

2003 Stock Assessment and Fishery Evaluation Report
 King and Tanner Crab Fisheries in the
 Bering Sea and Aleutian Islands

Executive Summary

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 summarizes the current biological and economic status of fisheries, guideline harvest levels (GHL), and analytical information used for management decisions or changes in harvest strategies. The report is assembled by the crab plan team with contributions from the State of Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS), and is available to the public and presented to the Council on an annual basis. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the NMFS web page at www.fakr.noaa.gov and the Alaska Department of Fish and Game (ADF&G) Westward Region web page at www.cf.adfg.state.ak.us/region4/rgn4home.htm.

Status of Annually Surveyed Crab Stocks

Table 1 provides summary information on the basic elements of stock condition for the six stocks that are surveyed annually by NMFS. The Federal requirements for determining the status of the stocks are the minimum stock size threshold (MSST) and the maximum fishing mortality threshold (MFMT). These requirements are contained in the FMP and outlined in the following section, overfishing parameters. The MSST is 50% of the mean total spawning biomass (SB = total biomass of mature males and females, also known as TMB = total mature biomass) for the period 1983-1997, upon which the maximum sustainable yield (MSY) was based. A stock is overfished if the SB is below the MSST. The MFMT is represented by the sustainable yield (SY) in a given year, which is the MSY rule applied to the current SB (the MSY control rule is $F = 0.2$ for king crabs, and $F = 0.3$ for Tanner and snow crabs). Overfishing occurs if the harvest level exceeds the SY in one year. GHLs are developed from joint NMFS and ADF&G assessment of stock conditions based on harvest strategies developed by ADF&G. Figures 1-6 show each crab stock's spawning biomass and catch history relative to overfishing.

Stock	MSST	2003 SB	2003 SY	2003/2004 GHL
Bristol Bay red king	44.8	178.1	35.7	15.7
Pribilof Islands red king	3.3	14.5	2.9	0
Pribilof Islands blue king	6.6	4.1	.8	0
St Matthew blue king	11.0	12.8	2.6	0
EBS Tanner	94.8	100.8	30.2	0
EBS snow	460.8	306.2	91.9	20.8

As well as the Federal requirements, survey results for five stocks (Pribilof blue king crab, St. Matthew blue king crab, Bristol Bay red king crab, eastern Bering Sea Tanner crab, and eastern Bering Sea snow crab) are compared to thresholds established in State of Alaska harvest strategies and regulations. ADF&G uses these thresholds to determine if a fishery should be opened and to calculate the GHL. Please refer to the attached report "Executive Summary: Status of King Crab Stocks in the Eastern Bering

Sea in 2002" (Vining, et al 2002) for more detail on the population estimation methods for Bristol Bay red king crab, Pribilof Islands red and blue king crab, and St. Matthew blue king crab.

Bering Sea Tanner crab
(*Chionoecetes bairdi*):

The 2003 survey estimate of spawning biomass increased to 100.8 million pounds from the 2002 estimate of 69.4 million pounds, which was essentially unchanged from the 2001 estimate (67.7 million pounds). In 2003, this stock increased above the MSST (94.8 million pounds spawning biomass) for the first time in six years.

The fishery was closed in 1997 due to near-record low stock abundance in the 1997 NMFS survey and extremely poor performance in the 1996 fishery. The Council adopted a rebuilding plan for this stock in October 1999. NMFS approved the rebuilding plan in June 2000 (65 FR 38216). The fishery has remained closed under the rebuilding harvest strategy since 1999. ADF&G will reopen the fishery when the female biomass is above the threshold and the fishery GHL is above the minimum identified in the rebuilding harvest strategy. Given the 2003 survey data, this stock is not expected to be above the "rebuilt" level (MSY biomass, defined in the FMP as 189.6 million pounds of total mature biomass) in 2004.

Estimated abundance in 2003 of molting mature males is 10.3 million animals (71% greater than the estimate for 2002). Estimates for abundance of mature-sized

Table 2. Threshold Values in State of Alaska Harvest Strategies for Bering Sea King and Tanner Crabs and Guideline Harvest Levels (GHLs) for 2003/2004 season.

Pribilof blue king crab	
<u>Stock threshold for fishery opening</u>	<u>2003 estimate</u>
0.77 million crab, males >119-mm CL	.291 million crab ^a
St. Matthew blue king crab	
<u>Stock threshold for fishery opening</u>	<u>2003 estimate</u>
2.9 million lbs, males >104 - mm CL	5.4 million lbs ^a
<u>Exploitation rate on mature males (>104-mm CL)</u>	
0, when $B_M < 2.9$ million lbs	
[[$(B_M - 2.9) / 8.7$]*0.1 + 0.1, when $B_M \geq 2.9$ million lbs and $B_M < 11.6$ million lbs	
0.2, when $B_M \geq 11.6$ million lbs	
where B_M = biomass of males >104-mm CL.	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2003 season</u>
2.5 million lbs	Fishery closed
Bristol Bay red king crab	
<u>Stock threshold for fishery opening</u>	<u>2003 estimate</u>
8.4 million crab, females >89 - mm CL and	29.69 million crab ^b
14.5 million lbs effective spawning biomass	60.70 million lbs ^b
<u>Exploitation rate</u>	
10% when ESB is between 14.5 and 34.75 million lbs.	
12.5% when ESB is between 34.75 and 55 million lbs.	
15 % when ESB is at or above 55 million lbs	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2003 season</u>
4 million lbs	15.713 million lbs
Eastern Bering Sea Tanner crab (<i>bairdi</i>)	
<u>Stock threshold for fishery opening</u>	<u>2003 estimate</u>
21 million lbs, females > 79 - mm CW	20.8 million lbs ^c
<u>Exploitation rate on molting mature males</u>	
0, when $B_F < 21$ million lbs	
0.1, when $B_F \geq 21$ million lbs and $B_F < 45$ million lbs	
0.2, when $B_F \geq 45$ million lbs	
where B_F = biomass of females >79 - mm CW.	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2003 season</u>
4 million lbs	Fishery closed
Eastern Bering Sea snow crab (<i>opilio</i>)	
<u>Stock threshold for fishery opening</u>	<u>2003 estimate</u>
230.4 million lbs of spawning biomass (SB)	306.2 million lbs ^c
<u>Exploitation rate on mature male biomass</u>	
0, when $SB < 230.4$ million lbs	
0.1 + $(SB - 230.4) / (0.125 / 691.2)$, when $SB \geq 230.4$ million lbs	
and $SB < 921.6$ million lbs	
0.225, when $SB \geq 921.6$ million lbs	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2003 season</u>
15 million lbs	20.8 million lbs
^a Catch-survey analysis estimate	
^b Length-based analysis estimate	
^c Area swept estimate	

males and mature-sized females also show increases from 2002 to 2003; 44% greater than the 2002 estimate for mature-sized males and 52% greater than the 2002 estimate for mature-sized females. Abundance of exploitable legal males is, at 3.1 million animals, only slightly above the point estimate for 2002, however.

Although a sign of recruitment of males and females in the 1999 survey (a size-frequency mode at 80 to 90-mm CW) disappeared in the 2000 and 2001 surveys, the two size modes indicating juveniles recruiting to the stock in the 2001 survey track well into the 2002 data. These two juvenile size modes that first appeared in earlier survey data have continued to track well into the 2003 data. The 2001 survey data showed a new, large mode representing small (30-mm CW) juveniles that tracked to a mode at roughly 40-mm CW in the 2002 data and has apparently tracked to a mode of approximately 60-mm CW in the 2003 data. A mode of small (30-mm CW) juveniles that appeared in the 1999 survey tracked through to a mode at roughly 60-65 mm CW in 2002. That mode has apparently tracked to a mode at approximately 75-80 mm CW in the 2003 data; in the case of females, this mode has begun to contribute to the mature-sized female component in 2003. That these modes have tracked well for the last 3 years provides some confidence that there has been recruitment to the surveyed population. The amplitude of the modes tends to decrease with successive years, and it remains to be seen how much these modes will contribute to stock rebuilding as they grow into the mature- and legal-size classes.

Harvest Strategy: The Tanner crab fishery has thresholds against which survey data must be compared (Table 2; ADF&G 1999): one for a fishery opening, and a minimum GHL to assure manageability. The minimum stock threshold for a fishery opening is 21 million pounds of females > 79-mm carapace width (CW). The 2003 estimate for Tanner crab females > 79-mm CW is below the threshold at 20.8 million pounds. Hence, the fishery was closed for the 2003 season. When the female biomass is above the threshold, the GHL will be based on a harvest rate of 10% on molting mature males when the biomass of females >79 mm CW is <45.0 million pounds. When the biomass of females >79 mm CW is \geq 45.0 million pounds, the harvest rate on molting mature males is increased to 20%. The legal harvest rate cap will be 50% of exploitable legal males. The first year the stock is above the female threshold, the GHL is reduced by one-half the value as computed by this rule. The minimum GHL for a fishery is 4 million pounds for the general (that is, “non-CDQ”) fishery east of 168° W longitude to ensure manageability.

Bering Sea snow crab (*Chionoecetes opilio*):

Snow crab spawning biomass in 2003 is estimated to be 306.2 million pounds. This stock is below the MSST of 406.8 million pounds, with an estimated SB that is the fourth lowest on record; estimated SB for 2003 exceeds only the estimates for 1985, 1986, and 1999. The SB estimated for 2003 (306.2 million pounds) is comparable to SB estimated in 2002 (313.3 million pounds), but is only 54% of the 571 million pounds that was estimated for SB in 2001. SB estimated for 2003 is only slightly higher than the estimate for 1999 (283.3 million pounds) that resulted in the “overfished” declaration. Estimated mature male biomass decreased to 82% of that estimated for 2002 (222.7 million pounds) and to 61% of that estimated 2001 (302 million pounds). This stock remains in a depressed condition and is unlikely to be estimated above the currently defined B_{MSY} in the next year; it is uncertain if it will be estimated above the thresholds that would allow for a commercial harvest in the 2005 season under the current FMP and harvest strategy.

Size frequency distributions from the 2003 survey show modes representing new-shell males and females centered at 40-50 mm CW that indicate some recruitment to the stock not apparent in the 2002 survey or the 1999 survey. However, similar signs of recruitment to the stock in the 2000 and 2001 proved ephemeral, disappearing in the 2002 survey and not reappearing in the 2003 survey. A size-based assessment model for EBS snow crab estimates recruitment to the stock in 2003 to be high relative to that

during 1995-2002, but low relative to that for the period 1979-1994.

The estimated abundance of males ≥ 4 in CW in 2003 (65-million animals) has also declined from an estimated 78 million animals in 2001 and an estimated 76 million animals in 2002. Fifty-four percent of the estimated males ≥ 4 -inches CW were from the Western Subdistrict. The percentage of new-shell males ≥ 4 -in CW from the 2003 survey (approximately 70%) is comparable to the 2002 estimate but higher than that for the 1999-2001.

The GHJ of 20.831 million pounds in the 2004 season represents 6.8% of the estimated SB and 11.4% of the estimated mature male biomass in 2003. At an average of 1.27 pounds per crab, the 20.831 million pound harvest would represent 16.403 million males. A harvest of 16.403 million males corresponds to 5% of the estimated mature male abundance (368 million animals), 36% of the abundance of new-shell males ≥ 4 -in CW, and 25% of the abundance of all males ≥ 4 -in CW estimated from the 2003 survey. The percentage of males ≥ 4 -in CW that are in new-shell condition in this year's survey has no impact on the determination of the 2004 GHJ under the harvest strategy.

Harvest Strategy: The harvest strategy adopted by the Alaska Board of Fisheries in March 2002 was used to estimate the GHJ for 2004. The harvest strategy determines a GHJ for snow crabs by the application of four rules: a minimum stock threshold for a fishery opening; a maximum exploitation rate on mature male biomass; a 58% cap on the removals of "exploitable legal males", and a minimum GHJ for fishery opening of 15 million pounds.

Stock threshold for fishery opening. The threshold level for opening the fishery is 230.4 million pounds of SB, or one-half of MSST. The fishery is closed if the stock is below that threshold level. If SB is above the 230.4 million-pound threshold for a fishery opening, the GHJ is computed as a function of the FMP's definitions for MSY biomass and overfishing rate and the estimated SB, the mature male biomass (MMB), and the "exploited legal male abundance". The GHJ is constrained by a maximum exploitation rate on MMB and a maximum harvest rate on "exploited legal males."

Maximum exploitation of mature male biomass. Under current FMP definitions for MSY biomass ($B_{MSY} = 921.6$ million pounds SB) and overfishing rate ($F_{MSY} = 0.3$), the maximum exploitation rate on MMB, E_{MMB} , is determined as a function of SB as

- $E_{MMB} = 0.1 + (TMB - 230.4) \cdot (0.125 / 691.2)$, for $TMB \geq 230.4$ million pounds, but < 921.6 million pounds,
and
- $E_{MMB} = 0.225$, for $TMB \geq 921.6$ million pounds.

The maximum for a GHJ_{max} is determined by

$$GHJ_{max} = E_{MMB} \cdot MMB.$$

The SB benchmarks, 921.6 and 230.4 million pounds, for determining the exploitation rate are the MSY biomass (B_{MSY}) and MSST for eastern Bering Sea snow crab as specified in the FMP; 921.6 million pounds is B_{MSY} and 230.4 million pounds is one-half the MSST. Overfishing is avoided under this harvest strategy by applying an exploitation rate $< 30\%$ only to the mature male biomass portion of the SB. Avoidance of overfishing is further assured by a maximum exploitation rate on mature male biomass of 75% of 30% -- when the SB reaches or exceeds B_{MSY} . When the SB falls below B_{MSY} , but exceeds MSST, the exploitation rate reduces linearly with decreasing SB until to a value of 10% when SB

= one-half MSST. When SB is below one-half MSST, the directed snow crab fishery is closed.

58% maximum harvest rate on exploited legal male abundance. The harvest strategy also specifies that a maximum of 58% of the “exploited legal male abundance” may be harvested. “Exploited legal male abundance” is defined as the estimated abundance of all new-shell legal males ≥ 4.0 -in (102-mm) CW plus a percentage of the estimated abundance of old-shell legal males ≥ 4.0 -in CW. The percentage of estimated old-shell male abundance used to compute exploited legal male abundance is determined from the expected fishery selectivity for old-shell males relative to new-shell males; males in old-shell, very-old-shell and very-very-old-shell condition are included as old-shell males in this definition. Legal size for the fishery is 3.1-in CW (including spines) in regulation, but the “industry standard” for retention and processing has been 4.0-in CW. To protect from excessive harvest of the component of the legal males that are ≥ 4 -in CW, the targeted number of males ≥ 4.0 -in CW for commercial harvest is capped at 58% of the exploited legal male abundance. That cap is applied to the exploited legal male abundance, rather than to the unadjusted estimated abundance of all males ≥ 4 -in CW, to account for the fishery’s selectivity for legal crab in new-shell condition. Expected fishery selectivity for old-shell males can be estimated from historic fishery and preseason survey data and from preseason information on processing standards from the crab industry.

If GHL_{max} as computed by the exploitation rate applied to MMB results in a harvested number of males ≥ 4 -in CW that is greater than 58% of the exploitable legal male abundance, the final GHF must be adjusted downward from GHL_{max} . Hence, the 58% harvest cap on exploitable legal male abundance can constrain the final GHF determined for the season below GHL_{max} .

15 million pound minimum GHF. The fishery season will not be opened if the GHF for the general, non-CDQ, fishery is less than 15 million pounds. The minimum GHF addresses the inability to adequately manage the fishery towards a low GHF under the current fleet size, pot limit conditions, in-season data collection, and end-of-season gear requirements.

Application of Harvest Strategy for 2004 GHF: The GHF computed for the 2004 season is 20.831 million pounds. After removal of the 7.5% CDQ allocation (1.562 million pounds), the GHF remaining for the general fishery in 2004 (19.269 million pounds) is above the minimum of 15.0 million-pounds for a fishery opening. Details on the GHF computation are provided below.

Under the harvest strategy and with TMB at 306.2 million pounds, the maximum exploitation rate on mature male biomass (MMB) is

$$\begin{aligned} & (0.1 + (TMB-230.4) \cdot (0.125/691.2)) \\ = & (0.1 + (306.2-230.4) \cdot (0.125/691.2)) \\ & = 11.37\%. \end{aligned}$$

The 11.37% exploitation rate multiplied by the estimated MMB (183.2 million pounds) gives the maximum GHF:

$$\begin{aligned} & 0.1137 \cdot MMB \\ = & 0.1137 \cdot 183.2 \text{ million pounds} \\ & = 20.831 \text{ million pounds.} \end{aligned}$$

A GHL of 20.831 million pounds for the 2004 season would not result in a harvest exceeding 58% of “exploited legal males abundance,” even if the harvest was composed exclusively of new-shell crabs ≥ 4 -in CW. New-shell males account for 70%-73% of the number of males ≥ 4 -in CW estimated from the 2003 survey, or approximately 46 million animals. Average weight of males ≥ 4 -in CW estimated from the survey is 1.27 pounds. A harvest of 20.831 million pounds, at an average weight of 1.27 pounds per crab, represents a harvest of 16.403 million animals, which is roughly 36% of the estimated number of new-shell males ≥ 4 -in CW. That is, even if we defined “exploited legal males” for the 2004 season as only new-shell males ≥ 4 -in CW, the 58% harvest rate cap on exploited legal males has no effect on the GHL computation for the 2004 season.

Bristol Bay red king crab (*Paralithodes camtschaticus*):

Estimated SB for 2003 (178.1 million pounds) increased from the 2002 estimate of 129.9 million pounds, and increased over 50% from the 2001 estimate (88.0 million pounds). Estimated SB for 2003 is over 50% higher than the B_{MSY} stock level defined in the FMP (89.6 million pounds). Hence there are no expectations for this stock to approach its MSST of 44.8 million pounds in the near future.

The 2003 mature female abundance is estimated to be 29.69 million female crabs > 89 mm CL and effective spawning biomass (ESB) estimated at 60.70 million pounds. Therefore, this stock was estimated to be above the threshold for a fishery opening of 8.4 million female crabs > 89 mm CL and 14.5 million pounds ESB. With ESB estimated to be above the 55 million pound threshold, a 15% exploitation rate on mature males was used to determine the GHL of 15.713 million pounds (14.535 million pound GHL for the general commercial fishery and 1.178 million pounds harvest limit for the CDQ fishery). Length-based analysis (LBA) estimates indicate that the abundance of the mature portion of the stock has been essentially stable relative to 2001. Based on the 2003 LBA data, the ESB increased by 27% between 2002 and 2003. Mature male abundance increased 16% over the 2002 estimate and legal male abundance increased by 26%.

Indications from the 2002 survey data of future recruitment to the mature female size class and to the mature male size class continues to be evident in the 2003 survey data. That indication is given by the large mode for both males and females between 85 and 90 mm CL in the 2003 data. The mode of juvenile-sized females seen in the 2002 data has apparently contributed to the abundance of mature-sized females in 2003. That mode should continue to provide new recruitment to mature-sized females in 2004. For males, that mode may begin to provide some new recruitment to the mature male size class in 2004 and should provide increased recruitment to mature-sized males in 2005.

Pribilof Islands red king crab (*Paralithodes camtschaticus*):

The 2003 SB estimate from the survey was 14.5 million pounds, a continuing decrease from the 2002 estimate of 18.1 million pounds, and the 2001 survey SB estimate of 25.5 million pounds. This stock, however, presents particular problems to the NMFS trawl survey in providing reliable levels of precision in stock estimates. Abundance estimates for the Pribilof red king crab stock have fluctuated widely and unpredictably since the early 1990s, but precision of estimates is so poor that this stock can only be considered stable within the limits of the precision afforded by the assessment data. If the stock is stable, the actual level at which it is stable is unknown. NMFS estimates for total mature biomass in 2003 place this stock well above the MSST defined in the FMP (3.3 million pounds of spawning biomass). There are questions, however, whether the MSST defined for this stock is appropriate for “prevailing ecological conditions”.

ADF&G CSA and NMFS area-swept estimates for mature-sized males in 2003 are slightly lower than for 2002 (1.755 million crabs in 2002 as compared to 1.545 million in 2003 for the CSA estimates; 1.816 million in 2002 as compared to 1.298 million in 2003 for the area-swept estimates). The low precision for these estimates, however, precludes any conclusion on trend in abundance of mature males. The CSA estimate for legal males in 2003 (1.433 million) is comparable to that for 2002 (1.371 million). The NMFS area swept estimate for legal males in 2003 (1.251 million) is lower than for 2002 (1.799 million), but the 95% confidence interval of +/- 130% disallows any meaningful conclusions on trend. What is noteworthy in the 2003 data is that few sublegal males were captured during the 2003 survey; the NMFS area-swept estimate for sublegal males in 2003 is 0.047 million, as compared to an estimate of 1.251 million legal males. Poor representation of sublegal males in the 2003 and 2002 surveys provide low expectations for recruitment to the legal or mature male stock in the near future. The 2003 survey data, coupled with results from 2002, suggests that the two-fold increase in mature stock in the area-swept estimates between 2000 and 2001 was likely due to survey error in 2001. CSA point estimates of mature male abundance show an increasing trend from 1.021 million males since 1997 to, perhaps, a leveling out at approximately 1.5 million in 2002-2003. However, the 95% confidence interval for the 2003 mature male CSA estimate (0.709 million to 2.381 million) includes each of the point estimates for mature male abundance in 1991-2002. Such poor precision in abundance estimates makes it impossible to draw any conclusions on the reality of apparent trends or on the current status of the stock. At the level of precision that abundance is estimated, the mature male stock can be considered stable during 1999-2003. However, given the poor indications for recruitment, mature male abundance would be expected to decline with or without a fishery over the next several years; that decline may have already begun between 2002 and 2003.

The Pribilof red king crab fishery is prosecuted concurrent with the Pribilof blue king crab. No formal harvest strategy has been developed for this stock. The stock has been closed to fishing since 1999 due to imprecision of abundance estimates and concerns about bycatch of blue king crab.

This fishery will remain closed for the 2003 season due to concerns about bycatch effects on blue king crab and the poor precision of red king crab abundance estimates. The Pribilof District blue king crab stock is below threshold for a fishery opening and the estimate of total mature biomass for the Pribilof blue king crab stock provided by NMFS is below the MSST defining an "overfished" condition. The Magnuson-Stevens-Act is clear in its direction to managers of federal FMP fisheries to protect "overfished" stocks from fishing mortality that can impair stock rebuilding. There is no observer data available to estimate bycatch rates for blue king crab in a directed red king crab fishery. The timing and area covered by the NMFS EBS trawl survey is not sufficient to determine potential distributional overlap of blue and red king crab during the commercial season. However, fish ticket data from past Pribilof king crab fisheries indicate the potential for bycatch of blue king crab during a directed fishery on the Pribilof red king crab stock. Uncertainty on stock abundance and trends for Pribilof blue king crab is so great and past fishery performance has been so poor that managers and analysts cannot determine a GHL for Pribilof red king crab that could be achieved without the risk of a prolonged season that would increase the potential for blue king crab bycatch. Aside from the concerns for blue king crab bycatch, the lack of a formal harvest strategy for Pribilof red king crab, the uncertainty on stock conditions, and poor fishery performance in past fisheries also raises concerns for the Pribilof red king crab stock when attempting to determine an appropriate GHL.

Pribilof Islands blue king crab (*Paralithodes platypus*):

The 2003 survey estimate of SB was 4.1 million pounds, a decrease from the 2002 SB estimate of 4.5 million pounds, and the 2001 survey estimate of 7.0 million pounds. This stock remains below the MSST of 6.6 million pounds. Hence, NMFS declared the stock overfished. The Council is developing a

rebuilding plan for this stock. Although poor precision in abundance estimates makes year-to-year comparisons difficult, the trend in estimates since the mid-1990s indicates that this stock remains depressed and below MSST in 2003. Estimates of abundance for all male classes are low there is no indication that stock conditions are improving.

Under the existing harvest strategy developed for the Pribilof blue king crabs, fisheries are not opened unless the stocks exceed a threshold level of abundance (Pengilly and Schmidt 1995). The thresholds established for Pribilof Islands blue king crab is 0.77 million males > 119-mm carapace length (CL). Mature male abundance for 2003 is estimated at 0.291 million. The fishery has been closed since 1999 because the stock did not exceed the threshold level of abundance. Therefore, this population is declining in the absence of directed fishing pressure and in the absence of any bycatch during the Pribilof red king crab fishery; the Pribilof red king crab fishery has also remained closed since 1999. It is also worth noting that bycatch in trawl fisheries has not occurred due to the Pribilof trawl closure area. There is no evidence from this year's survey results that recruitment to the mature or legal male stock will occur in the near future.

St. Matthew blue king crab (*Paralithodes platypus*):

The 2003 SB estimate from the survey was 12.8 million pounds, an increase of over 50% from the 2002 estimate (4.7 million pounds), and value above the MSST. This stock is above the MSST (11.0 million pounds of SB) for the first time in five years. Estimated SB increased from 5.2 million pounds in 2000 to 9.0 million pounds in 2001, but dropped to 4.7 million pounds in 2002. Such erratic trends for this stock may reflect the low precision of the spawning biomass estimate. Low precision in estimation is due to the low number of tows that blue king crab are captured in during the trawl survey in the St. Matthew Island area; in that situation, only a few tows can have a large influence on the point estimate. Estimation of SB is particularly sensitive to the survey catch of mature females.

Total mature biomass would need to double from the 2003 estimate to 22.0 million pounds for the stock to be considered "rebuilt"; data from the 2003 survey do not provide any expectations for such an increase in the near-term future. This stock remains at a depressed level comparable to that seen in the mid-1980s. The low catch of blue king crab during each of the 1999-2002 trawl surveys makes it unlikely that the estimated stock condition is attributable to survey error; instead, it supports the hypothesis that natural mortality was higher than normal between the 1998 and 1999 surveys. The 1999-2003 CSA estimates of mature male abundance suggests some stability at this low level. However, given the low precision of estimates, no definitive statements on stock trends can be made.

There is a small indication that stock conditions are improving is that at least some small crabs were taken during the 2003 survey. The NMFS area-swept estimate for number of males <105 mm CL in 2003 (1.387 million) exceeds that for mature-sized (≥ 105 mm CL) in 2003 (0.824 million) by nearly 70%. Nonetheless, the low precision of estimates (95% confidence interval for the estimate of males < 105 mm CL is +/- 142 of the point estimate) suggests that we should adopt a "wait-and-see" attitude on this hopeful sign.

The fishery has been closed since 1999 and will remain closed in 2003. Although the stock is above the threshold for a fishery opening, the GHL of 0.685 million pounds computed according to the fishery harvest strategy is far below the minimum GHL of 2.5 million pounds that is considered manageable.

ADF&G developed the rebuilding harvest strategy for the St. Matthew Island blue king crab fishery that the Board adopted in March 2000. The harvest strategy includes four components: a stock threshold, a minimum GHL, variable mature harvest rates, and a cap on legal male harvest rate. A stock abundance

threshold was set to promote rebuilding and prevent against future instances of stock declines to "overfished" status. A minimum GHL was chosen because small GHLs are not manageable given the current size of the fishing fleet. A maximum legal harvest rate cap was set to prevent high removal rates of legal crabs when most mature males are sublegal size such as would be the case when a strong year class has yet to recruit to the fishery. The harvest strategy is closely based on NMFS technical guidance for implementing precautionary harvest strategies and rebuilding plans of Restrepo et al. (1998). The harvest strategy is detailed in the ADF&G report "Overview of Stock Assessment and Recommended Harvest Strategy for St. Matthew Island Blue king Crabs" (Zheng and Kruse 2000).

The harvest strategy's four components are as follows:

- 1) A minimum stock threshold of 2.9 million lbs of mature male (105 mm carapace length) biomass. This is 25% of the equivalent mature male biomass capable of producing maximum sustainable yield ($B_{msy}=11.6$ million lbs).
- 2) The GHL is determined by directed mature male harvest rates of: (1) 0 when mature male biomass (B) < 2.9 million lbs, (2) $[(B-2.9)/8.7]*0.1+0.1$ when $11.6 > B \geq 2.9$ million lbs, and (3) 0.2 when $B \geq 11.6$ million lbs.
- 3) The harvest rate on legal males is capped at 40%.
- 4) The minimum GHL for a fishery opening is 2.5 million pounds.

Crab Stocks With No Annual Survey

Stock status for the following stocks is unknown due to no survey biomass estimates: Pribilof Islands golden king crab (*Lithodes aequispinus*); Saint Lawrence Island blue king crab; Northern District golden king crab; Western Aleutian Tanner crab (*C. bairdi*); Aleutian Islands (AI) scarlet king crab (*Lithodes couesi*); Bering Sea triangle Tanner crab (*Chionoecetes angulatus*); Eastern AI triangle Tanner crab; Eastern AI grooved Tanner crabs (*Chionoecetes tanneri*); Western AI grooved Tanner crabs and Bering Sea grooved Tanner crabs. The permit fisheries for the species identified in Table 3 are by ADF&G commissioner's permit only with observer requirements. Estimation of MSST for these stocks is not possible at this time because of insufficient data on the basic stock abundance. The ADF&G Gulf of Alaska Marine Resource Assessment Survey is a triennial trawl survey east of 170°W that provides some information on EAI red king crab and EAI Tanner crab.

Aleutian Islands red king crab: WAI (Adak or Petrel Bank) and EAI (Dutch Harbor). The GHL for the eastern portion is based on the results of surveys performed by ADF&G on

a triennial basis; the most recent survey was performed in 2003. Few red king crabs have been caught in surveys of the eastern Aleutians since 1995. The eastern portion has been closed since 1983. Historically, the GHL for the western portion has been based on the most recent fishery performance. The western portion was closed for the 1996/97 and 1997/98 seasons due to poor performance and poor signs of recruitment during the 1995/96 season. The western portion was reopened for limited exploratory fishing in some areas in 1998/99. Based on the results of the 1998/99 season, the fishery in the western portion was closed in 1999/2000. In 1999 the Crab Plan Team identified the need for standardized surveys in areas of historical production prior to reopening the fishery in the western portion; prior to that meeting, the western portion had not been surveyed since 1977. A cooperative ADF&G-Industry pot survey was performed in the Petrel Bank-Semisopochnoi Island area under the provisions of a permit fishery in January-February and November of 2001. Results of those surveys show high densities of legal crabs within limited portions of the surveyed area. Survey catches of females and prerecruit sized males were not as strong. Based on results of the 2001 surveys and recommendations from ADF&G and the public, the Alaska Board of Fisheries adopted pot limits, and modified the season opening date. A GHL of 0.5 million pounds was set for the 2002-03 season in the Petrel Bank area. Because only relative abundance information is available, ADF&G monitored the fishery utilizing inseason CPUE. The management goal is to maintain a fishery CPUE of at least 10-legal crabs per pot. The 2002-03 fishery in the Petrel Bank area of the WAI harvested 505,000 pounds. The fishing CPUE was 18. Based on fishery performance, ADF&G has announced a 0.5 million pound GHL for the 2003-04 fishery.

Table 3. 2002/2003 Guideline harvest levels (GHL), status of the fishery, and MSY estimates for BSAI king and Tanner crab stocks not annually surveyed. Estimated values are in millions of pounds. (NA indicates that insufficient data exists at this time to estimate the value)

Stock	GHL	Fishery/Season	MSY
WAI (Adak) red king	0.5	10/25	1.5
EAI (Dutch Harbor) red king	0	closed	NA
Norton Sound red king	.248	6/15-9/3:11/15-5/15	0.5
St Lawrence blue king	NA	permit	0.1
AI golden king	5.7	8/15	15.0
Pribilof Is. golden king	0.15	permit	0.3
St. Matthew golden king	0.015	permit	0.3
AI scarlet king	NA	permit	NA
EBS scarlet king	NA	permit	NA
EAI Tanner	0	closed	0.7
WAI Tanner	0	closed	0.4
EAI angulatus	NA	permit	1.0
EBS angulatus	NA	permit	0.1
EAI tanneri	.05 to 0.2	permit	1.8
EBS tanneri	.05 to 0.2	permit	1.5
WAI tanneri	NA	permit	0.2

In order to assess red king crab in other portions of the western AI, during November 2002, a survey was conducted between 172° W long., and 179° W long. (area around Adak, Atka, and Amila Islands). The survey of these waters yielded very few red king crab. That area will remain closed until further notice.

Norton Sound red king crab: The Norton Sound red king crab legal male abundance is estimated from the triennial trawl survey. The 2002 ADF&G trawl survey estimated 2.3 million pounds of legal crab, a decrease from the 1999 survey estimate of 4.3 million pounds of legal male crab. This decrease in abundance was the result of weak recruitment over the previous three years. Recruitment is anticipated to be stronger over the next three years. Only the trawl survey conducted in 1996 produced a smaller biomass estimate. The Norton Sound crab fishery operates in the summer and in the winter. The legal male abundance remained in a range that allowed a harvest rate of 8% to be applied to the 2002 legal biomass estimate. The 2003 GHL was 253,000 lbs, based on the triennial trawl survey stock abundance estimates. The open access fishery was open July 1 by regulation and was closed by emergency order on August 13, 2003. The open access goal was 234,000 lbs, and the harvest was 253,284 lbs. The CDQ portion opened June 15, 2003 and closed June 28, 2003. Because the open access harvest exceeded their allocation, the CDQ fishery reopened on August 15, 2003 after the readjusting their allocation. The CDQ fishery closed for the second time on August 24, 2003. Total harvest for the CDQ fisheries was 13,923 pounds. ADF&G never set a GHL for the winter fishery which ran Nov 15, 2002 until May 15, 2003.

Aleutian Islands golden king crab (Eastern Aleutian Islands and Western Aleutian Islands golden king crab stocks): A standardized triennial pot survey for golden king crab in a portion of the eastern Aleutian Islands (in the vicinity of Amukta, Chagulak, and Yunaska Islands) was initiated in 1997. Results from the 2002 survey of that area indicate that catch per unit effort (CPUE) of legal male crabs has dropped by roughly one-third from the 1997 CPUE, whereas female and pre-recruit male CPUEs remained roughly stable at their 1997 levels. Analysis of 1996-2002 golden king crab fishery performance and observer data from the entire area east of 174° W longitude, on the other hand, indicate that the golden king crab stock has remained stable in that larger area. The 2003-04 GHL for the Aleutian Islands has again been set at 5.7 million pounds, with 2.7 million pounds for the area west of 174°W, and 3.0 million pounds for the area east of 174°W. The pot survey was again conducted in July 2003, but information is not yet available.

Eastern Aleutian Islands *C. bairdi* Tanner crab: The fishery has been closed since 1995 due to declining stock size estimated from surveys and poor fishery performance. In the 2000 survey, prerecruit and recruit sized Tanner crabs declined from the 1999 survey in the Eastern Aleutian District. Tanner crab abundance in the eastern Aleutian Islands remains below levels observed in the early 1990s. The Alaska Board of Fisheries recently implemented individual and overall fishery pot limits. In 2003 ADF&G and industry conducted a pot survey of limited portions of the Eastern Aleutians district, results are pending. A decision on the 2004 fishing is expected in November 2003.

Overfishing Parameters

The FMP identifies the following overfishing definitions to provide objective and measurable criteria for identifying when the BSAI crab fisheries are overfished or overfishing is occurring, as required by the Magnuson-Stevens Fishery Conservation and Management Act. Table 4 provides the MSST, MSY, OY and maximum fishery mortality threshold (MFMT) control rule estimates for the BSAI king and Tanner crab stocks. The Crab Plan Team will reevaluate these estimates every five years or when environmental conditions indicate a regime shift.

Table 4. MSST, MSY, OY, and the MFMT estimates for BSAI king and Tanner crab stocks. Estimated values are in millions of pounds.				
(NA indicates that insufficient data exists at this time to estimate the value)				
Stock	MSST	MSY	OY range	MFMT
WAI (Adak) red king	NA	1.5	0 - 1.5	0.2
Bristol Bay red king	44.8	17.9	0 - 17.9	0.2
EAI (Dutch Harbor) red king	NA	NA	NA	0.2
Pribilof Islands red king	3.3	1.3	0 - 1.3	0.2
Norton Sound red king	NA	0.5	0 - 0.5	0.2
Pribilof Islands blue king	6.6	2.6	0 - 2.6	0.2
St Matthew blue king	11.0	4.4	0 - 4.4	0.2
St Lawrence blue king	NA	0.1	0 - 0.1	0.2
Aleutian Is. golden king	NA	15.0	0 - 15.0	0.2
Pribilof Is. golden king	NA	0.3	0 - 0.3	0.2
St. Matthew golden king	NA	0.3	0 - 0.3	0.2
Aleutian Is. scarlet king	NA	NA	NA	0.2
EBS scarlet king	NA	NA	NA	0.2
TOTAL king crab		43.9	0 - 43.9	
E. Aleutian Is. Tanner	NA	0.7	0 - 0.7	0.3
EBS Tanner	94.8	56.9	0 - 56.9	0.3
W. Aleutian Is. Tanner	NA	0.4	0 - 0.4	0.3
TOTAL Tanner crab		58.0	0 - 58.0	
EBS snow	460.8	276.5	0 - 276.5	0.3
TOTAL snow crab		276.5	0 - 276.5	
E. Aleutian Is. angulatus	NA	1.0	0 - 1.0	0.3
EBS angulatus	NA	0.3	0 - 0.3	0.3
E. Aleutian Is. tanneri	NA	1.8	0 - 1.8	0.3
EBS tanneri	NA	1.5	0 - 1.5	0.3
W. Aleutian Is. Tanneri	NA	0.2	0 - 0.2	0.3
TOTAL other Tanners		4.8	0 - 4.8	

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. Proxy stocks are used for BSAI crab stocks where insufficient scientific data exists to estimate biological reference points and stock dynamics are inadequately understood. MSY for crab species is computed on the basis of the estimated biomass of the mature portion of the male and female population or total spawning biomass (SB) of a stock. A fraction of the

SB is considered sustained yield (*SY*) for a given year and the average of the *SY*s over a suitable period of time is considered the MSY.

Overfishing and Overfished: The term “overfishing” and “overfished” mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce MSY on a continuing basis. Overfishing is defined for king and Tanner crab stocks in the BSAI management area as any rate of fishing mortality in excess of the maximum fishing mortality threshold, F_{msy} , for a period of 1 year or more. Should the actual size of the stock in a given year fall below the minimum stock size threshold, the stock is considered overfished. If a stock or stock complex is considered overfished or if overfishing is occurring, the Secretary will notify the Council to take action to rebuild the stock or stock complex.

MSY control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. The MSY control rule for king and Tanner crabs is the mature biomass of a stock under prevailing environmental conditions, or proxy thereof, exploited at a fishing mortality rate equal to a conservative estimate of natural mortality. Sustainable yield (*SY*) in a given year is the MSY rule applied to the current spawning biomass. Overfishing occurs if the *SY* is exceeded for one year or more.

MSY stock size is the average size of the stock, measured in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof. It is the stock size that would be achieved under the MSY control rule. It is also the minimum standard for a rebuilding target when remedial management action is required. For king and Tanner crab, the MSY stock size is the average mature biomass observed over the past 15 years, from 1983 to 1997.

Maximum fishing mortality threshold (MFMT) is defined by the MSY control rule, and is expressed as the fishing mortality rate. The MSY fishing mortality rate $F_{msy} = M$, is a conservative natural mortality value set equal to 0.20 for all species of king crab, and 0.30 for all *Chionoecetes* species.

Minimum stock size threshold (MSST) is whichever is greater: one half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold. The minimum stock size threshold is expressed in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof.

Management Programs

Community Development Quota Crab Fisheries

The Magnuson-Stevens Act mandates that the Council and NMFS establish a Community Development Quota (CDQ) program under which a percentage of the total allowable catch for Bering Sea and Aleutian Island crab fisheries is allocated to the CDQ program (16 U.S.C. 1855 (i)(1)(A)). The Council and NMFS deferred management authority of the BSAI king and Tanner crab fisheries, including the CDQ fisheries, to the State, with federal oversight. The State/Federal cooperative management regime established in the FMP

specifies three categories of management measures, which provide the framework for Federal/State management of the crab fisheries, including the determination of the GHLS and fishery seasons. Additionally, the FMP

authorizes the State to allocate the crab CDQ reserve among CDQ groups and to manage crab harvesting activity of the BSAI CDQ groups (§8.1.4.2 of the FMP).

Table 5. 2003-2005 CDQ program percent allocation by group.

<u>Fishery</u>	<u>APICDA</u>	<u>BBEDC</u>	<u>CBSFA</u>	<u>CVRF</u>	<u>NSEDC</u>	<u>YDFDA</u>
Bristol Bay red king crab	17	19	10	18	18	18
Pribilof red & blue king	0	0	100	0	0	0
St. Matthew blue king	50	12	0	12	14	12
Norton Sound red king	0	0	0	0	50	50
Tanner crab	10	19	19	17	18	17
Snow crab	8	20	20	17	18	17

Table 6. 2003/2004 CDQ reserve (in pounds).

<u>Fishery</u>	<u>CDQ</u>
Bristol Bay red king crab	1,178,000
Pribilof red & blue king	0
St. Matthew blue king	0
Norton Sound red king	19,800
Tanner crab	0
Snow crab	1,562,000

Sixty-five communities along the Bering Sea are eligible for the CDQ program. These villages aligned into six CDQ groups: Aleutian Pribilof Island Community Development Association (APICDA), Bristol Bay Economic Development Corporation (BBEDC), Central Bering Sea Fishermen's Association (CBSFA), Coastal Villages Regional Fund (CVRF), Norton Sound Economic Development Corporation (NSEDC), and Yukon Delta Fisheries Development

Association (YDFDA). The CDQ reserve is 7.5% of the GHL for the following Bering Sea fisheries: Bristol Bay red king crab, Pribilof red and blue king crab, Norton Sound red king crab, snow crab, and Tanner crab. ADF&G divides the 7.5% reserve among the six CDQ groups.

License Limitation Program

Fishing under the crab

Table 7: Crab Licenses Limitation Program: number of licenses issued as of May 2003

Number of crab licenses: 320 (56 of which are interim licenses)

Number of crab licenses with specific endorsements, by crab fishery:

<u>Endorsement</u>	<u>Licenses</u>	<u>Interim</u>	<u>Total</u>
Aleutian Is. golden king	27	11	38
Aleutian Is. red king	26	11	37
EBS Tanner	254	54	308
Bristol Bay red king	250	52	302
Norton Sound king	60	3	63
Pribilof Is. king	110	26	136
St. Matthew Is. blue king	165	34	199

Notes: A crab license may contain more than one endorsement. EBS Tanner endorsements included both snow crab (*C. opilio*) and Tanner crab (*C. bairdi*).

license limitation programs (LLP) began in January 2000. The goal of the LLP is to limit access to the crab fisheries to the historic participants or to people who purchase licenses from historic participants. Owners of vessels must have a valid LLP license in order to participate in the BSAI crab fisheries. NMFS issued licenses based on fishing history during a general qualifying period, with area/species endorsements based on additional qualifying periods for each species by area, and a recent qualifying period. Licenses also limit the size of the vessel deployed under the license. Interim licenses were also issued to any applicant that had a valid moratorium qualification for crab in 1999. Interim licenses are temporary and the total numbers of licenses will decrease as interim licenses either are denied or licenses granted. Interim licenses are issued if any part of a person’s claim is contested. Also, the number of licenses may change as a result of a small number of new licenses issued from late filed claims.

American Fisheries Act Crab Sideboards

In 1998, Congress passed the American Fisheries Act (AFA) to establish a new allocation scheme for the BSAI pollock fishery. The AFA required harvest restrictions (commonly known as “sideboards”) on the pollock fishermen who received exclusive harvesting privileges under the AFA to protect the interests of fishermen who are not directly benefited by the AFA. The sideboards for the AFA vessels to participate in the crab fisheries are as follows.

Under regulations implementing the AFA, an AFA vessel is ineligible to participate in any BSAI crab fishery unless that specific vessel participated in a specific crab fishery during certain qualifying years. AFA vessel permits could be endorsed for the Bristol Bay red king crab, snow crab, *C. bairdi* Tanner crab, St. Matthew blue king crab, Pribilof Islands king crab, Aleutian Islands red king crab, and Aleutian Islands golden king crab fisheries. To participate in a BSAI crab fishery, the operator of an AFA vessel would have to have a valid LLP license for that crab fishery as well as an AFA vessel permit containing an endorsement for that crab fishery.

In addition to the historic participation requirements, there is a cap on the amount of Bristol Bay red king crab and *C. bairdi*

Tanner crab that the AFA vessels can harvest. The Bristol Bay red king crab harvest cap is based on the aggregate 5-year (1991-1997, excluding 1994-1995) weighted average share. Under this cap, AFA vessels may

Table 8: Participation requirements for AFA catcher vessels to determine eligibility to harvest crab species. An AFA vessel must have participated in the directed crab fishery below during the participating years listed in order to be eligible to participate in that fishery in the future.	
<u>Fishery</u>	<u>Participating years</u>
Bristol Bay red king	Made landings of BSAI king or Tanner crab species in 1996, 1997, <i>or</i> on or before February 7, 1998
St. Matthew blue king	1995, 1996, <i>or</i> 1997
Pribilof Islands king	1995, 1996, <i>or</i> 1997
Aleutian Is. golden king	1997/1998 <i>and</i> 1998/1999
Aleutian Is. red king	1995/1996 <i>and</i> 1998/1999
Snow crab	Made landing in each of four or more years from 1988-1997
<i>C. bairdi</i> Tanner	1995 <i>or</i> 1996

harvest up to 10.96% of the regular commercial GHL, which equals 1,593,036 pounds for the 2003 fishery. The amount of the harvest cap may change if the number of AFA vessels with Bristol Bay red king crab endorsements changes. An aggregate harvest cap will be established for *C. bairdi* Tanner crab once the stock rebuilds. This harvest cap will be based on the aggregate historic catch of the endorsed *C. bairdi* Tanner crab vessels for 1995-1996. Management and implementation of these crab harvest cap sideboards is deferred to the State of Alaska.

Table 9: Number of AFA vessels eligible to harvest crab and 2003 harvest cap for AFA vessels, by crab fishery:

<u>Fishery</u>	<u>AFA Endorsements</u>	<u>2003 Harvest Cap</u>
Aleutian Is. golden king	0	-
Aleutian Is. red king	0	-
<i>C. bairdi</i> Tanner	28	NA
Bristol Bay red king	41	1,593,036 pounds
Snow crab	6	-
Pribilof Is. king	2	-
St. Matthew Is. blue king	1	-

Note: NA indicates a harvest cap is not applicable because the fishery is closed for 2003.

Capacity Reduction Program

NMFS is developing regulations to implement a capacity reduction program (a.k.a. buyback program) for the BSAI crab fisheries, excluding Norton Sound, pursuant to Section 144(d) of Public Law 106-554 (section 144), as amended by Public Law 107-20. NMFS published the proposed rule on December 12, 2002 (67 FR 76329), but has yet to publish the final rule. Section 144 mandates a specific capacity reduction program. The objective of the program is to permanently remove harvesting capacity from the BSAI crab fisheries by permanently reducing the number of license limitation program licenses issued pursuant to the FMP. The action is necessary because the BSAI crab fisheries are over capitalized. The program will: 1) prevent certain crab vessels from fishing again anywhere in the world; 2) revoke the crab LLP licenses based on the vessels' fishing history; 3) revoke any NMFS issued non-crab licenses that the vessels' owners hold; and, 4) revoke the vessels' fishing histories upon which NMFS based the licenses to be revoked.