

**2002 Stock Assessment and Fishery Evaluation Report**  
for the King and Tanner Crab Fisheries  
of the Bering Sea and Aleutian Islands Areas

**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 the Bering Sea/Aleutian Islands King and Tanner Crabs (FMP)*, and a federal requirement [50 CFR Section 602.12(e)]. The SAFE details 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 <http://www.fakr.noaa.gov>.

**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 =

**Table 1. MSST, 2002 spawning biomass (SB), sustained yield (SY), and 2001/2002 guideline harvest level (GHL) estimates for BSAI king and Tanner crab stocks. Estimated values are in millions of pounds.**

<b>Stock</b>	<b>MSST</b>	<b>2002 SB</b>	<b>2002 SY</b>	<b>2002/2003 GHL</b>
Bristol Bay red king	44.8	129.9	26.0	9.3
Pribilof Islands red king	3.3	18.1	3.6	0
Pribilof Islands blue king	6.6	4.5	0.9	0
St Matthew blue king	11.0	4.7	0.9	0
EBS Tanner	94.8	69.4	20.8	0
EBS snow	460.8	313.3	93.7	25.6

**total biomass of mature males and females)** 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.

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 2002 survey estimate of spawning biomass (69.4 million pounds) was essentially unchanged from the 2001 estimate (67.7 million pounds). This stock remains below MSST (94.8 million pounds spawning biomass) for the sixth year in a row. Estimated total mature biomass is above that for 1997 and 1998, but comparable to that for 1999 through 2001. The increase above the female-biomass threshold needed for a fishery opening in 2002 that was hoped for from the 2001 survey data did not occur. Two size modes for juveniles in the 2002 survey track well with the 1999 through 2001 survey data, but it remains uncertain if these will provide the recruitment to the mature and legal stocks necessary for a future fishery opening.

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 fishery was again closed in 1998 due to continued low stock abundance and to the estimated total mature biomass (36.9 million pounds) being below the MSST that was established in that year. 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

**Table 2. Threshold Values in State of Alaska Harvest Strategies for Bering Sea King and Tanner Crabs and Guideline Harvest Levels (GHLs) for 2002/2003 season.**

<b>Pribilof blue king crab</b>	
<u>Stock threshold for fishery opening</u>	<u>2002 estimate</u>
0.77 million crab, males >119-mm CL	.338 million crab <sup>a</sup>
	<u>GHL for 2002 season</u>
	0.0 (Fishery closed)
<b>St. Matthew blue king crab</b>	
<u>Stock threshold for fishery opening</u>	<u>2002 estimate</u>
2.9 million lbs, males >104 - mm CL	5.3 million lbs <sup>a</sup>
<u>Exploitation rate on mature males (&gt;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 2002 season</u>
2.5 million lbs	0.0 (Fishery closed)
<b>Bristol Bay red king crab</b>	
<u>Stock threshold for fishery opening</u>	<u>2002 estimate</u>
8.4 million crab, females >89 - mm CL and 14.5 million lbs effective spawning biomass	18.61 million crab <sup>b</sup> 37.71 million lbs <sup>b</sup>
<u>Stock threshold for increasing exploitation rate from 10% to 15%</u>	
55 million pounds effective spawning biomass	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2002 season</u>
4 million lbs	9.27 million lbs
<b>Eastern Bering Sea Tanner crab (<i>bairdi</i>)</b>	
<u>Stock threshold for fishery opening</u>	<u>2002 estimate</u>
21 million lbs, females > 79 - mm CW	13.8 million lbs <sup>c</sup>
<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 2002 season</u>
4 million lbs	0.0 (Fishery closed)
<b>Eastern Bering Sea snow crab (<i>opilio</i>)</b>	
<u>Stock threshold for fishery opening</u>	<u>2002 estimate</u>
230.4 million lbs of spawning biomass (SB)	313.3 million lbs <sup>c</sup>
<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	
where SB=spawning biomass.	
<u>GHL threshold for fishery opening</u>	<u>GHL for 2003 season</u>
15 million lbs	25.605 million lbs

the 2002 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 2003.

Relative to levels seen in 1998 when the stock was declared overfished, abundance of mature males and females is higher in 2002. However, mature and legal abundance in 2002 is only comparable to or lower than the levels estimated for 1999-2001. Estimated abundance of mature-sized males (>112-mm carapace width, CW) and legal males in 2002 is 20 million and 7 million animals, respectively. Those values are comparable to the 2001 estimates. When the stock is above the threshold for a fishery opening under the harvest strategy (see below), ADF&G applies exploitation rates to the estimated abundance of “molting mature males” (defined as all new-shell males >112-mm CW plus 15% of all old-shell males >112-mm CW) and caps the harvested number of “exploitable legal males” (defined as all new-shell legal males plus 32% of all old shell legal males). Due to the aging of the mature and legal male component of the stock, the estimates of molting mature males and exploitable legal males, which discount the contribution of old-shell animals, are both lower in 2002 relative to 2001. Estimated abundance in 2002 of molting mature males is 6.0 million animals (54% of the 2001 estimate); estimated abundance of exploitable legal males is 2.8 million animals (67% of the 2001 estimate). Estimated abundance of mature females in 2002 (18.6 million animals) is down from the 1999 estimate (32.0 million animals), but comparable to that in 2000 (19.4 million animals) and 2001 (20.9 million animals).

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. 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. A mode of small (30-mm CW) juveniles that appeared in the 1999 survey, tracked through the 2001 data as a mode at roughly 50-mm CW data, and has tracked to a mode at roughly 60-65 mm CW in 2002. The amplitude of those modes has decreased from 2001 and it is uncertain how those modes will track, and at what amplitude, into 2003.

**Harvest Strategy:** The Tanner crab fishery has three thresholds against which survey data must be compared (Table 2; ADF&G 1999): one for a fishery opening; one for increasing the exploitation rate on mature males; 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 2002 estimate for Tanner crab females > 79-mm CW is below the threshold at 15.9 million pounds. Hence, the fishery was closed for the 2002 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 ≥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 and prevent exceeding the GHL.

**Bering Sea snow crab** (*Chionoecetes opilio*):

This stock in 2002 is below MSST (460.8 million pounds spawning biomass) with an estimated SB (313 million pounds) that is the fourth lowest on record; only the estimates for 1985, 1986, and 1999 are lower. The SB estimated for 2002 represents a decrease to 55% of the 571 million pounds that was estimated in 2001. Estimated mature male biomass (223 million pounds) decreased to 74% of that estimated for 2001 and estimated mature female biomass (90 million pounds) in 2002 is 34% of the 2001 estimate. The estimated number of mature females (550 million) is the lowest since 1985. This decrease was not expected and is also associated with the unexpected loss in 2002 of promising size classes of males and

females that appeared in the 2000 and 2001 surveys. Total estimated numbers of all males and females  $\geq 40$ -mm CW in 2002 are roughly 1/3 and 1/2, respectively, of the estimates for 2001; the estimate of males  $\geq 40$ -mm CW in 2002 (653 million) is the lowest since 1985. In short, estimates for all sex-size classes – mature and immature – are at depressed levels. Rather than providing an increase, as was expected from the 2000 and 2001 survey data, the estimated spawning biomass in 2002 represents the continuation of an overall decreasing trend since 1991. Although we cannot predict the stock level that will appear in the 2003 survey, this year’s survey data suggests that reductions in spawning biomass, mature male biomass, or exploited legal male abundance to levels below that which would allow for a fishery season for 2004 are entirely possible.

Although both spawning biomass and mature male biomass decreased markedly from the 2001 survey, the estimated abundance of males  $\geq 4$ -in CW has remained nearly constant (78 million animals in 2001 and 76 million animals in 2002). However, the percentage of males  $\geq 4$ -in CW in new-shell condition in the 2002 survey (68%) is higher than that for the previous three years.

### **Harvest Strategy:**

The harvest strategy adopted by the Alaska Board of Fisheries in March 2002 was used to estimate the GHL for 2003. The harvest strategy determines a GHL 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 GHL 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 spawning biomass (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 GHL 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 GHL 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  $GHL_{max}$  is determined by

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

The SB benchmarks, 921.6 and 230.8 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  $\geq 4.0$ -in (102-mm) CW plus a percentage of the estimated abundance of old-shell legal males  $\geq 4.0$ -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  $\geq 4$ -in CW, the targeted number of males  $\geq 4.0$ -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  $\geq 4$ -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  $\geq 4$ -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 (that is, “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 2003 GHF:**

With a SB of 313.3 million pounds a maximum GHF is determined by applying an 11.5% exploitation rate to the biomass of mature males. Estimated mature male biomass for 2002 is 230.4 million pounds. Applying the 11.5% yields a maximum GHF of 25.605 million pounds. Given the estimated abundance of legal males in 2002 (76 million animals) and the relatively low percentage in old-shell condition (32%), the 58% maximum harvest rate on exploitable legal males does not result in a downward adjust from the maximum GHF. Hence the GHF for the 2003 season is 25.605 million pounds.

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

Estimated SB for 2002 (129.9 million pounds) increased by nearly 50% over the 2001 estimate (88.0 million pounds). Rather than representing a true increase in spawning biomass, much of that apparent increase from the 2001 estimate may be attributable to underestimation (in particular, of mature male abundance and biomass) from the 2001 survey data. Estimated SB for 2002 is nearly 50% higher than the  $B_{MSY}$  stock level defined in the FMP (89.6 million pounds) and would have to decrease to almost one-third of its current level in the next year for the stock to be below MSST in 2003. Hence there are no expectations for this stock to approach MSST in the near future.

Length-based analysis estimates indicate that the abundance of the mature portion of the stock has been essentially stable relative to 2001. Much of the mature male and female abundance in 2002 represents an aging cohort that first recruited to mature size classes in 1997 (for females) and 1998 (for males). The

modest recruitment of males and females 90-110-mm carapace length (CL) indicated in the 2001 survey data has tracked well to a 105-125 mm CL size mode for males and a 100-115 mm CL size mode for females in 2002. The 105-125 mm CL size mode for males in 2002 should provide some recruitment to the mature and legal male size classes in 2003, although that will be offset to some degree by natural and fishery mortality. The 90-115 mm CL size mode for females in 2002, however, is fully recruited to the female mature size class and the 2002 size frequency data indicates that there will be poor recruitment to the mature female size class in 2003. Some females from the 70-80 mm CL size class indicated in this year's survey (see below) may recruit to the mature size class in 2003, but that may not be enough to offset natural mortality. Hence some decline in mature-sized females should be expected in 2003, whereas abundance in the mature and legal male size classes may remain stable next year. Although some decline in mature abundance in 2003 would not be surprising, stock levels in 2002 are such that reductions to levels below MSST or the stock thresholds for a fishery opening should not be anticipated in 2003.

There is the indication in the 2002 survey data that a large recruitment to the mature female size class and to the mature male size class could occur in 2-3 and 3-4 years, respectively. That indication is given by a high catch of both males and females with a size distribution centered at roughly 70-mm to 75-mm CL. The estimated abundance for males and females in that size class in 2002 is far greater than that for at least the preceding 8 years. Anticipation of such future recruitment to the mature stock should be tempered by the realization that abundance estimates for smaller sizes classes of king crab can track poorly from year to year and can be poor forecasters of future stock levels. Although it is promising that the catch of small males and females in 2002 occurred at several widely-spaced stations and not in a single tow, it's important to note that more than one-half of the animals in this size class were captured in only two tows. Hence, this size class will need to be tracked for at least the next two years to provide confidence on any projections for recruitment.

In summary, this stock was estimated to be above the stock threshold for a fishery opening. With effective spawning biomass (ESB) estimated as less than 55.0 million pounds, a 10% exploitation rate on mature males and a 6.5-pound average weight for legal males was used to determine the GHL.

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

The 2002 SB estimate from the survey was 18.1 million pounds, a decrease from the 2001 survey estimate of 25.5 million pounds SB. This stock, however, presents particular problems to the NMFS trawl survey in providing reliable levels of precision in stock estimates. The 2002 survey data suggests that the two-fold increase in mature stock between 2000 and 2001 indicated from area-swept estimates was likely due to survey error in 2001. 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, in fact, stable, the actual level at which it is stable is unknown. NMFS estimates for total mature biomass in 2002 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". Although estimates for legal male abundance are essentially unchanged from 2001 to 2002, most of the legals captured during the 2002 survey were post-recruits and, unlike 2001, few sublegal males were captured. It should be noted, however, that only 72 males were captured during the 2002 and 85% of those were produced by only two survey tows.

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. Estimated mature male abundance in 2002 (catch-

survey analysis estimate) is 1.7 million animals. The stock was closed to fishing in 1999, 2000, and 2001 on abundance estimates of 1.6 million, 1.3 million, and 1.8 million mature males, respectively, due to imprecision of abundance estimates and concerns about bycatch of blue king crab.

This fishery will remain closed for the 2002 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 Fishery Conservation and Management 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 2002 survey estimate of SB was 4.5 million pounds, a decrease from the 2001 survey estimate of 7.0 million pounds and below the MSST of 6.6 million pounds SB. Stock abundance is hence in the “overfished” category for the first time. Under the 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). The 2002 catch-survey analysis (CSA) estimate for Pribilof Islands blue king crab > 119-mm CL is 0.338 million crab, therefore the fishery will remain closed in 2002. The fishery was also closed in 1999, 2000, and 2001 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. Only 12 male blue king crab were captured in the Pribilof District during the 2002 survey: one old-shell pre-recruit, two recruit legals, and nine post-recruit legals.

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

The 2002 SB estimate from the survey was 4.7 million pounds, a value below MSST (11.0 million pounds of SB). This stock remains depressed and below MSST for the fourth year in a row. Total mature biomass would need to increase by more than four-fold from the 2002 estimate to 22.0 million pounds for the stock to be considered “rebuilt”; data from the 2002 survey do not provide any expectations for such an increase in the near-term future. Size frequencies of males captured during the 2002 trawl survey give no reason to expect recruitment to the mature or legal male component in the near future; abundance is low for all size classes. Comparison of the 2002 size frequency data with the 1998-2001 data provides

little insight beyond demonstrating the marked decrease in abundance that occurred between 1998 and 1999 and the continued depressed condition of the stock. 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.

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.

The fishery was closed from 1999 through 2001 and will remain closed in 2002. Although the stock is above the threshold for a fishery opening, the GHL 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 scarlet king crab (*Lithodes couesi*); Bering Sea triangle Tanner crab (*Chionoecetes angulatus*); Eastern Aleutian Islands triangle Tanner crab; Eastern Aleutian Islands grooved Tanner crabs (*Chionoecetes tanneri*); Western Aleutian Islands 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 Dutch Harbor red king crab and E. Aleutian Islands Tanner crab.

**Aleutian Islands red king crab** (Adak and Dutch Harbor red king crab stocks) The GHL for the eastern portion (Dutch Harbor stock)

is based on the results of surveys performed by ADF&G on a triennial basis; the most recent survey was performed in 2000. 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 (Adak stock) 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 sign 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 a 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-Semisopchnoi 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 has been set for the 2002-03 season in the Petrel Bank area. Because only relative abundance information is available, the ADF&G will monitor the fishery utilizing inseason CPUE. The management goal is to maintain a fishery CPUE of at least 10-legal crabs per pot. In order to assess red king crab in other portions of the western Aleutian Islands a survey is planned between 172° W long., and 179° W long. during November 2002.

**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
Adak red king	0.5	10/25	1.5
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
Aleutian Is. 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
Aleutian Is. scarlet king	NA	permit	NA
EBS scarlet king	NA	permit	NA
E. Aleutian Is. Tanner	0	closed	0.7
W. Aleutian Is. Tanner	0	closed	0.4
E. Aleutian Is. angulatus	NA	permit	1.0
EBS angulatus	NA	permit	0.1
E. Aleutian Is. tanneri	.05 to 0.2	permit	1.8
EBS tanneri	.05 to 0.2	permit	1.5
W. Aleutian Is. tanneri	NA	permit	0.2

**Norton Sound red king crab:** The Norton Sound red king crab legal male abundance is estimated from the triennial trawl survey. The 1999 ADF&G trawl survey estimated 4.3 million pounds of legal crab, a significant increase from the 1996 survey estimate of 1.6 million pounds of legal male crab. This increase in abundance was the result of strong recruitment over the previous three years. Recruitment is not anticipated to be as strong over the next three years. However, the current biomass is the largest biomass estimate produced from a trawl survey since the commercial fishery began. Only the trawl survey conducted in 1976 produced a larger biomass estimate. The 2002 trawl survey was conducted from July 27 through August 6, 2002. The Norton Sound crab fishery operates in the summer and in the winter. Due to increasing legal male abundance, a harvest rate of 8% was applied to the legal biomass estimated in 1999. The 2002 GHL was 248,000 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 6, 2002. The open access goal was 229,400 lbs, and the harvest was 244,376 lbs. The CDQ portion opened June 15, 2002 and closed June 28, 2002. Catch was estimated at 10,551 pounds. Because the open access harvest exceeded their allocation, the CDQ fishery reopened on August 9, 2002 after the readjusting their allocation. The CDQ fishery closed for the second time on September 3, 2002. Total harvest for the CDQ fisheries was 15,226 pounds. ADF&G has never set a GHL for the winter fishery. The winter season runs Nov 15, 2002 until May 15, 2003.

**Aleutian Islands golden king crab** (Eastern Aleutians (Dutch Harbor) and Adak 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 2000 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 1996-2001 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 2002/2003 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.

**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. ADF&G and industry plan to continue assessment of stock abundance for potential fishery openings.

## 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.

<b>Table 4. MSST, MSY, OY, and the MFMT estimates for BSAI king and Tanner crab stocks. Estimated values are in millions of pounds.</b>				
<b>(NA indicates that insufficient data exists at this time to estimate the value)</b>				
<b>Stock</b>	<b>MSST</b>	<b>MSY</b>	<b>OY range</b>	<b>MFMT</b>
Adak red king	NA	1.5	0 - 1.5	0.2
Bristol Bay red king	44.8	17.9	0 - 17.9	0.2
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
<b>TOTAL king crab</b>		<b>43.9</b>	<b>0 - 43.9</b>	
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
<b>TOTAL Tanner crab</b>		<b>58.0</b>	<b>0 - 58.0</b>	
EBS snow	460.8	276.5	0 - 276.5	0.3
<b>TOTAL snow crab</b>		<b>276.5</b>	<b>0 - 276.5</b>	
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
<b>TOTAL other Tanners</b>		<b>4.8</b>	<b>0 - 4.8</b>	

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 SYs 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 more than one year.

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

**Table 5. 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	20	20	0	20	20	20
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	10	19	19	17	18	17

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 6. 2002/2003 CDQ reserve (in pounds).**

<u>Fishery</u>	<u>CDQ</u>
Bristol Bay red king crab	695,000
Pribilof red & blue king	0
St. Matthew blue king	0
Norton Sound red king	19,800
Tanner crab	0
Snow crab	1,920,000

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 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. 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.

**Table 7: Crab Licenses Limitation Program: number of licenses issued as of September 2002**

Number of crab licenses: 387 (91 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	26	12	38
Aleutian Is. red king	24	16	40
EBS Tanner	238	75	313
Bristol Bay red king	224	79	303
Norton Sound king	59	5	64
Pribilof Is. king	100	39	139
St. Matthew Is. blue king	149	54	200

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

The LLP is still being modified and the implementing regulations will change because of an amendment (Amendment 10) recommended by the Council that included changes to the basic eligibility criteria for crab. Amendment 10 would require recent participation in the BSAI king and Tanner crab fisheries in order to qualify for a license under the crab LLP. The recent participation requirement would apply to the general

licenses only; if a vessel satisfies the recent participation criteria, the owner would receive the original license and all of the species/area endorsements for which it qualified under the original criteria. No new species/area endorsements could be earned during the recent qualification. The Secretary approved Amendment 10, but has yet to implement regulations. The total number of crab licenses will decrease when Amendment 10 is implemented.

**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, a 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.*

**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

*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 harvest up to 10.96% of the regular commercial GHL, which equals 939,842 pounds for the 2002 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 2002 harvest cap for AFA vessels, by crab fishery:**

<u>Fishery</u>	<u>AFA Endorsements</u>	<u>2002 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	939,842 pounds
Snow crab	6	-
Pribilof Is. king	2	NA
St. Matthew Is. blue king	1	NA

**Note:** NA indicates a harvest cap is not applicable because the fishery is closed for 2002.

### Capacity Reduction Program

NMFS is developing a proposed rule to implement a capacity reduction 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 has yet to publish the proposed 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 still hold; and, 4) revoke the vessels' fishing histories upon which NMFS based the licenses to be revoked.