AGENDA D-5
SEPTEMBER 1994

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: September 20, 1994

SUBJECT: Other Groundfish Issues

ESTIMATED TIME
1 HOUR

ACTION REQUIRED

Receive status report on bycatch of snow crab in groundfish fisheries.

BACKGROUND

In June, the Council reviewed information on C. opilio (snow crab) bycatch in the BSAI groundfish fisheries. NMFS data showed that a total of 14,476,797 snow crabs were caught as bycatch in the 1992 BSAI trawl fisheries. The data also showed that bycatch in the groundfish fisheries is concentrated in regulatory areas 513 and 514. No size information on these crabs was provided however, making it difficult to estimate the impacts of bycatch on the directed snow crab fishery.

The Council requested staff to provide additional information on snow crab bycatch for the September meeting. Specifically, the Council requested information on the following: historical bycatch by fishery, breeding habitat, bycatch mortality, percentage of total biomass, percentage of TAC, information on age composition and adult equivalents, bycatch avoidance potential like the Sea State Program, and observer methodology and identification. The attached discussion paper was prepared to summarize available information, which should assist the Council with determining whether or not a comprehensive analysis of PSC caps or other program is warranted.

Discussion Paper:
Snow Crab (C. opilio) Bycatch in the Groundfish Trawl Fisheries

Prepared by NMFS and Council Staff

In June, the Council reviewed information on Chionoecetes opilio (snow crab) bycatch in the BSAI groundfish fisheries. NMFS data showed that a total of 14,476,797 snow crabs were caught as bycatch in the 1992 BSAI trawl fisheries (**Table 1**). The data also showed that bycatch in the groundfish fisheries is concentrated in regulatory areas 513 and 514 (**Table 2**), which are shown in **Figure 1**. No size information on these crabs was provided, however, making it difficult to estimate the impacts of bycatch on the directed snow crab fishery.

The Council requested staff to provide additional information on snow crab bycatch for the September meeting. Specifically, the Council requested information on the following: historical bycatch by fishery, breeding habitat, bycatch mortality, percentage of total biomass, percentage of TAC, information on age composition and adult equivalents, bycatch avoidance potential like the Sea State Program, and observer methodology and identification. This discussion paper was written to summarize available information, which should assist the Council with determining whether or not a comprehensive analysis of PSC caps or other program is warranted.

Snow Crab Biology

Snow crabs are distributed on the continental shelf of the Bering Sea, Chukchi Sea, and in the western Atlantic Ocean as far south as Maine. In the Bering Sea, snow crabs are rare at depths greater than 200 meters. The eastern Bering Sea (EBS) 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.

Growth patterns of snow crab in the EBS are extremely complex and not well understood. 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 (CW). Breeding habitat can be inferred from the distribution of female snow crab larger than 50 mm CW (**Figure 2**). Females cease growing with a terminal molt upon reaching maturity, and rarely exceed 80 mm CW. 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 CW (approximately 4 years old). Males larger than 60 mm grow at about 20 mm per molt, but individuals vary widely in this regard.

Only adult males are harvested. Average sizes of crab taken in the EBS fishery ranged from 105 mm to 118 mm (0.5 kg to 0.63 kg) for the years 1977 to 1994. Only 1% of snow crabs in the fishery exceed 140 mm. The legal size limit is 78 mm and is thought to allow at least one opportunity to breed based upon a median size of maturity of 65 mm CW. Small males are not marketable and processors generally do not purchase crabs smaller than 102 mm CW (4.0 inches).

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. Presumably this reproductive strategy evolved to maintain reproductive potential of populations at times when distributional factors prevent females from finding mates. Because of this reproductive strategy, fishery managers may not need to be as concerned with sex ratios of adult snow crab as they are with respect to king crab.

Snow crab feed on an extensive variety of benthic organisms including bivalves, brittle stars, crustaceans (including other snow crabs), polychaeta and other worms, gastropods, and fish. In turn they are

consumed by a wide variety of predators including Pacific cod, halibut and other flatfish, eel pouts, sculpins, and skates. In the northern part of their range, they are preyed upon by bearded seals and sometimes make up all of the seal's stomach contents.

Snow Crab Abundance and Landings

Abundance of snow crab increased dramatically from 1983 to 1991 (**Table 3**), 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 48% decrease from 1992 (**Table 4**). Small (3-4") legal-size males also declined in abundance, consistent with the decline in large males observed since 1991. A continued westward shift of the population was also observed, with the highest sampling densities north and west of the Pribilof Islands. Abundance of small female crab increased 66% in 1993 and sublegal (<3.1") male crab showed a 92% increase in abundance. Recruitment of these small crab should result in increased snow crab landings in 1995 or 1996 (Stevens et al. 1993, Morrison and Gish 1994).

Landings from the directed snow crab fishery increased steadily from 11,852 tons in 1983 to 73,402 tons in 1990, then jumped to 149,073 in 1991. Landings have since declined, with 1992 landings of 143,020 tons (227.4 million crab), 104,700 tons in 1993, and only 67,938 tons (114.8 million crab) in 1994. Participation in the fishery, as measured by numbers of vessels, has increased steadily since the mid-1980's, with 254 vessels participating in 1993 and a record high 273 vessels in 1994. Combined with a declining exploitable biomass, seasons are becoming shorter in duration. The 1993 fishery lasted only two months from January 15 - March 15. A summary of 1993 regulations is shown in **Figure 3**.

Bycatch of Snow Crab in the Groundfish Trawl Fisheries

Crab bycatch is estimated by the National Marine Fisheries Service through the Observer Program. Bycatch data for crab are available for the 1991, 1992, and 1993 groundfish trawl fisheries in the BSAI and GOA trawl fisheries by target fishery and regulatory areas (**Table 5**), which are shown in **Figure 1**. The observer database categorizes crab bycatch into king crab, Tanner crab (C. bairdi), and "other" crab categories. In the Bering Sea, the "other crab" is comprised almost entirely of snow crab, whereas in the GOA, "other" crab consists mostly of C. tanneri and C. angulatus, with the bycatch of snow crab virtually nil. Bycatch of "other" crab in the GOA trawl fisheries is relatively low for the years examined (less than 30,000 crabs per year), so this analysis focuses primarily on BSAI fisheries. Bycatch of snow crab in BSAI groundfish fisheries totalled 10.5 million crabs in 1991, 14.5 million crabs in 1992, and 14.8 million crabs in 1993. Data show that the yellowfin sole fisheries in 513 and 514 consistently have the highest bycatch in numbers of snow crab, followed by the rock sole/other flatfish target fishery in the same areas. Together, these fisheries accounted for 5,629,807 crabs (54%) of the BSAI snow crab bycatch in 1991, 12,779,142 (88%) in 1992, and 13,726,499 (87%) in 1993. Much of the 1991 remainder was taken by pollock fisheries in statistical area 521.

Length frequencies of crab taken as bycatch, provided by the NMFS Observer Program, indicate that size of snow crab bycatch depends on year, target fishery, and regulatory area. Data summarizing snow crab bycatch length frequency for 1991, 1992, and 1993 trawl fisheries in regulatory areas 511, 513, 514, 517, 521, and 522 was provided, and are shown in **Figures 4-9**. As previously stated, the highest bycatch in numbers occurs in the yellowfin sole and other flatfish fisheries in areas 513 and 514. The size of snow crab taken is generally small, with most crab about 40-80 mm (1.6"-3.1") in carapace width. In 1991, opilio taken as bycatch were generally larger (to 140 mm) in these two areas. In the other regulatory areas (511, 517, 521, and 522), fewer crab were taken as bycatch in all years, but all sizes of crab were represented. Marketable size crab (>102 mm) were taken in bottom pollock, rock sole, and other flatfish fisheries in other areas in 1991 and 1992.

Conversion of length data to age data for purposes of estimating snow crab bycatch as a percentage of total biomass and snow crab GHL would require additional analysis. However, for reference, respective abundance estimates for 1991, 1992, and 1993 were 11.3 billion, 7.8 billion, and 11.7 billion snow crabs of all sizes in the Bering Sea (Stevens et al. 1993). Corresponding BSAI snow crab bycatches were 10.5 million, 14.5 million and 14.8 million crabs, or 0.09%, 0.19%, and 0.13% of the total crab available in those years.

Discard Mortality

Few studies have estimated mortality of crabs taken as bycatch and discarded. One hundred percent mortality is assumed for Tanner crab and king crab bycatch in groundfish fisheries. For Tanner crab taken as bycatch in the weathervane scallop fishery, Urban et al. (1994) recorded that 13-35% were dead or moribund before being discarded, with the highest mortality rate occurring on small (< 40 mm cw) and large (>120 mm cw) crabs. Delayed mortality resulting from injury or stress was not estimated. In the directed crab pot fishery, handling mortality of trap-captured crabs has been assumed to be negligible (Schmidt and Pengilly 1993).

In a study of crab taken from research trawls, Hays (1973) tested snow crab for discard mortality. Large males (> 110 mm CW) were held on deck in air (5 to 10 degrees C.) to simulate handling in Japanese commercial fisheries. The results were as follows:

Storage time (hrs):	0	6	12	24	48
No. alive/No. held:	8/10	10/10	7/10	3/10	0/10

Stevens (1990) studied the survival of red king crab and Tanner crab in sole fisheries and found that overall survival (including delayed mortality) was 21 to 22% for crab that were taken in an August joint-venture fishery and delivered to a processing vessel. Delayed mortality of both species increased with total time in captivity. Mortality of king crab increased with size of trawl catches, but mortality of Tanner crab was not affected. However, mortalities would be expected to be much higher during the molting period and immediately after it, when crab are soft. Data collected by Stevens (1990) were done on hardshelled crab, and may not be representative of other times of the year. Unlike king and Tanner crab, EBS snow crab molt in the summer (June and early July) and molting occurs somewhat later in more northerly areas. Higher discard mortality rates for snow crab may thus be expected in the summer months.

Bycatch Avoidance Program

A bycatch avoidance program for snow crab, like the Sea State Program for salmon, may not be a viable alternative at this time. A potential problem is that observers are already fully utilized. In addition to collecting, compiling, and analyzing biological information, the Sea State program has burdened the observer program with additional duties. A program for snow crab may be more complicated than salmon (i.e., more data to collect, enter, and analyze), and may result in re-prioritizing observer duties away from collecting biological data (e.g. length frequency information) from the fisheries (J. Berger, NMFS, personal communication).

PSC Caps

Establishing a prohibited species (PSC) cap could be considered as an alternative to restrict the amount of snow crab taken as bycatch in the groundfish fisheries. Current regulations for the BSAI and GOA groundfish fisheries provide a number of regimes to manage the incidental take of PSC, or bycatch of Pacific halibut, Pacific herring, Pacific salmon, Steelhead trout, and King and Tanner crab. One example

of bycatch management would be time and area closures triggered by attainment of an established PSC limit. PSC limits can be in the form of a percentage of biomass, such as herring in the BSAI, an established number, as with king and Tanner crab in the BSAI, or an estimated mortality rate, as with halibut in both the BSAI and GOA.

Fisheries are closed when PSC caps are reached. For example, the 1994 rock sole/other flatfish trawl fishery was closed on February 25 in Zone 1 (Areas 511, 512, 516) due to attainment of the red king crab PSC cap; Zone 2 (Areas 513, 517, and 521) was closed to this fishery on May 7 due to attainment of the Tanner crab PSC cap. Costs associated with establishing PSC caps would depend on how high the caps are set relative to crab biomass; low caps could have substantial impacts on groundfish fisheries.

Bycatch from trawl fisheries accounts for a very small portion of the total BSAI snow crab abundance, in the order of 0.1 to 0.2% yearly. Proportionally, this bycatch is less than for other crab species with PSC caps. In 1993, bycatch of PSC crab in trawl fisheries totalled 183,713 red king crab and 3,374,031 Tanner crab. Existing PSC crab caps for the BSAI trawl fisheries total 200,000 red king crab and 4,000,000 Tanner crab. Corresponding 1993 abundance was 38.8 million Bristol Bay red king crab and 254.9 million EBS Tanner crab of all sizes (Stevens et al. 1993). Hence, the caps represented 0.5% and 1.6% of the total number of BSAI king and Tanner crab, and the overall BSAI bycatch represented 0.5% and 1.3% of red king crab and Tanner crab, respectively.

Other Bycatch Restrictions

There are other methods to restrict the amount of bycatch taken. One program that has been established is the vessel incentive program (VIP) for the BSAI and GOA trawl fisheries. Enforcement of the VIP standards has proven difficult, and may not hold much potential for reducing snow crab bycatch. Another method that has been used to reduce bycatch has been to adjust seasonal starting dates for some groundfish fisheries in order that the fisheries are conducted during a time of relatively lower bycatch rates. Time/area closures may have some potential to reduce snow crab bycatch. The Council recently established hotspot time/area closures for chum salmon, and a permanent area closure to trawl gear to protect blue king crab around the Pribilof Islands. Although the highest snow crab bycatch occurs in statistical areas 513 and 514, additional analysis may identify more discrete areas of high bycatch (hotspots).

Literature Cited

Hays, M.L. 1973. Survival of Tanner crabs (Chionoectes bairdi) after capture in trawls and subsequent handling and storage aboard fishing boats. International North Pacific Fisheries Commission. 9p.

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Schmidt, D.C. and D. Pengilly. 1993. Review of harvest strategies used in the management of lithoid crab in Alaska. In: Kruse, Eggers, Marasco, Pautzke, and Quinn (Editors). Proceedings of the International Symposium on Management Strategies for Exploited Fish Populations, Alaska Sea Grant College Program, AK-SG-93-02:385-407.

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Stevens, B.G. R.A. MacIntosh, J.A. Haaga, and J.H. Bowerman. 1993. Report to the Industry on the 1993 Eastern bering Sea Crab Survey. NMFS-AFSC 93-14.

Urban, D, D. Pengilly, and I. Vining. 1994. The scallop observer program and statewide data analysis summary to the Board of Fisheries. Alaska Department of Fish and Game, Kodiak. 54 p.

Table 1. 1993 Bycatches (numbers of animals) of Opilio Tanner Crab occurring in trawl fisheries for groundfish in the Bering Sea/Aleutian Islands and Gulf of Alaska Management Areas.

BERING SEA/ALEUTIAN ISLANDS	
Target Fisheries	Number
Pollock	727,177
Pacific cod	165,638
Rock Sole/Other flatfish	4,257,881
Yellowfin sole	9,326,101
Total	14,476,797

GULF OF ALASKA	
Rockfish	2,591
Deep water flatfish	454
Shallow water flatfish	2,571
Sablefish	78
Total	5,694

Table 2. 1993 Bycatches (numbers of animals) of Opilio Tanner Crab occurring in the rocksole/"other flatfish" and yellowfin sole target fishery categories by reporting area in the Bering Sea/Aleutian Islands management area.

Target Fisheries	Reporting Area	Number
Rock Sole/Other flatfish	508	0
	509	2731
	513	2,752,190
	514	1,116,592
	516	1,449
	517	16,038
	519	0
	521	110,515
	523	0
	524	258,367
	540	0
	Total	4,257,882
Yellowfin Sole	508	0
	509	8,468
	513	5,167,494
	514	3,797,439
	516	0
	521	0
	524	352,700
	Total	9,326,101

Table 3. Bering Sea opilio crab fishery data 1980-1993 (source: Morrison and Gish 1994).

Year	GHL[a]	Season Total[a]	Number of Vessels	Number of Landings	Number of Pots Registered[b]	Number of Pots Pulled	Value Exvessel	Value Total[c]	Season Length[d]
1979/80	N/A	39.3	134	597	35,503	255,022	$ 0.21	$ 83.0	307
1981	39.5-91.0	50.5	153	867	39,789	435,742	$ 0.26	$ 13.1	229
1982	16.0-22.0	28.3	112	803	35,522	469,091	$ 0.73	$ 20.7	167
1983	15.8	24.8	109	462	15,39	287,127	$ 0.35	$ 8.7	120
1984[e]	49.0	26.0	52	367	12,493	173,591	$ 0.30	$ 7.8	320
1985[e]	98.0	64.9	75	718	15,325	372,045	$ 0.30	$ 19.5	333
1986[e]	57.0	96.6	88	992	13,750	543,744	$ 0.60	$ 60.0	252
1987	56.4	100.9	103	1,038	19,386	616,113	$ 0.75	$ 75.7	158
1988	110.7	130.8	171	1,285	38,765	766,907	$ 0.77	$100.7	120
1989	132.0	147.6	168	1,341	43,607	663,442	$ 0.75	$110.7	112
1990	139.8	161.8	189	1,565	46,440	911,613	$ 0.64	$102.3	148
1991	315.0	325.2	228	2,788	76,056	1,391,583	$ 0.50	$162.6	159
1992	333.0	313.0	250	2,763	77,858[f]	1,281,796	$ 0.50	$156.5	97
1993	207.2	230.8	254	1,836	65,081	971,046	$ 0.75	$171.9	59

[a]Millions of pounds.
[b]Same gear as *C. bairdi* fishery.
[c]Millions of dollars.
[d]In days.
[e]Partial closures only.
[f]Gear of *C. opilio* vessels only.

Table 4. Abundance estimates (millions of crabs) for eastern Bering Sea opilio crabs from NMFS trawl surveys, all districts combined (source: Stevens et al. 1993).

	Males				Females			
		Large	V. Large		Small	Large		Grand
Size[1] (mm) Width (in)	<102 <4.0	≥102 ≥4.0	≥110 ≥4.3	Total	<50 <2.0	≥50 ≥2.0	Total	Total
1982	*	*	22	2073	403	2256	2658	4732
1983	*	*	22	1858	673	1228	1913	3760
1984	1237	153	74	1391	610	582	1192	2583
1985	548	75	41	623	258	123	382	1004
1986	1179	83	46	1262	791	422	1212	2474
1987	4439	151	70	4590	2919	2929	5849	10438
1988	3467	171	90	3638	1235	2323	3556	7194
1989	3646	187	81	3833	1923	3791	5713	9546
1990	2860	420	189	3281	1463	2798	4261	7542
1991	3971	484	323	4455	3289	3575	6864	11319
1992	3158	256	165	3414	2434	1914	4348	7763
1993	5597	135	78	5732	3990	1983	5972	11704
East (%)[2]	54	47	52	54	48	48	48	51
Limits[3]								
Lower	3391	104	60	3526	2523	1308	4021	7547
Upper	7802	166	96	7937	5457	2657	7924	15860
± %	39	23	23	38	37	34	33	35

[1] Carapace width (mm).
[2] Proportion of size group in Eastern District.
[3] Mean ± 2 standard errors for most recent year.
* Estimates not available at present time.

Table 5. Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

BYCATCH OF OPILIO TANNER CRAB BY TARGET FISHERY AND ZONE

YEAR	BERING SEA AND ALEUTIAN ISLANDS TARGET FISHERIES	ZONE	NUMBER
1993	ATKA MACKEREL	540	10
			10
	POLLOCK	509	3,651
	BOTTOM	513	38,047
		514	92,636
		517	143,176
		519	3,836
		521	210,906
		523	8,188
		524	22,076
			522,517
	PACIFIC COD	509	5,005
		512	45
		513	6,332
		514	96,282
		517	6,243
		518	120
		519	1,889
		521	129,767
		523	4,102
		524	41,455
		540	685
			291,924
	ROCKFISH	509	54
		519	6
		521	412
		523	4
		540	2
		541	1
			479
	OTHER SPECIES	521	666
			666
	POLLOCK	508	36

GULF OF ALASKA TARGET FISHERIES	ZONE	NUMBER
PACIFIC COD	610	511
	620	2,082
	630	866
	640	88
	649	132
	650	1
	659	8
		3,687
DEEP WATER	610	177
FLATFISH	620	2,062
	630	178
		2,418
SHALLOW WATER	620	75
FLATFISH	630	2,439
		2,514
ROCKFISH	610	2,075
	620	304
	630	133
	640	83
		2,595
OTHER SPECIES	610	4
	620	65
	630	9
		79
SABLEFISH	610	8,749
	620	1,919
	630	479
	640	895
	649	205
	650	2,525
	659	2,510
		17,282

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

MIDWATER	509	4,936
	513	30,088
	516	42
	517	22,748
	518	9
	519	73
	521	156,912
	523	898
	540	1
		215,743
ROCK SOLE/ OTHER FLATFISH	508	18
	509	2,728
	513	2,752,187
	514	1,116,574
	516	1,449
	517	15,990
	521	110,473
	524	258,203
		4,257,622
SABLEFISH	517	16
	518	94
	519	36
	521	1
	540	384
	541	169
	542	28
		728
GREENLAND TURBOT	509	8
	517	645
	518	512
	519	145
	521	572
	523	201
	524	4
	540	65
		2,153
YELLOWFIN SOLE	509	22,637
	513	5,296,972
	514	3,796,975
	524	352,293
ARROWTOOTH FLOUNDER	610	13
		13

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

		9,468,877			
NO RETAINED SPECIES	509	2			
		2			
1992					
POLLOCK BOTTOM	511	5,790			
	513	64,068			
	517	59,271			
	519	14,837			
	521	846,141			
	522	20,633			
		1,010,740			
PACIFIC COD	511	19,004	POLLOCK BOTTOM	610	261
	512	232		620	148
	513	27,698		630	331
	514	276			740
	515	204			
	516	27			
	517	32,634	PACIFIC COD	610	895
	518	1,731		620	180
	519	8,433		630	789
	521	166,058		640	7
	522	52,266		649	6
	540	673		659	3
		309,236			1,881
			DEEP WATER FLATFISH	620	176
ROCKFISH	518	1		630	423
	521	433			599
	522	98			
	540	225	SHALLOW WATER FLATFISH	630	20
		756			20
OTHER SPECIES	511	6			
	513	36	ROCKFISH	610	24
	519	1		620	150
	521	42		630	64
	522	99		640	113
		184		650	75
					426
POLLOCK MIDWATER	511	19,507			
	512	1,838	OTHER SPECIES	610	104

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

	513	184,218
	514	140
	515	2,540
	517	45,253
	519	1,035
	521	3,252,204
	522	52,187
	540	1,079
		3,560,001
ROCK SOLE/ OTHER FLATFISH	511	15,501
	513	940,016
	514	1,179,596
	516	421
	517	12,516
	521	21,816
	522	473
		2,170,339
SABLEFISH	511	2
	517	98
	518	134
	519	62
	521	207
	522	131
	530	5
	540	299
		938
GREENLAND TURBOT	519	4
	540	3
		8
ARROWTOOTH FLOUNDER	519	700
		700
YELLOWFIN SOLE	511	42,458
	513	5,894,074
	514	4,216,946
	521	449,563
	522	5,761
		10,608,803
	630	15
		119
SABLEFISH	610	4,324
	620	463
	630	1,186
	640	984
	649	70
	650	718
	659	918
		8,663

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

NO RETAINED SPECIES	511	59			
	514	786			
		845			
1991					
ATKA MACKEREL	515	22	POLLOCK BOTTOM	610	310
	517	685		620	12
	519	17		621	31
	540	123		630	643
		848		650	3
					999
POLLOCK BOTTOM	511	63,402			
	513	409,907	PACIFIC COD	610	318
	514	6		620	3
	515	45,287		621	7
	516	122		630	98
	517	106,802		640	1
	519	83,220		650	2
	521	1,986,602			428
	522	992			
		2,696,339	DEEP WATER FLATFISH	610	94
				620	2,684
PACIFIC COD	511	25,868		630	85
	513	2,016			2,863
	514	107			
	515	7,175			
	516	13	ROCKFISH	610	2,541
	517	92,352		620	311
	518	1,486		630	289
	519	2,551		640	72
	521	72,831		650	4
	522	7,334		680	4
	540	1,744			3,221
		213,476			
			POLLOCK MIDWATER	610	2
					2
ROCKFISH	513	2			
	517	72			
	521	795	SABLEFISH	610	531
	522	145		620	202
	540	47		621	1
		1,061		630	217
				640	262
				650	481
OTHER SPECIES	511	2		680	113

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

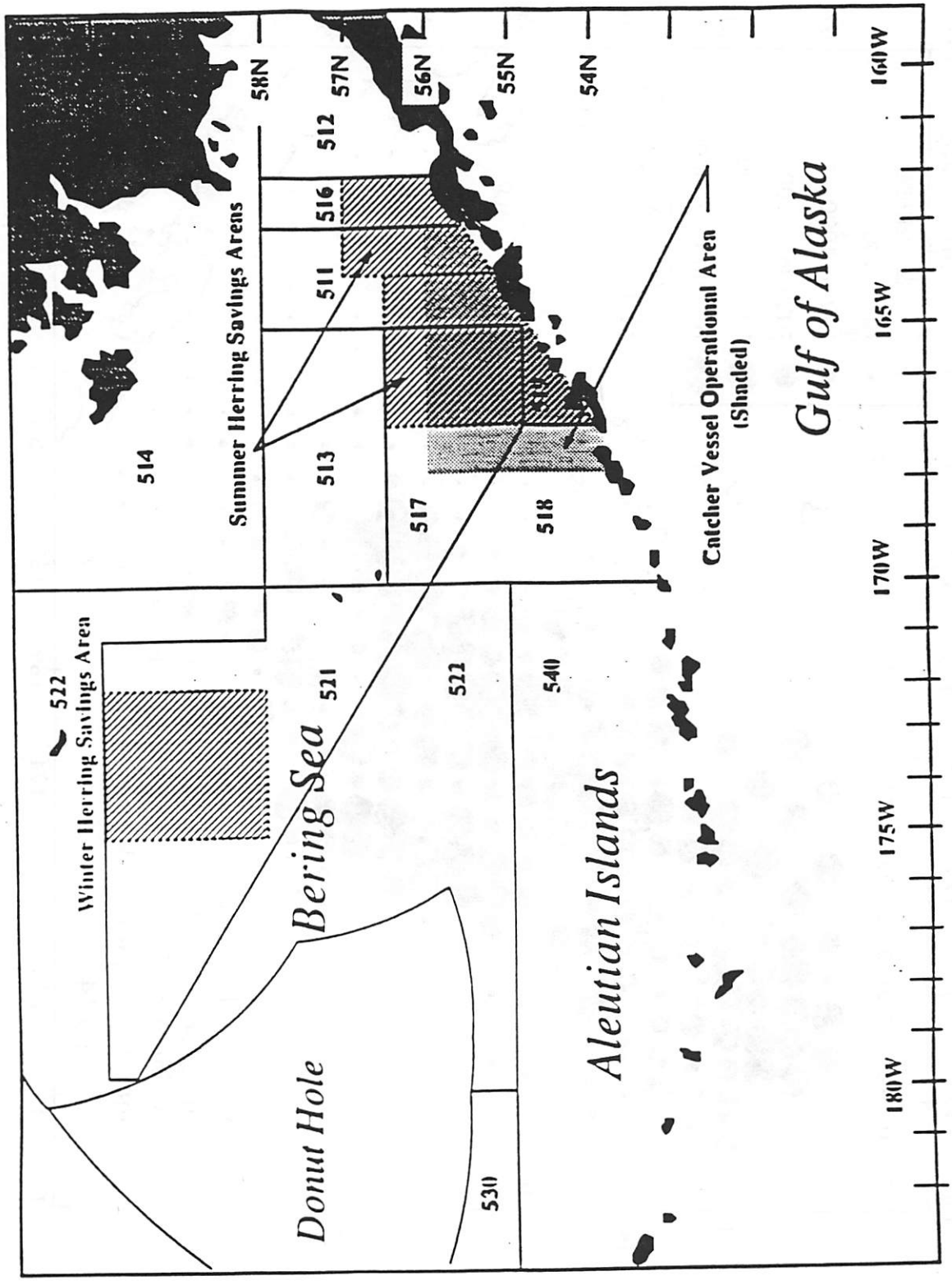
	513	30,315	
	515	36	1,807
	517	613	
	519	279	
	521	29	
	522	903	
		32,177	
POLLOCK MIDWATER	511	3,001	
	513	66,534	
	515	12,281	
	517	31,180	
	518	2,015	
	519	15	
	521	1,544,616	
	522	24,043	
	540	2	
		1,683,686	
ROCK SOLE/ OTHER FLATFISH	511	47,012	
	513	2,590,826	
	514	2,809,310	
	515	4,271	
	516	4,295	
	517	12,340	
	519	528	
	521	81,723	
	522	79,480	
	540	22	
		5,629,807	
SABLEFISH	511	1	
	515	24	
	517	6	
	518	8	
	519	1	
	521	2	
	522	1	
	540	70	
		114	
GREENLAND TURBOT	515	217,253	
	517	10,042	
	518	6,031	
	519	2,370	

Table 5 (continued). Bycatch of opilio crab (in numbers) in groundfish fisheries of the Bering Sea/Aleutian Islands and the Gulf of Alaska, 1991-1993, by target fishery and zone.

	521	220
	522	2
	540	2,174
		238,092
ARROWTOOTH	511	693
FLOUNDER	515	56
	517	2,408
	518	28
	519	170
	521	19,252
	522	4,887
	540	126
		27,620

The targets for which there is no zone information had zero bycatch

Figure 1. Regulatory areas in the Bering Sea/Aleutian Islands and Gulf of Alaska.



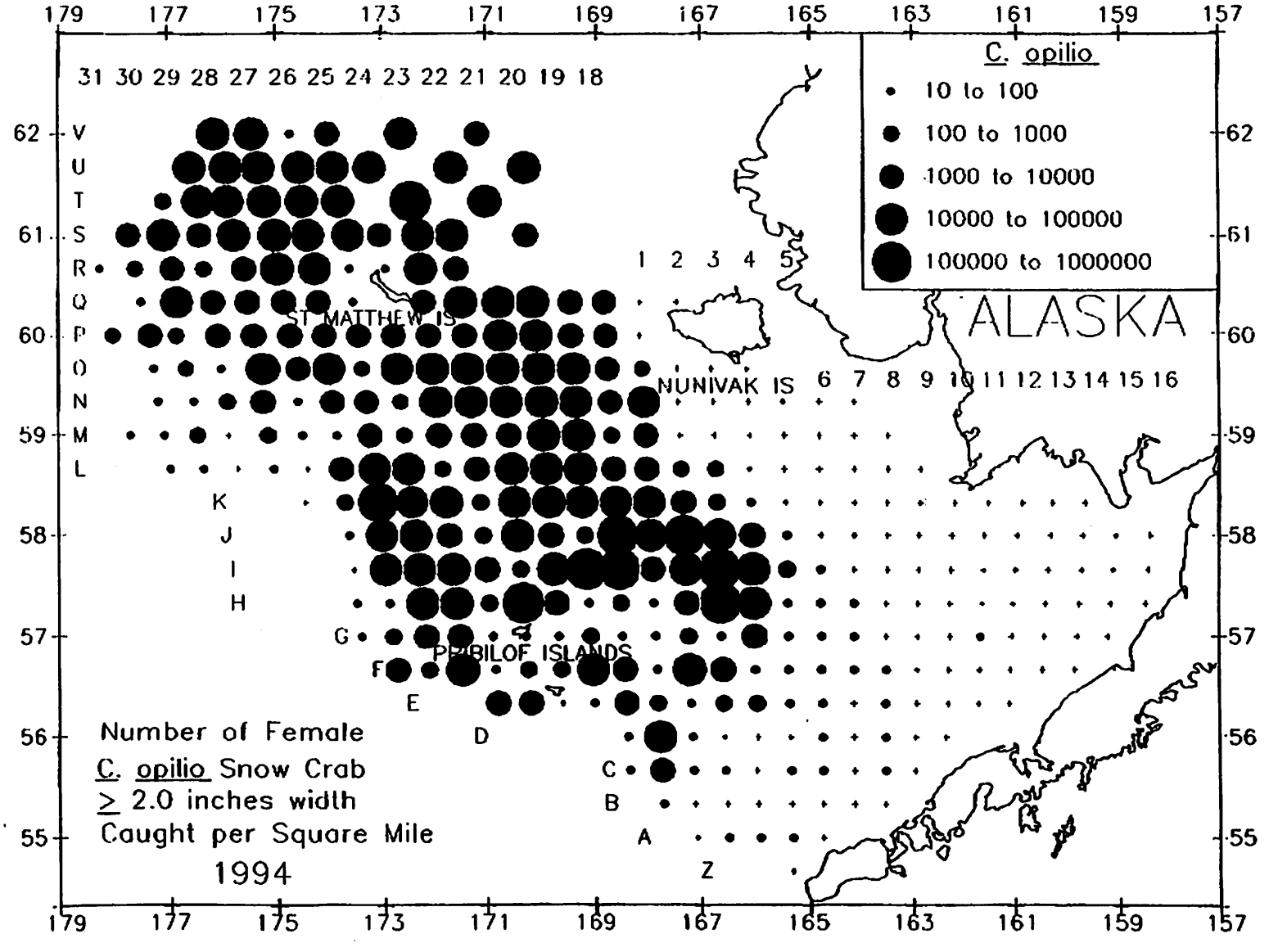
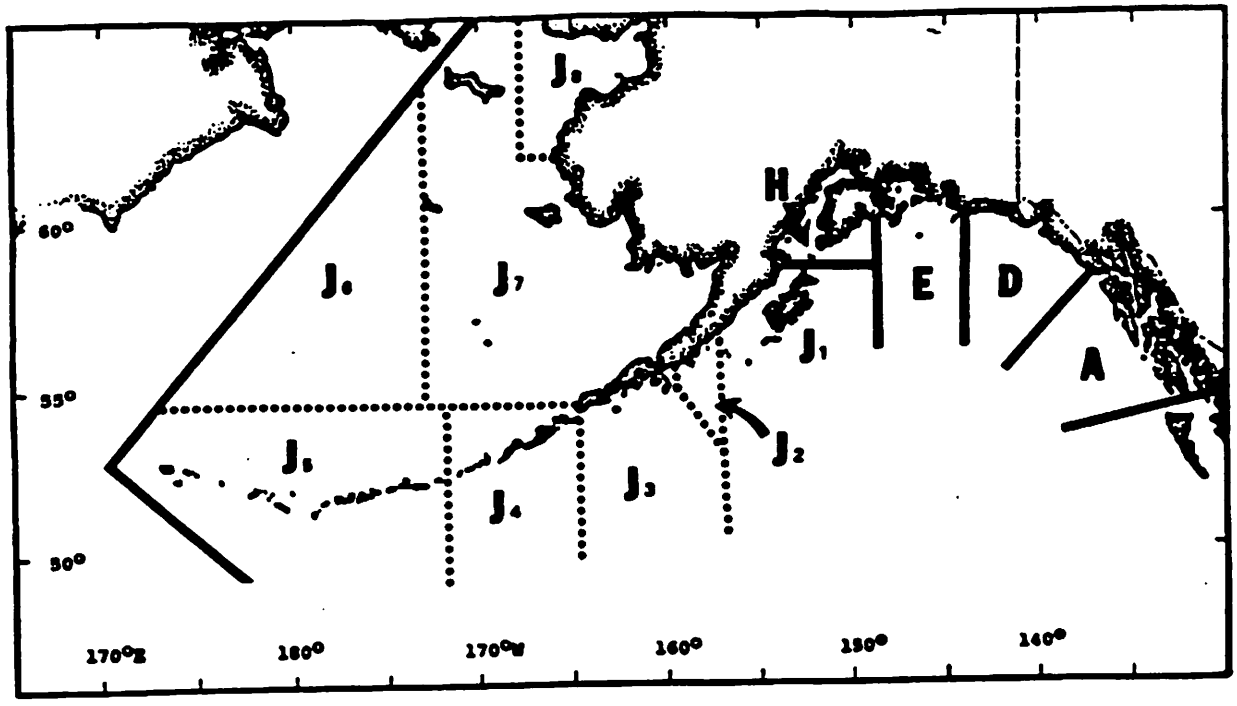


Figure 2. Distribution of female snow crab greater than 50 mm CW from the 1994 NMFS EBS crab survey.

Figure 3. Summary of 1993 Tanner and snow crab regulations.



TANNER CRAB SEASON REGULATIONS SUMMARY

J8: BERING SEA DISTRICT EASTERN SUBDISTRICT NORTON SOUND SECTION
Reg: No open season

J7: BERING SEA DISTRICT EASTERN SUBDISTRICT
Reg: Nonexclusive
Pot Limit:
250, for Vessels over 125 feet
200 for Vessels 125 or less
Dates: *C. bairdi* -
East of 168° W. long., Concurrent With Area T.
Red King Crab Season and reopen again 10 days after Area T king crab season between 163° and 173° W. long.
If no Area T king crab season, open between 163° and 173° W. long. on November 1.
C. opilio - January 15
Size: *C. bairdi* - 5.5 inches
C. opilio - 3.1 inches

J6: BERING SEA DISTRICT WESTERN SUBDISTRICT
Reg: Nonexclusive
Pot Limit:
250, for Vessels over 125 feet
200 for Vessels 125 or less
Dates: *C. bairdi* - January 15
C. opilio - January 15
Size: *C. bairdi* - 5.5 inches
C. olilio - 3.1 inches

J5: WESTERN ALEUTIANS
Reg: Nonexclusive
Pot Limit: None
Dates: November 1
Size: *C. bairdi* - 5.5 inches

J4: EASTERN ALEUTIANS
Reg: Nonexclusive
Pot Limit: None
Dates: January 15
Size: *C. bairdi* - 5.5 inches

J3: SOUTH PENINSULA
Reg: Nonexclusive
Pot Limit:
40 or 75 Depending on GHL
Dates: January 15
Size: *C. bairdi* - 5.5 inches

J2: CHIGNIK
Reg: Nonexclusive
Limit:
40 or 75 Depending on GHL
Date: January 15
Size: *C. bairdi* - 5.5 inches

J1: KODIAK
Reg: Nonexclusive
Pot Limit: 75
Dates: January 15
Size: *C. bairdi* - 5.5 inches

H: COOK INLET
Reg: Superexclusive
Pot Limit: 40 or 75 depending on GHL in Southern District
Dates: January 15
Size: 5.5 inches

E: PRINCE WILLIAM SOUND
Reg: Superexclusive
Pot Limit: 100 or 175 Depending on Area
Dates: January 15
Size: 5.3 inches

D: YAKUTAT
Reg: Nonexclusive
Pot Limit: 100 in Yakutat Bay
Dates: January 15
Size: 5.5 inches

A: SOUTHEASTERN
Reg: Superexclusive
Pot Limit: 100 Pot Limit in Inside Waters
Dates: February 15
Size: 5.5 inches

KEY:
Registration ..... Reg: Opening Dates ..... Dates:
Guideline Harvest Level . GHL Minimum Legal Size ..... Size:

Figure 4. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 511. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.

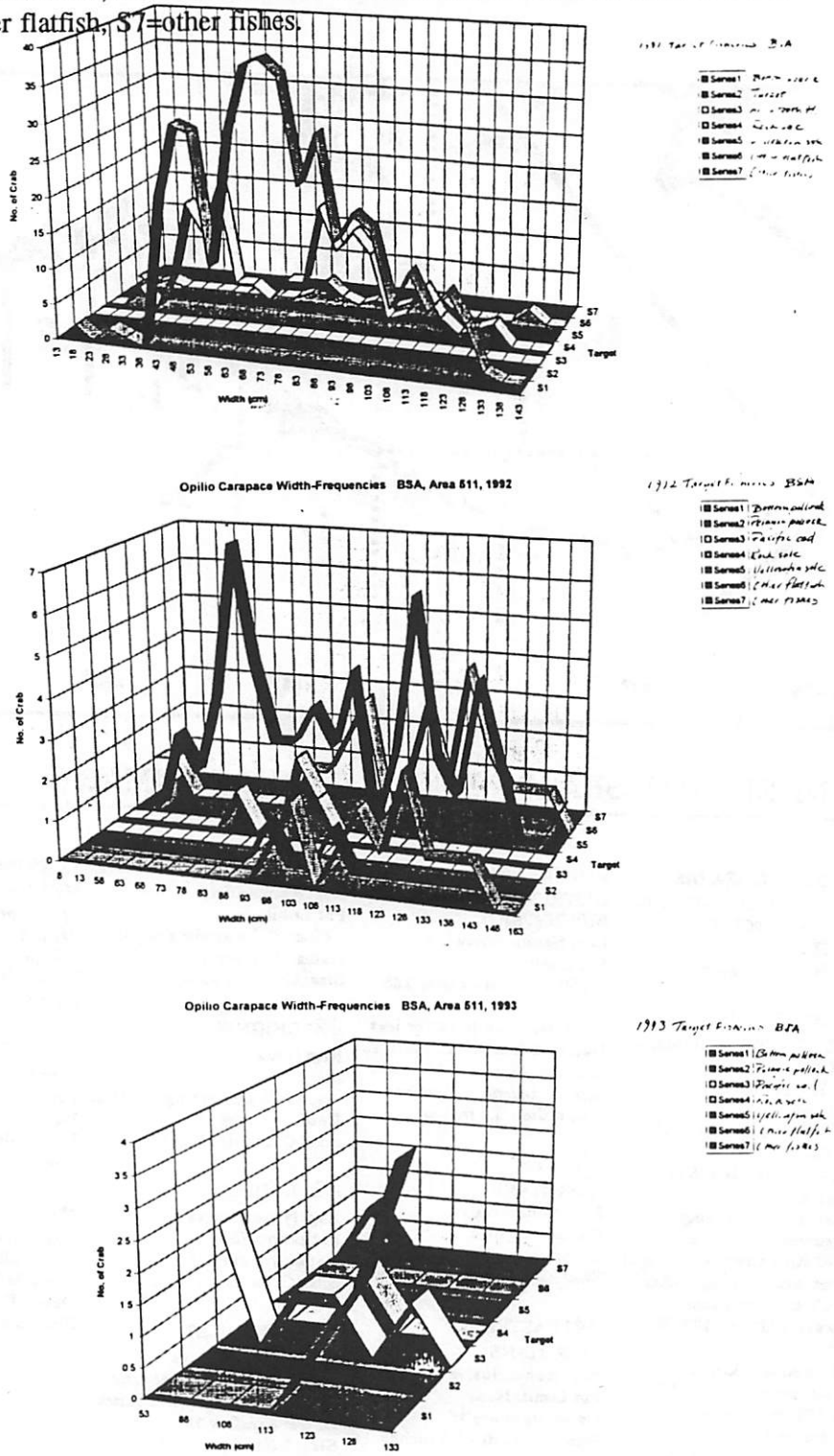
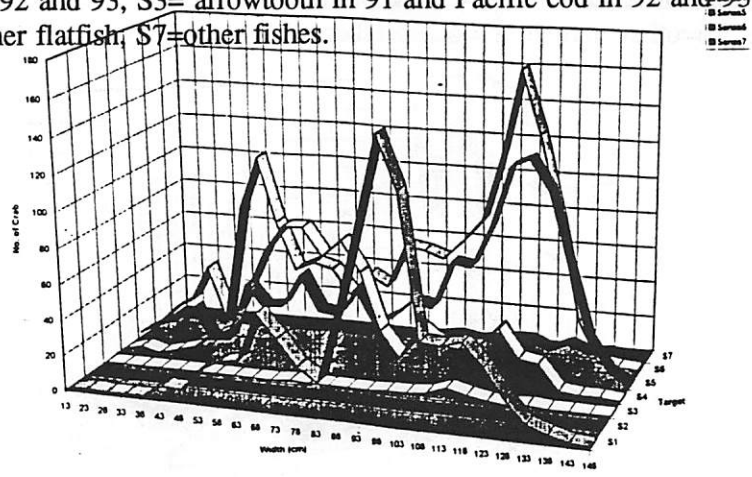
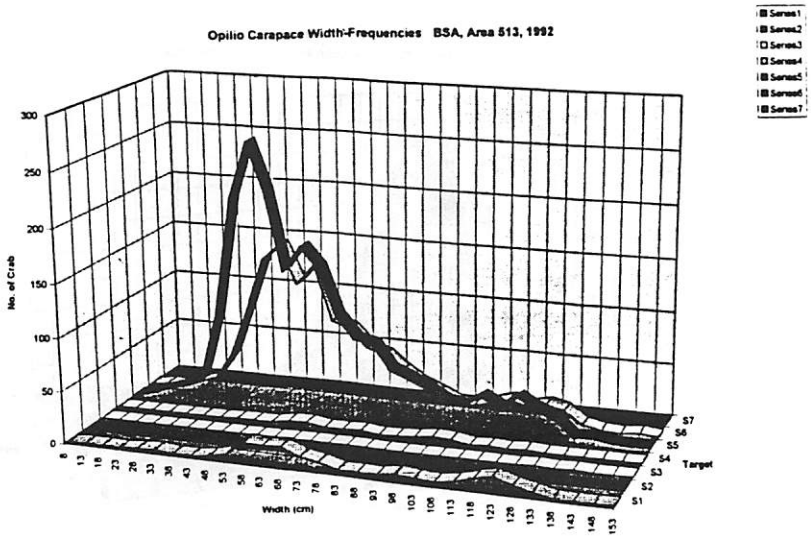


Figure 5. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 513. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.





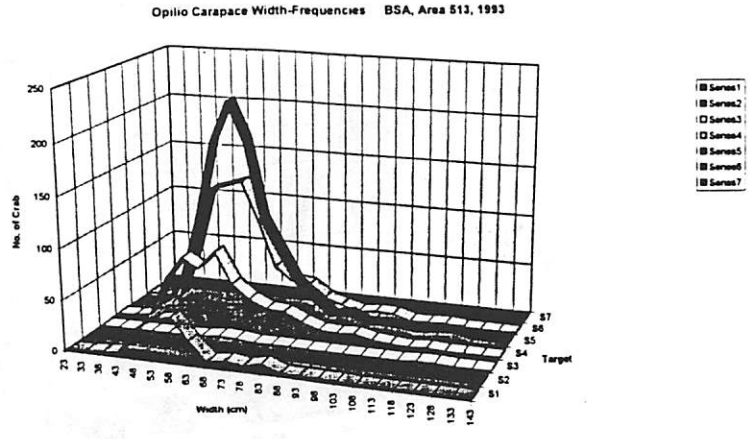
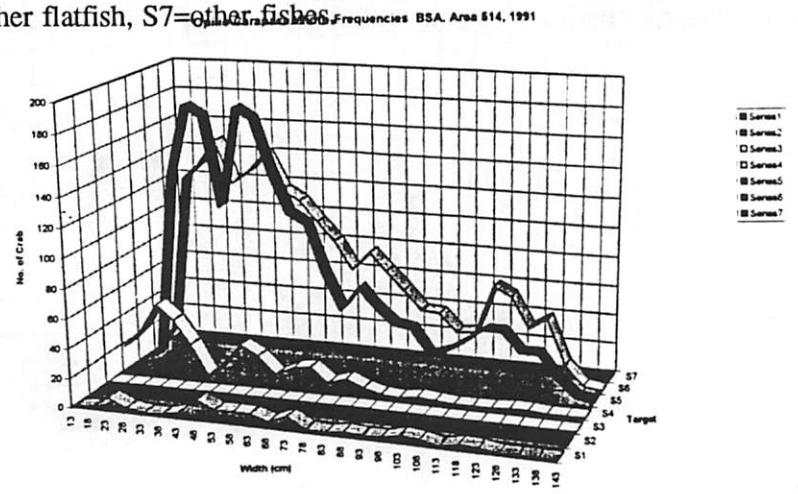
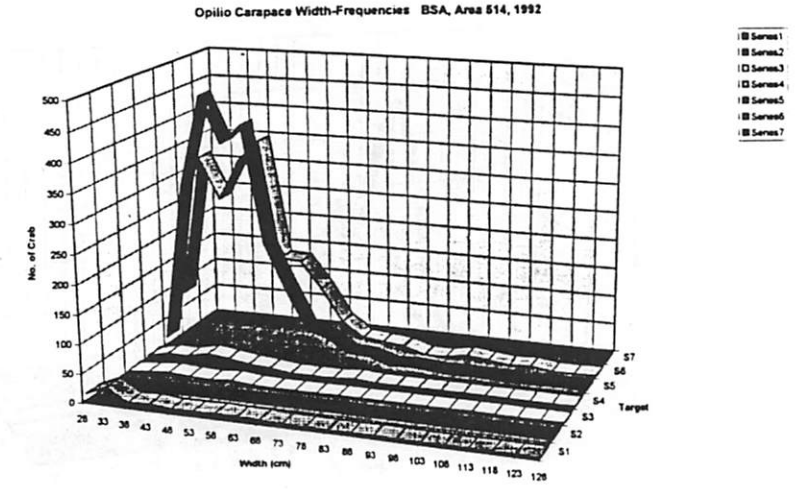


Figure 6. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 514. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.





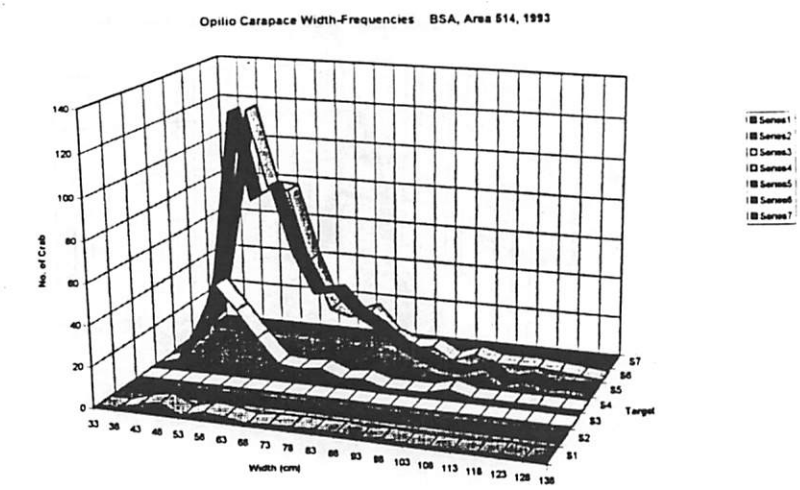


Figure 7. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 517. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.

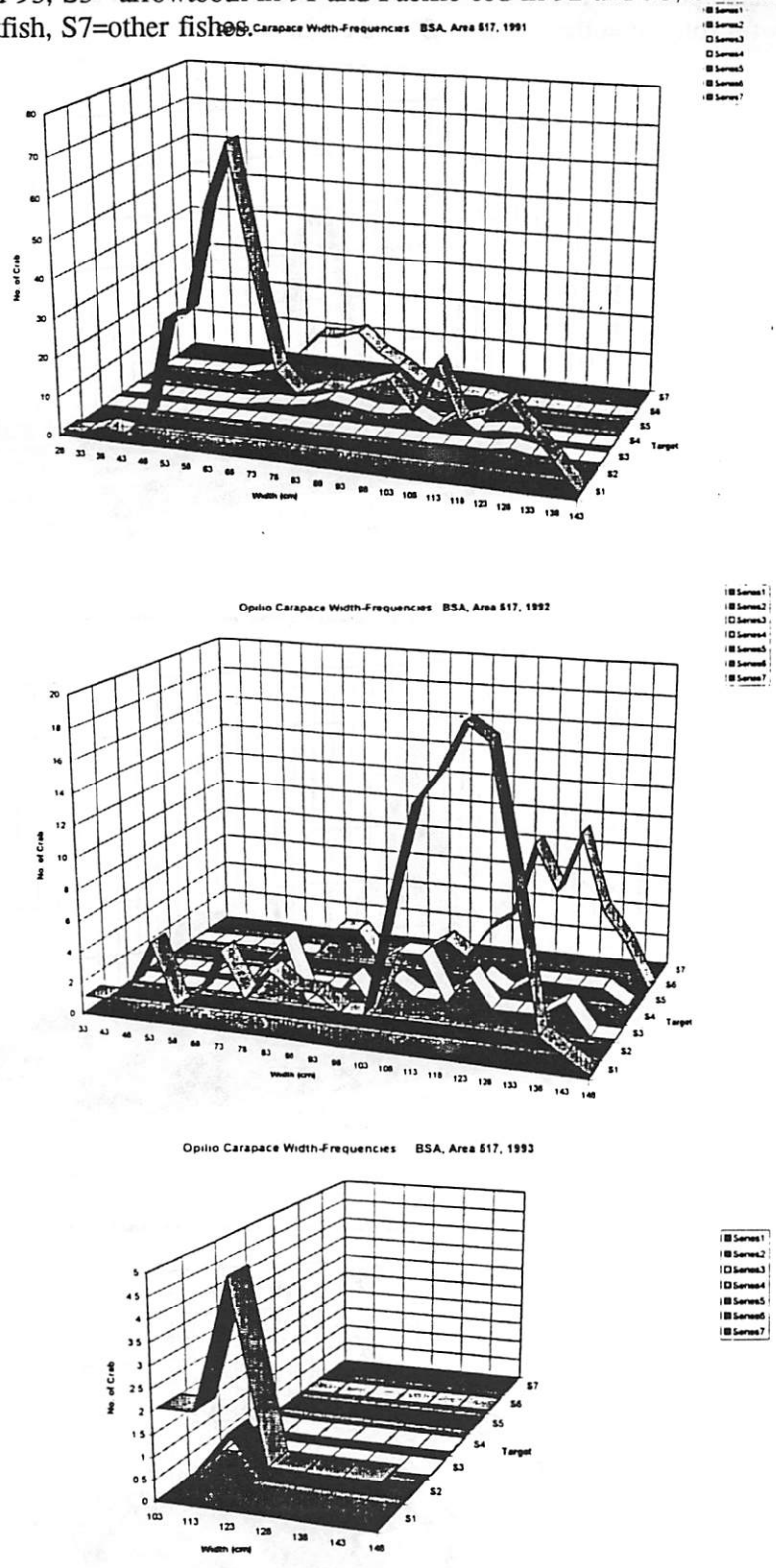
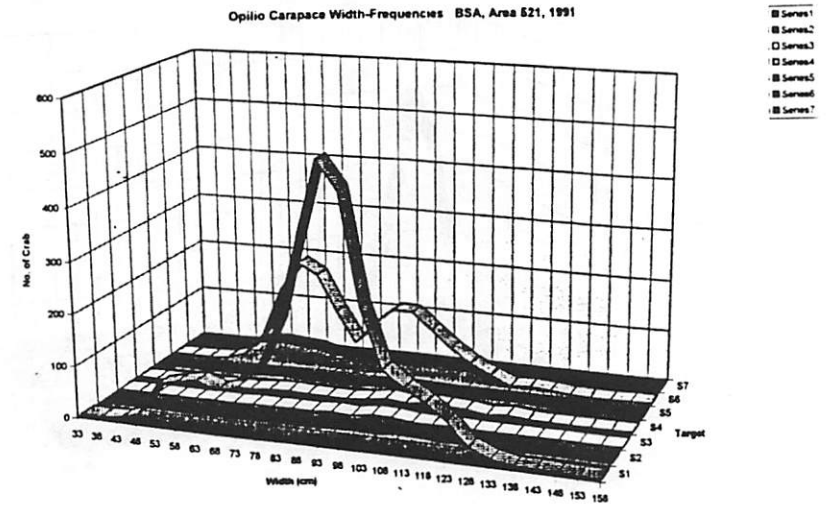
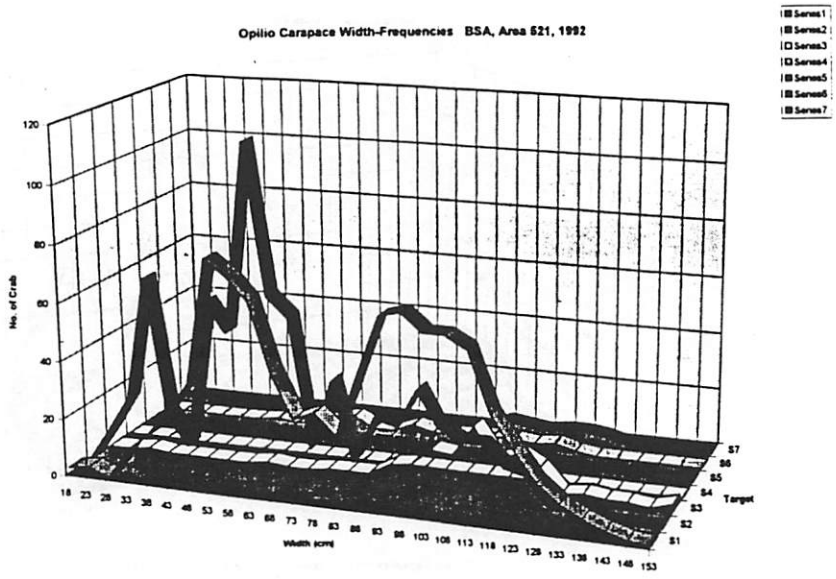


Figure 8. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 521. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.





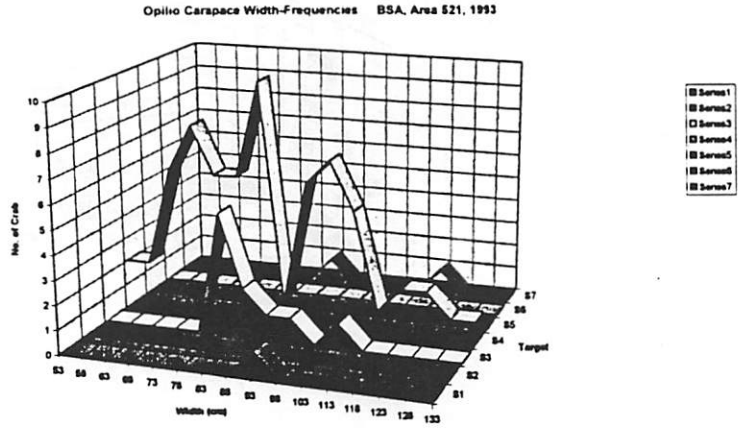


Figure 9. Length Frequencies (carapace width, mm) of snow crab bycatch taken in 1991, 1992, and 1993 trawl fisheries in BSAI Regulatory Area 522. KEY to target fisheries: S1=bottom pollock, S2=turbot in 91 and pelagic pollock in 92 and 93, S3= arrowtooth in 91 and Pacific cod in 92 and 93, S4=rock sole, S5=yellowfin sole, S6=other flatfish, S7=other fishes.