Pribilof Islands Golden King Crab

2008 Crab SAFE Report Chapter

Douglas Pengilly, ADF&G, Kodiak, 20 August 2008

Executive Summary

Stock: Golden king crab/Pribilof Islands

Catches: The domestic fishery developed in 1982. Since then, participation in the fishery has been sporadic and annually retained catch has been variable, from 0 pounds in the seven years that no vessels participated (1984, 1986, 1990–1992, 2006–2007) up to a maximum of 342-thousand pounds in 1995, when seven vessels made landings. The fishery is not rationalized and has been managed towards a GHL of 150-thousand pounds since 2000. Non-retained bycatch can occur in the directed fishery, as well as in the eastern Bering Sea snow crab fishery, the Bering Sea grooved Tanner crab fishery, and Bering Sea groundfish fisheries. Estimated weight of non-retained bycatch during crab fisheries has ranged from 19-thousand to 49-thousand pounds annually during 2000–2005, whereas discarded bycatch during Bering Sea groundfish fisheries has ranged from 700 to 3,000 pounds annually during 2003–2007.

Data and assessment: There is no survey and no assessment model in use for this stock. Available data are from fish tickets (including retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date), size-frequency data from samples of landed crabs, at-sea observer data from pot lifts sampled during crab fisheries (including date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc.), and data on bycatch during groundfish fisheries. However, much of the directed fishery data are confidential due to low numbers of participating vessels or processors.

Unresolved problems and major uncertainties: Stock abundance and size composition within the stock is unknown and has not been estimated; knowledge on stock distribution is poor.

Reference points: The assessment author recommended that this stock be managed as a Tier 5 stock at the May 2008 Crab Plan Team (CPT) meeting; the CPT (at their May 2008 meeting) and the SSC (at their June 2008 meeting) concurred with that recommendation. For Tier 5 stocks BMSY and MSST are not estimated and OFL is defined as "the average retained catch from a time period determined to be representative of the production potential of the stock" (NPFMC 2007). The assessment author made no recommendation on the OFL to the CPT at the May 2008 meeting, but the CPT recommended defining the OFL as the average retained catch during the time period 1993–1999, which is equal to 174,206 pounds (retained catch). The SSC concurred with that recommendation at their June 2008 meeting.

Stock biomass: Estimates of stock biomass are not available.

Recruitment: Between 2002 and 2005, the average size of legal male golden king crab taken during the commercial fishery has decreased while CPUE has increased, suggesting that strong recruitment to the legal male portion of the stock has recently occurred.

Exploitation status: Estimates of fishing mortality are not available. No landings were reported for the directed fishery in 2006 and 2007.

Management performance: The fishery has been managed with a GHL of 150,000 pounds since 2000. During 2000–2002 the retained catch was within 15% of the GHL.

Forecasts: No forecasts of catch and biomass are available.

Decision table: Not available.

Recommendations: This stock was recommended for management as a Tier 5 stock by the assessment author and the CPT in May 2008; the SSC concurred in June 2008. OFL was recommended as 174,206 lbs of retained catch (equal to the average retained catch during the time period, 1993-1999) by the CPT in May 2008 with concurrence of SSC in June 2008. The SSC recommended in June 2008 that future assessments provide data for considering a total-catch OFL (as opposed to a retained-catch OFL).

Responses to SSC Comments

At their June 2008 meeting, the SSC reviewed the May 2008 draft of this SAFE chapter and the recommendations made in May 2008 by the assessment author and the CPT. Recommendations from the SSC specific to management of this stock or to this SAFE chapter are listed below followed by the response from the author.

1. Manage this stock as a Tier 5 stock.
    - The author agrees with this recommendation; it follows the recommendation of the CPT at their May 2008 meeting.
2. OFL=174,206 lbs of retained catch (equal to the average retained catch during the time period, 1993-1999).
    - The author made no recommendation on the OFL to the CPT at their May 2008 meeting; this recommendation by the SSC follows the May 2008 recommendation of the CPT exactly.
3. Include data to support a total-catch OFL for inclusion in the next year's assessment.
    - The draft of this chapter in the May 2008 Draft Crab SAFE did include data on bycatch from crab and groundfish fisheries. In next year' s report the author will consolidate tables on catch and bycatch to allow for easier inspection of data and consideration of a total catch OFL for this stock. However, it should be noted that there are only two years (2001 and 2002) that estimates of retained catch and bycatch are both available and non-confidential. Consideration of a total-catch OFL for this stock will also involve consideration of the variety of fisheries in which bycatch can occur and the lack of estimates of the handling mortality rates for golden king crabs in those fisheries.

Recommendations from the SSC on assessments in general that have application to this SAFE chapter are listed below followed by the response from the author.

4. Omit sections from chapter that are not relevant to this stock.
    - Sections that are not relevant to this stock and chapter have been removed (e.g., "Summary of Major Changes," "Model Structure," "Parameters Estimated Conditionally," "Model Evaluation," etc) and section/sub-section headings have been reworded as needed to be more appropriate to this chapter.
5. Provide a range of alternative time periods for the CPT and SSC to consider when setting OFLs.
    - The number of years with fishery data that are not confidential representing seasons with unconstrained fishing (i.e., no GHL) is limited. The average retained catch during a

period limited to fishing seasons that were not constrained by a GHL and during two periods that include seasons that were constrained by a GHL are presented in this draft for examination.

6. Clearly articulate the rationale for selecting a specific time period for establishing an OFL based on catch histories; the default should be the full time series for which data are available, unless compelling reasons exist to choose a different period.
    - Can do. Will do. Did.
7. To the extent possible, bycatch information should be provided in the SAFE in order to move stocks from "retained catch OFL" to "total catch OFL".
    - See response to SSC comment #3, above.
8. Expand ecosystem considerations section to include information on prey and predator composition in a consistent format (e.g., pie charts); a discussion of seabird predation would be a useful addition.
    - This chapter contains no section on ecosystem considerations. Realistically, a section on ecosystem considerations section for this unsurveyed, remote, and poorly-known stock is a long ways away. Presently, priority effort should be towards gaining and presenting data on stock distribution, abundance, and dynamics. However, any information provided to the author on ecosystem considerations (e.g., predators and prey) for this stock would be included in future chapters.
9. Include figures showing available time series of catch (in addition to tables) to facilitate comparisons of appropriate time periods.
    - A graph of the time series of retained catch has been added to this draft.

Introduction

Scientific name: *Lithodes aequispinus* J. E. Benedict, 1895

Description of general distribution
General distribution of golden king crabs is summarized by NMFS (2004):

> Golden king crab, also called brown king crab, range from Japan to British Columbia. In the BSAI, golden king crab are found at depths from 200 m to 1,000 m, generally in high-relief habitat such as inter-island passes (page 3-34).

> Golden, or brown, king crab occur from the Japan Sea to the northern Bering Sea (ca. 61° N latitude), around the Aleutian Islands, on various sea mounts, and as far south as northern British Columbia (Alice Arm) (Jewett et al. 1985). They are typically found on the continental slope at depths of 300-1,000 m on extremely rough bottom. They are frequently found on coral bottom (page 3-43).

Commercial fishing for golden king crabs in the Bering Sea typically occurs at depths of 100–300 fathoms (183–549 m; Neufeld and Barnard 2003; Barnard and Burt 2004, 2006; Burt and Barnard 2005, 2006); average depth of pots fished in the Pribilof golden king crab fishery during the 2001 fishery (the most recently prosecuted fishery for which fishery data are not confidential) was 214 fathoms (391 m; Table 1).

Description of management units and spatial and/or seasonal management measures
The Pribilof Islands king crab stock boundary is defined by the boundaries of the Pribilof District of Registration Area Q (Figure 1). Bowers et al. (2008, page 79–80) define those boundaries:

> The Bering Sea king crab Registration Area Q has as its southern boundary a line from 54° 36' N lat., 168° W long., to 54° 36' N lat., 171° W long., to 55° 30' N lat., 171° W. long., to 55° 30' N lat., 173° 30' E long., as its northern boundary the latitude of Point Hope (68° 21' N lat.), as its eastern boundary a line from 54° 36' N lat., 168° W long., to 58° 39' N lat., 168° W long., to Cape Newenham (58° 39' N lat.), and as its western boundary the United States-Russia Maritime Boundary Line of 1991. Area Q is divided into the Pribilof District, which includes waters south of Cape Newenham, and the Northern District, which incorporates all waters north of Cape Newenham.

By State of Alaska regulation (5 AAC 34.910 (b) (3)), male golden king crab may be taken from January 1 through December 31 only under conditions of a permit issued by the commissioner.

Evidence of stock structure

We are aware of no data for evaluating stock structure within this stock.

Description of life history characteristics relevant to stock assessments

The following review of molt timing and reproductive cycle of golden king crabs is adapted from Watson et al. (2002):

> Unlike red king crabs, golden king crabs may have an asynchronous molting cycle (McBride et al. 1982, Otto and Cummiskey 1985, Sloan 1985, Blau and Pengilly 1994). In a sample of male golden king crabs 95–155-mm CL and female golden king crabs 104–157-mm CL collected from Prince William Sound and held in seawater tanks, Paul and Paul (2000) observed molting in every month of the year, although the highest frequency of molting occurred during May–October. Watson et al. (2002) estimated that only 50% of 139-mm CL male golden king crabs in the eastern Aleutian Islands molt annually and that the intermolt period for males ≥150-mm CL averages >1 year.
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> Female lithodids molt before copulation and egg extrusion (Nyblade 1987). From their observations on embryo development in golden king crabs, Otto and Cummiskey's (1985) suggested that time between successive ovipositions was roughly twice that of embryo development and that spawning and molting of mature females occurs approximately every two years. Sloan (1985) also suggested a reproductive cycle >1 year with a protracted barren phase for female golden king crabs. Data from tagging studies on female golden king crabs in the Aleutian Islands are generally consistent with a molt period for mature females of ≤2 years and that females carry embryos for less than two years with a prolonged period in which they remain in barren condition (Watson et al 2002). From laboratory studies of golden king crabs collected from Prince William Sound, Paul and Paul (2001c) estimated a 20-month reproductive cycle with a 12-month clutch brooding period.
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> Numerous observations on clutch and embryo condition of mature female golden king crabs captured during surveys have been consistent with asynchronous, aseasonal reproduction (Otto and Cummiskey 1985, Hiramoto 1985, Sloan 1985, Somerton and Otto 1986, Blau and Pengilly 1994, Blau et al. 1998, Watson et al. 2002). Based on data from Japan (Hiramoto and Sato 1970), McBride et al. (1982) suggested that spawning of golden king crab in the Bering Sea and Aleutian Islands occurs predominately during the summer and fall.

The success of asynchronous and aseasonal spawning of golden king crabs may be facilitated by fully lecithotrophic larval development (i.e., the larvae can develop successfully to juvenile crabs without eating; Shirley and Zhou 1997).

Note that asynchronous, aseasonal molting and the prolonged intermolt period (>1 year) of mature female and the larger male golden king crabs likely makes scoring shell conditions very difficult and especially difficult to relate to "time post-molt," posing problems for inclusion of shell condition data into assessment models.

Fishery

Description of the directed fishery

Only males of a minimum legal size may be retained by the Pribilof Islands golden king crab fishery. By State of Alaska regulation (5 AAC 34.920 (a)), the minimum legal size limit is 5.5-inches (140 mm) carapace width (CW), including spines. A carapace length (CL) ≥124 mm is used to identify legal-size males when CW measurements are not available (Table 3-5 in NPFMC 2007).

Golden king crabs may be commercially fished only with king crab pots (as defined in 5 AAC 34.050). Pots used to fish for golden king crabs in the Pribilof Islands must have at least four escape rings of no less than five and one-half inches inside diameter installed on the vertical plane or at least one-third of one vertical surface of the pot composed of not less than nine-inch stretched mesh webbing to permit escapement of undersized golden king crabs (5 AAC 34.925 (c)).

The following historical review of the Pribilof District golden king crab fishery is from Bowers et al. (2008, pages 84–85):

> Golden king crabs *Lithodes aequispina* are found in commercial concentrations in only a few deep canyons in the Bering Sea and have never sustained large harvests when compared to other Bering Sea king crab fisheries. As with many other crab fisheries in the Bering Sea, the fishery for golden king crabs was pioneered by foreign fishing fleets. A domestic fishery developed during the 1982/83 season after the Alaska Board of Fisheries (BOF) directed ADF&G to regulate fishing for golden king crabs in the Pribilof District by emergency order. By the 1984 season, BOF directed ADF&G to manage the Area Q golden king crab fishery under authority of a commissioner's permit that allowed the fishery to develop and expand into new areas.
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> The first domestic harvest of golden king crabs in the Bering Sea occurred in June of 1982 when two vessels fished in the Pribilof District. Effort increased to 10 vessels during the following season with a harvest of nearly 70,000 pounds. The size limit for golden king crabs in the Pribilof District was reduced from six and one-half inches to five and one-half inches in 1983. Subsequently, effort in the Pribilof District peaked during the 1983/84 season when 50 vessels harvested 856,000 pounds of golden king crabs. From 1984 to 1992, no more than two vessels participated each year in the fishery. Since the 1983/84 season, harvest has not exceeded 350,000 pounds annually. The Pribilof District golden king crab fishery reached a maximum exvessel value of just over $1.1 million in 1995, and the highest price fishers received per pound was $3.99 in 1994. During the last nine years in the Pribilof District fishery an average of five vessels have annually harvested an average of 166,000 pounds. CPUE has averaged seven legal crabs per pot lift with an average weight of 4.0 pounds. Most harvest in the Pribilof District has occurred in the area immediately to the south of the Pribilof Islands.

At the March 1993 meeting, BOF developed pot limits for all king crab fisheries in the Bering Sea. Current pot limits in the Pribilof District are set at 40 pots for vessels 125 feet or less in length and 50 pots for vessels greater than 125 feet in length.
In 2000, the Pribilof District golden king crab fishery opened with a GHL of 150,000 pounds, which was 50,000 pounds less than the 1999 harvest level. This adjustment better complies with guidelines outlined in the FMP for the king and Tanner crab fisheries of the Bering Sea and Aleutian Islands and is based on the average harvest from 1983 to 1997. Seven vessels harvested 127,000 pounds in 2000. The GHL was not reached; thus the fishery remained open until the end of the year. In 2001, six vessels harvested 146,000 pounds and the fishery was closed by emergency order.

The golden king crab fishery in the Bering Sea is managed using inseason catch reports provided by processors and observers. Fishing is restricted to depths of 100 fathoms or greater. Starting in 2001, 100% observer coverage was required for each vessel registered for the fishery to provide fishery and biological data that has not previously been available. In addition, vessel logbooks issued with the commissioner's permit provide location of fishing operations, effort, and estimates of bycatch that supplement data collected by observers. Primary bycatch species include non-retained golden king crabs, Pacific halibut *Hippoglossus stenolepis*, Pacific cod *Gadus macrocephalus* and snow crabs.

The 2002 fishery opened January 1 with a GHL of 150,000 pounds, and closed by emergency order on May 14. The total harvest was 150,434 pounds. CPUE averaged six legal crabs per pot lift, a decrease from the CPUE of eight legal crabs per pot during the 2001 fishery. Landed crabs averaged 4.3 pounds per crab, the same as the 2001 season. The 2002 Pribilof District golden king crab fishery had a total fishery value of $438,000, which was $9,000 more than the 2001 fishery value.

The 2003 Pribilof District golden king crab fishery opened on January 1 with a GHL of 150,000 pounds. Three vessels registered for the fishery and began fishing in late March. A fourth vessel registered in April but did not fish. Because only two processors participated in the fishery, most harvest information is confidential. The majority of the harvest in 2003 occurred south of Saint George Island near Pibilof Canyon.

Five vessels registered for the 2004 Pribilof District golden king crab fishery. Fishing effort began in late February and the fishery was closed by emergency order on March 12. Most of the 2004 harvest information is confidential because only two processors purchased the harvest. Catch rates during the 2004 fishery were among the highest on record and the fishery was the shortest ever at approximately three weeks in duration. Most of the 2004 harvest occurred immediately to the south of Saint George Island in the vicinity of the Pribilof Canyon.

Four vessels participated in the 2005 Pribilof District golden king crab fishery, however harvest information is confidential because only two processors purchased the harvest. The entire GHL was not taken in 2005, therefore the fishery was open until December 31, 2005.

No vessels registered to fish for Pribilof Islands golden king in 2006 and 2007.

The Pribilof Islands golden king crab fishery is not included in the Crab Rationalization program.

Information on bycatch and discards

Information on bycatch and discards during the Pribilof Islands golden king crab fishery and other Bering Sea crab fisheries is obtained by observers deployed on fishing vessels by the State of Alaska shellfish observer program (Schwenzfeier et al. 2008). 2001 was the first year observers were deployed in Bering Sea golden king crab fisheries (Neufeld and Barnard 2003) and 100% observer coverage is required in this fishery (Scwhenzfeier et al. 2008). A summary of the information obtained by observers on bycatch and discards during the Pribilof Islands golden king crab fishery is provided in annual reports (e.g., Barnard and Burt 2006); however, much of the data on this fishery in those reports are confidential due to low participation of vessels or processors. Estimates of bycatch of golden king crabs in reporting areas 513, 517, and 521 provided by NMFS (summary of the data provided by J. Mondragon, NMFS-Alaska Region Office, 31 March 2008) are used to estimate the bycatch of the Pribilof Islands stock.

Summary of historical catch distributions

A total catch weight (retained catch plus handling mortality of discards) was not estimated because of the variety of fisheries in which bycatch can occur and the lack of accepted handling mortality rates for golden king crabs in those fisheries. Catch data that includes estimates of both the retained catch and the discarded bycatch of Pribilof Islands golden king crabs are limited to only the few recent years that observers were required during the directed fishery and to those years that the directed fishery data are not confidential. Table 2a provides the time series of GHLs, weight of the retained catch during the directed fishery, and estimated weight of discarded bycatch during crab fisheries for 2001–2005. Most of the bycatch of Pribilof Islands golden king crabs occurs during the directed fishery, when prosecuted. Table 2b provides estimates of golden king crab bycatch during groundfish fisheries in reporting area 513, 517, and 521 during 2003–2007. Weight of discarded bycatch during groundfish fisheries averages about 4% of the weight of the discarded bycatch during crab fisheries.

The actual retained catch and GHL for the Pribilof Islands golden king crab fishery for 2000–2002 is compared graphically in Figure 2; in other years there was either no GHL established or the retained catch data are confidential. Over the period 2000–2002 the average retained catch has been as much as 15% below the GHL (2000) and as much as 0.3% above the GHL (2002).

Table 3 provides the longer history of retained-catch weights during 1981–2007; see Figure 3 for a graphical presentation.

Data

Survey data

There is no survey for Pribilof Islands golden king crabs.

Total catch

Harvest history for the Pribilof Islands golden king crab fishery (number of vessels, number of landings, number of crabs and pounds of crabs landed, pot lifts, fishery catch per unit effort, and average weight of landed crabs, average carapace length of landed crabs) by fishery season from the 1981/82 season through 2006 is provided in Table 3.

Collection of observer data on size distribution and estimated catch numbers of non-retained catch collected began in the Pribilof Islands golden king crab fishery in 2001. Those data, combined with observer data from the the eastern Bering sea snow crab fishery and the Bering sea grooved Tanner crab fishery were used to estimate the annual weight of non-retained catch of golden king crabs during commercial crab fisheries from 2001–2005 (provided by D. Barnard, ADF&G, 20 July 2007).

Catch at age or catch at length
The size (carapace length, CL, mm) distribution of retained legal male golden king crabs from the Pribilof Islands golden king crab fishery sampled prior to processing at-sea and dockside by observers and ADF&G catch samplers during 2002 is provided in Table 4. 2002 is the only year for which these data are not confidential and which can be separated from catch samples from the St. Matthew golden king crab fishery.

Fishing effort
The time series of fishing effort (pot lifts) are provided in Table 3.

Sample sizes for length samples
Sample size for the length sample from the 2002 fishery is provided in Table 4.

Independently-Estimated Life-History Parameters

Length at age
There is no length-at-age relationship established for golden king crab.

Growth per molt
We are not aware of data on growth per molt of Pribilof Islands golden king crabs. Growth per molt of juvenile golden king crabs, 2–35-mm CL, collected from Prince William Sound have been observed in a laboratory setting and equations describing the increase in CL and intermolt period were estimated from those observations (Paul and Paul 2001a); those results are not provided here.

Weight at length or weight at age
Parameters for estimating weight (g) from carapace length (CL, mm) of Pribolof Islands golden king crabs are provided in Table 5.

Natural mortality rate:
The default natural mortality rate assumed for king crab species by NPFMC (2007) is M =0.18. There are no estimates of natural mortality pertaining specifically to Pribilof Islands golden king crabs. Using data on tag recoveries of golden king crabs in the Aleutian Islands commercial fisheries, Siddeek et al (2002) provide an estimate of M = 0.38 as the most plausible among various estimates.

Parameters governing the maturity schedule:

- Males: Carapace length (CL) at maturity for male golden king crabs in the Bering Sea has been estimated by Otto and Cummiskey (1985) using Somerton's (1980) method of estimating the intersection point of lines estimated to fit two phases of growth in height of the right chela relative to CL:
    - Central Bering Sea (north of 54°14' N and south of 58°31' Nlatitude): 107.0-mm CL (SD = 4.6 mm)

  Paul and Paul (2001b) studied mating success of male golden king crabs collected from Prince William Sound. The two smallest males studied (95-mm CL and 99-mm CL) could not induce females to ovulate. The smallest male examined that fertilized a female (a 101-mm CL male) fertilized a clutch in which only 71% of the eggs initiated division. In almost all of the clutches fertilized by hardshell males ≥107-mm CL, ≥90% of the eggs initiated division.

- Females: Otto and Cummiskey (1985) estimated CL at maturity for female golden king crabs in three areas within the Aleutian Islands Area as the estimated CL at which 50% of females are mature (SM50; as evidenced by presence or absence of clutches of eggs):
    - Central Bering Sea (north of 54°14' N and south of 58° 31' N latitude): 99.9-mm CL (SD = 0.2 mm)

Background and Analysis for Tier-5 OFL and Recommended OFL

No assessment model for the Pribilof Islands golden king crab stock exists and none is in development; hence this stock is recommended to be managed as a Tier 5 stock. For Tier 5 stocks only an OFL is estimated, because it is not possible to estimate MSST without an estimate of biomass, and "the OFL represents the average retained catch from a time period determined to be representative of the production potential of the stock" (NPFMC 2007). Additionally, NPFMC (2007) states that for estimating the OFL of Tier 5 stocks, "The time period selected for computing the average catch, hence the OFL, should be based on the best scientific information available and provide the required risk aversion for stock conservation and utilization goals." This section provides background for considering the appropriate time period for estimating OFL.

Time periods for averaging the retained catch.
NPFMC (2007) suggested using the average retained catch over the years 1993 to 1999 as the estimated OFL for Pribilof Islands golden king crab. Years post-1984 were chosen based on an assumed 8-year lag between hatching during the 1976/77 "regime shift" and growth to legal size. With regard to excluding data from years 1985 to 1992 and years after 1999, NPFMC (2007) states, "The excluded years are from 1985 to 1992 and from 2000 to 2005 for Pribilof Islands golden king crab when the fishing effort was less than 10% of the average or the GHL was set below the previous average catch."

With regard to the period 1985–1992, it should also be noted that for four of those years (1985, 1987–1989) the retained catch is confidential and for the other four years (1986, 1990–1992) there were no landings from the fishery (Table 3, Figure 3). With regard to using years after 1999, it should be noted that for three of the years (2003–2005) the retained catch is confidential, for two of the years (2006 and 2007) there were no landings from the fishery, and for the remaining three years (2000–2002) the retained catch is from fisheries which were managed for the first time to a GHL of 150,000 pounds.

Recent observations on stock status
Bowers et al. (2008, pages 85–86) offered the following recent observations on stock status:

> The golden king crab population in the Pribilof District is not surveyed and no estimate of abundance has been made. There are no plans to survey this population, nor has a formal harvest strategy been developed. Population size is believed to be limited by the amount of available habitat in the Pribilof District. The fishery is currently managed using a GHL set from the long-term average harvest. Data collected by onboard observers in conjunction with data from the landed catch are used to annually evaluate the status of the stock. Since 2002, the average size of legal male golden king crab taken during the commercial fishery has decreased while CPUE has increased suggesting that strong recruitment to the legal male portion of the stock has recently occurred.

Computations of average retained catch as estimate of OFL.

In 10 of the 12 seasons prior to the 1993 season, there was either no fishery effort (five seasons) or the fishery data are confidential (five seasons). Hence the author recommends that years prior to the 1993 fishery season not be included in any computation of average retained-catch weight as a measure of OFL. Likewise, in the five completed seasons since the 2002, fishery data for three of the seasons are confidential and there was no fishery effort in the remaining two seasons. Hence the author recommends that years after the 2002 fishery season not be included in any computation of average retained catch weight as a measure of OFL. Average retained catch 1993–2002 was 164,297 pounds. The 1993–2002 period includes the 2000–2002 seasons, which were each constrained by a GHL of 150,000 pounds. The average retained catch during the "pre-GHL" seasons of 1993–1999 was 174,206 pounds. The average retained catch during the 2000–2002 seasons, which were constrained by the GHL of 150,000 pounds, was 141,176 pounds. See Table 6.

Recommended OFL**.**

- The assessment author made no recommendation on the OFL for this stock to the CPT at their May 2008 meeting.
- At their May 2008 meeting, the CPT recommended that the OFL be set as a retained catch of 174,206 pounds (the average annual retained catch during the 1993–1999 seasons). The recommendation was based on the 1993–1999 seasons representing a period that the fishery was developed but unconstrained by a GHL.
- At their June 2008 meeting, the SSC concurred with the CPT's recommendation and recommended that the OFL be set as a retained catch of 174,206 pounds. The recommendation was based on the 1993–1999 seasons representing a period that the fishery was developed but unconstrained by a GHL.

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Table 1. Mean CPUE by depth for 1,497 bycatch samples taken during the 2002 Pribilof Islands golden king crab fishery. (from Barnard and Burt 2004).

Depth	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
101-110	0.2	0	0	0	0
111-120	0.5	0.6	0.3	0	0.9
121-130	1.4	3.4	0.1	0	3.6
131-140	4.9	5.7	0.5	0.1	6.3
141-150	10.8	5.8	1.3	0.6	7.7
151-160	10.8	6.6	2.6	1.0	10.2
161-170	7.3	8.7	2.7	1.1	12.6
171-180	4.9	8.1	4.7	3.4	16.3
181-190	9.6	10.4	10.3	5.6	26.3
191-200	4.2	8.6	8.3	4.0	20.8
201-210	3.1	11.2	3.6	4.2	19.0
211-220	1.9	10.2	1.8	2.1	14.1
221-230	2.1	8.0	1.3	0.9	10.2
231-240	1.0	6.3	1.3	1.1	8.7
241-250	2.5	4.4	1.4	0.6	6.4
251-260	2.2	6.8	2.1	1.3	10.2
261-270	5.1	6.1	2.9	2.5	11.4
271-280	5.3	5.9	3.9	3.4	13.2
281-290	5.5	7.2	2.1	1.5	10.7
291-300	2.7	6.9	1.2	1.1	9.2
301-310	2.7	11.4	3.3	2.1	16.8
311-320	3.6	11.3	2.2	0.6	14.2
321-330	3.4	10.2	1.9	0.4	12.5
331-340	3.6	8.9	1.6	0.4	10.9
341-350	0.1	0	2.0	0	2.0
351-360	0.3	0.3	0.3	0	0.5
361-370	0.1	0	0	0	0
371-380	0.1	0	0	0	0

Table 2a. Annual guideline harvest level (GHL) for retained catch (pounds), actual retained catch (pounds), and estimated non-retained discards (pounds) for the Pribilof Islands golden king crab fishery, 2001–2005. There were no landings of Pribilof Islands golden king crab during 2006–2007. Non-retained catch includes bycatch during the Pribilof Islands golden king crab fishery, the eastern Bering Sea snow crab fishery, and the Bering Sea grooved Tanner crab fishery (bycatch weight estimates were provided by D. Barnard, ADF&G, 20 July 2007).

Year	GHL	Retained catch	Non-retained discards
2001	150,000	145,876	42,054
2002	150,000	150,434	42,223
2003	150,000	Confidential	49,118
2004	150,000	Confidential	30,266
2005	150,000	Confidential	18,659

Table 2b. Estimated annual weight (pounds) of discarded bycatch of golden king crabs (all sizes, males and females) during groundfish fisheries (all gear types and fisheries pooled) in reporting areas 513, 517, and 521, 2003–2007 (summary of the data provided by J. Mondragon, NMFS-Alaska Region Office, 31 March 2008).

Year	513	517	521	Total
2003	12	988	145	1,144
2004	1	605	93	699
2005	4	365	601	970
2006	1	2,762	204	2,968
2007	25	1,887	251	2,162
Average	9	1,321	259	1,589

Table 3. Harvest history for the Pribilof Islands golden king crab fishery from the 1981/82 season through the 2006; no effort and landings occurred in 2007.

	Number of					Average			
Season	Vessels	Landings	Crabs[a]	Pots lifted	Harvest[a,b]	Weight[b]	CPUE[c]	Length[d]	Deadloss[b]
1981/82	2				CONFIDENTIAL				
1982/83	10	19	15,330	5,252	69,970	4.6	3	151	570
1983/84	50	115	253,162	26,035	856,475	3.4	10	127	20,041
1984	0				NO LANDINGS				
1985	1				CONFIDENTIAL				
1986	0				NO LANDINGS				
1987	1				CONFIDENTIAL				
1988	2				CONFIDENTIAL				
1989	2				CONFIDENTIAL				
1990	0				NO LANDINGS				
1991	0				NO LANDINGS				
1992	0				NO LANDINGS				
1993	5	15	17,643	15,395	67,458	3.8	1	NA	0
1994	3	5	21,477	1,845	88,985	4.1	12	NA	730
1995	7	22	82,489	9,551	341,908	4.1	9	NA	716
1996	6	32	91,947	9,952	329,009	3.6	9	NA	3,570
1997	7	23	43,305	4,673	179,249	4.1	9	NA	5,554
1998	3	9	9,205	1,530	35,722	3.9	6	NA	474
1999	3	9	44,098	2,995	177,108	4.0	15	NA	319
2000	7	19	29,145	5,450	127,217	4.4	5	NA	4,599
2001	6	14	33,723	4,262	145,876	4.3	8	143	8,227
2002	8	20	34,860	5,279	150,434	4.3	6	144	8,984
2003	3				CONFIDENTIAL				
2004	5				CONFIDENTIAL				
2005	4				CONFIDENTIAL				
2006	0				NO LANDINGS				

[a]Deadloss included.

[b]In pounds.

[c]Number of legal crabs per pot lift.

[d]Carapace length in millimeters.

NA = Not available.

Confidential = Less than three vessels or processors participated in the fishery.

Table 4. Carapace length (CL, mm) frequency distribution from biological measurements of retained golden king crabs sampled by season during the 2002 Pribilof Islands golden king crab fishery (data from ADF&G shellfish observer database, Kodiak, April 2008).

CL (mm)	Count
116	1
117	0
118	1
119	1
120	1
121	2
122	5
123	4
124	11
125	11
126	18
127	13
128	24
129	12
130	22
131	15
132	22
133	18
134	29
135	32
136	18
137	25
138	29
139	20
140	33
141	21
142	33
143	26
144	29
145	23
146	18
147	20
148	20
149	18
150	30
151	10
152	21
153	19
154	18
155	15
156	14
157	14
158	18
159	14
160	11
161	12
162	5
163	12
164	8
165	12
166	10
167	10
168	12
169	3
170	9
171	1
172	5
173	4
174	3
175	1
176	0
177	2
178	1
179	0
180	2
181	0
182	0
183	0
184	0
185	0
186	0
187	1
Total	872

Table 5. Estimated parameters (A and B) for estimating weight (g) from carapace length (CL, mm) of male and ovigerous female golden king crabs according to the equation, Weight = $A*CL^B$ (from Table 3-5, NPFMC 2007).

Parameter	Males	Ovigerous females
A	0.0002988	0.001424
B	3.135	2.781

Table 6. Average annual retained catch (pounds) in the Pribilof Islands golden king crab fishery during the periods 1993–2002, 1993–1999, and 2000–2002.

Time Period	Average retained catch (pounds)
1993–2002[a]	164,297
1993–1999	174,206
2000–2002[a]	141,176

a. The 2000–2002 seasons were constrained by a GHL of 150,000 pounds.

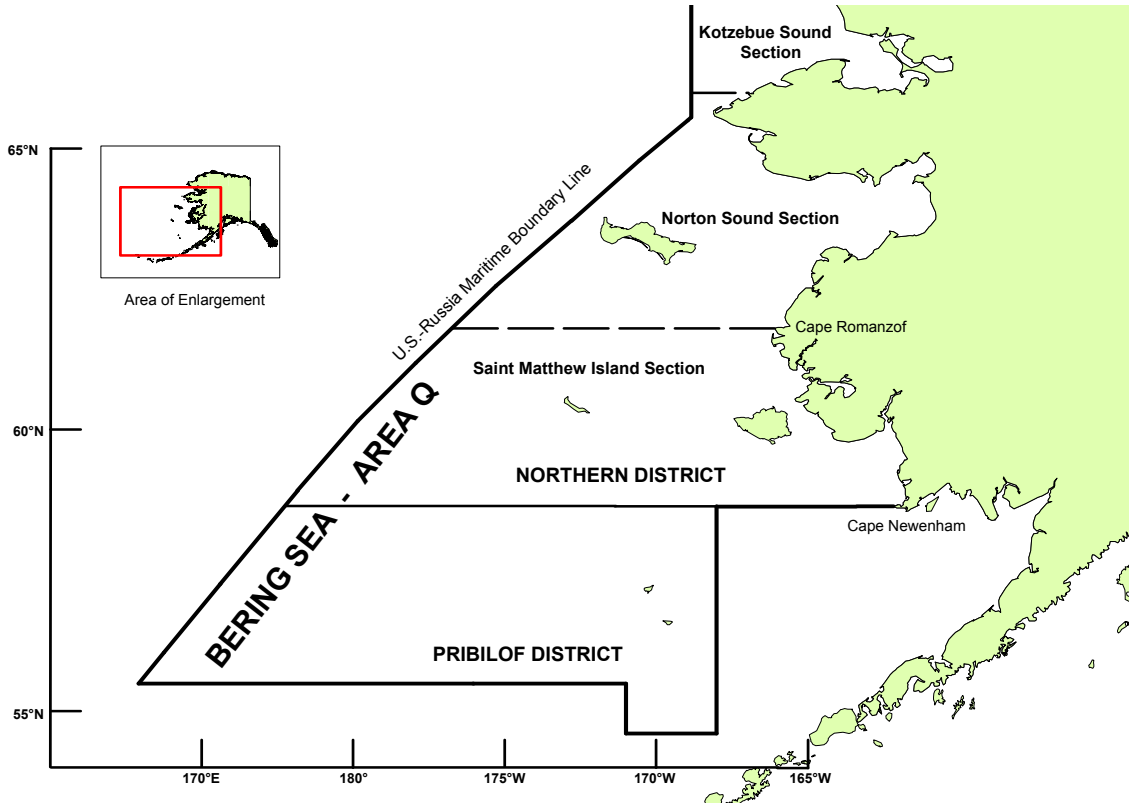

Figure 1. King crab Registration Area Q (Bering Sea) (from Bowers et al. 2008).

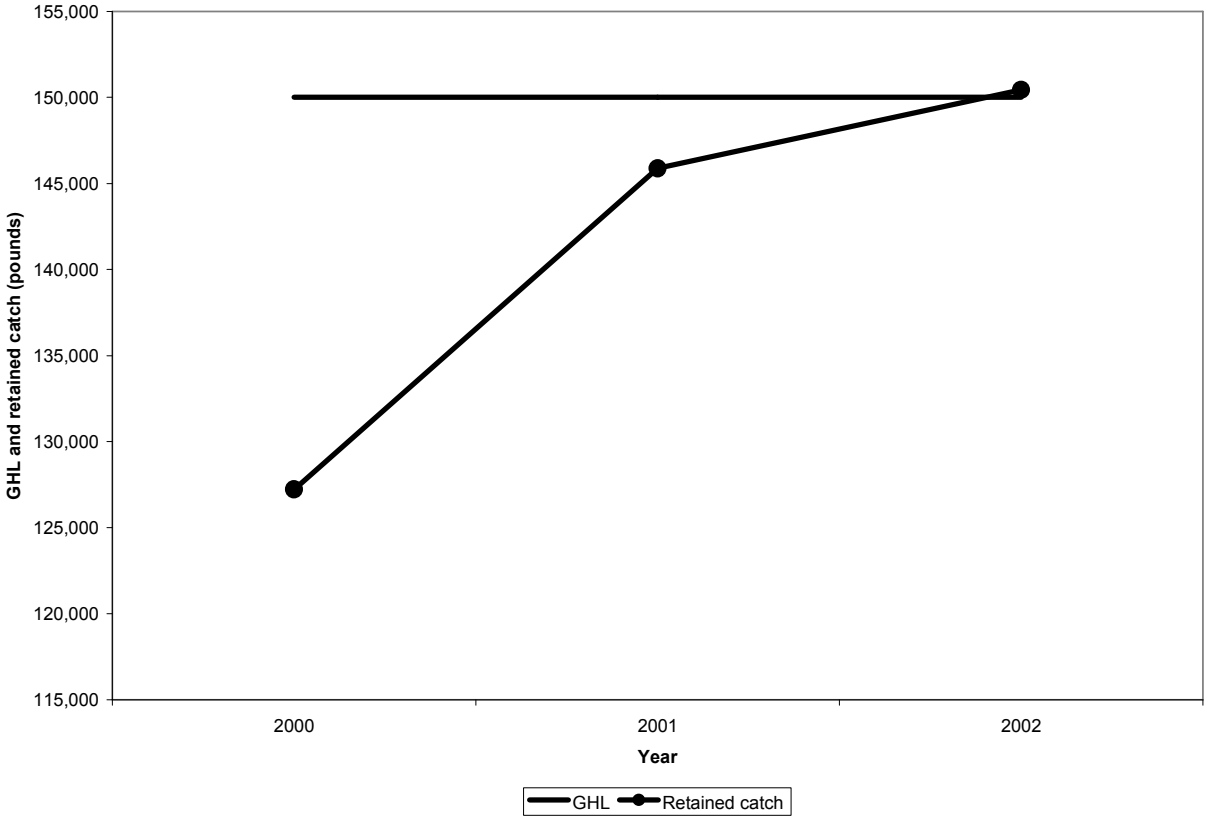

Figure 2. Pre-season GHL (pounds) compared to the retained catch (pounds) during 2000–2002 Pribilof Islands golden king crab fishery.

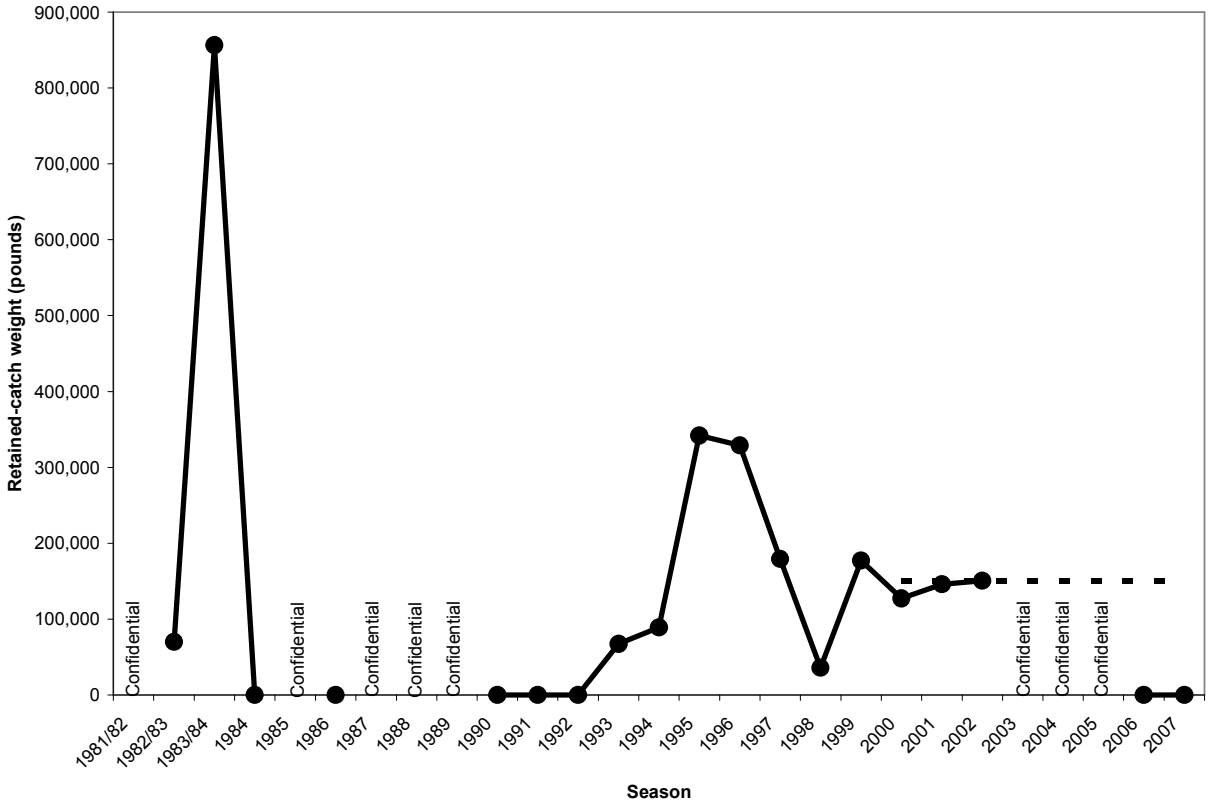

Figure 3. Retained catch (pounds; filled circles and solid line) during the 1981/82 through 2007 Pribilof Islands golden king crab fishery seasons, as compared to the 150-thousand pound GHL established for the fishery during the 2000–2007 seasons (dashed line).