Crab Bycatch in the Bering Sea/ Aleutian Islands Fisheries

Staff Discussion Paper

May 2010

Table of Contents

List of Tables

List of Figures

1. Introduction

The Bering Sea/Aleutian Islands (BSAI) Crab Fishery Management Plan (FMP) applies to ten crab stocks in the BSAI: four red king crab, *Paralithodes camtschaticus*, in Bristol Bay, the Pribilof Islands, Norton Sound, and Adak; two blue king crab, *Paralithodes platypus*, in the Pribilof District and around Saint Matthew Island, two golden (or brown) king crab stocks, *Lithodes aequispinus*, in the Aleutian and Pribilof Islands; the Eastern Bering Sea (EBS) Tanner crab, *Chionoecetes bairdi*; and the EBS snow crab, *C. opilio*. All other BSAI crab stocks are exclusively managed by the State of Alaska (State). Following approval of Amendment 24 to the BSAI Crab FMP, these stocks now have annually-specified overfishing limits (OFLs). For all stocks for which information is available, these OFLs are intended to cover total removals from the stock, including bycatch in groundfish and scallop fisheries. Additional requirements for catch removals for crab stocks will be necessary to comply with Annual Catch Limits (ACLs). The Crab Plan Team (CPT, or Team) discussed relative bycatch management measures in groundfish and scallop fisheries at the May 2009 meeting. The Team recommended that the Council consider measures to restrict bycatch in groundfish fisheries. The Team reiterated its request and discussed specific bycatch concerns related to individual stocks at the September 2009 meeting as well as in conjunction with ACLs and Accountability Measures (AMs) at the March and May 2010 meetings. This discussion paper responds to two specific motions by the Council in April 2010 (Appendix A) and October 2009 (Appendix B) as well as to several requests by the Crab Plan Team at their recent meetings. This paper intends to provide the Council with the information necessary to determine whether or not to initiate an analysis at this meeting to restrict bycatch of crab stocks in groundfish and scallop fisheries in order to prevent exceeding an annually specified ACL or OFL by crab stock due to catch outside of the directed crab fisheries.

2. Current crab bycatch measures in BSAI groundfish fisheries

The BSAI groundfish FMP specifies crab bycatch management measures for protection of Bristol Bay red king crab, EBS Tanner crab, EBS snow crab, Pribilof blue king crab and St. Matthew blue king crab stocks (Table 1). These measures consist of triggered or fixed time and area closures for trawl fisheries. No measures are currently in place for any fixed gear fisheries, nor are overall limits placed on bycatch of any crab species. Bycatch management measures are not linked to new BSAI crab FMP requirements to account for total removals from all fisheries under new OFLs. The sections below describe the individual existing time and area closures in more detail for those crab stocks and, where applicable, the limits that trigger the closure using 2009 as an example where limits are annually varying. Information on relative bycatch levels for each stock is then summarized in the subsequent section by gear type and where available (2008/09 data) by fishery.

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

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

2.1. Bristol Bay red king crab measures

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

2.1.1. Red King Crab Savings Area

Non-pelagic trawling is prohibited year round within the area indicated in with the exception that a subarea of the Red King Crab Savings Area between 56°00' N. and 56°10' N. latitude and 162°00' W. and 164°00' W. longitude may be opened to non-pelagic by the NMFS Alaska Regional Administrator in consultation with the Council. This is done during the annual specifications process by the Council in December 2009.

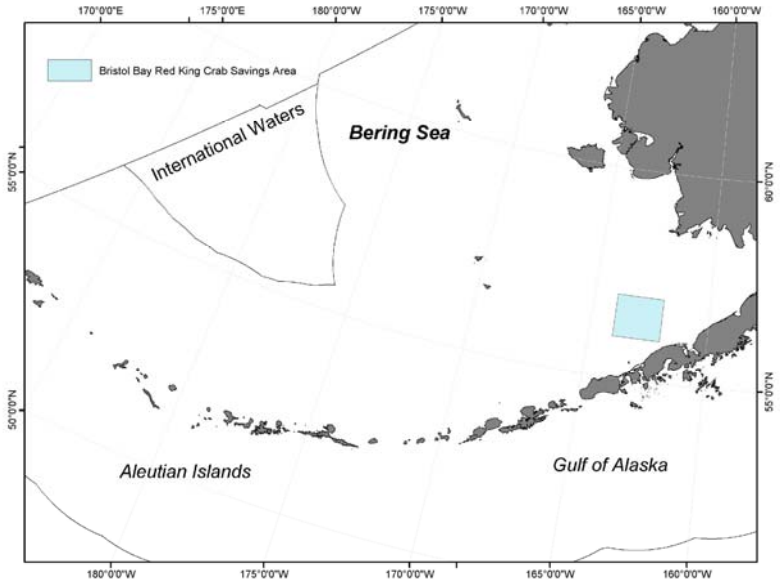


Figure 1. Bristol Bay red king crab savings area.

2.1.2. Nearshore Bristol Bay Trawl Closure

All trawling is prohibited year round in Bristol Bay east of 162°00' W. longitude, except the subarea that is open to trawling during the period April 1 to June 15 each year (Figure 2).

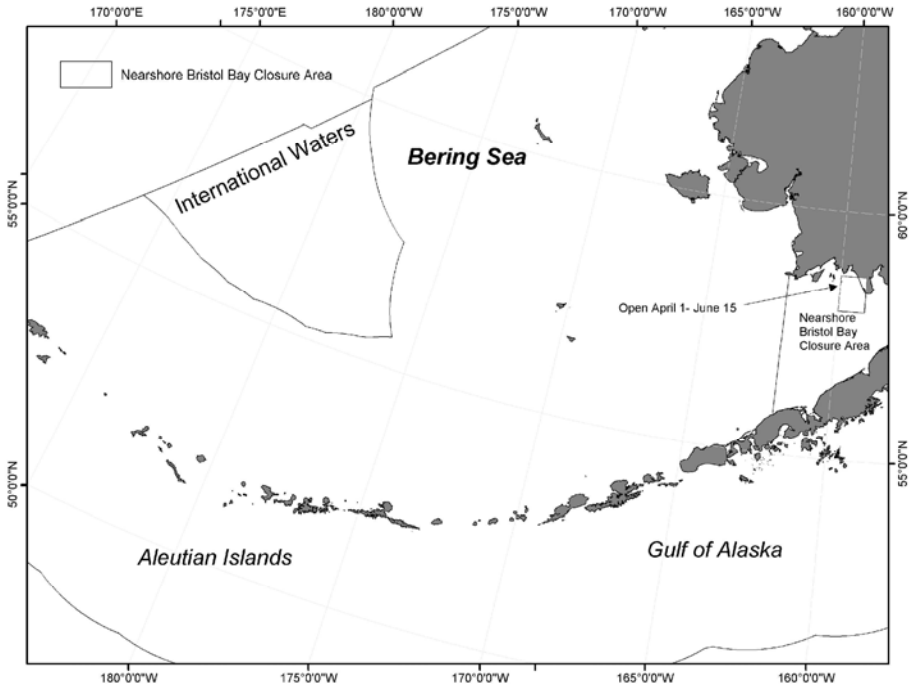


Figure 2. Nearshore Bristol Bay trawl closure.

2.1.3. Zones 1 and 2

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

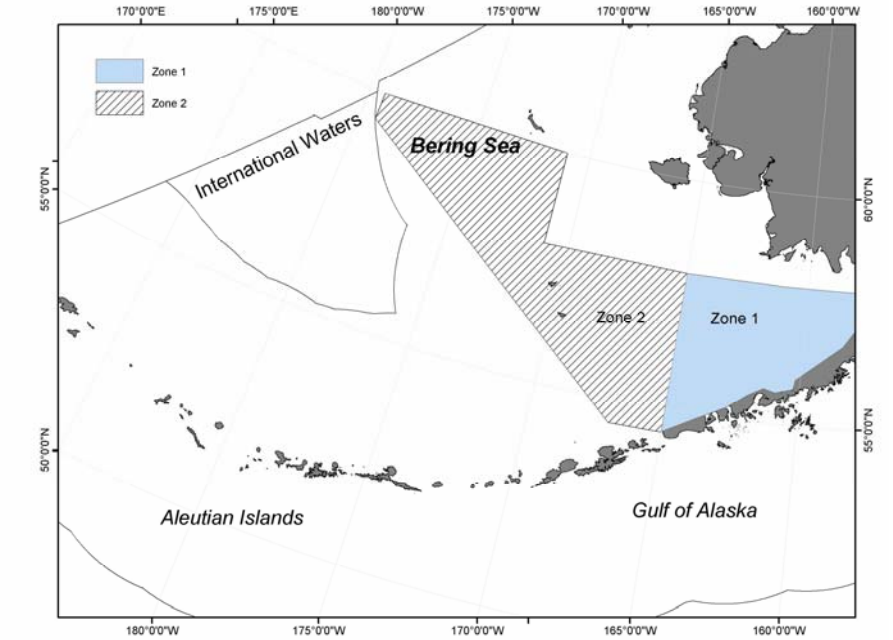


Figure 3. Zones 1 and 2 area for closures (Bristol Bay red king crab and EBS Tanner crab).

Table 2. PSC limits for red king crab.

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

The stair step procedure for determining PSC limits for red king crab taken in Zone 1 trawl fisheries is based on abundance of Bristol Bay red king crab (Table 2). Based on the 2008 estimate of effective spawning biomass of 75 million pounds, the PSC limit for 2009 is 197,000 red king crabs. Up to 25% of the red king crab PSC limit can be used in the 56°00' - 56º10 'N. strip of the Red King Crab Savings Area. The red king crab cap has generally been allocated among the pollock/mackerel/other species, Pacific cod, rock sole, and yellowfin sole fisheries.

2.2. EBS Tanner crab management measures

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

Table 3. PSC limits for EBS Tanner crab.

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

2.3. Pribilof Islands blue king crab management measures

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

was established based upon the distribution and habitat of the blue king crab in the NMFS annual trawl surveys and on observer data (NPFMC, 1994).

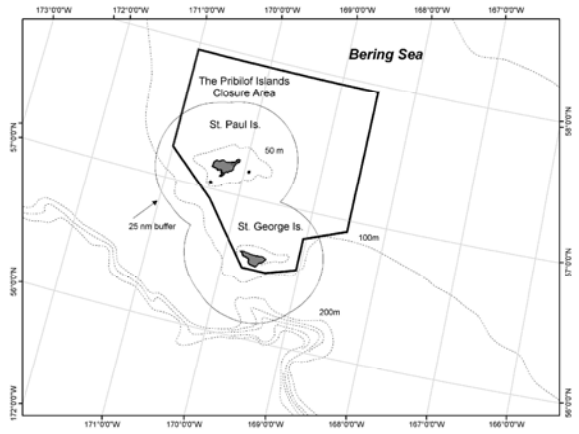


Figure 4. Pribilof Islands Habitat Conservation Zone.

2.4. EBS Snow crab management measures

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

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

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

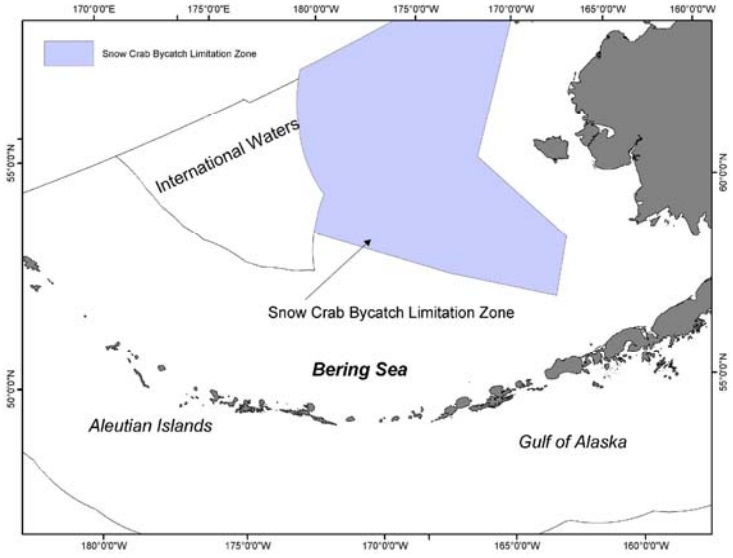


Figure 5. *C. opilio* Bycatch Limitation Zone (COBLZ)

EBS snow crab PSC limits are based on total abundance of snow crab as indicated by the NMFS standard trawl survey. The cap is set at 0.1133% of snow crab abundance index, with a minimum of 4.5 million snow crabs and a maximum of 13 million snow crabs; the cap is further reduced by 150,000 crabs. The

2008 survey estimate of 2.60 billion crabs resulted in a 2009 snow crab PSC limit of 2,943,421 crabs, if left unadjusted. However, the BSAI groundfish FMP mandates a minimum of 4,350,000 snow crabs. Only snow crab taken within the COBLZ accrue toward the PSC limits established for individual trawl fisheries.

2.5. St. Matthew blue king crab management measures

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

2.5.1. Habitat Conservation Areas

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

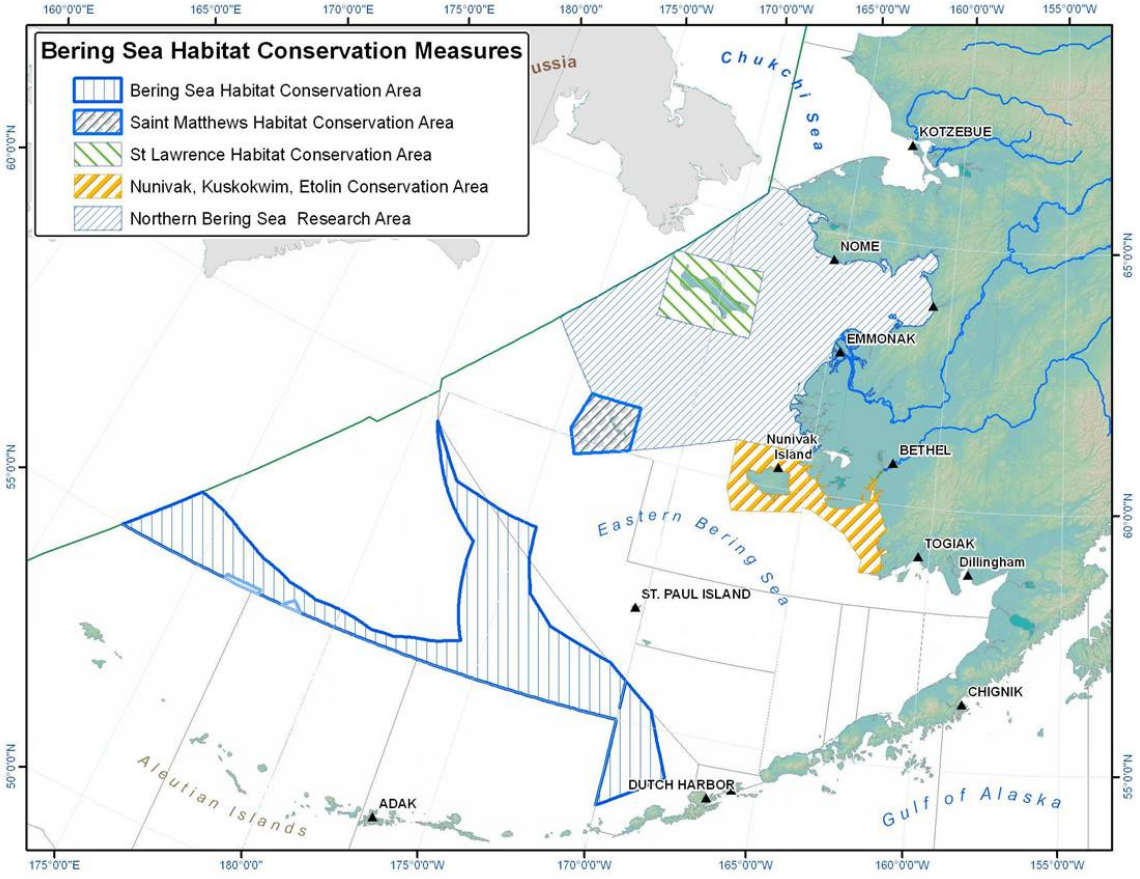


Figure 6. Bering Sea Habitat Conservation measures closure areas.

1.6 Trawl Crab Bycatch PSC Apportionments and Seasonal Allocations

Crab bycatch limits were established for trawl fisheries beginning in 1986. Bycatch limits for crab, which are termed Prohibited Species Catch (PSC) limits, are apportioned into limitation zones and allocated

among groundfish trawl fisheries. To allocate the total groundfish harvest under the annually established PSC limits, PSC is apportioned among trawl fisheries during the annual specification process. When a target fishery attains a PSC apportionment or seasonal allocation specified in regulations, the bycatch zone to which the allocation applies closes to the target fishery for the remainder of the season.

Crab PSC limits are specified annually based on abundance and spawning biomass, and allocated annually to vessels in the CDQ, Amendment 80, and the BSAI trawl limited access sectors. The BSAI sector includes trawl catcher vessels and trawl catcher/processors not in the Amendment 80 program. During the harvest specifications process, the Advisory Panel (AP) makes recommendations to the Council on the amounts of the PSC limits allocated to each fishery category. The public has opportunity to comment on allocations during the AP and Council meetings. The Council votes on the final PSC limits which, if approved by the Secretary of Commerce, are published in the Federal Register. The fishery categories are: greenland turbot/Arrowtooth, flounder/sablefish, Pacific cod, Pollock/Atka mackerel/other species, rockfish, rock sole/flathead sole/other flatfish, and yellowfin sole.

10.7% of each PSC limit specified for crab is taken off the top and allocated for use by the groundfish CDQ program. The remaining available PSC allocations are split between the BSAI trawl limited access sectors and the Amendment 80 sector. The BSAI trawl limited access sectors and the Amendment 80 sector are allocated PSC limits according to percentage multipliers in Tables 35 and 36, CFR part 679. The Amendment 80 allocation is further apportioned between Amendment 80 cooperatives and Amendment 80 limited access fishery (those Amendment 80 vessels that do not join a cooperative) based on their relative proportion of Amendment 80 species quot shares. The Amendment 80 cooperatives are allocated PSC limits proportional to the amount of Amendment 80 quota shares held by its members. PSC allocations for the BSAI trawl limited access sectors and Amendment 80 limited access sectors are further allocated between trawl fisheries categories.

Each Amendment 80 cooperative receives an exclusive allocation of the crab PSC, whereas the Amendment 80 limited access fishery must share crab PSC allocations with all other Amendment 80 limited access fishery participants. The Amendment 80 sector is the only sector that may receive a reallocation of unused PSC limits. There is no specific provision for reallocations to or from the cooperatives or from the BSAI trawl limited access sectors. The cooperatives can freely trade their allocations, subject to use cap limits, including post-delivery transfers from another cooperative. If NMFS projects that some of the PSC limits in the BSAI trawl limited sector will not be used, it has the discretion to reallocate those PSC limits to the Amendment 80 cooperatives. A reallocation from the BSAI trawl limited access sector is based on projected harvest rates in the trawl sector and on other criteria. Each cooperative would receive a reallocation based on the proportion of the quota share held by that cooperative as compared with all other Amendment 80 cooperatives. The Amendment 80 limited access sector, however, would not receive reallocated PSC limits.

A little more detail shows that percentages apportioned to the Amendment 80 sector for each crab PSC were selected based on the historic usage in all groundfish fisheries from 2000-2002 for red king crab, and from 1995-2002 for all other crab PSC species. The percentages selected at the time of implementation of Amendment 80 were 62.48% for red king crab, 61.44% for snow crab, 52.64% for Zone 1 Tanner crab, and 29.59% for Zone 2 Tanner crab. In order to reduce the overall crab PSC removals from the BSAI, each PSC limit is reduced 5% per year until the apportionment for the Amendment 80 sector is at 80% of the initial allocation (Table 4). The apportionment of PSC limits to the trawl limited access fisheries, as shown in (Table 4, were calculated using the sum of the AFA CP and CV sideboards. In addition, apportionment percentages presented in (Table 4 do not equal 100%. Because the sum of the Amendment 80 and BSAI trawl PSC apportionments do not equal 100%, any unallocated crabs remain in the water. In summary, both the Amendment 80 and the BSAI trawl limited

access sectors receive a fixed percentage of the total trawl crab PSC limit, so the Amendment 80 crab PSC allocations do not effect the availability of crab PSC to the BSAI trawl limited access sectors.

Table 4 Apportionment of crab PSC between the Amendment 80 and BSAI trawl limited access sectors.

Fishery	Year	Zone 1 PSC red king crab limit in the BSAI	C. *opilio* (snow) crab PSC limit (COBLZ)	Zone 1 Tanner crab (*C. bairdi)* PSC limit	Zone 2 Tanner crab (*C. bairdi)* PSC limit
		*As a percentage of the total BSAI trawl PSC limit after allocation as PSQ			
Amendment 80 Sector	2008	62.48	61.44	52.64	29.59
	2009	59.36	58.37	50.01	28.11
	2010	56.23	55.3	47.38	26.63
	2011	53.11	52.22	44.74	25.15
	2012, and all future years	49.98	49.15	42.11	23.67
BSAI trawl limit access Sector		30.58	32.14	46.99	46.81

1.7 Crab Bycatch Limits in the Scallop Fishery

Bycatch of crabs in the scallop fishery is controlled through the use of Crab Bycatch Limits (CBLs) that are based on the condition of individual crab stocks. CBLs were first instituted by the state in July 1993. Methods used to determine CBLs in 1993 and 1994 were approved by the BOF and the NPFMC and, with few exceptions, remain unchanged. Annual CBLs are established preseason by ADF&G for areas with current crab resource abundance information (surveys). For areas without crab abundance estimates, CBLs may be set as a fixed number of crabs that is not adjusted seasonally.

In the Kodiak, Alaska Peninsula, and Dutch Harbor Registration Areas, the CBLs are set at 0.5% or 1.0% of the total crab stock abundance estimate based on the most recent survey data (

Table 5). In registration areas or districts where red king crab or Tanner crab abundance is sufficient to support a commercial crab fishery, the cap is set at 1.0% of the most recent red king crab or Tanner crab abundance estimate. In registration areas or districts where the red king crab or Tanner crab abundance is insufficient to support a commercial fishery, the CBL is set at 0.5% of the most recent red king crab or Tanner crab abundance estimate. Bycatch caps are expressed in numbers of crabs and include all sizes of crabs caught in the scallop fishery.

In the Kamishak District of the Cook Inlet Registration Area, the Tanner crab bycatch limit is set at 0.5% of the total crab stock abundance from the most recent dredge survey and the red king crab limit is fixed at 60 crabs. In 2001, ADF&G set Tanner crab bycatch caps in the Prince William Sound Registration Area at 0.5% of the Tanner crab population estimate from the 2000 scallop survey. This resulted in bycatch limits of 2,700 and 8,700 crabs for the east and west harvest areas. These levels have remained in place for all subsequent years.

CBLs in the Bering Sea (registration Area Q) have evolved from fixed numbers in 1993 to a three tier approach used in the current fishery. In 1993, Bering Sea CBLs were set by ADF&G to allow the fleet adequate opportunity to explore and harvest scallop stocks while protecting the crab resource. CBLs were established at 260,000 *Chionoecetes* spp. and 17,000 red king crabs. In 1995, ADF&G recommended that

CBLs be established at 0.003176% of the best available estimate of *C. opilio* (snow crab) and 0.13542% of the best available estimate of Tanner crab abundance in Registration Area Q. That equated to about 300,000 snow and 260,000 Tanner crabs based on 1994 crab abundance estimates in Registration area Q. In Amendment 1 of the federal scallop FMP, the NPFMC approved the CBLs established by ADF&G. The NPFMC also recommended that king crab bycatch limits be set within a range of 500 to 3,000 crabs annually. Beginning with the 1996/97 fishing season, ADF&G took a conservative approach and set the red king crab limit in Registration Area Q at 500 red king crabs annually.

From the 1996/97 through 1998/99 fishing seasons, the CBL for *Chionoecetes* spp. in the Bering Sea was established annually by applying the percentages established for snow and Tanner crab limits in Amendment 1 of the FMP. In 1998, consistent with the Tanner crab rebuilding plan in the Bering Sea, crab bycatch limits were modified.

The current three tier approach was established utilizing the bycatch limits established in Amendment 1 of the FMP: 300,000 snow and 260,000 Tanner crabs. The three tiers include: (1) Tanner crab spawning biomass above minimum stock size threshold (MSST); bycatch limit is set at 260,000 crabs; (2) Tanner crab spawning biomass below MSST; bycatch limit is set at 130,000 crabs; and (3) Tanner crab spawning biomass is below MSST and the commercial fishing season is closed; Tanner crab limit is set at 65,000 crabs. A similar three tier approach was taken with the snow crab bycatch caps. The three tiers include: (1) snow crab spawning biomass above the MSST; bycatch limit is set at 300,000 crabs; (2) snow crab spawning biomass below MSST; bycatch limit is set at 150,000 crabs; and (3) snow crab spawning biomass below MSST and the commercial fishing season is closed; the snow crab limit is set at 75,000 crabs.

Table 5 Statewide crab bycatch limits in percentage of crab abundance estimates (where available) or number of crabs.

Area/District	Red King Crab	*C. bairdi*	*C. opilio*
Yakutat District 16	NE[a]	NE	NA[b]
Yakutat Area D	NE	NE	NA
Prince William Sound	NE	0.5%	NA
Cook Inlet Kamishak District	60 crab	0.5%	NA
Kodiak Northeast District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Shelikof District	0.5% or 1.0%	0.5% or 1.0%	NA
Kodiak Semidi District	NE	NE	NA
Alaska Peninsula	0.5% or 1.0%	0.5% or 1.0%	NA
Bering Sea	500 crab[c]	3 tier approach	3 tier approach
Dutch Harbor	0.5% or 1.0%	0.5% or 1.0%	NA
Adak[d]	50	10,000 crab	NA

[a] Not established.
[b] Not applicable.
[c] Fixed CBL.
[d] Bycatch limit established to provide scallop fleet opportunity for exploratory fishing while protecting crab resources.

3. Groundfish bycatch by crab stock

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

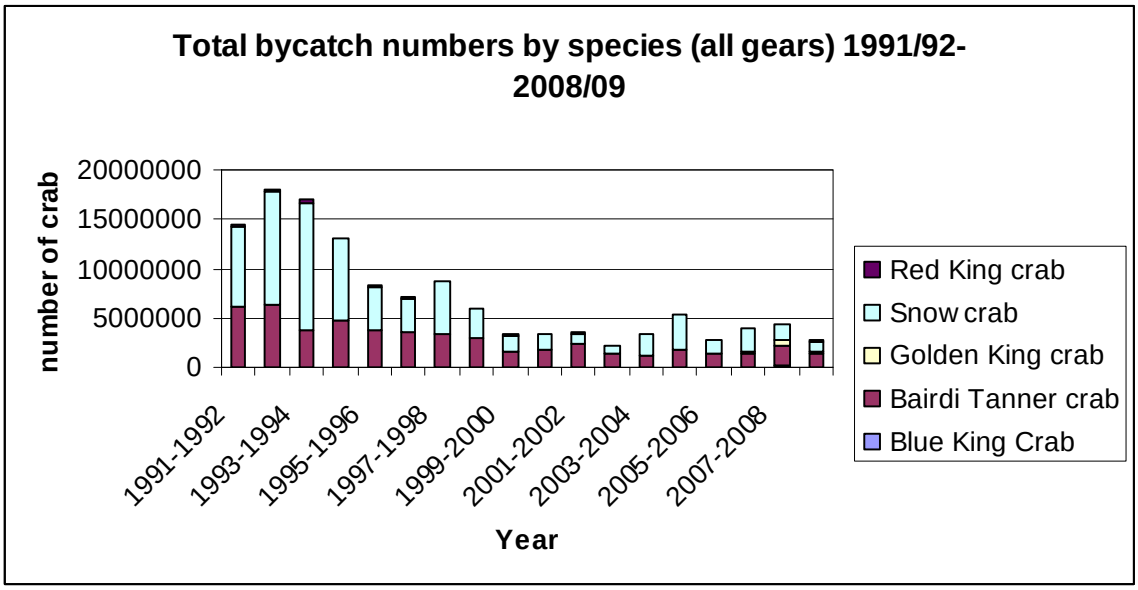


Figure 7 Total bycatch numbers by species (all gears). Numbers not adjusted for mortality.

3.1. Methodology to estimate crab mortality

In groundfish fisheries, crab bycatch is currently tabulated by number of crabs. The overall weight of crabs in crab fisheries (in kilograms and lbs) is also tabulated. For purposes of accruing against the stock-specific OFLs, the weight is the important measure. NMFS has developed a procedure for catch accounting applying the average crab weights by year against the extrapolated numbers of crab in the observer database. Described below is a general description of the procedure of moving from extrapolated numbers of crab to weight of crab for purposes of accruing against stock-specific OFLs (excerpted from Gasper et al. 2009). Data have been compiled by crab stock from 1991/92-2008/09 fishing years for mortality. These data are now used in all assessments for which a total catch OFL is specified. For purposes if this discussion paper, data from 2003/04-2008/09 for mortality by fishery has also been compiled.

Observer information must be used to infer the total of weight of crabs because both the blend and catch accounting systems (CAS) only estimate the number of crabs. Crab bycatch numbers are estimated by the NMFS through the Groundfish Observer Program. Observer coverage depends on vessel length: 100% observer coverage on vessels >125 feet, 30% coverage on vessels 60-125 feet, and no required coverage on vessels <60 feet. Shoreside processors are required to have 100% coverage. 100% coverage, however, means that an observer is always required on board, not that every haul or landing is observed. Approximately 50-60% of hauls are actually observed on a 100% observed-covered trawl vessel. Observers weigh each component of the sample, count crabs, and weigh, measure, and sex a portion of the caught crabs. Catch data are reported to the NMFS-Alaska Fisheries Science Center (AFSC)

Observer Program in Seattle for extrapolation, next forwarded to the NMFS inseason management division, who run the extrapolated data through the blend program to estimate the total catch. The observed PSC bycatch rate is then applied to the estimated total catch to obtain the PSC bycatch number used in management of the fishery.

Observer data was obtained from the AFSC for each crab year between 1991 and 2009. The observer data consists of random samples taken within a haul on a vessel. These random samples contain the total weight of crabs and the number of crabs contained in a sample.

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

Currently there is mismatch in the units used to sample and estimate crab bycatch in the Alaska groundfish fisheries. The observer program obtains samples of crab as weight and then converts the weight into numbers of individual crabs. This conversion is done so that the Alaska Region can estimate crab PSC (prohibited species catch) as numbers of crab because the current crab PSC management measures set limits on the number of crabs. The crab stock assessment authors, however, need estimates of crab catch in total weight. Thus, to obtain an estimate for the stock assessment authors, the Alaska Region converts total PSC estimates of number of crabs back to weight of crab using a global average weight per crab by gear (fixed or trawl), species, and crab year. This process results in multiple conversions, from weight to number and then back to weight, that rely on averages that do not necessarily correspond with the sampling frame. For this reason, the estimates of crab bycatch by gear and groundfish fishery should be viewed as relative comparison rather than a true estimate of the crab bycatch amount.

For the future, the Alaska Region recommends setting any PSC limits as weight of crab rather than numbers to avoid the problem of converting numbers into weight and vise versa. Further, the haul level observer information by weight will provide a better estimate of bycatch to the stock assessment authors. The change to estimate crab PSC by weight, however, would require programming changes for both the observer program database and the catch accounting system which could not be completed until sometime in 2011.

Once these estimates of total weights of crab are provided to stock assessment authors, authors apply a mortality rate by gear type to discount for handling mortality prior to inclusion in the assessment. Generally authors apply a 50% handling mortality for fixed gear and an 80% handling mortality for trawl gear (NPFMC 2010). Previously, handling mortality rates used to estimate mortality in groundfish fisheries in conjunction with annual estimates of bycatch mortality by crab stock were 80% for groundfish trawl gear and 20% for groundfish fixed gear (NPFMC 2007). The evolution of handling rates used in Council documents is provided in the following section.

3.2. Crab bycatch handling mortality rates

The following section summarizes the origin and current usage of handling mortality rates for crab.

3.2.1. Groundfish Trawl Fisheries

Rate: The estimated mortality rate of red king crab and Tanner crab caught as bycatch in the trawl groundfish fisheries is 80% (NPFMC 2010).

Origins: The Council has consistently used an estimated mortality rate of 80% for crab bycatch in trawl fisheries in Council analyses, since the early 1990s (Table 6). This rate is an approximation based on a trawl research study conducted in 1987 in the BSAI joint venture fisheries (Stevens 1990). Species targeted were yellowfin sole, rock sole, and Pacific cod. The study found that 21% of the king crabs and 22% of the Tanner crabs captured incidentally in BSAI trawl fisheries survived at least two days following capture. A few earlier studies also looked at bycatch mortality in the trawl fisheries (Blackburn and Schmidt 1988, Owen 1988, Fukuhara and Worlund 1973, Hayes 1973), which generally indicated that soft shell crab are much more vulnerable to impacts from trawling than hard shell crab, and that mortality appears to be directly correlated with time out of water. This latter finding was also apparent from the Stevens study, which noted that captivity time (which includes both towing time and deck sorting time) may have been longer in the study than it would be in a normal fishery, especially for king crab. There have been no recent studies of crab bycatch mortality in the Alaska trawl fisheries.

Table 6 History of mortality rate calculations for crab bycatch in groundfish fisheries, in research studies and Council analyses

Study		King crab			Tanner/snow crab			Notes/rationale
		Trawl	Pot	Longline	Trawl	Pot	Longline	
1987 trawl comparison research study on bycatch in BSAI joint venture fishery targeting yellowfin sole, rock sole, Pacific cod	Stevens 1990	78%			79%			Red king crab and Tanner crab study. Mortality rate directly proportional to captivity time (which in study may have been longer than is normal in fishery), esp for king crab (at 3 hours captivity, 0% mortality, at 17 hours, 100% mortality).
1990 Observer Program study of condition factor of crab bycatch	Guttormsen et al 1992	20.1% (+27.5% poor)	0% (+0% poor)		37.5% (+32.0% poor)	1.3% (+1.4% poor)	7.5% (+21.7% poor)	Observers identified 3 condition factors: excellent, poor, dead. No estimate available for longline king crab bycatch.
BSAI groundfish FMP amendment 24 (Pacific cod gear allocations)	NMFS 1993	80%	37%	37%	80%	30%	45%	Trawl mortality rate based on Stevens 1990; pot and longline rates proportionally adjusted from Guttormsen et al 1992, so that trawl = 80% as per Stevens 1990.
BSAI groundfish FMP amendment 37 (Bristol Bay nearshore closure)	NPFMC 1996	80%	8%	37%	80%	30%	45%	Mortality rates supposedly based on NMFS 1993, no explanation for change in pot king crab rate.
BSAI crab FMP amendment 11 (Tanner crab rebuilding)	NPFMC 2000				80%	35%	35%	Mortality rate for combined fixed gear, based on NPFMC 1996; assumes average 2/3 of bycatch from pot gear (30% mortality rate) and 1/3 from longline gear (45% mortality rate)
BSAI crab FMP amendment 14 (Snow crab rebuilding)	NPFMC 2000				80%	20%	20%	Mortality for combined fixed gear, no rationale in analysis for change in mortality rate
BSAI crab FMP amendment 15 (St Matthew blue king crab rebuilding)	NPFMC 2000	80%	8%	37%				Mortality rates based on NPFMC 1996
Chapter on BSAI bycatch in Council's BSAI Crab SAFE reports	NPFMC 2001-2007	80%	20%	20%	80%	20%	20%	No rationale in analysis for choice of mortality rates. May have averaged fixed gear rates for king crab from NPFMC 1996, and used fixed gear rate from NPFMC 2000 (snow crab rebuilding) for Tanner/ snow crab.
BSAI bycatch considered as part of stock assessments in BSAI Crab SAFE reports	NPFMC 2008-2009	80%	80%	80%	80%	80%	80%	Crab Plan Team directive in 2008 SAFE report to use 80% for bycatch in groundfish fisheries (presumably because most bycatch was assumed to be from trawl)
BSAI bycatch considered as part of stock assessments in BSAI Crab SAFE report	NPFMC 2010	80%	50-80%	50-80%	80%	50-80%	50-80%	Pribilof Is red, blue, and golden king crab, AI golden king crab, and Adak red king crab assessments use 50% mortality for fixed gear; others use 80%

3.2.2. Groundfish Pot and Longline Fisheries

Rate: The estimated mortality rate of red king crab and Tanner crab caught as bycatch in the fixed gear (pot and longline) groundfish fisheries is 50% (NPFMC 2010)[1].

1 Note, 50% mortality rate for fixed gear is used by all stock assessments in the 2010 BSAI Crab SAFE report that distinguish among groundfish gear types when accounting for crab bycatch in the groundfish

Origin:
Since the 1990s, various mortality rates have been used for crab bycatch in the fixed gear groundfish fisheries in the analysis of Council amendments (Table 6). No direct research studies have been conducted on mortality of crab caught as bycatch in the longline or pot groundfish fisheries. A study was conducted through the observer program in 1990 which evaluated the condition of crab caught as bycatch in the groundfish fisheries. Combining these results with the Stevens (1990) research that looked at trawl mortality, a calculation was made for a 1993 Council analysis to scale the mortality results from the observer study for pot and longline crab bycatch upwards proportional to the difference between the observer study and Stevens' findings for trawl crab bycatch. Consequently, the Council's 1993 analysis used 30% pot and 45% longline mortality rates for Tanner crab bycatch, and 37% mortality rates for both gears for king crab bycatch2. These rates were also used in subsequent Council analyses for several years, with the exception that NPFMC (1996) changed the pot bycatch mortality rate for red king crab to 8% (the rationale for this change is not clear, but is likely from research in the directed crab fishery about mortality rates of crab bycatch in crab pots). In 2000, the Council's snow crab rebuilding amendment assigned a 20% mortality rate to bycatch from the pot and longline groundfish fisheries, but it is not clear what the rationale was for this change. This rate did, however, get perpetuated for much of the 2000s in the Council's bycatch chapter in the BSAI Crab SAFE report, and the 20% rate was also applied to king crab bycatch (again, the rationale is not entirely clear, but may result from an averaging of the 8% pot mortality rate and 37% longline mortality rate that had previously been used).

With the implementation, in 2008, of overfishing limits in the BSAI Crab SAFE, and assessments that accounted for total catch, the Crab Plan Team issued a directive that all assessments should use an 80% mortality rate for all bycatch in the groundfish fisheries, under the assumption that most of the bycatch originated from trawl vessels. Following a presentation to the Crab Plan Team in 2009 about the occurrence of crab bycatch in the pot and longline groundfish fisheries, the assessment authors have now begun to distinguish among gear types in accounting for crab bycatch in the groundfish fisheries. A 50% mortality rate is currently applied to crab bycatch in the directed Tanner crab pot fisheries, consequently this rate is now also being applied to all crab bycatch in the fixed gear groundfish fisheries (where the assessment distinguishes bycatch among gear types).

3.2.3. Scallop Fishery

Rate: The estimated mortality rate of crab caught as bycatch in the scallop dredge fishery is 40%.

Origin:
Observations from scallop fisheries across the state suggest that mortality of crab bycatch is low relative to trawl gear due to shorter tow times, shorter exposure times, and lower catch weight and volume. For crab taken as bycatch in the Gulf of Alaska weathervane scallop fishery, Hennick (1973) estimated that about 30% of Tanner crabs and 42% of the red king crabs bycaught in scallop dredges were killed or injured. Hammerstrom and Merrit (1985) estimated mortality of Tanner crab at 8% in Cook Inlet. Kaiser (1986) estimated mortality rates of 19% for Tanner crab and 48% for red king crab bycaught off Kodiak Island. Urban el al. (1994) reported that in 1992, 13-35% of the Tanner crab bycaught were dead or moribund before being discarded, with the highest mortality rate occurring on small (<40 mm cw) and large (>120 mm cw) crabs. Delayed mortality resulting from injury or stress was not estimated.

---

fisheries. For those assessments that do not yet distinguish among gear types, all bycatch is assumed to come from the trawl fishery, and is assigned an 80% mortality rate.
2 There were no results for longline red king crab bycatch in the observer study, consequently it is assumed that the pot mortality rate was simply cross-applied to longline gear.

Mortality in the Bering Sea appears to be lower than in the Gulf of Alaska, in part due to different sizes of crab taken. Observations from the 1993 Bering Sea scallop fishery indicated lower bycatch mortality of red king crab (10%), Tanner crab (11%), and snow crab (19%). As with observations from the Gulf of Alaska, mortality appeared to be related to size, with larger and smaller crabs having higher mortality rates on average than mid-sized crabs (D. Pengilly, ADF&G, unpublished data). Immediate mortality of Tanner crabs from the 1996 Bering Sea scallop fishery was 12.6% (Barnhart and Sagalkin 1998). Delayed mortality was not estimated. In the analysis made for Amendment 41, a 40% discard mortality rate (immediate and delayed mortality combined) was assumed for all crab species. Currently bycatch of Tanner crabs have not been included in the accrual of total mortality under the Tanner crab OFL. However it is assumed that the estimated bycatch from the scallop fishery (in weight) will accrue towards the Tanner crab OFL (and eventually the ACL) and a 40% handling mortality rate will be applied to that estimate.

3.3. Unobserved handling mortality rates

In addition to observed mortality, fishing activities cause crab mortality in ways that cannot be directly observed.

3.3.1. Trawl Gear

Not all crabs in the path of a trawl are captured. Some crab pass under the gear, or pass through the trawl meshes. Trawls may affect non-retained crabs through contact of the doors and sweeps, footropes and footrope gear, and the net sweeping along the seafloor, as well as exposure to silt clouds produced by trawl and dredge gear. Only a few studies have been conducted to estimate catchability of crabs by trawl gear.

Summary of Trawl Gear Studies:
There are few studies that have evaluated escape mortalities in the trawls (Donaldson 1990; Rose 1999). Recently, however, two studies in the Bering Sea (conducted in the summer of 2008 and 2009) have estimated mortality rates for snow, Tanner, and red king crabs that encounter bottom trawls, but remain on the seafloor. The studies estimated mortalities for all three species encountering various different parts of the trawl, including the sweeps (cables between the trawl doors and the footrope) and the footrope (both at the side sections (wings) and in the center; Rose et al, in review). Briefly, crabs were captured by auxiliary nets fished behind different parts of a commercial bottom trawl. They were carefully brought aboard and assessed using a six part reflex test. A subsample of those crabs was held for 5 to 12 days to establish the relation between reflex state and delayed mortalities. The proportions of crabs in different reflex states and the reflex-mortality relationship were used to estimate raw mortality rates for crabs encountering each part of the trawl. Results for crabs captured with a control net, fished in front of the trawl to serve as a scientific control for the effects of the recapture net itself, were used to assess and adjust for mortalities due to capture and handling.

Estimates of mortality for Tanner, snow, and red king crabs encountering parts of the trawl are identified in Figure 8. Mortality to Tanner and snow crab resulting from interaction with the trawl gear ranged from 4% to 15%. Red king crab are more vulnerable than bairdi and snow crab, with mortality rates ranging from 9 to 32%. Overall mortality rate estimates for Bering Sea flatfish trawls, when weighted for the area swept by each component (90% sweeps, 6% footrope wings, 4% footrope center), were 6% for snow crab, 5% for Tanner crab and 11% for red king crab (Rose et al, in review). Other Alaska bottom trawl fisheries, for example for Pacific cod) use similar footropes, however they use much shorter sweeps. Therefore, while cod trawls would cover less seafloor (and hence contact fewer crabs) per mile towed than flatfish trawls, a higher proportion of the affected crabs would die because more of them would encounter the footrope components (Rose et al, in review).

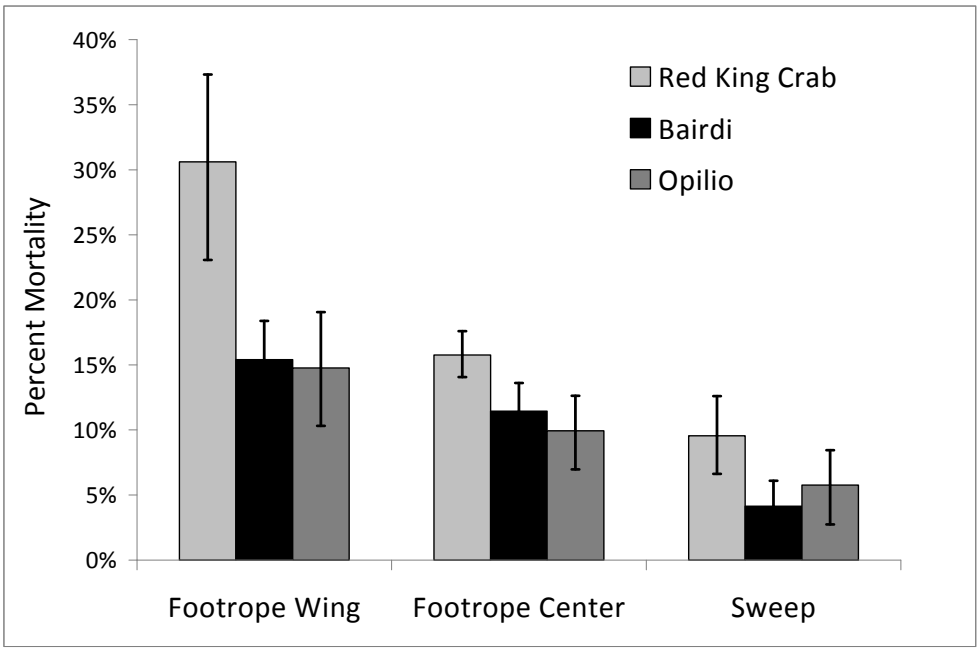


Figure 8Estimates and 95% confidence intervals of mortality rates of red king crab, snow crab, and Tanner crab resulting from contacting three different components of a bottom trawl representative of those used in Bering Sea bottom trawl fisheries (Rose et al, in review).

Management measures to reduce unobserved mortality of crab in the trawl fishery

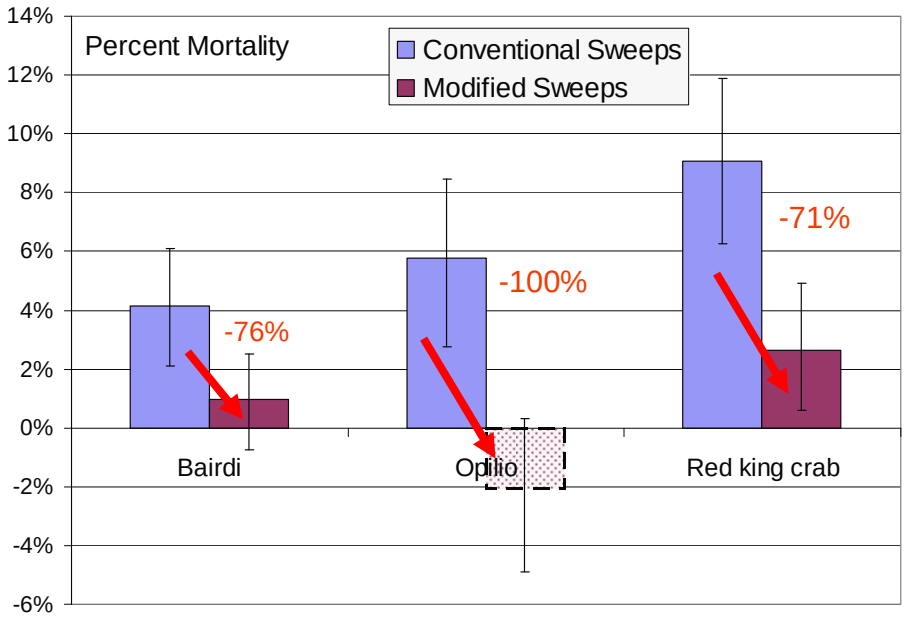
In 2009, the Council approved a gear modification requirement that trawl sweeps used for all flatfish fishing in the Bering Sea must be modified. Vessels must install elevating devices (Figure 9) on the sweeps at regular intervals, in order to raise the sweeps off the seafloor and reduce adverse impacts on benthic animals. For most Bering Sea flatfish trawls, sweeps are so long (up to 1500 ft) that they sweep 90 percent of the area covered between the trawl doors. The proposed modifications elevate most of the sweep area 2 to 3 inches above the substrate, allowing space for animals to pass beneath. Mortality rates dropped to nearly zero for crab encountering the modified sweeps (Figure 10). Significance levels for these decreases (conventional versus modified) were 0.002 for *Chionoecetes bairdi* and <0.001 for *C. opilio*. The mortality reduction due to the sweep modification persisted across sizes and sexes. Results indicate a similar trend in reduced mortality rates for king crab encountering the modified sweeps. The demonstrated reductions in mortality to crabs likely indicate that any mortality of other, smaller epibenthos (such as other crab, sea stars, or shrimp) would also be reduced. If the Secretary of Commerce approves the Council's gear modification requirement, the regulations will likely be implemented for the beginning of the 2011 fishing year.

Figure 9 Examples of elevating devices.

10 inch elevating bobbin connected to 2-inch (52-mm) combination wire with hammerlocks (coupling links).

8 inch elevating discs mounted on body of 2-inch (52-mm) combination wire with stopper swages each side.

Figure 10 **Estimated mortalities of *Chionoecetes opilio, C. bairdi,* and red king crab after contact with conventional and modified sweeps.**
Rates have been adjusted for handling mortality based on mortality estimates from a control net. (Apparent negative mortality is a non-significant artifact of the control adjustment).



3.3.2. Crab Fishery

Catching mortality is ascribed to those crabs that enter a pot and are eaten by other pot inhabitants before the pot is retrieved. Catching mortality likely occurs during the molting period, when crabs are more susceptible to cannibalism. Most crab fisheries are set to occur outside of the molting season, and catching mortality in these fisheries may be limited to octopus or large fish entering a pot. Because no evidence of crab is left in the pot, these mortalities remain unassessed. Mortality is also caused by ghost fishing of lost crab pots and groundfish pots. Ghost fishing is the term used to describe continued fishing by lost or derelict gear. The impact of ghost fishing on crab stocks remains unknown. It has been estimated that 10% to 20% of crab pots are lost each year (Meyer 1971, Kruse and Kimker 1993). Based on skipper interviews, about 10,000 pots were estimated lost in the 1992 Bristol Bay red king, and Bering Sea Tanner and snow crab fisheries (Tracy 1994). Fewer pots are expected to be lost under pot limit

regulations and shorter seasons. Bob Schofield, a major crab pot manufacturer, testified at the January 1996 Council meeting that he was making fewer pots since inception of the pot limit. He estimated that 6,461 pots were replaced in 1995. It is not known how long lost pots may persist and continue to fish, or just litter the bottom.

A sonar survey of inner Chiniak Bay (Kodiak, Alaska) found a high density of lost crab pots (190 pots) in an area of about 4.5 km2 (Vining et al. 1997). Underwater observations indicated that crabs and fish were common residents of crab pots, whether or not the pot mesh was intact. Intact pots recovered from the Chiniak Bay study area often contained crabs (primarily Tanner crabs) and octopus. High (1985) and High and Worlund (1979) observed that 20% of legal sized male red king crab and 8% of the sublegals captured by lost pots failed to escape.

Crabs captured in lost pots may die of starvation or by predation. Captured crabs are subject to cannibalism (Paul et al. 1993), and predation by octopus, halibut and Pacific cod (High 1976). Crabs may have limited abilities to withstand starvation. In a simulated field study, 39% mortality of Tanner crabs was observed after 119 days of starvation (Kimker 1994). In a laboratory study, 10% of the Tanner crabs tested died of starvation in 90 days. Of the 90% that had survived 90 days, all later died even though they were freely fed (Paul et al. 1993). However, highest survival rates for juvenile king crabs fed a variety of diets were from those treatments receiving no food, even for extended period of 3 to 4 months (Shirley, unpublished data). To reduce starvation mortality in lost pots, crab pots have been required to be fitted with degradable escape mechanisms. Regulations required #120 cotton thread from 1977-1993. Beginning in 1993, regulations required #30 cotton thread or 30-day galvanic timed release mechanisms. A #30 cotton thread section is also required in groundfish pots. The average time for #30 cotton twine to degrade is 89 days, and the galvanic timed release about 30 days to degrade. Pots fitted with an escape mechanism of #72 cotton twine had a fishable life of 3-8 years and documented retention of up to 100 crabs per lost pot (Meyer 1971). High and Wolund (1979) estimated an effective fishing life of 15 years for king crab pots. Pots without escape mechanisms could continue to catch and kill crabs for many years, however testimony from crabbers and pot manufacturers indicate that all pots currently fished in Bering Sea crab fisheries contain escape mechanisms.
Mortality of crab caused by ghost fishing is difficult to estimate with precision given existing information.

Mortality caused by continuous fishing of lost pots has not been estimated, but unbaited crab pots continue to catch crabs (Breen 1987, Meyer 1971), and pots are subject to rebaiting due to capture of Pacific cod, halibut, sablefish, and flatfish. In addition to mortality of trapped crab by ghost pots, and predation by octopus and fish, pot mesh itself can kill crabs. Lost pots retrieved by NMFS trawl surveys occasionally contain dead crabs trapped in loose webbing (Brad Stevens, NMFS, pers. comm). Pot limits and escape mechanisms may have greatly minimized ghost fishing due to pot loss in recent years.

Another very minor source of human induced crab mortality is direct gear impacts. Direct gear impacts result from a pot landing on the ocean floor when it is being set, presumably damaging any crab on which it lands. With reasonable assumptions, direct gear impacts are only a very minor source of mortality, however. An estimate of this impact can be derived by multiplying the number of pot lifts, the area they occupy, and relative crab density within areas fished in the Bering Sea. Assuming that pots land on different areas after each lift, and crab pots are set non-randomly over areas with relatively high density of crabs in directed fisheries, the total number of crab impacted can be roughly estimated. For 1993 the red king crab fishery, assuming a density of 5,000 red king crab of all sizes per square mile (density data from Stevens et al. 1998), a maximum of about two thousand red king crab were impacted (NPFMC 1996). Similarly, a maximum of 9,000 Tanner crabs (assuming 10,000 crab/mile^2) and 110 thousand snow crabs (assuming 75,000 crab/mile^2) were impacted by direct gear impacts in respective crab fisheries in 1993. It is not known what proportion of these crabs die when a crab pot lands on them.

4. Groundfish PSC historical development and related bycatch reductions

The following section summarizes the development, implementation and modifications over time of the current PSC limits and closures for the triggered closures for Bristol Bay red king crab, Tanner crab and EBS snow crab under the BSAI groundfish FMP.

The BSAI groundfish FMP seeks to minimize the impacts of groundfish fishing. All gear types used have some potential to catch crab incidentally, but the majority of crab bycatch occurs in the dredge and trawl fisheries. Crab bycatch in scallop dredge and groundfish trawl fisheries have long been a concern (NPFMC 1986, Thomson 1989, NPFMC 1995). In 1983, Amendment 3 established a bycatch reduction schedule of 25% over 5 years for king and Tanner crab bycatch in foreign fisheries. In 1987, Amendment 10 established PSC Zones and limits for yellowfin sole/other flatfish trawl fisheries. The PSC limits established were: Zone 1, 135,000 red king and 80,000 Tanner crabs; Zone 2, 326,000 Tanner crabs. In 1989, Amendment 12a extended PSC limits to all trawl fisheries and established PSC limits at: Zone 1, 200,000 red king and 1,000,000 Tanner crabs; Zone 2, 3,000,000 Tanner crabs. Amendment 12a also closed the Crab Protection Area 516 to all trawl fishing from March 15-June 15. Amendment 16, in 1991, authorized seasonal apportionment of PSC limits to specific trawl fisheries.

The Vessel Incentive Program (VIP), designed to reduce bycatch, was established, and the season opening date for the BSAI yellowfin sole/other flat fish was delayed from January 1 to May 1 by regulatory amendment. Amendment 19 revised the time/area (hotspot) authority to reduce PSC bycatch in 1992. The VIP was also expanded to cover all trawl fisheries. In 1995, Amendment 21a prohibited all trawl fishing in the Pribilof Islands Habitat Conservation Area. In 1995/96, Amendment 37 and subsequent inseason management actions prohibited trawl fishing in the Bristol Bay Red King Crab Savings Area from January 1-March 31, and then through June 15. Amendment 41 further modified these limits whereby the current stair-step levels were approved as negotiated by industry representatives (NPFMC 1997).

Red king crab – Amendment 37

Amendment 37 is the bundled-together management action to protect the Bristol Bay red king crab from possible impacts of the groundfish fishery. The 1995, NMFS bottom trawl survey indicated that red king crab, Tanner crab, and snow crab were at a record low of one-fifth of their exploitable biomass (Stevens et al. 1995) prompting the Council to recommend an emergency action rule to NMFS closing Bristol Bay to non-pelagic trawling. The Council formed a committee to develop a rebuilding plan for red king crab (Witherell 1995) and initiated several analyses to examine the impacts of crab bycatch control measures in the groundfish fishery, incorporating input from the Council's Advisory Panel and the State, who examined each crab species seperately: reducing existing bycatch limits (based on abundance), initiating snow crab bycatch limits, and closing the northeast section of Bristol Bay to protect juvenile red king crab. The PSC limits established would fluctuate with crab abundance, as indicated by NMFS annual bottom trawl survey.

The Bristol Bay Red King Crab Savings Area was adopted and later extended by inseason authority at the Council's January 1996 meeting, closing the area to trawling from January 1 through June 15 to protect red kung crab during the molting and mating period. The Council also asked staff to examine the impacts of a six month or year-round closure, and the management measures of modifying the Crab Savings Area, crab PSC bycatch limits, and the northern Bristol Bay closure area. The Council further asked its crab rebuilding committee to provide scientific advice and recommendations. To protect juvenile red king crab and critical rearing habitat, the Council recommended that all trawling be prohibited on a year-round basis in the nearshore waters of Bristol Bay, with a small excepted area open from April 1 to June 15

(159°-160°W and 58°-58°43'N). The Council reasoned that this time/area closure would protect juvenile red king crab while permitting trawling in a high catch area for flatfish.

PSC limits modification for red king crab in trawl fisheries

In June 1996, the Council recommended adoption of a stair-step limit regime for red king crab in Zone 1 based on abundance because stair-steps would address possible biases caused by rate-based limits and smoothed year-to-year variability while providing for reduced bycatch limits at low stock sizes. The stair-step limits were originally recommended by the Crab Plan Team and based on the number and weight of crab, similar to the State's definition for threshold for Bristol Bay red king crab. The Council's recommended PSC limits were the following (Table 7):

Table 7 Originally considered PSC limits for red king crab – for comparative purposes (X indicates the number of mature female crab).

Threshold (in millions of crab)	Effective Spawning Biomass (ESB) (in millions of pounds)	Zone 1 red king crab PSC limit (in crabs)	The Council 's Reasoning
Originally considered PSC limits for red king crab – Amendment 37, 1996			
X < or X=8.4	X < 14.5	35,000	Limit is based on the level of bycatch observed in the 1995 flatfish fisheries in Zone 1 with the Crab Savings Area closed to trawling.
X > 8.4	X= or X>14.5, but X<55.0	100,000	Limit corresponds to a 50% reduction from the previous PSC limit. Limit is the same percentage as applied by the BOF in 1996.
X > 8.4	X= or X> 55.0	200,000	Limit assumes a year in which the crab stock is rebuilt (i.e., above 55.0).

The current stair-steps of PSC limits for red king crab taken in the Zone 1 trawl fisheries is based on abundance of Bristol Bay red king crab and reflect a 3,000 crab reduction from the previous limits (Table 2). The 2008 estimate of effective spawning biomass is 75 million pounds, thus the PSC limit for 2009 is 197,000 red king crabs.

Snow crab – COBLZ

A closure for EBS snow crab (*C. opilio*) is triggered if the PSC limit is reached in certain specified fisheries. The PSC limit accrues for bycatch taken within the *C. opilio* Bycatch Limitation Zone (COBLZ). That area then closes for the fishery that reaches its specified limit (Figure 5). A crab PSC limit is established for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The snow crab PSC cap is established at 0.1133% of the total Bering Sea abundance, as indicated by the NMFS standard trawl survey, with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crabs taken within the COBLZ accrue towards the snow crab PSC limits established for individual trawl fisheries. Upon the attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery is prohibited from fishing within the COBLZ. Only snow crab taken within the COBLZ accrue toward the PSC limits established for individual trawl fisheries. The 2008 NMFS survey estimate of 2.60 billion crabs resulted in a 2009 snow crab PSC limit of 2,943,421 crabs, if left unadjusted. However, the BSAI groundfish FMP mandates a minimum of 4,350,000 snow crabs.

Tanner crab

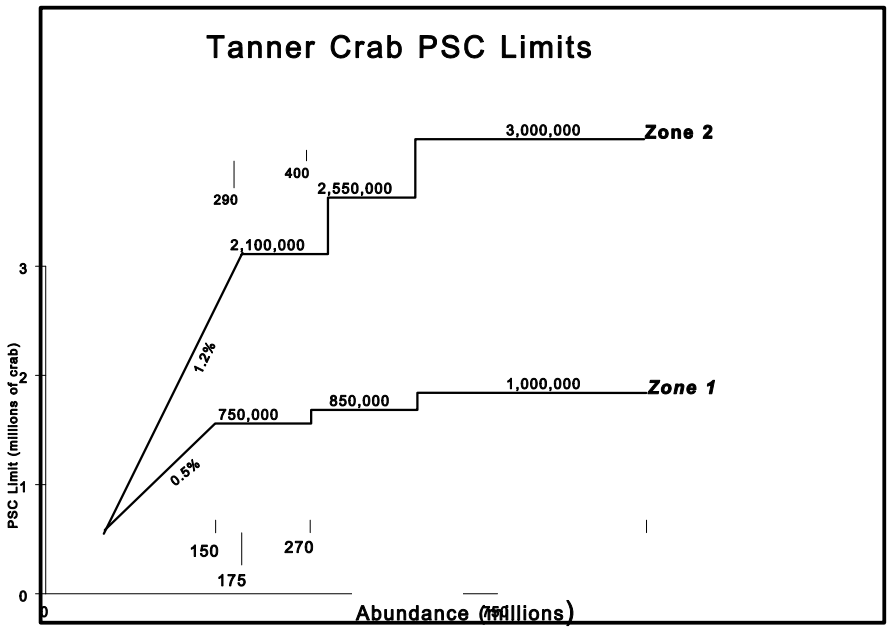
Stairstep measures in place for Tanner crab are shown in Table 8. These limits are established in Zones 1 and 2 based on the total abundance of Tanner crab (as indicated by the NMFS trawl survey). Attainment of Tanner crab PSC limits closes the respective fishery in the Zone in which the limit was attained.

Table 8 PSC limits for tanner crab.

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

The process by which these caps were initially established was a combination of proposals for limits put forward by the State of Alaska, recommendations from the Crab Plan Team, and by committee discussions amongst interested stakeholders. For Tanner crab, proposed lower threshold limits were based upon the average observed bycatch for the stock at that level of abundance (NPFMC 1996). The upper range of the limit was based on negotiated amounts when the stock was at a high abundance in 1988 (NPFMC 1996). The middle "step" level was established at an intermediary level between steps 1 and 3 (Figure 11).

Figure 11 Tanner Crab PSC Limits.



Amendment 41 further modified these limits whereby the current stair-step levels were approved as negotiated by industry representatives (NPFMC 1997). This negotiation process was the following: In

June, 1996, the Council formed an industry workgroup to review proposed PSC limits for Tanner and snow crab as detailed in the analysis for Amendment 37 (the red king crab PSC amendment). This Council work group consisted of three crab fishery representatives, three trawl fishery representatives, and one shoreside processing representative. The group met over two days in August 1996 and came to consensus on bycatch limits for Tanner crab. The stair-step PSC limits, as shown (table above and figure below) were agreed upon by the workgroup and were primarily developed from historical bycatch data.

5. Relationship of BSAI Crab FMP to BSAI Groundfish FMP

Under the annual OFLs established by Amendment 24 to the BSAI Crab FMP, all crab bycatch in groundfish (and scallop) fisheries counts against the OFL for each stock. There is no explicit linkage between the BSAI Crab FMP and the BSAI Groundfish FMP or Alaskan Scallop FMP. Scallop bycatch is almost entirely Tanner crab and at very low levels. Limits do exist in the Scallop fishery for Tanner crab and are based on abundance thresholds in relation to the Tanner crab stock status. Tanner crab removals by the scallop fishery will be explicitly considered in the next EBS Tanner crab assessment but represent a very low ratio of total removals. Following Crab Plan Team discussion in May 2009 on the relative removals from the scallop fishery as compared with the groundfish fishery, the CPT recommended that examination of limits and bycatch by stock in the groundfish fisheries were a high priority and removals from the scallop fishery were minimal.

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

> If an OFL for a crab species is exceeded in a given year, an overfishing determination will be found at the end of the crab fishing year, and a corresponding reduction in the harvest will be taken the following year so as to avoid a subsequent overfishing determination. Amendment 24 does not provide an in-season mechanism for determining if overfishing is occurring or a response for management measures in the directed crab fisheries. Overfishing is prevented by setting the OFLs prior to the State setting the TAC for the up coming crab fishing year. The TAC is constrained by the OFLs. The State is not mandated to close directed crab fisheries for exceeding the OFL in-season. This is distinctly different from Federal groundfish fisheries management.
>
> However, regardless of having an overfishing determination the following season, there are currently no corresponding management measures which occur in the groundfish or scallop fisheries to further limit crab bycatch. Crab catch in these fisheries is solely regulated by the bycatch limits as described in sections 10.1 – 10.4. Under all alternatives, regulations to reduce the bycatch of crab in groundfish and scallop fisheries would be considered when a crab stock becomes overfished and necessitates a rebuilding plan (or revisions to an existing rebuilding plan). Or, if the Council determines measure are necessary to end overfishing. In order for there to be any further feedback management mechanism in either the groundfish fisheries or scallop fisheries in the case that the catch of a particular crab stock exceeded its OFL, the respective BSAI groundfish FMP and Scallop FMP would need to be amended. Should a crab stock become overfished and necessitate the creation of a rebuilding plan (or revisions to an existing rebuilding plan), regulations on the bycatch of crab in groundfish and scallop fisheries would be considered again at that time and additional regulations under those FMPs may be considered in a new (or revised) rebuilding plan (pages 141-142 of the EA for Amendment 24 to the BSAI King and Tanner Crab FMP, NPFMC, 2008).

Under new ACL requirements, accountability measures must be specified. The intent of the AMs is to further protect a stock from overfishing by providing for a transparent response mechanism in the event that the established ACLs are exceeded.

The Council indicated in April that it is considering initiating an analysis to evaluate appropriate bycatch limits by crab stock on groundfish fisheries (see Appendix A, Council motion from April 2010). Limits in these fisheries by crab stock would effectively ensure that if the directed fishery TAC was set sufficiently below the ACL to account for both the estimate of bycatch in the directed crab fisheries as well as the sum of the bycatch limits in the groundfish fisheries, that the bycatch by groundfish fisheries would not drive the catch over the annually estimated ACL. Currently there is a risk that groundfish bycatch of crab species could potentially drive the annual catch to exceed the ACL. The Council will consider this issue at their June 2010 Council meeting.

The initial review draft for the ACL analysis includes the estimated breakdown of the sources mortality of crab for the 2009/10 OFL by stock. All catch accrues towards the OFL currently and these limits may be more constraining under new ACLs. Thus is any catch component exceeds its estimated breakdown it has the potential to drive the total catch over the OFL (and eventually the more constraining ACL). These tables are shown in Table 9 to Table 14 (see NPFMC 2010 for more information on how estimated sources of mortality by stock are calculated). For AIGKC and NSRKC the 2009/10 OFL was a retained catch OFL thus these breakdowns reflect the retained catch components only. The CPT recommends total catch OFLs for AIGKC, PIGKC and Adak red king crab for the 2010/11 crab fishing year. The final recommendation on OFLs and what to component of the catch they apply will be recommended by the SSC in June. Treatment of bycatch estimation from the groundfish fishery is described in the SAFE introduction (see 2010 draft Crab SAFE report).

Table 9 Breakdown of the 2009/10 OFL for Bering sea snow crab among the sources of mortality included in the OFL.

Component	Catch (1000t)
Directed fishery retained	21.8
Male discard in the directed fishery	2.07
Female discard in the direct fishery	0.02
Bycatch in the groundfish fishery	0.36
Total	**24.2**

Table 10 Breakdown of the 2009/10 OFL for Bristol Bay red king crab among the sources of mortality included in the OFL

Component	Catch (t)
Directed fishery	9,559
Male discard in the directed fishery	942
Female discard in the direct fishery	152
Bycatch in the trawl fishery	108
Bycatch in the Tanner fishery	13
Total	**10,774**

Table 11 Breakdown of the model-based estimate of the 2010/11 OFL for Pribilof Islands red king crab among the sources of mortality included in the OFL.

Component	Catch (t)
Directed fishery	392
Male discard in the directed fishery	5
Bycatch in the trawl fishery	13
Bycatch in the Fixed gear fishery	1
Total	413

Table 12 Breakdown of the 2010/11 OFL for St Mathews Island blue king crab among the sources of mortality included in the OFL

Component	Catch (t)
Directed fishery	1,015
Male discard in the directed fishery	92
Bycatch in the trawl fishery	1
Bycatch in the Fixed gear fishery	31
Total	**1,140**

Table 13 Breakdown of the 2009 OFL for Norton Sound red king crab among the sources of mortality included in the OFL.

Component	Catch (t)
Summer fishery	253
Winter fishery	6
Subsistence fishery	11
Total	**270**

Table 14 Breakdown of the 2009/2010 OFL for Aleutian's Islands golden king crab among the sources of mortality included in the OFL.

(a) Dutch Harbor golden king crab

Component	Catch (t)
Retained males	11,874
Discarded males	645
Total	12,519

(b) Adak golden king crab

Component	Catch (t)
Retained males	8,254
Discarded males	721
Total	8,976

Until any additional action is taken to manage the annual bycatch of crab species, if the ACL is exceeded in any given year the accountability measure would be for some reduction in the directed fishery catch in the subsequent year in order to buffer against the possibility of exceeding the ACL in the following year.

6. Bycatch by Crab Stock

The following sections provide an overview of groundfish bycatch by gear type from 2003/04 through 2008/09. Bycatch is listed by crab fishing year (July through the following June), consistent with the time period over which removals accrue against the OFL for crab stocks. All crab bycatch data are from the NMFS catch accounting and are consistent with the information provided to crab stock assessment authors for use in their most recent stock assessments. The catch accounting system estimates were used for 2003-2009.

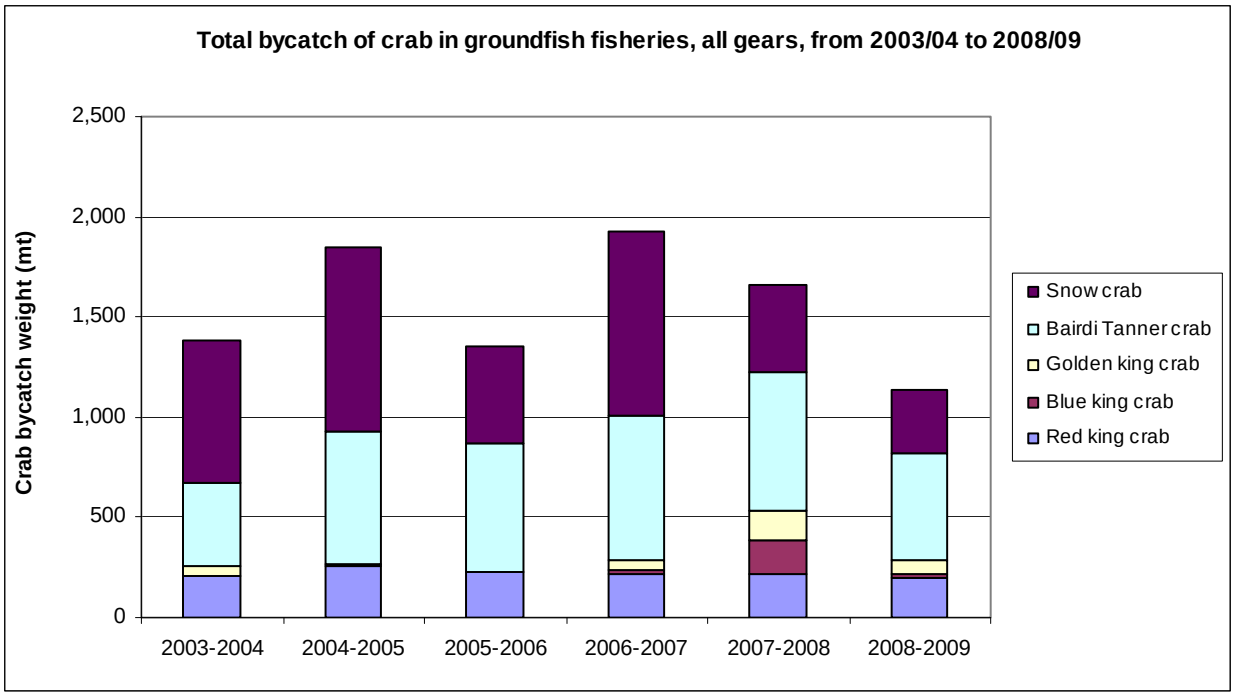


Figure 12 Total bycatch in wt (mt) of all species of crab by all groundfish gear types, 2003/04-2008/09.

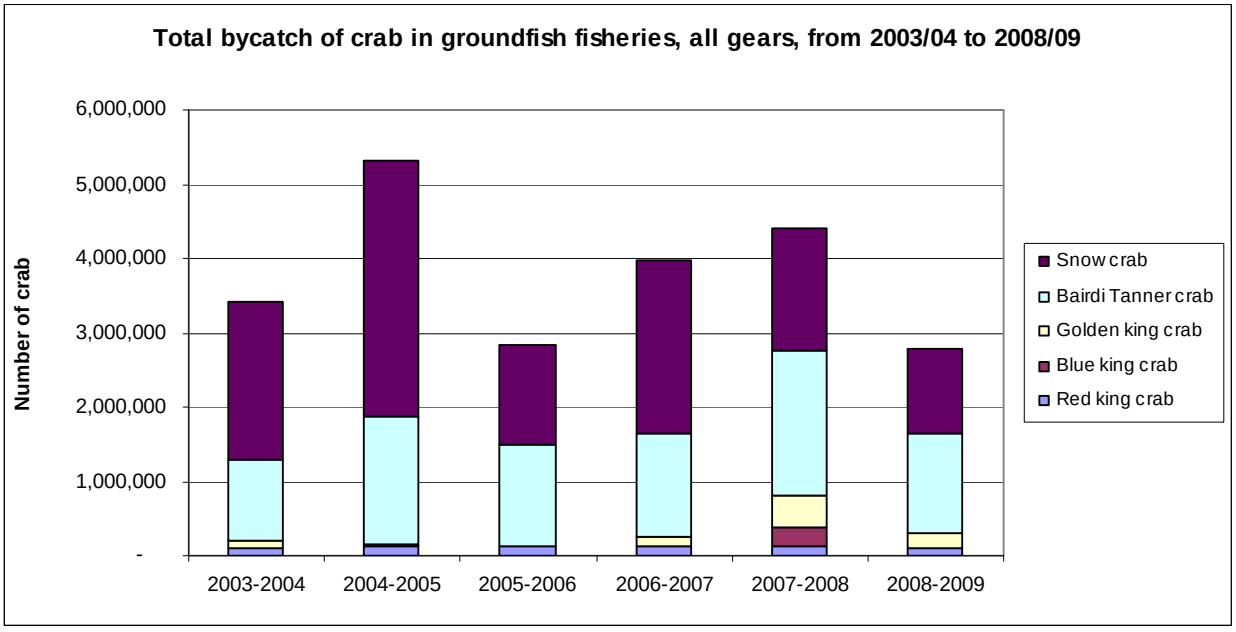


Figure 13 Total bycatch in numbers of all species of crab by all groundfish gear types, 2003/04-2008/09

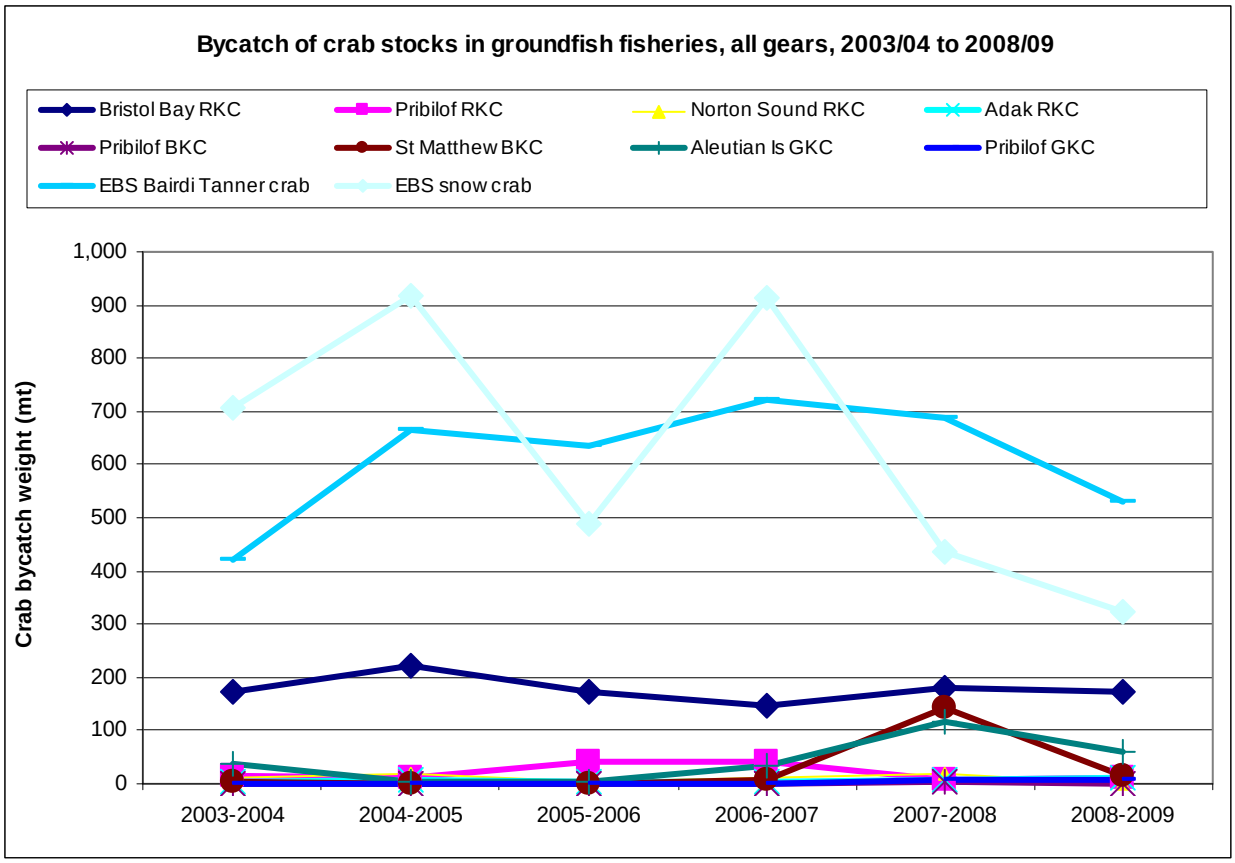


Figure 14 Bycatch by weight of all crab by stock by all groundfish fishery gears 2003/04-2008/09

Additional summary information is provided in figures X through XX for bycatch and mortality by all groundfish fisheries by individual species and stock. For Snow crab and Tanner crab stocks, figures detailing all the trends in time since 2003/04 are contained in the individual sections for those stocks.

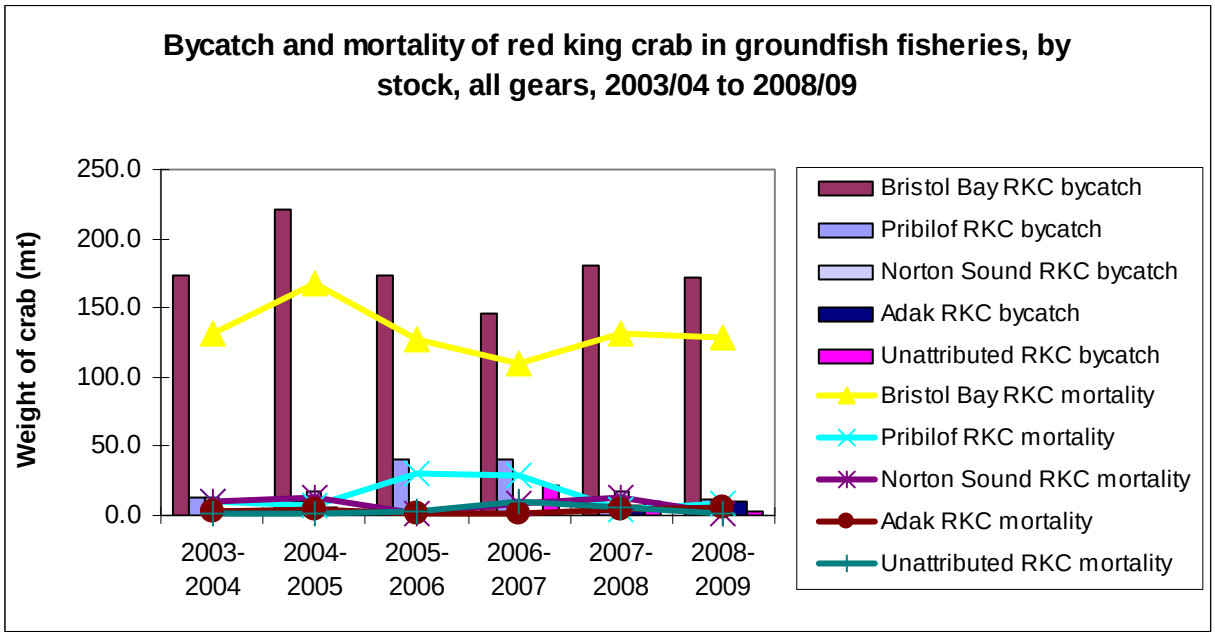


Figure 15 Bycatch (mt) and mortality (50% for fixed gear, 80% trawl gear) for all red king crab stocks.

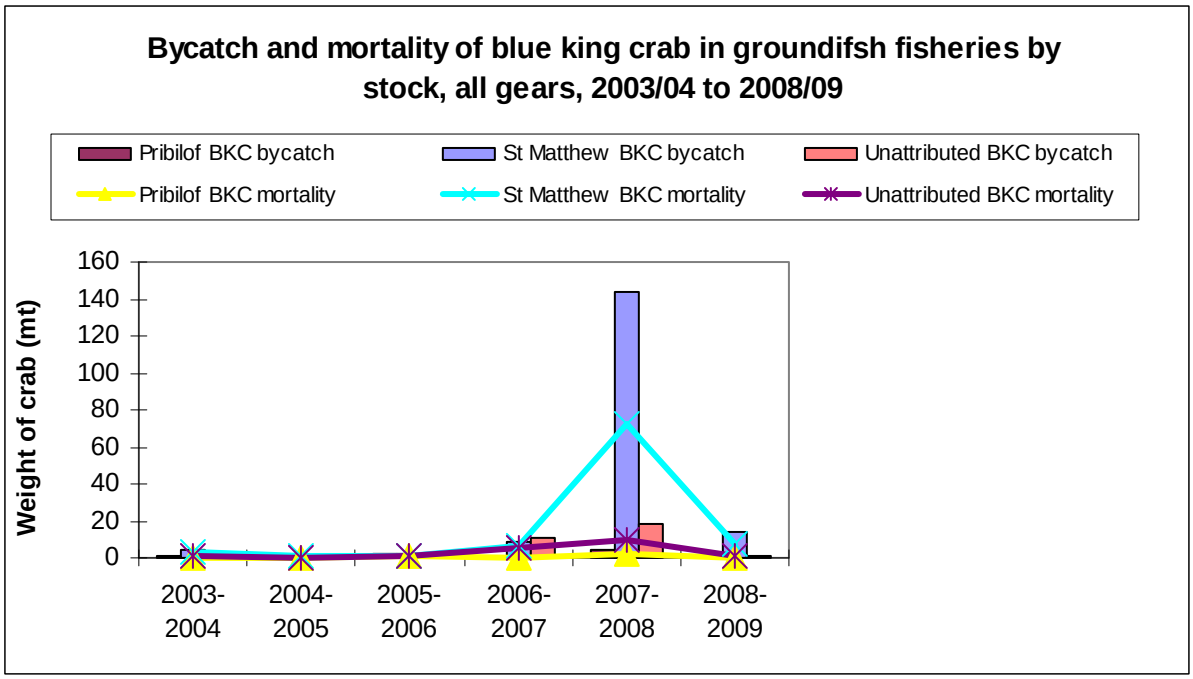


Figure 16 Bycatch (mt) and mortality (50% for fixed gear, 80% trawl gear) for all blue king crab stocks.

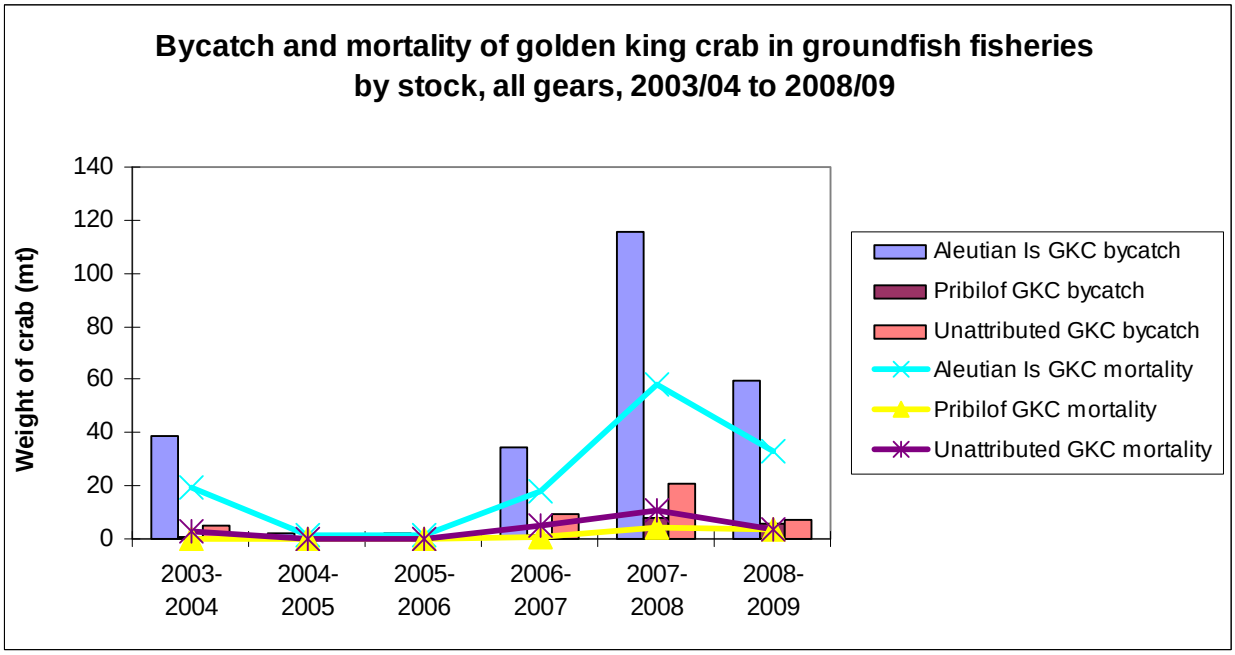


Figure 17 Bycatch (mt) and mortality (50% for fixed gear, 80% trawl gear) for all blue king crab stocks.

Bycatch by fishery for the years 2003/04-2008/09 are summarized here as well as the percentage of the OFL represented by these removals in the most recent year (2008/09). This information is included in

response to the Council's October 2009 motion (see Appendix D) to provide some indication of which fisheries are most likely to be affected by any subsequent limitation of crab bycatch by stock, should the Council move forward with an analysis of additional crab bycatch measures.

Bycatch for stocks under a total catch OFL are all summarized here. At the May 2010 Crab Plan Team meeting, the CPT recommended a total catch OFL for all stocks which had been previously prosecuted under a retained catch OFL (see Crab Plan Team meeting report, May 2010). The SSC will make the final recommendations for these stocks in June 2010.

Bycatch data are summarized by removals in millions of lbs (with mortality applied as 50% for fixed gear and 80% for trawl gear). Bycatch data are also summarized by removals in mt with and without mortality rates applied as well as in overall numbers of crabs (no mortality applied) in Appendix D. Groundfish fishing patterns in 2008/09 changed as a result of the implementation of Amendment 80, which created sector allocations and cooperatives for the head and gut trawl catcher/processor fleet for five species: Atka mackerel, Pacific ocean perch, yellowfin sole, flathead sole, and rocksole. Additionally, 2008/09 is the first year of implementation of Amendment 24 to the Crab FMP, whereby all crab removals from groundfish, crab, and scallop fisheries accrue against stock-specific OFLs. In each section below, a single comparison is made for stocks indicating which percentage the total catch in 2008/09 in groundfish fisheries was compared to the OFL for that stock.

6.1.1. Aleutian Islands Golden King Crab

Bycatch mortality rates of AIGKC by year and gear type are shown in Figure 18 and. Fishery-specific bycatch (screened for confidentiality) for 2003/04 to 2008/09 is shown in Table 15.

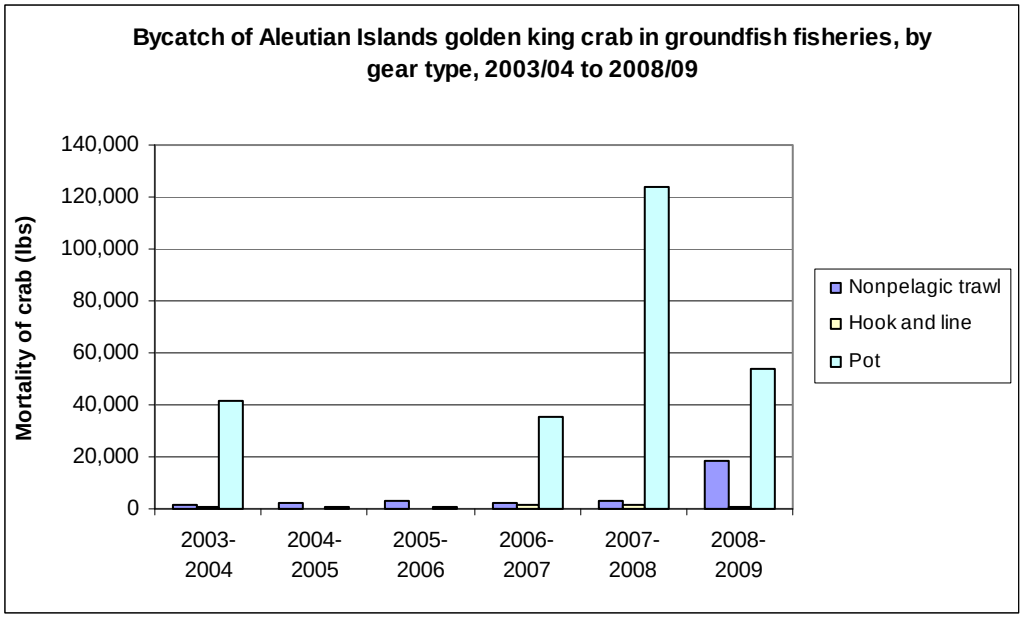


Figure 18. Bycatch mortality (lbs) for Aleutian Islands golden king crab, all gears 2003/04-2008/09.

Table 15. Bycatch mortality by fishery and gear type in millions of lbs. for Aleutian Islands golden king crab 2003/04-2008/09. Note halibut included in hook and line is not from the directed halibut fishery.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pacific cod	0	14	125	237	4	53	72
	Arrowtooth flounder						786	131
	Greenland turbot						549	91
	Rockfish	1,199	1,940	1,759	1,622	1,938	2,047	1,750
	Atka mackerel	0	8	1,437	602	972	14,735	2,959
Hook and line	Pacific cod	0	0	3	7	167	191	61
	Sablefish	104	66	50	118	466	127	155
	Arrowtooth flounder			22	247	131		67
	Greenland turbot	92	5	0	594	471	0	194
	Other species	0	1	1	109			18
	Halibut	255	121	110	130	4	70	115
Pot	Pacific cod				28	1	0	5
	Sablefish	41,818	970	414	35,527	124,136	53,919	42,797
Grand Total		43,467	3,124	3,922	39,220	128,288	72,482	48,417

AIGKC in the 2008/09 crab fishing year operated under a retained catch OFL of 9.18 million pounds. For comparison against this amount, the total groundfish crab bycatch mortality in 2008/09 was approximately 39,906 lbs or 0.4% of the retained catch OFL. The highest mortality occurred in the sablefish pot fishery, followed by the Atka mackerel trawl fishery. Bycatch by month in numbers of crabs (not discounted for mortality) in the sablefish pot fishery indicated the highest bycatch in May (Figure 19). Bycatch was primarily taken in Area 541. In contrast, bycatch in the Atka mackerel trawl fishery was highest in September/October. Observer coverage in the sablefish pot fishery is low. Relative levels of observed catch from 2004 to 2007 indicate that 28-59% of the catch was observed in the sablefish pot fishery (http://www.fakr.noaa.gov/npfmc/current_issues/observer/percent_observed.pdf). Sablefish pot fishing has increased dramatically in the Aleutian Islands and the Bering Sea since 1999. In 2007, pot gear accounted for 81% of the Bering Sea fixed gear IFQ catch and 56% of the catch in the Aleutians (Hanselman et al, 2008). The Atka mackerel trawl fishery has high observer coverage (100% over the time frame 2004-2007), given that it is mainly prosecuted by vessels >125'.

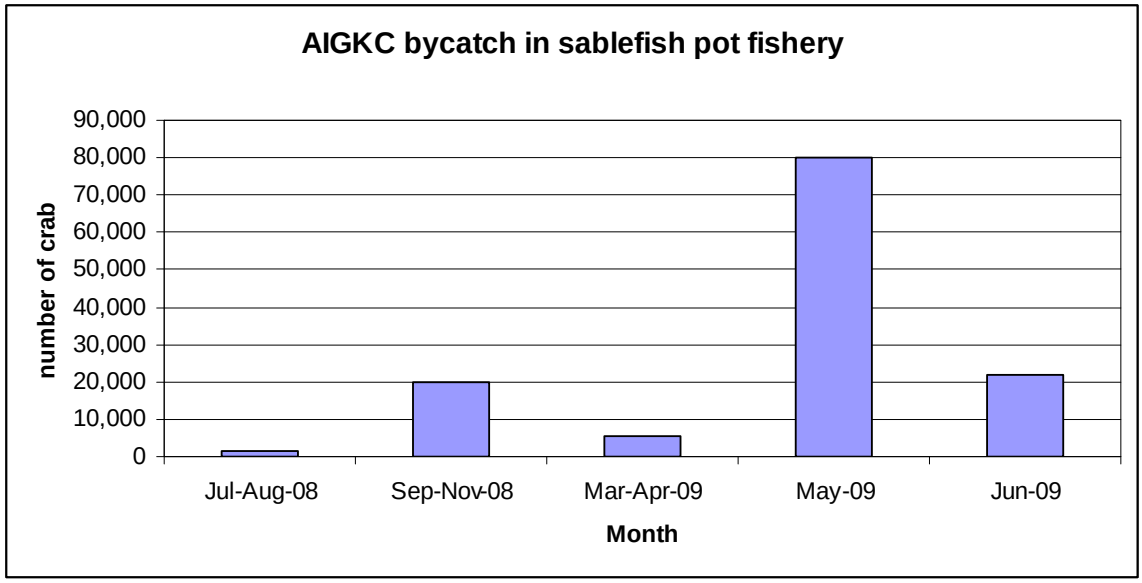
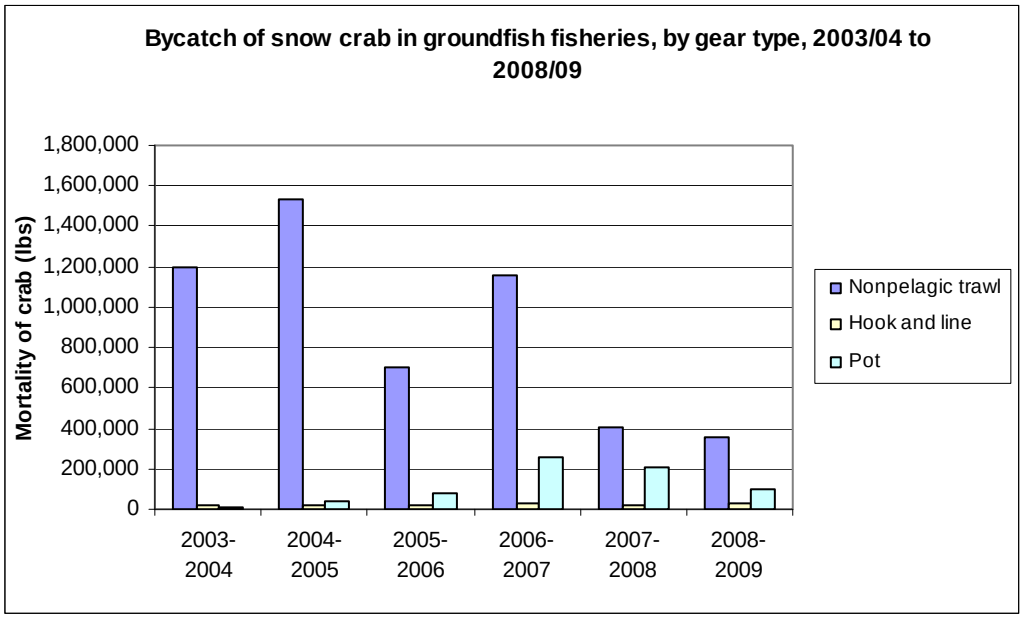


Figure 19. Bycatch of AIGKC in the sablefish pot fishery (numbers of crab, not discounted for mortality) 2008/09 crab fishing year.

6.1.2. EBS snow crab

Bycatch mortality from groundfish fisheries by gear type from 2003/04 to 2008/09 is shown in



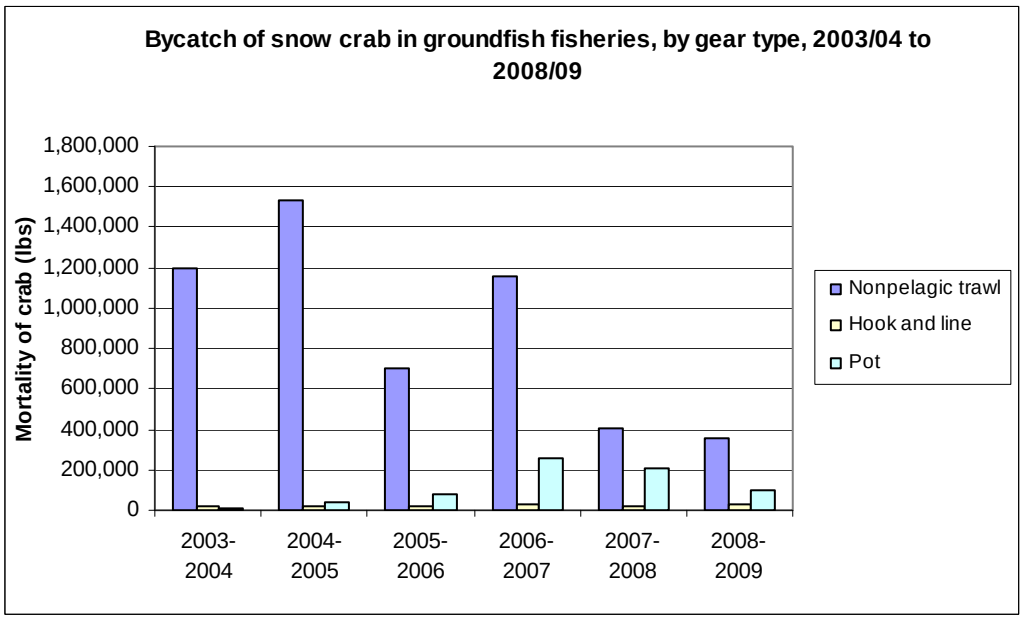


Figure 20. Bycatch mortality (lbs) for EBS snow crab, all gears 2003/04-2008/09.

Fishery-specific bycatch (screened for confidentiality) for 2003/04 to 2008/09 is shown in Table 16

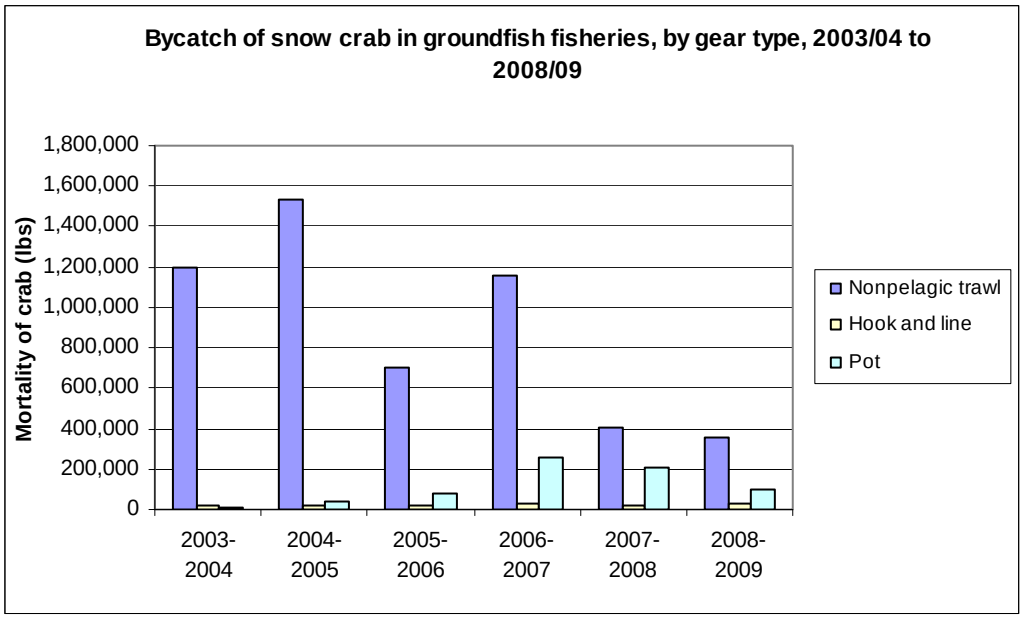


Figure 20. Bycatch mortality of snow crab (in mt) by gear type for EBS snow crab.

Table 16. Bycatch mortality of snow crab by fishery and gear type (lbs) for 2003/04 – 2008/09

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock	4	0	56	195	1,883	1,369	585
	Pacific cod	36,812	47,373	32,886	212,414	32,739	7,407	61,605
	Alaska plaice			126	107	3,995	189	736
	Yellowfin sole	904,107	1,178,536	475,910	819,117	203,005	241,469	637,024
	Rock sole	111,303	247,524	70,357	70,741	13,629	6,445	86,666
	Arrowtooth flounder	599	489	532	7,108	523	4,752	2,334
	Flathead sole	144,444	49,930	122,177	50,357	139,341	96,720	100,495
	Other flatfish	65	514	210	140	0	2	155
	Greenland turbot	1,052	31	0			0	181
	Other species	125	6,343	102	86	6,639		2,216
Pelagic trawl	Pollock	340	638	972	2,212	1,548	2,851	1
Hook and line	Pacific cod	18,641	18,158	23,530	25,773	18,041	27,354	21,916
Pot	Pacific cod	11,371	36,374	77,057	253,556	209,366	103,184	115,151
Grand Total		1,228,939	1,585,966	804,053	1,441,881	630,812	491,826	1,030,580

The 2008/09 OFL for EBS snow crab was 77.30 million pounds. Total groundfish fishery mortality of snow crabs in 2008/09 was approximately 410,240 lbs or approximately 0.5% of the OFL. Mortality occurred primarily in the yellowfin sole trawl fishery, with lesser amounts in the flathead sole trawl fishery and the Pacific cod pot fishery. Timing of bycatch in 2008/09 (aggregated by month) in the yellowfin sole fishery indicates the majority of the bycatch occurs between August and November with additional high numbers in April (Figure 21).

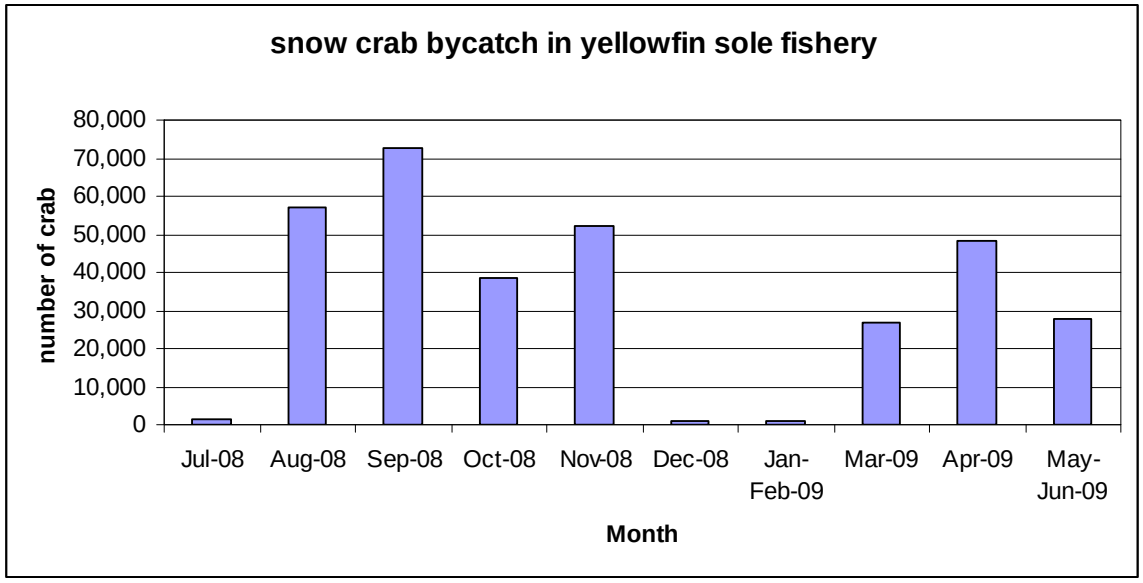


Figure 21. Bycatch by month (numbers of crab, no mortality applied) of snow crab in the yellowfin sole fishery 2008/09 (crab fishing year).

6.1.3. Bristol Bay red king crab

Bycatch mortality from groundfish fisheries by gear type from 2003/04 to 2008/09 is shown in Figure 22.

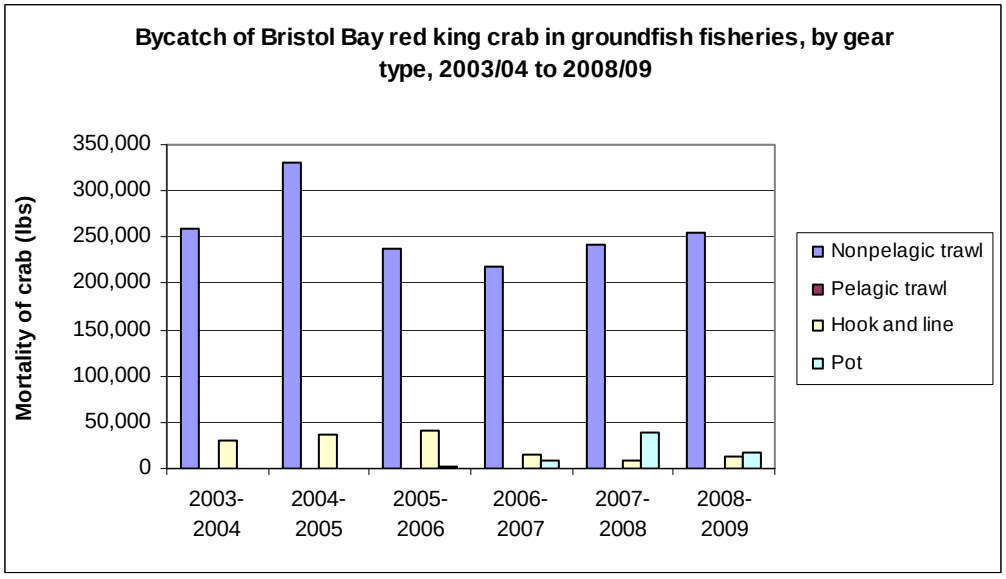


Figure 22. Bycatch mortality (lbs) by gear type Bristol Bay red king crab.

Total bycatch mortality by fishery from 2003/04 to 2008/09 is shown in Table 17.

Table 17. Bycatch mortality by fishery and gear type for Bristol Bay red king crab 2003/04-2008/09.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock, bottom	38	0	583		0	4,996	936
	Pacific cod	2,268	5,994	19,724	5,095	3,486	3,069	6,606
	Yellowfin sole	108,704	167,176	33,931	36,456	62,600	68,615	79,580
	Rock sole	147,069	156,821	181,336	173,150	173,829	169,139	166,891
	Arrowtooth flounder	186	0	0	2,731	0	152	511
	Flathead sole	0	1,304	932	432	1,360	7,937	1,994
Hook and line	Pacific cod	30,247	36,472	41,426	16,032	8,255	13,015	24,241
Pot	Pacific cod	14	257	1,359	8,970	39,855	17,213	11,278
Grand Total		288,669	368,211	279,819	242,915	289,644	284,248	292,251

The Bristol Bay red king crab OFL in 2008/09 was 24.20 million lbs. Groundfish bycatch over this time period accruing towards the OFL was approximately 297,670 lbs or approximately 1.2% of the OFL. The highest source of mortality by fishery was in the rocksole trawl fishery, followed by the yellowfin sole trawl fishery and the Pacific cod fisheries (fixed gear and trawl) (Table 17). Bycatch by month for July 2008-June 2009 (crab fishing year) in the rock sole trawl fishery indicates the majority of bycatch was taken in January and February (Figure 23).

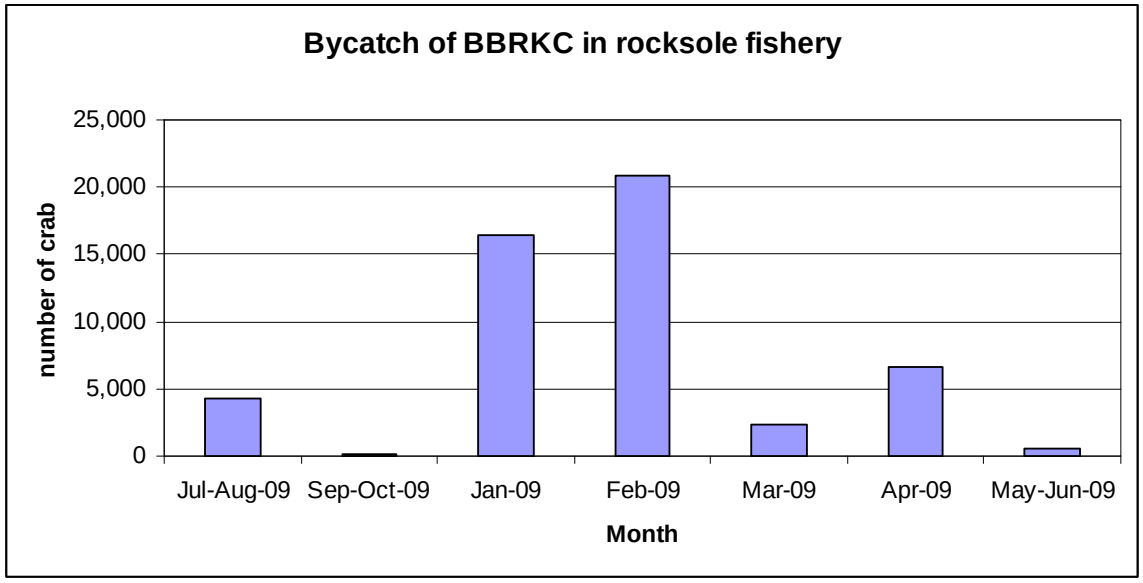


Figure 23. Bycatch by month of Bristol Bay red king crab in the rocksole trawl fishery July 2008-June 2009 (Crab fishing year). Numbers of crab aggregated by month (not discounted for mortality).

6.1.4. EBS Tanner crab

Bycatch mortality from groundfish fisheries by gear type from 2003/04 to 2008/09 is shown in Figure 24. Mortality by fishery from 2003/04 to 2008/09 is shown in Table 18.

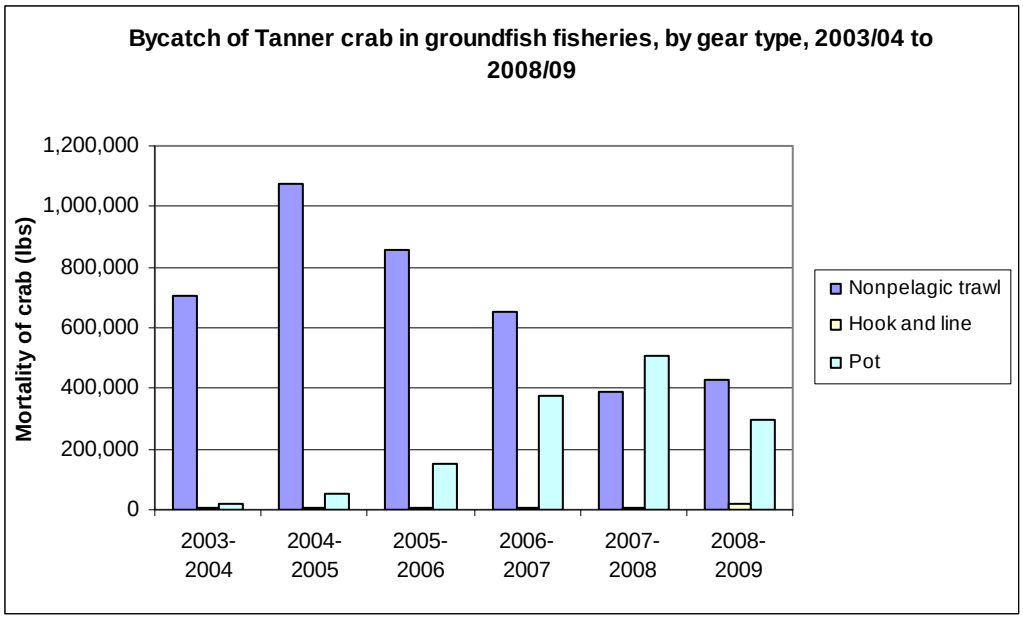


Figure 24. Bycatch mortality (lbs) by gear type for EBS Tanner crab.

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

Table 18. Bycatch mortality by fishery and gear type (lbs) for EBS Tanner crab 2003/042008/09.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock, bottom	7	2	466	525	1,284	4,762	1,174
	Pacific cod	86,048	200,165	142,498	153,343	28,181	10,041	103,379
	Yellowfin sole	240,869	487,846	294,700	274,736	177,198	269,327	290,779
	Rock sole	119,531	240,985	130,217	88,603	62,740	64,831	117,818
	Arrowtooth flounder	4,150	7,150	7,295	37,350	1,363	23,862	13,528
	Flathead sole	247,616	130,322	281,921	95,416	114,601	57,851	154,621
	Other flatfish	3,344	5,962	2,094	3,229	1,933	413	2,829
	Greenland turbot	1,977	0	72			0	341
	Atka mackerel	526	1,151	42	253	65	0	340
	Other species	221	1,485	46	112	689	28	430
Pelagic trawl	Pollock	324	778	554	1,054	681	763	692
Hook and line	Pacific cod	3,843	5,441	8,130	9,769	6,797	16,461	8,407
Pot	Pacific cod	18,727	54,624	154,684	378,143	508,508	297,445	235,355
Grand Total		727,441	1,136,080	1,023,787	1,042,687	904,545	746,121	930,110

Bycatch by month in the yellowfin sole fishery from July 2008-June 2009 shows that the highest bycatch was taken in the spring from March to May in 2009 (Figure 25). Bycatch was also taken in this fishery in the fall between September and November in 2008. This is the first year of rationalized flatfish fisheries (under Amendment 80), thus for these fisheries the snapshot of bycatch (timing and amounts) may be representative of future conditions given the transition form open-access to rationalization in these fisheries. Observer coverage is also increased as a result of implementation of Amendment 80. Bycatch in the Pacific cod pot fishery was highest in January 2009, with bycatch also taken in high numbers in September and October of 2008 (Figure 26). Observer coverage in the Pacific cod pot fishery is variable (http://www.fakr.noaa.gov/npfmc/current_issues/observer/percent_observed.pdf), but much of the catch is taken in the shoreside sector with lower observer coverage. The observed catch percentages from 2004-2007 in the shoreside sector for Pacific cod pot fishery ranged from 0-41% of the catch observed depending upon vessel size (0% in the <60' and a high of 41% observed catch in 2007 in the >125' class in 2007).

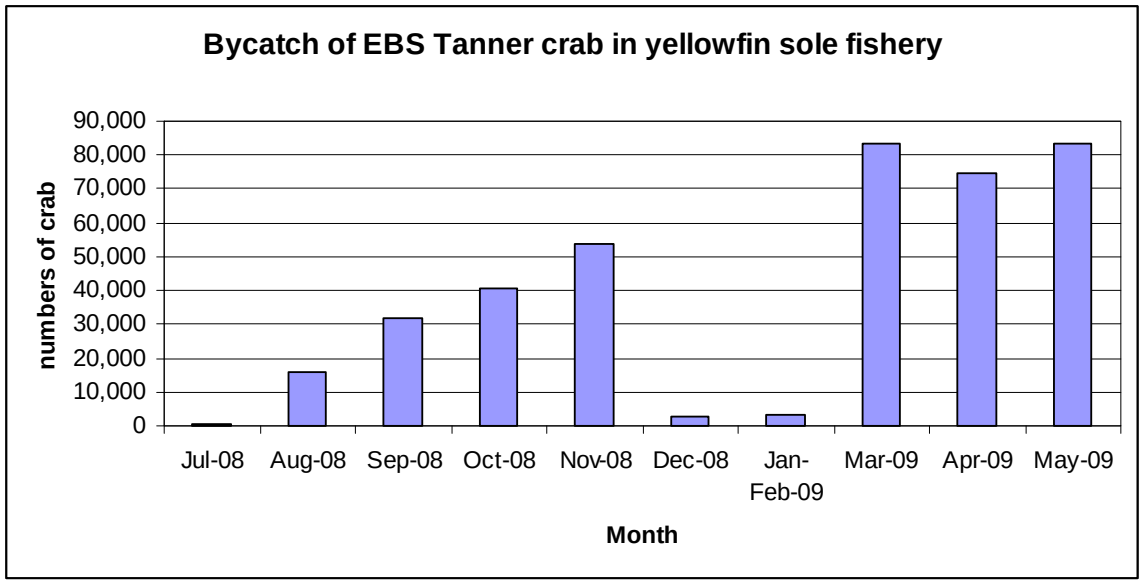


Figure 25. Bycatch of EBS Tanner crab in the Yellowfin sole fishery from July 2008-June 2009 (crab fishing year). Numbers of crab, not discounted for mortality.

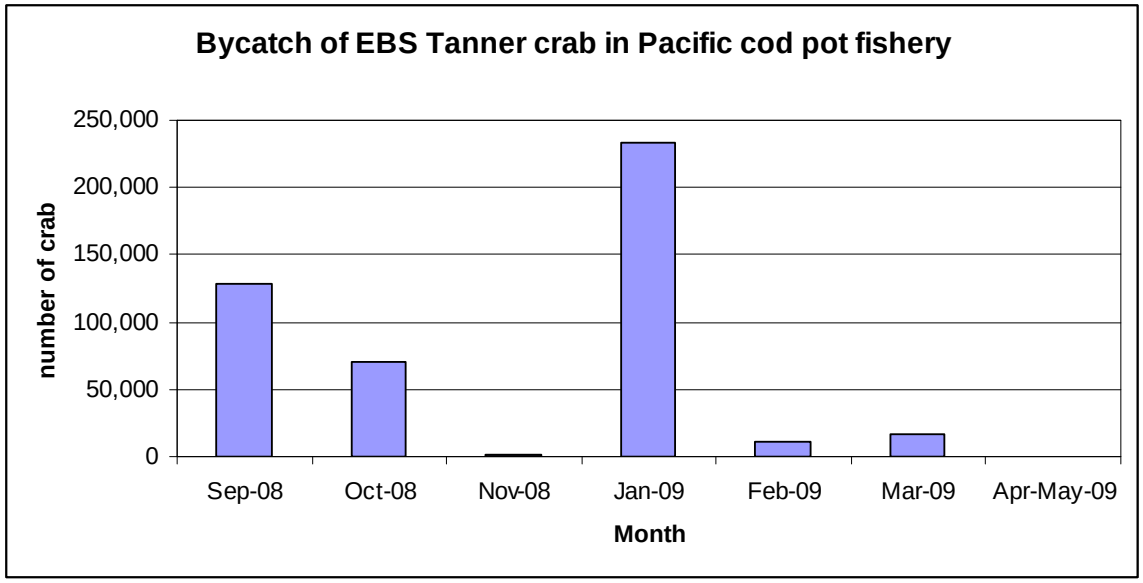


Figure 26. Bycatch of EBS Tanner crab in the Pacific cod pot fishery from July 2008-June 2009 (crab fishing year). Numbers of crab, not discounted for mortality.

6.1.5. Pribilof Island blue king crab

Bycatch mortality levels of PIBKC 1991/92-2008/09 are shown in Figure 27. Total bycatch mortality by fishery from 2003/04 to 2008/09 is shown in Table 19. The majority of the bycatch in 2008/09 occurred in the Pacific cod hook and line fisheries, and in the flatfish trawl fisheries. The initial review draft of the revised rebuilding plan for this stock will be reviewed at the October 2010 Council meeting. Alternatives include PSC limits by fishery and time and area closures.

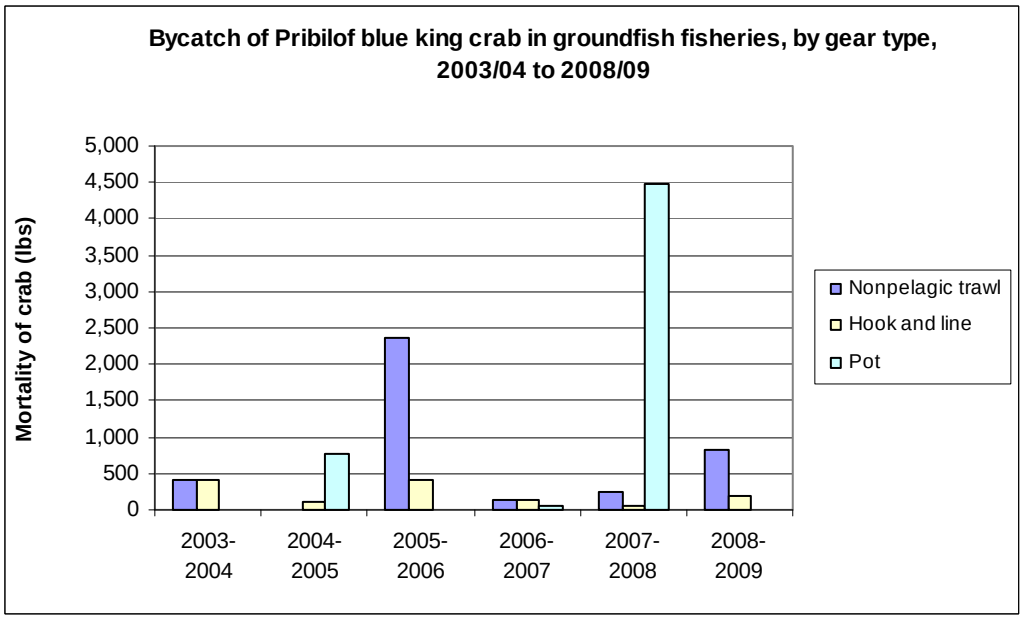


Figure 27. Bycatch mortality by gear type for Pribilof Island blue king crab

Table 19 Bycatch mortality by fishery (lbs) from 2003/04-2008/09 for Pribilof Islands blue king crab.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	7	0	1,564	94	182	835	447
	Rock sole	0	0	745	0	0	0	124
	Flathead sole	391	0	54	0	51	0	83
Hook and line	Pacific cod	403	111	418	131	56	180	216
Pot	Pacific cod	0	759		47	4,482	1	881
Grand Total		803	872	2,780	309	4,771	1,017	1759

6.1.6. Pribilof Island red king crab

Bycatch mortality of PIRKC in groundfish fisheries by gear type from 2003/04 to 2008/09 is shown in Figure 28. Table X shows the bycatch mortality by groundfish fishery from 2003/04 to 2008/09. The 2008/09 OFL for PIRKC was 3.32 million pounds. The total mortality from bycatch in groundfish fisheries applied towards this OFL was approximately 16,750 lbs or 0.5% of the OFL. Given the observed decrease in biomass for this stock, the recommended 2009/10 OFL was 0.50 million pounds (NPFMC 2009). Similar groundfish bycatch levels represent a greater portion of the OFL in the 2009/10 assessment cycle.

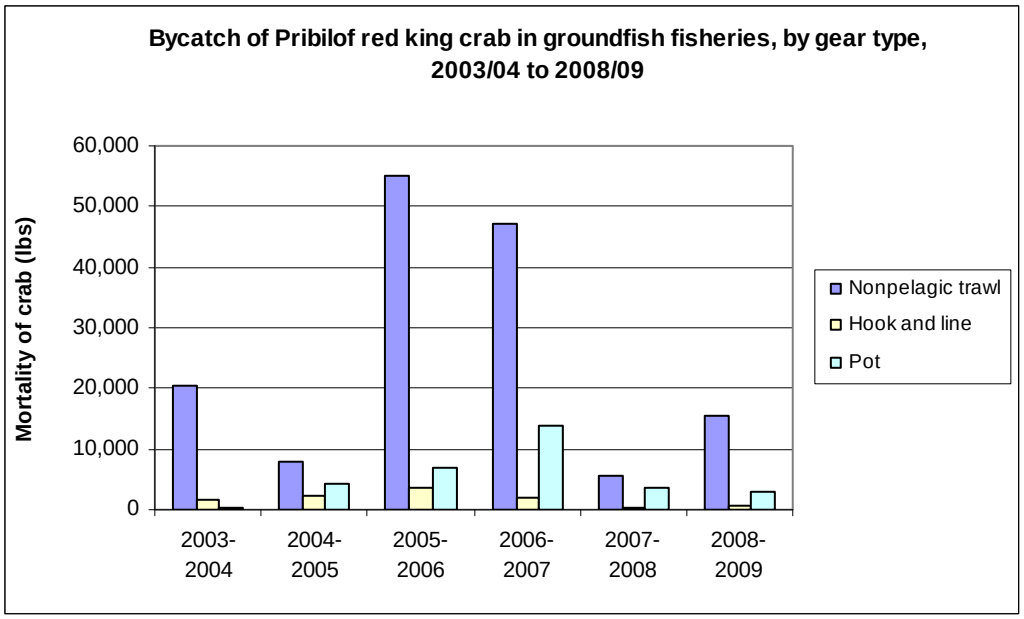


Figure 28. Bycatch mortality by gear type for Pribilof Islands red king crab.

Table 20. Bycatch mortality by fishery and gear type (lbs) for PIRKC 2003/04 to 2008/09.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	18,844	7,507	39,048	45,117	3,382	8,450	20,391
	Rock sole	1,473	0	15,955	133	131	1,905	3,266
	Flathead sole	58	243	3	1,821	2,078	3,773	1,329
Hook and line	Pacific cod	1,492	2,355	3,597	1,840	293	545	1,687
Pot	Pacific cod	378	4,364	6,963	13,806	3,691	3,039	5,374
Grand Total		22,313	14,488	65,702	62,731	9,750	19,159	32,357

6.1.7. St. Matthew blue king crab

Bycatch mortality from groundfish fisheries by gear type from 2003/04 to 2008/09 is shown in Figure 29. Table X shows the bycatch mortality by groundfish fishery from 2003/04 to 2008/09.

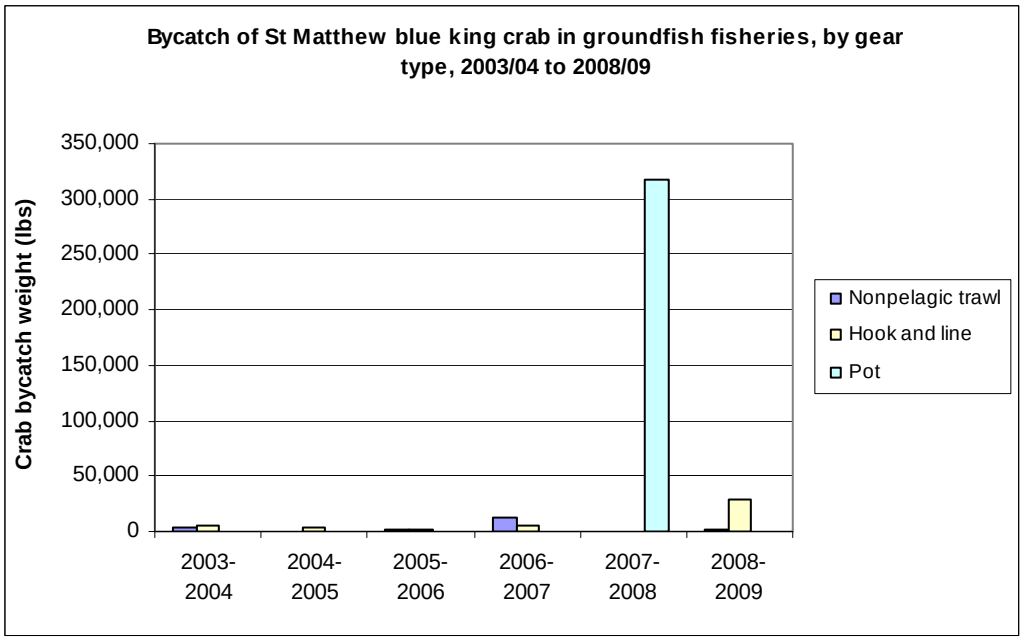


Figure 29. Bycatch mortality (lbs) by gear type for St. Matthew blue king crab stock.

The retained catch OFL for St. Matthew blue king crab in 2008/09 was 1.63 million pounds. For comparison, the total bycatch mortality in the groundfish fisheries for 2008/09 was approximately 6,885 lbs or 0.4% of the OFL. This was primarily from the Pacific cod fishery. This amount did not accrue towards the OFL, however, because the OFL for that year was retained-catch only. In 2009/10, the OFL is for all catch. For comparison, in 2007/2008 (where the bycatch in groundfish fisheries, especially fixed gear, was quite high), the total catch was approximately 77,200 lbs (which, when compared against an OFL of 1.63 million pounds, would have represented approximately 4.7% of the OFL).

Table 21. Bycatch mortality by fishery and gear type (lbs) for St. Matthew blue king crab2003/04 to 2008/09.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09

Nonpelagic trawl	Pacific cod	3,565	306	0	9,513	0	401	2,298
	Yellowfin sole	11	67	1,042	343	139	211	302
	Rock sole	0	0	6	73	0	0	13
	Arrowtooth flounder		0	0	0	127	230	60
	Flathead sole	0	0	1	0	41	106	25
Hook and line	Pacific cod	2,491	1,367	1,329	3,109	178	14,567	3,840
Pot	Pacific cod	112	23		201	158,595	2	26,489
Grand Total		6,178	1,766	2,384	13,239	159,081	15,541	33,031

6.1.8. Adak red king crab

Adak red king crabs are a Tier 5 stock and thus have a retained catch OFL in 2008/09-2009/10. The CPT has recommended a total catch OFL for 2010/11. Bycatch from the groundfish fisheries of Adak RKC is summarized in Table 24 by gear type and Table 22 by fishery for 2003/04 to 2008/09.

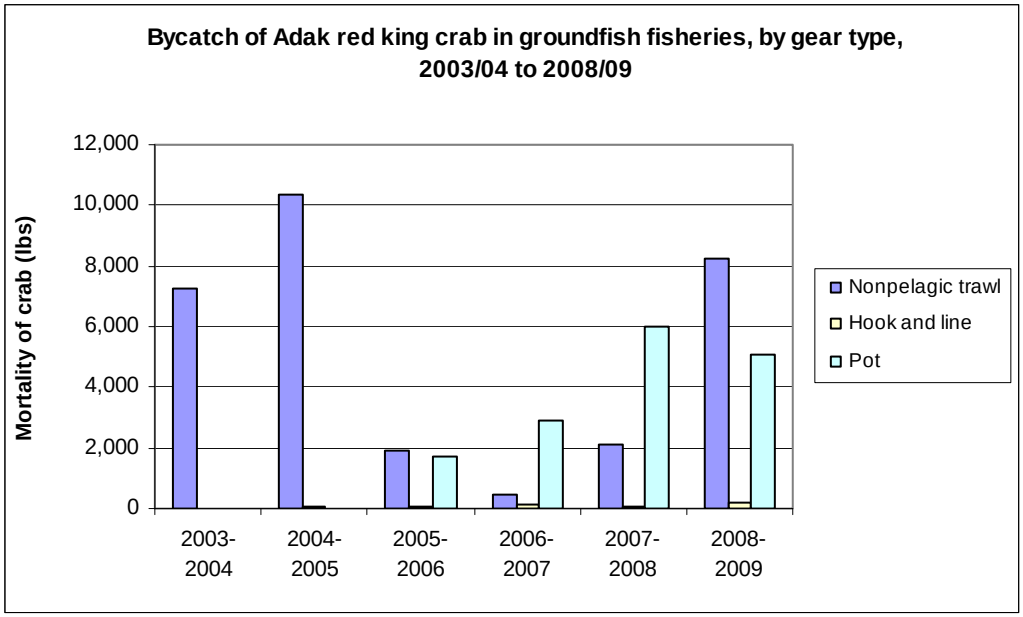


Figure 30. Total groundfish bycatch numbers (no mortality applied) all gear types for Adak red king crab.

Table 22. Bycatch mortality by fishery and gear type (lbs) for Adak red king crab 2003/04 to 2008/09.

	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
NPT	Pacific cod	2,657	10,344	64	118	343	1,747	2,545
	Rockfish	4,544	0	1,645	203	586	802	1,297
	Atka mackerel	78	0	175	172	1,174	5,684	1,214
HAL	Pacific cod	2	0	32	3	43	147	38
	Sablefish	0	60	1	0	31	22	19
	Greenland turbot	0	0	0	114	0	0	19
POT	Pacific cod			4	2,931	5,923	5,061	2,320

	Sablefish	0	0	1,705	0	80		297
Grand Total		7,282	10,434	3,629	3,554	8,181	13,462	7,757

6.1.9. Northern District red king crab bycatch

Red king crab bycatch in the Northern District (Area 514) is not counted towards any stock. A summary of bycatch in groundfish fisheries in this area is shown in Figure 31). Bycatch in this area is almost entirely by trawl gear.

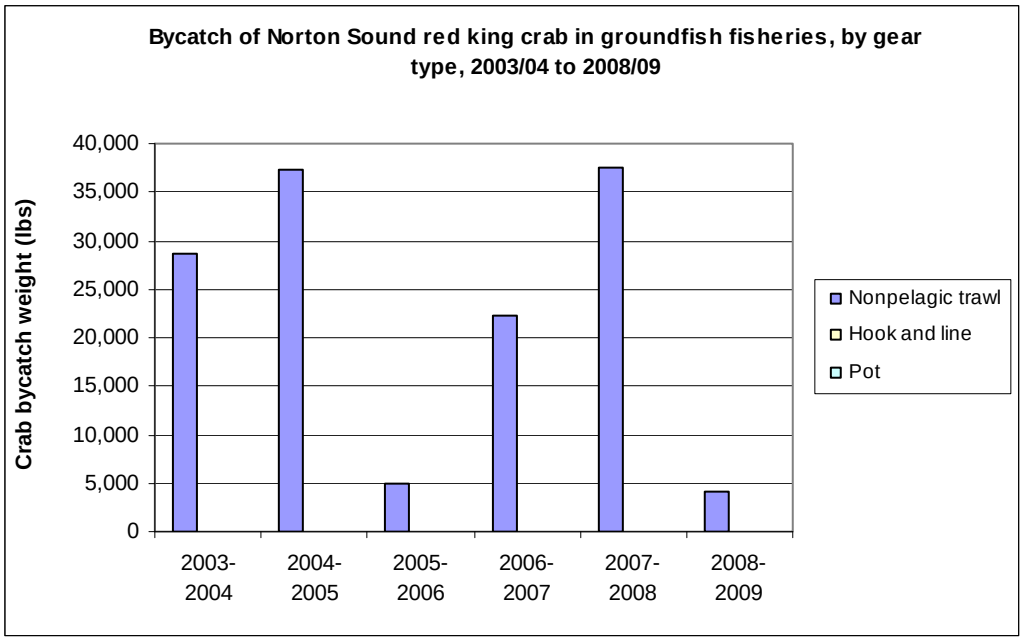


Figure 31. Total bycatch numbers all groundfish gear types, no mortality applied, for red king crab in the Northern District.

Bycatch of red king crab in Area 514 has been exclusively in the yellowfin sole and rock sole trawl fisheries (Table 23).

Table 23. Bycatch mortality by fishery and gear type and overall bycatch numbers for Northern District red king crab 2008/09.

	Target fishery	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	25,399	29,111	3,720	9,390	3,538	2,364	12,254
	Rock sole	3,270	8,246	1,207	12,969	33,756	1,675	10,187
Grand Total		28,669	37,357	4,934	22,359	37,486	4,039	22,474

6.2. Spatial maps of crab bycatch in groundfish fisheries by crab stock

In the October 2009 Council motion the Council specifically requested "[insert language from bullet" (Appendix B). In order to evaluate this, NMFS RO staff compiled spatial data on observed bycatch over the time frame 2003/04 to 2008/09. These maps of total observed bycatch by crab stock are included in

Appendix E. These maps show the observed bycatch by gear type from 2003/04 to 2008/09 and show both the stock boundaries, federal reporting areas as well as relevant BBRKC (Zone 1), Tanner (Zones 1 and 2) and snow crab (COBLZ) closures for each stock. As indicated previously those closures apply only to trawl gear. Evaluation of the trawl gear bycatch shows the relative extent of trawl bycatch inside and outside of those zonal closures. There are no closures for fixed gear for any crab stock in groundfish fisheries.

6.3. Crab length data, size and sex comp of bycatch

Another request in the Council's October 2009 motion included "insert language"(Appendix B). These data are included in Appendix F (Note data are being compiled and Appendix F will be made available in Council briefing books for the June 2010 meeting).

7. Scallop

In conjunction with the April 2010 Council motion (Appendix A) the Council requested additional information on the relative bycatch of crab species by the Scallop fishery. There are only three stocks of crab bycaught in the scallop fishery: Bristol Bay red king crab, Tanner crab, and snow crab. This section summarizes the numbers of crabs taken as incidental catch in directed fisheries for crab, groundfish, and scallop fisheries. A conversion of total numbers to weights is provided for Bristol Bay red king crab and Bristol Bay red king crab and EBS snow crab are shown here to demonstrate that most crab taken in the scallop fishery are small and their combined weight is small in comparison to bycatch in directed crab and groundfish fisheries.

Bycatch of snow, Tanner, and Bristol Bay red king crabs by scallop fisheries are shown in Table 24. Bycatch of snow, king, and Tanner crabs during the Bering Sea scallop fishery tends to be much lower than for other Bering Sea fisheries. Scallop fishery closures due to attainment of CBLs have decreased over the years, in part due to decreased crab abundance (Barnhart and Rosenkranz 2003) as well as a voluntary industry cooperative which provides the fleet additional flexibility to move off of high bycatch areas. ADF&G closely monitors bycatch rates during scallop seasons and has used a rate of one crab per pound of scallop meats as a benchmark since 1993. Bycatch may affect harvest and CPUE in the Bering Sea scallop fishery as vessel operators move or cease fishing when bycatch rates meet or exceed this benchmark.

Table 24 Bycatch of crabs (number crabs) by species in the Bering Sea scallop fishery, 1995–2008.

Year	Snow crab	Bristol Bay red king crab	Tanner crab
1995	0	0	0
1996	104,836	0	17,000
1997	195,345	0	28,000
1998	232,911	146	36,000
1999	150,421	1	n/a
2000	105,602	2	53,614
2001	68,458	0	48,718
2002	70,795	2	48,053
2003	16,206	0	31,316
2004	3,843	0	15,303
2005	5,211	2	15,529
2006	8,543	10	45,204
2007	19,367	1	35,288
2008	17,205	1	60,373

Total weights associated with the scallop bycatch in recent years were estimated using a newly developed NMFS *Chionoecetes* carapace width-weight relationship (G. Rosenkrantz, pers. comm.). These are tabulated to give an indication of the relative magnitude of bycatch of these species in the scallop fishery (Table 25).

Table 25 Estimated weight in lbs for number of Tanner crab and snow crab caught in Bering sea fisheries 2006/07 to 2008/09

Year	Number Tanner crab	Total weight Tanner crab (lbs)	Number Snow crab	Total weight snow crab (lbs)
2006/07	45,204	23,780	8,543	6,171
2007/08	35,288	16,892	19,367	13,698
2008/09	60,373	31,263	17,205	8,794

8. Considerations for Council

At the June meeting the Council may wish to consider initiating a comprehensive analysis to restrict crab bycatch in groundfish fisheries to some level in light of the need to ensure that ACLs to be instituted for the 10 BSAI crab stocks in 2011/12 are not annually exceeded due to bycatch. As noted previously, absent any amendment to link restrictions on mortality of crab bycatch in groundfish fisheries, total mortality will accrue towards annually specified ACLs under the crab FMP, and if an ACL is exceeded due to bycatch in groundfish fisheries, the AM will be to enact some form of penalty against the directed crab fisheries to guard against exceeding the ACL the following year. The Council may also consider limits on a stock by stock basis (i.e. multiple BSAI groundfish amendments successively) based upon relative contribution of groundfish bycatch towards the OFL and specific conservation or allocative concerns by stock.

The Council could consider overall limits by crab stock (allocated either BSAI groundfish fishery-wide or by individual fishery), or limits which trigger time and area closures. For either of these options, the Council would need to consider the scale over which a limit or area closure applies as it is important to delineate between crab stocks of the same species (i.e. a red king crab limit alone would not be sufficient as there are three different stocks of red king crab in the BSAI, each with its own OFL and ACL to which removals in that area apply).

Other issues that should be considered by the Council include:

1. Should current trawl closures as listed in this paper be re-examined for their effectiveness?
2. Catch accounting issues:
    a. PSC accounting timing: crab is accounted on a crab fishing year (June-May). Current bycatch for groundfish fisheries must be accounting over this time period. However current accounting if for a calendar year, and crab limits for time/area closures are accounted on a calendar year.
    b. Bycatch numbers as recorded in groundfish fishery vs. weight of crab accrued towards OFL. Currently average weight of crab is multiplied by number for the total estimated weight to apply against crab OFL.

References

Barnhart, J. P., and G. Rosenkranz. 2003. Summary and analysis of onboard observer-collected data from the 1999/2000 through 2001/2002 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K03-9, Kodiak.

Donaldson, W.E. 1990. Determination of experimentally induced non-observable mortality on red king crab. Alaska Department of Fish and Game Regional Information Report 4K90-13. 27pp. (available at http://www.cf.adfg.state.ak.us/region4/pubs/r4pubhom.php).

Gasper , J., Mondragon, J. and J. Cahalen. 2009. Documentation for dataset on crab bycatch in the BSAI groundfish fisheries (1991-2009). Discussion paper prepared for the crab stock assessment authors and Crab Plan Team, September 2009. National Marine Fisheries Service, Juneau, AK.

Barnhart, J.P., and N. Sagalkin. 1998. Summary and analysis of onboard collected data from the 1996/97 statewide commercial weathervane scallop fishery. Alaska Department of Fish and Game Commercial Fisheries, Regional Information Report. Kodiak.

Blackburn, J. and D. Schmidt. 1988. Injury and apparent mortality rates from incidental trawl catches of halibut, king crab, and Tanner crab in the Kodiak area, 1978-81. Regional Information Report No. 4-K-88-21. Alaska Department of Fish and Game. Kodiak, Alaska. April 1988.

Guttormsen, M., R. Narita, J. Berger, J. Gharrett, and G. Tromble. 1992. Summary of U.S. observer sampling of domestic groundfish fisheries in the Northeast Pacific Ocean and Eastern Bering Sea, 1990. Alaska Fisheries Science Center, NMFS, NOAA.

Hammerstrom, L.F., and M.F. Merritt. 1985. A survey of Pacific weathervane scallops (*Patinopecten caurinus*) in Kamishak Bay, Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet 252.

Hanselman, D., Lunsford, C., Fujioka, J. and C. Rodgveller. 2008. Assessment of the Sablefish stock in Alaska. In: Stock Assessment and Fishery Evaluation report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region. Compiled by the Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands. North Pacific Fishery Management Council, Anchorage, AK.

Hennick, D.P. 1973. Sea scallop, Patinopecten caurinus, investigations in Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Completion Report 5-23-R.

Kaiser (1986)

NMFS. 1993. Environmental Assessment / Regulatory Impact Review / Initial Regulatory Flexibility Analysis of Alternatives to Allow the Pacific cod Total Allowable Catch by Gear and/or Directly Change the Seasonality of the Cod Fisheries. Amendment 24 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area. National Marine Fisheries Service, Seattle, Washington. October 5, 1993.

North Pacific Fishery Management Council (NPFMC). 1996. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Assessment for amendment 37 the BSAI groundfish FMP. Secretarial Review Draft. North Pacific Fishery Management Council, Anchorage AK 99501.

North Pacific Fishery Management Council (NPFMC). 1997. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Assessment for amendment 41 to the BSAI groundfish FMP. Secretarial Review Draft. North Pacific Fishery Management Council, Anchorage AK 99501.

North Pacific Fishery Management Council (NPFMC). 2007. Stock Assessment and Fishery Evaluation Report for the Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions. North Pacific Fishery Management Council, Anchorage, AK.

North Pacific Fishery Management Council (NPFMC). 2009. Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Region. Compiled by the Plan Team for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Region. North Pacific Fishery Management Council, Anchorage, AK.

North Pacific Fishery Management Council (NPFMC). 2008. Final Environmental Assessment for Amendment 24 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs to Revise Overfishing Definitions. Prepared by staff of the Alaska Fisheries Science Center, Alaska Department of Fish and Game, National Marine Fisheries Service and North Pacific Fishery Management Council. North Pacific Fishery Management Council, Anchorage, AK.

North Pacific Fishery Management Council (NPFMC). 2007. Stram, D., Pengilly, D., Barnard, D. and D. Witherell. Chapter 5 BSAI Crab Bycatch. In: Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Region. Compiled by the Plan Team for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Region. North Pacific Fishery Management Council, Anchorage, AK.

North Pacific Fishery Management Council (NPFMC). 1994. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Amendment 21A to the Fishery Management Plan for the Groundfish Resources of the Bering Sea and Aleutian Islands to establish a Pribilof Island Habitat Conservation Zone. North Pacific Fishery Management Council, Anchorage, AK.

Owen, D. 1988. A bottom trawl survey on the west side of Kodiak Island: Viekoda Bay, Spiridon Bay, and Kupreanof Strait (November 1987). Regional Information Report No. 4K88-28. Alaska Department of Fish and Game, Kodiak, Alaska. February 1988.

Pengilly, D. ADF&G, unpublished data.

Rose, C.S. 1999. Injury rates of red king crab, *Paralithodes camtschaticus*, passing under bottom-trawl footropes. Mar. Fish. Rev. 61(2) 72-76.

Rose, C.S., C.F. Hammond, A.W. Stoner, J.E. Munk, and J.R. Gauvin. *In review*. Quantification of unobserved mortality rates of snow, Tanner and red king crabs *(Chionoecetes opilio, C. bairdi and Paralithodes camtschaticus*) after encounters with trawls on the seafloor.

Stevens, B.G. 1990. Survival of king and Tanner crabs captured by commercial sole trawls. Fish. Bull. U.S. 88: 731-744.

Urban, D., D. Pengilly, and I. Vining. 1994. The scallop observer program and statewide data analysis summary to the Board of Fisheries. Alaska Department of Fish and Game Report 4K94-28.

Appendix A: Council motion (on Crab ACLs) April 2010

From the April 11, 2010 Council meeting, regarding Agenda item:
D-1(a) Crab ACL Analysis and BSAI snow and Tanner crab rebuilding

The Council directs staff to incorporate SSC and Plan Team recommendations as well as the following comments in preparing the analysis for initial review.

The Council supports the SSA and AP recommendations on the draft snow crab rebuilding plan and proposed ABC control rules that would be used to annually establish crab ACLs.

Despite this support, the Council has the following concerns:

- The annual stock assessment and OFL specification process should avoid inclusion of multiple conservative buffers. The Council believes that the appropriate venue for consideration of precautionary measures is in recommendation of ABC by the Crab Plan Team and SSC and in TAC setting conducted by the State of Alaska.
- The Council would like to have a clearer understanding of the National Standard 1 guideline requirements to inform selection of a preliminary preferred alternative. For example, would a range for additional uncertainty of 0.1-0.3 rather than 0.2-0.6 satisfy requirements?
- Moving the timing of the ABC recommendation to June as described in the SSA and AP minutes under a new Option 4 would not allow for use of survey data from the most recent year. As well the Council may set a one year, rather than two year standard, for rebuilt crab stocks. One or both of these options may present an unnecessary risk given the sometimes dramatic inter-annual fluctuations in abundance experienced by some crab stocks.
- Accountability Measures are a means of addressing crab bycatch in fisheries contributing to crab mortality. The Council should begin to develop crab bycatch management measures including PSC limits for each crab species. It is the Council's intent that PSC limits be analyzed to identify the groundfish and scallop fishery sectors contributing to crab bycatch and quantify their relative contribution to total crab bycatch mortality. The Council believes that Accountability Measures should establish a linkage between the crab and groundfish FMPs to equitably spread the burden of crab bycatch mortality amongst all fishery participants.

Appendix B: Council motion October 2009

From the October, 2009 Council meeting, regarding Agenda item:

C-4 (e) Approve BSAI Crab SAFE report and OFLs; receive discussion paper on crab bycatch and PSC limits

The Council requests staff to expand the discussion paper on crab bycatch to include AP and SSC suggestions, and to include expansion to PSC limits as they affect the crab fishery and OFL limits:

- *Describe how crab PSCs are allocated between sectors during the annual specifications process, and how inseason reallocations are accomplished when a sector attains a limit;*
- *Describe in more detail the specific crab PSC zones and determine if the zones cover the entire range of the king, tanner and snow crab stocks;*
- *Describe if the current crab closure areas are appropriate to stock boundaries*
- *Discuss the impacts of retaining current PSC caps and thresholds compared with removing the lower COBLZ threshold and upper limits for all caps;*
- *Expand the time series of PSCs to a minimum of 15 years for each of the groundfish fisheries;*
- *Discuss if current PSC caps create conservation concerns for each crab stock.*
- *Discuss how non-limiting PSC caps, with no inseason adjustment authority can contribute to overfishing of a crab stock;*
- *Show the separation and distribution of bycatch of Eastern and Western Tanner crab stocks;*
- *Discuss size and sex composition of bycatch of various crab stocks;*
- *Consider appropriate maximum upper limits on bycatch by stock and sector;*
- *Include a discussion of observed and unobserved mortality of crab from all sectors, including a discussion of the origin of handling mortality rates employed in groundfish and scallop fisheries;*
- *Historical perspective of the development of crab PSC caps and related reductions in crab bycatch;*
- *Include a discussion of the effect of Amendment 80 crab PSC allocations on availability of crab PSC to trawl sectors;*
- *Future analysis should be made on a stock by (crab) stock basis to evaluate both the conservation and allocation concerns;*
- *Include crab OFLs expressed in weight and groundfish bycatch expressed in numbers;*
- *Define crab stock-specific boundaries; and*
- *Define the handling mortality rates to be used.*

Appendix C: *Excerpts from the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area*

3.6 Catch Restrictions

This section describes the retention and utilization restrictions for the groundfish fisheries, including prohibited species restrictions and incentive programs to reduce bycatch.

3.6.1 Prohibited Species

Pacific halibut, Pacific herring, Pacific salmon and steelhead, king crab, and Tanner crab are prohibited species and must be avoided while fishing for groundfish and must be returned to the sea with a minimum of injury except when their retention is authorized by other applicable law.

Groundfish species and species groups under this FMP for which the TAC has been achieved shall be treated in the same manner as prohibited species.

3.6.1.1 Prohibited Species Donation Program

The Prohibited Species Donation Program authorizes the distribution of specified prohibited species, taken as bycatch in the groundfish trawl fisheries off Alaska, to economically disadvantaged individuals through a NMFS-authorized distributor selected by the Regional Administrator in accordance with regulations that implement the FMP. The program is limited to the following species:

1. Pacific salmon
2. Pacific halibut

3.6.2 Prohibited Species Catch Limits

When a target fishery, as specified in regulations implementing the FMP, attains a prohibited species catch (PSC) limit apportionment or seasonal allocation as described in the FMP (Section 3.6.2.1) and specified in regulations implementing the FMP, the bycatch zone(s) or management area(s) to which the PSC limit apportionment or seasonal allocation applies (described in Section 3.6.2.2) will be closed to that target fishery (or components thereof) for the remainder of the year or season, whichever is applicable. The procedure for apportioning PSC limits is detailed in Section 3.6.2.3. PSC assigned to a non-AFA trawl catcher/processor cooperative under Section is not subject to fishery or seasonal apportionment.

3.6.2.1 Individual Species Limits

The following species have PSC limits specified either in the FMP or in regulations implementing the FMP: red king crab, *Chionoecetes bairdi*, *C. opilio*, Pacific halibut, Pacific herring, Chinook salmon, and other salmon.

3.6.2.1.1 Red King Crab

A PSC limit for red king crab in Zone 1 (as described in Section 0) is established in the following manner:

- When the number of mature female red king crab is below or equal to the threshold of 8.4 million mature crab, or the spawning biomass is less than 14.5 million lbs, the Zone 1 PSC limit will be 32,000 red king crab.
- When the number of mature female red king crab is above the threshold of 8.4 million mature crab and the effective spawning biomass is equal to or greater than 14.5 but less than 55 million lbs, the Zone 1 PSC limit will be 97,000 red king crab.

- When the number of mature female red king crab is above the threshold of 8.4 million mature crab, and the effective spawning biomass is equal to or greater than 55 million lbs, the Zone 1 PSC limit will be 197,000 red king crab.

3.6.2.1.2 C. bairdi *Crab*

The PSC limit for *C. bairdi* Tanner crab is established in regulations implementing the FMP based on their abundance as indicated by the NMFS bottom trawl survey.

3.6.2.1.3 C. opilio *Crab*

The PSC limit for *C. opilio* crab is established in regulations implementing the FMP based on their total abundance as estimated by the NMFS bottom trawl survey. Minimum and maximum PSC limits are also established in regulation.

3.6.2.1.4 Pacific Halibut

Annual BSAI-wide Pacific halibut bycatch mortality limits for trawl and non-trawl gear fisheries will be established in regulations and may be amended by regulatory amendment. When initiating a regulatory amendment to change a halibut bycatch mortality limit, the Secretary, after consultation with the Council, will consider information that includes:

3. estimated change in halibut biomass and stock condition;
4. potential impacts on halibut stocks and fisheries;
5. potential impacts on groundfish fisheries;
6. estimated bycatch mortality during prior years;
7. expected halibut bycatch mortality;
8. methods available to reduce halibut bycatch mortality;
9. the cost of reducing halibut bycatch mortality; and
10. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives.

3.6.2.1.5 Pacific Herring

The annual PSC limit of Pacific herring caught while conducting a trawl fishery for groundfish in the BSAI management area is one percent of the annual biomass of herring in the eastern Bering Sea.

3.6.2.1.6 Chinook Salmon

PSC limits for Chinook salmon are established for the Bering Sea and Aleutian Islands subareas in regulations implementing the FMP.

3.6.2.1.7 Other Salmon

When the Regional Administrator determines that 42,000 non-Chinook salmon have been caught by vessels using trawl gear during the time period of August 15 through October 14 in the catcher vessel operational area (see Section **Error! Reference source not found.**), NMFS will prohibit directed fishing for pollock with trawl gear for the remainder of the period September 14 through October 14 in the chum salmon savings area (see Section 3.6.2.2.2), unless the vessel is operating under a salmon bycatch reduction inter-cooperative agreement. Accounting for the 42,000 fish PSC limit will begin on August 15.

3.6.2.2 PSC Limitation Zones

Restrictions within the following areas are triggered by the attainment of bycatch limits as described in the FMP (Section 3.6.2.1) or specified in regulations implementing the FMP. Annual area closures that may also serve to limit the bycatch of prohibited species are listed in Section Zones 1 and 2

Zones 1 and 2 close to directed fishing when crab bycatch limits, as specified in regulations, are attained in specific fisheries. The areas are described in Appendix B and.

3.6.2.2.1 C. Opilio *Bycatch Limitation Zone*

Upon attainment of the *C. Opilio* Bycatch Limitation Zone (COBLZ) bycatch allowance of *C. opilio* crab specified for a particular fishery category, the COBLZ will be closed to directed fishing for each category for the remainder of the year or for the remainder of the season. The area is described in Appendix B and Herring Savings Areas

If the Regional Administrator determines that the PSC limit of herring is attained, the herring savings areas may be closed for the remainder of the year or season. The herring savings areas are any of the three areas described in Appendix B and. Summer Herring Savings Area 1 applies from June 15 through July 1 of a fishing year. Summer Herring Savings Area 2 applies July 1 through August 15 of a fishing year. Winter Herring Savings Area applies from September 1 through March 1 of the succeeding fishing year. Openings and closures begin and end at noon local time.

3.6.2.2.2 Chum Salmon Savings Area

Upon attainment of the limit described in Section 3.6.2.1.7, NMFS will prohibit directed fishing for pollock with trawl gear for the remainder of the period September 14 through October 14 in the chum salmon savings area (described in Appendix B and), unless the vessel is operating under a salmon bycatch reduction inter-cooperative agreement. This area is also closed to vessels directed fishing for pollock and not operating under a salmon bycatch reduction inter-cooperative agreement from August 1 through August 31, as described in Section

3.6.2.2.3 Chinook Salmon Savings Areas

If the Regional Administrator determines that the Bering Sea subarea PSC limit of Chinook salmon is caught while harvesting pollock with trawl gear in the Bering Sea subarea between January 1 and December 31, NMFS will prohibit directed fishing for pollock with trawl gear in Chinook salmon savings areas 1 and 2 (described in Appendix B and) during time periods specified in regulations. Vessels operating under a salmon bycatch reduction inter-cooperative agreement may participate in directed fishing for pollock by trawl gear in area 2.

If the Regional Administrator determines that the Aleutian Islands subarea PSC limit of Chinook salmon is caught while harvesting pollock with trawl gear in the Aleutian Islands subarea between January 1 and December 31, NMFS will prohibit directed fishing for pollock with trawl gear in Chinook salmon savings area 1 (described in Appendix B and), during time periods specified in regulations.

Figure 32 Crab PSC Limitation Zones 1 and 2.

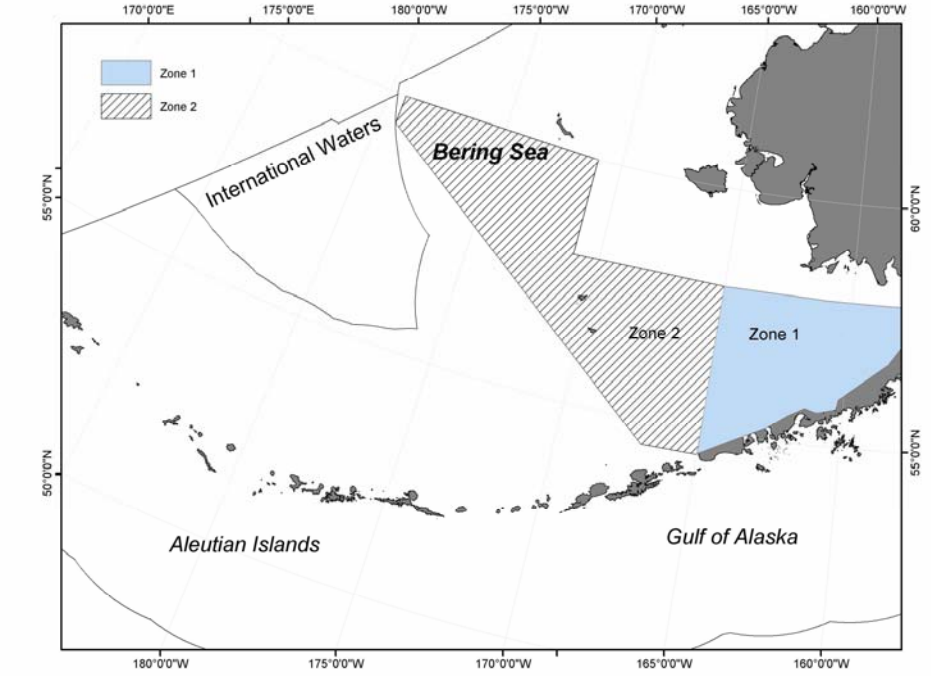


Figure -33 Chinoecetes opilio Bycatch Limitation Zone.

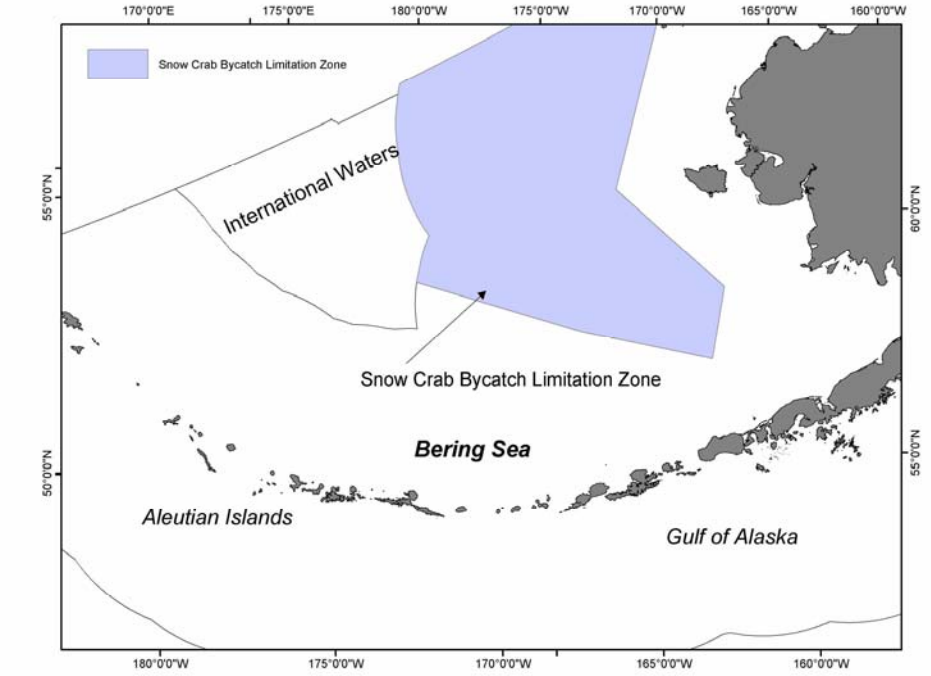


Figure -34 Herring Savings Areas.

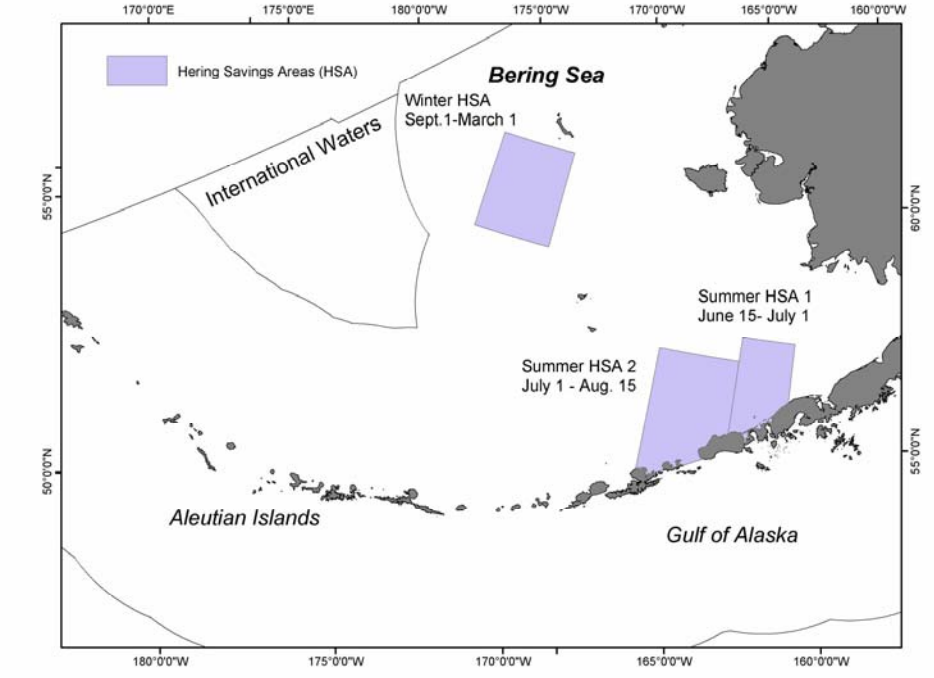


Figure Error! No text of specified style in document.**-35 Chinook Salmon Savings Areas.**

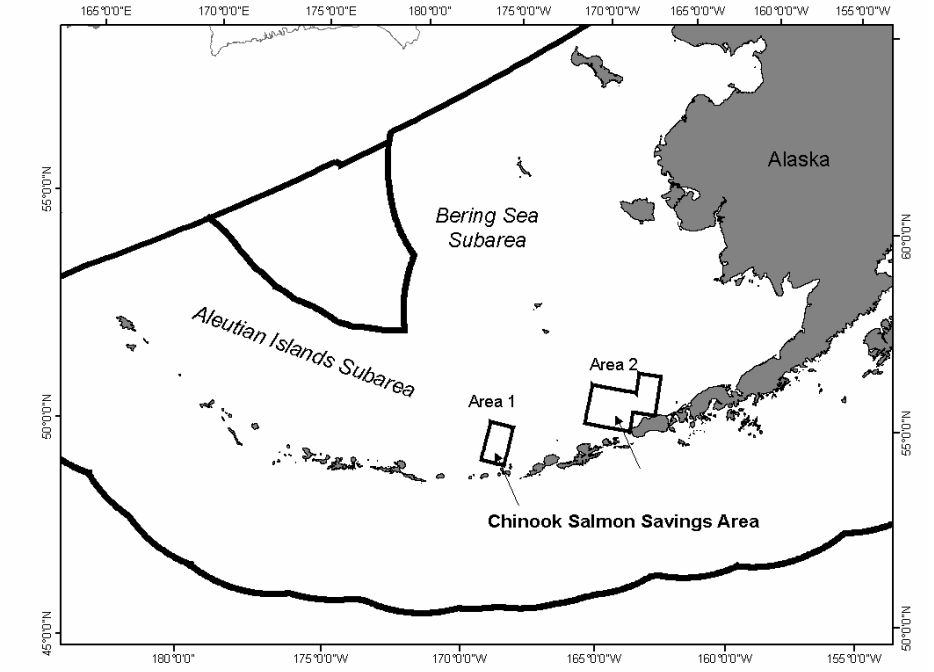


Figure -36 Bering Sea Habitat Conservation Area

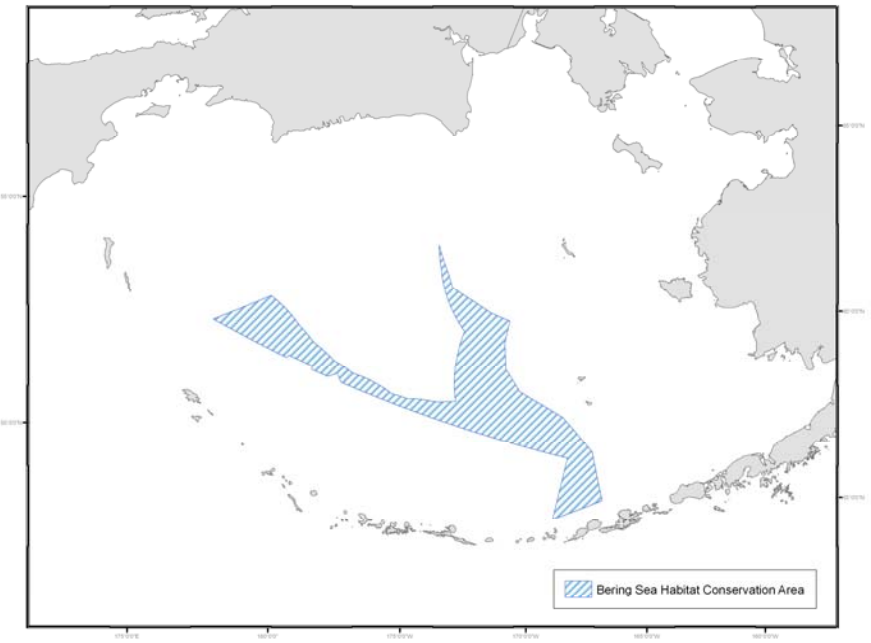


Figure-37 St. Matthew Island Habitat Conservation Area

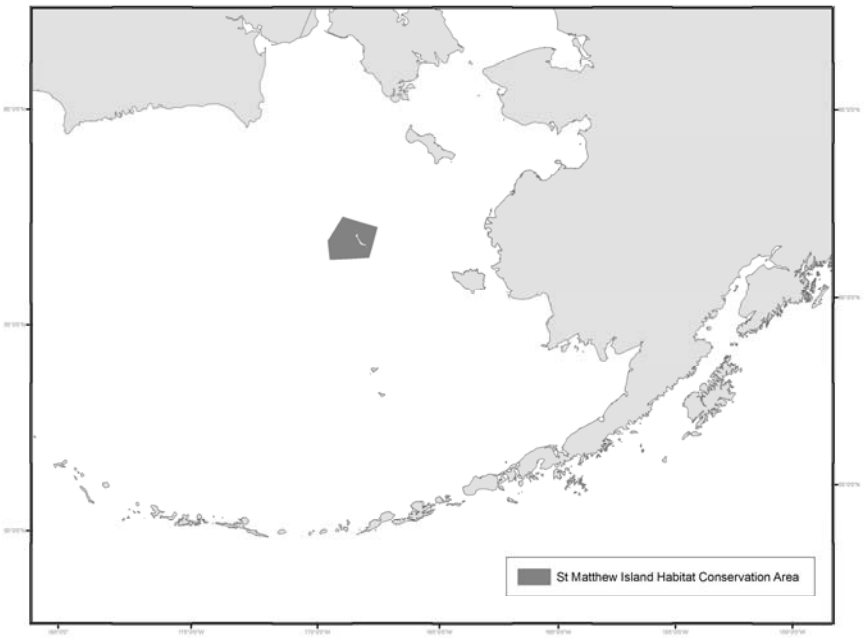


Figure 38 St. Lawrence Island Habitat Conservation Area

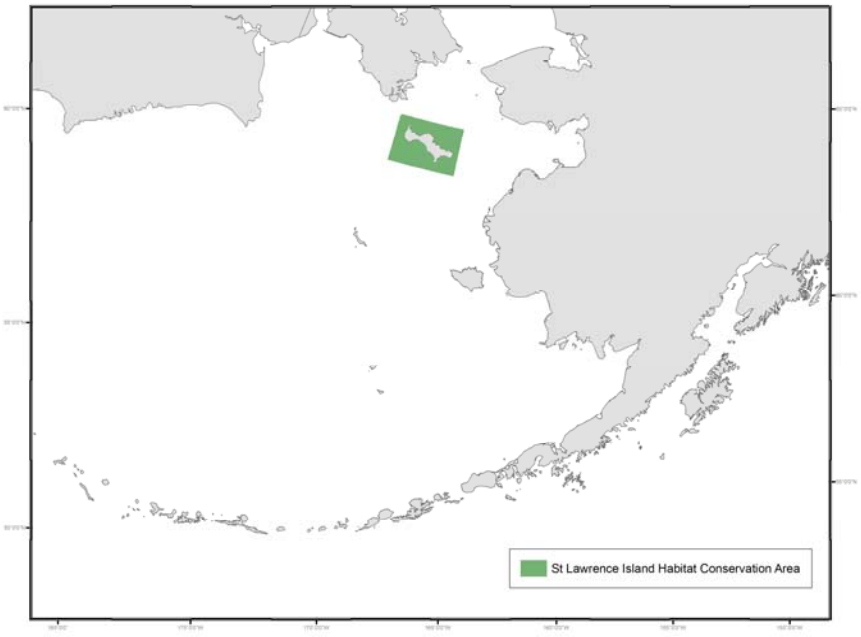


Figure -39 Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area

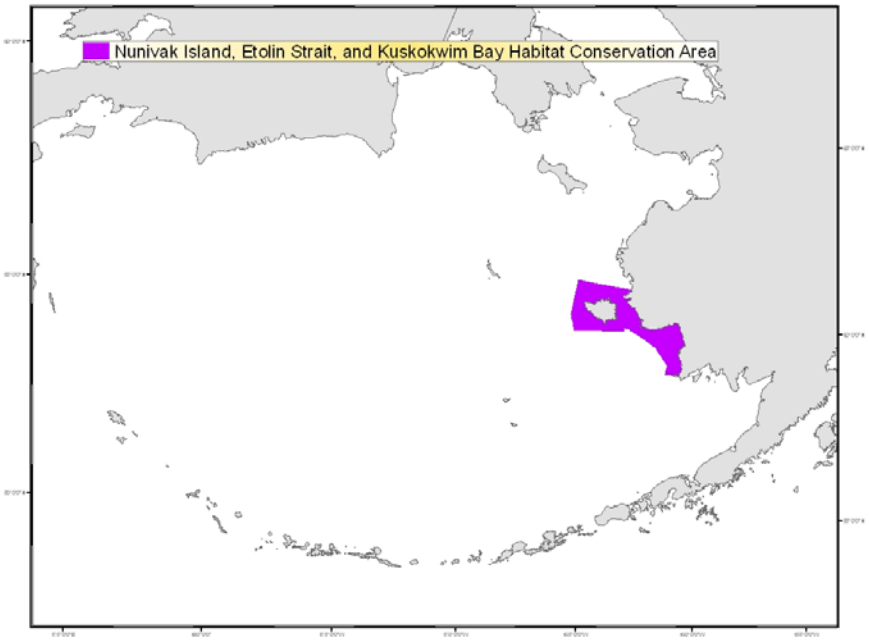
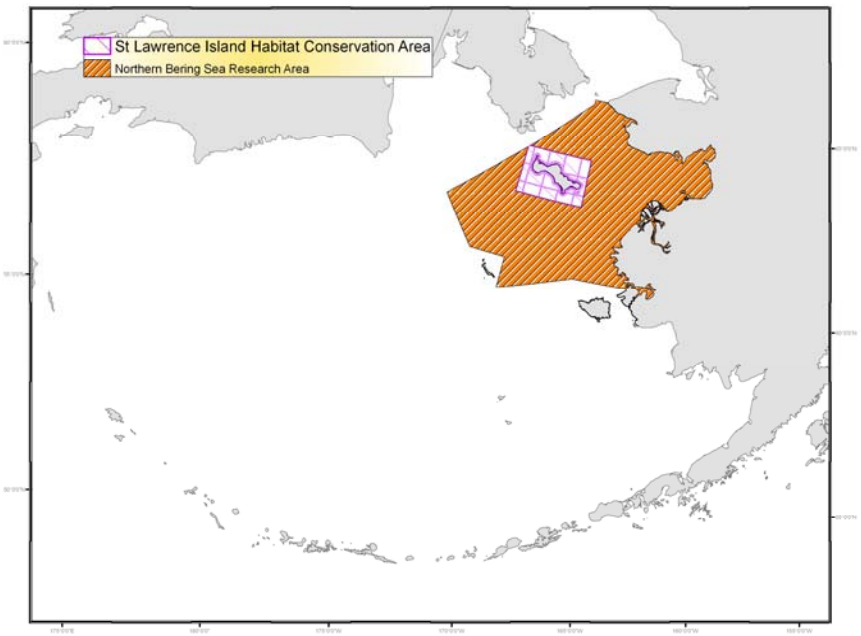


Figure-40 Northern Bering Sea Research Area



3.6.2.3 Apportionment of Prohibited Species Catch Limits

3.6.2.3.1 Target Fishery Categories

Trawl fisheries: The Pacific halibut PSC limit for trawl gear and the PSC limits for *C. bairdi* crab, *C. opilio* crab, red king crab, and herring apply to trawl fisheries for groundfish that are categorized by target species or species groups.

Non-trawl fisheries: The Pacific halibut PSC limit for non-trawl gear applies to non-trawl groundfish fisheries that may be categorized by target species or species groups, gear type, and area.

Fishery categories will be implemented by regulations that implement the goals and objectives of the FMP, the Magnuson-Stevens Act, and other applicable law. Fishery categories will remain in effect unless amended by regulations implementing the FMP. When recommending a regulatory amendment to revise fishery categories, the Council will consider the best information available on whether recommended fishery categories would best optimize groundfish harvests under the PSC limits established under Section 3.6.2.

3.6.2.3.2 Apportionments and Seasonal Allocations

Apportionments of PSC limits to target fishery categories established in Section 3.6.2.3.1 and seasonal allocations of those apportionments may be determined annually by the Secretary of Commerce, after consultation with the Council, using the following procedure:

1. Prior to the October Council meeting. The Plan Team will provide the Council the best available information on estimated prohibited species bycatch and mortality rates in the target groundfish fisheries, and estimates of seasonal and annual bycatch rates and amounts.

2. October Council meeting. While recommending proposed groundfish harvest levels under Section , the Council will also review the need to control the bycatch of prohibited species and will recommend appropriate apportionments of PSC limits to fishery categories as bycatch

allowances. Fishery bycatch allowances are intended to optimize total groundfish harvest under established PSC limits, taking into consideration the anticipated amounts of incidental catch of prohibited species in each fishery category. The Council may recommend exempting specified non-trawl fishery categories from the non-trawl halibut bycatch mortality limit restrictions after considering the same factors (1) through (8) set forth under Section 3.6.2.1.4. The Council will also review the need for seasonal apportionments of fishery bycatch allowances.

The Council will consider the best available information when recommending fishery apportionments of PSC limits and seasonal allocation of those apportionments. Types of information that the Council will consider relevant to seasonal allocation of fishery bycatch quotas include:

a. seasonal distribution of prohibited species;

b. seasonal distribution of target groundfish species relative to prohibited species distribution;

c. expected prohibited species bycatch needs on a seasonal basis relevant to changes in prohibited species biomass and expected catches of target groundfish species;

d. expected bycatch rates on a seasonal basis;

e. expected changes in directed groundfish fishing seasons;

f. expected start of fishing effort; and

g. economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry.

3. As soon as practicable after the Council's October meeting, the Secretary will publish the Council's recommendations as a notice in the *Federal Register*. Information on which the recommendations are based will also be published in the *Federal Register* or otherwise made available by the Council. Public comments will be invited by means specified in regulations implementing the FMP.

4. Prior to the December Council meeting. The Plan Team will prepare for the Council a final SAFE report under Section ..which provides the best available information on estimated prohibited species bycatch rates in the target groundfish fisheries, recommendations for halibut PSC limits and apportionments thereof among the target fisheries and gear types, and also may include an economic analysis of effects of the apportionments.

5. December Council meeting. While recommending final groundfish harvest levels, the Council reviews public comments, takes public testimony, and makes final decisions on apportionments of PSC limits among fisheries and seasons, using the factors (a) through (g) set forth under (2) above. The Council also makes final decisions on the exemption of any non-trawl fishery category from halibut bycatch mortality restrictions using the factors (1) through (8) set forth under Section 3.6.2.1.4.

6. As soon as practicable after the Council's December meeting, the Secretary will publish the Council's final decisions as a notice in the *Federal Register*. Information on which the final recommendations are based will also be published in the *Federal Register* or otherwise made available by the Council.

3.6.3 Retention and Utilization Requirements

3.6.3.1 Utilization of Pollock

Roe-stripping of pollock is prohibited, and the Regional Administrator is authorized to issue regulations to limit this practice to the maximum extent practicable. It is the Council's policy that the pollock harvest shall be utilized to the maximum extent possible for human consumption.

3.6.3.2 Improved Retention/Improved Utilization Program

Minimum retention requirements

All vessels participating in the groundfish fisheries are required to retain all catch of Improved Retention/ Improved Utilization Program (IR/IU) species, pollock and Pacific cod, when directed fishing for those species is open, regardless of gear type employed and target fishery. When directed fishing for an IR/IU species is prohibited, retention of that species is required only up to any maximum retainable amount in effect for that species, and these retention requirements are superseded if retention of an IR/IU species is prohibited by other regulations.

No discarding of whole fish of these species is allowed, either prior to or subsequent to that species being brought on board the vessel except as permitted in the regulations. At-sea discarding of any processed product from any IR/IU species is also prohibited, unless required by other regulations.

Minimum utilization requirements

All IR/IU species caught in the BSAI must be either 1) processed at sea subject to minimum product recovery rates and/or other requirements established by regulations implementing the FMP, or 2) delivered in their entirety to onshore processing plants for which similar processing requirements are implemented by State regulations.

3.6.4 Bycatch Reduction Incentive Programs

3.6.4.1 Prohibited Species Catch

The Secretary of Commerce, after consultation with the Council, may implement by regulation measures that provide incentives to individual vessels to reduce bycatch rates of prohibited species for which PSC limits are established under Section 3.6.2. The intended effect of such measures is to increase the opportunity to harvest groundfish TACs before established PSC limits are reached.

----- *Break* -----

3.7.4.6 Prohibited Species Allocations

The following allocations of the PSC limits will be made to the CDQ Program:

Halibut:	In 2008 and 2009, 343 mt of mortality.
	In 2010 and thereafter, 393 mt of mortality.
Crab:	10.7 percent of each crab PSC limit in the BSAI.
Chinook salmon:	7.5 percent of the Chinook salmon PSC limit in the BSAI.
Non-Chinook salmon:	10.7 percent of the non-Chinook salmon PSC limit in the BSAI.

PSC allocations to the CDQ Program are not allocated by gear or target fishery.

----- *Break* -----

3.7.5.2 PSC Allowance for the Non-AFA Trawl Catcher Processor Sector and the CDQ Program

3.7.5.2.1 Allocation Formula

The trawl PSC limit for halibut, Zone 1 red king crab, C. opilio crab PSC (COBLZ), Zone 1 C. bairdi crab PSC, and Zone 2 C. bairdi crab PSC is apportioned between the non-AFA trawl CP and the BSAI trawl limited access sector as follows:

Sector	Year after implement ation.	Halibut PSC limit in the BSAI (mt)	Zone 1 Red king crab PSC limit...	C. opilio crab PSC limit (COBLZ)...	Zone 1 C. bairdi crab PSC limit...	Zone 2 C. bairdi crab PSC limit...
			as a percentage of the total BSAI trawl PSC limit after allocation as PSQ			
Amendment 80 sector	Year 1	2,525 mt	62.48	61.44	52.64	29.59
	Year 2	2,475 mt	59.36	58.37	50.01	28.11
	Year 3	2,425 mt	56.23	55.30	47.38	26.63
	Year 4	2,375 mt	53.11	52.22	44.74	25.15
	Year 5 and all future years	2,325 mt	49.98	49.15	42.11	23.67
BSAI trawl limited access	All years	875 mt	30.58	32.14	46.99	46.81

3.7.5.3 Rollover of ITAC, PSC, and ICA

3.7.5.3.1 Target species ITAC, ICA, and PSC rollover:

1. Any unharvested portion of the yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod ITAC or ICA or unused portion of PSC in the BSAI trawl limited access fishery that is projected to remain unused may be rolled over to non-AFA trawl catcher/processor cooperatives. The distribution of any rollover to a cooperative shall be proportional to the amount of CQ initially issued to that cooperative for that year.
2. Any rollover of halibut PSC to non-AFA Trawl CP cooperatives shall be discounted by 5%. Once the initial allocation has been determined, the non-AFA trawl CP cooperatives may re-allocate the PSC among the target species.
3. NMFS shall evaluate the possibility of rolling over unused ITAC, ICA, or PSC as it deems appropriate. In making its determination, NMFS shall consider current catch and PSC usage, historic catch and PSC usage, harvest capacity and stated harvest intent, as well as other relevant information.

----- *Break* -----

3.8.1 Inseason Adjustments

Harvest levels for each groundfish species or species group that are set by the Council for a new fishing year are based on the best biological, ecological, and socioeconomic information available. The Council finds, however, that new information and data relating to stock status may become available to the Regional Administrator and/or the Council during the course of a fishing year which warrants inseason adjustments to a fishery.

Such changes in stock status might not have been anticipated or were not sufficiently understood at the time harvest levels were being set. Changes may become known from events within the fishery as it proceeds, or they may become known from new scientific survey data. Certain changes warrant swift action by the Regional Administrator to protect the resource from biological harm by instituting gear modifications or adjustments through closures or restrictions. Other changes warrant action to provide greater fishing opportunities for the industry by instituting time or area adjustments through openings or extension of a season beyond a scheduled closure.

Other inseason actions may be necessary to promulgate interim fishery closures in portions of the Bering Sea and the Aleutian Islands management subareas to reduce prohibited species bycatch rates and the

probability of premature attainment of PSC limits and allowances. The intent of such interim closures would be to provide fishermen with a greater opportunity to harvest groundfish quota amounts by guaranteeing a longer fishing period before PSC limits or allowances are reached and bycatch zones or areas are closed to specified fisheries or gear types.

Ideally, the need to implement interim closures of areas to limit fishery operations that exhibit unexpectedly high bycatch rates would be identified through an examination of bycatch data collected inseason by observers. At times, however, data on bycatch rates may not be timely enough for effective implementation of season closures. Alternatively, the fishery bycatch rates may vary so much from week to week that the Regional Administrator may have difficultly determining whether bycatch rates in a fishery or area are intrinsically high, are an exhibition of "dirty fishing", or simply reflect natural variability in an otherwise "clean" fishery or area. Historical data could be used, therefore, to determine whether consistent "hot spots" occur. Historical information may then be compared with variable inseason data to help determine whether an inseason closure is warranted to reduce overall bycatch rates.

The need for inseason action for conservation purposes may be related to several circumstances. For instance, certain target or bycatch species may have decreased in abundance. When new information indicates that a species has decreased in abundance, allowing a fishery to continue to a harvest level now known to be too high could increase the risk of overfishing that species. Conservation measures limited to establishing prohibited species catch limits for such prohibited species may be necessary during the course of the fishery to prevent jeopardizing the well-being of prohibited species stocks.

When current information demonstrates a harvest level to have been set too low, closing a fishery at the annually specified harvest level would result in under-harvesting that species, which also results in the fishery unnecessarily foregoing economic benefits during that year unless the total allowable catch were increased and the fishery allowed to continue.

Similarly, current information may indicate that a prohibited species is more abundant than was anticipated when limits were set. Closing a fishery on the basis of the preseason PSC limit that is proven to be too low would impose unnecessary costs on the fishery. Increasing the PSC limits may be appropriate if such additional mortality inflicted on the prohibited species of concern would not impose detrimental effects on the stock or unreasonable costs on a fishery that utilize the prohibited species. However, adjustments to target quotas or PSC limits that are not initially specified on the basis of biological stock status is not appropriate.

The Council finds that inseason adjustments are accomplished most effectively by management personnel who are monitoring the fishery and communicating with those in the fishing industry who would be directly affected by such adjustments. Therefore, the Council authorizes the Secretary, by means of his or her delegation to the Regional Administrator of NMFS, to make inseason adjustments to conserve fishery resources on the basis of all relevant information. Using all available information, he or she may extend, open, or close fisheries in all or part of a regulatory area, or restrict the use of any type of fishing gear as a means of conserving the resource. He or she may also change any previously specified TAC or PSC limit if such are proven to be incorrectly specified on the basis of the best available scientific information or biological stock status. Such inseason adjustments must be necessary to prevent one of the following occurrences:

h. the overfishing of any species or stock of fish, including those for which PSC limits have been set; and/or

i. the harvest of a TAC for any groundfish, the taking of a PSC limit for any prohibited species, or the closure of any fishery based on a TAC or PSC limit that, on the basis of currently available information, is found by the Secretary to be incorrectly specified.

The Regional Administrator may also promulgate an inseason closure of an area to reduce prohibited species bycatch rates provided the closure period extends no longer than the time period specified in

regulations. Interim closures must be based upon a determination that such closures are necessary to prevent:

j. a continuation of relatively high bycatch rates in a statistical areas, or portion thereof;

k. the take of an excessive share of PSC limits or allowances established under Section 3.6.2 by vessels fishing in an area;

l. the closure of one or more directed groundfish fisheries due to excessive prohibited species bycatch rates occurring in a specified target fishery; and

m. the premature attainment of established PSC limits or allowances and associated loss of opportunity to vessels to harvest the groundfish optimum yield.

The types of information that the Regional Administrator will consider in determining whether conditions exist that require an inseason adjustment or action are described as follows, although he or she is not precluded from using information not described but determined to be relevant to the issue:

n. the effect of overall fishing effort within an area;

o. catch per unit of effort and rate of harvest;

p. relative distribution and abundance of stocks of target groundfish species and prohibited species within an area;

q. the condition of a stock in all or part of an area;

r. inseason prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

s. historical prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

t. economic impacts of fishing businesses being affected; or

u. any other factor relevant to the conservation and management of groundfish species or any incidentally-caught species that are designated as a prohibited species or for which a PSC limit has been specified.

The Regional Administrator is constrained, however, in his or her choice of management responses to prevent potential overfishing by having to first consider the least restrictive adjustments to conserve the resource. The order in which the Regional Administrator must consider inseason adjustments to prevent overfishing are specified as: 1) any gear modification that would protect the species in need of conservation protection, but that would still allow fisheries to continue for other species; 2) a time or area closure that would allow fisheries for other species to continue in non-critical areas and time periods; and 3) total closure of the management area and season.

The procedure that the Secretary must follow requires that the Secretary publish a notice of proposed adjustments in the *Federal Register* before they are made final, unless the Secretary finds for good cause that such notice is impracticable or contrary to the public interest. If the Secretary determines that the prior comment period should be waived, he or she is still required to request comments for 15 days after the notice is made effective, and respond to any comments by publishing in the *Federal Register* either notice of continued effectiveness or a notice modifying or rescinding the adjustment.

To effectively manage each groundfish resource throughout its range, the Regional Administrator must coordinate inseason adjustments, when appropriate, with the State of Alaska to assure uniformity of management in both State and Federal waters.

Any inseason time or area adjustments made by the Regional Administrator will be carried out within the authority of this FMP. Such action is not considered to constitute an emergency that would warrant a plan amendment within the scope of Section 305(e) of the Magnuson-Stevens Act. Any adjustments will be

made by the Regional Administrator by such procedures provided under existing law. Any inseason adjustments that are beyond the scope of the above authority will be accomplished by emergency regulations as provided for under Section 305(e) of the Magnuson-Stevens Act.

----- *Break* -----

4.5.4 Community Development Quota Program Communities

The purpose of the CDQ program was to provide western Alaska fishing communities an opportunity to participate in the BSAI fisheries that had been foreclosed to them because of the high capital investment needed to enter the fishery. The program was intended to help western Alaska communities to diversify their local economies and to provide new opportunities for stable, long-term employment. The original Council guidance for implementing the CDQ Program focused on using the allocations to develop a self-sustaining fisheries economy.

Although the program was initially proposed for the fixed gear sablefish fishery, it was first implemented for BSAI pollock. The program originally set aside 7.5 percent of the annual BSAI pollock TAC for allocation to qualifying rural Alaskan communities. The Sustainable Fisheries Act, which amended the Magnuson-Stevens Act, institutionalized the program in 1996. CDQ allocations for BSAI sablefish and halibut were added in 1995, and the multispecies groundfish CDQ Program was implemented in late 1998. The program currently allocates CDQ for each groundfish species or species group with a directed fishery in the BSAI, and halibut and crab. A portion of the PSC limits for halibut, crab, and salmon also are allocated to the CDQ Program. In 1999, the American Fisheries Act increased the pollock allocation to 10 percent as a directed fishing allowance. Amendments to the Magnuson-Stevens Act required an allocation to the CDQ Program of 10.7 percent of the TAC for each directed fishery in the BSAI, except pollock, sablefish, halibut, and crab, starting in 2008.

The purpose of the CDQ program is, essentially, to allow a portion of the economic and social benefits derived from the rich fishery resources of the BSAI management areas to accrue to coastal communities in western Alaska that had not been able to capitalize on their proximity to these commercial fisheries. The CDQ region is historically an area with few economic alternatives. By providing CDQ shares to qualifying communities, these communities are able to invest in capital infrastructure, community development projects, training and education of local residents, and develop regionally based commercial fishing or related businesses.

The eligibility criteria for the CDQ communities are established in the Magnuson-Stevens Act. The CDQ communities are comprised of predominantly Alaska Native residents. They are remote, isolated settlements with few natural assets with which to develop and sustain a viable diversified economic base. As a result, unemployment rates are chronically high, which impedes community instability.

While these communities effectively border some of the richest fishing grounds in the world, they have not been able, for the most part, to exploit their advantageous proximity. The full Americanization of these highly valued offshore fisheries has taken place relatively quickly (i.e., the last participation by foreign fishing vessels ended in the Bering Sea in 1990). But the scale of these fisheries (e.g., 2 million mt groundfish TAC), the severe physical conditions within which the fisheries are prosecuted, and the very high capital investment required to compete in the open-access management environment, all contributed to effectively precluding these villages from participating in this development. The CDQ program serves to extend an opportunity to qualifying communities to directly benefit from the exploitation of these local resources.

The communities that are currently eligible to participate in the CDQ program include 65 coastal Alaska villages, with a combined population estimated at roughly 274,000. The CDQ-qualifying communities have organized themselves into six non-profit groups (with between 1 and 20 villages in each group). The CDQ-

villages are geographically dispersed, extending from Atka, on the Aleutian chain, along the Bering Sea coast, to the village of Wales, near the Arctic Circle. The current CDQ groups are listed below.

Aleutian Pribilof Island Community Development Association (APICDA): The communities represented by APICDA are relatively small and located adjacent to the fishing grounds. Population of the six communities is approximately 1,140.

Bristol Bay Economic Development Corporation (BBEDC): BBEDC represents villages distributed around the circumference of Bristol Bay, including Dillingham, the second-largest CDQ community with approximately 2,470 residents and the location of BBEDC's home office. Total population is approximately 5,930.

Central Bering Sea Fisherman's Association (CBSFA): CBSFA is unusual among CDQ groups in that it represents a single community, St. Paul in the Pribilof Islands, with a population of 530.

Coastal Villages Region Fund (CVRF): CVRF manages the CDQ harvest for its member villages. The villages are located along the coast between the southern end of Kuskokwim Bay and Scammon Bay, including Nunivak Island.

Norton Sound Economic Development Corporation (NSEDC): Approximately 8,500 people make up the region represented by NSEDC, which ranges from St. Michael to Diomede.

Yukon Delta Fisheries Development Association (YDFDA): YDFDA represents the communities, Alakanuk, Emmonak, Grayling, Kotlik, Mountain Village, and Sheldon Point, containing approximately 3,120 people.

One of the criteria for community eligibility in the CDQ Program is that the community could not have previously developed harvesting or processing capability sufficient to support substantial groundfish fisheries participation in the BSAI (unless the community could show that benefits from CDQ allocations would be the only way to realize a return on previous investments). Therefore, to derive economic benefit from their respective allocations, it has been necessary (with the exception of some of the halibut and sablefish CDQs) for each CDQ group to enter into a relationship with one or more of the commercial fishing companies which participate in the fisheries. In this way, the CDQ community brings to the relationship preferential access to the fish and the partnering firm brings the harvesting/processing capacity. The nature of these relationships differs from group to group, but all of the groups are part owners in one or more fishing vessels and companies. In every case, the CDQ community receives royalty payments on apportioned catch shares. Some of the agreements also provide for training and employment of CDQ-community members within the partners' fishing operations, as well as other community development benefits.

Appendix D: Crab bycatch, by stock

Table of Contents

1 Red king crab

1.1 Bristol Bay red king crab

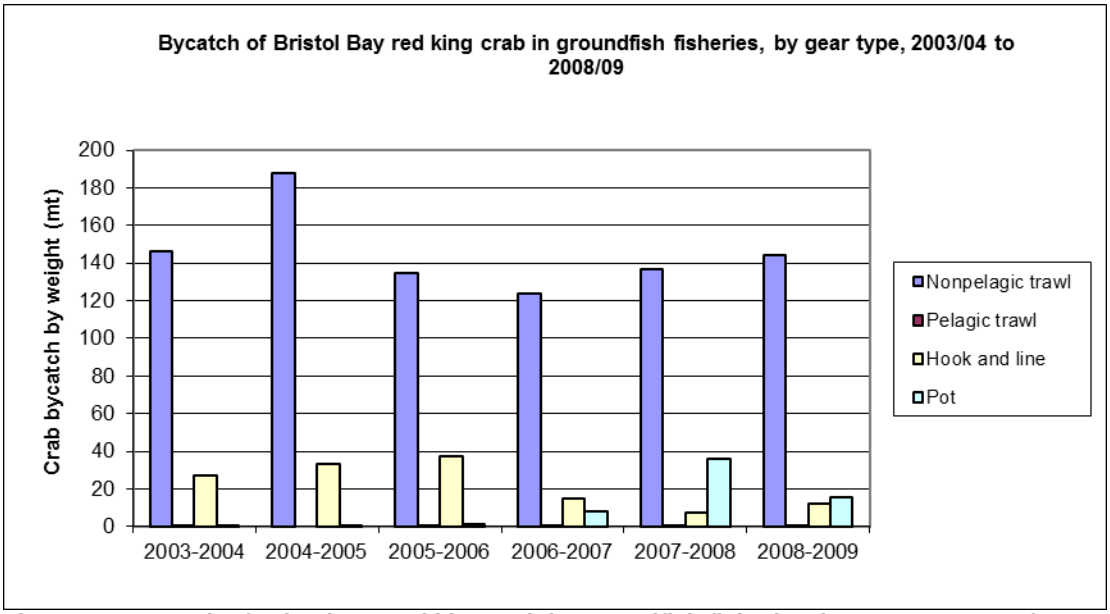


Figure 1 Bycatch of Bristol Bay red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

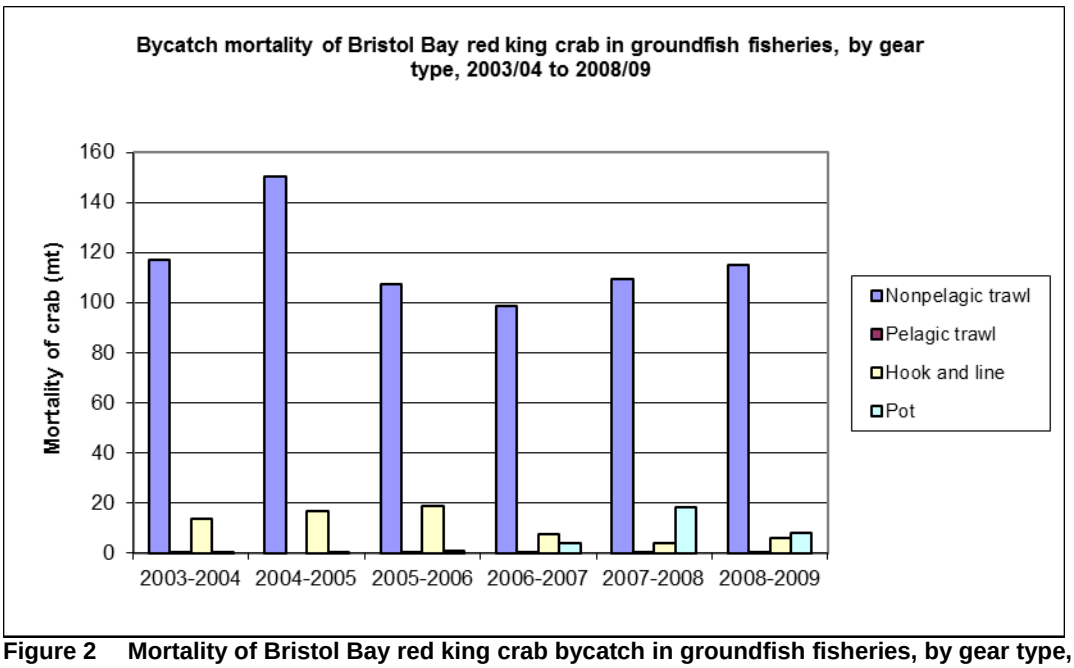


Figure 2 Mortality of Bristol Bay red king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 1 Bycatch of Bristol Bay red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	74,618	84%	41	0%	13,982	16%	6	0%	88,648
2004-2005	97,304	85%	0	0%	17,146	15%	121	0%	114,571
2005-2006	71,657	78%	23	0%	20,044	22%	658	1%	92,382
2006-2007	67,102	84%	11	0%	7,904	10%	4,420	6%	79,437
2007-2008	84,253	76%	35	0%	4,611	4%	22,318	20%	111,217
2008-2009	75,049	84%	28	0%	6,155	7%	8,149	9%	89,381

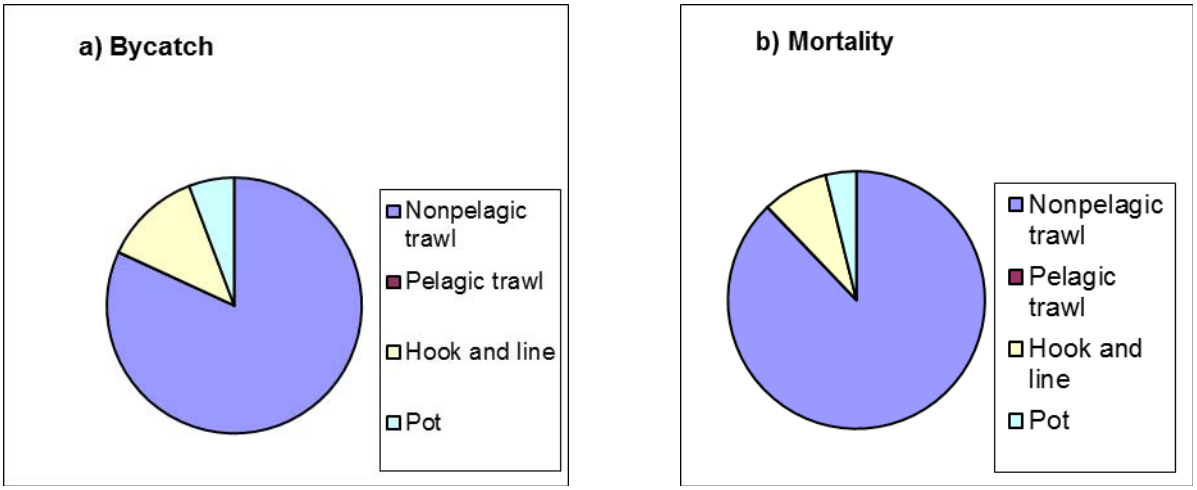


Figure 3 Average proportion of Bristol Bay red king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 2 Bycatch of Bristol Bay red king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock, bottom	11	0	176		0	1,477	277
	Pacific cod	655	1,760	5,965	1,569	1,217	907	2,012
	Yellowfin sole	31,407	49,078	10,261	11,228	21,854	20,281	24,018
	Rock sole	42,491	46,038	54,837	53,328	60,686	49,993	51,229
	Arrowtooth flounder	54	0	0	841	0	45	157
	Flathead sole	0	383	282	133	475	2,346	603
Hook and line	Pacific cod	13,982	17,131	20,044	7,900	4,611	6,155	11,637
Pot	Pacific cod	6	121	658	4,420	22,262	8,140	5,935
Grand Total		88,648	114,571	92,382	79,437	111,217	89,381	95,939

1.2 Pribilof red king crab

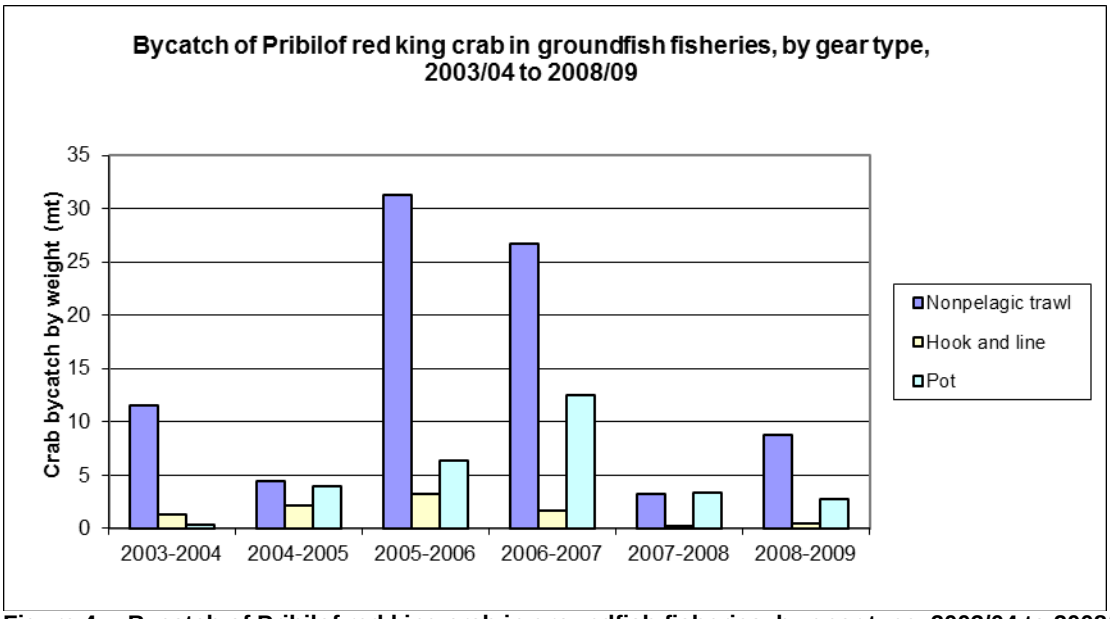


Figure 4 **Bycatch of Pribilof red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons**

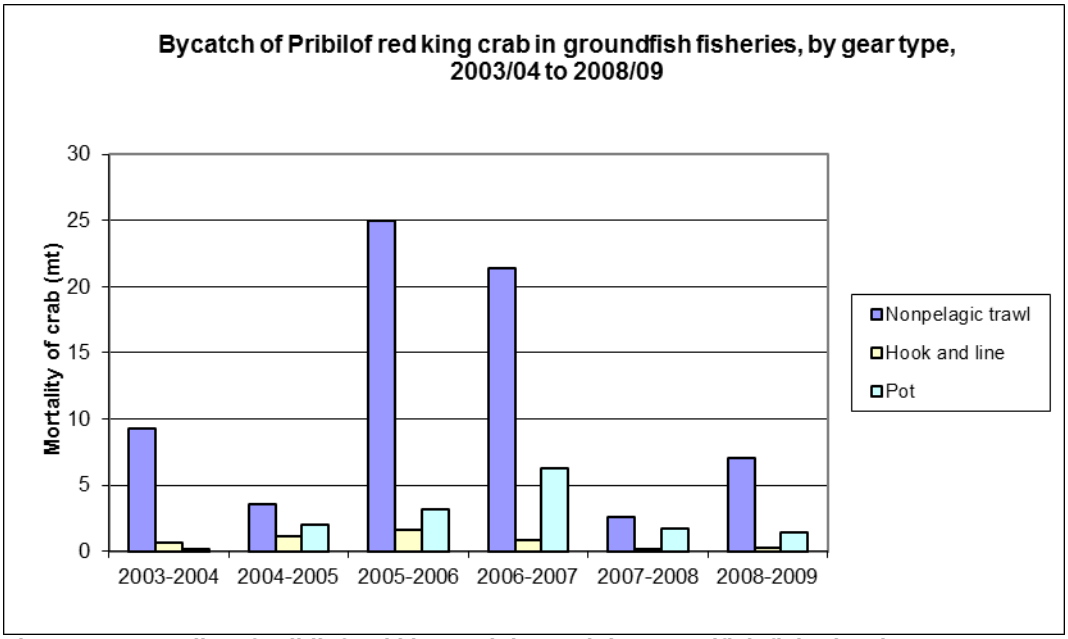


Figure 5 **Mortality of Pribilof red king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons**

Table 3 Bycatch of Pribilof red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	5,906	87%	0	0%	690	10%	175	3%	6,771
2004-2005	2,276	42%	0	0%	1,114	20%	2,050	38%	5,440
2005-2006	16,673	77%	0	0%	1,744	8%	3,369	15%	21,786
2006-2007	14,498	65%	0	0%	912	4%	6,803	31%	22,214
2007-2008	2,012	47%	0	0%	165	4%	2,062	49%	4,239
2008-2009	4,603	73%	1	0%	259	4%	1,437	23%	6,299

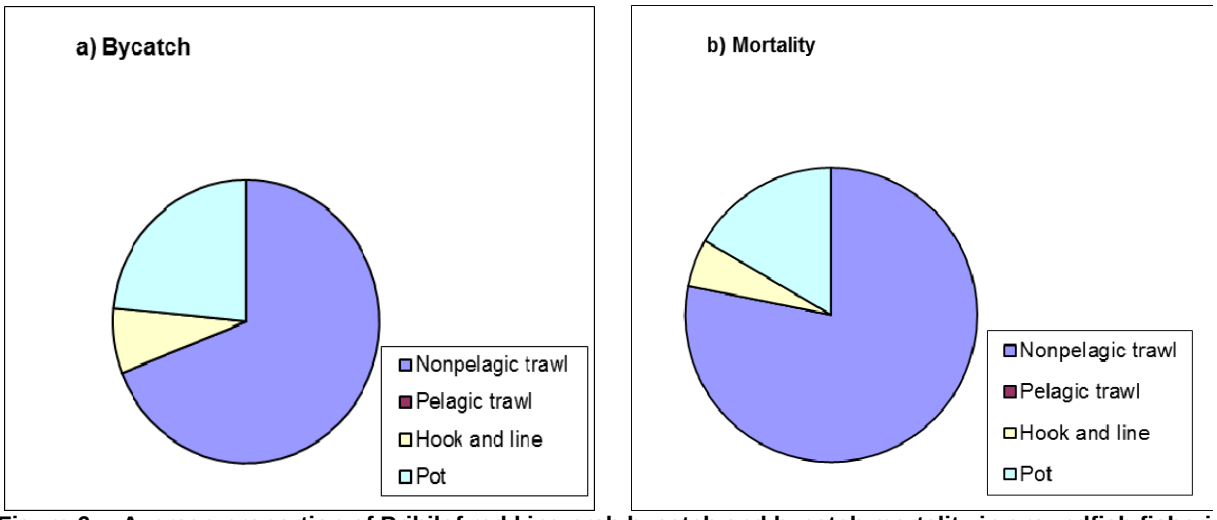


Figure 6 Average proportion of Pribilof red king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 4 Bycatch of Pribilof red king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	5,444	2,204	11,808	13,896	1,181	2,497	6,172
	Rock sole	426	0	4,825	41	46	563	983
	Flathead sole	17	71	1	561	725	1,115	415
Hook and line	Pacific cod	690	1,106	1,741	907	164	258	811
Pot	Pacific cod	175	2,050	3,369	6,803	2,062	1,437	2,649
Grand Total		6,771	5,440	21,786	22,214	4,239	6,299	11,125

1.3 Norton Sound red king crab

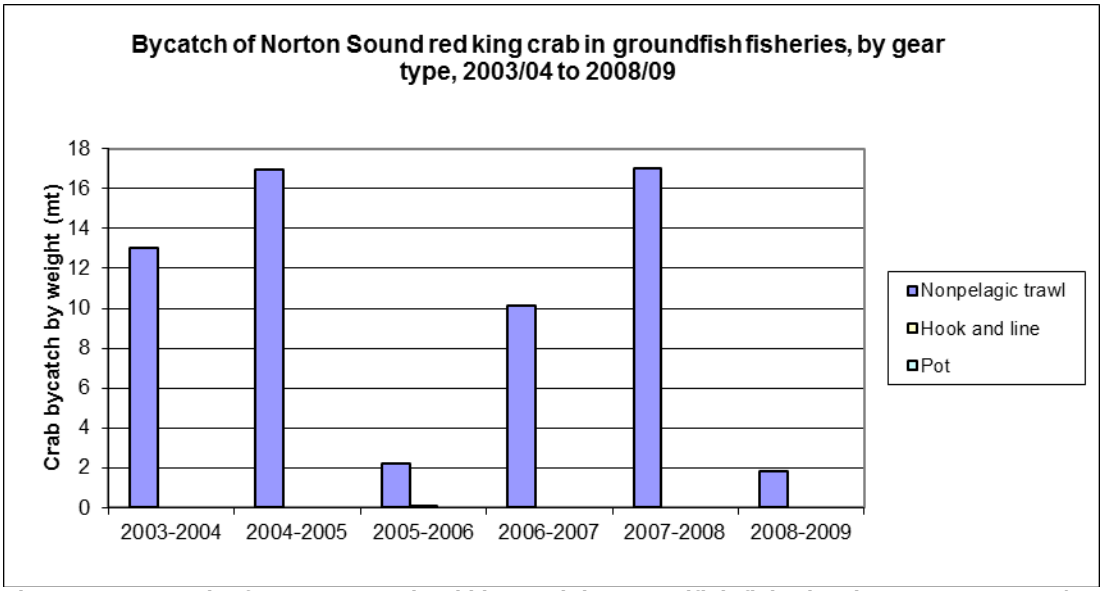


Figure 7 Bycatch of Norton Sound red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

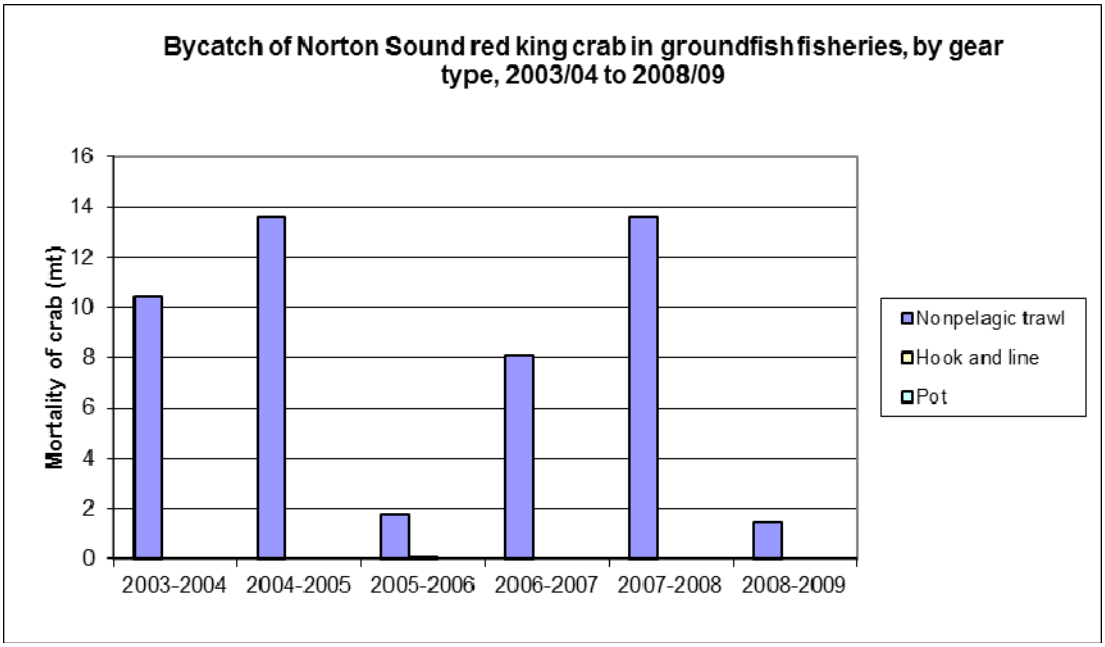


Figure 8 Mortality of Norton Sound red king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 5 Bycatch of Norton Sound red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	6,627	100%		0%	0	0%		0%	6,627
2004-2005	8,774	100%		0%	0	0%		0%	8,774
2005-2006	1,192	100%		0%	2	0%		0%	1,194
2006-2007	5,509	100%	0	0%	0	0%		0%	5,509
2007-2008	10,469	100%		0%		0%		0%	10,469
2008-2009	955	100%		0%	0	0%		0%	955

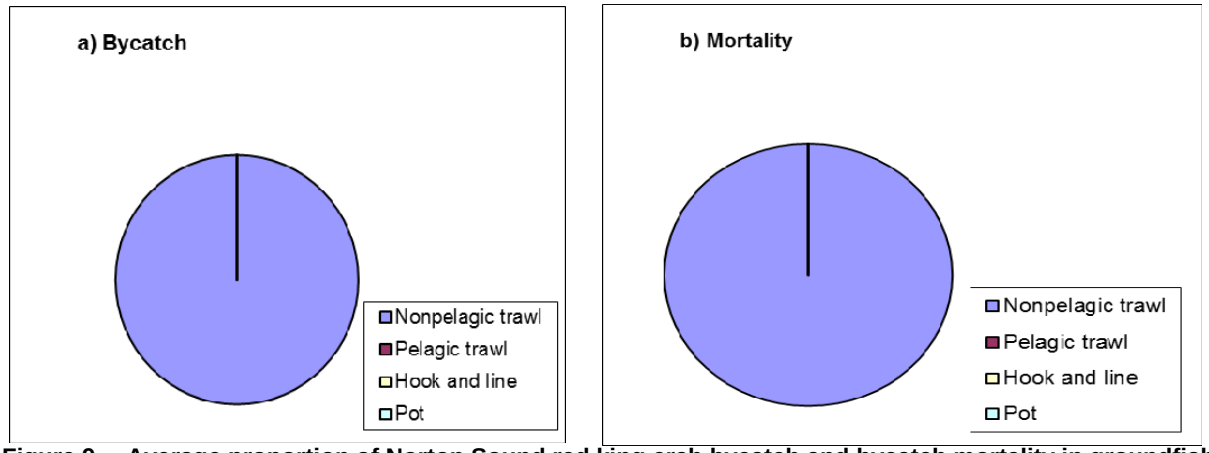


Figure 9 Average proportion of Norton Sound red king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 6 Bycatch of Norton Sound red king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	5,871	6,837	900	2,314	988	559	2,911
	Rock sole	756	1,937	292	3,195	9,428	396	2,667
Grand Total		6,627	8,774	1,194	5,509	10,469	955	5,588

1.4 Adak red king crab

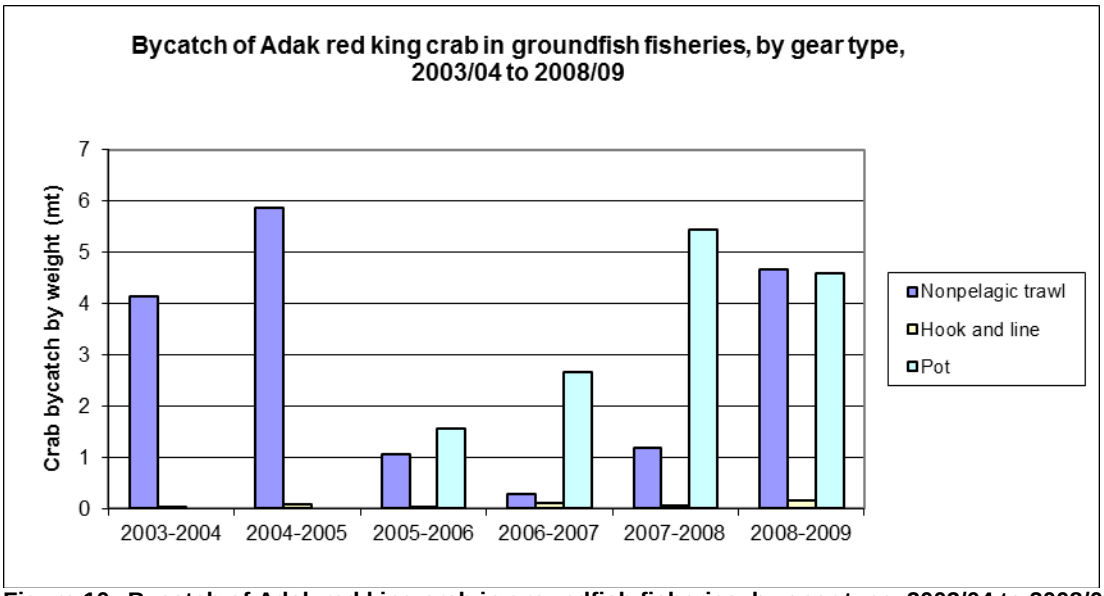


Figure 10 Bycatch of Adak red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

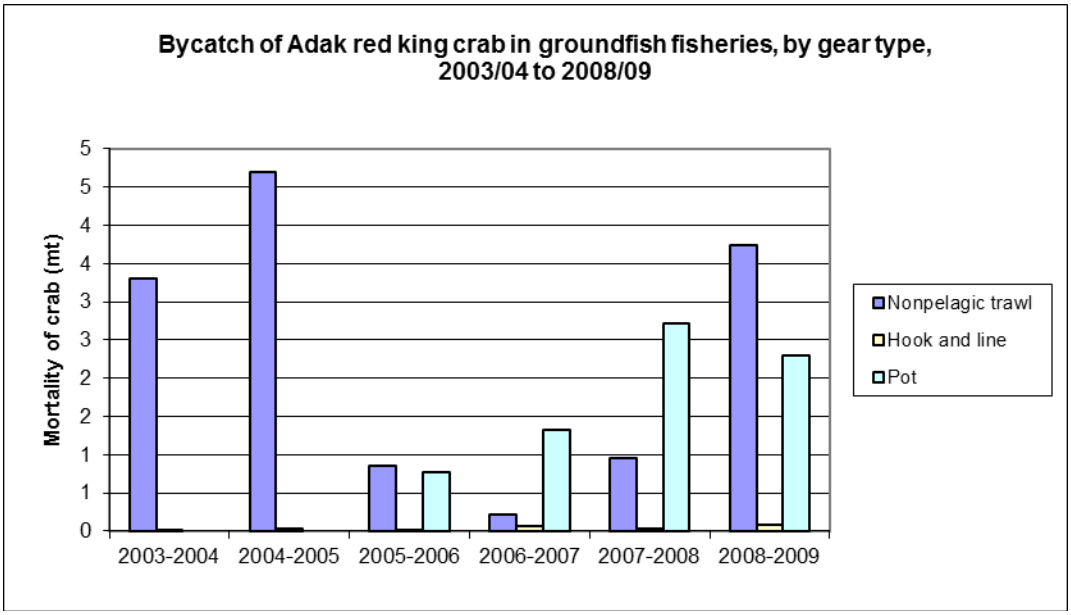


Figure 11 Mortality of Adak red king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 7 Bycatch of Adak red king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	2,103	100%		0%	1	0%	0	0%	2,104
2004-2005	3,037	99%	0	0%	43	1%	0	0%	3,079
2005-2006	570	40%	1	0%	16	1%	827	58%	1,414
2006-2007	152	9%	0	0%	64	4%	1,445	87%	1,660
2007-2008	734	18%	0	0%	42	1%	3,353	81%	4,129
2008-2009	2,433	50%	0	0%	80	2%	2,393	49%	4,907

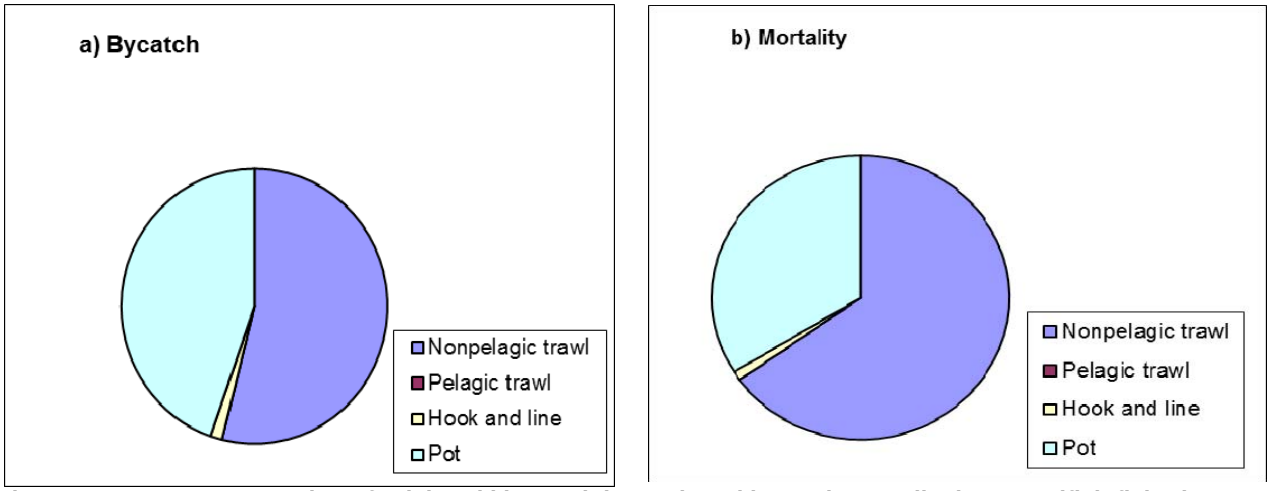


Figure 12 Average proportion of Adak red king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 8 Bycatch of Adak red king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pacific cod	768	3,037	19	36	120	516	749
	Rockfish	1,313	0	497	63	205	237	386
	Atka mackerel	23	0	53	53	410	1,680	370
Hook and line	Pacific cod	1	0	16	2	24	70	19
	Sablefish	0	28	0	0	18	11	9
	Greenland turbot	0	0	0	56	0	0	9
Pot	Pacific cod			2	1,445	3,308	2,393	1,191
	Sablefish	0	0	825	0	45		145
Grand Total		2,104	3,079	1,414	1,660	4,129	4,907	2,882

2 Blue king crab

2.1 Pribilof blue king crab

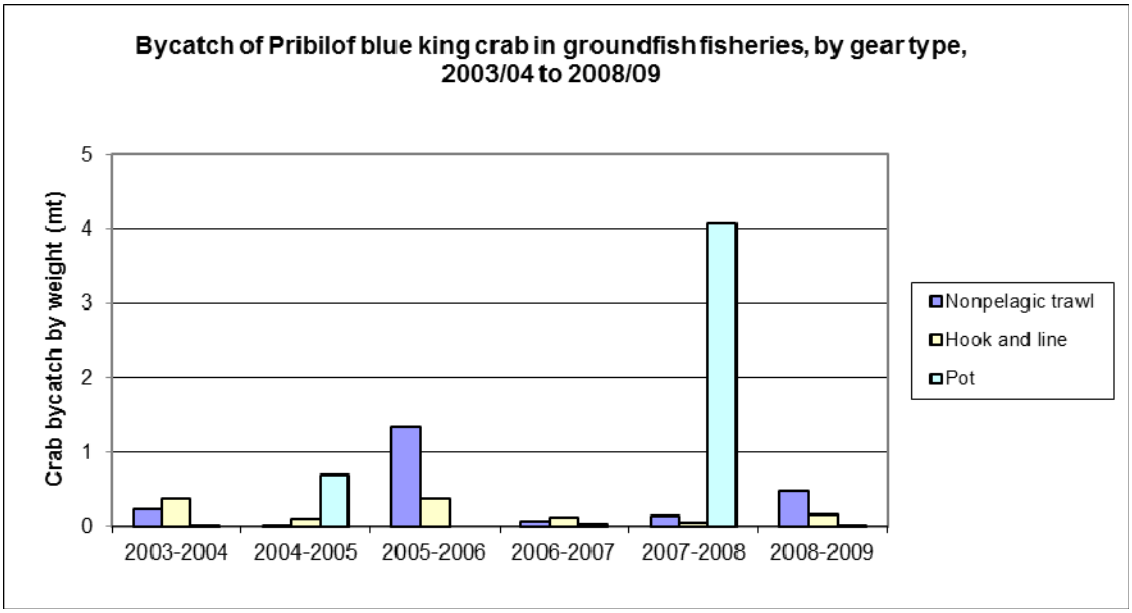


Figure 13 Bycatch of Pribilof blue king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

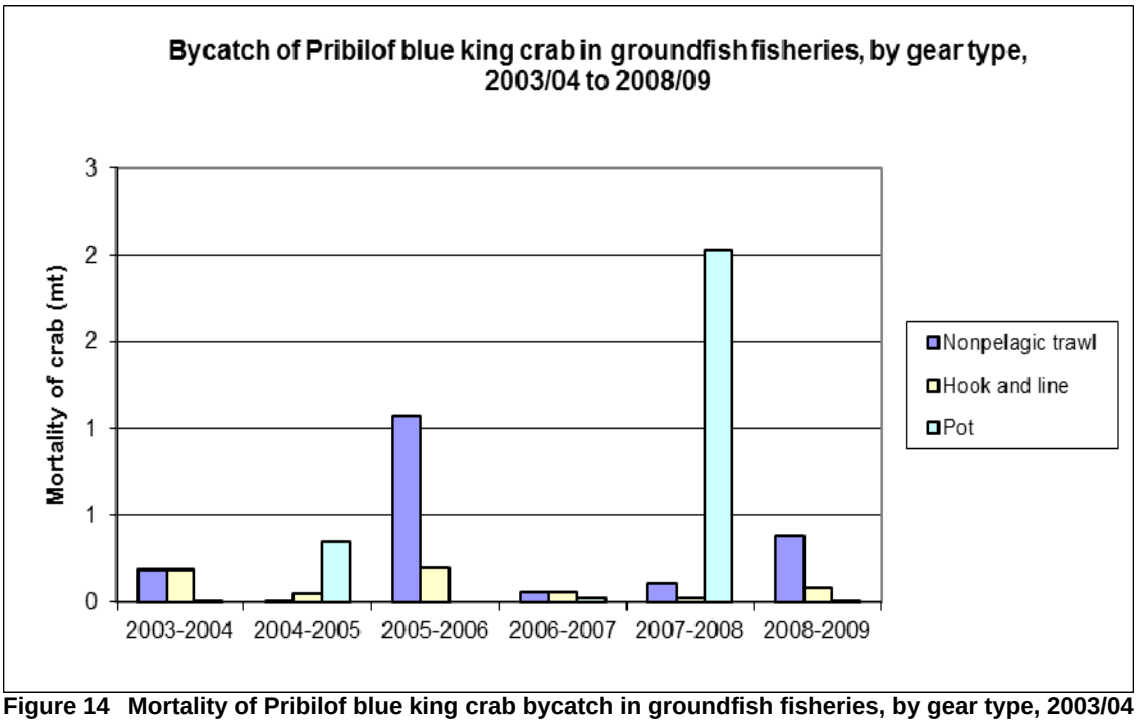


Figure 14 Mortality of Pribilof blue king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 9 Bycatch of Pribilof blue king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	157	38%	0	0%	253	62%	0	0%	411
2004-2005	1	0%	0	0%	64	13%	436	87%	501
2005-2006	798	78%	0	0%	226	22%		0%	1,024
2006-2007	52	31%	0	0%	84	51%	30	18%	166
2007-2008	187	3%	0	0%	72	1%	5,749	96%	6,008
2008-2009	308	74%	0	0%	107	26%	0	0%	415

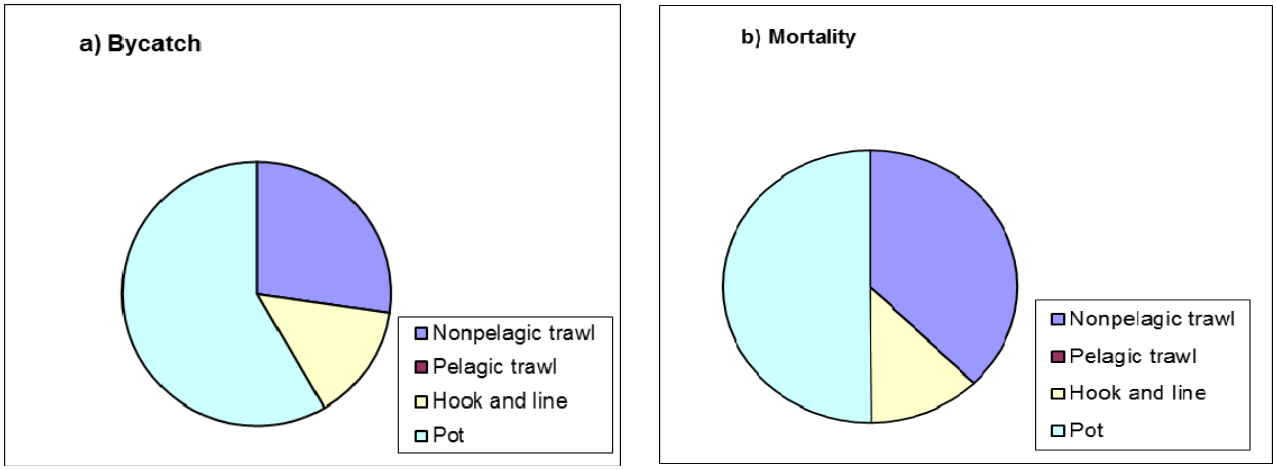


Figure 15 Average proportion of Pribilof blue king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 10 Bycatch of Pribilof blue king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Yellowfin sole	3	0	528	38	146	308	170
	Rock sole	0	0	252	0	0	0	42
	Flathead sole	154	0	18	0	41	0	36
Hook and line	Pacific cod	253	64	226	84	72	107	134
Pot	Pacific cod	0	436		30	5,749	0	1036
Grand Total		411	501	1,024	166	6,008	415	1421

2.2 St Matthew blue king crab

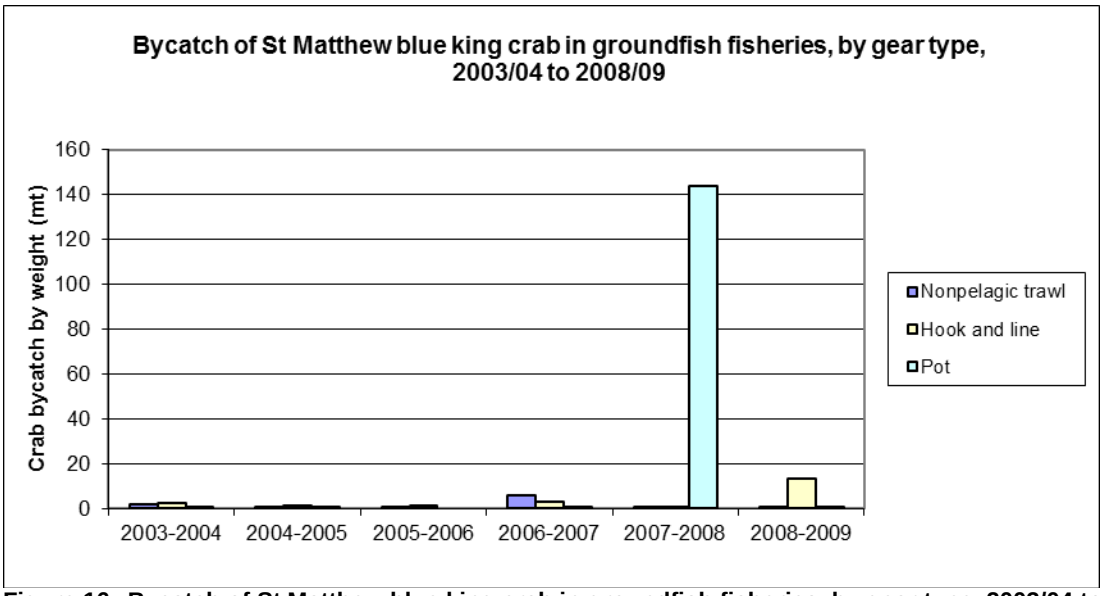


Figure 16 Bycatch of St Matthew blue king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

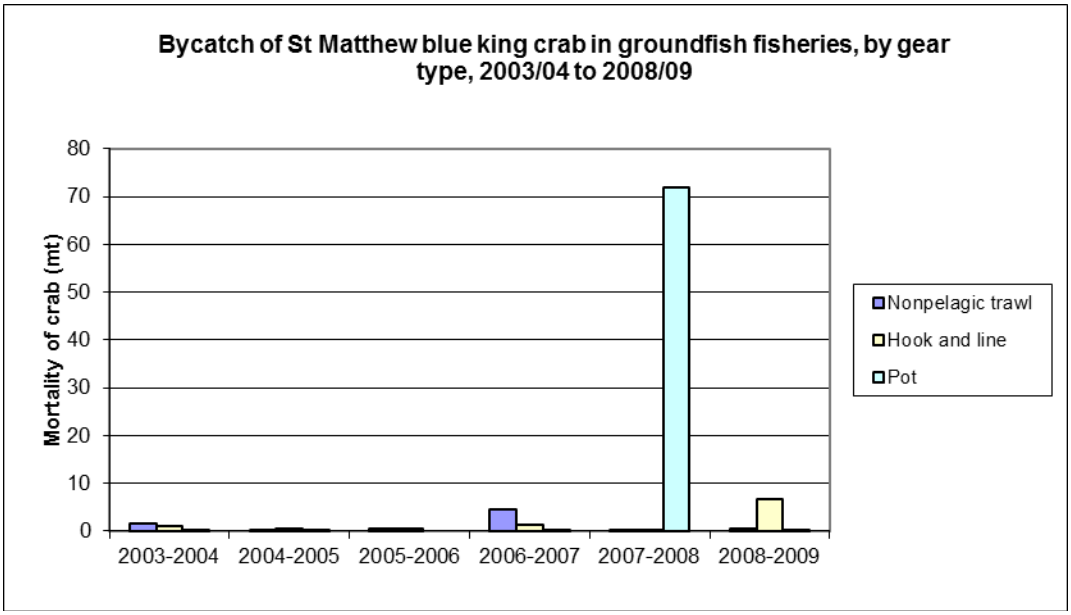


Figure 17 Mortality of St Matthew blue king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 11 Bycatch of St Matthew blue king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	1,407	46%	0	0%	1,568	51%	70	2%	3,045
2004-2005	134	14%	0	0%	787	84%	13	1%	934
2005-2006	354	33%	0	0%	722	67%		0%	1,076
2006-2007	3,974	65%	0	0%	1,991	33%	129	2%	6,094
2007-2008	247	0%	0	0%	230	0%	203,436	100%	203,912
2008-2009	350	4%	8	0%	8,600	96%	1	0%	8,959

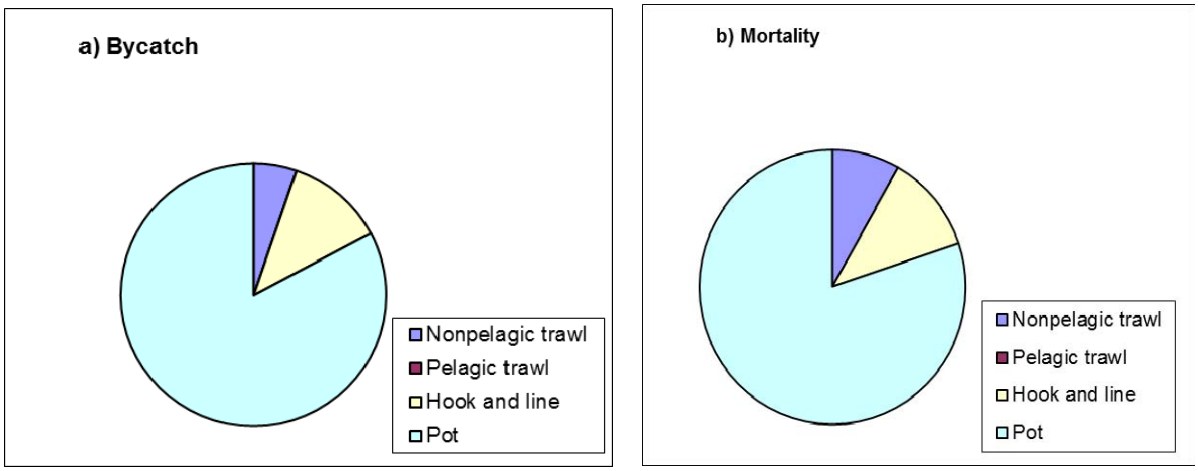


Figure 18 Average proportion of St Matthew blue king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 12 Bycatch of St Matthew blue king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pacific cod	1,403	110	0	3,808	0	148	911
	Yellowfin sole	4	24	352	137	112	78	118
	Rock sole	0	0	2	29	0	0	5
	Arrowtooth flounder		0	0	0	102	85	31
	Flathead sole	0	0	0	0	33	39	12
Hook and line	Pacific cod	1,568	786	718	1,991	228	8,599	2,315
Pot	Pacific cod	70	13		129	203,436	1	33,942
Grand Total		3,045	934	1,076	6,094	203,912	8,959	37,337

3 Golden king crab

3.1 Aleutian Islands golden king crab

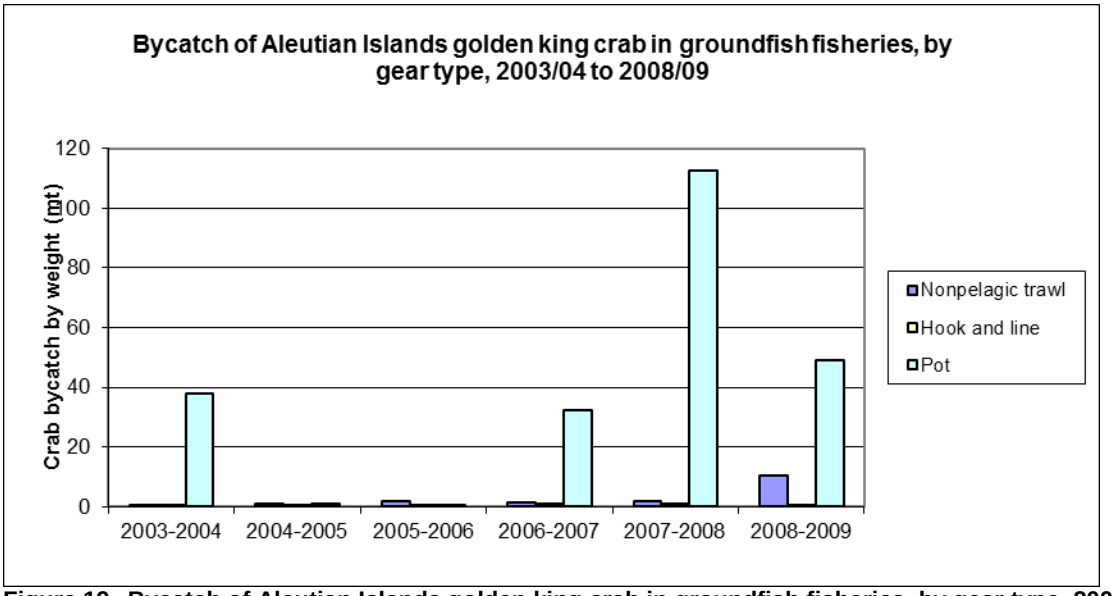


Figure 19 Bycatch of Aleutian Islands golden king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

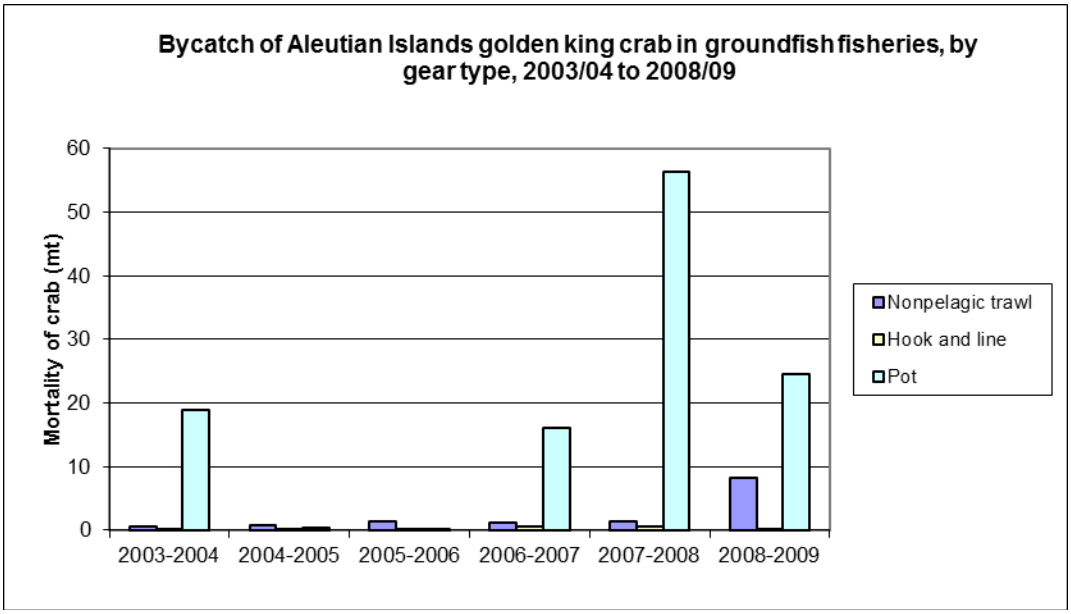


Figure 20 Mortality of Aleutian Islands golden king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 13 Bycatch of Aleutian Islands golden king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	1,623	2%		0%	977	1%	90,611	97%	93,212
2004-2005	1,966	51%	0	0%	309	8%	1,555	41%	3,830
2005-2006	8,376	78%	0	0%	754	7%	1,672	15%	10,801
2006-2007	3,961	4%	0	0%	3,103	3%	91,548	93%	98,612
2007-2008	5,039	1%	0	0%	3,428	1%	343,517	98%	351,983
2008-2009	26,959	17%	0	0%	934	1%	128,009	82%	155,901

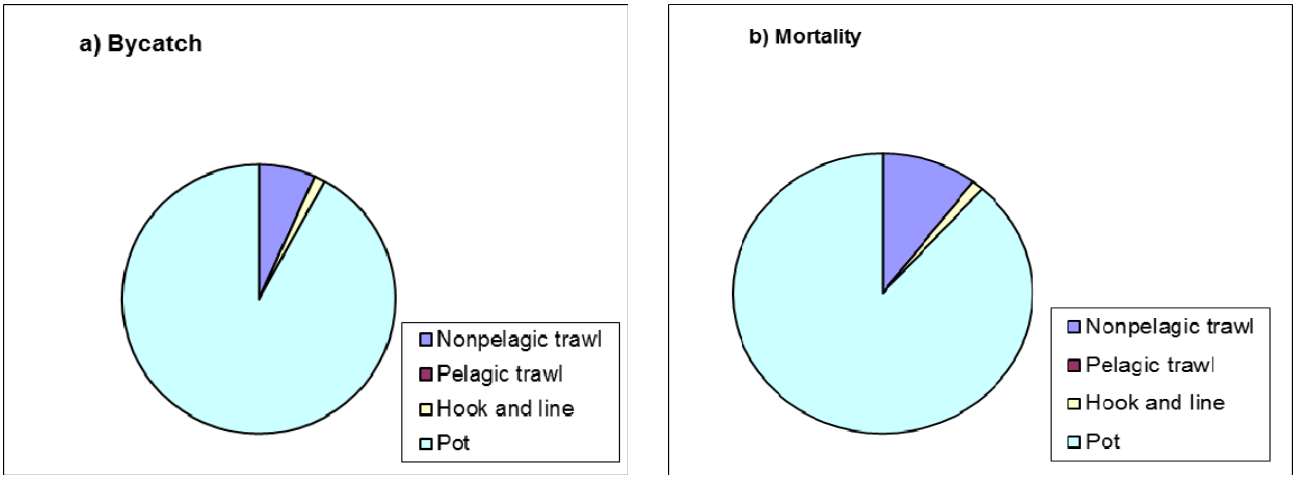


Figure 21 Average proportion of Aleutian Islands golden king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 14 Bycatch of Aleutian Islands golden king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pacific cod	0	14	316	382	6	79	133
	Arrowtooth flounder						1,166	194
	Greenland turbot						814	136
	Rockfish	1,623	1,944	4,435	2,610	3,352	3,037	2,833
	Atka mackerel	0	8	3,624	969	1,681	21,864	4,691
Hook and line	Pacific cod	0	0	11	19	461	453	157
	Sablefish	224	106	203	303	1,289	303	405
	Arrowtooth flounder			89	637	364		182
	Greenland turbot	200	7	0	1,529	1,303	0	507
	Other species	0	1	6	280			48
	Halibut	553	194	445	335	11	165	284
Pot	Pacific cod				71	1	1	12
	Sablefish	90,611	1,555	1,672	91,477	343,516	128,008	109,473
Grand Total		93,212	3,830	10,801	98,612	351,983	155,901	119,057

3.2 Pribilof golden king crab

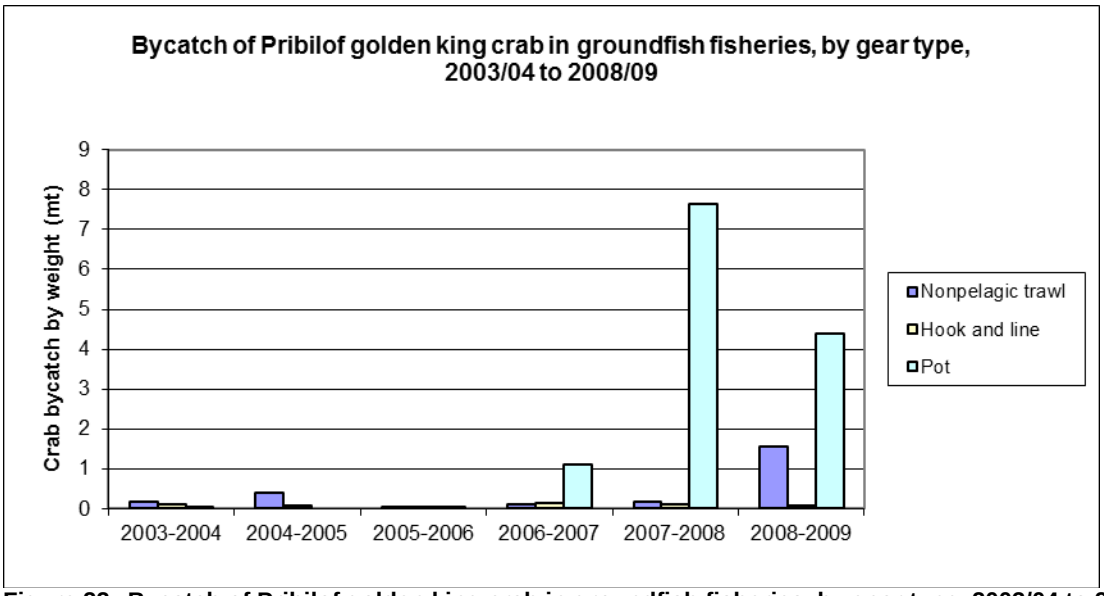


Figure 22 Bycatch of Pribilof golden king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

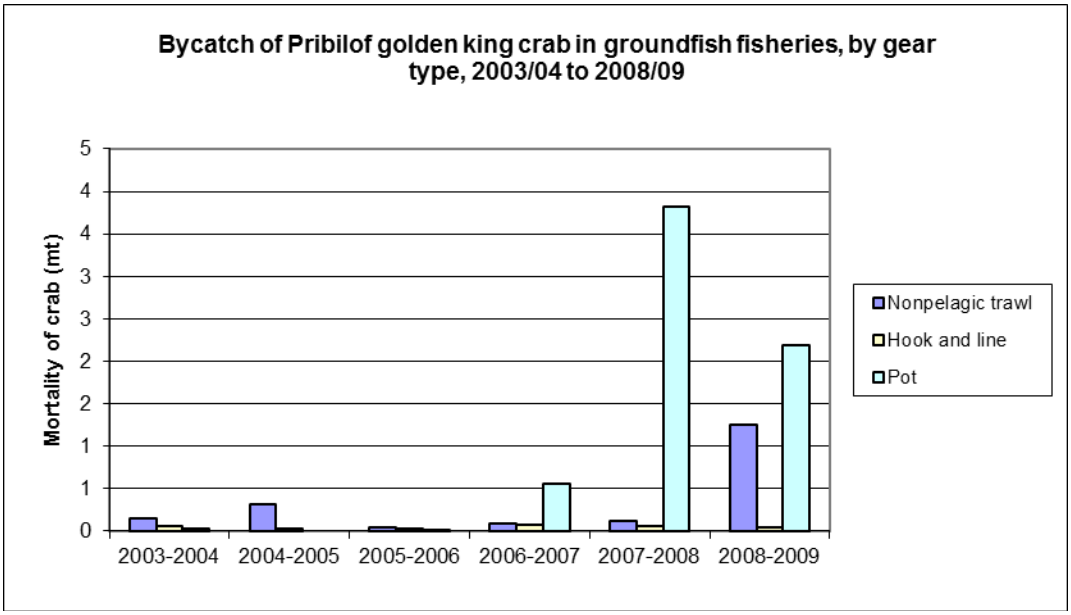


Figure 23 Mortality of Pribilof golden king crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 15 Bycatch of Pribilof golden king crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	435	50%	0	0%	293	34%	139	16%	867
2004-2005	688	86%	2	0%	112	14%	0	0%	801
2005-2006	252	54%	1	0%	210	45%	5	1%	468
2006-2007	323	8%	3	0%	403	10%	3,137	81%	3,865
2007-2008	485	2%	0	0%	333	1%	23,299	97%	24,117
2008-2009	4,074	26%	0	0%	220	1%	11,454	73%	15,747

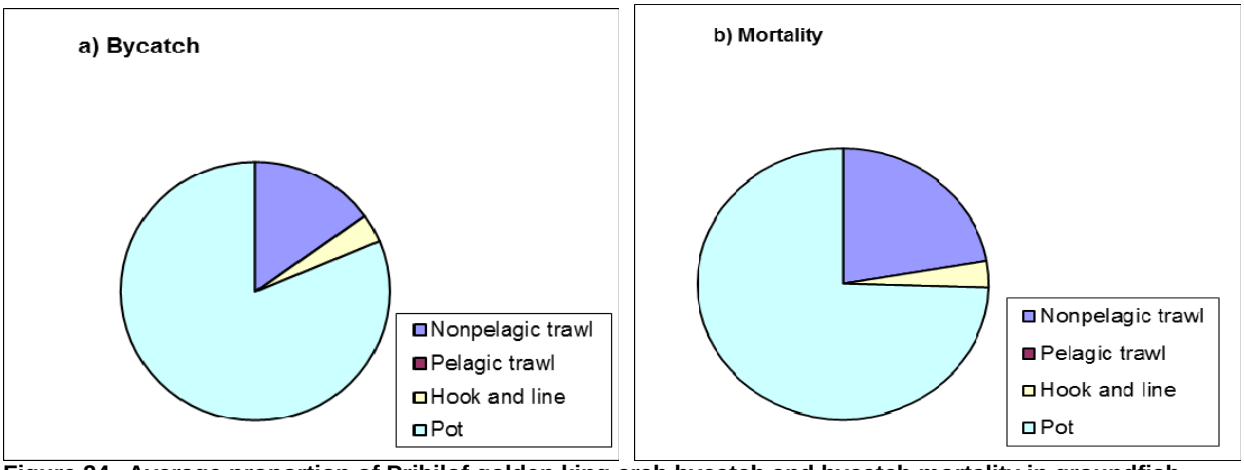


Figure 24 Average proportion of Pribilof golden king crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 16 Bycatch of Pribilof golden king crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pacific cod	9	10	50	6	0	0	12
	Arrowtooth flounder	117	619	182	235	62	3,089	717
	Flathead sole	147	0	0	0	423	57	105
	Other flatfish	0	0	0	0	0	928	155
	Greenland turbot	99	58	16				29
	Rockfish	64	0	5	78		0	25
Hook and line	Pacific cod	227	54	179	123	202	213	166
	Greenland turbot	47	24	18	266	109	1	77
Pot	Sablefish	139		5	3,127	23,272	11,454	6,333
Grand Total		867	801	468	3,865	24,117	15,747	7,644

4 Tanner crab

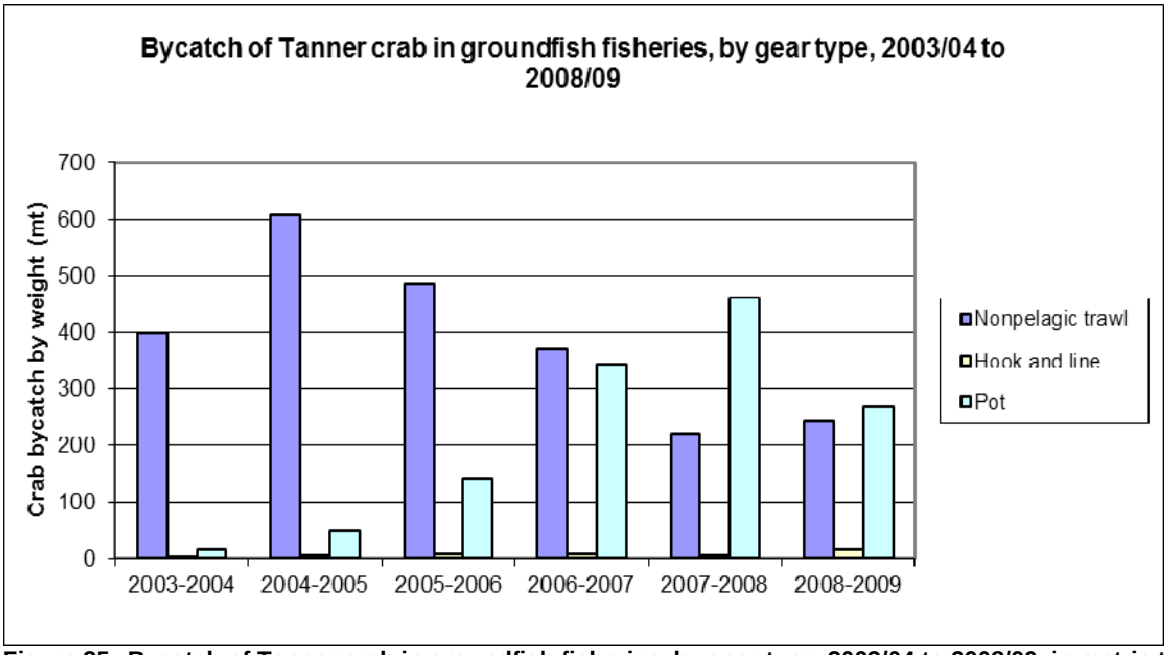


Figure 25 Bycatch of Tanner crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

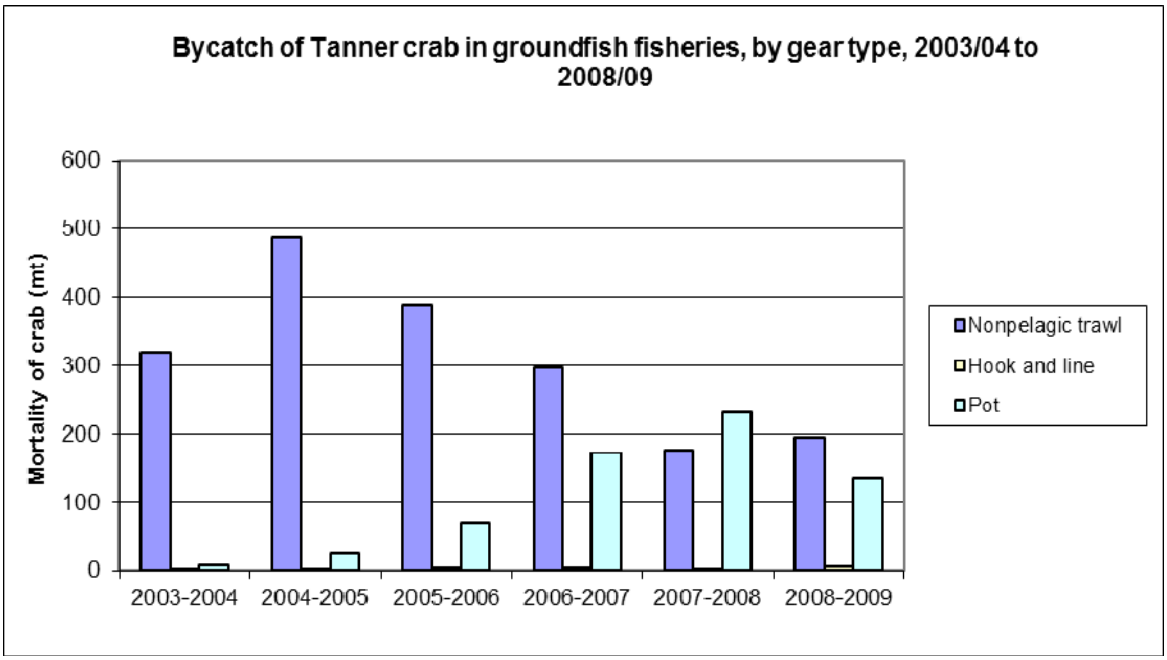


Figure 26 Mortality of Tanner crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 17 Bycatch of Tanner crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	1,027,982	95%	474	0%	8,975	1%	43,983	4%	1,081,414
2004-2005	1,589,157	92%	1,150	0%	12,883	1%	129,410	7%	1,732,600
2005-2006	1,045,060	77%	781	0%	15,859	1%	300,731	22%	1,362,431
2006-2007	710,284	51%	1,145	0%	17,019	1%	657,442	47%	1,385,890
2007-2008	626,137	32%	1,097	0%	17,533	1%	1,311,811	67%	1,956,579
2008-2009	621,883	46%	1,101	0%	38,429	3%	686,305	51%	1,347,718

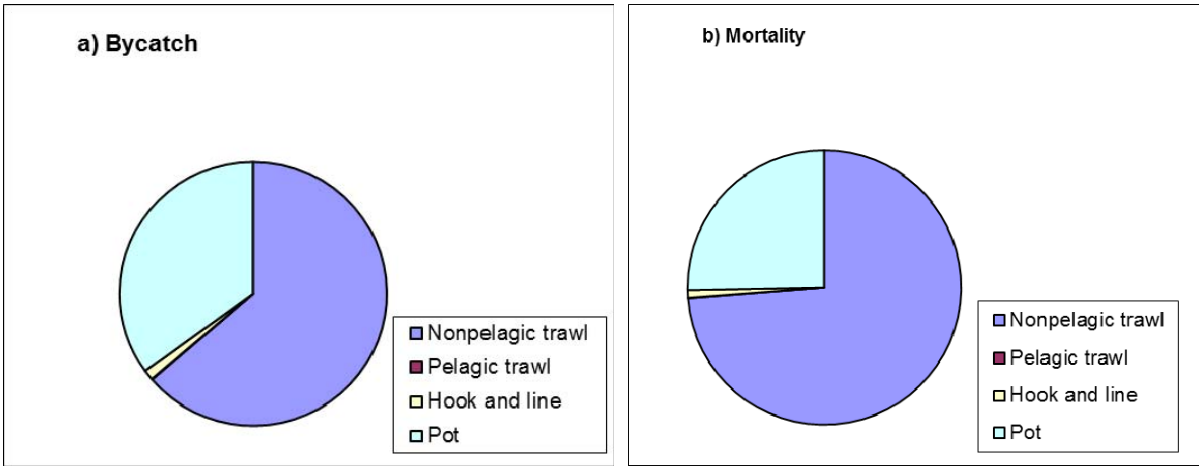


Figure 27 Average proportion of Tanner crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 18 Bycatch of Tanner crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock, bottom	11	2	567	570	2,070	6,867	1,681
	Pacific cod	125,569	295,864	173,109	166,620	45,427	14,480	136,845
	Yellowfin sole	351,499	721,086	358,005	298,524	285,633	388,383	400,522
	Rock sole	174,432	356,200	158,189	96,274	101,134	93,489	163,286
	Arrowtooth flounder	6,056	10,569	8,862	40,584	2,196	34,410	17,113
	Flathead sole	361,345	192,629	342,481	103,678	184,730	83,424	211,381
	Other flatfish	4,880	8,812	2,544	3,509	3,115	596	3,909
	Greenland turbot	2,884	0	88			0	495
	Atka mackerel	767	1,701	51	275	105	0	483
	Other species	323	2,194	56	122	1,110	40	641
Pelagic trawl	Pollock	474	1,150	673	1,145	1,097	1,101	940
Hook and line	Pacific cod	8,973	12,868	15,803	16,983	17,529	37,980	18,356
Pot	Pacific cod	43,725	129,184	300,660	657,414	1,311,498	686,289	521,462
Grand Total		1,081,414	1,732,600	1,362,431	1,385,890	1,956,579	1,347,718	1,477,772

5 Snow crab

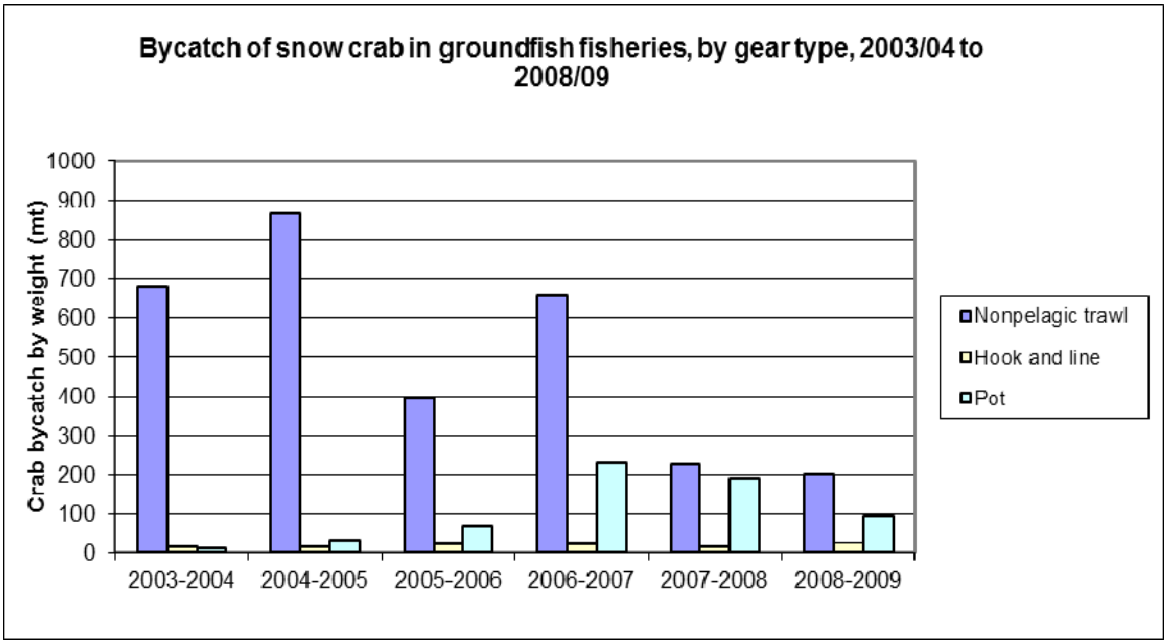


Figure 28 Bycatch of snow crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

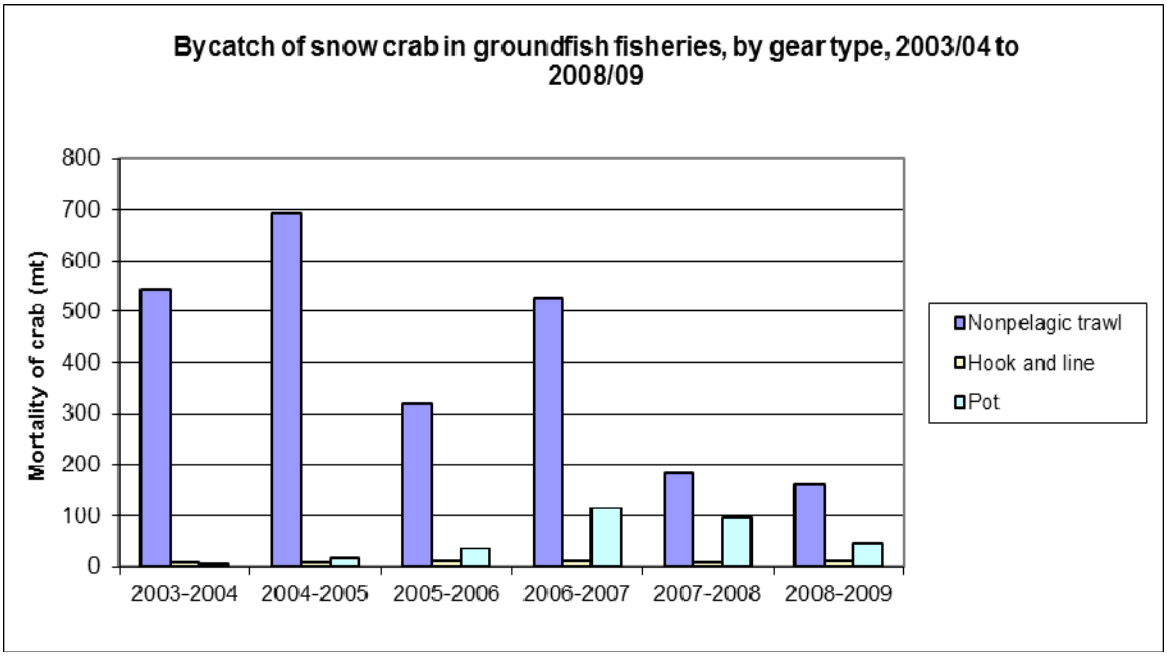


Figure 29 Mortality of snow crab bycatch in groundfish fisheries, by gear type, 2003/04 to 2008/09, in metric tons

Table 19 Bycatch of snow crab in groundfish fisheries, by gear type, 2003/04 to 2008/09, in number of crab

YEAR	Nonpelagic trawl		Pelagic trawl		Hook and line		Pot		Grand Total
2003-2004	2,050,206	96%	581	0%	51,033	2%	31,133	1%	2,132,953
2004-2005	3,248,589	95%	1,353	0%	61,660	2%	123,599	4%	3,435,201
2005-2006	1,085,472	81%	1,502	0%	58,180	4%	190,686	14%	1,335,841
2006-2007	1,677,866	72%	3,198	0%	59,738	3%	586,741	25%	2,327,543
2007-2008	851,568	52%	3,281	0%	61,219	4%	710,054	44%	1,626,122
2008-2009	707,545	63%	5,629	1%	86,459	8%	326,176	29%	1,125,808

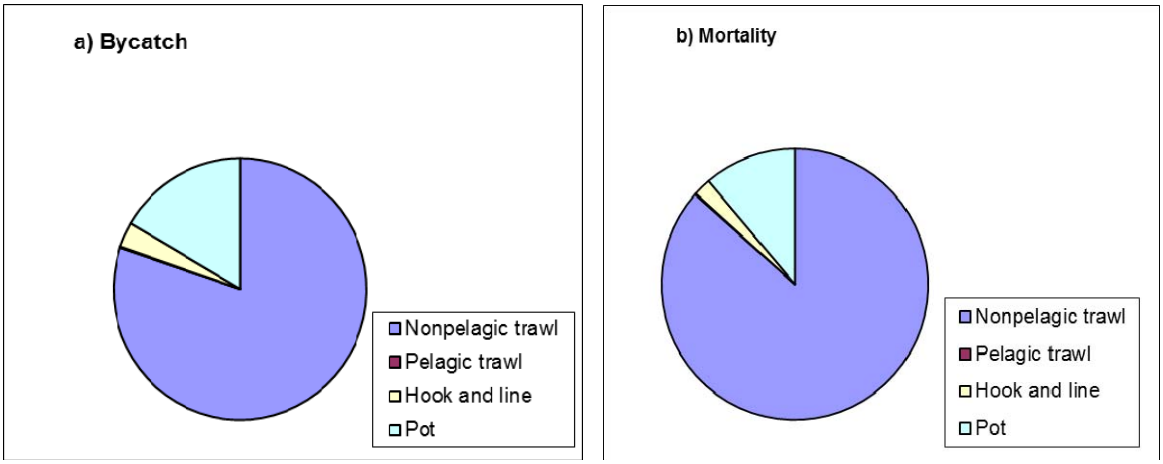


Figure 30 Average proportion of snow crab bycatch and bycatch mortality in groundfish fisheries by gear type, 2003/04 to 2008/09

Table 20 Bycatch of snow crab in groundfish fisheries, by gear type and target fishery, 2003/04 to 2008/09, in number of crab

Gear	Target fishery	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	Average 03/04 to 08/09
Nonpelagic trawl	Pollock	7	0	86	282	3,990	2,703	1,178
	Pacific cod	62,968	100,535	50,820	307,173	69,384	14,624	100,918
	Alaska plaice			195	154	8,467	374	1,532
	Yellowfin sole	1,546,505	2,501,082	735,431	1,184,530	430,233	476,760	1,145,757
	Rock sole	190,388	525,294	108,723	102,299	28,885	12,725	161,386
	Arrowtooth flounder	1,025	1,037	823	10,279	1,109	9,382	3,942
	Flathead sole	247,077	105,962	188,802	72,821	295,308	190,967	183,489
	Other flatfish	112	1,091	325	203	0	4	289
	Greenland turbot	1,800	66	0			0	311
	Other species	214	13,462	157	124	14,070		4,671
Pelagic trawl	Pollock	581	1,353	1,502	3,198	3,281	5,629	1
Hook and line	Pacific cod	51,019	61,657	58,178	59,634	61,176	86,413	63,013
Pot	Pacific cod	31,121	123,507	190,524	586,669	709,944	325,966	327,955
Grand Total		2,132,953	3,435,201	1,335,841	2,327,543	1,626,122	1,125,808	1,997,245

Appendix E: Maps of Crab bycatch by gear type and stock boundary: 2003-2009

Figure 1 Observed number of blue king crab by gear type 2003-2009. Black boxes delineate the boundaries between the St. Matthew blue king crab stock and the Pribilof Islands blue king crab stock.

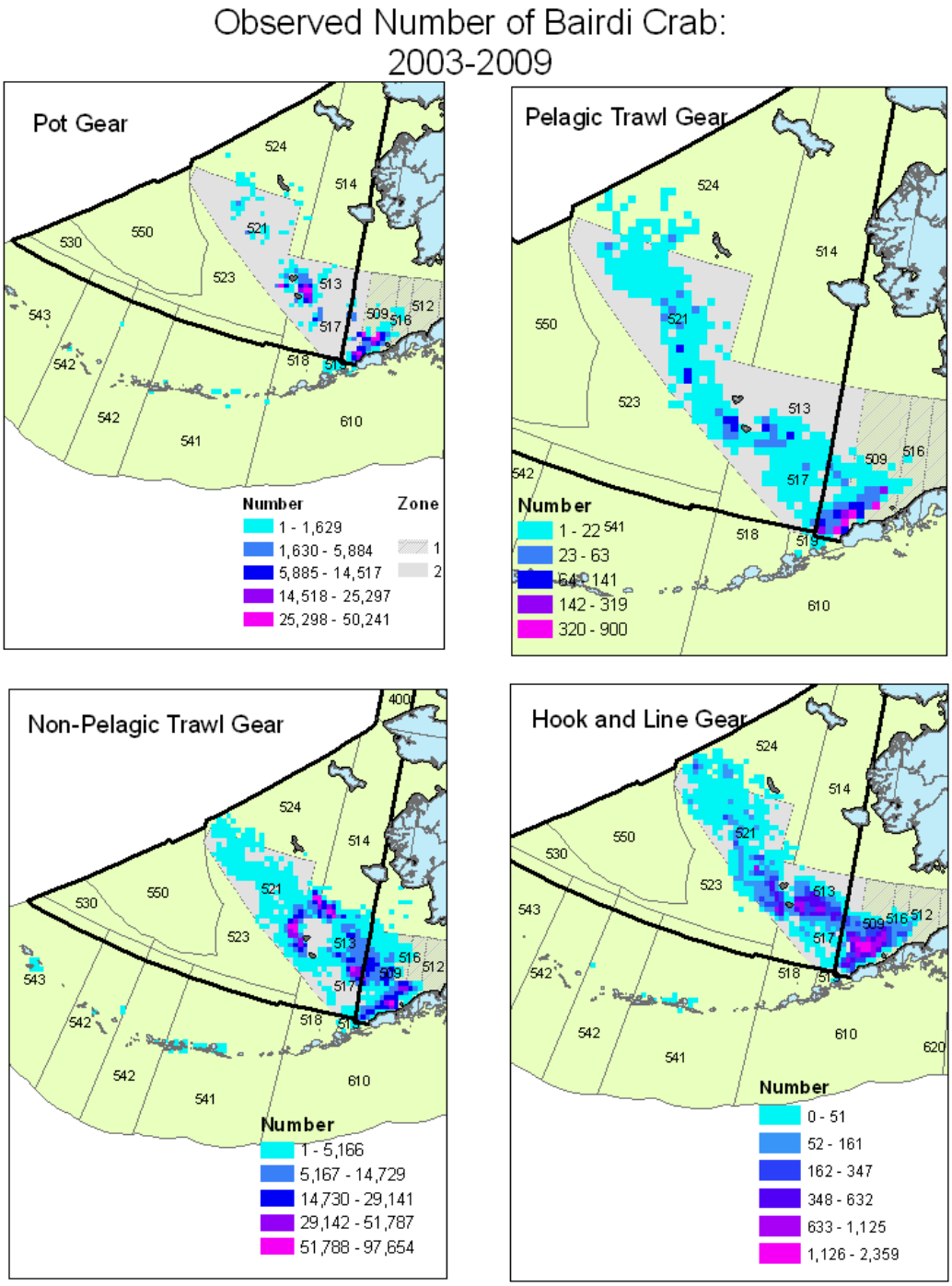


Figure 2 Observed number of Bairdi Tanner crab by gear type 2003-2009.

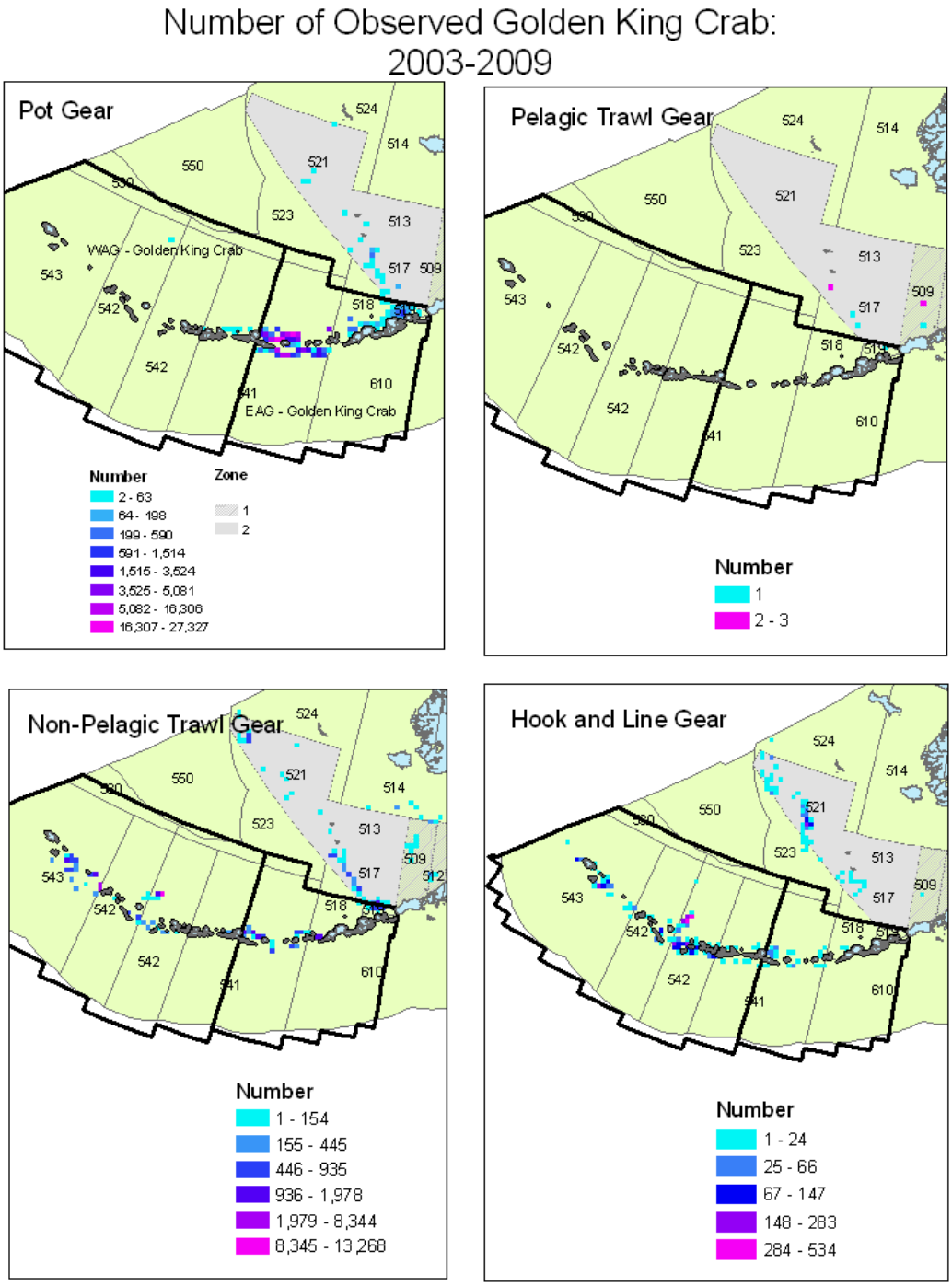


Figure 3 Observed number of golden king crab by gear type 2003-2009. Black boxes delineate the boundaries between the western and eastern Aleutian Islands king crab stocks.

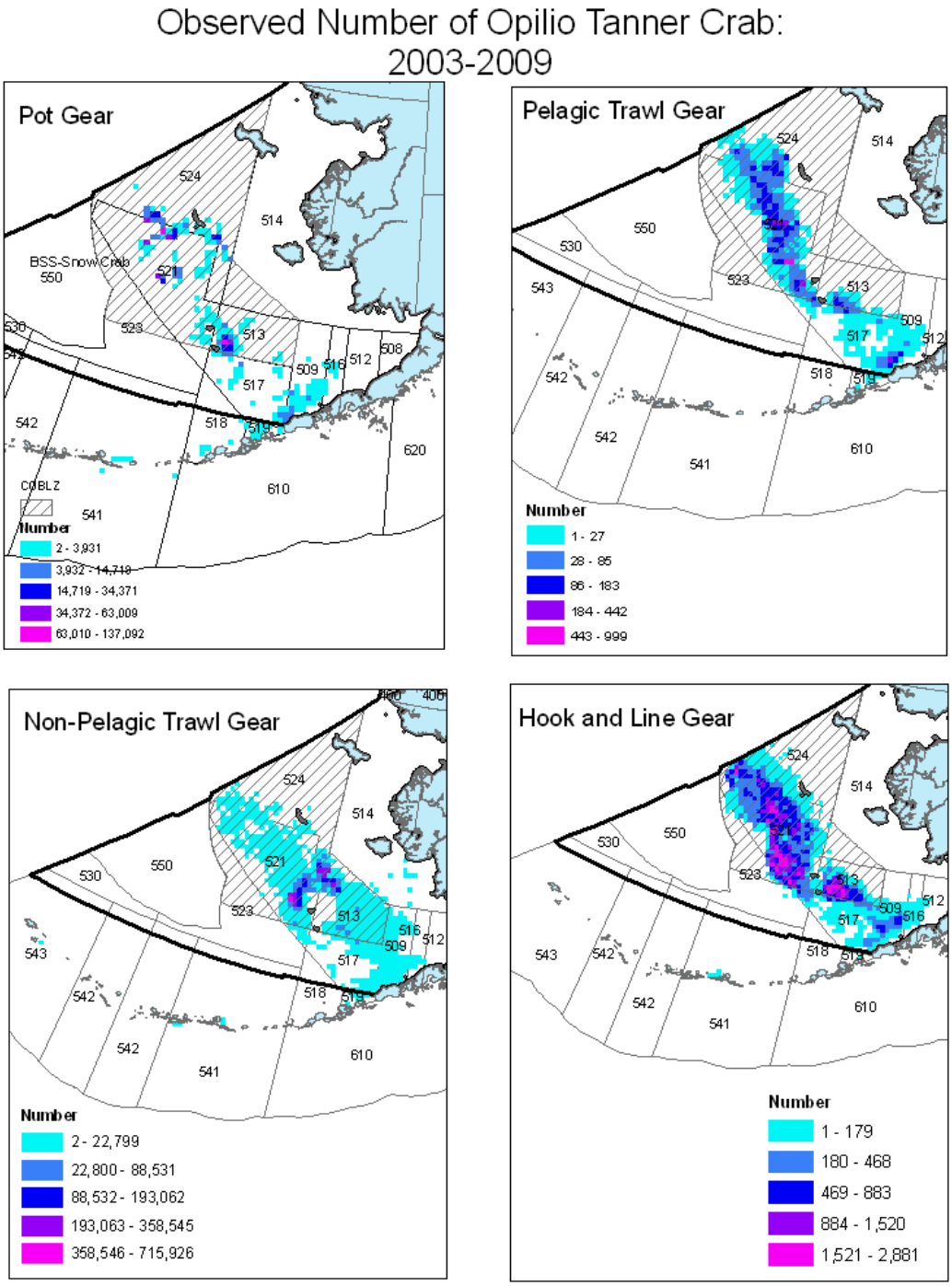


Figure 4 Observed number of snow crab by gear type 2003-2009.

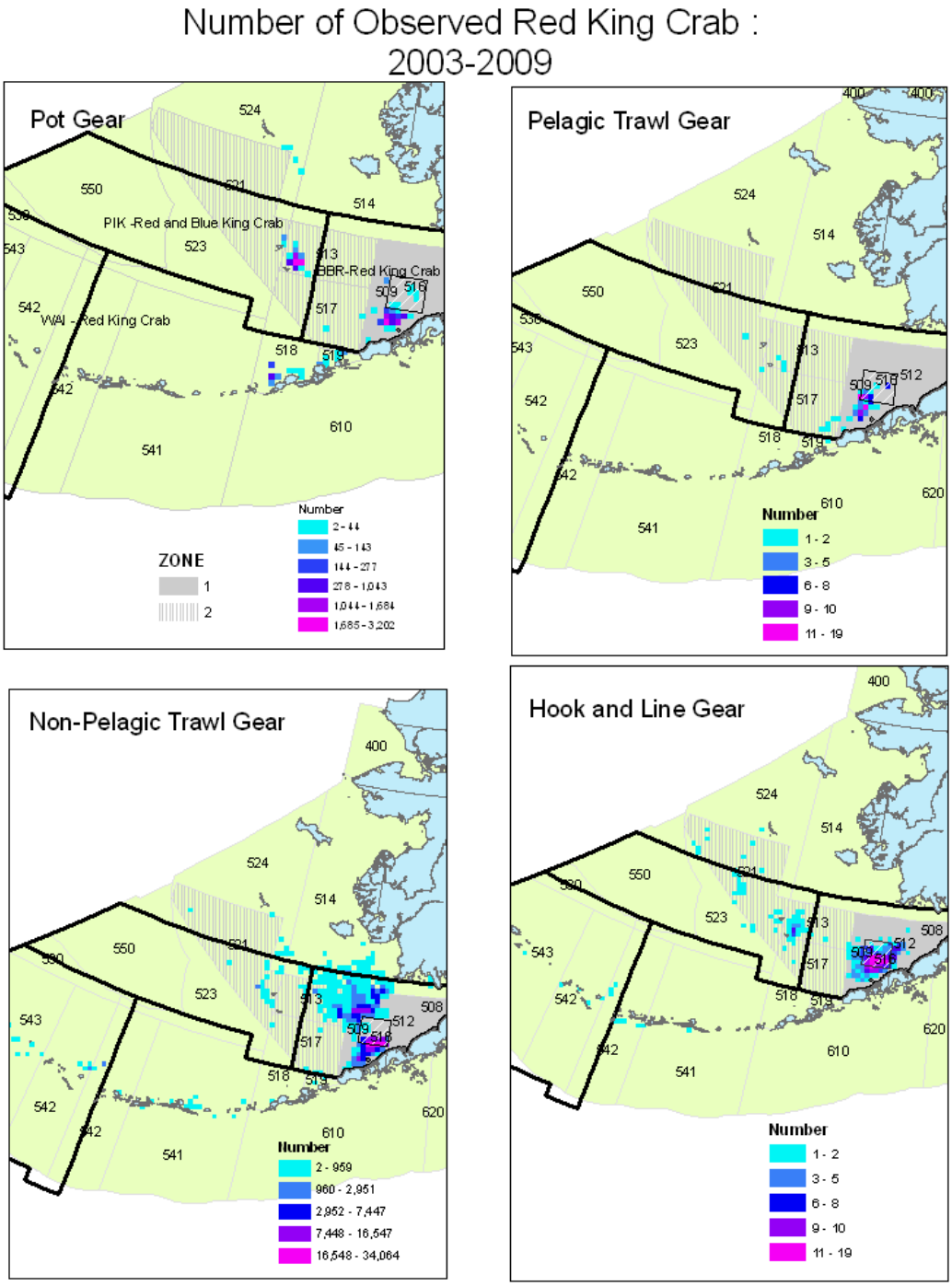


Figure 5 Observed number of red king crab by gear type 2003-2009. Black boxes delineate the boundaries between the Bristol Bay red king crab stock, the Pribilof Islands red king crab stock and Adak red king crab stock.