



UNITED STATES DEPARTMENT OF COMMERCE  
Office of the Under Secretary for  
Oceans and Atmosphere  
Washington, D.C. 20230

OCT 31 1997

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Environmental Assessment of Amendment 40 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area

LOCATION: Federal Waters of the Bering Sea and Aleutian Islands Management Area

SUMMARY: Amendment 40 will establish a prohibited species catch (PSC) limit for Chionoecetes opilio crab in a new C. opilio PSC Bycatch Limitation Zone of the Bering Sea. The PSC would be established annually to fluctuate with crab abundance, within minimum and maximum limits, as a percentage of the NMFS bottom trawl survey index.

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The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information. Also, please send one copy of your comments to me in Room 5805, PSP, U.S. Department of Commerce, Washington, D.C. 20230.

Sincerely,

*Susan Tinc*

Acting NEPA Coordinator

Enclosure





ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/  
FINAL REGULATORY FLEXIBILITY ANALYSIS  
FOR

**AMENDMENT 40**

**Management of Snow Crab (*Chionoecetes opilio*) Bycatch Limits  
in Bering Sea Groundfish Trawl Fisheries**

an Amendment to the Fishery Management Plan  
for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area



Prepared by staff of the  
North Pacific Fishery Management Council

October 2, 1997

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## Executive Summary

Bering Sea crab stocks are currently at relatively low levels based on recent National Marine Fisheries Service (NMFS) bottom trawl surveys. Crab fisheries have been impacted by these low stock sizes, such that no Bristol Bay red king crab fishery occurred in 1994 or 1995, and harvests of Tanner and snow crabs have been much reduced. An EA/RIR, which examined impacts of management measures proposed to reduce the impacts of trawling on red king crab, Tanner crab, and snow crab was released for public review on May 10, 1996 (NPFMC, 5/10/96). In June 1996, the Council took final action on Amendment 37, providing several measures to protect the red king crab stock from possible impacts due to groundfish fisheries. At its September 1996 meeting, the Council took final action on Amendment 41, which modified bycatch limits of Tanner crab taken incidentally in trawl fisheries. This measure for snow crab bycatch limits is proposed as Amendment 40 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea/Aleutian Islands (BSAI) area.

Bycatch limits for snow crab have never been established for Bering Sea trawl fisheries. Bycatch of snow crab may impact crab rebuilding and future crab harvests by pot fisheries. Bycatch limits (termed Prohibited Species Catch limits, or PSC) for red king crab and Tanner crab were established for trawl fisheries beginning in 1986, and have recently been modified to reflect current stock status. The alternatives examined for snow crab bycatch management included the following:

Alternative 1: Status quo, no action. No PSC limits would be set for snow crab.

Alternative 2: Establish a fixed PSC limit for snow crab. Based on a three year average (1992-1994), a PSC limit would be established at a fixed level of 11,000,000 snow crab in Zone 2. No snow crab PSC limit would be established for Zone 1, as bycatch in this area has been minuscule by comparison.

Option A: Establish PSC limit at 6 million snow crab in Zone 2.

Alternative 3: Establish PSC limits for snow crab that fluctuate with crab abundance. Annual PSC limits would be set as a percentage of the NMFS bottom trawl survey index. Limits for Zone 2 would be set at a percentage within the range 0.005 to 0.25% of the snow crab total population index (all districts combined). No snow crab PSC limit would be established for Zone 1.

Option A: Set fixed upper limit for PSC at 12 million snow crab in Zone 2.

Alternative 4 (Preferred): Establish a PSC limit for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The PSC cap will be set at 0.1133% of the total Bering Sea abundance (as indicated by the NMFS trawl survey), with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crab taken within the "C. opilio Bycatch

Coordinates of the Snow Crab Bycatch Limitation Zone, as agreed upon by the negotiating committee.

North latitude	West longitude
56°30'	Donut Hole
56°30'	165°00'
58°00'	165°00'
59°30'	170°00'
US-Russia Line	170°00'

Limitation Zone" (COBLZ) would accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery would be prohibited from fishing within the COBLZ. This alternative would yield a snow crab PSC limit of 6,147,000 snow crab for 1997, which is 0.1133% of the total 1996 NMFS survey abundance of 5,424,886,000 snow crab (both sexes, all size groups).

The biological impacts of this management measure on crab populations were measured on the basis of adult equivalents. The adult equivalent formula incorporated data from groundfish and crab fisheries including bycatch numbers, size and sex of catch and bycatch, discard mortality, and natural mortality. Results indicated that, assuming only observed crab are impacted, bycatch in groundfish fisheries has relatively small impact on crab populations, and therefore establishing a snow crab PSC limit as proposed under Alternatives 2-4 may not drastically improve or rebuild crab stocks from current levels. At lower stock sizes, however, reduced bycatch could result in conservation benefits. The COBLZ proposed under Alternative 4 encompasses nearly the entire distribution of snow crab in the Bering Sea.

The economic impacts of this management measure depend on the alternative chosen. For snow crab, recent data indicated that the current bycatch has been reduced in the past few years. Hence, establishing a PSC limit based on historic data may not impact groundfish fisheries if the available PSC is optimally allocated. Simulation modeling indicated no net benefits or costs associated with setting caps at or near current bycatch levels. However, because PSC allocation becomes fixed for the year during the annual specification process, optimal allocation may be difficult to achieve. Bycatch of snow crab was much reduced in 1995 and 1996, suggesting that the PSC limit proposed under Alternatives 2-4 may be achievable without substantially impacting trawl fisheries. One major assumption regarding assessment of impacts for Alternative 2 is that crab stock abundance will remain relatively stable in future years.

The impacts of Alternatives 3 and 4 depend on the PSC rate chosen. On average 1992-1995, groundfish fisheries took 0.14% of the snow crab population as bycatch (bycatch as percentage of total crab survey abundance). As with other alternatives, PSC limits set at these rates (current bycatch use) would not impact groundfish fisheries if the available PSC is optimally allocated. Fixed upper and lower limits, proposed under Alternative 4, may constrain trawl fisheries when crab abundance is low or high. The potential benefit of stairsteps is that while they allow bycatch levels to fluctuate with crab abundance, they also would temper year-to-year variability in PSC limits caused by trawl survey abundance estimates. Some stability may also be beneficial to long-term financial planning for trawl companies.

## 1.0 INTRODUCTION

The groundfish fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) off Alaska are managed under the Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska and the Fishery Management Plan for the Groundfish Fisheries of the Bering Sea and Aleutian Islands Area. Both fishery management plans (FMP) were developed by the North Pacific Fishery Management Council (Council) under the Magnuson Fishery Conservation and Management Act (Magnuson Act). The Gulf of Alaska (GOA) FMP was approved by the Secretary of Commerce and become effective in 1978 and the Bering Sea and Aleutian Islands Area (BSAI) FMP become effective in 1982.

Actions taken to amend FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NEPA, E.O. 12866 and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1 of this document. Section 2 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 3 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered. Section 4 contains the Final Regulatory Flexibility Analysis (FRFA) required by the RFA which specifically addresses the impacts of the proposed action on small businesses.

This Environmental Assessment/Regulatory Impact Review/Final Regulatory Flexibility Analysis (EA/RIR/FRFA) addresses proposals to reduce the impacts of trawling on Bering Sea snow crab and increase the probability of crab stock rebuilding.

### 1.1 Purpose of and Need for the Action

Bering Sea crab stocks are currently at relatively low levels based on recent National Marine Fisheries Service (NMFS) bottom trawl survey data. Recruitment and exploitable biomass of Bristol Bay red king crab (*Paralithodes camtschaticus*), and Bering Sea Tanner crab (*Chionoecetes bairdi*), and snow crab (*C. opilio*) stocks are at relatively low levels. The 1995 snow crab season produced only 50.7 million pounds. This is the lowest catch since 1984. The overall stock remains at low levels. Preliminary 1996 survey data indicates that adult males are abundant, but females and pre-recruits are becoming less abundant (Bob Otto,

Abundance (millions) of snow crab (*C. opilio*) in from NMFS surveys, in the Bering Sea (all districts) 1988-1996.

	MALES			FEMALES		Grand Total
	Juveniles <102	Large ≥ 102	V. Large ≥ 110	Small <50	Large ≥ 50	
1988	3,467	171	90.1	1,235	2,323	7,194
1989	3,646	187	81.2	1,923	3,791	9,546
1990	2,860	420	188.7	1,463	2,798	7,542
1991	3,971	484	323.0	3,289	3,575	11,319
1992	3,158	256	164.8	2,434	1,914	7,763
1993	5,594	135	77.9	3,990	1,983	11,704
1994	4,283	72	39.9	3,418	1,674	9,446
1995	4,087	69	30.9	2,090	2,409	8,655
1996 (Prel)	2,700	172	64.8	1,189	1,364	5,425

NMFS, pers. comm), as shown in the adjacent table. A summary of snow crab biology, the fishery, and management is provided in Appendix 1.

## 1.2 Problem Statement

Bycatch limits for snow crab have never been established for Bering Sea trawl fisheries. Bycatch of snow crab may impact crab rebuilding and future crab harvests by pot fisheries.

## 1.3 Alternatives Considered

Four main alternatives were examined. In addition to the status quo, Alternative 1, the impacts of establishing a fixed bycatch limit and floating caps were examined. These alternatives and options are shown graphically by Figures 1 and 2. Bycatch limitation zones are shown in Figure 3, and the C. opilio Bycatch Limitation Zone (COBLZ) proposed under Alternative 4 is shown in Figure 4.

Alternative 1: Status quo, no action. No PSC limits would be set for snow crab.

Alternative 2: Establish a fixed PSC limit for snow crab. Based on a three year average (1992-1994), a PSC limit would be established at a fixed level of 11,000,000 snow crab in Zone 2. No snow crab PSC limit would be established for Zone 1, as bycatch in this area has been minuscule by comparison.

Option A: Establish PSC limit at 6 million snow crab in Zone 2.

Alternative 3: Establish PSC limits for snow crab that fluctuate with crab abundance. Annual PSC limits would be set as a percentage of the NMFS bottom trawl survey index. Limits for Zone 2 would be set at a percentage within the range 0.005 to 0.25% of the snow crab total population index (all districts combined). No snow crab PSC limit would be established for Zone 1.

Option A: Set fixed upper limit for PSC at 12 million snow crab in Zone 2.

Alternative 4 (Preferred): Establish a PSC limit for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The PSC cap will be set at 0.1133% of the total Bering Sea abundance (as indicated by the NMFS trawl survey), with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crab taken within the "C. opilio Bycatch Limitation Zone" (COBLZ) would accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery would be prohibited from fishing within the COBLZ. This alternative would yield a snow crab PSC limit of 6,147,000 snow crab for 1997, which is 0.1133% of

Coordinates of the Snow Crab Bycatch Limitation Zone, as agreed upon by the negotiating committee.

<u>North latitude</u>	<u>West longitude</u>	
56°30'		Donut Hole
56°30'		165°00'
58°00'		165°00'
59°30'		170°00'
US-Russia Line	170°00'	



the total 1996 NMFS survey abundance of 5,424,886,000 snow crab (both sexes, all size groups).

#### 1.4 Background

In January 1995, the Council initiated several analyses to examine impacts of proposals to control crab bycatch in the groundfish fisheries. Among these proposals was a reduction of existing red king crab and Tanner crab bycatch limits (with an option that the limits be based on crab abundance), and initiation of bycatch limits for snow crab. The Council suggested specific alternatives for PSC bycatch limits be examined, based on input from its Advisory Panel and a proposal by the State of Alaska.

At its January 1996 meeting, the Council requested that staff examine the suite of management measures (modified Crab Savings Area, crab PSC bycatch limits, and northern Bristol Bay closure area) in one package, so that the impacts of these measures can be analyzed in a comprehensive manner. An additional option of establishing PSC limits for Tanner crab based on abundance thresholds, was proposed by the Alaska Crab Coalition in January 1996, and was added to the analysis at the request of the Council.

At its April 1996 meeting, the Council modified the alternatives to include reduced PSC limits for Tanner crab and snow crab. The range of PSC rates for red king crab and Tanner crab were also reduced, as data indicated that bycatch in 1995 was much lower than in previous years. The Council also requested the analysts also include some discussion regarding the Crab Rebuilding Committee's recommendation that PSC limits be based on survey index of adult crab, rather than total population. The SSC noted that modification of PSC rates should occur as a separate, follow-up amendment.

In June 1996, the Council took final action on Amendment 37, which contained several measures to protect the red king crab stock from possible impacts due to groundfish fisheries. First, the Council recommended a year-round closure to non-pelagic trawling in the Red King Crab Savings Area (162° to 164° W, 56° to 57° N). An extended duration of the closure period provides for increased protection of adult red king crab and their habitat. To allow some access to productive rock sole fishing areas, the area bounded by 56° to 56°10' N latitude would remain open during the years in which a guideline harvest level for Bristol Bay red king crab is established. A separate bycatch limit for this area would be established at no more than 35% of the red king crab prohibited species catch (PSC) limits apportioned to the rock sole fishery.

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. Specifically, the area east of 162° W (i.e., all of Bristol Bay) would be closed to trawling, with the exception of an area bounded by 159° to 160° W and 58° to 58°43' N that would remain open to trawling during the period April 1 to June 15 each year. It was felt that such a closure area would protect known areas of juvenile red king crab habitat while at the same time allow trawling in an area that can have high catches of flatfish and low bycatch of other species. The area north of 58°43' N was closed to reduce bycatch of herring, and also of halibut, which move into the nearshore area in June. In addition to establishing nearshore trawl closure areas, the Council also recommended that NMFS rescind regulations allowing trawling for Pacific cod in the area off Port Moller, as these regulations are out of date given the current status of red king crab and scientific knowledge of critical habitat.

The third management measure adopted by the Council was a reduction of PSC limits for red king crab taken in trawl fisheries. Specifically, the Council recommended adoption of a staircase-based PSC limit for red

king crab in Zone 1. PSC limits would be based on abundance of Bristol Bay red king crab as shown in the adjacent table. In years when red king crab in Bristol Bay are below threshold of 8.4 million mature crabs, a PSC limit of 35,000 red king crab would be established in Zone 1. This limit was based on the level of bycatch observed in the 1995 flatfish fisheries operating in Zone 1 with the Red King Crab Savings Area closed to trawling. In years when the stock is above threshold but below the target rebuilding level of 55 million pounds of effective spawning biomass, a PSC limit of 100,000 red king crab would be established. The 100,000 crab PSC limit corresponds to a 50% reduction from the current PSC limit, the same percentage reduction as applied by the Alaska Board of Fisheries in 1996 to the harvest rate for the directed red king crab fishery when the stock is above threshold but below 55 million pounds of effective spawning biomass. A 200,000 PSC limit would be established in years when the Bristol Bay red king crab stock is rebuilt (above threshold and above 55 million pounds of effective spawning biomass). Based on the 1996 abundance estimate (10.2 million mature females and 20.3 million lbs of effective spawning biomass), the PSC limit for 1997 will be 100,000 red king crab.

Amendment 37 PSC limits for Zone 1 red king crab.

<u>Abundance</u>	<u>PSC Limit</u>
Below threshold or 14.5 million lbs of effective spawning biomass (ESB)	35,000 crabs
Above threshold, but below 55 million lbs of ESB	100,000 crabs
Above 55 million lbs of ESB	200,000 crabs

In June 1996, the Council did not make any recommendations regarding PSC limits for Tanner and snow crabs, although the analysis was completed (NPFMC, May 10, 1996). Rather, the Council formed an industry workgroup to review proposed PSC limits for these crab species. This work group consisted on three crab fishery representatives, three trawl fishery representatives, and one shoreside processing representative. The group met August 29-30 and came to a consensus on bycatch limits for bairdi crab.

At its September 1996 meeting, the Council took final action on Amendment 41. Based on its review of the draft EA/RIR and input from its advisory bodies and public testimony, the Council adopted Alternative 3, Option C for PSC limits for *C. bairdi* Tanner crab taken in BSAI trawl fisheries. Under this Alternative, PSC limits for bairdi in Zones 1 and 2 will be based on total abundance of bairdi crab as indicated by the NMFS trawl survey. Based on 1996 abundance (185 million crabs), the PSC limit for *C. bairdi* in 1997 will be 750,000 crabs in Zone 1 and 2,100,000 crab in Zone 2. The Council's intent was for crab bycatch accrued from January 1 until publication of the final rule (expected by April 1997) would be applied to revised bycatch limits established for specified fisheries. Although the Council did not take final action at its September meeting, it requested its industry workgroup to review snow crab bycatch data and provide a recommendation to the Council in December (Appendix 2).

Amendment 41 PSC limits adopted for bairdi Tanner crab.

<u>Zone</u>	<u>Abundance</u>	<u>PSC Limit</u>
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

In December 1996, the Council took final action on Amendment 40. Based on its review of the draft EA/RIR and input from its advisory bodies and public testimony, the Council adopted Alternative 4 for PSC limits for *C. opilio* snow crab taken in BSAI trawl fisheries. Under proposed Amendment 40, PSC limits for snow

crab would be based on total abundance of opilio crab as indicated by the NMFS standard trawl survey. For 1998 and thereafter, the snow crab PSC cap would be set at 0.1133% of the Bering Sea snow crab abundance index, with a minimum PSC of 4.5 million snow crab and a maximum of 13 million snow crab. Snow crab taken within the "C. opilio Bycatch Limitation Zone" (COBLZ) would accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery would be prohibited from fishing within the COBLZ.

For 1997 only, all snow crab bycatch in areas, 513, 514, 521, 523, and 524 would accrue to the PSC limit, and the PSC limit will be increased by 10%. Based on 1996 survey abundance (5,425 million crabs), the 1997 snow crab PSC limit would be 6,760,000 crabs. Snow crab bycatch accrued from January 1 until publication of the final rule (expected by July) would apply to all fisheries that take snow crab in 1997.

#### 1.4.1 Bycatch Management

In harvesting groundfish, fisheries catch crab incidentally as bycatch. Among the objectives of the BSAI groundfish FMP is minimizing the impact of groundfish fisheries on crab and other prohibited species, while providing for rational and optimal use of the region's fishery resources. All gear types used to catch groundfish have some potential to catch crab incidentally, but the large majority of crab bycatch occurs in dredge and trawl fisheries.

Crab bycatch limits were established for trawl fisheries beginning in 1986. Bycatch limits (termed Prohibited Species Catch limits, or PSC) for red king crab and Tanner crab are apportioned into limitation zones (Figure 3), and allocated among groundfish trawl fisheries. To allocate total groundfish harvest under established PSC limits, PSC is apportioned among trawl fisheries during the annual specification process (e.g., Table 1). When a target fishery attains a PSC apportionment or seasonal allocation specified in regulations, the bycatch zone to which the allocation applies closes to that target fishery for the remainder of the season.

#### 1.4.2 Bycatch of Snow Crab in Groundfish Trawl Fisheries

Crab bycatch is estimated by the National Marine Fisheries Service through the groundfish Observer Program. Bycatch of snow crab in BSAI groundfish fisheries totaled 5.4 million crab in 1995. Bycatch has been drastically reduced since 1992, when 17.66 million snow crab were taken in groundfish fisheries. Most snow crab bycatch is taken in the trawl fisheries (99%) and to a lesser extent in the longline (0.7%) and groundfish pot fisheries (0.3%). Although snow crabs are

Snow crab bycatch in the 1992-1995 BSAI groundfish fisheries, by zone (all gears/targets). Preliminary 1996 data through 10/96.

	<u>Zone 1</u>	<u>Zone 2</u>	<u>Other areas</u>	<u>Total</u>
1992	104,844	11,996,347	5,561,358	17,662,549
1993	40,611	8,922,155	5,797,956	14,760,722
<u>1994</u>	<u>25,334</u>	<u>11,424,057</u>	<u>1,032,736</u>	<u>12,482,127</u>
92-94 Ave	56,930	10,780,853	4,130,683	14,968,466
1995	94,307	4,338,013	963,469	5,395,789
1996	267,145	2,747,141	127,187	3,141,473

bycaught in nearly every trawl fishery, the yellowfin sole fishery takes the vast majority (70% on average 1992-1994). Bycatch is highest in the areas north and east of the Pribilof Islands, corresponding to NMFS statistical areas 513, 514, and 521 (NPFMC 1994). Relatively few snow crab are taken in Zone 1. On the other hand, about 75% of the snow crab bycatch comes from the area encompassed by the existing crab protection Zone 2. This is not surprising given that Zone 2 encompasses much of the adult population. Average snow crab bycatch in Zone 2 was about 10.8 million crabs, or about 0.11% of the NMFS total

population index on average, 1992-1994. Bycatch of snow crab in 1995 was much lower than in previous years, totaling 5,395,788 crabs (Table 2). Of the total, 4,338,013 snow crabs were taken in Zone 2, corresponding to 0.05 % of the total population index. Bycatch was even less in 1996, with preliminary estimates of only 3.1 million snow crabs taken throughout the BSAI.

Examination of crab bycatch carapace width frequency suggests that most snow crab bycatch in trawl fisheries is smaller than market size (102 mm), but larger than the size of 50% maturity for females (50 mm). Width frequency data from the 1994 and 1995 trawl fisheries suggest that the average size is relatively constant from year to year. A rough estimate on average width of snow crabs taken as bycatch, based on these data and total crab bycatch by regulatory area, is 75 mm for males in 1994 and 1995. A rough estimate of average width for female snow crab is 63 mm in 1993 and 1995 trawl fisheries. In general, smaller snow crab are taken in regulatory areas 513 and 514 (east and northeast of the Pribilof Islands), and larger crab are taken in other areas (Figures 5 and 6). Narita et al. (1994) reported average carapace widths of 89 mm for males and 59 mm for females taken as bycatch in 1991 domestic BSAI groundfish fisheries.

Observer data had indicate that a vast majority of snow crab taken as bycatch in trawl fisheries are males. On average, 1993-1995, about 80% of the snow crab measured by observers were male. A high male sex ratio appeared throughout the data for all statistical areas and years examined (NPFMC 1996). In BSAI groundfish pot and longline fisheries nearly all snow crab measured by observers were male. Average carapace width for male snow crabs was about 90 mm in pot fisheries and 110 mm in longline fisheries.

#### Bycatch Mortality

The impact of crab bycatch on crab stocks is somewhat tempered by survival of discarded crabs. There have been numerous studies done on crab bycatch mortality, with each study having different objectives, methodology, and results. A summary of these studies is provided below, but many questions remain unanswered. Stevens (1990) found that 21% of the king crabs and 22% of the Tanner crabs captured incidentally in BSAI trawl fisheries survived at least 2 days following capture. Blackburn and Schmidt (1988) made observations on instantaneous mortality of crab taken by domestic trawl fisheries in the Kodiak area. They found mortality for softshell red king crab averaged 21%, hard shelled red king crab 1.2%, and 12.6% for Tanner crab. Another trawl study indicated that trawl induced mortalities aboard ship were 12% for Tanner crab and 19% for red king crab (Owen 1988). Fukuhara and Worlund (1973) observed an overall Tanner crab mortality of 60-70% in the foreign Bering Sea trawl fisheries. They also noted that mortality was higher in the summer (95%) than in the spring (50%). Hayes (1973) found that mortality of Tanner crab captured by trawl gear was due to time out of water, with 50% mortality after 12 hours. Natural Resource Consultants (1988) reported that overall survival of red king crab and Tanner crab bycaught and held in circulation tanks for 24-48 hours was <22%. In previous analyses, the estimated mortality rate of trawl bycaught red king crab, Tanner crab, and snow crab was 80% (NPFMC 1993, 1996).

## 2.0 NEPA REQUIREMENTS: ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in significant impact on the human environment. The environmental analysis in the EA provides the basis for this determination and must analyze the intensity or severity of the impact of an action and the significance of an action with respect to society as a whole, the affected region and interests, and the locality. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact study (EIS) must be prepared for major Federal actions significantly affecting the human environment.

An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers. The purpose and alternatives were discussed in Section 1, and the list of preparers is in Section 10. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

The environmental impacts generally associated with fishery management actions are effects resulting from 1) harvest of fish stocks which may result in changes in food availability to predators, changes in the population structure of target fish stocks, and changes in community structure; 2) changes in the physical and biological structure of the benthic environment as a result of fishing practices, e.g., effects of gear use and fish processing discards; and 3) entanglement/entrapment of non-target organisms in active or inactive fishing gear. A summary of the effects of the 1995 groundfish total allowable catch amounts on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the final environmental assessment for the 1995 groundfish total allowable catch specifications.

### 2.1 Potential Impacts of Establishing Snow Crab Bycatch Limits on Groundfish Stocks

None of the alternatives considered in this document is likely to have significant impacts on groundfish stocks. Catch of all groundfish is counted against the TAC, regardless where or when it is caught. Closure of bycatch zones to groundfish trawling will likely be offset by increased effort outside the closure areas. No changes to groundfish stock status from the status quo are expected, as it is likely that fisheries will continue to remove about two million metric tons of groundfish per year from the BSAI region.

### 2.2 Potential Impacts of Establishing Snow Crab Bycatch Limits on Crab Stocks

There are several ways to measure relative crab mortality caused by the trawl fishery. The simplest way is to compare current levels of bycatch as a percentage of total crab population. For example, current bycatch amounts to about 0.6% of the snow crab population based on recent NMFS survey indices of abundance. It should be noted that the NMFS survey provides population estimates as an index only; small crab are not fully vulnerable to the trawl gear used, and consequently the "real" crab population size is likely much larger than the survey index. Therefore,

Crab bycatch in trawl fisheries as a percentage of total crab abundance as indexed by NMFS surveys.

	Snow crab population (millions)	Bycatch (millions)	Bycatch as percent of population
1992	7,763	17.44	0.22 %
1993	11,704	14.63	0.13 %
1994	9,446	12.35	0.13 %
1995	8,655	5.40	0.06 %
1996	5,425	3.14	0.06 %

bycatch accounts for a smaller percentage of the actual population than indicated by the survey index comparisons.

A better measurement of impacts would take into account other factors such as the size and sex of crab taken. In January 1995, the Council's Scientific and Statistical committee recommended that the impacts of crab bycatch should be measured by adult equivalents. This also provides better estimates of impacts across fisheries.

The exercise of determining adult equivalents (detailed in NPFMC, 5/10/96) provided two major insights into the impact of trawl bycatch. First, a comparison of adult equivalent mortality across fisheries is

instructive for developing a crab rebuilding policy. In years when a GHF is established, the single largest source of human induced crab mortality is removals of legal males by directed crab fisheries. This is true for male crab of all three species. Crab fisheries accounted for about 98% of the male red king crab, 85% of male Tanner crab, and 98% of the male snow crab

Average adult equivalent crab removals by groundfish, scallop, and crab fisheries as a percentage of total crab abundance, 1993.

Fishery	Bristol Bay Red king		EBS Tanner		EBS Snow	
	male	female	male	female	male	female
Groundfish	0.82 %	0.98 %	4.24 %	1.73 %	1.06 %	0.12 %
Scallop	0.00 %	0.00 %	0.09 %	0.19 %	0.00 %	0.00 %
Crab	35.23 %	2.04 %	29.73 %	1.79 %	80.39 %	0.01 %

mortality. The crab fishery has a relatively smaller impact on females. For females, crab fisheries accounted for 68% of the female red king crab, 47% of the Tanner crab, and 6% of the snow crab mortality. Most of the remaining removals are due to the trawl and other groundfish fisheries. In all cases examined, the scallop fishery had relatively little impact on crab stocks as measured by observed bycatch. These data indicate that reductions in crab quotas for crab fisheries may have relatively more impact on rebuilding than reductions in crab bycatch in trawl or dredge fisheries.

The second insight provided by this exercise is a measurement of adult equivalent removals relative to population size. As indicated by the adjacent table, bycatch in groundfish fisheries has relatively small impacts on crab populations. Of these crab

species, groundfish fisheries impact Tanner crab the most, killing almost 5% of the adult male stock as bycatch. Smaller impacts on red king crab and snow crab were estimated. On average, the groundfish fisheries killed 1.47% of the male snow crab. The impact on female snow crab was less (0.09%), as far fewer females are taken as bycatch. Additionally, impacts due to the 1995 groundfish fisheries on these crab species were generally lower than in previous years.

Average adult equivalent crab bycatch in groundfish fisheries as a percentage of total crab abundance, 1993-1995.

Year	Bristol Bay Red king		EBS Tanner		EBS Snow	
	male	female	male	female	male	female
1993	0.82 %	0.98 %	4.24 %	1.73 %	1.06 %	0.12 %
1994	0.88 %	1.47 %	4.25 %	1.87 %	2.27 %	0.12 %
1995	0.22 %	0.24 %	5.69 %	0.91 %	1.09 %	0.03 %
Average	0.64 %	0.90 %	4.73 %	1.50 %	1.47 %	0.09 %

This analysis indicates that reducing the PSC limits may not drastically improve or rebuild crab stocks. Because bycatch mortality caused by trawl fisheries is very small relative to other sources of removals due to natural and fishing mortality, reductions in bycatch limits may not result in measurable improvements to crab stock abundance. Potential "savings" of crab through PSC reductions proposed under Alternative 2-4 will increase crab available for harvest or spawning only slightly. This was also the conclusion of Witherell

and Harrington (1995) and Stevens (1990) who stated that "Removals of this magnitude (0.5% of the population as trawl bycatch) are well below the ability of the NMFS crab survey to detect, and probably have no significant biological impact".

Although concern has been raised about the unknown mortality of crabs caused by trawling, reducing PSC limits may exacerbate these unobservable impacts. In an attempt to catch less crabs (via reduced bycatch limits, VIP regulations, or proposed measures such as IBQ's, Harvest Priority, etc.), trawl fishermen may modify their gear. Modifications to footrope design, roller size, and mesh size can result in fewer crabs being retained and counted by observers. For trawl fisheries historically limited by bycatch limits, reduced bycatch rates of PSC species may result in increased effort (at least until limited by TAC of targets). In turn, increased trawl effort could result in increased unobservable impacts on crab resources. This possibility was also raised during the Council's 1993 deliberations over trawl codend mesh size, but the benefits of reduced bycatch were felt to outweigh the possible costs of unobserved mortality due to non-retention.

Another possible way to base PSC caps on abundance of the size of crab taken as bycatch in trawl fisheries, rather than based on the total survey index of all size groups. A shortcoming of Alternatives 3 and 4 is due to the fact that minor changes in survey station or crab distribution can create major changes in the survey population estimate. This is because the population index is dominated by small animals (true for all 3 species) and survey estimates of small crab and their distribution are highly variable from year to year. With Alternatives 3 and 4, annual PSC limits could be set disproportional to the abundance of the size of crab taken in trawl fisheries (which consists primarily of larger sized crab). Of concern is the potential for a high PSC limit generated by large numbers of juveniles. A similar concern occurs at the opposite extreme where an artificially low PSC limit could needlessly constrain trawl fisheries. In reviewing the draft EA/RIR, the Council's Crab Rebuilding Committee concluded that Alternative 3 would have less problems if PSC limits were based on the survey abundance of large crab, but noted that there would still be annual variability. At its April 1996 meeting, the Council's Scientific and Statistical Committee recommended that this approach be considered, but as a separate amendment. The following is an excerpt from their minutes:

*"In examining the alternatives for PSC limits that fluctuate with abundance, the SSC discussed the recommendation made by the Crab Rebuilding Committee that a different "currency" be used in establishing caps (e.g., the use of a cap in terms of "large" crab rather than total number of crab may be more stable over time than the total number of crab due to recruitment fluctuation). The SSC believes that a change to a new "currency" system should be done carefully with requisite analyses, because the effects of using different measures may be complicated (nonlinear, highly variable). If the Council wishes to move in this direction, the SSC suggests it be done as a separate amendment to avoid confusion."*

Due to time limitations, a comprehensive analysis of PSC limits based on abundance of large crab was not undertaken for this amendment package. If the Council's preferred option is Alternative 3 or Alternative 4, then a follow up amendment analysis to modify the index may be prepared in the future to address these concerns. Such an analysis would examine the effects of using a different "currency" for establishing the PSC limits, rather than based on total population index.

Information about the distribution of snow crab is useful for evaluating areas that would close due to PSC limits. Alternatives 2 and 3 specify closure of Zone 2 only (statistical areas 513, 517, and 521). Approximately 70% of the snow crab bycatch has come from this area. However, snow crab are also abundant in parts of statistical areas 514 and 524. A more comprehensive area is proposed under Alternative

4. The COBLZ proposed encompasses nearly the entire population of snow crab according the NMFS summer trawl survey (Figures 7 and 8). Only a small number of snow crab (primarily males) are found to the south, outside of this area. Very little effort for flatfish has occurred to the south of the COBLZ (Figure 9). Hence, Alternative 4 would appear to offer more protection to the snow crab stock than the other areas examined.

### 2.3 Impacts on Endangered or Threatened Species

Listed and candidate species under the Endangered Species Act (ESA) that may be present in the GOA and BSAI include:

#### *Endangered*

Northern right whale	<u>Balaena glacialis</u>
Sei whale	<u>Balaenoptera borealis</u>
Blue whale	<u>Balaenoptera musculus</u>
Fin whale	<u>Balaenoptera physalus</u>
Humpback whale	<u>Megaptera novaeangliae</u>
Sperm whale	<u>Physeter macrocephalus</u>
Snake River sockeye salmon	<u>Oncorhynchus nerka</u>
Short-tailed albatross	<u>Diomedea albatrus</u>
Steller sea lion (western population)	<u>Eumetopias jubatus</u>

#### *Threatened*

Steller sea lion (eastern population)	<u>Eumetopias jubatus</u>
Snake River spring and summer chinook salmon	<u>Oncorhynchus tshawytscha</u>
Snake R. fall chinook salmon	<u>Oncorhynchus tshawytscha</u>
Spectacled eider	<u>Somateria fischeri</u>

The impact of BSAI and GOA groundfish fisheries on Steller sea lions was addressed in a formal consultation on April 19, 1991. NMFS concluded that the BSAI groundfish fisheries were not likely to adversely affect listed cetaceans or to jeopardize the continued existence or recovery of Steller sea lions or affect their respective critical habitats. NMFS determined that section 7 consultation should be reinitiated for Steller sea lions if any proposed change in the BSAI fishery was likely to adversely affect them, if new information regarding the effects of the fishery on Steller sea lions was obtained, or if there was a change in the status of sea lions. Since April 1991, NMFS has reinitiated section 7 consultation for several regulatory amendments and for the annual total allowable catch specifications.

Formal consultation conducted on effects of the GOA and BSAI groundfish fisheries concluded that the continued operation of these fisheries would not adversely affect listed species of salmon as long as current observer coverage levels continued and salmon bycatch was monitored on a weekly basis. Critical habitats of listed salmon species are not affected by this action. Consultation must be reinitiated if chinook salmon bycatch exceeds 40,000 fish in either the BSAI or GOA or sockeye salmon bycatch exceeds 200 fish in the BSAI or 100 fish in the GOA.



Endangered, threatened, and proposed species of seabirds that may be found within the regions of the GOA and BSAI where the groundfish fisheries operate, and potential impacts of the groundfish fisheries on these species are discussed in the EA prepared for the TAC specifications. The U.S. Fish and Wildlife Service (USFWS), in consultation on the 1995 specifications, concluded that groundfish operations will not jeopardize the continued existence of the short-tailed albatross (letter, Rappoport to Pennoyer, February 19, 1997). This action is not expected to affect threatened or endangered seabird species or their critical habitat in any manner or extent not already addressed under previous consultations.

None of the alternatives is expected to affect endangered or threatened species or critical habitat of listed whales.

#### 2.4 Impacts on Marine Mammals

Marine mammals not listed under the Endangered Species Act that may be present in the GOA and BSAI include cetaceans. [minke whale (Balaenoptera acutorostrata), killer whale (Orcinus orca), Dall's porpoise (Phocoenoides dalli), harbor porpoise (Phocoena phocoena), Pacific white-sided dolphin (Lagenorhynchus obliquidens), and the beaked whales (e.g., Berardius bairdi and Mesoplodon spp.)] as well as pinnipeds [northern fur seals (Callorhinus ursinus), and Pacific harbor seals (Phoca vitulina)] and the sea otter (Enhydra lutris).

None of the alternatives is expected to impact marine mammals not listed under the Endangered Species Act.

#### 2.5 Coastal Zone Management Act

Implementation of any of the alternatives would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

#### 2.6 Conclusions or Finding of No Significant Impact

None of the alternatives is likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

David L Evans

OCT 15 1997

DATE

### 3.0 REGULATORY IMPACT REVIEW: ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade offs between qualitative and quantitative benefits and costs.

The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

This section also addresses the requirements of both E.O. 12866 and the Regulatory Flexibility Act to provide adequate information to determine whether an action is "significant" under E.O. 12866 or will result in "significant" impacts on small entities under the RFA.

E. O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant". A "significant regulatory action" is one that is likely to:

- (1) Have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;
- (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- (3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant."

#### 3.1 Background Economic Information on Bering Sea Crab and Groundfish Fisheries

The most recent description of the groundfish fishery is contained in the Economic Status of the Groundfish Fisheries Off Alaska, 1995 (Kinoshita et al. 1995). The report includes information on the catch and value of the fisheries, the numbers and sizes of fishing vessels and processing plants, and other economic variables that describe or affect the performance of the fisheries. Catch of groundfish in the Bering Sea has remained relatively stable over the past 10 years, averaging about 1.8 million metric tons, consisting primarily of pollock). About 2,000 vessels fish for groundfish in the BSAI and GOA each year. Preliminary data for 1995 indicate that in the BSAI area, 112 vessels fished with hook and line, 105 vessels fished with groundfish pot gear, and 156 vessels fished with trawls. Catch in the domestic groundfish fisheries off Alaska totaled over 2 million metric tons in 1994, worth \$439 million in ex-vessel value. The value of resulting products was over \$1.1 billion.

The economics of BSAI crab fisheries are summarized in ADF&G's Annual Area Management Reports. Total value of these crab fisheries in recent years is about \$180 million to \$260 million per year. Most vessels that participate in Tanner crab fisheries also participate in the Snow crab and Bristol Bay red king crab fisheries. Since 1982, the snow crab fishery has generated much higher values than the other crab fisheries. Although snow crab landings had dropped drastically since the peak in 1991 (325 million lbs.), price increased such that average gross ex-vessel value increased to over \$710,000 per vessel in the 1995 snow crab fishery. In the Tanner crab fishery, price did not keep up with reduced landings since 1992, and gross ex-vessel value was only \$60,000 per vessel in 1995. Assuming that all vessels in the snow crab fishery also fished for Tanner crab in 1995, vessels averaged about \$770,000 in ex-vessel value. The Bristol Bay red king crab fishery did not open in 1995. Ex-vessel values had averaged about \$175,000 per vessel per year in that fishery.

Gross revenues from crab fisheries are expected to be lower in 1996 than in previous years. The 1996 snow crab fishery produced only about 50.7 million pounds. At an exvessel price of \$1.25 per pound, this fishery generated a total of approximately \$63 million. This represents a 65% decline over the 1995 fishery gross revenues (\$180 million). In addition, the 1996 fisheries for Bristol Bay red king crab and Bering Sea Tanner crab occurred at very reduced levels. Preliminary catch information indicated that the 1996 crab fishery harvested 8.1 million pounds of red king crab and only 2.1 million pounds of Tanner crab. As a consequence of low stock sizes, the crab fleet is expected to experience major changes in revenues in 1996.

### 3.2 Potential Impacts of Establishing Snow Crab Bycatch Limits

#### 3.2.1 Alternative 1: Status quo, no action. No PSC limit would be established for snow crab.

In general, crab PSC limits have not constrained most groundfish trawl fisheries. Rather, these fisheries close either upon reaching the total allowable catch quota (TAC) or attainment of halibut PSC limits. The one notable exception is the rock sole/other flatfish trawl fishery, which was limited in 1993 and 1994 despite relatively high levels of crab PSC apportioned to that fishery. For example, in 1994 Zone 1 was closed on February 28 due to attainment of red king crab PSC limit (110,000 crabs) and Zone 2 closed on May 7 due to the Tanner crab PSC limit (260,000 crabs). The yellowfin sole fishery was closed out of Zone 1 due to Tanner crab bycatch on April 14, 1995.

Even under status quo, halibut and crab PSC limits may become more constraining to groundfish trawl fisheries if pollock TAC's are reduced in the future. Total annual BSAI groundfish harvest is limited by an optimum yield (OY) cap of two million metric tons. Pollock accounts for about 1.1 to 1.3 million mt of the

total OY cap. The rest is apportioned among other fisheries. This OY cap generally results in TAC allocations to higher valued species and fisheries with lower halibut bycatch (such as the pollock fishery) than to flatfish fisheries (Witherell 1994). For example, in 1996, pollock TAC was set at the ABC level, whereas TACs for flatfish were 665,000 mt below ABC. Hence, if pollock TAC is reduced in the future, fisheries will have higher TAC of flatfish to harvest. However, fisheries may be unable to harvest this additional flatfish TAC even under existing PSC limits. Reduced PSC limits would make achieving a two million mt OY even more challenging.

In evaluating the status quo, or proposed reductions, it is informative to know what crab bycatch in groundfish fisheries costs the directed crab fisheries. The answer to this question can be derived from the adult equivalent exercise made in the previous section. If groundfish fisheries caught no crab incidentally, the crab fishery may increase total ex-vessel revenues by about \$10.5 million. This represents an estimate of opportunity costs. Assuming there are about 275 crab vessels, these crab would equate to about \$38,000 per vessel in gross ex-vessel value. Potential costs of proposed alternative crab PSC limits for trawl fisheries can be measured against potential benefits to crab fisheries.

Value of crab bycatch in groundfish fisheries to directed crab fisheries, based on 1993-1995 average bycatch and price.

	Adult male Equivalents	Adult weight	Average price/lb	Total value (\$)
Red king crab	33,231	6.5	3.80	820,800
Tanner crab	920,060	2.3	2.80	5,925,000
Snow crab	1,958,138	1.3	1.50	2,818,000
Total				\$10,563,800

3.2.2 Alternative 2: Establish a fixed PSC limit for snow crab. Based on a three year average (1992-1994), a PSC limit would be established at a fixed level of 11,000,000 snow crab in Zone 2. No snow crab PSC limit would be established for Zone 1, as bycatch in this area has been minuscule by comparison.

Option A: Establish PSC limit at 6 million snow crab in Zone 2.

Recent data indicate that PSC limits for snow crab could be established, yet not impact groundfish fisheries if the available PSC is optimally allocated among target fisheries and seasons. On average, bycatch taken in recent years has been less than the PSC limits proposed under Alternative 2. Bycatch was 4.3 million snow crabs in 1995, and only 2.7 million snow crabs in Zone 2 in 1996. Hence, based on average bycatch needs, PSC limits could be established at either 6 million or 11 million crab in Zone 2 without much impact on the groundfish fleet. Optimal allocation will be difficult to achieve because these apportionments are made pre-season. However, the Council will be considering an FMP amendment in the future that would allow individual vessel bycatch accountability, a tool that has potential to reduce bycatch and better allocate available PSC.

Snow crab bycatch in the 1992-1995 BSAI groundfish fisheries, by zone (all gears/targets). Preliminary 1996 data through 10/96.

	Zone 1	Zone 2	Other areas	Total
1992	104,844	11,996,347	5,561,358	17,662,549
1993	40,611	8,922,155	5,797,956	14,760,722
1994	25,334	11,424,057	1,032,736	12,482,127
1995	94,307	4,338,013	963,469	5,395,789
1996	267,145	2,747,141	127,187	3,141,473

As with all PSC limits proposed under this alternative, trawl fisheries may be negatively impacted if PSC limits are not optimally allocated pre-season. In particular, the yellowfin sole fishery stands to be the most

impacted fishery. Recent implementation of trawl closure areas in Bristol Bay (Amendment 37) and around the Pribilof Islands (Amendment 21a) have limited grounds available to this fishery.

The major assumption regarding assessment of impacts for Alternative 2 is that crab stock abundance will remain relatively stable, or that the trawl fishery will adapt to changes in crab abundance. As crab stocks increase, bycatch will further constrain trawl fisheries if fixed PSC limits are established. This may be expected for snow crab PSC limits, in particular, as abundance of large snow crab is projected to increase in the near future. On the other hand, if crab stocks continue to decline, bycatch will account for a higher proportion of the total annual mortality.

- 3.2.3 Alternative 3: Establish PSC limits for snow crab that fluctuate with crab abundance. Annual PSC limits would be set as a percentage of the NMFS bottom trawl survey index. Limits for Zone 2 would be set at a percentage within the range 0.005 to 0.25% of the snow crab total population index (all districts combined). No snow crab PSC limit would be established for Zone 1.

Option A: Set fixed upper limit for PSC at 12 million snow crab in Zone 2.

- 3.2.4 Alternative 4 (Preferred): Establish a PSC limit for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The PSC cap will be set at 0.1133% of the total Bering Sea abundance (as indicated by the NMFS trawl survey), with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crab taken within the "C. opilio Bycatch Limitation Zone" (COBLZ) would accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery would be prohibited from fishing within the COBLZ. This alternative would yield a snow crab PSC limit of 6,147,000 snow crab for 1997, which is 0.1133% of the total 1996 NMFS survey abundance of 5,424,886,000 snow crab (both sexes, all size groups).

Coordinates of the Snow Crab Bycatch Limitation Zone, as agreed upon by the negotiating committee.

North latitude	West longitude
56°30'	Donut Hole
56°30'	165°00'
58°00'	165°00'
59°30'	170°00'
US-Russia Line	170°00'

Alternatives 3 and 4 specify a PSC limit that varies with crab abundance. This is similar to the way PSC limits are set for Pacific herring in BSAI trawl fisheries and crab in BSAI scallop fisheries. The measures are frameworked such that they are established during the annual specification process. Herring PSC limits are set at 1% of the projected adult herring biomass (Amendment 16a). For the BSAI scallop fishery, the Council adopted floating crab PSC limits as part of the Amendment 1 package. Crab PSC limits for the scallop fishery are set annually as a percentage of the NMFS survey abundance for Tanner crab (0.13542%) and snow crab (0.003176%), but a fixed limit for red king crab within the range of 500 to 3,000 crab.

Impacts of Alternative 3 and Alternative 4 to the trawl fishery depend on the percentage or rate chosen. A PSC limit established based on a higher percentage of crab abundance will cause the least negative impacts to trawl fisheries. Alternatively, a lower rate that equates to smaller PSC limits than set under the status quo may result in negative impacts to the trawl fleet (via increased costs, shorter seasons, less fish harvested, etc.).

Examination of recent bycatch as a percent of the total NMFS population index (all sizes of crab) provides some guidance on bycatch needs of the groundfish fisheries. Bycatch of Tanner crab, 1992 through 1995, as a percentage of the total index ranged from 0.26% to 0.49% in Zone 1 and 0.62% to 0.91% in Zone 2. Snow crab bycatch in Zone 2 has ranged from 0.05% to 0.15% of the survey index. Average bycatch rates, 1992-1995, based on survey percentages are shown in the adjacent table. If PSC limits were established at these rates, impacts would depend on the speed and magnitude of changes in crab stock abundance.

Crab PSC rates based on average bycatch, 1992-1995, and annual crab abundance index of all sizes.

	(Zone 1)	(Zone 2)
Red king crab	0.40%	-
Tanner crab	0.39%	0.79%
Snow crab	-	0.10%

The threshold limits proposed under Alternatives 3 and 4 were developed from historical bycatch data, and therefore may not substantially impact fisheries if PSC can be optimally allocated among trawl fisheries. Based on recent bycatch performance, and historic snow crab abundance, impacts on trawl fisheries under Alternatives 3 and 4 may be only somewhat constraining to trawl fisheries as long as PSC limits can be efficiently allocated among various trawl fisheries. The potential benefit of threshold limits is that while it allows bycatch levels to fluctuate with crab abundance, it would temper year-to-year variability in PSC limits caused by trawl survey abundance estimates. Some stability may also be beneficial to long-term financial planning for trawl companies.

### 3.3 Bering Sea Fishery Simulation Model Results

The Bering Sea fishery simulation model (Ackley 1995) was employed to estimate the economic impacts of reducing crab caps in the Bering Sea. A general discussion of the model follows in the next section, and a detailed discussion can be found in Amendments 21a and 21b, as well as in the EA/RIR for Amendment 37 (NPFMC 5/10/96, pp.64-66 and Appendix 8). Detailed output from the model was not provided for this section in order to conserve space, and because the output is similar to other model runs in this amendment.

The Bering Sea fishery simulation model was modified to include the bycatch of *Chionoecetes opilio* crab and assign caps for this species. The value data for *C. bairdi*, *C. opilio* and red king crab were updated for this analysis as well. The model was run with the most constraining options in place to examine the greatest expected changes from Status Quo. Model runs using both the 1993 and 1994 data sets included the following options: (1) Status Quo which included a three month closure of the Red King Crab Savings Area; (2) a Zone 1 cap for bairdi crab of 850,000 and a Zone 2 bairdi crab cap of 1.5 million crab; (3) a Zone 1 cap of 35,000 red king crab; (4) a Zone 2 cap of 11 million opilio crab; (5) a run with all of the above caps in place (850,000 Zone 1 bairdi, 1.5 million Zone 2 bairdi, 11 million Zone 2 opilio, and 35,000 Zone 1 red king crab) as well as the closure of the Red King Crab Savings Area; (6) a run with all of the above caps, the Red King Crab Savings Area closure, and the Northern Bristol Bay closure (7) the caps and closures as above in (6) with the additional constraint of a 6 million opilio crab cap in Zone 2; and (8) The June 1996 Council action to close the Red King Crab Savings Area on an annual basis, close Northern Bristol Bay to trawling (the 2 block opening not included in this analysis), and based on population size, set the Zone 1 cap of red king crab at 100,000 crab. In addition (8) applies a Zone 1 cap on bairdi at 750,000 crab and the Zone 2 bairdi cap at 2.1 million crab.

Option (8) above served as a new Status Quo for five additional runs which varied the opilio crab bycatch cap and added the options for a cap-based closure of Zone 2, or of the entire Bering Sea outside of Zone 1. The four additional runs were as follows: (9) a run with a Zone 2 opilio cap of 11 million crab; (10) the four-year average bycatch (12.45 million crab) was apportioned among fisheries, and Zone 2 was closed when

the cap was attained; (11) a run which applied a cap of 7.32 million crab (.135% of the 1996 abundance estimate of 5.42 billion crab) with a Zone 2 closure; (12) a run which had a cap of 12.45 million crab with a closure of all areas except Zone 1 when the cap was attained; and (13) a run with a cap of 7.32 million crab which also closed the Bering Sea exclusive of Zone 1 when the cap was attained.

The model runs which examined the impacts of various area alternatives for the Red King Crab Savings Area were presented in Amendment 37. The impacts of the Northern Bristol Bay Closure were estimated by model runs and presented in sections 4.0 and 6.0 of Amendment 41. The results of the cap analysis runs presented here can be compared with the previous runs with the caution that splitting Tanner crab into bairdi and opilio separately may have changed the bycatch rates of areas, and that the crab values have been updated. Details of the model and assumptions are available in Amendment 41.

### Initial Analysis

The bycatch of the crab species in 1993 and 1994, largely because of existing caps, were not generally in excess of the most restrictive options used in the model runs, and often were below the more restrictive caps. For instance, under Status Quo in the 1993 data, 7.5 million opilio crab were estimated to be bycaught in Zone 2 in the absence of a cap, and in 1994 approximately 10 million opilio crab were estimated to be bycaught in Zone 2. The cap used for opilio crab was 11 million, so that only specific fisheries might be affected by the opilio cap, since the overall cap of 11 million exceeded the bycatch from all fisheries in each year. Thus the model does not capture the impacts of years in which the bycatch rates for any of the species might be higher. Similarly, the impacts of a cap might be less than the model predicts if crab were caught at a higher rate in 1993 or 1994 than would happen in future fisheries, as was the case in 1994. The bycatch of red king crab predicted by the model from 1994 data was approximately 90,000 red king crab with the 3 month Red King Crab Savings Area closure in place, while in 1995 the actual number bycaught was approximately at the most restrictive cap of 35,000 crab.

The constraints on the fishing fleet by the individual crab caps (Alternatives Bairdi (850,000 Zone 1, 1.5 million Zone 2); Red (35,000 Zone 1); and Opilio (11 million Zone 2) resulted in changes in net benefits to the Nation from Status Quo of less than approximately \$500,000 under the 1993 data set (Tables 3 and 4). This is because the bycatch of each crab species available to the model was similar to the caps in that year. The model runs based on the 1994 data estimated decrements to the net benefits to the Nation of from approximately \$1 million to \$4.8 million. The reduction of the red king crab cap to 35,000 resulted in the greatest change from Status Quo under both the 1993 and 1994 data.

Model runs to estimate the impacts of all three management measures in place concurrently were also made using the 1993 and 1994 data. These runs simulated a closure of the Red King Crab Savings Area for the first three months of the year, a closure of the Northern Bristol Bay area, and caps of 850,000 bairdi crab in Zone 1, 1.5 million bairdi crab in Zone 2, 11 million opilio crab in Zone 2, and 35,000 red king crab in Zone 1 (indicated as RKC, Caps, N.BB in Tables 3 and 4). With these constraints in place, the estimated net benefits to the Nation decreased by approximately \$1.4 million using the 1993 data set and by approximately \$3.9 million using the 1994 data set.

Reducing the opilio cap to 6 million crab in addition to all of the proposed closures and caps above reduced the estimated net benefits to the nation from status quo by approximately \$1.4 million using the 1993 data and by approximately \$11.1 million using the 1994 data (indicated as RKC, Cap, BB, 6 mil.Op in the attached Tables 1 and 2). The reason there was no change from all proposed closures and caps in place using

the 1993 data and decreasing the opilio cap by 5 million crab was that the bairdi caps closed the Zone 2 fisheries which would have been impacted by the reduced caps. Using the 1994 data, it was the opilio cap rather than the bairdi cap which was more constraining. The overall bycatch of opilio crab was not greatly reduced in 1993 from status quo because the bairdi crab closure caused fishing to occur outside of Zone 2 where opilio crab bycatch is still substantial.

### Bairdi Caps

Additional runs to estimate the impacts of measures taken in June 1996 with the most recent (September 1996) suggested caps for bairdi crab in place were also made (indicated as RKC, current, BB in Tables 3 and 4). Under these runs with the 1993 and 1994 data the following assumptions applied: (1) Annual closure of the Red King Crab Savings Area; (2) Annual closure of Northern Bristol Bay (due to programming difficulty and time available, the summer opening of two blocks for yellowfin sole fishing was not included as an option); (3) a 100,000 red king crab cap in Zone 1 based on current population estimates for 1996; (4) a Zone 1 cap of 750,000 bairdi crab and a Zone 2 cap of 2.1 million bairdi crab. The estimated net benefits to the nation decreased by approximately \$1.2 million using the 1993 data set and by approximately \$2.2 million using the 1994 data set. These decrements in net benefits to the Nation represent changes from Status Quo of 0.4% and 0.8% in the 1993 and 1994 data sets, respectively.

### Opilio Caps

In order to provide background for possible action to address C. opilio caps, the above run (RKC, CURRENT, BB) was assumed to be the new Status Quo with the following measures in place for 1997: an annual closure of the Red King Crab Savings Area; the Northern Bristol Bay closure; a cap of 100,000 red king crab in Zone 1; and a Zone 1 cap for bairdi crab of 750,000 crab and a Zone 2 cap of 2.1 million bairdi crab. Five model runs using the 1993 and 1994 data sets included the following assumptions: a Zone 2 cap for opilio of 11 million crab (indicated in Tables 3 and 4 as Opilio 11.0, Zn 2); a Zone 2 cap for opilio of 12.45 million (Opavgcap(12.45), Zn 2 in Tables 3 and 4); a Zone 2 cap for opilio of 7.32 million (Op96cap(7.32), Zn2 in Tables 3 and 4); a cap for all areas outside of Zone 1 of 12.45 million opilio (Opavgcap(12.45), BS in Tables 3 and 4); and a cap for all areas outside of Zone 1 of 7.32 million opilio (Op96cap(7.32), BS in Tables 3 and 4). The cap of 11 million was as suggested by the Crab Plan Team, 12.45 million crab was the average bycatch of opilio crab for the years 1992 - 1995, and 7.32 million crab was equal to .135% of the 1996 opilio crab abundance estimate of 5.43 billion opilio crab. Between 1992 and 1995, the average bycatch as a percentage of the total estimated opilio abundance was .135%.

The bycatch of opilio crab in 1993 was higher than in 1994 (14.8 million crab and 12.5 million crab in 1993 and 1994, respectively). However, in 1993 approximately 60% of the opilio crab bycatch was taken in Zone 2 whereas in 1994 approximately 92% of the opilio crab were taken within Zone 2 so that the Zone 2 bycatch of opilio crab was actually higher in 1994. The application of a Zone 2 cap using the 1993 data showed little impact because of the smaller proportion of crab (60%, or approximately 9 million crab) taken in Zone 2. In 1994, on the other hand, a much higher proportion and number of crab were taken in Zone 2 (92% or approximately 11.5 million crab), and thus the Zone 2 caps would have a much greater impact using the 1994 data set.

A Zone 2 cap of 11 million crab resulted in a net decrement in benefits to the nation of approximately \$34,000 due to late attainment of the cap by the flatfish/rocksole fisheries using the 1993 data set. Note that the opilio cap was not attained under the Zone 2 cap of 12.45 million crab using the 1993 data. Yellowfin



sole attained their portion of the 11 million Zone 2 opilio cap using the 1994 data for a net decrement in benefits to the nation of approximately \$1.6 million. Again, the 12.45 million Zone 2 cap showed no impact. Reduction of the opilio cap to 7.32 million crab in Zone 2 resulted in a reduction of net benefits to the nation of approximately \$118,000 using the 1993 data set and a reduction of net benefits to the nation of approximately \$8.75 million using the 1994 data set. The effect of the Zone 2 closure is especially apparent in 1994 due to the concentration of effort and bycatch within Zone 2 in 1994. Without effort in areas outside of Zone 2, the model had no areas to transfer effort to when Zone 2 was closed to fisheries. The model therefore overestimates the impacts in cases when target is actually available outside of Zone 2, and is more representative of cases where the target is only available in Zone 2.

Closure of the entire Bering Sea outside of Zone 1 upon fishery attainment of opilio caps showed small impacts with a high cap, such as 12.45 million, but large impacts with a lower cap of 7.32 million. Using the 1993 data set, the loss of net benefits to the nation was approximately \$771,000 with a Bering Sea cap of 7.32 million crab. Using the 1994 data set, the loss in net benefits to the nation reached approximately \$11.5 million with a 7.32 million opilio cap. The fishery which attained its portion of the cap and was most impacted by the reduced cap was the yellowfin sole fishery. Under this model run the overall bycatch of opilio crab was reduced by approximately 4.6 million crab, but the total catch of groundfish was reduced by approximately 115,000 metric tons due to the attainment of caps.

#### Opilio Negotiations 11/6/96-11/7/96

As additional analyses for the opilio crab cap negotiations, model runs using the 1993 and 1994 data were made with a Bering Sea wide cap of 4,464,693 crab (indicated in Tables 3 and 4 as Op96cap(4.46),BS). This cap is equivalent to 0.0823% of the 1996 abundance estimate of 5.4249 billion opilio crab. The results of these runs indicated a greater impact to groundfish fisheries than those runs with a Bering Sea cap of 7.32 million crab. Under the 4.46 million crab cap, the model projected a greater decrease in net benefits to the Nation of \$2.5 and \$13.7 million using the 1993 and 1994 data, respectively. It should be noted that in 1993 and 1994, between 12 and 14 million crab were bycaught. Using 1995 or 1996 data when fewer crab were bycaught the model would be expected to estimate lower impacts (e.g. fisheries would catch crab at a lower rate and be closed later in the season due to caps).

### 3.4 Potential Cumulative Impacts and Interactions with Other Management Measures

Implementation of Amendment 41, along with area closures implemented under Amendment 37, may have cumulative effects on groundfish trawl fisheries. As noted by the Scientific and Statistical Committee, time-area closures cause area shifts in groundfish fishery effort. With each additional bycatch restriction, options for the groundfish trawl fleets are reduced and these effort shift could increase the bycatch of other prohibited species. To some extent, this situation occurred in the rock sole trawl fishery as a result of implementing the Bristol Bay Red King Crab Savings Area by inseason action in 1995 and 1996. The 1996 directed rock sole fishery was apparently closed early due to increased halibut

Catch and bycatch in the rock sole trawl fishery through the first PSC closure, 1993-1995.

Year	Date Closed	Reason for closure	Harvest (mt) of rock sole	Zone 1 Tanner crab	Zone 1 red king crab	halibut mortality (mt)
1993	Feb 16	RKC, Zone 1	38,000	420,000	181,000	667
1994	Feb 28	RKC, Zone 1	37,000	259,000	154,000	281
1995	Feb 21	Halibut	32,000	320,000	19,000	428
1996	Feb 26	Halibut	19,000	290,000	9,000	436

bycatch per metric ton of groundfish. Bycatch rates for Tanner crab also increased (note that about the same amount of Tanner crab bycatch was taken, and less rock sole was caught), but bycatch of red king crab was much reduced due to the closure.

The impacts of trawl closure areas on the trawl fleet may be further exacerbated by reduced crab PSC limits. As discussed in the previous paragraph, implementation of the Red King Crab Savings Area may cause higher bycatch rates for Tanner crab in the rock sole fishery. Hence, to maintain the rock sole fishery in Zone 1 at current harvest levels, a relatively high proportion of Tanner crab PSC (requiring ~300,000 crab) could be allocated to the early season rock sole fishery. The nearshore Bristol Bay trawl closure adopted under Amendment 37 may similarly shift effort of the yellowfin sole trawl fishery into Zones 1 and 2, which may have higher bycatch rates of Tanner crab, snow crab, and halibut. Hence, the yellowfin sole fishery may require increased allocation of Tanner crabs and halibut to maintain harvest levels. Allocations of crab PSC among trawl fisheries will become much more contentious, even at current halibut and crab PSC limits. With snow crab PSC limits established for a certain area, all trawl fisheries could be affected, as fisheries may be shut out of better fishing areas sooner. Flatfish fisheries may be "forced" to shift effort into Area 514, an area that receives some effort for flatfish (Figure 9), but which typically has moderately high bycatch rates of halibut. Because attainment of the halibut cap shuts down fishing in the entire Bering Sea for the affected fishery, the combination of closure areas and crab PSC limits may have significant negative effects on certain trawl fisheries, particularly those targeting flatfish.

### 3.5 Administrative, Enforcement and Information Costs

Some additional costs for administration are expected under any of the alternatives to the status quo. Establishing a new PSC limit for snow crab will require small additional costs to monitor bycatch inseason, and to notify the fishing fleet when these limits are met. No additional costs for enforcement or information requirements are expected under any of the alternatives to the status quo. Observers already collect information necessary to monitor the bycatch of snow crab.

#### 4.0 FINAL REGULATORY FLEXIBILITY ANALYSIS

The objective of the Regulatory Flexibility Act is to require consideration of the capacity of those affected by regulations to bear the direct and indirect costs of regulation. If an action will have a significant impact on a substantial number of small entities an Final Regulatory Flexibility Analysis (FRFA) must be prepared to identify the need for the action, alternatives, potential costs and benefits of the action, the distribution of these impacts, and a determination of net benefits.

NMFS has defined all fish-harvesting or hatchery businesses that are independently owned and operated, not dominant in their field of operation, with annual receipts not in excess of \$2,000,000 as small businesses. In addition, seafood processors with 500 employees or fewer, wholesale industry members with 100 employees or fewer, not-for-profit enterprises, and government jurisdictions with a population of 50,000 or less are considered small entities. A "substantial number" of small entities would generally be 20% of the total universe of small entities affected by the regulation. A regulation would have a "significant impact" on these small entities if it reduced annual gross revenues by more than 5 percent, increased total costs of production by more than 5 percent, or resulted in compliance costs for small entities that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

If an action is determined to affect a substantial number of small entities, the analysis must include:

- (1) a description and estimate of the number of small entities and total number of entities in a particular affected sector, and total number of small entities affected; and
- (2) analysis of economic impact on small entities, including direct and indirect compliance costs, burden of completing paperwork or recordkeeping requirements, effect on the competitive position of small entities, effect on the small entity's cashflow and liquidity, and ability of small entities to remain in the market.

Under Section 603(c) of the RFA, each IRFA must contain a description of any significant alternatives to the proposal that accomplish the statutory objectives and minimize the significant economic impact of the proposal on small entities. These alternatives could include:

- (1) The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
- (2) The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
- (3) The use of performance rather than design standards;
- (4) An exemption from coverage of the rule, or any part thereof, for such small entities.

#### 4.1 Economic Impact on Small Entities

Most trawl vessels and processor participating in the BSAI groundfish fishery would be affected by the management measures proposed under all alternatives to the Status quo for the three management measures under consideration.

Most catcher vessels harvesting groundfish off Alaska meet the definition of a small entity under the RFA. In 1993, 132 trawl catcher vessels landed groundfish from the BSAI. Many of these vessels would be affected by PSC limits considered under alternatives to the status quo. The economic impact on small entities could result in a reduction in annual gross revenues by more than 5 percent and could, therefore, potentially have a significant economic impact on a substantial number of small entities.

Alternatives that addressed modifying reporting requirements for small entities or the use of performance rather than design standards for small entities were not considered by the Council or in this analysis. Such alternatives are not relevant to this proposed action and would not mitigate the impacts on small entities. Allowing exemptions for small entities from this proposed action would not be appropriate because the objective to further limit C. opilio bycatch in the BSAI groundfish fisheries could not be achieved if small entities were exempted.

The proposed rule to implement Amendment 40 was published in the Federal Register on August 13, 1997 (62 FR 43307) and comments were invited on the IRFA. No comments were received on the IRFA.

## 5.0 REFERENCES

- Ackley, D. 1995. Bering Sea Fishery Simulation Model. Alaska Fishery Research Bulletin 2(1):83-86.
- 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, 1977-81. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report 4K88-21.
- Fukuhara, F.M., and D. Worlund. 1973. Incidence of halibut and Tanner crab in catches by the eastern Bering Sea mothership trawl fishery and independent trawlers. NOAA/NMFS/NAFC Report to the International North Pacific Fisheries Commission.
- Hayes, M.L. 1973. Survival of Tanner crab (*Chionoecetes bairdi*) after capture in trawls and subsequent handling and storage aboard fishing boats. NOAA/NMFS report to the International North Pacific Fisheries Commission.
- Natural Resource Consultants. 1988. Minimization of king and Tanner crab by-catch in trawl fisheries directed at demersal groundfish in the Bering Sea. Report of NOAA Award 86-ABH-0042, Seattle.
- NPFMC (North Pacific Fishery Management Council). 1996. Additional analysis for Amendment 37 and an Environmental Assessment/Regulatory Impact Review/ Initial Regulatory Flexibility analysis for Amendment 41. May 10, 1996. 268 p.
- NPFMC (North Pacific Fishery Management Council). 1996b. Environmental Assessment/Regulatory Impact Review/ Initial Regulatory Flexibility analysis for Amendment 37 and analysis of alternatives for Tanner crab and snow crab bycatch limits in Bering Sea groundfish trawl fisheries. Draft for Secretarial Review. June 21, 1996.
- Owen D. 1988. A bottom trawl survey on the west side of Kodiak Island: Vieckoda Bay, Spiridon Bay, and Kupreanof Strait. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K88-28.
- Stevens, B.G. 1990. Survival of king and Tanner crabs captured by commercial sole trawls. Fishery Bulletin 88:731-744.
- Witherell, D., and G. Harrington. 1995. Evaluation of Alternative Management Measures to Reduce the Impacts of Trawling and Dredging on Bering Sea Crab Stocks. Proceedings of the International Symposium on Biology, Management, and Economics of Crabs from High Latitude Habitats. Alaska Sea Grant Program Report AK-SG-96-02: 41-58.

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NPFMC Advisory Panel

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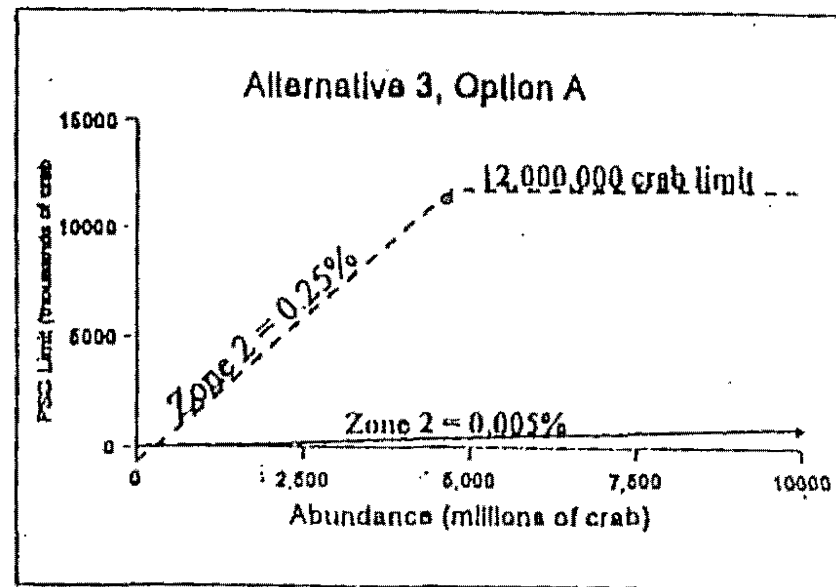
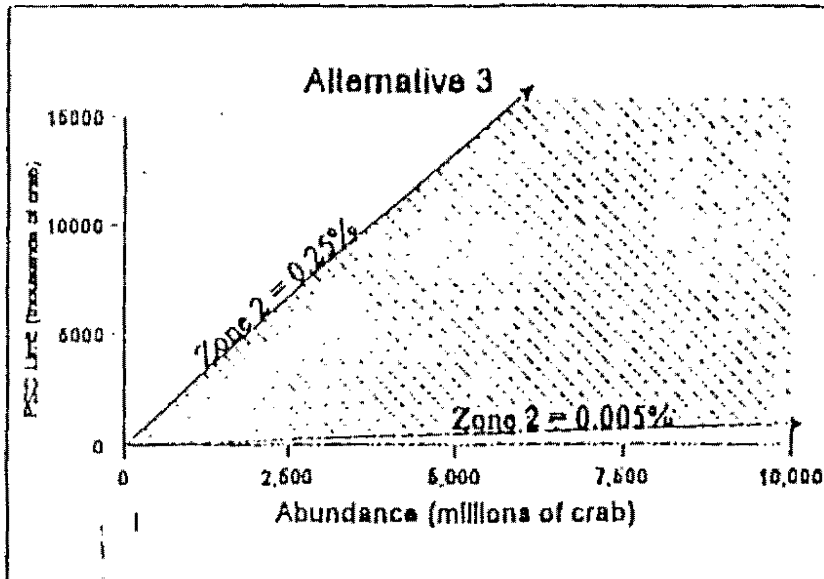
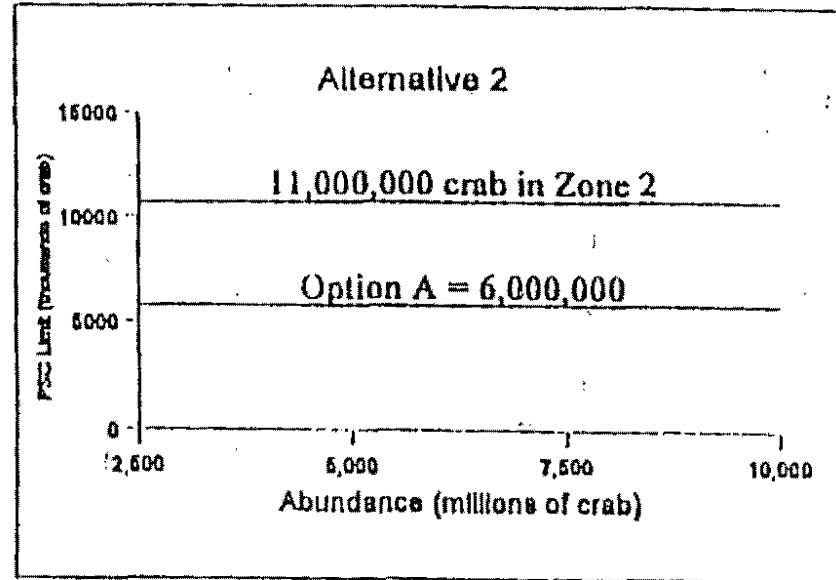
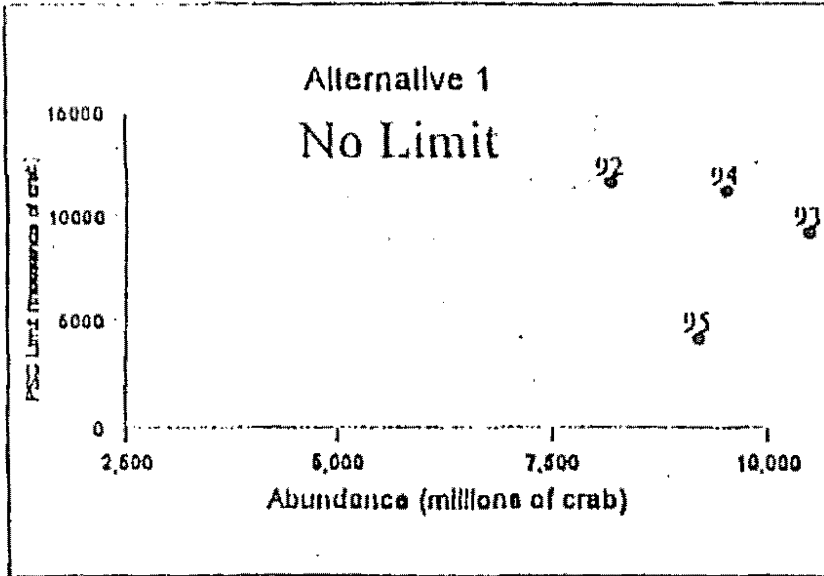
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# Snow Crab

Figure 1. Alternatives 1-3 for prohibited species catch limits for Bering Sea snow crab (*Chionoecetes opilio*) examined by this analysis.



# Snow Crab PSC Limits Negotiating Committee Agreement

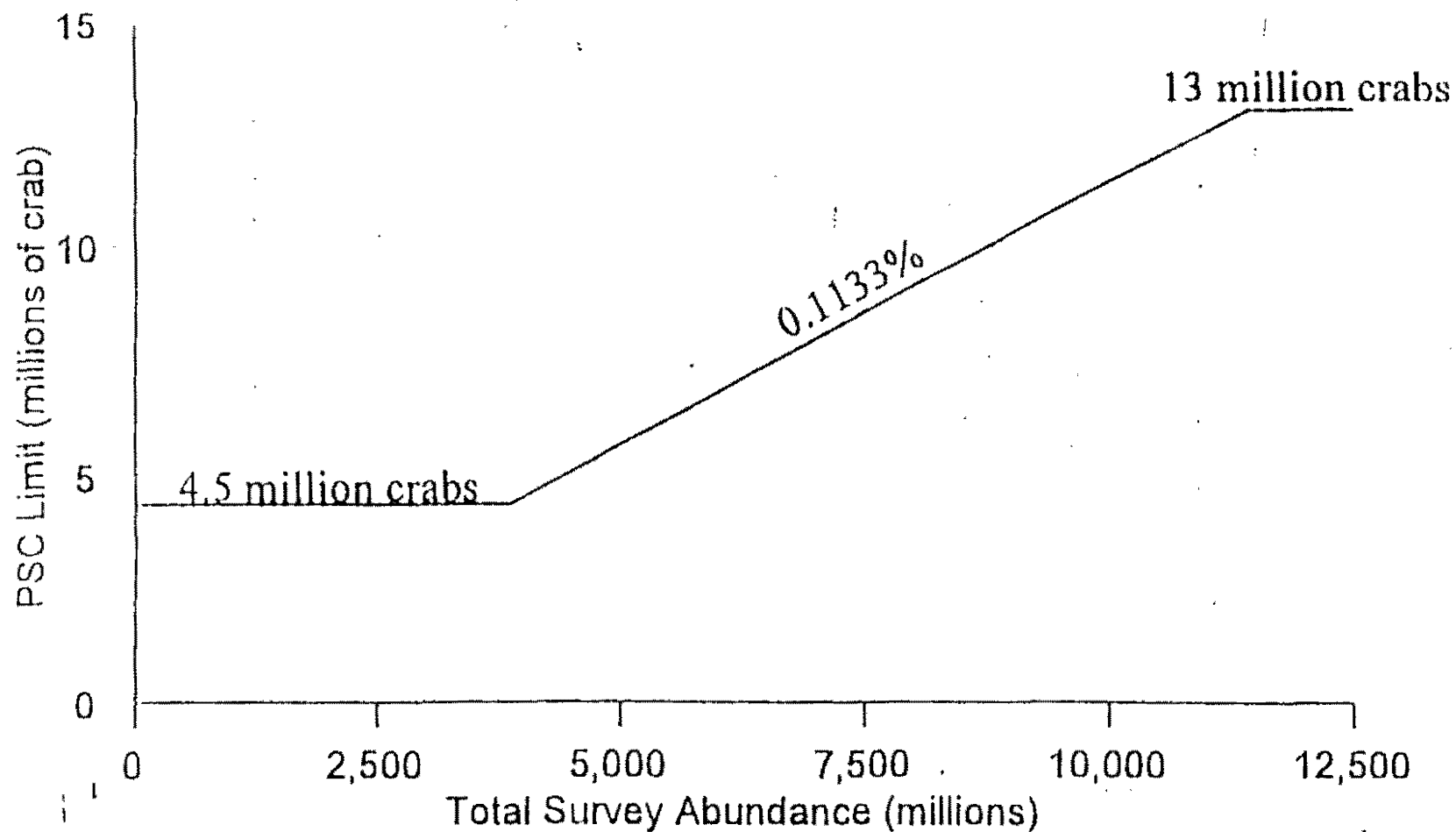
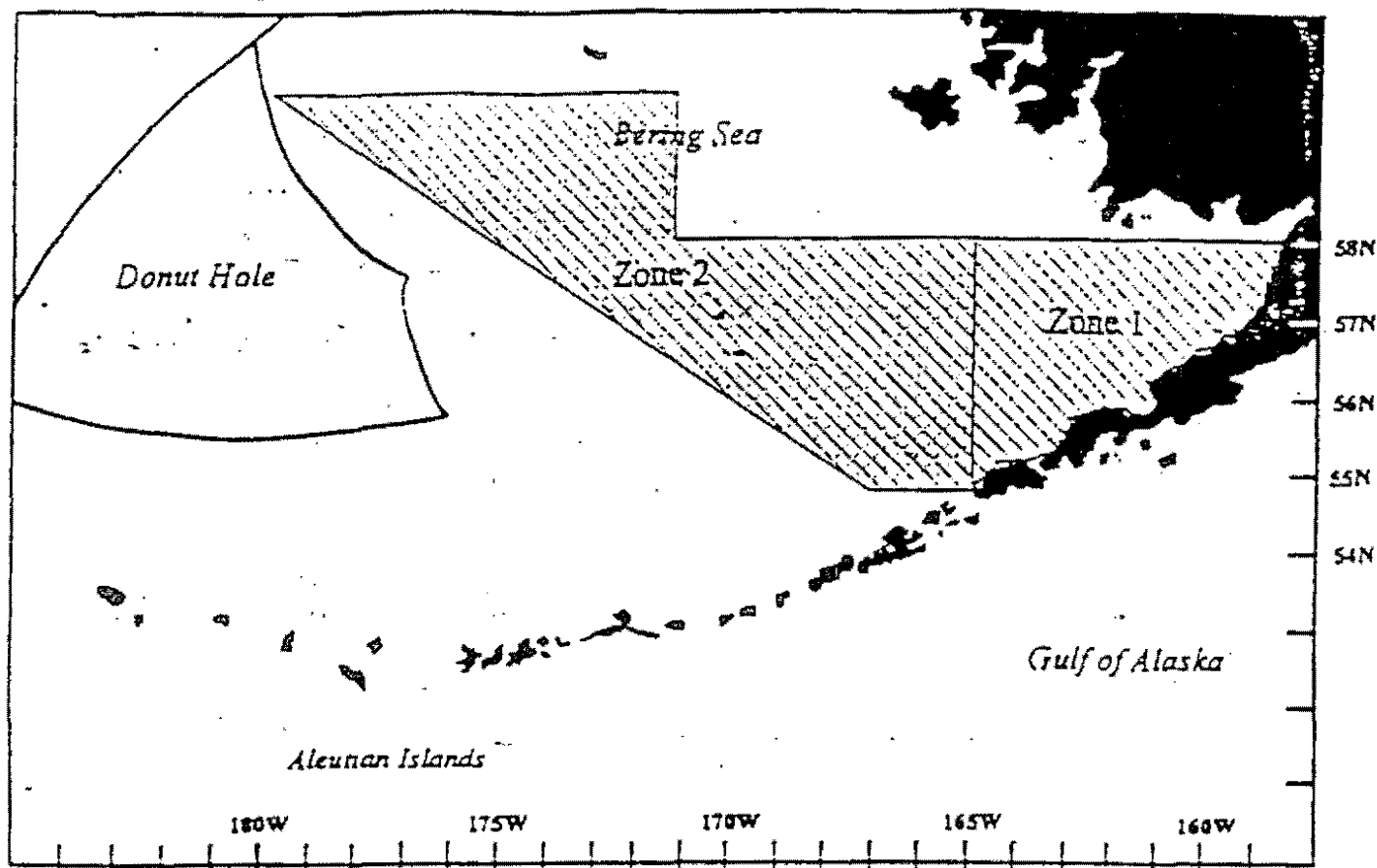


Figure 2. Alternative 4 prohibited species catch limits for Bering Sea snow crab (*Chionoecetes opilio*) examined by this analysis.

Figure 3. Prohibited species bycatch limitation zones in the Bering Sea for red king crab and Tanner crab.



### Prohibited Species Bycatch Limitation Zones

Rationale for Closure: To allow for control of red king crab and *C. bairdi* Tanner crab bycatch.

Origin: Implemented under Amendment 10 on March 16, 1987.

Description of Area: Areas close to directed fishing when crab bycatch caps are attained in specified fisheries. Bycatch Limitation Zone 1 means that part of the Bering Sea Subarea that is south of 58° 00' N. latitude and east of 165° 00' W. longitude. Bycatch Limitation Zone 2 means that part of the Bering Sea Subarea bounded by straight lines connecting the following coordinates in the order listed:

North latitude	West longitude
54° 30'	165° 00'
58° 00'	165° 00'
58° 00'	171° 00'
60° 00'	171° 00'
60° 00'	179° 20'
59° 25'	179° 20'
54° 30'	167° 00'
54° 30'	165° 00'

Figure 4. The snow crab bycatch limitation zone (SCBLZ) proposed under Alternative 4.

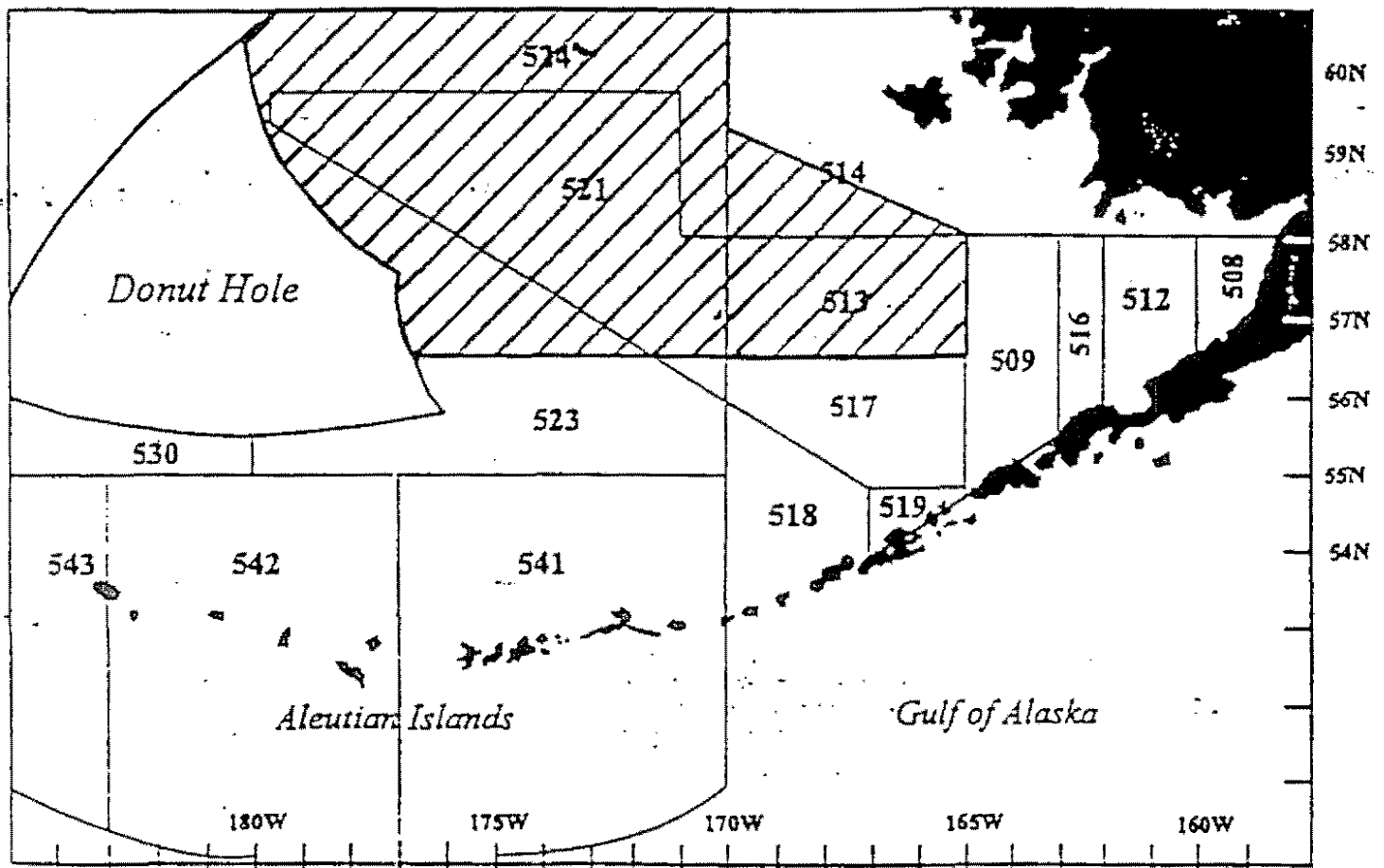


Figure 5. Average carapace width of snow crab males taken as bycatch in BSAI groundfish trawl fisheries, by statistical area, 1992-1995.

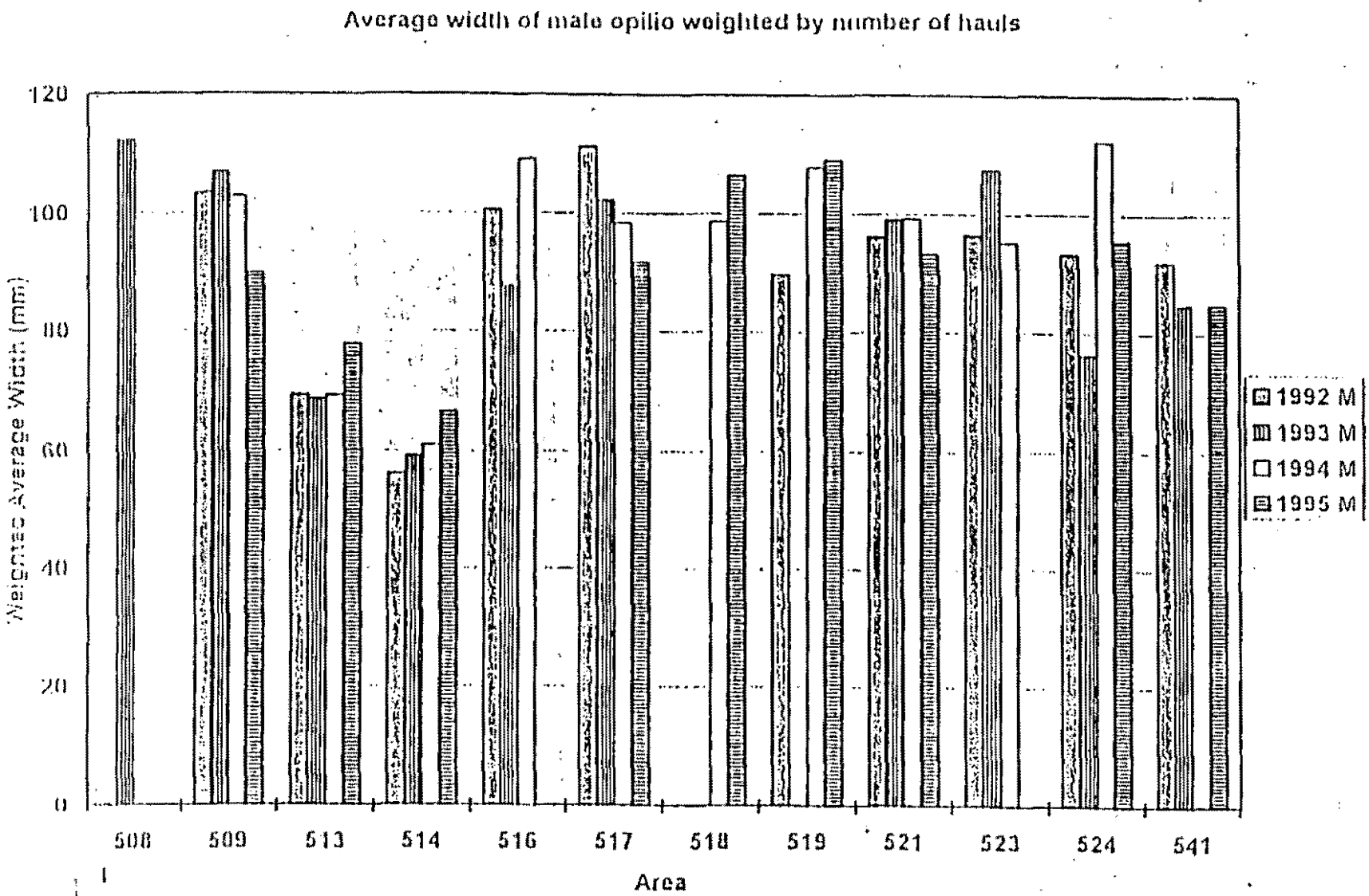


Figure 6. Average carapace width of snow crab females taken as bycatch in BSAI groundfish trawl fisheries, by statistical area, 1992-1995.

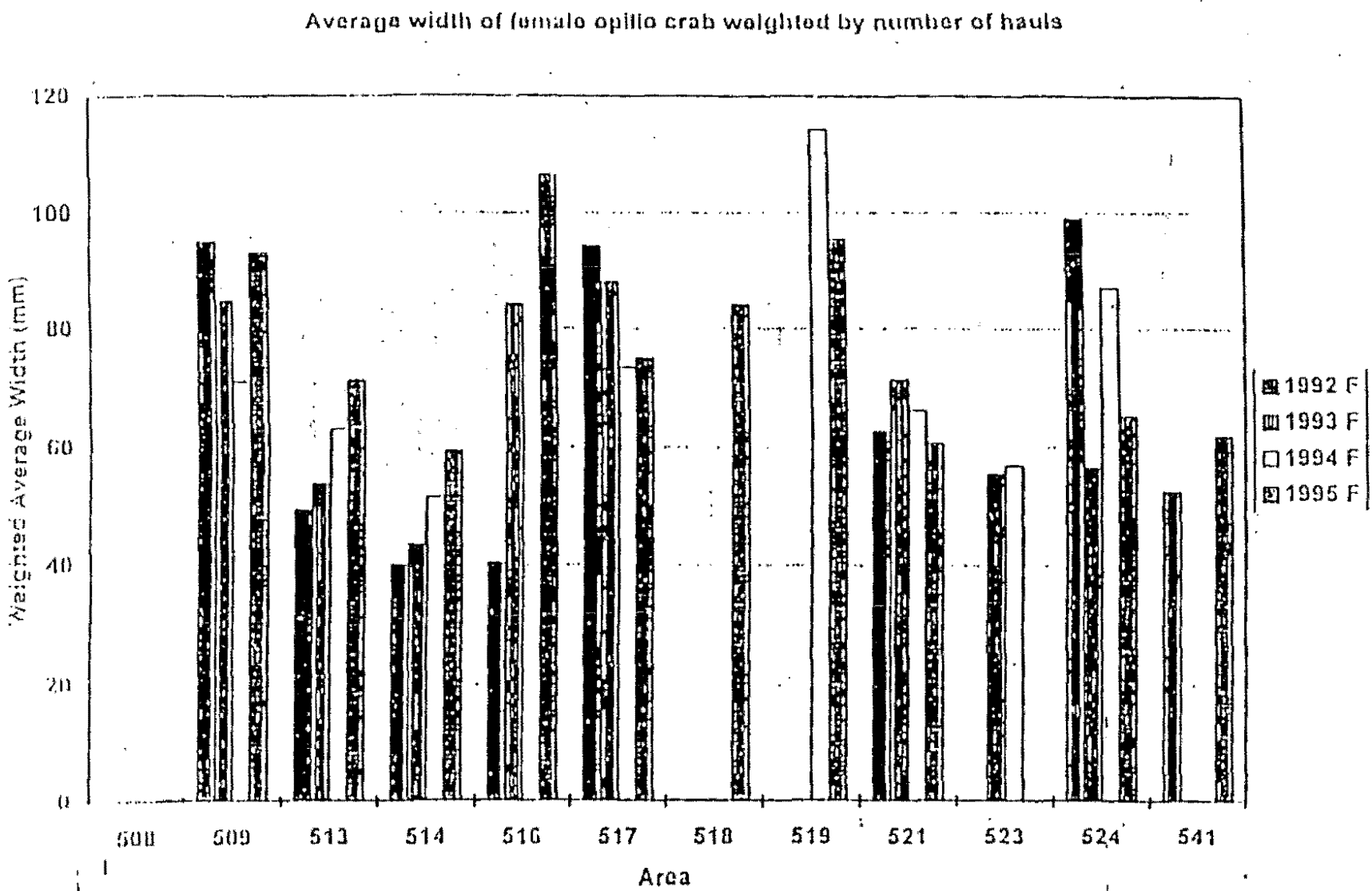
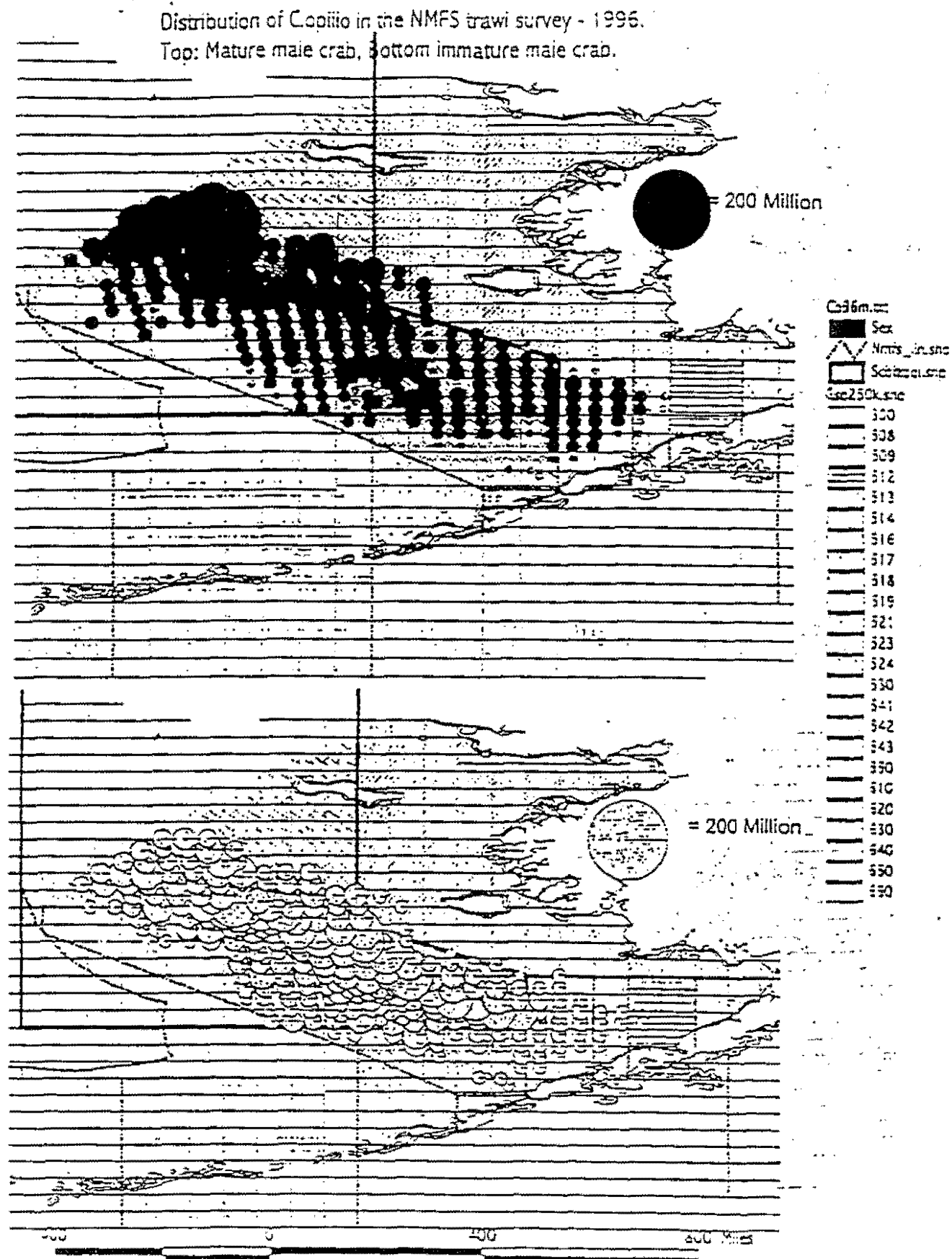


Figure 7. Distribution of male snow crab in the 1996 NMFS trawl survey. Top: mature male crab. Bottom: immature male crab.



Top: Mature female crab Bottom immature female crab.

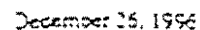




Figure 9. Distribution of observed trawl hauls in the 1994 fisheries with yellowfin sole, rock sole, and other flatfish as targets.

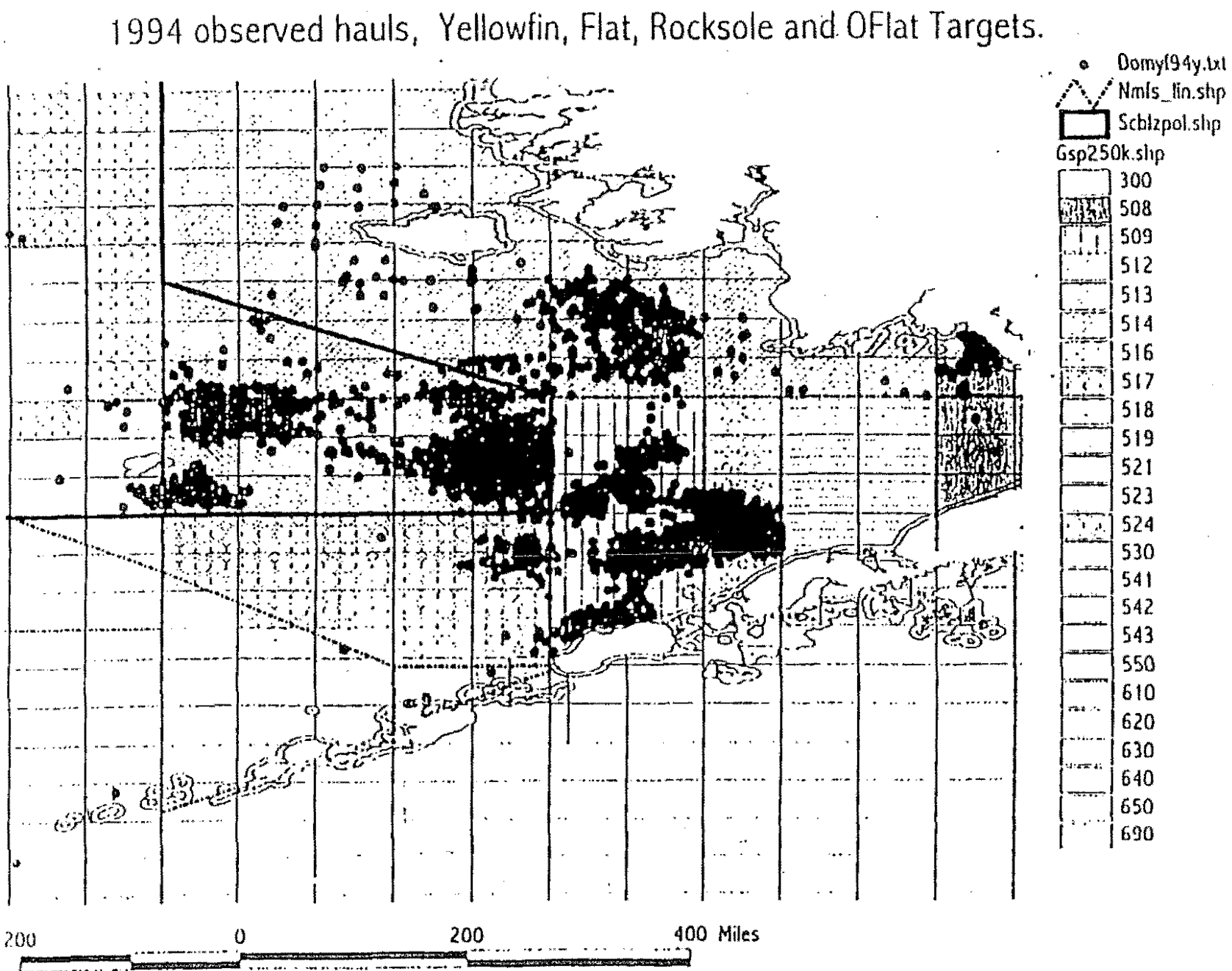


Table 1. Prohibited species catch (PSC) apportionment for 1996 BSAI trawl fisheries.

Final 1996 BSAI Trawl Fisheries PSC  
Apportionments and Seasonal Allowances

Fishery Group	Hallbut Mortality Cap (mt)	Herring (mt)	Red King Crab (animals) Zone1	C. bairdi Zone1	C. bairdi Zone2
Yellowfin sole	820	287	50,000	250,000	1,530,000
January 20 - March 31	160		5,000	50,000	
April 1 - May 10	150		15,000	200,000	
May 11 - August 14	100		10,000		
August 15 - Dec 31	410		20,000		
Rocksole/other flatfish	730		110,000	425,000	510,000
January 20-March 29	453				
March 30 - June 28	139				
June 29-December 31	138				
Turbot/sablefish/ Arrowtooth	0				0
Rockfish	110	7			10,000
Jan. 1 - Mar. 29	30				
Mar. 30 - June 28	50				
June 29 - Dec. 31	30				
Pacific cod	1,685	22	10,000	250,000	260,000
January 20-October 24	1,585				
Oct. 25-December 31	100				
Pollock/mackerel/o species	430	154	30,000	75,000	690,000
January 20-April 15	330				
April 16- December 31	100				
Pelagic Trawl Pollock		1,227			
<b>TOTAL</b>	<b>3,775</b>	<b>1,697</b>	<b>200,000</b>	<b>1,000,000</b>	<b>3,000,000</b>

Note: unused PSC allowances may be rolled into the following seasonal apportionment.

Table 2. Crab bycatch (numbers of crab, all sizes) from 1995 BSAI trawl fisheries, by gear, target, and area.  
Source: Blend estimates supplied by NMFS Alaska Region 2/14/96.

1995 crab bycatch data		Red King	bairdi	o.Tanner
by gear and target				
Hook & Line				
	P. cod	202	24,582	75,303
	sablefish	28	21	562
	other	51	33	907
	Total all targets	281	24,636	76,772
Groundfish Pot				
	P. cod	2,976	63,038	153,431
	other	0	0	30
	Total all targets	2,976	63,038	153,461
Trawl				
	bottom pollock	2,631	107,706	146,715
	P. cod	4,883	244,088	45,922
	flathead sole	93	57,934	456,552
	midwater pollock	2,014	46,260	59,939
	rock sole/o.flats	22,839	403,047	1,204,128
	yellowfin sole	8,648	1,349,275	3,196,459
	other	3,826	3,871	55,840
	Total all targets	44,934	2,212,181	5,165,555
Total all gears/targets		48,191	2,299,855	5,395,788

1995 crab bycatch data		Red King	bairdi	o.Tanner
by area (all gears/targets)				
Regulatory Area				
	508	160	324	39
	509	14,278	903,847	93,973
	512	1,985	281	25
	513	1,882	884,937	3,697,634
	514	2,187	13,105	747,528
	516	19,215	18,636	270
	517	4,410	431,358	435,333
	518	8	8,001	31,744
	519	345	8,319	19,990
	521	239	25,599	205,046
	523	0	328	3,065
	524	12	4,306	153,902
	541	3,134	800	4,315
	542	336	15	2,921
	543	1	0	6
Total all areas		48,192	2,299,856	5,395,789

Summary of total catch, bycatch, total gross and net values of catch and bycatch, and estimated total net benefits to the Nation under status quo and combinations of baited, opilio, and red king crab PSC caps - 1993 and 1994 data.

**Table** Summary of total catch, bycatch, total gross and net values of catch and bycatch, and estimated total net benefits to the Nation under status quo and combinations of babul, opilio and red king crab caps - 1993 and 1994 date.

[illegible][illegible]

Table 4.

Summary of total catch, bycatch, total gross and net values of catch and bycatch, and estimated total net benefits to the Nation under status quo and combinations of bairdi, opilio, and red king crab PSC caps - 1993 and 1994 data. Listed are differences from status quo.

**Table** Summary of total catch, bycatch, total gross and net values of catch and bycatch, and estimated total net benefits to the Nation under status quo and combinations of banail, opilio and red king crab caps - 1993 and 1994 data.

[illegible][illegible]



## Snow Crab

**Biology:** Snow crabs (*Chionoecetes opilio*) are distributed on the continental shelf of the Bering Sea, Chukchi Sea, and in the western Atlantic Ocean as far south as Maine. Snow crab are not present in the Gulf of Alaska. In the Bering Sea, snow crabs are common at depths less than 200 meters. The eastern Bering Sea population within U.S. waters is managed as a single stock, however, the distribution of the population extends into Russian waters to an unknown degree. While 50% of the females are mature at 50 mm, the mean size of mature females varies from year to year over a range of 63 mm to 72 mm carapace width. Females cease growing with a terminal molt upon reaching maturity, and rarely exceed 80 mm carapace width. Males similarly cease growing upon reaching a terminal molt when they acquire the large claw characteristic of maturity. The median size of maturity for males is 65 mm carapace width (approximately 4 years old). Males larger than 60 mm grow at about 20 mm per molt, but individuals vary widely in this regard. Female snow crabs are able to store spermatophores in seminal vesicles and fertilize subsequent egg clutches without mating. At least two clutches can be fertilized from stored spermatophores, but the frequency of this occurring in nature is not known. Snow crab feed on an extensive variety of benthic organisms including bivalves, brittle stars, crustaceans (including other snow crabs), polychaetes and other worms, gastropods, and fish. In turn, they are consumed by a wide variety of predators including bearded seals, Pacific cod, halibut and other flatfish, eel pouts, sculpins, and skates.

**Management:** The Bering Sea snow crab stock is managed by the State of Alaska through a federal BSAI King and Tanner crab fishery management plan (FMP). Under the FMP, management measures fall into three categories: (1) those that are fixed in the FMP under Council control, (2) those that are frameworked so that the State can change following criteria outlined in the FMP, and (3) those measures under complete discretion of the State. The State sets pre-season guideline harvest levels for snow crab based on a mature male harvest rate of 53% for snow crab larger than 4 inches. Maximum allowable fishing mortality for the mature male snow crab stock, as established by the FMP, is  $F_{0.53} = F_{0.53} \cdot F_{11} (=0.25)$ . Although the minimum legal size for snow crab is 73 mm (3 inches), the fishery has generally harvested crabs over 4 inches in carapace width.

### Management measures implemented in the BSAI King and Tanner crab fisheries, as defined by the federal crab FMP, by category.

#### Category 1 (Fixed in FMP)

- Legal Gear
- Permit Requirements
- Federal Observer Requirements
- Limited Access
- Norton Sound Superselective Registration Area

#### Category 2 (Frameworked in FMP)

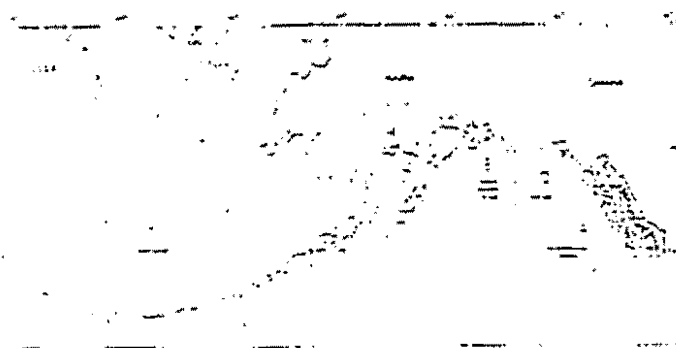
- Minimum Size Limits
- Guideline Harvest Levels
- Inseason Adjustments
- Districts, Subdistricts and Sections
- Fishing Seasons
- Sex Restrictions
- Closed Waters
- Pot Limits
- Registration Areas

#### Category 3 (Discretion of State)

- Reporting Requirements
- Gear Placement and Removal
- Gear Storage
- Gear Modifications
- Vessel Tank Inspections
- State Observer Requirements
- Bycatch Limits (in crab fisheries)
- Other

In addition to minimum size and sex restrictions, the State has numerous other regulations for the Eastern Bering Sea crab fisheries. The State requires vessels to register with the state by obtaining licenses and permits, and register for each fishery and each area. Observers are required on all vessels processing crab in the BSAI. Season opening dates are set to maximize yield per recruit and minimize handling of softshell crabs. The season opening date for snow crab fisheries is January 15. Pot limits have been established based on vessel size; the current pot limits are 250 for vessels  $\geq 125$  feet, and 200 for vessels  $< 125$  feet. A 3" maximum tunnel height opening for snow crab pots is required to inhibit the bycatch of red king crab. Escape rings were adopted by the Board in 1996 to reduce capture and handling mortality of non-target crab; a minimum of four 3.75" rings are required on snow crab pots. Other gear restrictions include a requirement that crab pots be fitted with a degradable escape mechanism consisting of #30 cotton thread (max. diameter) or a 30-day galvanic timed release mechanism.

### ALASKA TANNER AND SNOW CRAB MANAGEMENT AREAS



**Stock Structure:** Snow crab are thought to be one stock throughout its range in the BSAI area, and is managed accordingly.

**Eastern Bering Sea Stock:** Abundance of large male snow crab increased dramatically from 1983 to 1991, but has since declined. The 1993 NMFS Bering Sea trawl survey indicated the total abundance of large males (over 4 inches) at 135 million crab, a 43% decrease from 1992. Small (3-4") legal-size males also declined in abundance, consistent with the decline in large males observed since 1991. The 1993 NMFS bottom trawl survey indicated relatively low levels of large male crab. However, the



survey indicated an 88% increase in the numbers of pre-recruits, and a 34% increase in the number of large females. These signs of strong recruitment were apparent in the 1996 survey, as survey results indicated the number of large crab doubled.

Catch of Bering Sea snow crab increased from under 1 million pounds in 1974 to over 315 million pounds in 1992. The 1992 peak catch was followed by reduced landings thereafter. The 1995 opilio fishery was prosecuted by 253 vessels. The season began on January 15 and lasted 33 days. A total of 74 million pounds were landed. Average weight of crab retained was 1.2 pounds worth \$2.43 per pound exvessel. Total value of the 1995 snow crab fishery was \$180 million exvessel.

Increased landings are expected in coming years due to good recruitment of sublegal males. A GHL of 117.0 million pounds was established for the 1997 fishery, which begins on January 15.

Abundance of large males (millions of crab  $\geq 4.0''$  from NMFS trawl survey), pre-season guideline harvest levels (millions of pounds), and total catches (millions of pounds, including deadloss) of Bering Sea snow crab, 1980-1996.

Year	Abundance	GHL	Catch
1980	na	na	39.6
1981	na	59.5 - 91.0	52.8
1982	na	16.0 - 22.0	29.4
1983	na	15.3	26.1
1984	226.9	49.0	26.8
1985	115.7	98.0	66.0
1986	128.9	57.0	93.0
1987	221.0	56.4	101.9
1988	261.1	110.7	134.0
1989	263.2	132.0	149.5
1990	608.7	139.8	161.8
1991	307.0	315.0	323.6
1992	420.8	353.0	315.3
1993	212.9	207.2	250.8
1994	111.9	105.3	149.8
1995	99.9	73.6	75.3
1996	236.5	50.7	65.7
1997		117.0	

## 11.0 APPENDIX 2 Crab Bycatch Committee Agreement

On November 7, 1996, the following agreement was reached by the negotiating committee on PSC caps for *C. opilio* in the Bering Sea trawl fisheries.

### PSC caps for *C. opilio*

The PSC limit for snow crab (*C. opilio*) taken in Bering Sea trawl fisheries will be based on total abundance of *C. opilio* as indicated by the NMFS annual bottom trawl survey. The PSC cap will be set at 0.1133% of the total Bering Sea abundance, with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crab taken within the "Snow Crab Bycatch Limitation Zone" (SCBLZ) would accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery would be prohibited from fishing within the SCBLZ.

Note that this agreement would yield a snow crab PSC limit of 6,147,000 snow crab for 1997. This number is 0.1133% of the total 1996 NMFS survey abundance of 5,424,886,000 snow crab (both sexes, all size groups).

Coordinates of the Snow Crab Bycatch Limitation Zone, as agreed upon by the negotiating committee.

North latitude	West longitude
56°30'	Dear Hole
56°30'	155°00'
55°00'	155°00'
59°30'	170°00'
US-Russia Line	170°00'

### Creations and Recommendations:

1. If area 517 bycatch exceeds 500,000 snow crab in any one year, the Council should consider moving the southern boundary of the snow crab bycatch limitation zone from 56°30' to 56°00'.
2. These snow crab PSC limits will be subject to a 5 year review.

### Industry Support:

All parties here below signed will support this agreement at the North Pacific Fishery Management Council meeting through Secretarial review and approval. The Committee strongly recommends that the NPFMC approve this agreement without change. Any substantive change from this agreement releases the parties from supporting said agreement.

Joe Fanning

James Landis

Bob C. Rain

[Signature]

Vincent A. Perry

Gordon Blue