

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

Note that under the process for setting OFLs and ABCs this May SAFE report introduction contains only summary information and recommendations for Chapters 7-10 (stocks with summer fisheries and the Tier 5 stocks).

Recommendations for the remaining 6 stocks (Chapters 1-6) and the full introduction will be prepared for the Final Crab SAFE report in September 2013. Additional recommendations for those stocks based upon the May 2013 Crab Plan Team assessment review are contained in the Crab Plan Team report (prepared for the June 2013 Council meeting briefing materials).

7 Norton Sound Red King Crab

Fishery information relative to OFL setting

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

Data and assessment methodology

Four types of surveys have been conducted periodically during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot, but none of these surveys have been conducted every year. To improve abundance estimates, a length-based model of male crab abundance was previously developed that combines multiple sources of data. A maximum likelihood approach was used to estimate abundance, recruitment, and selectivity and catchability of the commercial pot gear. The model has been updated with data from 2011/12 winter pot survey, 2012 summer commercial fishery, 2012 summer trawl survey, 2011/12 winter commercial and subsistence finalized catch, and the 2011/12 winter commercial and subsistence catch (based on available data). New data on the 2012 summer commercial fishery observer data, and standardized catch CPUE and CV were added. The 1981-85 summer pot survey data were dropped because of the lack of raw data and unverifiable abundance estimates. The current model assumes $M=0.18\text{yr}^{-1}$ for all length classes, except $M=0.68\text{yr}^{-1}$ for the largest ($> 123\text{ mm CL}$) length group.

In March 2012, the Board of Fisheries adopted a revised GHL to increase the maximum harvest rate for legal male biomass. The GHL specifies: (1) 0% harvest rate of legal crab when estimated legal biomass < 1.25 million lbs; (2) $\leq 7\%$ of legal male abundance when the estimated legal biomass falls within the range 1.25-2.0 million lbs; (3) $\leq 13\%$ of legal male abundance when the estimated legal biomass falls within the range 2.0-3.0 million lbs; and (3) $\leq 15\%$ of legal male when estimated legal biomass > 3.0 million lbs.

Stock biomass and recruitment trends

Mature male biomass was estimated to be on an upward trend following a recent low in 1997 and an historic low in 1982 following a crash from the peak biomass in 1977. Model estimated recruitment was weak during the late 1970s and high during the early 1980s with a slight downward trend from 1983 to 1993. Estimated recruitment has been highly variable but on an increasing trend in recent years.

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

The Team recommended Tier 4 stock status for Norton Sound red king crab. The Team selected the S3-1 model run because the Team was not in a position to fully evaluate the S3-6 and S3-7 model runs. The S3-1 model is similar to previously reviewed and adopted models. This model run improves the base model used for the 2012 stock assessment by addressing recommendations from the 2013 Crab Modeling Workshop. This run has maximum effective sample size set at 20, does not use the summer pot data, uses CPUE in standardized form, sets $M=0.18\text{y}^{-1}$ for the first five size classes and fixes M for the largest size class to 0.68y^{-1} , sets Q for the ADFG survey at 1 and estimates Q for the NMFS survey.

Status and catch specifications (million lb.)

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

Status and catch specifications (1000t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2009/10	0.70 ^A	2.64	0.17	0.18	0.22	0.32 ^A	
2010/11	0.71 ^B	2.47	0.18	0.19	0.22	0.33 ^B	
2011/12	0.71 ^C	2.13	0.16	0.18	0.20	0.30 ^C	0.27
2012/13	0.80 ^D	2.08	0.21	0.21	0.21	0.24 ^D	0.22
2013/14	0.93 ^E	2.27				0.26 ^E	0.24

^A-Calculated from the assessment reviewed by the Crab Plan Team in May 2009

^B-Calculated from the assessment reviewed by the Crab Plan Team in May 2010

^C-Calculated from the assessment reviewed by the Crab Plan Team in May 2011

^D-Calculated from the assessment reviewed by the Crab Plan Team in May 2012

^E-Calculated from the assessment reviewed by the Crab Plan Team in May 2013

The maximum permissible ABC would be 0.58 million lb. The CPT recommended an ABC less than the maximum permissible due to potential concerns with model specification, lack of historical bycatch data, and uncertainty in M. The CPT recommended an ABC = 90% of the OFL (10% buffer) of 0.52 million pounds.

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

Additional Plan Team recommendations

The Team recommends shifting the assessment cycle from October to September rather than July to June to allow for summer fishery data to be included in the assessment. This would also allow for stock status determination and OFL and ABC-setting to occur in time for the October Council meeting and prior to the November 15th fishery opening.

8 Aleutian Islands golden king crab

Fishery information relative to OFL setting

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

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

Data and assessment methodology

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

Stock biomass and recruitment trends

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

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

Summary of major changes

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

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

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

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

$$OFL_{2013/14} = (1 + R_{90/91-95/96}) \cdot RET_{85/86-95/96} + BM_{GF,93/94-08/09} = 12,537,757 \text{ lb}$$

where,

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

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

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

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

A – retained catch

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

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

A – retained catch

No overfished determination is possible for this stock given the lack of biomass information. The final 2012/13 total catch relative to the 2012/13 OFL and ABC will be reviewed by the CPT in September 2013 to determine if overfishing occurred.

Additional Plan Team recommendations

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

9 Pribilof District Golden King Crab

Fishery information relative to OFL setting

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

Data and assessment methodology

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

Stock biomass and recruitment trends

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

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

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

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

$$OFL_{TOT,2013} = (1+R_{2001-2010}) * RET_{1993-1998} + BM_{NC,1994-1998} + BM_{GF,92/93-98/99}$$

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

The average of the estimated annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010 is used to estimate bycatch mortality in the directed fishery during 1993–1998 because, whereas there are no data on bycatch for the directed fishery during 1993–1998, there are such data from the directed fishery during 2001–2010 (excluding 2006–2009, when there was no

fishery effort).

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

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

Status and catch specifications (millions lb)

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

A= Retained-catch OFL
Conf. = confidential

Status and catch specifications (t)

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

A= Retained-catch OFL
Conf. = confidential

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

10 Adak red king crab, Aleutian Islands

Fishery information relative to OFL and ABC setting

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

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

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

Data and assessment methodology

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

Stock biomass and recruitment trends

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

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

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

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

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

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

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

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

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

Status and catch specifications (t) of Adak RKC.

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

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

No overfished determination is possible for this stock given the lack of biomass information. Total catch was 0.002 million lb, below the OFL in 2011/12, therefore overfishing did not occur.

Additional Plan Team discussion

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