northern District red king crab bycatch

Red king crab bycatch in the Northern District (514) is not counted towards any stock. A summary of bycatch in groundfish fisheries in this area is shown below by number (no mortality applied, Figure 28). Bycatch in this area is almost entirely by trawl gear.

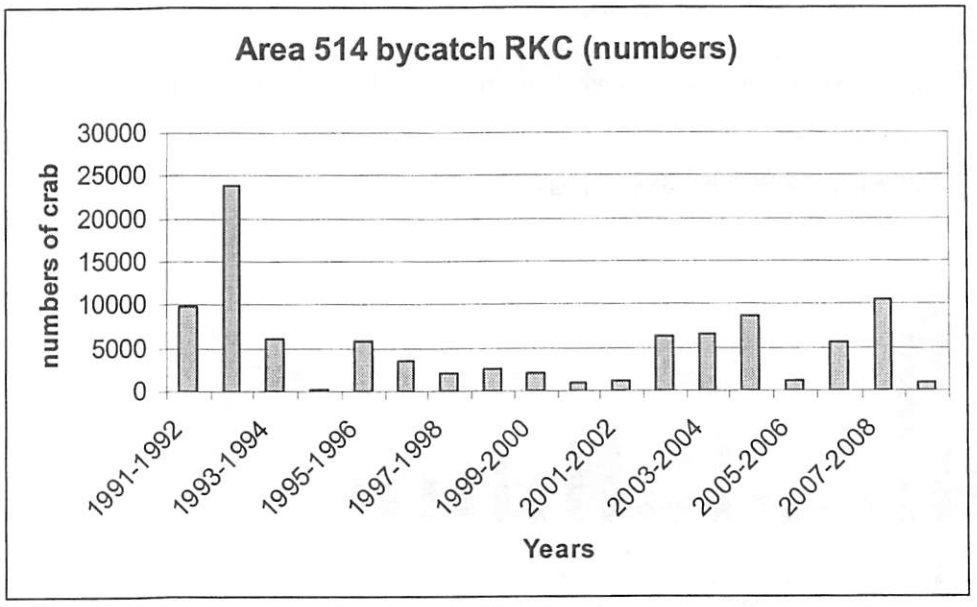

Figure 28 Total bycatch numbers all groundfish gear types, no mortality applied, for red king crab in Northern District

Bycatch of red king crab in Area 514 in 2008/09 was in the yellowfin sole and rock sole trawl fisheries (Table 11).

Table 11 Bycatch mortality by fishery and gear type and overall bycatch numbers for Northern District red king king crab 2008/09.

2008/09 mortality of red king crab in area 514 by fishery			
Fishery	Gear: NPT	Total mortality KG	Total # crab
Rock sole	608	608	396
yellowfin sole	861	861	561
Total	1,469	1,469	957

3. *Considerations for Council*

At this meeting the Council will discuss the current trends in crab bycatch in the groundfish fisheries. All crab bycatch in groundfish fisheries counts against the OFL for that stock (except where noted as retained catch only OFLs for three crab stocks in 2009/10). As mentioned throughout the Amendment 24 analysis, the Council should consider that there is no explicit linkage between the BSAI Crab FMP and the BSAI Groundfish FMP. Absent any additional measures to establish limits and linkages between the Groundfish FMP and Crab FMP, if conservation concerns arise for these crab stocks, any resulting catch limitation can only come from the directed crab fishery. Furthermore, existing measures to control bycatch in trawl fisheries were enacted prior to the current management system for OFLs by crab stock, thus they may not be responsive to current conditions and management of these stocks.

The Council should consider the following issues:

1. Should there be an overall limit on bycatch in groundfish fisheries of crab as it relates to the OFL for those crab stocks under the BSAI Crab FMP?
    a. If so for which crab stocks? Absent overall limits any increase in groundfish bycatch annually must always be accounted for by a greater buffer between OFL and TAC (and eventually with ACLs, OFL and ABC) for those crab stocks in annual specifications. Note that for stocks under rebuilding plans (to be revised) bycatch in groundfish fisheries will be examined in conjunction with alternatives for rebuilding these stocks.
    b. If not, are there issues with otherwise limiting or controlling bycatch of crab species in groundfish fisheries (time/area closures, fixed closures, other measures?)? If so for which species?
2. Should current trawl closures as listed in this paper be re-examined for their effectiveness?
3. Should additional measures be considered (limits or time/area closures) for fixed gear fisheries? If so for which stocks?
4. Catch accounting issues:
    a. PSC accounting timing: crab is accounted on a crab fishing year (June-May). Current bycatch for groundfish fisheries must be accounting over this time

period. However current accounting if for a calendar year, and crab limits for time/area closures are accounted on a calendar year.

b. Bycatch numbers as recorded in groundfish fishery vs weight of crab accrued towards OFL. Currently average weight of crab is multiplied by number for the total estimated weight to apply against crab OFL.

References

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Appendix A: Crab Plan Team discussion of groundfish bycatch (excerpt from May 2009 CPT meeting minutes)

Crab Prohibited Species Catch limits in Groundfish and Scallop Fisheries:
Diana Stram summarized the existing crab catch limits in the BSAI groundfish and scallop fisheries. The team has noted multiple times that these limits should be reevaluated in the context of new crab OFLs and the lack of feedback between crab and groundfish FMPs, particularly with respect to crab bycatch in the BSAI groundfish fisheries, and that these catches currently accrue towards crab OFLs under the Crab FMP. Any impact on catch levels as a result of an overfishing determination for exceeding a crab OFL will only be counted against the directed crab fishery regardless of what caused the catch to exceed that level (e.g., even if it was caused by excess bycatch in the groundfish fisheries). Currently PSC limits in the BSAI groundfish FMP exist for red king crab, Tanner crab and EBS snow crab in the trawl fisheries only as time/area closures triggered by PSC caps. There are no crab bycatch limits in any fixed gear groundfish fisheries.

Given the issues brought forward from the NMFS RO on fixed gear bycatch, the team recommends a reevaluation of groundfish and scallop PSC limits in light of crab stock sizes, total catch OFL structure and changes in the groundfish fisheries fishing practices, fleet sizes, etc. For all stocks with a total catch OFL, a means is needed to allocate shares of total catch between directed and non-directed catch, including all gears. Consideration should also be given to the actual sizes of crabs caught since currently limits are formulated solely on number of crab (with no distinction on size, sex, or maturity). The CPT encourages the Council to initiate an analysis of all PSC limits for crab species under the new catch OFLs.

The team further notes that the use of total catch OFLs allow for setting upper limits (caps) to bycatch and that upper limits (caps) may be needed to assure that the total catch OFL is not exceeded. The team further noted these catches may or may not represent a conservation problem but regardless the current system may cause problems for the directed crab fishery as populations decline and this could be affecting crab stock recovery. An analysis of the appropriateness of the current bycatch and limits would indicate to what extent this additional catch in other fisheries is affecting individual crab stocks.

While this may be primarily an allocation issue in terms of who catches the crab and where the control mechanisms lie with no feedback to other FMPs, it could hypothetically drive an overfishing determination. All sources of fishing mortality should have controls, including bycatch from the non-directed fishery.

Jim Stone noted that scallop bycatch limits are structured based upon biomass thresholds and fishery closures have occurred in the past for crab bycatch. He also commented that the fleet operates responsively to avoid areas of high crab bycatch. The team noted that bycatch of Tanner crabs in the scallop fishery is not the dominant issue, and clarified that the primary concern is crab bycatch in groundfish fisheries in terms of the potential to drive overfishing. The team does recommend however that assessment authors consider all sources of crab mortality, including bycatch in the scallop fishery, when compiling assessments, something that has not always been done.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

AGENDA C-4(f)(1)
OCTOBER 2009

September 24, 2009

Mr. Eric Olson, Chair
North Pacific Fishery Management Council
605 West 4th Avenue, Suite 306
Anchorage, Alaska 99601

Mr. Denby S. Lloyd, Commissioner
Alaska Department of Fish and Game
P.O. Box 115526
Juneau, Alaska 99811-5526

Dear Chairman Olson and Commissioner Lloyd:

This letter provides notification of changes in the status of four crab stocks: (1) St. Matthew blue king crab (*Paralithodes platypus*) is now rebuilt, (2) Tanner crab (*Chionoecetes bairdi*) is approaching an overfished condition, and (3) the rebuilding plan for snow crab (*C. opilio*) and the rebuilding plan for Pribilof Islands blue king crab have not resulted in adequate progress toward rebuilding these stocks. The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires amendments to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP) to prevent overfishing and rebuild these three crab stocks. The attached memorandum from the Alaska Fisheries Science Center provides a report of the status of all crab stocks under the FMP.

St. Matthew blue king crab is rebuilt because mature male biomass (MMB) was estimated to be above the level of biomass estimated to produce maximum sustainable yield for the fishery (noted as B_{MSY}) in 2007/2008 and 2008/2009. Additionally, MMB is projected to be above B_{MSY} again in 2009/2010. The St. Matthew blue king crab fishery has been closed since 1999. The Alaska Board of Fisheries may modify the harvest strategy in regulation to allow the fishery to open in 2009/2010.

Tanner crab is approaching a condition of being overfished because MMB is projected to drop below the minimum stock size threshold (MSST) of 94.9 million pounds of MMB next crab fishing year. The Tanner crab stock is projected to decline from an estimated 118.23 million pounds of MMB in 2008/2009 to 70.16 million pounds of MMB in 2009/2010. To comply with section 304(e)(3) of the Magnuson-Stevens Act, the North Pacific Fishery Management Council (Council) has two years from this notification to prepare and implement a rebuilding plan for Tanner crab.

Snow crab MMB was below B_{MSY} last February and is projected to be below B_{MSY} again in 2009/2010, the last year of the ten-year rebuilding period specified in the FMP. Therefore, it is

not possible to rebuild the stock within the rebuilding period. While this stock has not made adequate progress towards rebuilding within the rebuilding period, the stock assessment model shows that MMB has increased from a low of 146 million pounds of mature male biomass in 2002 to 241 million pounds of MMB in 2008/09. MMB in 2008/2009 is 74 percent of the B_{MSY}. The stock assessment model projects MMB to increase next year to 251 million pounds assuming harvest is equal to the overfishing level, which would amount to a total catch of 73 million pounds. To comply with section 304(e)(7) of the Magnuson-Stevens Act, the Council has two years from this notification to prepare and implement an amended snow crab rebuilding plan.

As prescribed by section 304(e)(7) of the Magnuson-Stevens Act, we recommend the following conservation and management measures for the Council to consider in amending the snow crab rebuilding plan. We recommend that the Council consider specifying a 5-year time period for rebuilding that ends in the 2013/2014 crab fishing year, assuming that rebuilt is defined as MMB above B_{MSY} for two consecutive years. In comparison, closing the fishery is projected to rebuild the stock in the 2011/2012 fishing season.

Based on the September 2, 2009, draft stock assessment of eastern Bering Sea snow crab, a 5-year time period appears to balance competing requirements under section 304(e)(4) of the Magnuson- Stevens Act to rebuild the stock in as short a time as possible and to account for the status and biology of the stock and the needs of fishing communities. The stock assessment provides a preliminary analysis of various rebuilding scenarios. Analysis in the stock assessment indicates that allowing five years for rebuilding rather than three years would provide the fishing communities an estimated average harvest of 54 million pounds per year during the 5-year rebuilding period. Additionally, at 74 percent of the B_{MSY} and with biomass projected to continue to increase, the status of this stock indicates it can support a fishery during this rebuilding period.

For the 2009/2010 snow crab fishery, the harvest rate must be reduced from the current rebuilding harvest strategy. As discussed in our letter dated July 21, 2009, the National Standard 1 Guidelines specify a default maximum limit on the harvest rate when a stock fails to rebuild within the specified rebuilding period. As provided in the Guidelines, the total fishing mortality for the 2009/2010 snow crab fishery, including bycatch, should be no greater than the default limit of 75 percent of the overfishing level. This would equate to a maximum total allowable catch of 50.5 million pounds.

The harvest rate may vary each year during the rebuilding period based on the most recent information available to enable us to meet our recommended goal of being rebuilt in the 2013/2014 crab fishing year. Allowing the maximum catch this year may result in a potentially greater reduction in the harvest rate in future years to meet the rebuilding goal. Conversely, a more conservative harvest rate this year may allow for a higher harvest rate in the future and still meet this goal.

We also recommend that the Council consider maintaining the requirement that MMB remain above B_{MSY} for two consecutive years for the stock to be rebuilt. This definition of rebuilt is unique to rebuilding plans for crab stocks under this FMP and was implemented as a

precautionary measure to account for the inherent and dynamic variability in crab stock abundance. If the Council decides to change the definition of rebuilt to MMB above B_{MSY} in one year, then we recommend that the Council consider reducing the rebuilding time period to four years.

Additionally, we recommend that the Council consider revising the snow crab prohibited species catch (PSC) measures for the Bering Sea groundfish fisheries. One measure to consider would be to remove the minimum PSC limit of 4,350,000 snow crab to allow the limit to decrease when snow crab abundance decreases.

Pribilof Islands blue king crab remains overfished. The current rebuilding plan has not achieved adequate progress to rebuild the stock by 2014. The rebuilding plan was approved on March 18, 2004. The 2008/2009 estimated MMB of 0.25 million pounds was below the MSST of 4.65 million pounds. While Pribilof Islands blue king crab biomass is projected to increase to 1.13 million pounds in 2009/2010, the stock will remain overfished. The Pribilof Islands blue king crab fishery has remained closed since 1999 and bycatch in 2008/2009 was below the overfishing level. To comply with section 304(e)(7) of the Magnuson-Stevens Act, the Council has two years from this notification to prepare and implement an amended Pribilof Islands blue king crab rebuilding plan.

As prescribed by section 304(e)(7) of the Magnuson-Stevens Act, we recommend the following conservation and management measures for the Council to consider in amending the Pribilof Islands blue king crab rebuilding plan. Based on the Crab Plan Team's recommendations, we recommend the Council examine the following alternative measures to restrict blue king crab bycatch in the groundfish fisheries and protect habitat:

- Close the existing Pribilof Islands Habitat Conservation Zone to either the Pacific cod pot fishery or all groundfish fisheries;
- Close ADF&G's existing crab fishery area closure to either the Pacific cod pot fishery or all groundfish fisheries;
- Close an area that covers the entire distribution of the Pribilof Islands blue king crab stock; and
- Analyze modifications to Pacific cod pot gear that could reduce blue king crab bycatch.

We look forward to working with the Council and ADF&G to develop, analyze, and implement rebuilding plan amendments for the Tanner crab, snow crab, and Pribilof Islands blue king crab stocks.

Sincerely,

Robert D. Mecum

Robert D. Mecum
Acting Administrator, Alaska Region

Attachment: Memorandum from Douglas P. DeMaster, Science and Research Director, Alaska Region, regarding the 2009 status of the stocks, rebuilding progress, and overfishing levels for Bering Sea and Aleutian Islands Crab Stocks

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
7600 Sand Point Way N.E.
Bldg. 4, F/AKC
Seattle, Washington 98115-0070

September 21, 2009

MEMORANDUM FOR: Robert D. Mecum

FROM: Douglas P. DeMaster,
Science and Research Director, Alaska Region

SUBJECT: 2009 status of stocks, rebuilding progress, and overfishing levels for Bering Sea and Aleutian Island Crab Stocks

This memorandum provides the current status of stocks, progress towards rebuilding, and the Alaska Fisheries Science Center's recommendations for the 2009/2010 overfishing levels for ten eastern Bering Sea crab stocks.

2009 Status of Stocks Determinations

At the September 2009 meeting of the North Pacific Fishery Management Council's Bering Sea/Aleutian Islands Crab Plan Team, the status of the ten Fishery Management Plan (FMP) crab stocks were reviewed and their status relative to overfished and overfishing determined (Table 1). A stock is determined to be overfished if the 2008/2009 annual biomass estimate of mature male biomass on February 15, 2009 (MMB_{mating}) was below the minimum stock size threshold (MSST) or 0.5 B_{MSY}. The status was found to be approaching an overfished condition if the projected 2009/2010 MMB_{mating} is below the projected 2009/2010 MSST. ***Note that Tanner crab is approaching an overfished condition and Pribilof Islands blue king crab remains overfished.***

Overfishing is occurring if the total crab catch exceeds the 2008/2009 overfishing level (OFL) for the stock. The 2008/2009 overfishing determinations for the ten FMP crab stocks were reviewed by the Crab Plan Team in September 2009. The OFL is based on total catches including retained and discard mortalities except where noted. ***As shown in Table 1, there were no stocks where overfishing occurred in 2008/2009.***

Table 1. 2009 Status of stocks relative to the 2008/2009 overfishing determination and the current overfished status for ten Being Sea/Aleutian Islands crab stocks. Additional information on status and catch specifications can be found in the 2008 and 2009 Stock Assessment and Fishery Evaluation Reports for the King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands

Stock	Tier	MSST (10^6 lbs)	2008/2009* MMB_{mating} (10^6 lbs)	Overfished status	2008/2009 OFL (10^6 lbs)	2008/2009 Total catch (10^6 lbs)	2008/2009 Overfishing status
Bristol Bay red king crab	3	34.3	87.8	No	24.2	23.1	No
Eastern Bering Sea snow crab	3	163.4	241	No	77.3	69.5	No
Eastern Bering Sea Tanner crab	4	94.9	118.0	Approaching	15.52	4.96	No
Pribilof Islands red king crab	4	4.39	11.06	No	3.32	0.021	No
Pribilof Islands blue king crab	4	4.5	0.24	Yes	0.004	0.001	No
St Matthew Island blue king crab	4	4.0	10.74	No	1.63 [retained]	0.20	No
Pribilof Island golden king crab	5	NA	NA	NA**	0.17 [retained]	0.001	No
Adak red king crab	5	NA	NA	NA**	0.46 [retained]	0.0	No
Norton Sound red king crab	4	1.54	5.83	No	0.7125 [retained]	0.42	No
Aleutian Island golden king crab	5	NA	NA	NA**	6.93 [retained]	6.3	No

*MMB as estimated during the 2009 assessment.

**For Tier 5 stocks, it is not possible to set an MSST to determine overfished status because there are no reliable estimates of biomass.

2009 Progress Towards Stock Rebuilding

In 2008/2009 there were three Bering Sea/Aleutian Islands King and Tanner crab stocks still under rebuilding plans: Eastern Bering Sea snow crab, Pribilof Islands blue king crab, and St. Matthew Island blue king crab. A review of the status of these stocks relative to rebuilding found that:

1. The St. Matthew Island blue king crab stock MMB_{mating} was greater than B_{MSY} for the second year in a row and is now, therefore, considered rebuilt.

2. The Pribilof Islands blue king crab stock is not making adequate progress towards the 2012/2013 target rebuilding date. As a result, a revised rebuilding plan will be considered in 2009/2010. A low total catch OFL was recommended by the Crab Plan Team in September 2009 to account for low bycatch levels expected to occur in 2009/2010.

3. The eastern Bering Sea snow crab stock is not making adequate progress towards the 2009/2010 target rebuilding period. In order to be considered rebuilt by the established 10 year time period, MMB_{mating} would have needed to be greater than B_{MSY} in 2008/2009 and again in 2009/2010 in order to meet the two year standard above B_{MSY} required for rebuilding. The MMB_{mating} in 2008/2009 (241.1 million lbs) was determined to be below B35% (326.7 million lbs) and the projected MMB_{mating} in 2009/2010 if fished at F=0 would also be below B35% at 316.8 million lbs. As a result, a revised rebuilding plan will need to be developed by the North Pacific Fisheries Management Council (NPFMC) in collaboration with the National Marine Fisheries Service Alaska Region and the Alaska Department of Fish and Game (ADF&G) in 2009/2010. In the interim, to make faster progress towards rebuilding of the stock, the AFSC recommends taking a more conservative approach between F=0 and the maximum permissible under the National Standard Guidelines of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) to best meet the MSFCMA (Section 304(e)(4)) requirements for rebuilding time periods that are as short as possible, taking into account the needs of fishing communities. Four stock projections for F were considered in the 2009 stock assessment of eastern Bering Sea snow crab: F=0, 55% F35% which would result in exploitation rates below or consistent with the 1999 to 2008 average, maximum permissible 75% F35% under the MSFCMA (Section 304(e)(4)), and the current rebuilding strategy. The rebuilding times under these projections range from 3 years to 9 years starting from the 2009/2010 fishing season. The 55% F35% interim rebuilding strategy appears to best meet the MSFCMA requirements mentioned above, allowing for the possibility of a 5 year additional rebuilding time frame from 2009/2010 and fishery harvests comparable to or above those during the period 2000-2006. This interim rebuilding strategy is also recommended to address the following conservation concerns: 1) it provides a Spawning Exploitation Rate that is at or below recent levels, 2) it provides additional protection to Tanner crab, which is caught in the directed snow crab fishery and which is now approaching an overfished condition, and 3) it reduces the possibility that snow crab will experience the crab stock collapses observed in the Gulf of Alaska. More details regarding this interim strategy can be found in the 2009 EBS Snow Crab Stock Assessment and Fishery Evaluation (SAFE) document.

Recommended 2009/2010 Overfishing Level Definitions

OFL definitions for Norton Sound red king crab and Aleutian Island golden king crab stocks were reviewed by the NPFMC Crab Plan Team and the Scientific and Statistical Committee in June 2009. These two stocks are considered in June due to their early fishery start date in the July 2009 to June 2010 crab fishing year cycle. Stock assessments for the remaining eight stocks were discussed and reviewed at the September Crab Plan Team meeting and recommendations were made for OFLs (Table 2). Total allowable catch and guideline harvest levels are set by the ADF&G consistent with the FMP for the Bering Sea/Aleutian Islands King and Tanner crab and the State/Federal Action Plan for Management of Commercial King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands. For all ten stocks, SAFE reports which present the stock data, model estimates, and biological reference points have been prepared for review by the SSC and NPFMC in October.

Table 2. 2009/2010 Overfishing Levels for ten Being Sea/Aleutian Islands crab stocks. Additional information on status and catch specifications can be found in the 2009 Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands

Stock	Tier	2009/2010 MMB_{mating} (10^6 lbs)	F_{OFL}	2009/2010 OFL (10^6 lbs)
Bristol Bay red king crab	3a	95.17	0.32	22.56
Eastern Bering Sea snow crab	3b	251.0	0.52	73.00
Eastern Bering Sea Tanner crab	4b	70.20	0.07	5.57
Pribilof Islands red king crab	4b	4.46	0.08	0.50
Pribilof Islands blue king crab	4c	1.13	0	0.004
St Matthew Island blue king crab	4a	12.47	0.18	1.72*
Pribilof Island golden king crab	5	NA	NA	0.18**
Adak red king crab	5	NA	NA	0.50**
Norton Sound red king crab	5	5.83	0.18	0.71**
Aleutian Island golden king crab	5	NA	NA	6.93**

NA = not applicable

*total male catch; **retained only

AGENDA C-4(e)
Supplemental
OCTOBER 2009

Crab Plan Team Report

The Crab Plan Team met September 14-15th, 2009 at the Alaska Fisheries Science Center in Seattle, WA.

Crab Plan Team members present:
Ginny Eckert (UAF/UAS), Vice-Chair
Diana Stram (NPFMC)
Doug Pengilly (ADF&G-Kodiak)
Gretchen Harrington (NOAA Fisheries –Juneau)
Wayne Donaldson(ADF&G-Kodiak)
Jack Turnock (NOAA Fisheries/AFSC-Seattle)
Shareef Siddeek (ADF&G-Juneau)
Herman Savikko (ADF&G-Juneau)
Lou Rugolo NOAA Fisheries /AFSC-Kodiak)
André Punt (Univ. Of Washington)
Bill Bechtol (UAF)
Bob Foy (NOAA Fisheries /AFSC-Kodiak)
Brian Garber-Yonts (NOAA Fisheries-AFSC Seattle)

Ginny Eckert chaired the meeting. Forrest Bowers (ADF&G, CPT Chair) participated by teleconference from Dutch Harbor due to travel difficulties. Josh Greenberg (UAF) was unable to attend. The attached agenda was approved for the meeting with no changes. Minutes from the May 2009 meeting were approved with one change to the snow crab section.

Members of the public (and state and agency staff) present for all or part of the meeting include: Arni Thomson, Anne Vanderhoeven, Heather McCarty, Frank Kelty, Dave Benson, Rob Rogers, Margo Posten, Brett Reasor, Laura Slater (ADF&G), Doug Wells, David Barnard (ADF&G), Dave Hambleton, Ray Nomura, Kevin Kaldestad, Gordon Kristianson, Mark Casto, Jack Tagart, Lance Farr, Stefanie Moreland (ADF&G), Erik Olson, Liz Chilton (NOAA Fisheries), Mike Shelford, Grehor Gadmundsson, Bill Wilson (NPFMC), Matthew Eagleton (NOAA Fisheries), Jeff Kauffman, Steve Hughes, Scott Goodman, Earl Krygier, Cody Szuwalski, Diana Evans (NPFMC), Brett Reasor, Mark Stichert, Peggy Murphy (NOAA Fisheries), Mark Casto, Gary Loncon, Edward Poulsen, David Witherell (NPFMC), Anne Hollowed (NOAA Fisheries), Lenny Herzog, Jim Balsiger (NOAA Fisheries), Doug DeMaster (NOAA Fisheries), Linda Kozak, Jim Stone, Sue Salveson (NOAA Fisheries), Clayton Jernigan (NOAA GC), Jie Zheng (ADF&G), Pat Livingston (NOAA Fisheries).

Workshop report

André Punt presented the main findings from the Alaska Crab Stock Assessment Workshop held in May 2009. The report from the workshop, including the guidelines for stock assessments, was appended to the SAFE report. Doug Pengilly provided an edit to Appendix C (guidelines). Although the workshop report is finalized, and the stock assessment guidelines will be revised over time as needed, the current report guidelines should be used for stock assessments presented in May 2010; guidelines will also be posted on the Council web-site.

The team discussed the appropriate timeframe and data to be utilized in the determination of overfishing, overfished, and rebuilding. The final survey data and catch data for the current year is necessary to determine stock status (and rebuilt status). The CPT agreed that stock status relates to the previous February to determine if a stock is overfished. The stock status is also projected ahead to next February to determine whether a stock is approaching an overfished condition, as occurred with EBS Tanner crab this year, but there remains a one-year lag to make an absolute determination of overfished. The CPT also agreed that the determination of whether overfishing occurred is made by comparing the catch for a year with the OFL for that year.

Survey results

Bob Foy summarized the 2009 BSAI trawl survey results. Notably, Pribilof Island red king crab abundance dropped substantially with the new survey. Bob described progress in modifying the survey database to correct for data errors, omissions, and adjustments for the variable net width. Observed error fixes affected the time series of snow crab and Tanner crab abundances more than other stocks.

A working group of CPT members is to be formed this fall with the intent of producing a paper with statistical comparisons and analyses to be presented to the CPT in May 2010. This report will likely become an in-house technical memo for CPT review, with subsequent publication. CPT members expressed appreciation for the work undertaken to disentangle changes to the database from the presentation of preliminary data in May.

A new time series of survey abundance estimates will result from these modifications. Resolution of strata issues will make the new time series available for use by assessment authors in the May 2010 assessment. Note that assessment authors should compare the old and new time series in the next assessment cycle if new data are available following the March CPT meeting. The default preference is that the bulk of the analyses be conducted using the revised database including error fixes and variable net width. These data were already used as the status quo for all assessments except for snow and Tanner crabs (for which comparison against the revised dataset was included as an appendix to each assessment). Time will be allotted at the March meeting for review of the new dataset changes and where major modifications occur.

The team discussed the potential size differences due to growth between re-tows of Bristol Bay red king crab and the procedure for utilizing the re-tow data. Currently, males are averaged between the leg 1 tow and the leg 3 re-tow, while females from only leg 3 are applied to survey abundance estimates. Lou Rugolo discussed issues in using females only from leg 3, noting that because Bristol Bay is not entirely resampled, retow data are not available from all stations, crab migration between survey legs cannot be evaluated. Bob answered that re-tow stations were moved one line were extended to the east to address this issue but a full account of changes in reproductive status and survey biomass would require resampling of the entire area.

Bering Sea Fishery Research Foundation presentation

Ken Weinberg (AFSC) and Steve Hughes (NRC-BSFRF), Scott Goodman (BSFRF) provided an overview of the joint NMFS-BSFRF survey results, focusing on catch comparisons between two NMFS vessels and one BSFRF vessel. The CPT discussed the confidence intervals around the estimates and further analyses with this study, noting that variability will differ with changing approaches. BSFRF produced a short document for CPT distribution with plans to put together a peer-reviewed publication in the future. CPT members questioned whether broader area and depth range sampling would be beneficial. Steve Hughes noted that substrate composition is very important and was considered in this study, but funding issues limit the ability to broaden the survey.

The CPT discussed the protocol for considering these new results, noting that the September CPT meeting is not the meeting for incorporation of new survey data into the assessments. Questions posed for future consideration included: (1) is the experimental design sufficient to drive changes; (2) are samples in this study sufficient to indicate that there are changes necessary;)3) are data in a form that is usable by the assessment authors; and (4) how should the data be included? The BSFSF survey information, if included in the assessment, should simply be treated as an additional data source. Process-wise, these data represent new information that is potentially influential and should be evaluated.

Some notes of caution were expressed by team members regarding the use of these data, including issues associated with 5 minute tows and habitat affects on net selectivity. In particular, large differences in survey results appear to be driven by large catch differences in individual tows.

The team recommended that the snow crab stock assessment authors evaluate these data prior to incorporation into the assessment in May. The assessment authors plan to evaluate the data this winter and consider incorporation into the next assessment.

SAFE report

Snow crab

Jack Turnock summarized the snow crab assessment. André commented on retrospective patterns, noting they appear consistent in overestimating biomass and thus potential recovery.

The team discussed OFL projections and the use of the old and new survey data. The CPT deferred discussion of model assessment changes (i.e. not using the new survey data) to the May 2010 meeting per the assessment review process under amendment 24. Discussion at this meeting was focused on inclusion of the BSFRF data in the assessment, implications of changing the survey data, and the stock status determination. Further discussion was held on progress towards rebuilding for the snow crab stock.

The team discussed rebuilding issues: (1) the stock will not rebuild in the 10-year time frame established in the rebuilding plan; and (2) upon determination that adequate progress has not been made towards rebuilding, what conservation and management measures shall be analyzed for a revised rebuilding plan. Jack presented a range of options that could be considered in terms of further conservation measures. The Team discussed the CPT role in either recommending harvest strategies or discussing alternative management measures in a revised rebuilding plan. The CPT notes that the approach for conducting the projections and illustrating the trade-off between rebuilding time and catch is consistent with how the assessment is conducted. However, the CPT recognized that it does not recommend harvest strategies for TAC setting.

The team briefly discussed the appendix to the stock assessment which provided an economic analysis of rebuilding options. The team notes that methodology for economic analyses should also be reviewed at the May meeting if the intention is to incorporate these into the stock assessment or rebuilding plan analysis.

The team deferred discussion of timing for the rebuilding analysis to new business in conjunction with other analyses to come forward at that time.

Bristol Bay red king crab

Jie Zheng summarized the BBRKC assessment results. A CIE review was conducted this summer. Further discussion of the CIE review results and the author's plans to revise the assessment accordingly will occur in May 2010.

The team discussed the retrospective pattern on F rates in the assessment. The pattern indicates the assessment consistently overestimates biomass in the current time period when new data are added. This should be better characterized as uncertainty in the assessment. André noted that with ACLs, the buffer should be greater to account for this overestimation. André also noted that the uncertainty surrounding the OFL should be brought forward in the assessment and highlighted in the SAFE summary; this will have further bearing as we move into ACLs.

The team discussed the movement of the crab population back to southern Bristol Bay in 2008 and 2009. Concerns were raised regarding habitat damage in southern Bristol Bay due to groundfish trawling in this region. Team members suggested looking at spatial aspects of groundfish bycatch in this region to see if there are any changes in the spatial extent of the fishery. This habitat concern should be raised in conjunction with EFH and potentially revising those definitions in the coming year.

The assessment author raised concerns over the current stock assessment boundaries of BBRKC given recent occurrences of red king crab in the Northern. The CPT requested further evaluation, particularly given questions about the contribution of these "northern" crabs to stock productivity. Arni Thomson suggested additional research is needed into stock structure and movement of reproductive stock into other portions of Bristol Bay.

EBS Tanner crab

Lou Rugolo summarized the EBS Tanner crab assessment, noting the change in stock status from 2008 to 2009 with the projected biomass in February 2010 falling below MSST, even under a zero catch harvest strategy. Thus, the stock is approaching an overfished condition. The CPT suggested that Tanner crab bycatch in the Scallop fishery be included in estimates of total removals in next year's assessment.

An appendix to the assessment provided comparative information on the use of the revised survey dataset compared with the old survey dataset; the old dataset is used in the assessment. Although these revised data are not used in this assessment, the team noted the direction of OFL and biomass (lower) with these new data incorporated, a consideration in the upcoming rebuilding analyses.

The Council will receive a letter from NMFS notifying the Council that the stock is approaching an overfished condition and that a rebuilding plan must be prepared. The team noted that the current stock status for EBS Tanner crab highlights the importance of a model-based stock assessment to evaluate the inherent trade-offs under rebuilding scenarios. This model development should be the highest priority for crab stock assessments next year.

Jack Tagart expressed concern with the lengthy vetting process to develop a model, and the chance that any proposed model may not be approved for use in the first year. Jack Turnock expressed concern with TAC setting this year, in particular the level the State may set as compared to the retained catch estimate in the assessment. If the State sets this year's TAC at the retained catch OFL estimate then recommendations on additional conservation measures may be warranted.

Bycatch considerations are a particular concern with this stock. While snow crab bycatch is best estimated in the snow crab fishery, bycatch in other fisheries could drive an overfishing determination.

Ed Poulsen also noted that new regulations prohibit the targeting of Tanner crab in the snow crab fishery, a factor that previously drove high Tanner crab bycatch rates.

St. Matthew blue king crab

Jie Zheng reviewed the stock assessment for St. Matthew blue king crab. The author did not include bycatch data in the assessment for groundfish trawl fisheries and, thus, does not compute a total catch OFL. The assessment is also male-only. The Team requests that the most recent trawl survey data points be included in the graphs depicting trends. This should be done for the final report this week. The CPT previously recommended model scenario 1 and time frame 1989-2009 for defining the B_{MSY} proxy.

The team requested the authors revise Table 7 to clarify dates and specify which components of the table are outputs from model and which are projections. The summary should also note that the best available information indicates the stock has now been above B_{MSY} two years in a row (three years with the projection) and that this stock is now rebuilt.

The team discussed estimation of total catch OFL for this stock. Jie indicated that he needs by size and sex data from the observer database. Bob Foy will work to get Jie these data for the next stock assessment. The CPT noted that some assumptions regarding sex ratio are needed if females continue to be excluded from the assessment. Team members commented that directed fishery bycatch is primarily females.

The Team recommends the male pot catch OFL, as suggested by the author, noting that this moves closer to a total catch OFL, but that female bycatch and groundfish fishery bycatch are not yet included in the model.

Pribilof Islands red king crab

Bob Foy summarized the Pribilof Islands red king crab assessment. Based on recent survey results, biomass has declined and stock size is now estimated to be very close to the MSST, a consideration in evaluating bycatch given that the directed fishery itself remains closed.

The team discussed population trends for this stock. For example, old large animals appear to be missing now. The Team notes high variability in the historical survey estimates of abundance for this population. However, between-year changes in abundance would not likely be significant if account was taken of the precision of the estimates. In the next assessment the Team recommends the authors add confidence intervals to graphs, even just on one group to show the relative variability. Stock size variability in the survey biomass estimates provided a good argument for not basing the OFL on the most recent year. A CSA-model is forthcoming and will include pot survey data from 2008 and previous years.

Pribilof Islands blue king crab

Bob Foy reviewed the Pribilof Islands blue king crab assessment. The team reviewed the previously recommended rebuilding alternatives, noting that the SSC suggested considering slick groundfish pot tunnel ramps for gear modifications. Analyses are forthcoming for rebuilding alternatives to see which of the proposed alternatives make most sense for further consideration.

The team requests that the authors evaluate more specifically the spatial component of the bycatch in 2008/09, particularly in the hook-and-line fishery and the Pacific cod fishery.

Pribilof Islands golden king crab

Doug Pengilly summarized the Pribilof Islands golden king crab assessment. The team discussed the alternative time periods for establishing the average catch calculation. The author recommended 1993-1998 as this time frame is neither constrained by a GHL nor contained years of confidential catch. Problems were noted with the ability to have a total catch OFL for this stock as data are not available from directed fisheries over the entire time frame for the OFL average total catch determination. Bycatch

mortality in crab fisheries was presented in the assessment. This information could be used to establish alternative total catch OFL options in the 2010 assessment. However directed fishery bycatch from 2000-2001 would need to be extrapolated to previous years for bycatch estimation. The author noted that slope survey data could be used in a Tier 4 assessment for this stock. However, data retrieval, consistency in standard surveys, and catchability with slope survey gear are issues that need to be resolved.

The team recommends the assessment author further evaluate all sources of mortality in order to present alternative total catch OFL options for the 2010 assessment. The team encourages further inclusion of the slope survey data to consider whether or not information may be sufficient to move this assessment up to Tier 4 in future years.

Adak red king crab

Doug Pengilly reviewed the Adak red king crab assessment. The author discussed the data limitations associated with moving this stock out of Tier 5 and conservation concerns regarding the current status of this stock. An ADF&G commissioner's permit request was granted for test fishing with no retention this fall/winter. The test fishery is intended to determine presence/absence of red king crab in areas that have historically been important red king crab habitat in the western Aleutian Islands.

The author will reexamine the available bycatch data for possible inclusion in the OFL calculation for the 2010 assessment. However, recent data are not comparable to past data (as opposed to the proposal for a total catch OFL for Pribilof Islands golden king crab assessment). Team members noted that most of the non-retained crab is from the groundfish fisheries. The team discussed how to establish applicable data as it is important to limit bycatch in this stock given conservation concerns regarding stock productivity. Coupling of total catch OFL with limits in the groundfish fishery might provide a reasonable solution.

The team agreed with the author recommendation to use the time period 1984/85-2007/08 for the 2009/10 retained catch OFL.

Economic SAFE

Brian Garber-Yonts provided an overview of the process and preparation for a new economic SAFE report for crab fisheries. Further discussion of the timing and plan teams role in economic SAFE reports will be discussed in the joint meeting (9/16) with groundfish plan teams. Scheduling for a fall economic report is infeasible in order to incorporate the most recent information into the report.

The Team discussed time frames for any review period for economic analyses. The team requests the ability to review relevant analyses using the crab data, particularly in relation to stock assessment and rebuilding. The actual data themselves are not feasible to be evaluated within the current plan team function and role.

A draft economic SAFE will be available next month. The team would like to have a role in providing some input into the analyses used in the economic SAFE. The team will agenda additional time for the May meeting to review and comment on the economic SAFE report and discuss the appropriate role for team review.

Trawl Sweeps

The team received presentations from Diana Evans and Craig Rose about the trawl sweep modification analysis, and associated considerations of revisions to the St. Matthew Island HCA and Northern Bering Sea Research Area boundaries. Craig briefed the team about the August 2009 research showing that the trawl sweep modification reduced injury and mortality in unobserved red king crab encounters with the trawl sweeps. Robert Foy presented information from the NMFS trawl survey on blue king crab, Tanner

crab, and snow crab distribution in the St. Matthew Island HCA area and to the east, in the Modified Gear Trawl Zone. Bob noted that some blue king crab were found in the survey stations east of the current boundary of the St. Matthew HCA, but the numbers were low, especially compared to the abundance of crab just outside the boundary to the south. For other crab species, there are consistently very few Tanner crab to the east, but in 2009 there were some high catches of snow crab at survey stations to the east. Diana also presented information from the survey on flatfish distribution in these areas. John Gauvin commented that the timing for fisheries likely to occur in the Modified Gear Trawl Zone would be May to June for the yellowfin sole fishery, and July for flathead sole (Bering flounder). He also noted that the Bering Sea sediment map, included in the trawl sweep modification analysis, indicates a change in sediment type east of St. Matthew Island that may correspond with the relatively low abundance of flatfish immediately east of the island, and a higher abundance at the next survey station to the east. The team noted that molt timing, the period when red king crab would be most susceptible to injury from trawl encounters, occurs from spring to early summer.

With respect to the trawl sweep modification research, the team questioned how to ascertain the magnitude of unobserved mortality, occurring from crab encounters with the trawl sweep and footrope, relative to observed crab bycatch in trawl nets. Regarding the Council's question of whether the St. Matthew HCA boundary was appropriate for protecting blue king crab, the team discussed the importance of protecting the small population to the east from trawling impacts. The team recommended moving the eastern boundary of the St. Matthew HCA eastward to encompass the territorial sea around St. Matthew Island, 12 miles east of the island. The new boundary line would parallel the current boundary, but move the boundary approximately halfway to the next survey station grid, between survey stations 23 and 22, providing additional protection to the blue king crab observed to occur in this region.

The team noted that other areas to the south and west of the St. Matthew Island HCA are also important areas for crab populations and habitat, but did not comment on other changes to the HCA boundaries. The team may agenda this item for review and discussion at a future date.

Crab bycatch in groundfish fisheries

Diana Stram provided an overview of a staff discussion paper to the Council summarizing current closures under the BSAI groundfish FMP for crab protection measures and bycatch in the groundfish fisheries by individual crab stock. This presentation was a follow up to the team discussion in May 2009 which resulted in a recommendation to the Council to consider limits on crab bycatch by stock in groundfish fisheries given that, under the new OFL system, all groundfish fishery catch accrues towards stock specific crab OFLs, but bycatch of a number of crab stocks is not limited by any management measures in groundfish fisheries. The team reiterated the request to the Council to consider limits for crab bycatch in groundfish fisheries. The team further recommends that it will be most important to consider limits on bycatch in those crab stocks that are most vulnerable (i.e., closed fishery stocks, overfished stocks, etc.). The team noted that while bycatch limits may be evaluated for some stocks in conjunction with development or revision of rebuilding plans, there is no separate action for other stocks. Total catch for many stocks is close to the OFL already and any increase in removals by the groundfish fishery could drive total catch above the OFL.

The size and sex composition of bycatch should also be considered in any further analysis. This consideration has previously been noted by the team, particularly in relation to the relative rate of removals under the snow crab COBLZ limit; differential exploitation by size class could result in removals in excess of the general exploitation rate imposed by the aggregate limit.

Team members questioned whether there is a trend in the ratio of bycatch as a function of the OFL over-time. If this is increasing then there is an implicit allocation issue. For some stocks (e.g. around Adak), groundfish bycatch could represent a conservation concern. Bycatch in the Northern District was also

highlighted as it does not currently accrue towards any stock. It has already been recommended that the BBRKC authors investigate revising stock boundaries to potentially include parts of the Northern District.

Research priorities

The team discussed pertinent research priorities to recommend to the Council in this annual cycle. The CPT would like more information and understanding of how suggestions from the CPT are incorporated into the final list. The Team suggested that assessment authors include a list of research priorities in the individual assessments for improving the assessment and to better inform the most critical research needs.

These will be compiled into an internal list of research priorities that could be circulated and retained for review at the next meeting in conjunction with this annual review. For the current cycle however, the team discussed research needs and identified the following items as being of the highest priority for informing crab management.

I. Specific research needs for assessment purposes:

1. Catchability. Management advice for crab stocks relates directly to estimates of the size of the stocks concerned. Research to refine the estimates of survey catchability, q, used to infer absolute rather than relative abundance would substantially improve the quality of management advice.

2. Handling mortality rate. Improved understanding on the post-release mortality rate of discarded crab from directed and non-directed crab pot fisheries and principal groundfish (trawl, pot and hook and line) fisheries is required. The magnitude of post-release mortality is an essential parameter used in the determination of total annual catch limits used to evaluate overfishing and in stock assessment and projection modeling.

3. Research towards developing a quantitative female reproductive index for the surveyed BSAI crab stocks. The current stock-status assessment process for surveyed BSAI crab stocks uses the estimated mature male biomass at the presumed time of mating as the best available proxy for fertilized egg production. Research on mating, fecundity, fertilization rates, and, for *Chionoecetes*, sperm reserves and biennial spawning, is needed to develop annual indices of fertilized egg production that can be incorporated into the stock assessment process and to model the effects of sex ratios, stock distribution, and environmental change on stock productivity. Priority stocks for study are eastern Being Sea snow and Tanner crabs and Bristol Bay red king crab.

4. The Tier 4 OFL control rule for crab stocks involves basing F_{OFL} on the product of natural mortality and a parameter, γ. Research to refine the basis for setting γ is needed, including: (a) simulation testing of methods to estimate γ based on only survey data, (b) calculation of $F_{35\%}/M$ and F_{MSY}/M for generic crab-related life histories, and (c) construction of the distribution for F_{MSY}/M using data for crab fisheries worldwide.

5. Bycatch. A synthesis is needed to estimate the cumulative impact of bycatch on all crab stocks.

6. Natural mortality. Explore life history and model based natural mortality estimators for BSAI crab stocks. This includes developing longevity-based estimators of natural mortality for BSAI crab by determining maximum age or maximum lifespan post terminal molt, tag-recapture, and integrated modeling.

II. Broad-based research concerns:

1. Non-recovering stocks. A pressing issue is why depleted stocks have failed to recover in the absence of fishing (e.g., Pribilof Island blue king crab and Adak red king crab). Research into all life history components is needed to identify population bottlenecks, an aspect that is critically needed to develop and implement rebuilding plans.

2. Identify and assess production periods that may represent recruitment shifts across BSAI crab stocks.

New business

Diana Stram reviewed the timing of amendments and analyses for the Crab FMP (Table attached). There are three rebuilding plans in need of revision (or development): EBS snow crab, Pribilof Islands blue king crab, and EBS Tanner crab. The ACL amendment must also be done in this next year. All four analyses must be completed for the start of the 2011/12 crab fishing year, which means that final action by the Council must be taken in 2010. In order to allow for sufficient time to review and comments on these draft analyses, the CPT has scheduled a special winter meeting in March 2010. Items for that meeting will include preliminary review of the rebuilding amendment analyses and ACL analysis, EFH review and recommendations by species, and update on trawl survey data revisions.

The team established dates and locations for their 2010 meetings as follows:

March 29-April 1: AFSC Seattle
May 10-14: Girdwood, AK
September 14-16: AFSC Seattle

The meeting adjourned at 5pm on Tuesday the 15th. The CPT met jointly with the BSAI and GOA groundfish plan teams on September 16th to discuss issues of common interest (EFH, HAPC and ACL). Minutes from that meeting are contained in a separate report.

NPFMC CRAB PLAN TEAM

DRAFT AGENDA (SEPTEMBER 2, 2009 VERSION) **September 14-16th 2009**

A.	Crab Plan Team	
	Monday September 14	**Traynor Room**
8:30	Introductions	Introductions, Additions to agenda and approval of agenda, Review and approval of May 2009 minutes
8:45	Workshop report	Review major findings of assessment workshop, TORs for assessments
9:30	Trawl survey	Review of 2009 survey, results of survey recalculations, BSFRF update on tow comparison
10:45	*Break*	
	Stock Assessment Review: Final SAFE Report	
11:00	EBS Snow Crab	Review final assessment results, recommendation on OFL and discussion of rebuilding plan
12:15	*Lunch*	
13:00	BBRKC	Review final assessment results, CIE review results
14:00	EBS Tanner	Review final assessment results
14:30	St Matthew BKC	Review final assessment results
15:00	PIRKC	Review final assessment results
15:30	PIBKC	Review final assessment results, update on rebuilding plan revisions
16:00	*Break*	
16:15	PIGKC	Review final assessment
16:45	Adak RKC	Review final assessment
	Tuesday September 15	**Observer Training Room 1055**
8:30		Finish assessment reviews (as necessary)
9:00	Economic SAFE	Update, draft Economic SAFE
9:30	SAFE Report Finalization	Review OFL recommendations, Report writing, Report finalization
10:45	*Break*	
11:00	SAFE Report Finalization	continue
12:00	*Lunch*	
13:00	Trawl Sweeps	Review boundaries of St. Matthew HCZ, discuss NBSRA, CPT comments
14:00	Bycatch of crab in groundfish fisheries	Review Council staff discussion paper of bycatch by species and gear type in groundfish fisheries in relation to OFLs (and possible ACLs), CPT recommendation to Council
15:00	*Break*	
15:15	Research Priorities	Review and revise
16:15	New Business	New business, plan for Winter 2010 (ACL analysis review) CPT mtg, May 2010 mtg *Adjourn CPT-only meeting: Note following day mtg with groundfish plan teams*
	Wednesday September 16 (Joint meeting with Groundfish Plan Teams)	**Traynor Room**
8:30	Introductions	Introductions, joint agenda approval, Council/RO activities upcoming, Review instructions to authors (ACL assessment removals, EFH by

			species, other), Role of economists on Council plan teams
9:30		EFH	5-year review process
10:45	*Break*		
11:15		HAPC	Review of HAPC criteria; recommendations for rating/proposal review
12:00	*Lunch*		
13:00		ACLs	Report from groundfish and crab analyses on progress towards application of uncertainty corrections
14:00			Proposed alternative ABC control rules for crab; direction for groundfish
15:00	*Break*		
15:15		ACLs (cont)	
	After mtg		*BBQ (or other event TBD)*

Summary of forthcoming amendments to Crab FMP related to rebuilding analyses and ACL requirements
(Prepared by NMFS and NPFMC staff for CPT discussion)

Month	**ACL analysis**	**Snow crab rebuilding analysis**	**Tanner crab rebuilding analysis**	**PIBKC rebuilding analysis**
September 2009	Plan teams review and recommend alternatives	Start 2 year clock to implementation fall 2011/12	Start 2 year clock to implementation fall 2011/12	Start 2 year clock to implementation fall 2011/12
October 2009		Council – staff tasking begin analysis with the NMFS recommended measures as a start for analysis	Council – staff tasking begin analysis with the NMFS recommended measures as a start for analysis	Council – staff tasking begin analysis with the NMFS recommended measures as a start for analysis (based on CPT alternatives)
October – February	Conduct analysis	Conduct analysis	Conduct analysis	Conduct analysis
Feb or March – CPT meeting	CPT review analysis	CPT review analysis	CPT review analysis	CPT review analysis
April-May	Revise analysis with CPT comments/ recommendations	Revise analysis with CPT comments/recommendations	Revise analysis with CPT comments/recommendations	Revise analysis with CPT comments/recommendations
June 2010	Council initial review	Council initial review	Council initial review	Council initial review
October 2010	Council-final action	Council-final action	Council-final action	Council-final action
October 2010– March 2011	Secretarial approval of FMP amendments			
May 2011	Stock assessments incorporate new amendments			
June 2011	SSC/Council review			
September 2011	OFL/ACL setting for 2011/2012 fishery			

October 1, 2009

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of General Counsel
P.O. Box 21109
Juneau, Alaska 99802-1109

MEMORANDUM FOR: North Pacific Fishery Management Council
Eric Olson, Chair
Chris Oliver, Executive Director

FROM: Lisa Lindeman, Regional Counsel
Alaska Region

SUBJECT: Clarification of the SSC's Role in Advising the Council on Rebuilding Crab Stocks

STATEMENT OF ISSUES

This memorandum addresses the role of the North Pacific Fishery Management Council's ("the Council") Scientific and Statistical Committee ("SSC") in providing advice on rebuilding the Eastern Bering Sea snow crab stock ("snow crab"). It responds to the June 2009 request by the SSC and the Council's interest in receiving "clarification . . . about [the SSC's] role in providing advice on rebuilding overfished crab stocks in which management authority has been delegated to the State of Alaska" under the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs ("FMP"). To elucidate the role of the SSC, this memorandum evaluates the following issue:

> Whether the SSC is authorized or required to provide scientific advice about whether the components of the existing rebuilding plan for snow crab, including the current harvest strategy and the resultant total allowable catch ("TAC") can be expected to achieve rebuilding targets, in light of the fact that the FMP defers authority to the State of Alaska to annually set the TAC.

SHORT ANSWER

The SSC clearly has the authority to provide scientific advice to the Council about whether the components of the existing rebuilding plan for snow crab can be expected to achieve rebuilding targets given the current status of the stock, notwithstanding the deferral of authority to the State of Alaska to annually set the TAC. This scientific information is relevant to the Council's assessment of whether any further amendment of the FMP is necessary to rebuild the stock.

Moreover, section 302(g)(1)(B) of the MSA requires the SSC to provide scientific advice to the Council about whether the components of the existing rebuilding plan can be expected to achieve rebuilding targets given the current status of the stock, notwithstanding the deferral of authority to the State of Alaska to annually set the TAC. The most legally sound interpretation of this provision would require the SSC to provide advice and recommendations for fishery management decisions that are relevant to the achievement of rebuilding targets for fisheries managed under a federal FMP, irrespective of who makes those decisions. An alternate interpretation would require the SSC to provide advice only for fishery management decisions made by the Council; nonetheless, under the specific terms of the FMP, the SSC would be obligated to provide advice and recommendations because the Council retains sufficient decision-making authority. Pursuant to a provision of the FMP, the Council is responsible for monitoring the effectiveness of the existing rebuilding plan to ensure its success. Even if the SSC's obligation to provide advice and recommendations to the Council for achieving rebuilding targets only pertains to management decisions made by the Council, the Council makes a "fishery management decision" when it assesses the adequacy of the existing rebuilding plan, accounting for the current status of the stock and its prospects for successfully rebuilding, even if it decides that the existing plan is adequate to rebuild the stock. Therefore, the SSC must provide the Council with scientific advice and/or a recommendation for achieving rebuilding targets during the Council's assessment of the existing plan.

BACKGROUND

The FMP defers limited management authority to the State of Alaska but expressly retains a role for the Council to oversee the implementation of the snow crab rebuilding plan:

The FMP developed by the Council to govern crab fisheries in the Bering Sea and Aleutian Islands defers much of the management of crab stocks in the exclusive economic zone ("EEZ") to the State of Alaska. Among other management decisions, the FMP defers authority to the State of Alaska to establish annual Guideline Harvest Levels ("GHL") or Total Allowable Catch levels ("TAC") for each crab stock, within certain limits. FMP §8.2.2. The TACs (or GHLs) established by the State are subject to review by both the Council and the Secretary of Commerce and may be appealed by affected persons. *See* Crab FMP §§ 8.2.2, 6.0, 9.0 & 10.0.

Even though the FMP defers to the State many facets of substantive management and several actions that are crucial to successfully rebuilding the stock, including authority to set the TAC (or GHL), it expressly retains a role for the Council to actively monitor the effectiveness of the snow crab rebuilding plan, *to ensure its success*, and to modify the plan, including the harvest strategy, as warranted by new scientific information. *See* FMP § 6.1.2 ("The Council or the State of Alaska may modify the components of the rebuilding plan[, which include the harvest strategy,] according to new scientific information. ... [Any] changes to the components of the plan must . . . be sufficient to rebuild the stock to the Bmsy level within a rebuilding time period that satisfies the requirements of section 304(e)(4)(A) of the Magnuson-Stevens Act ....

Mechanisms are in place for NMFS and the Council to monitor the effectiveness of the rebuilding plan to ensure that actions taken by the State of Alaska and the Council under the rebuilding plan rebuild the stock to the Bmsy level within 10 years."). Further, the FMP sets forth a process for the Council to annually monitor the effectiveness of the rebuilding plan. It states that "[a]nnually, the Council, Scientific and Statistical Committee, and Crab Plan Team will review (1) the stock assessment documents, [and] (2) the OFLs and total allowable catches or guideline harvest levels for the upcoming crab fishing year." FMP § 6.0. In sum, while deferring considerable management authority to the State of Alaska, the FMP specifically provides for substantial Council oversight of the development and implementation of the rebuilding plan for the snow crab stock.

The snow crab rebuilding plan & the SSC's role:

The snow crab (*Chionoecetes Opilio*) stock was declared overfished in September 1999, and an FMP amendment to rebuild the stock ("rebuilding plan") was approved by the Secretary of Commerce in December 2000. The snow crab stock continues to be managed under the rebuilding plan, which includes a harvest strategy codified in regulations adopted by the State of Alaska in 2000 and implemented by ADF&G in each fishing season since January 2001. The rebuilding plan established a ten-year rebuilding period for the stock, and the measures prescribed in the plan were expected to successfully rebuild the stock within this time.

The 2009-10 fishery is effectively the final fishing season within the ten-year rebuilding time period. The stock's biomass has increased under the rebuilding plan, but it has recently been determined that the stock will not successfully rebuild within the ten-year rebuilding period included in the plan.

At its meeting in May 2009, the Crab Plan Team recommended that the ADF&G set the TAC for the 2009-10 fishing season at a level that would allow the stock to reach its MSY biomass[1] at the end of the 2009-10 fishing season, with at least 50% probability. Unlike the Crab Plan Team, in June 2009, the SSC declined to make any specific recommendation about adjusting the TAC to increase the probability of the stock's reaching its MSY biomass at the end of the 2009-10 fishing season. Instead, it recommended "that changes in rebuilding policy be carefully evaluated under a range of management scenarios and population responses," noted that the "current harvest strategy provides for rebuilding to the target level," and requested clarification about its role in providing advice on rebuilding crab stocks for which management authority has been deferred to the State of Alaska. *See* Draft Minutes of NPFMC SSC Meeting at 3 of 17 (June 4, 2009) (emphasis omitted).

The request for clarification arose in the context of the SSC's decision to not advise the Council in June 2009 regarding the need to set a TAC that diverges from the current rebuilding harvest

[1] MSY biomass is the biomass level at which the stock produces the maximum sustainable yield for the fishery over the long term.

strategy to increase the likelihood of successfully rebuilding the snow crab stock. Therefore, this response focuses primarily on the SSC's role in providing advice to the Council regarding the current harvest strategy and resultant TAC for snow crab.

ANALYSIS

The SSC is clearly authorized to provide scientific advice and recommendations to the Council concerning the adequacy of the rebuilding harvest strategy and the resultant TAC for achieving rebuilding targets for snow crab, in light of information contained in the annual stock assessments. Indeed, the SSC is required to provide the Council with advice and recommendations regarding such matters.

The Magnuson-Stevens Fishery Conservation and Management Act ("MSA") generally describes the role of the SSC as follows:

> Each Council shall establish, maintain, and appoint the members of a scientific and statistical committee to assist it in the development, collection, evaluation, and peer review of such statistical, biological, economic, social, and other scientific information as is relevant to such Council's development and amendment of any fishery management plan.

16 U.S.C. § 1852(g)(1)(A) (MSA § 302(g)(1)(A)). The Council has taken action to rebuild several overfished crab stocks by developing FMP amendments. *See, e.g.*, 66 Fed. Reg. 742 (Jan. 4, 2001) (approval of Amendment 14 to the FMP). If the Secretary of Commerce determines that any of these existing amendments has not resulted in adequate progress towards rebuilding the affected stock, the Council may be required to promulgate additional FMP amendments or regulations to revise the existing rebuilding plan. 16 U.S.C. §§ 1854(e)(7) & (e)(3). The Council is obligated to include conservation and management measures in an FMP to rebuild overfished stocks, 16 U.S.C. § 1853(a)(1)(A), and may decide of its own accord to revise an inadequate rebuilding plan, without first receiving notification from the Secretary that the existing plan is deficient.

The SSC is authorized to assist the Council in evaluating the ongoing adequacy of a rebuilding harvest strategy and the resultant TAC. The level at which the State annually sets the total allowable catch ("TAC") for a rebuilding stock and the current status of the stock affect the ability of a stock to successfully rebuild consistent with the provisions of the FMP. Evaluating this information and assessing the likelihood that a stock will meet its rebuilding targets given its current status and rebuilding harvest strategy or TAC for the upcoming fishing season is relevant to the potential need for an FMP amendment to revise the rebuilding plan. Consequently, the SSC is authorized to advise the Council regarding the prospects for success of an existing plan, given the current status of the stock, the current harvest strategy, and the TAC.

There is a convincing argument that the MSA expressly *requires* the SSC to provide such advice and recommendations. As amended by the 2006 Magnuson-Stevens Reauthorization Act (MSRA), the MSA states:

> *Each scientific and statistical committee shall provide its Council ongoing scientific advice for fishery management decisions, including recommendations for* acceptable biological catch, preventing overfishing, maximum sustainable yield, and *achieving rebuilding targets*, and reports on stock status and health, bycatch, habitat status, social and economic impacts of management measures, and sustainability of fishing practices.

16 U.S.C. § 1852(g)(1)(B) (MSA § 302(g)(1)(B)) (emphasis added). As a general rule, Congress' use of the word "shall" imposes a mandatory duty that is not subject to discretion. *See Sacks v. Office of Foreign Assets Control*, 466 F.3d 764, 778 (9th Cir. 2006). Here, there is no indication that Congress intended "shall" to be interpreted as anything other than a mandate, so its use imposes an obligation on the SSC. This provision appears to presume that the Council will make the fishery management decisions relevant to each of the mandatory recommendations it references. The provision does not expressly address a fishery for which the Council has deferred substantive management authority to another entity, such as a state. This introduces the potential for ambiguity concerning whose "management decisions" trigger the requirement for the SSC to provide scientific advice and recommendations. There are two plausible interpretations of this provision that would resolve any such ambiguity. One of these interpretive options better effectuates an overriding purpose of MSRA, and therefore is more legally sound.

First, the provision could require the SSC to provide scientific advice and make recommendations for each of the referenced fishery management decisions made under an FMP irrespective of who has authority to make such decisions; the Council may defer decision making authority, but it may not, in doing so, eliminate the role prescribed for its scientific advisors, the SSC. This interpretation best adheres to a central purpose of the MSRA, as illuminated by its legislative history, of ensuring that scientifically based catch-limits are in place that will prove effective in ending overfishing and rebuilding overfished stocks.[2] Therefore, this interpretation

[2] The Legislative History of the MSRA makes clear that an overarching purpose of the amendments was to better accomplish the goals of the 1996 Sustainable Fisheries Act amendments (SFA) to the MSA, including to end overfishing and rebuild overfished stocks. The Report of the Committee on Commerce, Science and Transportation that accompanied MSRA ("the Committee Report") discusses the mixed results of rebuilding plans that have been implemented since passage of the SFA, and attributes many of their shortcomings to the lack of *scientifically-based* catch limits. *See* S. Rep. 109-229 at * 21 ("In many cases, this has resulted from failure of a plan to require adherence to scientifically-established mortality limits from one year to the next. As a result, the Committee determined that it needed to include a new mechanism in FMPs for ensuring compliance with the existing conservation requirements.") & *7 ("After numerous meetings and discussions with the Councils, industry, and conservation groups, the Committee determined that, to ensure compliance with the 1996 amendments, S. 2012 needed to require that: (1) scientifically established annual catch limits be set and adhered to in each managed fishery"). Thus, Congress provided, in MSRA, for annual catch limits for all federal fisheries, which were designed to work in concert with the requirements of 302(g)(1)(B), in order to ensure that catch limits are scientifically-based

would be more legally defensible than the interpretation discussed below. *See, e.g., Matter of Chicago Milwaukee, St. Paul and Pacific Railroad Co.*, 658 F.2d 1149, 1159 (7th Cir. 1981) ("It is perhaps the oldest canon of statutory construction that a statute be interpreted with the overriding purpose of Congress kept firmly in mind."); *Delgado v. Holder*, 563 F.3d 863, 868 n.7 (9th Cir. 2009) (*quoting Scheidler v. Nat'l Org. for Women*, 547 U.S. 9, 23, (2006)) ("Canons of statutory construction 'are tools designed to help courts better determine what Congress intended, not to lead courts to interpret the law contrary to that intent.'")

Under a second interpretation—one which is less faithful to the central purpose of the MSRA, because it might allow some fishery management decisions to evade a scientific basis—the SSC is obligated to provide scientific advice and make recommendations only when the Council itself makes the fishery management decision at issue. Because this second interpretation could undermine a central purpose of the MSRA, it would be less defensible in litigation. *See, e.g., Delgado*, 563 F.3d at 868 n.7. Nonetheless, in this situation, it would not change the outcome of the analysis. Under either of these interpretations, as discussed further below, the SSC would be required to provide scientific advice and recommendations to the Council about whether the components of the existing rebuilding plan for snow crab, including the rebuilding harvest strategy and resultant TAC can be expected to achieve rebuilding targets. Therefore, this memorandum need not resolve whether the second interpretive option might be so inconsistent with Congressional intent as to be impermissible.

Under the first interpretive option, the FMP's deferral of authority to the State to set the TAC would not relieve the SSC of its obligation to provide scientific advice and recommendations to the Council for management decisions relevant to achieving rebuilding targets. Such decisions include an annual determination regarding whether the existing rebuilding harvest rate and resultant TAC can be expected to achieve rebuilding targets in light of the current condition of the snow crab stock. Under this interpretation, Congress intended the SSC to provide the Council with scientific advice and recommendations for certain specified management decisions, irrespective of whether it is the Council or the state that makes those actual decisions.

Under the second interpretive option, section 302(g)(1)(B) obligates the SSC to provide scientific advice and recommendations for any "fishery management decisions" that the FMP assigns to the Council and that are relevant to achieving rebuilding targets. Thus, the relevant

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and therefore capable of preventing overfishing and rebuilding overfished stocks. *See* S. Rep. No. 109-229 at *7 ("The bill's catch limit provision works in concert with a number of provisions in the bill that respond to calls for strengthening the role of science in Council decision-making. First, section 103 of the bill specifies that the role of the SSCs would be to provide their Councils with the ongoing scientific advice they require in order to make management decisions, including development of mortality limits.") ("Section 103(b) would require the SSCs to provide recommendations for the Council to consider in establishing the annual catch limits. The Committee intends that these annual catch limits, taken with the existing overfishing and rebuilding authorities, will ensure full compliance with the Magnuson-Stevens Act").

inquiry is whether the FMP vests the Council with authority to make "management decisions" that may affect the ability of the snow crab stock to achieve rebuilding targets.

As provided by the snow crab rebuilding plan, the Council and NMFS retain joint responsibility to monitor the effectiveness of the plan to ensure its success. FMP § 6.1.2 ("Mechanisms are in place for NMFS and the Council to monitor the effectiveness of the rebuilding plan to ensure that actions taken by the State of Alaska and the Council under the rebuilding plan rebuild the stock to the [MSY biomass] within 10 years."). The FMP requires the Council and the SSC to annually review the stock assessment and TAC. FMP § 6.0. Moreover, the FMP expressly provides that the Council may modify the components of the rebuilding plan, including the harvest strategy, according to new scientific information, provided that such changes rebuild the stock within the statutory timeframe. FMP § 6.1.2. To meet its obligation to ensure rebuilding success, the Council must meaningfully assess the implications of state management actions given the current condition of the stock and determine whether a change in the plan is warranted. By periodically assessing the sufficiency of the plan and deeming it effective as is, the Council makes "management decisions," even if it does not act to modify a component of the plan. Given the Council's obligation to include conservation and management measures in an FMP to rebuild overfished stocks, 16 U.S.C. § 1853(a)(1)(A), its prescribed role to monitor progress to ensure success of the existing rebuilding plan for snow crab, and its authority to modify components of the plan, FMP § 6.1.2, a decision that the existing harvest strategy, resultant TAC, and other components of the rebuilding plan are adequate, given the current status of the stock, constitutes a "management decision" that may affect the stock's ability to achieve rebuilding targets; such a decision therefore requires the SSC to provide scientific advice and to make recommendations.

The type of advice required by section 302(g)(1)(B) varies with the Council "decision" that is at issue. For example, with respect to TAC setting, where the Council's role is limited to reviewing the TACs set by the state and deciding whether to modify a component of the rebuilding plan, the SSC could satisfy applicable obligations by advising the Council of the likelihood that the stock will achieve rebuilding targets, given the TAC established by the State. When the Council is faced with other decisions that implicate the ability of a stock to achieve rebuilding targets, the SSC should similarly provide advice on the consequences for achieving rebuilding targets of the proposed action that is before the Council.

Section 302(g)(1)(B) requires the SSC to provide "ongoing"[3] scientific advice and recommendations to the Council for its management decisions. In the context of the snow crab rebuilding plan, where the Council must assess the adequacy of the existing plan and determine whether new scientific information calls for modification of some aspect of the plan, this suggests that the SSC should advise the Council regarding the sufficiency of the existing

[3] The dictionary definitions of ongoing include, "that is continuously moving forward" and "making progress." Webster's Third New International Dictionary (1963).

rebuilding plan in light of newly available scientific information, and not forgo giving advice until the Council has before it a concrete proposal for a particular FMP amendment. As stated in the Committee Report, "The intent of this provision is to ensure that each Council utilizes its SSC meaningfully throughout the management process." S. Rep. No. 109-229 at *19. This further suggests that the Council must enlist the advice of the SSC as it evaluates the sufficiency of the snow crab rebuilding plan in light of the current condition of the stock.

CONCLUSION

It is clear that the SSC is authorized to provide the Council scientific advice regarding the sufficiency of the existing rebuilding plan to achieve rebuilding targets for snow crab, accounting for the current condition of the stock, and assist the Council to determine whether and how the rebuilding plan should be modified to achieve rebuilding targets. Moreover, the SSC is required to provide the Council with such advice and recommendations.

cc: Jane H. Chalmers
Acting NOAA General Counsel

Clayton Jernigan, Attorney-Advisor
NOAA General Counsel, Alaska Region

Robert D. Mecum, Acting Administrator
NOAA Fisheries, Alaska Region

PUBLIC TESTIMONY SIGN-UP SHEET

Agenda Item: C-4(e,f) BSAI CRAB SAFE, OFLs, Rebuilding

	NAME *(PLEASE PRINT)*	TESTIFYING ON BEHALF OF:
1	Linda Kozak	Crab Group of Ind. Harvesters
2	Leonard Herzog	Alaska King Crab Harvesters Coop
3	Arni Thomson	A.C.C.
4	Stephen Taufen	Groundswell Fisheries Movement
5	JOHN GAUVIN	Pet Use Coop-
6	LORI SWANSON	GROUNDFISH FORUM
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NOTE to persons providing oral or written testimony to the Council: Section 307(1)(I) of the Magnuson-Stevens Fishery Conservation and Management Act prohibits any person " to knowingly and willfully submit to a Council, the Secretary, or the Governor of a State false information (including, but not limited to, false information regarding the capacity and extent to which a United State fish processor, on an annual basis, will process a portion of the optimum yield of a fishery that will be harvested by fishing vessels of the United States) regarding any matter that the Council, Secretary, or Governor is considering in the course of carrying out this Act.

Chandont Jenny Hurtzog
C4cf

Preliminary Results of the 2009 NMFS – BSFRF Snow Crab Net Efficiency Study (Jointly Released by NMFS Alaska Fisheries Science Center and Bering Sea Fisheries Research Foundation)

September 4, 2009

The NMFS Alaska Fisheries Science Center Resource Assessment and Conservation Engineering Division's Groundfish Assessment Program, in partnership with the Bering Sea Fisheries Research Foundation, conducted a field experiment to estimate the net efficiencey (i.e. proportion of the animals in the trawl swept area that are captured) of the NMFS standard Bering Sea 83/112 survey trawl for snow crab *Chionoecetes opilio*. Similar field work by NMFS to address *opilio* catchability was done previously (Somerton and Otto, 1999. Net efficiency of a survey trawl for snow crab and Tanner crab. Fish. Bull. 97:617-625), however, the underbag methodology used in that previous study did not work well in the muddy areas inhabited by snow crab, so sampling could not be done randomly over the entire species distribution. Because of concerns about the potential bias of the net efficiency estimates produced by using an underbag, a new approach was tried at the end of the 2009 annual eastern Bering Sea bottom trawl survey, using a modified version of the survey trawl that initially included a tickler chain in front of the footrope, 37 kg of additional chain (7.9 m) strung along the center of the footrope, and a fine-mesh liner to capture all of the crabs in the trawl path. The modified trawl was not intended to be a replacement for the standard 83/112 trawl but to provide absolute density estimates of snow crab that could be used as the basis to compute the net efficiency of the standard trawl. Before beginning the experiment, the modified NMFS trawl was tested in the experimental area using a 15 minute tow, but the catch rate was so high that the weight tore the netting away from the head and foot ropes. Since the vessel carried only one additional modified trawl, the decision was made to remove the tickler chain, and shorten the length of the tow from 15 to 5 minutes.

The 2009 field experiment was designed and conducted as a three vessel trawl comparison consisting of: the NMFS chartered *F/V Arcturus* towing the standard 83/112 survey trawl, the NMFS chartered *F/V Aldebaran* towing the NMFS modified survey trawl and the BSFRF chartered *F/V American Eagle* towing a trawl designed for the European *nephrops* fishery. The NMFS modified trawl, with the ad hoc changes in design and fishing protocols, was used in the 24 triplicate side-by-side tows of the experiment involving the three gear types to determine

snow crab net efficiency. Exhibit 1 shows the location of the comparative tow work on Bering Sea snow crab grounds.

The first question considered was whether the modified survey trawl and the *nephrops* trawl estimated the same density of snow crab in each category. This question is important because the most unbiased estimate of density is needed to calculate the net efficiency of the standard 83/112 survey trawl. Thus, if the *nephrops* trawl produced a higher density, then its CPUE should be used as the basis for this calculation. For each of the categories, we therefore tested the hypotheses of equality in the CPUE (thousands of crabs per unit swept area) between the modified survey trawl and the *nephrops* trawl (Exhibit 2). Positive values of the test statistic (BSFRF CPUE – NMFS CPUE) and probability levels <0.05 indicate that the BSFRF net efficiency was higher. Crab catch data were divided into five size-sex categories, matching those used in the NMFS Annual Crab Report to Industry, in the following analysis of the experimental data. For all categories, the *nephrops* trawl caught significantly more crabs than the modified survey trawl. Exhibits 3-4 demonstrate the size frequencies of the captured crab by sex taken by each vessel.

The net efficiency of the standard 83/112 survey trawl was then estimated for each category assuming that the *nephrops* trawl caught everything in the tow path (i.e. CPUE of the standard 83/112 trawl divided by the CPUE of the BSFRF trawl averaged over all 24 tows). These values are substantially lower than those found in the previous snow crab net efficiency study. For the large males, for example, the previous estimate is approximately 0.80 while the new estimate is 0.35. This indicates that the standard 83/112 survey trawl has substantial escapement under the footrope of even the largest sizes of snow crab. Exhibits 5-9 provide tabular catch results in numbers of crab caught per square nautical mile by vessel/gear type and net efficiency estimates for each of the five size/sex categories. Exhibits 10-14 provide a graphic presentation of snow crab densities from each of the 24 triplicate tows by the same five size/sex categories and Exhibit 15 provides a summary of snow crab densities derived across the 24 triplicate tows by the same five size/sex categories. Exhibit 16 provides a summary of the NMFS standard 83/112 trawl net efficiency by size and sex category compared to the BSFRF *nephrops* trawl.

The results of this study as described above will be released to the public and to the North Pacific Fishery Management Council's Crab Plan Team meeting on September 14, 2009. Results will also be provided to the snow crab assessment authors for evaluation of the results on the snow crab assessment model during the next crab assessment cycle.

Exhibit 1. Chart showing locations of comparative tows for net efficiency experiment.

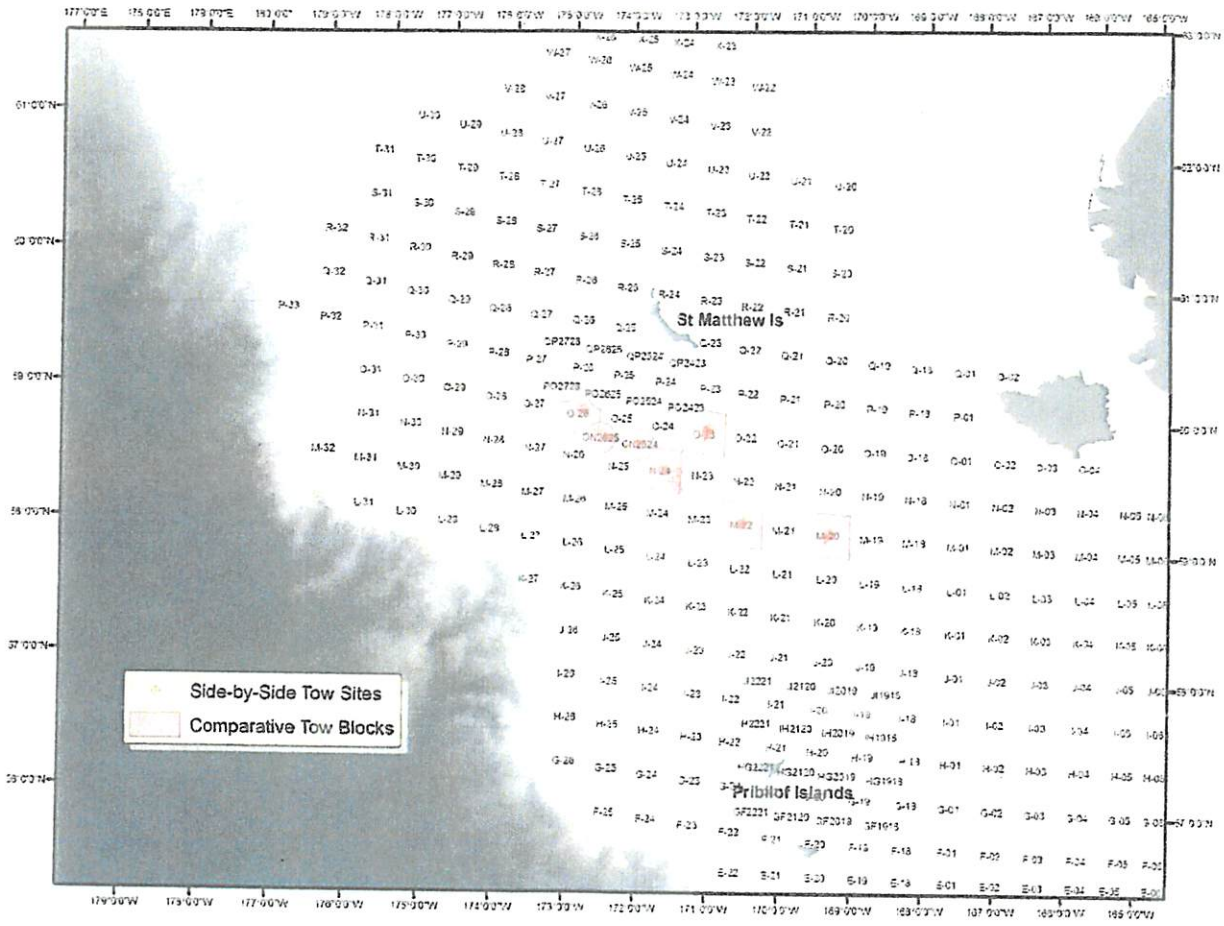


Exhibit 2. One-sample t-Test statistics for comparison of the snow crab CPUEs obtained by the NMFS modified trawl and the BSFRF trawl (BSFRF CPUE - NMFS CPUE). A positive *t*-value and a *p*-value less than 0.05, indicates that the BSFRF trawl was more efficient.

Snow crab length class (chelae width)	t	df	*p*-value
Large male (≥102 mm)	3.2323	23	0.0037
Medium male (78-101 mm)	5.1537	23	0.0000
Small male (<78 mm)	4.3412	23	0.0002
Large female (≥50mm)	2.4048	23	0.0246
Small female (<50mm)	3.5874	23	0.0016

Exhibit 3. Length frequencies of male *opilio* crab binned into 5 mm groups.

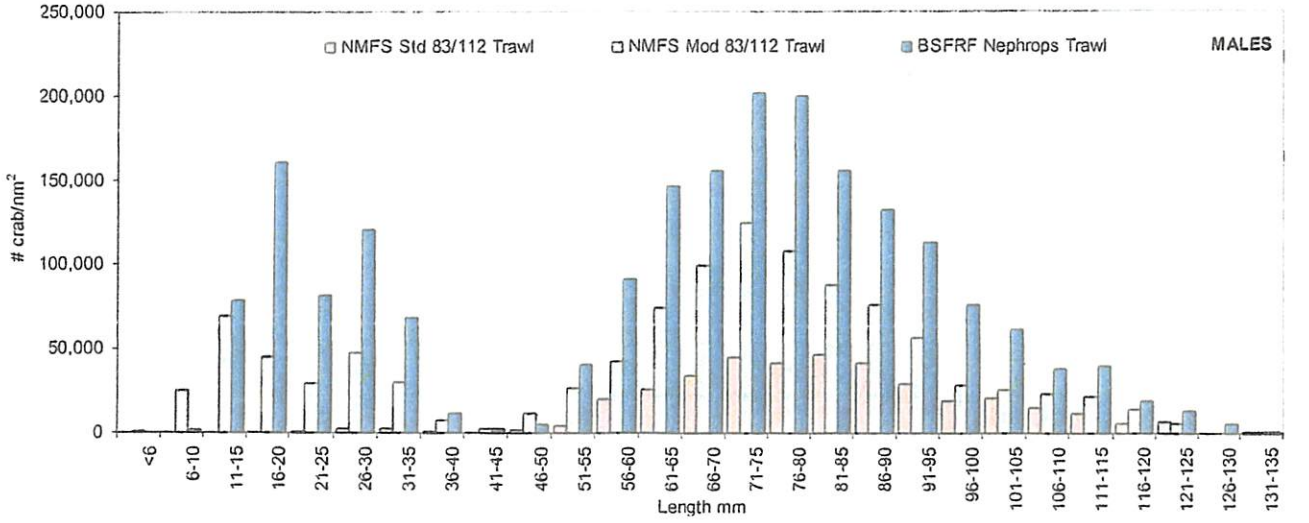


Exhibit 4. Length frequencies of female *opilio* crab binned into 5 mm groups.

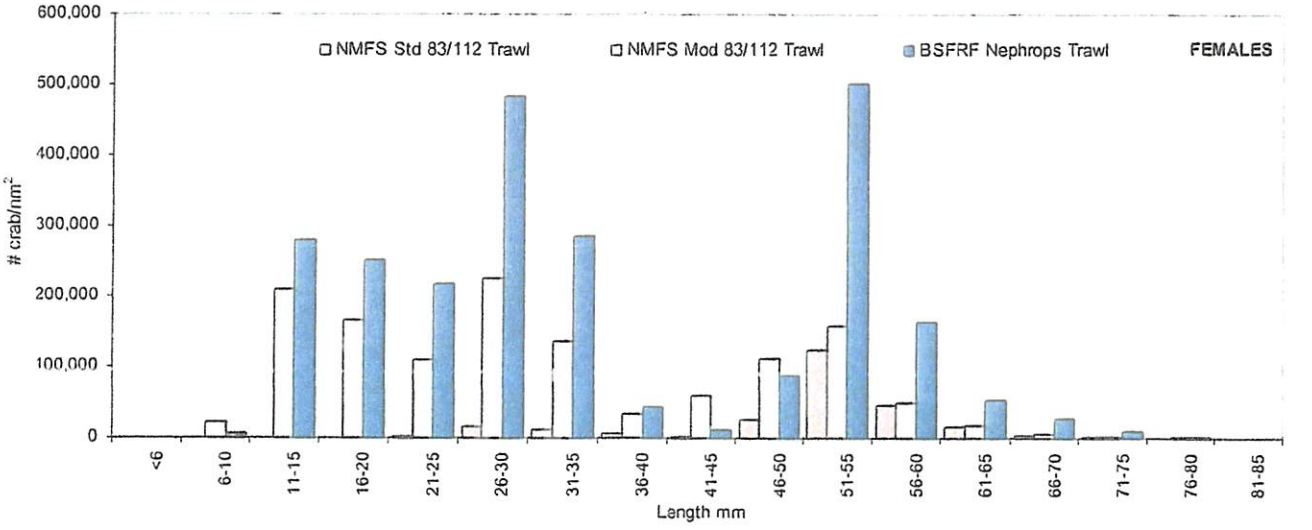


Exhibit 5. Comparison of densities for large male *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment. Net efficiency is defined as the proportion captured within the path of the trawl, which for the NMFS survey trawl for large *opilio* males was 0.35.

LGM	ARC	ALD	AME	Comp Magnitude			Net Efficiency
Tow	A	B	C	B÷A	C÷B	C÷A	A÷C
1	1,684	4,622	9,638	2.7	2.1	5.7	0.17
2	3,959	2,792	3,724	0.7	1.3	0.9	1.06
3	1,962	3,769	2,205	1.9	0.6	1.1	0.89
4	1,831	4,291	5,352	2.3	1.2	2.9	0.34
5	2,917	2,831	4,363	1.0	1.5	1.5	0.67
6	2,977	3,985	18,707	1.3	4.7	6.3	0.16
7	10,867	18,596	33,245	1.7	1.8	3.1	0.33
8	904	1,709	0	1.9	NA	NA	NA
9	284	277	662	1.0	2.4	2.3	0.43
10	0	278	0	NA	NA	NA	NA
11	648	0	1,254	NA	NA	1.9	0.52
12	0	271	589	NA	2.2	NA	0.00
13	2,825	3,946	5,731	1.4	1.5	2.0	0.49
14	8,506	8,786	19,213	1.0	2.2	2.3	0.44
15	4,796	8,302	20,233	1.7	2.4	4.2	0.24
16	7,622	11,915	19,878	1.6	1.7	2.6	0.38
17	1,749	5,969	9,839	3.4	1.6	5.6	0.18
18	1,219	1,070	3,159	0.9	3.0	2.6	0.39
19	1,614	831	1,869	0.5	2.3	1.2	0.86
20	298	1,377	1,370	4.6	1.0	4.6	0.22
21	0	0	0	NA	NA	NA	NA
22	0	663	0	NA	NA	NA	NA
23	0	0	1,659	NA	NA	NA	0.00
24	1,403	676	2,282	0.5	3.4	1.6	0.62
TTL	58,065	86,954	164,973	1.5	1.9	2.8	0.35
AVG	2,419	3,623	6,874				

LGM = large opilio males (≥ 102 mm CW)
ARC = F/V *Arcturus* using NMFS 83/112 std survey trawl
ALD = F/V *Aldebaran* using modified NMFS 83/112 std survey trawl
AME = F/V *American Eagle* using BSFRF *nephrops* survey trawl

Exhibit 6. Comparison of densities for medium male *opilio* (#crab/nm2) during 2009 *opilio* net efficiencey experiment. Net efficiency is defined as the proportion captured within the path of the trawl, which for the NMFS survey trawl for medium *opilio* males was 0.27.

MDM	ARC	ALD	AME	Comp Magnitude			Net Efficiency
Tow	A	B	C	B÷A	C÷B	C÷A	A÷C
1	3,367	7,541	16,233	2.2	2.2	4.8	0.21
2	3,959	5,816	14,897	1.5	2.6	3.8	0.27
3	6,130	20,731	20,950	3.4	1.0	3.4	0.29
4	5,798	18,235	34,253	3.1	1.9	5.9	0.17
5	8,166	21,802	43,626	2.7	2.0	5.3	0.19
6	1,786	1,860	11,107	1.0	6.0	6.2	0.16
7	10,867	18,870	66,491	1.7	3.5	6.1	0.16
8	1,808	2,849	6,000	1.6	2.1	3.3	0.30
9	1,419	2,489	7,948	1.8	3.2	5.6	0.18
10	625	1,668	8,634	2.7	5.2	13.8	0.07
11	1,619	2,149	10,657	1.3	5.0	6.6	0.15
12	2,156	2,439	8,243	1.1	3.4	3.8	0.26
13	5,337	5,637	14,327	1.1	2.5	2.7	0.37
14	2,734	7,936	15,058	2.9	1.9	5.5	0.18
15	3,083	5,634	12,718	1.8	2.3	4.1	0.24
16	6,533	7,830	7,178	1.2	0.9	1.1	0.91
17	4,198	9,129	11,684	2.2	1.3	2.8	0.36
18	11,278	11,497	23,375	1.0	2.0	2.1	0.48
19	10,005	12,181	31,152	1.2	2.6	3.1	0.32
20	10,134	12,117	21,242	1.2	1.8	2.1	0.48
21	20,877	20,969	42,508	1.0	2.0	2.0	0.49
22	11,720	17,889	25,086	1.5	1.4	2.1	0.47
23	20,773	32,309	74,104	1.6	2.3	3.6	0.28
24	12,281	66,201	82,912	5.4	1.3	6.8	0.15
TTL	166,654	315,777	610,382	1.9	1.9	3.7	0.27
AVG	6,944	13,157	25,433				

MDM = medium opilio males (78-101 mm CW)
ARC = F/V *Arcturus* using NMFS 83/112 std survey trawl
ALD = F/V *Aldebaran* using modified NMFS 83/112 std survey trawl
AME = F/V *American Eagle* using BSFRF *nephrops* survey trawl

Exhibit 7. Comparison of densities for small male *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment. Net efficiency is defined as the proportion captured within the path of the trawl, which for the NMFS survey trawl for small *opilio* males was 0.13.

SMM	ARC	ALD	AME	Comp Magnitude			Net Efficiency
Tow	A	B	C	B÷A	C÷B	C÷A	A÷C
1	962	8,270	31,958	8.6	3.9	33.2	0.03
2	2,969	19,077	36,178	6.4	1.9	12.2	0.08
3	1,226	20,312	20,399	16.6	1.0	16.6	0.06
4	1,221	7,509	20,337	6.2	2.7	16.7	0.06
5	2,042	2,831	22,436	1.4	7.9	11.0	0.09
6	0	3,985	10,523	NA	2.6	NA	NA
7	1,863	18,596	36,570	10.0	2.0	19.6	0.05
8	9,946	27,919	70,365	2.8	2.5	7.1	0.14
9	15,889	40,107	84,116	2.5	2.1	5.3	0.19
10	9,370	48,939	88,802	5.2	1.8	9.5	0.11
11	10,365	39,292	99,675	3.8	2.5	9.6	0.10
12	15,707	37,131	88,321	2.4	2.4	5.6	0.18
13	5,337	57,211	31,996	10.7	0.6	6.0	0.17
14	3,038	5,385	14,020	1.8	2.6	4.6	0.22
15	1,370	9,192	8,671	6.7	0.9	6.3	0.16
16	1,089	14,298	11,596	13.1	0.8	10.6	0.09
17	2,099	19,310	41,202	9.2	2.1	19.6	0.05
18	5,182	19,786	41,064	3.8	2.1	7.9	0.13
19	3,873	18,549	39,252	4.8	2.1	10.1	0.10
20	5,067	12,944	24,668	2.6	1.9	4.9	0.21
21	18,680	57,822	87,897	3.1	1.5	4.7	0.21
22	9,376	50,685	112,506	5.4	2.2	12.0	0.08
23	21,747	63,996	166,457	2.9	2.6	7.7	0.13
24	8,421	67,552	59,331	8.0	0.9	7.0	0.14
TTL	156,837	670,699	1,248,341	4.3	1.9	8.0	0.13
AVG	6,535	27,946	52,014				

SMM = small opilio males (<78 mm CW)
ARC = F/V *Arcturus* using NMFS 83/112 std survey trawl
ALD = F/V *Aldebaran* using modified NMFS 83/112 std survey trawl
AME = F/V *American Eagle* using BSFRF *nephrops* survey trawl

Exhibit 8. Comparison of densities for large female *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment. Net efficiency is defined as the proportion captured within the path of the trawl, which for the NMFS survey trawl for large *opilio* females was 0.25.

LGF	ARC	ALD	AME	Comp Magnitude			Net Efficiency
Tow	A	B	C	B÷A	C÷B	C÷A	A÷C
1	2,886	7,784	2,536	2.7	0.3	0.9	1.14
2	742	1,396	4,788	1.9	3.4	6.5	0.16
3	736	4,188	3,308	5.7	0.8	4.5	0.22
4	610	1,073	8,028	1.8	7.5	13.2	0.08
5	875	21,802	3,116	24.9	0.1	3.6	0.28
6	595	1,860	585	3.1	0.3	1.0	1.02
7	1,863	18,870	4,433	10.1	0.2	2.4	0.42
8	39,481	45,335	152,184	1.1	3.4	3.9	0.26
9	34,332	44,064	162,934	1.3	3.7	4.7	0.21
10	46,226	35,109	138,754	0.8	4.0	3.0	0.33
11	36,276	68,084	178,035	1.9	2.6	4.9	0.20
12	23,714	30,084	93,031	1.3	3.1	3.9	0.25
13	1,256	845	1,433	0.7	1.7	1.1	0.88
14	911	283	1,039	0.3	3.7	1.1	0.88
15	0	297	1,734	NA	5.8	NA	NA
16	726	681	1,104	0.9	1.6	1.5	0.66
17	350	702	1,845	2.0	2.6	5.3	0.19
18	3,048	802	4,422	0.3	5.5	1.5	0.69
19	645	1,938	10,592	3.0	5.5	16.4	0.06
20	2,086	6,059	9,593	2.9	1.6	4.6	0.22
21	366	953	3,602	2.6	3.8	9.8	0.10
22	670	2,650	6,842	4.0	2.6	10.2	0.10
23	1,298	1,864	3,871	1.4	2.1	3.0	0.34
24	0	1,689	6,846	NA	4.1	NA	0.00
TTL	199,695	298,412	804,654	1.5	2.7	4.0	0.25
AVG	8,321	12,434	33,527				

LGF = large opilio females (≥ 50 mm CW)
ARC = F/V *Arcturus* using NMFS 83/112 std survey trawl
ALD = F/V *Aldebaran* using modified NMFS 83/112 std survey trawl
AME = F/V *American Eagle* using BSFRF *nephrops* survey trawl

Exhibit 9. Comparison of densities for small female *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment. Net efficiency is defined as the proportion captured within the path of the trawl, which for the NMFS survey trawl for small *opilio* females was 0.03.

SMF	ARC	ALD	AME	Comp Magnitude			Net Efficiency
Tow	A	B	C	B÷A	C÷B	C÷A	A÷C
1	4,810	13,622	56,307	2.8	4.1	11.7	0.09
2	2,227	55,490	76,080	24.9	1.4	34.2	0.03
3	1,716	34,800	29,220	20.3	0.8	17.0	0.06
4	916	19,844	25,154	21.7	1.3	27.5	0.04
5	1,167	10,193	75,411	8.7	7.4	64.6	0.02
6	893	3,985	9,354	4.5	2.3	10.5	0.10
7	3,105	22,425	29,921	7.2	1.3	9.6	0.10
8	6,329	64,327	102,547	10.2	1.6	16.2	0.06
9	4,540	59,268	96,038	13.1	1.6	21.2	0.05
10	7,184	121,098	138,754	16.9	1.1	19.3	0.05
11	8,097	97,003	160,482	12.0	1.7	19.8	0.05
12	3,080	58,814	87,732	19.1	1.5	28.5	0.04
13	1,884	139,405	94,079	74.0	0.7	49.9	0.02
14	1,823	14,171	20,251	7.8	1.4	11.1	0.09
15	685	19,866	17,343	29.0	0.9	25.3	0.04
16	726	24,510	11,596	33.8	0.5	16.0	0.06
17	1,749	62,847	105,158	35.9	1.7	60.1	0.02
18	305	16,043	30,956	52.6	1.9	101.6	0.01
19	323	20,487	29,283	63.5	1.4	90.7	0.01
20	298	14,871	9,593	49.9	0.6	32.2	0.03
21	366	18,109	116,716	49.4	6.4	318.7	0.00
22	335	69,529	145,194	207.6	2.1	433.6	0.00
23	0	2,175	103,967	NA	47.8	NA	0.00
24	0	38,008	52,485	NA	1.4	NA	0.00
TTL	52,557	1,000,889	1,623,619	19.0	1.6	30.9	0.03
AVG	2,190	41,704	67,651				

SMF = small opilio females (< 50 mm CW)
ARC = F/V *Arcturus* using NMFS 83/112 std survey trawl
ALD = F/V *Aldebaran* using modified NMFS 83/112 std survey trawl
AME = F/V *American Eagle* using BSFRF *nephrops* survey trawl

Exhibit 10. Chart of densities by tow for large male *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment.

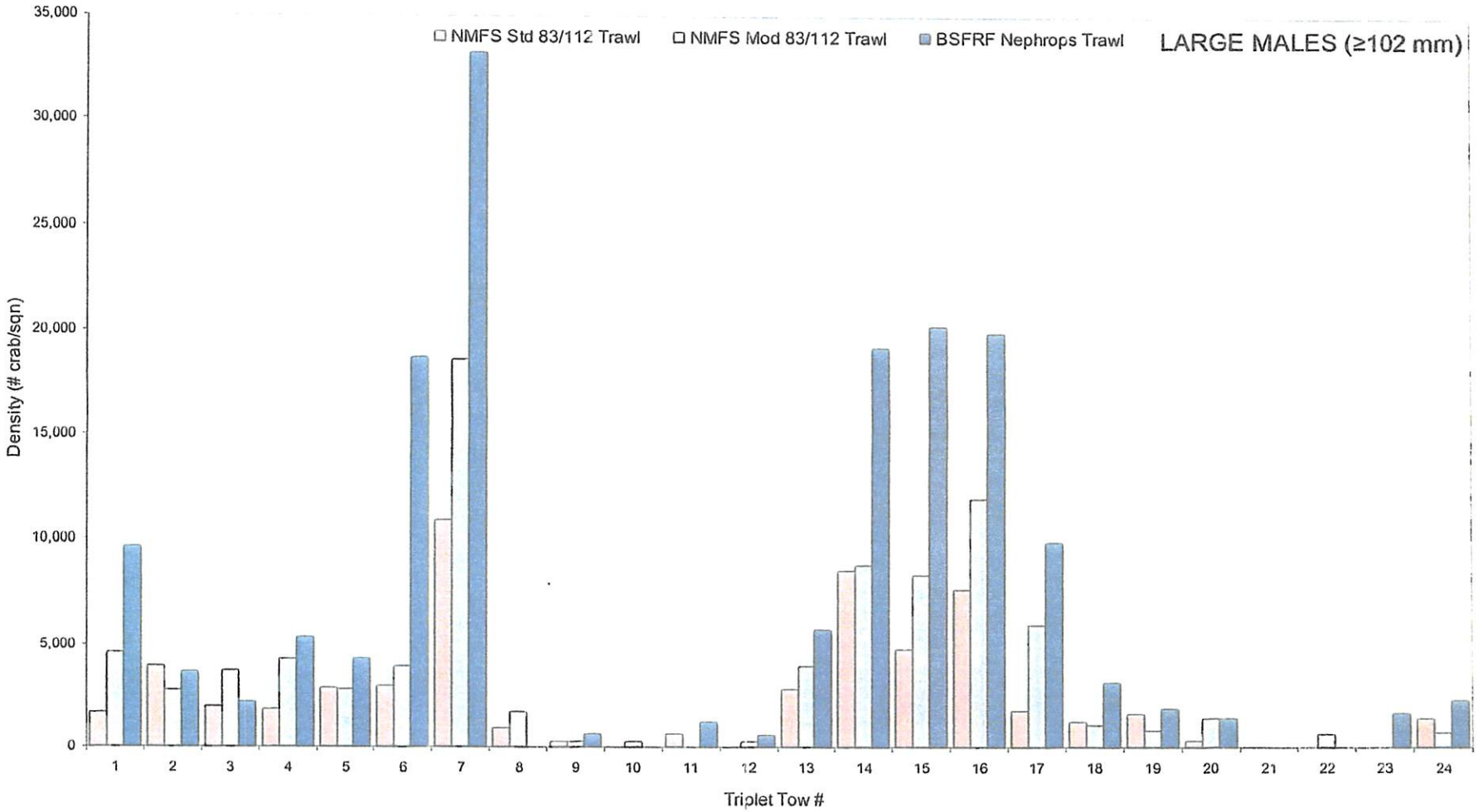


Exhibit 11. Chart of densities by tow for medium male *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment.

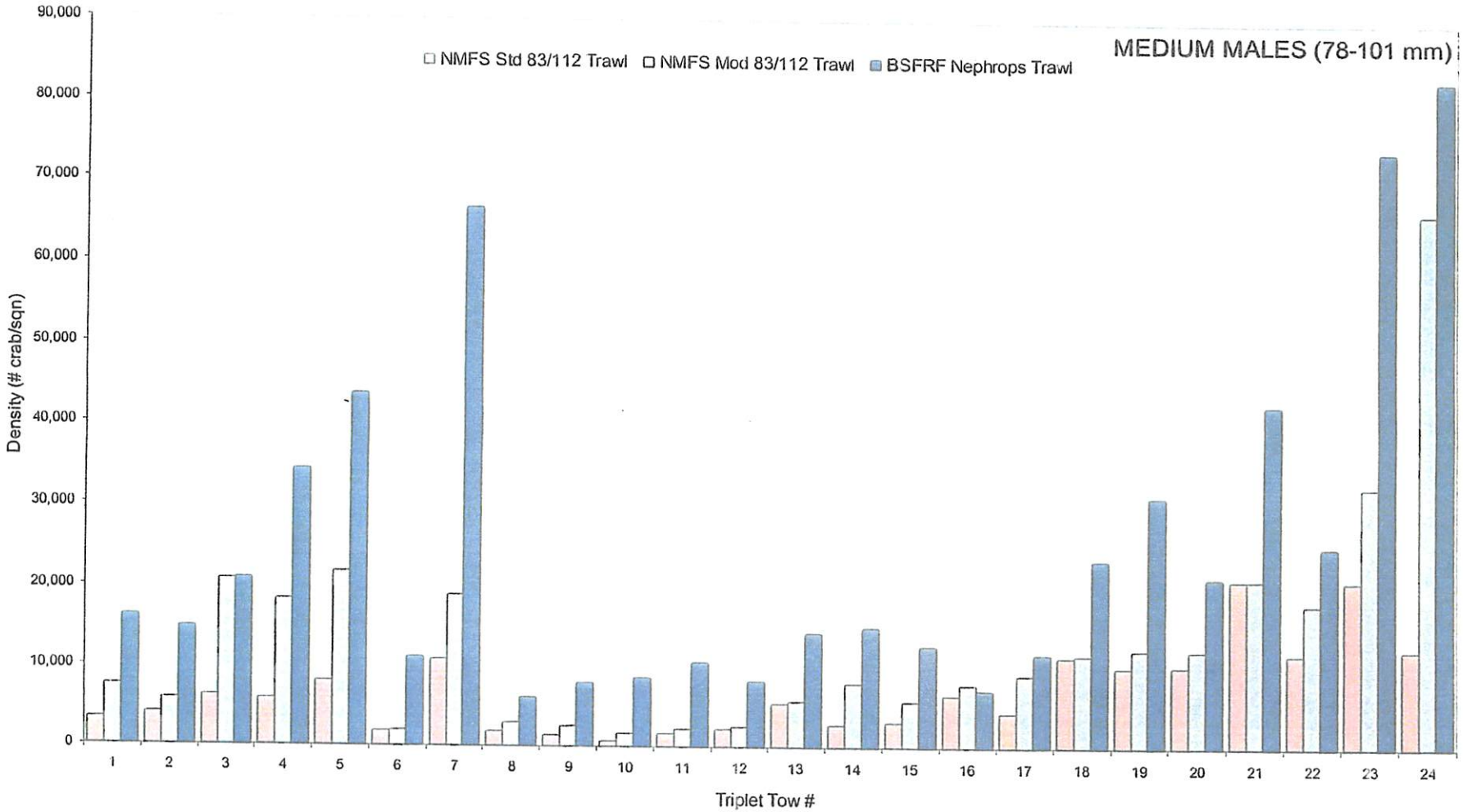


Exhibit 12. Chart of densities by tow for small male *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment.

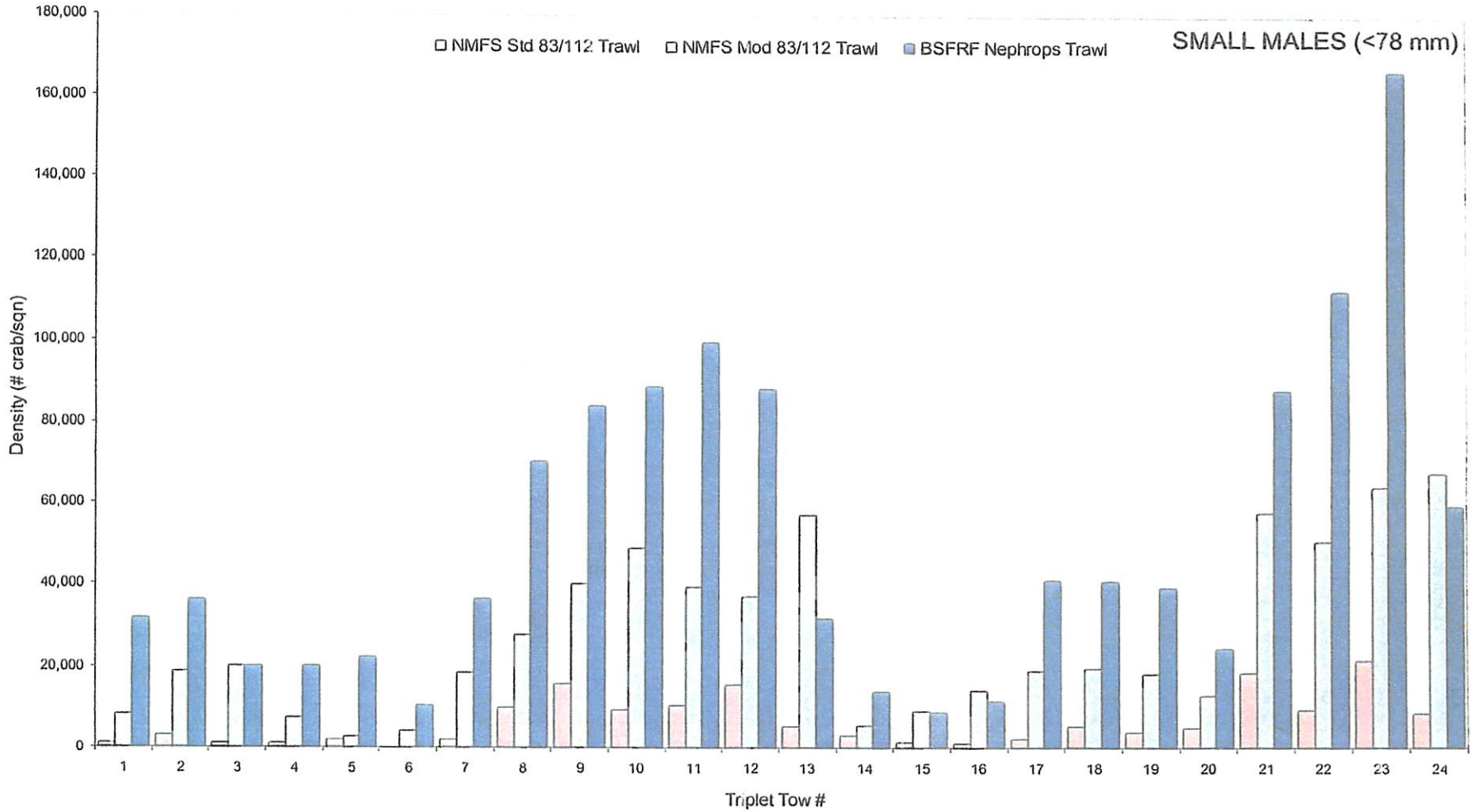


Exhibit 13. Chart of densities by tow for large female *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment.

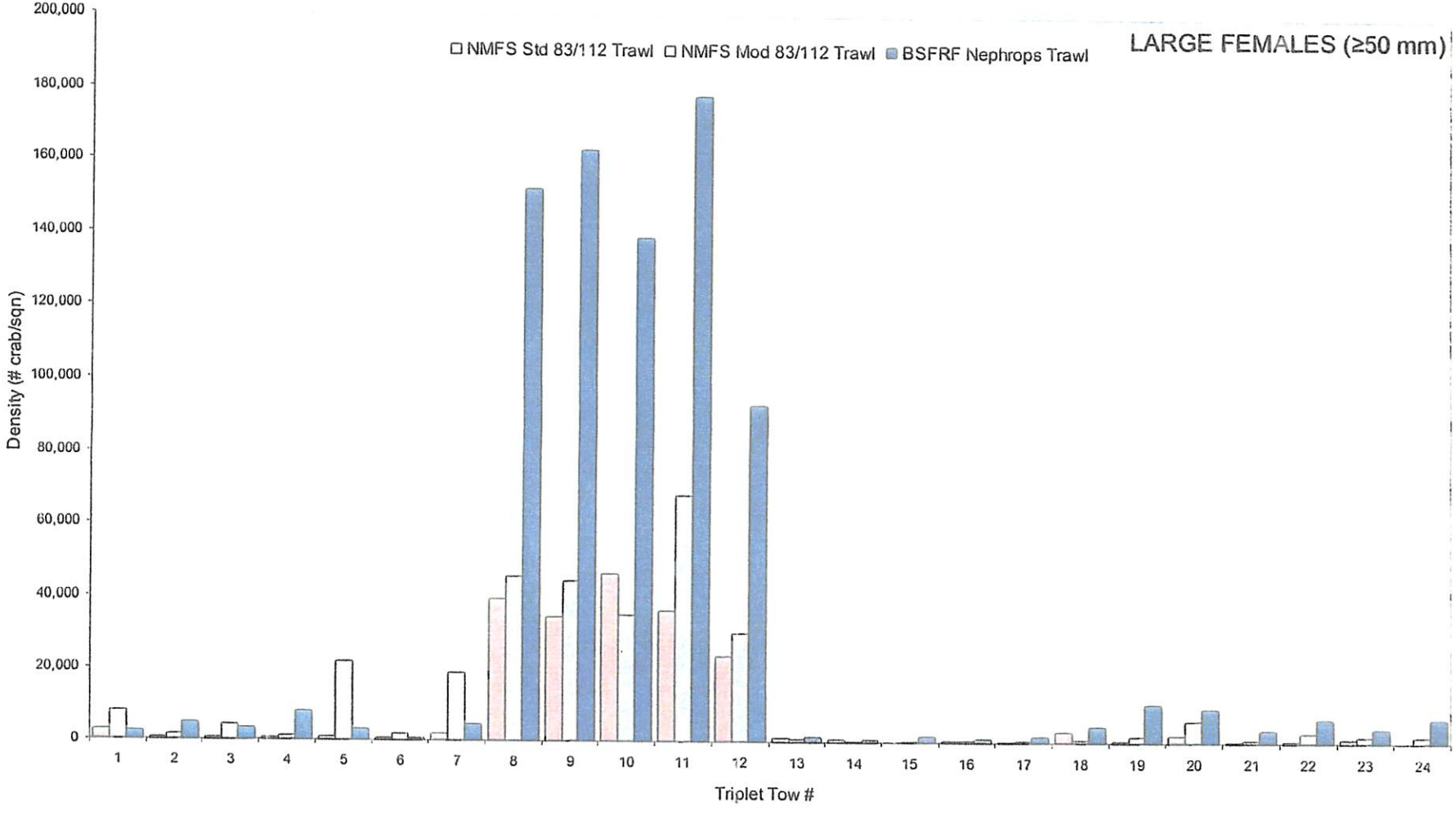


Exhibit 14. Chart of densities by tow for small female *opilio* (#crab/nm2) during 2009 *opilio* net efficiency experiment.

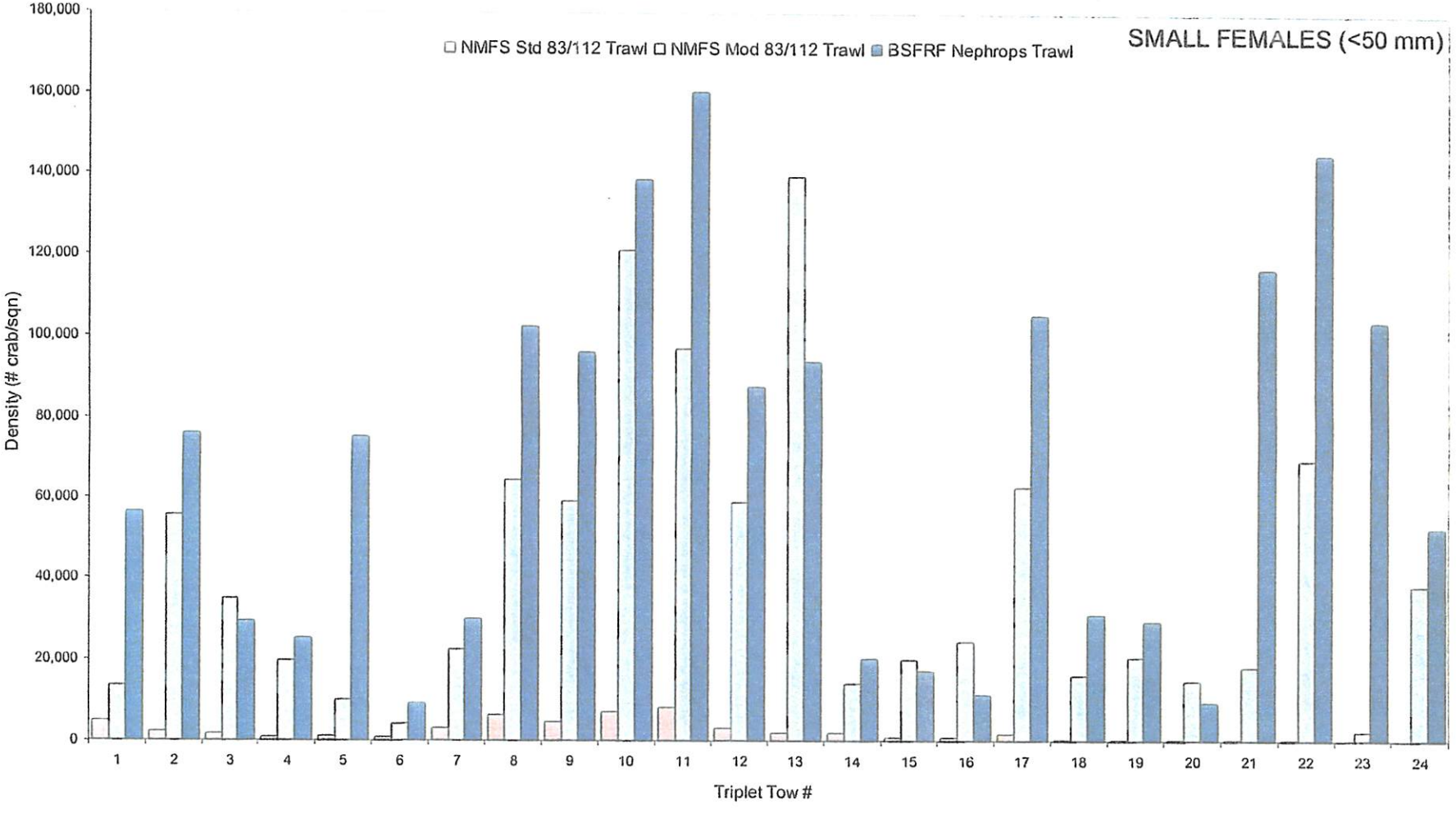
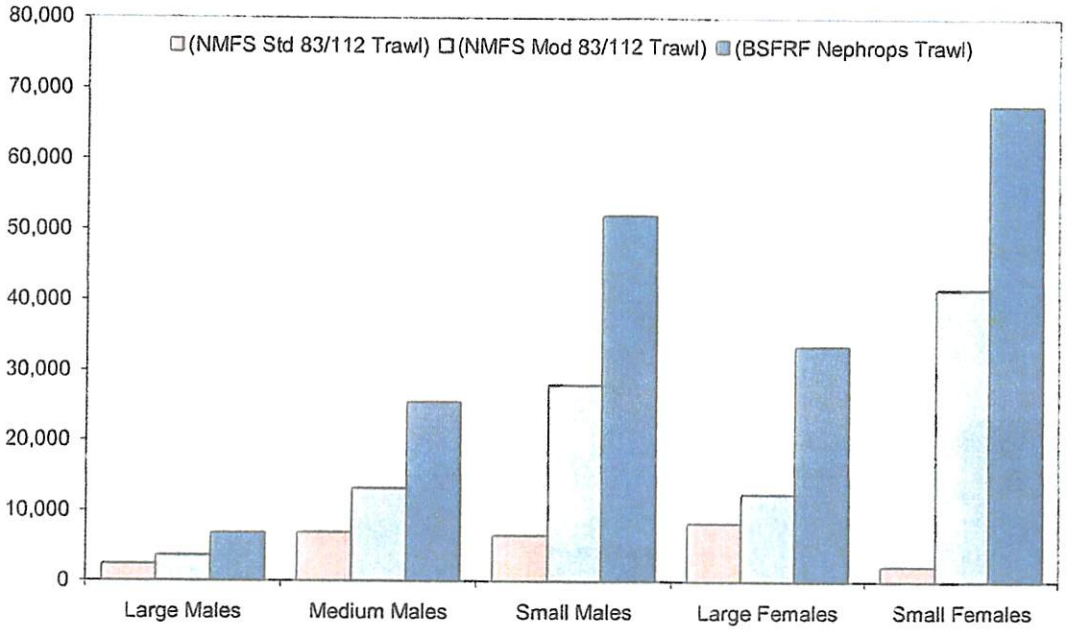
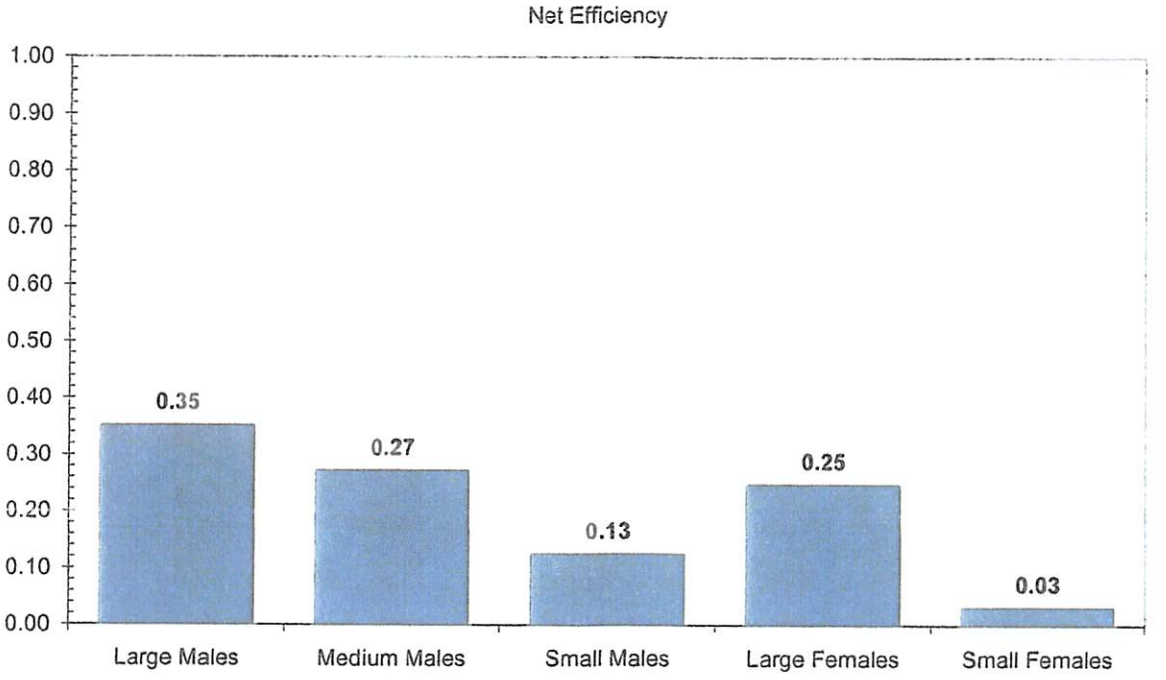


Exhibit 15. Chart and table of average densities for all tows (#crab/nm2) by size and sex category during 2009 *opilio* net efficiency experiment.



Opilio Size Sex Category	Density Averages from 24 Side by Side Tows (crab/nm^2) *F/V Arcturus* (NMFS Std 83/112 Trawl)	*F/V Aldebaran* (NMFS Mod 83/112 Trawl)	*F/V American Eagle* (BSFRF *Nephrops* Trawl)
Large Males (≥ 102 mm)	2,419	3,623	6,874
Medium Males (78-101 mm)	6,944	13,157	25,433
Small Males (< 78 mm)	6,535	27,946	52,014
Large Females (≥ 50 mm)	8,321	12,434	33,527
Small Females (< 50 mm)	2,190	41,704	67,651
Total Opilio (All Sizes)	26,409	98,864	185,499

Exhibit 16. Net efficiency by size and sex category for NMFS standard trawl based on results of 2009 *opilio* net efficiency experiment.



Opilio Size Sex Category	Density Averages from 24 Side by Side Tows (crab/nm^2) *F/V Arcturus* (NMFS Std 83/112 Trawl)	*F/V American Eagle* (BSFRF *Nephrops* Trawl)	Net Efficiency *F/V Arcturus* : *F/V American Eagle*
Large Males (≥ 102 mm)	2,419	6,874	0.35
Medium Males (78-101 mm)	6,944	25,433	0.27
Small Males (< 78 mm)	6,535	52,014	0.13
Large Females (≥ 50 mm)	8,321	33,527	0.25
Small Females (< 50 mm)	2,190	67,651	0.03

C4 ef Arni Thompson
Agendum

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Testimony of Arni Thomson, Executive Director
Of the Alaska Crab Coalition to the
North Pacific Fishery Management Council,
On Agenda Item C-4(e,f), BSAI Crab SAFE Reports and
St. Matthew and Pribilof Islands blue king crab and
Bering Sea Snow and Tanner Crab Rebuilding Plans
(M-S National Standard One, Overfishing Regulations)
October 5, 2009

Mr. Chairman and members of the NPFMC, my name is Arni Thomson, I am the Executive Director of the Alaska Crab Coalition (ACC) and I am here to provide comments on some of the anomalies of National Standard One, Overfishing Definitions, based on the ACC's experience with rebuilding plans in the Bering Sea crab fisheries over the past ten years. (Agenda Item C-4(e,f), the Crab SAFE and Rebuilding Plans). Since the fall of 1999, four fisheries, beginning with Bering Sea Tanner crab, then Bering Sea snow crab and St Matthews blue king crab, followed by Pribilof Island blue king crab, have been under the conservation restraints of closed fisheries or severely restricted harvests.

At this point, I wish to refer to the NMFS, Douglas Mecum letter of September 24, 2009, addressed to Eric Olson, Chair of the NPFMC and Denby Lloyd, Commissioner of the Alaska Department of Fish and Game (ADFG), that provides an official notification of changes in the status of four crab stocks: (1) St. Matthews blue king crab is now rebuilt, (2) Tanner crab (C. bairdi) is approaching an overfished condition, and (3) the rebuilding plan for for snow crab (C. opilio) and the rebuilding plan for Pribilof Islands blue king crab have not resulted in adequate progress toward rebuilding these stocks. The MSFCMA requires a second round of amendments to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP) to prevent overfishing and rebuild these three crab stocks. The FMP is unique in its delegation of management authority to the State of Alaska and its regulatory agencies, the Alaska Board of Fisheries (BOF) and ADFG. These two agencies have promulgated fisheries management policies and regulations for king and tanner crab fisheries, including conservation-based harvest strategies, since Alaska gained Statehood in 1959. The,

An attached memorandum from the Alaska Fisheries Science Center, Dr. Douglas DeMaster, provides a report of the status of all the crab stocks under the FMP. The memorandum forms the basis for some interesting comparisons of the problems associated with the implementation of the one-size-fits-all overfishing definitions and the inappropriateness of the inflexible ten-year time limit for rebuilding crab stocks.

The DeMaster memo notes that overfishing is defined as any amount of catch in excess of the overfishing level (OFL). The OFL is based on total catches, including retained and discard mortalities in all fisheries. The memo then refers to Table 1, and notes, "there were no stocks where overfishing occurred in 2008-2009."

Pribilof Islands blue king crab:
A review of Table 1 also shows that only one stock is in the "overfished" status, meaning it is below the Minimum Stock Size Threshold (MSST), Pribilof Islands blue king crab. Directed fishery harvest from 1983 until 1987 was annually less than 1.0 million pounds with low CPUE. The fishery was closed in 1988 until 1995. The fishery reopened from 1995 to 1998. Fishery harvests during this period ranged from 1.3 to 0.5 million pounds. The fishery closed again 1999 due to declining stock abundance and has remained closed through the 2008-2009 season. The stock was declared overfished in 2002.

Accordingly, directed fishing has not occurred on this king crab stock since 1998, the last year for a fishery. In addition, a 7,000 square mile, no trawl protection zone, the Pribilof Habitat Protection Zone, was implemented by the NPFMC in 1996, to protect both blue and red king crab brood stocks from bycatch in the trawl fisheries. Additional protection for blue king crab was implemented by the Alaska Department of Fish and Game, when it closed a core blue king crab habitat area to pot fishing for tanner and snow crab in blue king crab habitat. For over ten years, Pribilof Islands blue king crab have only been subjected to a de minimis amount of fishing pressure from a handful of pot and longline cod boats. Despite all the protectionist measures, there has been virtually no recruitment in the stocks, suggesting that environmental conditions have not been conducive to the development of a strong year class. Although overfishing has not occurred on this stock in 2009, it has not met the ten year rebuilding time frame. Therefore the Crab Plan Team is now recommending the NPFMC implement additional measures to insure no bycatch of blue king crab by the longline and pot fisheries for Pacific cod. To comply with section 304(e)(3) of the Magnuson-Stevens Act, the NPFMC will have two years to develop a new rebuilding plan that will incorporate a few new bycatch constraints in the groundfish fisheries that will not likely stimulate recovery of the Pribilof blue king crab stocks.

Pribilof Islands red king crab:
A second king crab stock in the Pribilofs is the red king crab, which has historically been harvested with blue king crabs, and they are currently the dominant species in the area. Since 1995, a combined catch of red and blue king crabs was set and ranged from 1.25 to 2.5 million pounds. The Pribilof red king crab fishery has been closed since 1999, because of uncertainty with estimated red king crab survey abundance and concerns for incidental catch and mortality of blue king crab. The stock has exhibited widely varying mature male and female abundances during the period 1980-2009. (NPFMC Crab Plan Team SAFE, p. 16.)

The estimate of MMB from the 2009 survey was 4.46 million pounds, down considerably from the 2008 survey estimate 11.06 million pounds, but it exceeds the MSST of 4.3 million pounds. This severe decline occurred even though there is no directed fishery. Recruitment indices are not well understood for Pribilof red king crab. Pre-recruitment has remained relatively consistent in the past 10 years, although may not be well assessed with the survey. Stock biomass in recent years has decreased since the 2007 survey, with a substantial decrease in all size classes in 2009. The total catch (bycatch only) for 2008-09 (0.021 million pounds) was less than the 2008-09 OFL (3.32 million pounds), so overfishing did not occur and therefore the stock is not overfished. The large variance between the OFL and total catch are indicative of a substantial foregone harvest worth millions of dollars, due to concerns of bycatch mortality impacts to blue king crab. The OFL for 2009-10 is .50 million pounds and there will be not fishery opening this season. (SAFE, p. 16.)

St. Matthews Island blue king crab:
Two hundred miles north of the Pribilof Islands is located St. Matthews Island. The shelf around the island is prime habitat for another discrete stock of blue king crab. (A 4,100 square mile no trawl protection zone, the St. Matthews Habitat Conservation Area around the island, was implemented in August of 2008 as part of the larger suite of protection areas, known as the Northern Bering Sea Research Area, Amendment 89. Because it is so recent, it cannot be considered to be a factor in the rebuilding of the blue king crab stocks.) The St. Matthews stock has been closed to directed crab fishing since 1998, similar to the Pribilof king crab fisheries. There has been very limited bottom trawl activity around the island and limited pot and hook and line fishing for cod during the rebuilding period. The stock rebounded to the level where it surpassed the rebuilt threshold for a fishery opening in 2008, but FMP rebuilding requirements call for two successive years above the rebuilt level. The St. Matthews blue king crab mature male biomass has doubled from 5.3 million pounds in 2005 to 10.74 million pounds in 2009, and exceeds the MSST of 4 million pounds. The fishery is reopening this fall with a total catch (TAC) of 1.16 million pounds. The industry got lucky on this one, but not so lucky on the EBS Tanner crab and snow crab stocks. It is likely not a coincidence that this stock has rebuilt while a cold water regime is in effect.

Eastern Bering Sea snow crab:
The snow crab fishery was declared overfished in the fall of 1999. This triggered development by ADFG of emergency measures to drastically curtail the fishery the following year through an emergency regulation adopted by the BOF that reduced the harvest rate to 20 percent of legal male abundance greater than 101 mm (the industry standard size). Simultaneously, the NPFMC, in conjunction with ADFG, initiated work on the development of a rebuilding plan that was codified in Amendment 14 to the King and Tanner Crab FMP. The 2008-09 stock assessment projection estimates the mature male biomass (at mating) at 241 million pounds, which exceeds the MSST of 163 million pounds, so the stock is not overfished. The target rebuild level is 326 million pounds. Therefore the stock is estimated to be at 74 percent of the rebuilt level. (NPFMC Crab Plan Team SAFE, p. 10.) Although the stock is not overfished, it has not met the target rebuilding level, therefore, the NPFMC will have to initiate NMFS and ADFG staff

action to develop a new rebuilding plan by the fall of 2011-12. The TAC for 2009-10 has been set at the default rate, 75%F35, 48 million pounds, in accordance with Mr. Mecum's guidance. A frustrating footnote to the issue of snow crab not being rebuilt at the close of the ten year timeframe is that if the 2009 stock survey had shown the stock to be at the 326 million pound rebuilt level, the TAC would have been set at 16-20 million pounds to insure that it was rebuilt at the close of the tenth year.

Eastern Bering Sea tanner crab:
ADFG and the BOF closed the tanner crab fishery from 1997 to 2005, due to low abundance, for conservation and rebuilding and revised the harvest strategy for reopening the fishery. NMFS declared this stock overfished in 1999 and the Council developed a rebuilding plan. There are two fisheries, one east and one west of 166 degrees W. longitude for Tanner crab. Under the Crab Rationalization Program, ADFG sets separate TACs and NMFS issues separate individual fishing quota (IFQ) for these two fisheries. However, one OFL level is set for the EBS Tanner crab, because evidence indicates that the EBS Tanner crab is one stock. In 2005, abundance increased to a level to support a fishery in the area west of 166 degrees W. longitude. ADFG opened both fisheries for the 2006-07 to 2008-09 crab fishing years. In 2007, NMFS determined the stock was rebuilt, because spawning biomass was above Bmsy for two consecutive years.

Tanner crab are caught as bycatch in the groundfish 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 the Bristol Bay red king crab).

Mature Male Biomass (MMB) and Legal Male Biomass (LMB) showed peaks in the mid-1970s and early 1990s. MMB at the time of the survey revealed an all-time high of 623.9 million pounds in 1975, and a second peak of 255 million pounds in 1991. From the late 1990s through 2007, MMB has risen at a moderate rate from a low of 25.1 million pounds in 1997. Post 1997, MMB at the time of the survey, increased to 185 million pounds in 2007 and subsequently decreased to 143 million pounds in 2008. In the 2008 survey, estimated abundance of legal males increased over the 2007 abundance estimate by 9 percent, however, the 2008 survey showed a marked decline in estimated abundance across all other size classes of males and females. In the 2009 survey, the MMB at the time of the survey decreased to 86.6 million pounds, a 36.8 percent decrease from 2008, and it is projected to decline further to 70 million pounds MMB in 2009-10, below the MSST of 94.9 million pounds. Most other size classes of males and females also showed a decline in estimated abundance, except for small females. Thus the status of the stocks memorandum notes that Tanner crab is approaching an overfished condition and the NPFMC will have two years to implement a rebuilding plan.
(NPFMC Crab Plan Team SAFE, p. 14.)

It is noteworthy that, since the directed fishery for Tanner crab reopened in 2005, there have been four seasons of fishing with only a relatively small fleet of boats targeting on Tanners. The economics of the fishery have resulted in a harvest of an estimated 50 percent of the TAC in the last two years, and 75 percent in the previous year, 2006-07. Thus, directed fishing pressure has been very low since the reopening of the fishery and

likely only a small part of the equation in terms of the stock decline. The Tanner crab fishery is another frustrating situation for the industry. As a result of the overfishing definitions we are caught up in swings between being "overfished" and "rebuilt" as a result of environmental conditions, and not directed fishing pressure.

In conclusion, I wish to refer to the minutes of the NPFMC Scientific and Statistical Committee (SSC) in their discussion of the EBS snow crab and St. Matthews blue king crab rebuilding plans at their April 12, 2000 meeting in Anchorage. The SSC raised several questions about the uncertainty in their knowledge of crab biology on which Bering Sea crab rebuilding simulations are based.

The SSC noted: "Sampling variability of surveys is large, and crab availability to surveys appear highly variable. Large declines in abundance appear triggered by surges in mortality that remain unexplained. Recruitment appears to be linked to environmental factors rather than biomass, so trends in recruitment are difficult to predict. Rebuilding simulations simply assume that the future will be similar to what we have observed in the past: highly variable. Rebuilding times can vary over an order of magnitude depending on the particular set of assumptions adopted. It should be emphasized therefore, that these rebuilding scenarios are highly uncertain and are not robust to mis-specification of recruitment variability. The exact functional form and parameters of the recruitment relationship are unknown."

"An exhaustive statistical study of C. bairdi (Tanner) showed that most of the change in recruitment could be explained by physical oceanographic factors (Rosenkrantz, Tyler, and Kruse, 1999). In particular, year-class strength is related to wind-driven currents, and bottom temperatures of the Bering Sea "cold pool". An effect of stock size on year-class strength could not be found. That is, even if the spawning stock size was reduced by the fishery, the effort was not severe enough to leave behind statistical evidence of a relationship between reduced stock size and year-class strength. C. opilio (snow) are closely related to C. bairdi and are also likely to be strongly influenced by oceanographic processes...."

The SSC goes on to make additional comments about recruitment of snow crab and St. Matthews blue king crab: "In reality, fishing has probably had little influence on recent declines of these populations. Rather, a massive natural mortality event between 1998 and 1999 was the most likely explanation given to the SSC for the decline in St. Matthews blue king crab. A period of low recruitment is thought to be the reason for the decline in C. opilio. These events are quite possibly triggered by corresponding events in the physical environment, such as the regime shift and warm Bering Sea conditions in 1997 and 1998. Furthermore, it was suggested that the reproductive capacity of these populations is related to the abundance or biomass of mature females, which are not affected to any great extent by the crab and groundfish fisheries. Only if the fertilization of females was compromised by the low abundance of mature males would the fishery be involved as a contributing factor. Unfortunately, the current state of knowledge precludes precise determination of a reproductive capacity of these crab populations."

The SSC minutes then refer to several previous minutes where they noted several problems with the current NMFS overfishing guidelines. The minutes note that the SSC prepared a draft letter to the NMFS from the NPFMC explaining the problems with the current NMFS guidelines and requesting greater flexibility in the development of overfishing definitions and status determination criteria. The letter also calls for NMFS to convene a workshop comprised of SSC and assessment scientists from around the country to craft a better set of procedures that have scientific credibility.

The SSC concluded with these statements: "If NMFS does not change its current guidelines, the SSC believes that (1) the perception will be created that NPFMC and Board of Fish management practices led to the decline of certain NPFMC populations because NMFS determined they were "overfished", even though fishing had no demonstable effect, (2) the deserved reputation of the NPFMC for its conservative management practices will be damaged, and (3) much time and energy of NPFMC members, staff, advisory bodies, and agency personnel will be squandered on meaningless overfishing compliance activities, which would be better spent on improved science and management." (NPFMC SSC Minutes, April 12, 2000)