Stock Assessment and Fishery Evaluation Report
for the
KING AND TANNER CRAB FISHERIES
of the
Bering Sea and Aleutian Islands Regions

2003 Crab SAFE

Compiled by

The Plan Team for the King and Tanner Crab Fisheries
of the Bering Sea and Aleutian Islands

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Table of Contents

RESULTS OF THE 2003 NMFS BERING SEA CRAB SURVEY
EXECUTIVE SUMMARY

This document summarizes data presented in the Report to Industry on the 2003 Eastern Bering Sea Trawl Survey. Numbers presented are trawl survey indices of population level and do not necessarily represent absolute abundance. For further information, contact Dr. Lou Rugolo, or Dr. Robert Otto, NMFS, P.O. Box 1638, Kodiak, AK 99615. Phone (907) 841-1700. GHLs (Guideline Harvest Levels) are for the combined open-access and CDQ fisheries. This draft reflects data analysis and management decision making through September 25, 2003

Red king crab (Paralithodes camtschaticus) Bristol Bay.

Legal males:	12.3 million crabs; 30% increase.
Pre-recruits:	6.8 million crabs; 33% decrease.
Large females:	34.0 million crabs; 79% increase.
Synopsis:	Abundance legal males increased substantially while that of pre-recruit males has decreased. This may indicate declining legal male abundance for 2004. Apparent abundance of mature females increased greatly, but this may be more of a reflection of instability in the female estimates than any real increase in stock abundance. High numbers of sub-legal male crab in 2002 evidently produced good recruitment to the 2003 legal stock. Almost all newshell females carried new eggs. Reproductive population estimates well above the minimum stock size threshold (MSST), stock not considered to be in the overfished level of abundance although it remains far below the peak population of the 1970's
GHL:	15.7 million pounds (7,100 metric tons, t). . Fishery opens October 15, 2003.

Red king crab (Paralithodes camtschaticus) Pribilof District.

Legal males:	1.3 million crabs; 26% decrease..
Pre-recruits:	0.1 million crabs; no real change.
Large females:	0.4 million crabs; no real change.
Outlook:	Crabs are highly concentrated, and indices have very low precision. Females in particular, are poorly estimated. Reproductive population estimates are above the MSST, stock not considered to be in the overfished level of abundance No recruitment is apparent. Red king crabs in the Pribilof Islands and usually harvested along with to blue king crabs and are currently the dominant species. Concern that unacceptable levels of blue king crab incidental catch could occur in a red king crab fishery. .
GHL:	Fishery will not open in 2003.

Pribilof Islands blue king crab (P. platypus) Pribilof District.

Legal males:	0.2 million crabs; no real change.
Pre-recruits:	< 0.1 million crabs; no real change.
Large females:	<0.1 million crabs; >100 % decrease.
Outlook:	Population is low and trends are not easily detectable. Little or no

	recruitment is apparent. Reproductive population estimate fell below the MSST in 2002 and remains so in 2003. The stock is now considered to be in the overfished level of abundance. A rebuilding plan has been drafted and will be before the Council in October 2003.
GHL:	Fishery will not open in 2003.

St. Matthew blue king crab (P. platypus) Northern District.

Legal males:	0.6 million crabs; no real change.
Pre-recruits:	0.3 million crabs; 68% increase.
Large females:	0.8 million crabs; 656 % increase. Not well estimated.
Outlook:	Indices are affected by the portion of the stock occupying untrawlable grounds. Population has declined steeply in 1999 and fell below the MSST. Reproductive population estimates continued to be below the MSST through 2002 but rose just above MSST in 2003. The stock has been at the overfished level of abundance for four years but may be showing signs of recovery. The picture is clouded by large uncertainty in female abundance. The abundance of mature males was below the threshold for opening the fishery.
GHL:	Fishery will not open in 2003.

Tanner crab (Chionoecetes bairdi) Eastern District.

Legal males:	7.3 million crabs, 6% increase.
Pre-recruits:	24.7 million crabs; 64% increase.
Large females:	15.1 million crabs; 34% increase.
Outlook:	Population indices increasing but uncertain and not really anticipated from size frequency data in 2001 and 2002. Reproductive population estimate was below the MSST 1997-2002 but just barely above it in 2003. The mature female biomass is still below the threshold value of 21 million pounds.
GHL:	Fishery will not open in 2003.

Snow crab (C. opilio) All districts combined.

Large males:	65.2 million crabs; 14% decrease.
Pre-recruits:	166.5 million crabs; 33% decrease.
Large females:	614.0 million crabs; 23% increase.
Outlook:	Large and pre- recruit males continue to decline while large females increased. The decline in spawner biomass was less severe than indicated by declining male abundance because it was partially offset by the increased female abundance index. Lack of recruitment to female reproductive stock over several years is still evidenced by high frequencies of very old shelled crab, especially at the largest sizes and despite the increase in overall abundance. Small males and females show increased

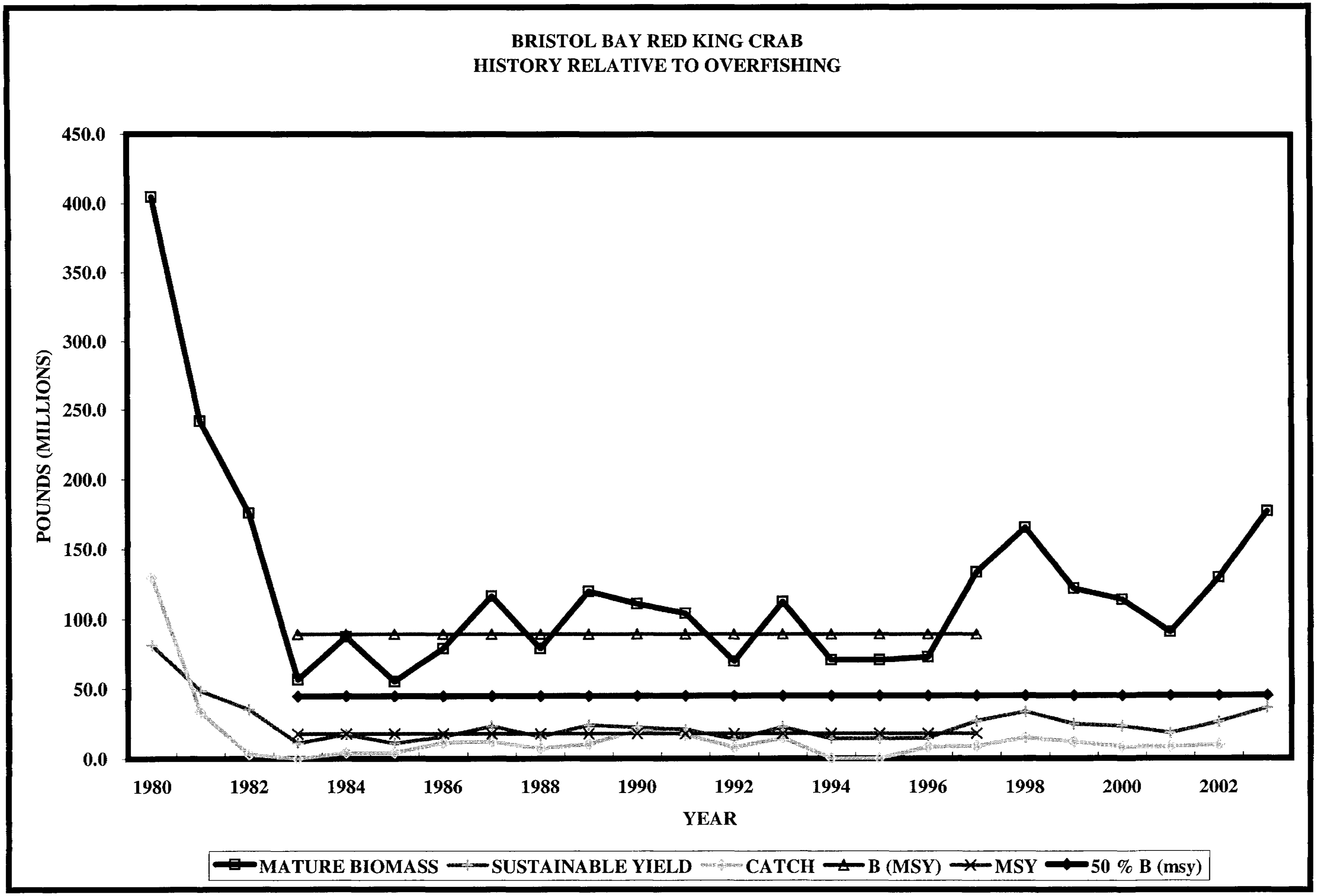
	abundance relative to 2002 but remain well below a 20 year average.. Reproductive population estimates that slightly exceeded MSST in 2001 were well below the MSST in 2002 and 2003. The stock is considered to be in the overfished level of abundance but is above 50% MSST. Under the current rebuilding plan and harvest strategy the fishery would be closed if the stock fell below 50% MSST.
GHL:	20.8 million pounds (9,400 t). Fishery is currently scheduled to open January 15, 2004.

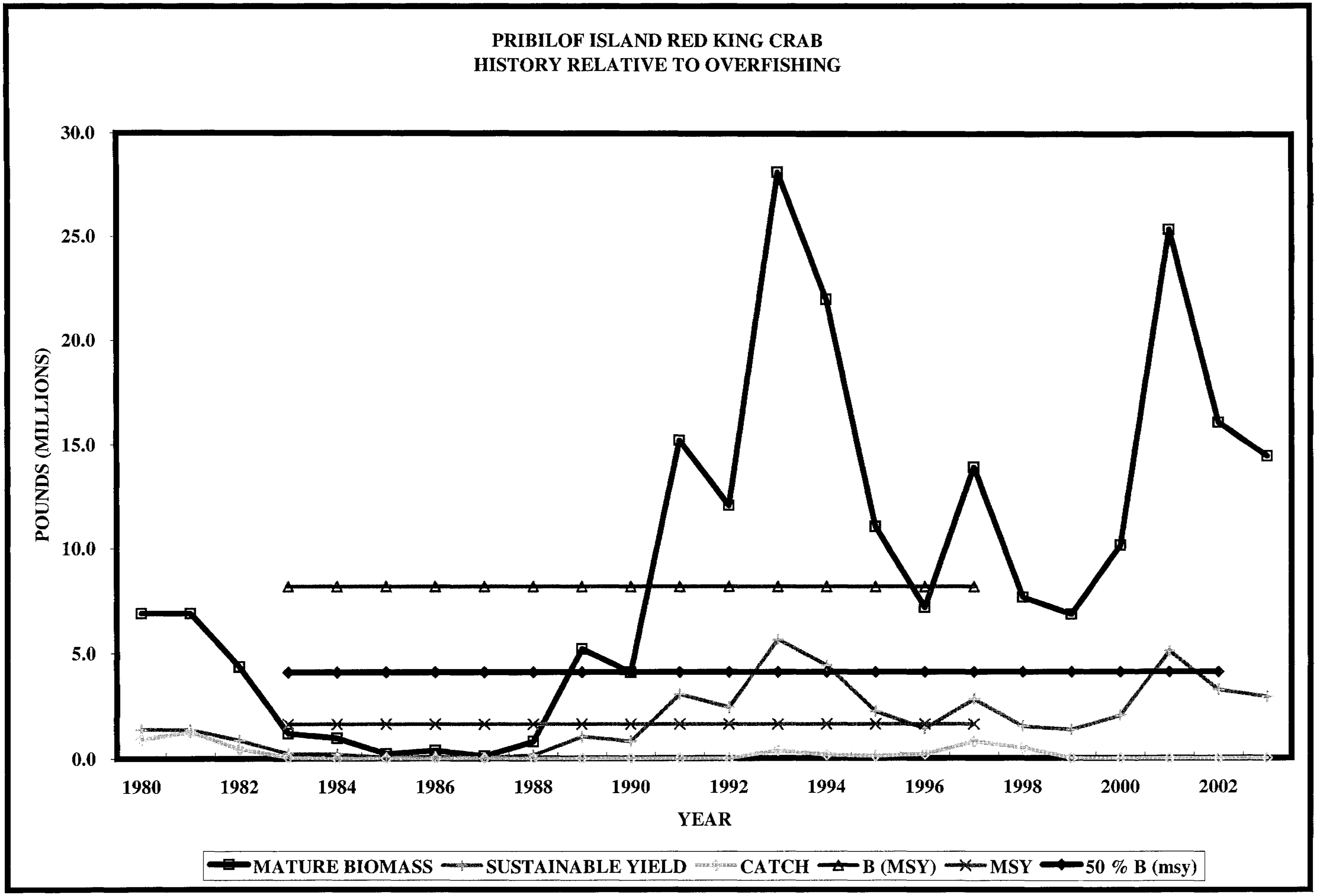
Hair crab (Erimacrus isenbeckii)

Large males:	2.1 million crabs; 52% decrease.
Large females:	0.2 million crabs; 65%decrease .Not well estimated.
Outlook:	Population has been declining for several years. Recruitment trends are unclear due to poor representation of small crabs in survey tows.
GHL:	None has been set at this time

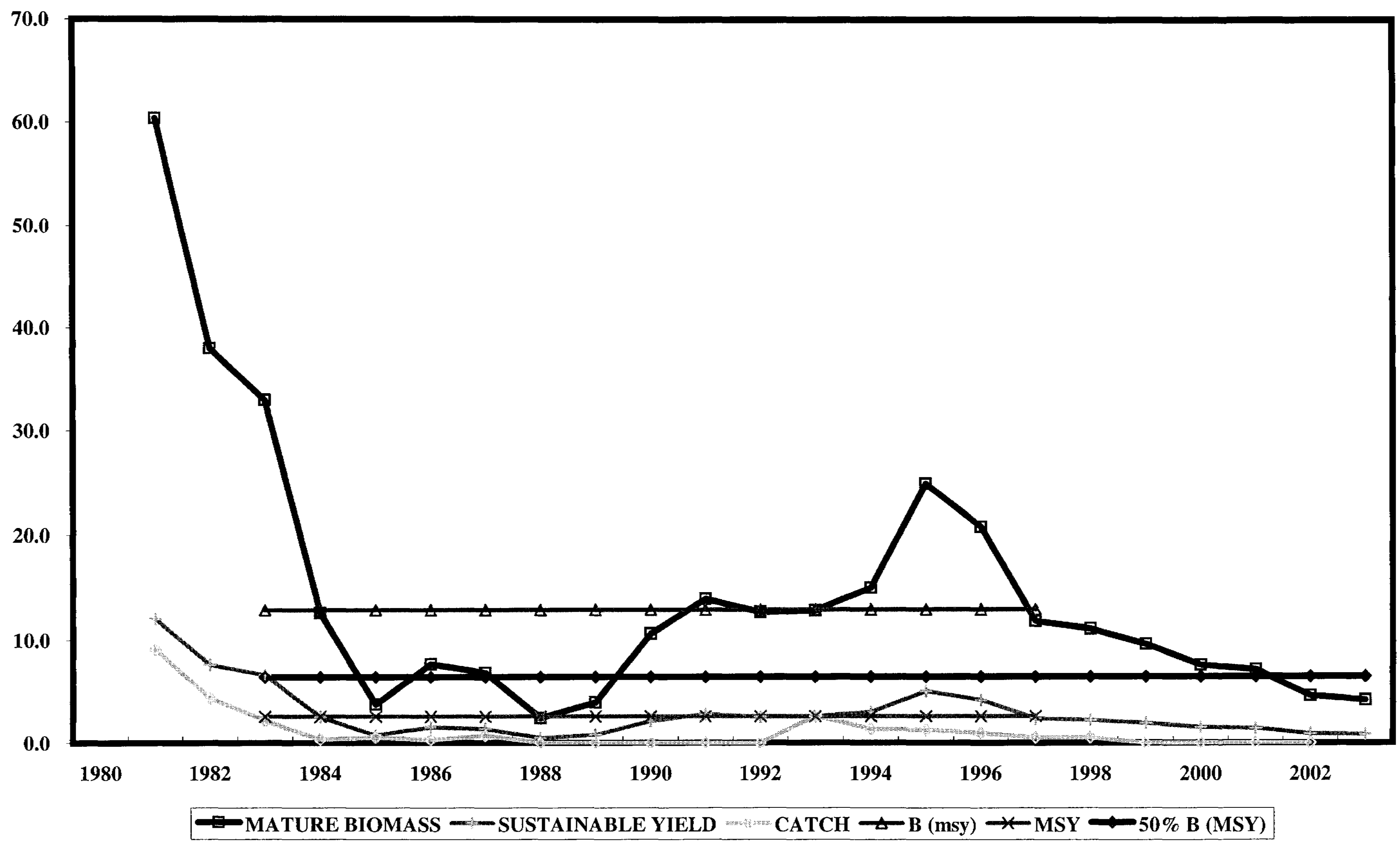
STATUS OF SURVEYED EBS STOCKS RELATIVE TO OVERFISHING FROM THE 2003 EBS SURVEY DATA.

STOCK	MSST	2003 SB	2003 SY	2003/4 GHL	MSST	2003 SB	2003 SY	2003/4 GHL
	-------- MILLIONS OF POUNDS --------				-------- 1000'S OF METRIC TONS --------			
Red King Crab:								
Bristol Bay	44.8	178.1	35.7	15.7	20.3	80.8	16.2	7.1
Pribilof Island	3.3	14.5	2.9	0	1.5	6.6	1.3	0.0
Blue King Crab:								
Pribilof Island	6.6	4.1	0.8	0	3.0	1.9	0.4	0.0
St. Mathhew Island	11	12.8	2.6	0	5.0	5.8	1.2	0.0
EBS Tanner crab	94.8	100.8	30.2	0	43.0	45.7	13.7	0.0
EBS snow crab	40.6	306.2	91.8	20.8	18.4	138.9	41.6	9.4

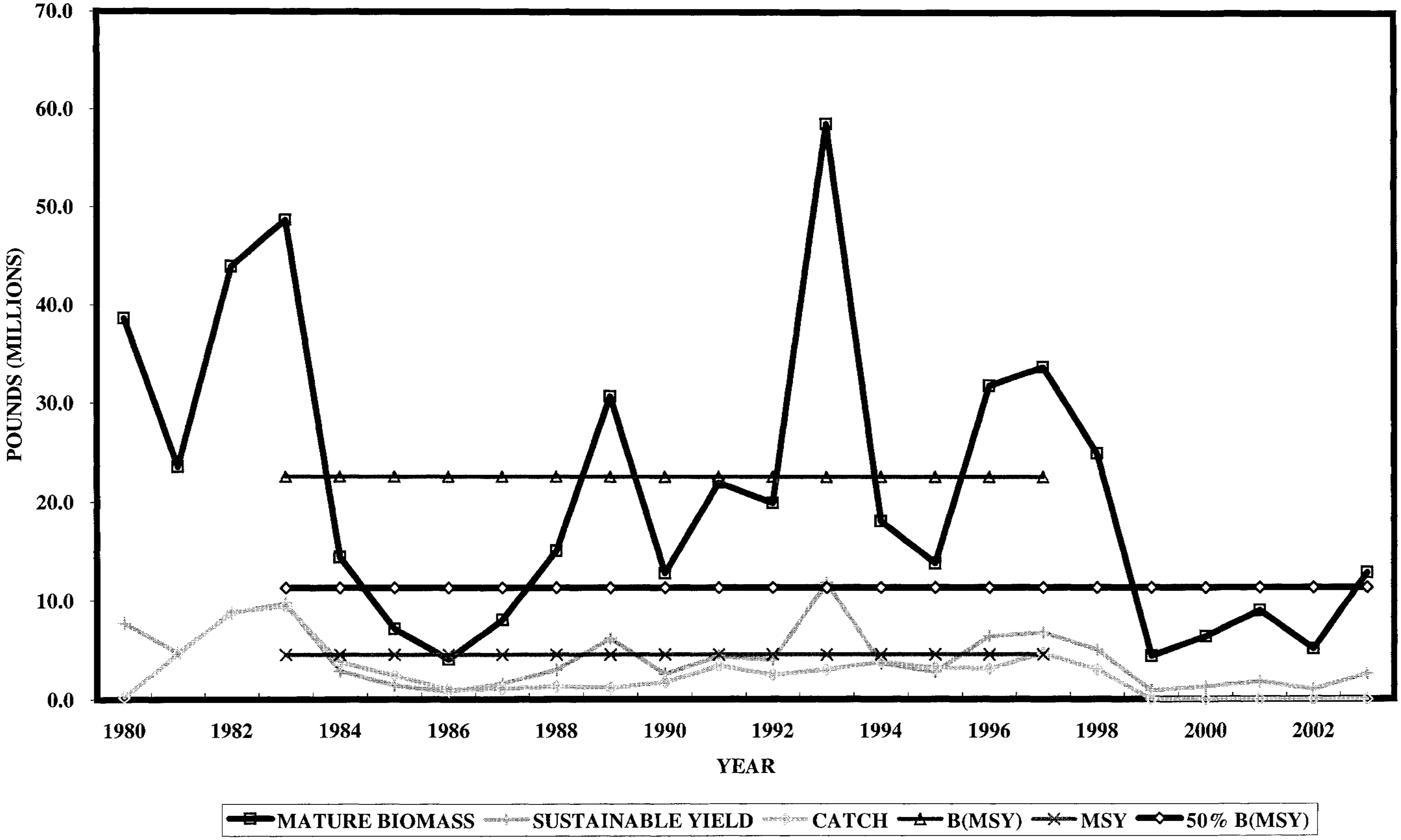

BRISTOL BAY RED KING CRAB
HISTORY RELATIVE TO OVERFISHING
POUNDS (MILLIONS)
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
YEAR
MATURE BIOMASS
SUSTAINABLE YIELD
CATCH
B (MSY)
MSY
50 % B (msy)

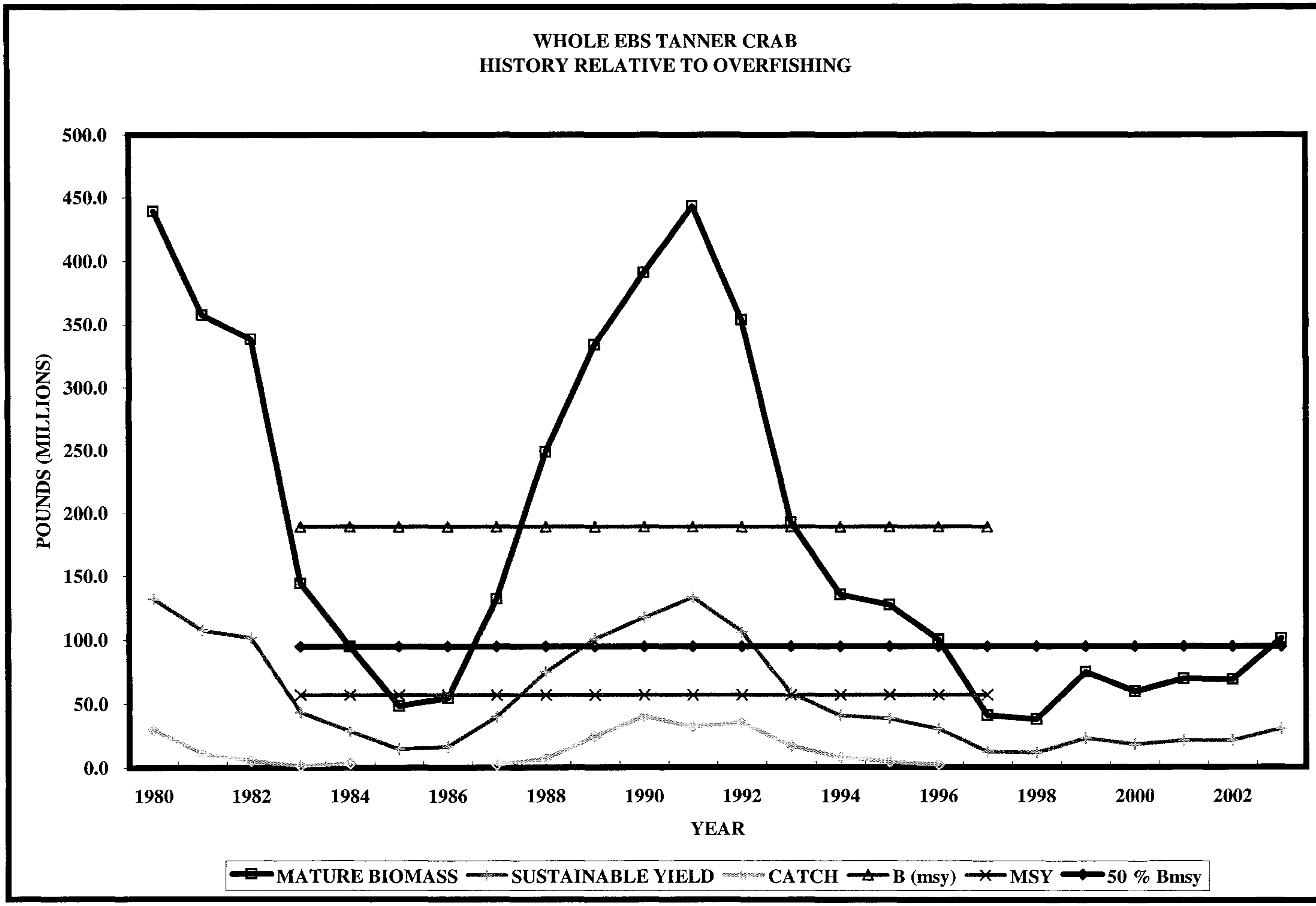

PRIBILOF ISLAND RED KING CRAB
HISTORY RELATIVE TO OVERFISHING
POUNDS (MILLIONS)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
YEAR
MATURE BIOMASS
SUSTAINABLE YIELD
CATCH
B (MSY)
MSY
50 % B (msy)

PRIBILOF ISLANDS BLUE KING CRAB
HISTORY RELATIVE TO OVERFISHING

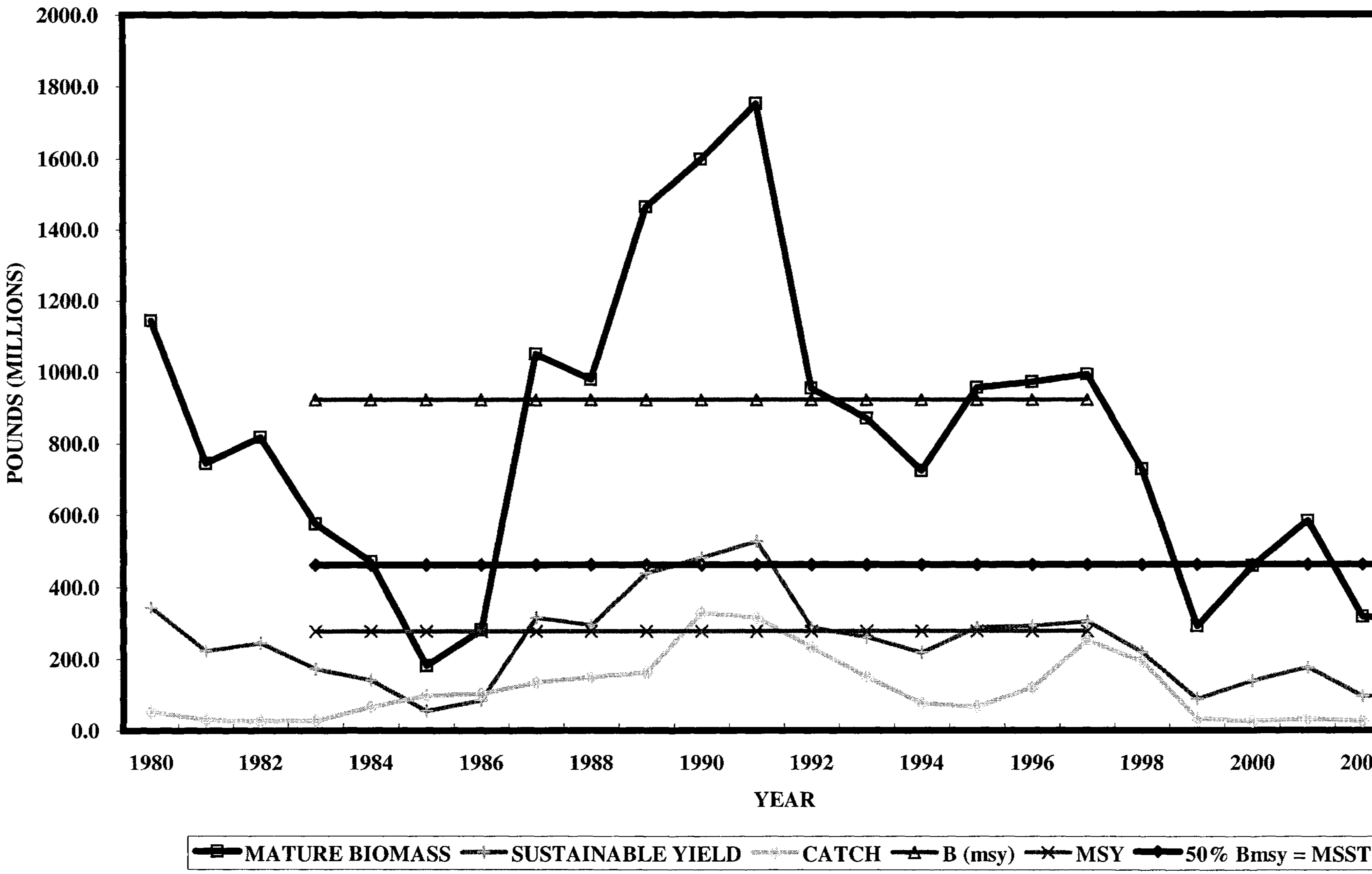


ST. MATTHEW IS. BLUE KING CRAB HISTORY
VS. OVERFISHING DEFINITIONS




WHOLE EBS TANNER CRAB
HISTORY RELATIVE TO OVERFISHING
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
POUNDS (MILLIONS)
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
YEAR
MATURE BIOMASS
SUSTAINABLE YIELD
CATCH
B (msy)
MSY
50 % Bmsy

WHOLE EBS SNOW CRAB
HISTORY RELATIVE TO OVERFISHING



EXECUTIVE SUMMARY:
STATUS OF KING CRAB STOCKS IN THE EASTERN BERING SEA IN 2003

By

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The Alaska Department of Fish and Game (ADF&G) performs stock assessment analyses for the Bristol Bay red king crab *Paralithodes camtschaticus*, Pribilof red king crab, Pribilof blue king crab *P. platypus*, and St. Matthew Island blue king crab stocks using the data provided by the annual National Marine Fisheries Service (NMFS) eastern Bering Sea trawl survey (Stevens et al. 2002), harvest data from the ADF&G fish ticket database, and ADF&G catch-sampling data. Two stock-assessment models developed by ADF&G are used: a length-based analysis (LBA) is used to estimate abundance of male and female Bristol Bay red king crabs and a catch-survey analysis (CSA) is used to estimate abundance of male Pribilof red king crabs, male and female Pribilof blue king crabs, and male St. Matthew Island blue king crabs. Both models differ from area-swept estimates of abundance in that they incorporate multiple years of trawl survey and fishery data to provide abundance estimates for the current survey year and previous survey years. The use of multiple years and sources of data in the LBA and CSA assessment methods results in abundance estimates that are generally more accurate than area-swept estimates based only on the current year's survey data. The LBA and CSA methods and their application to assessment of these stocks are reviewed in Zheng and Kruse (2000).

Bristol Bay red king crab

The LBA estimation procedure provides estimates of abundance of males ≥ 95 mm carapace length (CL), abundance of females ≥ 90 mm CL, new recruitment of males and females to the modeled size classes, and effective spawning biomass (ESB). ESB is the biomass of mature females that the population of mature males can successfully mate in a given year. LBA estimates of small males (95-109 mm CL), prerecruit males (110-134 mm CL), mature males (≥120 mm CL) and legal males (≥135 mm CL), mature females (≥90 mm CL), and ESB for the years 1972-2003 are provided in Table 1. Trends in mature male and female abundance over 1972-2003 and a comparison of LBA and annual area-swept estimates are portrayed graphically in Figure 1. Abundance estimates for males in the 95-109 mm CL, mature and legal-sized males all showed a slight increase in estimated abundance between the 2002 and 2003 surveys. The estimated abundances of mature and legal males for 2003 are 16.368 million and 10.401 million animals, respectively. Estimated abundance of mature-sized females also increased between 2002 and 2003; estimated abundance of mature females is 29.687 million animals in 2003. The estimate of ESB for 2003 is 60.698 million pounds, the highest estimate for the last 20 years.

Pribilof red king crab

The CSA estimation procedure for Pribilof red king crab provides estimates of the annual abundance during 1988-2003 for males in six size classes: Prerecruit 2 (105-119 mm CL), Prerecruit 1 (120-134 mm CL), Mature (≥120 mm CL), Recruit Legal (new-shells 135-149 mm CL), Postrecruit Legal (old-shells ≥135 mm CL and all ≥150 mm CL), and Legal (≥135 mm CL). Annual estimates of abundance for each size class for 1988-2003 are provided in Table 2; a graphical representation of the estimates of mature male abundance relative to area-swept estimates over 1988-2003 is provided in Figure 2. Estimated abundance of mature and legal males for 2003 is 1.545 million and 1.433 million animals, respectively. Point estimates of abundance for mature and legal-sized males show a slight increasing trend since the mid-1990s (Figure 2), but interpretation and reliability of such trends is difficult due to the very low precision of estimates (Table 2).

Pribilof blue king crab

The CSA estimation procedure for Pribilof blue king crabs provides estimates of the annual abundance during 1975-2003 for males in five size classes and females in four size classes (Zheng and Pengilly 2003). The five male size classes for which abundance is estimated are Prerecruit (105-134 mm CL), Mature (≥120 mm CL), Recruit Legal (new-shells 135-148 mm CL), Postrecruit Legal (old-shells ≥135 mm CL and all ≥149 mm CL), and Legal (≥135 mm CL). The four female size classes for which abundance is estimated are Group 1 (100-109 mm CL), Group 2 (110-119 mm CL), Group 3 (120-129 mm CL), and Group 4 (≥130 mm CL). The total of the estimates for the four female size classes provides an estimate of mature female abundance. Annual estimates of abundance for each size class for 1975-2003 are provided in Table 3; a graphical representation of the estimates of mature male and female abundance relative to area-swept estimates over 1975-2003 are provided in Figure 3. Estimated abundance of mature and legal males for 2003 is 0.291 million and 0.276 million animals, respectively. Estimated abundance of mature and legal males, as well as mature females, have shown a declining trend since the mid-1990s (Table 3, Figure 3). Estimated abundance of prerecruit males in 2003 (0.021 million animals) is very low and 0.243 million of the estimated 0.276 million legal males were accounted for by postrecruit males (Table 3).

St. Matthew blue king crab

The CSA estimation procedure for St. Matthew blue king crabs provides estimates of the annual abundance during 1978-2003 for males in five size classes: Prerecruit (90-119 mm CL), Mature (≥105 mm CL), Recruit Legal (new-shells 120-133 mm CL), Postrecruit Legal (old-shells ≥120 mm CL and all ≥134 mm CL), and Legal (≥120 mm CL). The CSA method for St. Matthew blue king crab assumes that natural mortality for the year between the 1998 and 1999 surveys was double that of other years to account for the drastic reduction in stock abundance observed between 1998 and 1999. Annual estimates of abundance for each size class for 1978-2003 are provided in Table 4; a graphical representation of the estimates of mature male abundance relative to area-swept estimates over 1978-2003 is provided in Figure 4. Estimated abundance of mature and legal males for 2003 is 1.326 million and 1.061 million animals, respectively. This stock is showing stability relative to the low stock size observed in 1999, but remains very low relative to the levels of 1991-1998.

Literature Cited

Stevens, B.G., R.A. MacIntosh, J.A. Haaga, C.E. Armistead, and R.S. Otto. 2002. Report to Industry on the 2002 eastern Bering Sea crab survey. U. S. Department of Commerce, National Marine Fisheries Service, Alaska Fisheries Science Center Processed Report 2002-05, Kodiak.

Zheng, J. and G.H. Kruse. 2000. Status of king crab stocks in the eastern Bering Sea in 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J00-09, Juneau.

Zheng, J. and D. Pengilly. 2003. Evaluation of alternative rebuilding strategies for Pribilof Islands blue king crabs. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J03-10, Juneau.

Table 1. Annual abundance estimates (millions of crabs), effective spawning biomass (ESB, millions of pounds), and 95% confidence intervals for 2003 for red king crabs in Bristol Bay estimated by length-based analysis from 1972-2003. Size measurements are mm CL.

	Males					Females		
Year mm→	Recruits (to model)	Small (95-109)	Prerec. (110-134)	Mature (>119)	Legal (>134)	Recruits (to model)	Mature (>89)	ESB (M lbs)
1972	NA	13.625	15.170	18.653	10.080	NA	59.860	55.905
1973	31.453	21.833	26.566	22.710	10.817	33.106	69.884	64.028
1974	21.080	15.482	35.663	34.506	14.851	28.201	71.180	94.753
1975	32.948	22.822	36.714	41.659	20.714	21.973	65.780	116.384
1976	45.195	31.480	46.334	49.450	25.619	34.025	74.533	128.399
1977	52.221	36.731	60.580	62.531	30.461	72.061	117.907	166.596
1978	19.385	15.403	58.729	75.463	39.675	46.935	119.353	199.663
1979	12.400	9.190	36.639	73.166	47.095	19.199	92.657	166.629
1980	24.062	16.517	25.660	58.709	43.540	36.201	93.328	166.161
1981	17.386	12.521	17.145	18.114	9.426	13.904	71.347	58.501
1982	23.080	16.026	16.030	10.090	2.951	17.756	30.155	23.730
1983	13.086	9.651	13.593	8.899	2.475	4.611	9.832	16.485
1984	18.905	13.087	12.917	8.113	2.368	11.685	13.389	16.518
1985	9.261	6.940	10.562	6.885	1.818	5.174	7.486	11.219
1986	6.130	4.632	12.338	11.532	4.304	4.123	9.357	14.887
1987	6.437	4.633	10.923	13.371	6.500	9.804	16.361	25.739
1988	6.099	4.419	9.972	13.985	7.949	5.903	17.350	28.992
1989	4.885	3.598	9.144	15.004	9.382	5.728	17.898	31.170
1990	1.372	1.207	6.948	14.607	9.892	0.926	13.482	25.989
1991	4.063	2.776	4.949	11.650	8.380	3.684	13.165	25.460
1992	5.551	3.906	5.884	9.726	6.648	3.175	12.414	24.281
1993	2.205	2.001	6.726	9.845	5.894	2.128	10.842	21.859
1994	1.039	0.958	5.342	8.485	4.743	0.411	8.026	17.489
1995	2.771	1.973	4.649	9.367	6.173	1.575	9.229	20.350
1996	3.197	2.416	5.209	10.343	7.188	4.340	13.130	27.114
1997	12.389	8.406	8.629	11.777	7.613	15.571	28.059	39.994
1998	2.636	3.049	12.764	15.002	7.942	1.724	28.354	51.325
1999	1.303	1.086	8.438	15.743	9.297	0.640	20.580	44.102
2000	3.678	2.576	6.057	13.129	8.806	4.531	19.008	40.100
2001	8.480	5.960	7.677	12.149	8.034	8.186	21.532	42.178
2002	2.272	2.424	10.038	14.112	8.281	2.506	22.975	47.754
2003	6.456	4.466	9.032	16.368	10.401	7.791	29.687	60.698
				95% Confidence Limits in 2003				
Lower	4.726	NA	6.941	12.506	7.821	6.061	24.215	NA
Upper	10.906	NA	10.944	19.249	12.616	12.172	37.227	NA

Table 2. Annual abundance estimates (millions of crabs) of Pribilof male red king crabs by 4-stage catch-survey analysis (CSA) from 1988-2003 with 95% confidence intervals for 2003. Recruit legals are new-shelled males 135-149-mm CL. All other legal males are postrecruits. Size ranges are in mm CL.

Year	PreRec. II	PreRec I	Mature	Recruit newshell	Post oldshell	Legal
	(105-119)	(120-134)	(≥120)	(135-149)	(≥135)	(≥135)
1988	0.280	0.041	0.062	0.021	0.000	0.021
1989	0.283	0.214	0.279	0.045	0.020	0.065
1990	2.018	0.250	0.462	0.146	0.066	0.212
1991	0.331	1.524	2.016	0.298	0.194	0.492
1992	0.087	0.572	1.986	0.918	0.496	1.414
1993	0.522	0.190	1.766	0.340	1.237	1.577
1994	0.165	0.424	1.601	0.153	1.023	1.177
1995	0.131	0.206	1.356	0.270	0.880	1.150
1996	0.053	0.138	1.170	0.132	0.899	1.031
1997	0.728	0.067	1.021	0.087	0.866	0.954
1998	0.398	0.557	1.392	0.096	0.739	0.835
1999	0.350	0.404	1.464	0.377	0.683	1.060
2000	0.368	0.340	1.547	0.280	0.927	1.207
2001	0.421	0.343	1.635	0.242	1.050	1.292
2002	0.054	0.384	1.755	0.248	1.123	1.371
2003	0.021	0.112	1.545	0.241	1.192	1.433
		95% Confidence Intervals				
Lower	NA	NA	0.709	NA	NA	0.631
Upper	NA	NA	2.381	NA	NA	2.235

Table 3. Annual abundance estimates (millions of crabs) of Pribilof male blue king crabs by 4-stage catch-survey analysis (CSA) from 1975-2002 with 95% confidence intervals for 2003. Recruit legals are new-shelled males 135-148-mm CL. All other legal males are postrecruits, and mature female blue king crabs by 4-stage survey analysis from 1975-2003. Size ranges are in mm CL.

	Males					Females				
Year	PreRec	Mature	Recruit Newshell	Post Rec Oldshell	Legal	Group 1	Group 2	Group 3	Group 4	Mature
mm→	(105-134)	(≥120)	(135-148)	(≥135)	(≥135)	(100-109)	(110-119)	(120-129)	(≥129)	(≥100)
1975	6.021	11.163	3.306	3.888	7.194	1.435	2.297	1.506	0.782	6.021
1976	3.400	10.240	2.795	5.181	7.976	3.357	1.775	1.524	0.779	7.435
1977	3.853	8.120	1.604	5.263	6.867	2.611	2.364	1.426	0.801	7.202
1978	4.554	7.739	1.000	4.448	5.448	1.794	2.212	1.552	0.808	6.366
1979	2.589	7.293	1.615	3.445	5.060	0.950	1.787	1.559	0.820	5.117
1980	1.299	5.274	1.390	3.140	4.530	1.630	1.251	1.427	0.818	5.126
1981	1.000	3.252	0.516	2.159	2.675	0.899	1.300	1.193	0.788	4.180
1982	0.863	1.874	0.417	1.030	1.447	0.509	1.034	1.052	0.726	3.322
1983	0.729	1.351	0.305	0.621	0.926	0.498	0.747	0.896	0.660	2.801
1984	0.418	1.092	0.286	0.480	0.766	0.238	0.601	0.733	0.592	2.164
1985	0.183	0.888	0.204	0.541	0.746	0.120	0.410	0.599	0.526	1.655
1986	0.072	0.643	0.092	0.491	0.583	0.073	0.256	0.472	0.466	1.266
1987	0.027	0.460	0.040	0.400	0.439	0.043	0.154	0.355	0.409	0.962
1988	0.011	0.270	0.016	0.247	0.263	0.047	0.092	0.256	0.353	0.748
1989	1.057	0.202	0.005	0.193	0.198	0.560	0.066	0.180	0.297	1.103
1990	1.453	1.062	0.067	0.145	0.212	0.792	0.324	0.127	0.245	1.488
1991	1.160	1.411	0.589	0.188	0.777	0.859	0.578	0.168	0.200	1.805
1992	1.139	1.566	0.415	0.592	1.006	1.298	0.732	0.267	0.172	2.469
1993	0.943	1.684	0.352	0.756	1.108	0.917	1.044	0.377	0.168	2.506
1994	0.839	1.581	0.333	0.829	1.162	1.693	0.955	0.548	0.183	3.379
1995	0.886	1.526	0.247	0.864	1.111	1.077	1.345	0.622	0.223	3.267
1996	0.717	1.370	0.235	0.692	0.927	0.632	1.176	0.782	0.262	2.852
1997	0.425	1.150	0.238	0.596	0.834	0.371	0.880	0.808	0.308	2.367
1998	0.289	0.894	0.157	0.566	0.724	0.258	0.615	0.730	0.340	1.943
1999	0.198	0.698	0.087	0.482	0.568	0.485	0.434	0.608	0.350	1.876
2000	0.129	0.568	0.063	0.419	0.482	0.319	0.474	0.485	0.340	1.619
2001	0.101	0.453	0.043	0.355	0.398	0.313	0.402	0.421	0.317	1.453
2002	0.057	0.378	0.036	0.293	0.330	0.166	0.361	0.363	0.291	1.182
2003	0.021	0.291	0.032	0.243	0.276	0.112	0.257	0.317	0.264	0.950

95% Confidence Limits in 2003:

Lower	NA	0.159	NA	NA	0.141	NA	NA	NA	NA	0.621
Upper	NA	0.423	NA	NA	0.410	NA	NA	NA	NA	1.280

Table 4. Annual abundance estimates (millions of crabs) and 95% confidence intervals for 2003 of St. Matthew Island male blue king crabs by 4-stage catch-survey analysis (CSA) from 1978-2003. Natural mortality in year 1998/99 was estimated separately from other years. Recruit legals are new-shelled males 120-133 mm CL. All other legal males are postrecruits. Size ranges are in mm CL.

Year	PreRec (90-119)	Mature (≥105)	Recruit Newshell (120-133)	Post oldshell (≥120)	Legal (≥120)
1978	2.810	3.429	1.095	0.541	1.637
1979	3.463	3.649	1.178	0.965	2.143
1980	4.388	5.281	1.120	1.633	2.753
1981	3.549	6.475	1.778	2.149	3.926
1982	2.440	5.521	1.791	2.263	4.055
1983	1.753	4.010	1.106	1.631	2.737
1984	0.955	2.215	0.931	0.610	1.541
1985	0.887	1.421	0.477	0.538	1.015
1986	1.043	1.326	0.303	0.401	0.704
1987	1.246	1.402	0.449	0.384	0.833
1988	1.535	1.768	0.449	0.468	0.917
1989	2.311	2.021	0.651	0.490	1.142
1990	2.914	3.202	0.731	0.704	1.435
1991	2.640	3.683	1.320	0.849	2.169
1992	2.646	3.732	1.142	1.123	2.265
1993	2.719	3.980	1.106	1.341	2.447
1994	2.699	4.108	1.142	1.408	2.551
1995	2.931	3.993	1.146	1.331	2.477
1996	3.223	4.378	1.175	1.403	2.578
1997	2.784	4.703	1.376	1.495	2.871
1998	1.940	4.133	1.330	1.495	2.826
1999	0.608	1.007	0.271	0.468	0.739
2000	0.743	1.208	0.209	0.568	0.777
2001	0.758	1.335	0.316	0.603	0.920
2002	0.619	1.466	0.290	0.709	0.999
2003	0.800	1.326	0.291	0.770	1.061
		95% Confidence Intervals			
Lower	NA	0.821	NA	NA	0.596
Upper	NA	1.831	NA	NA	1.525

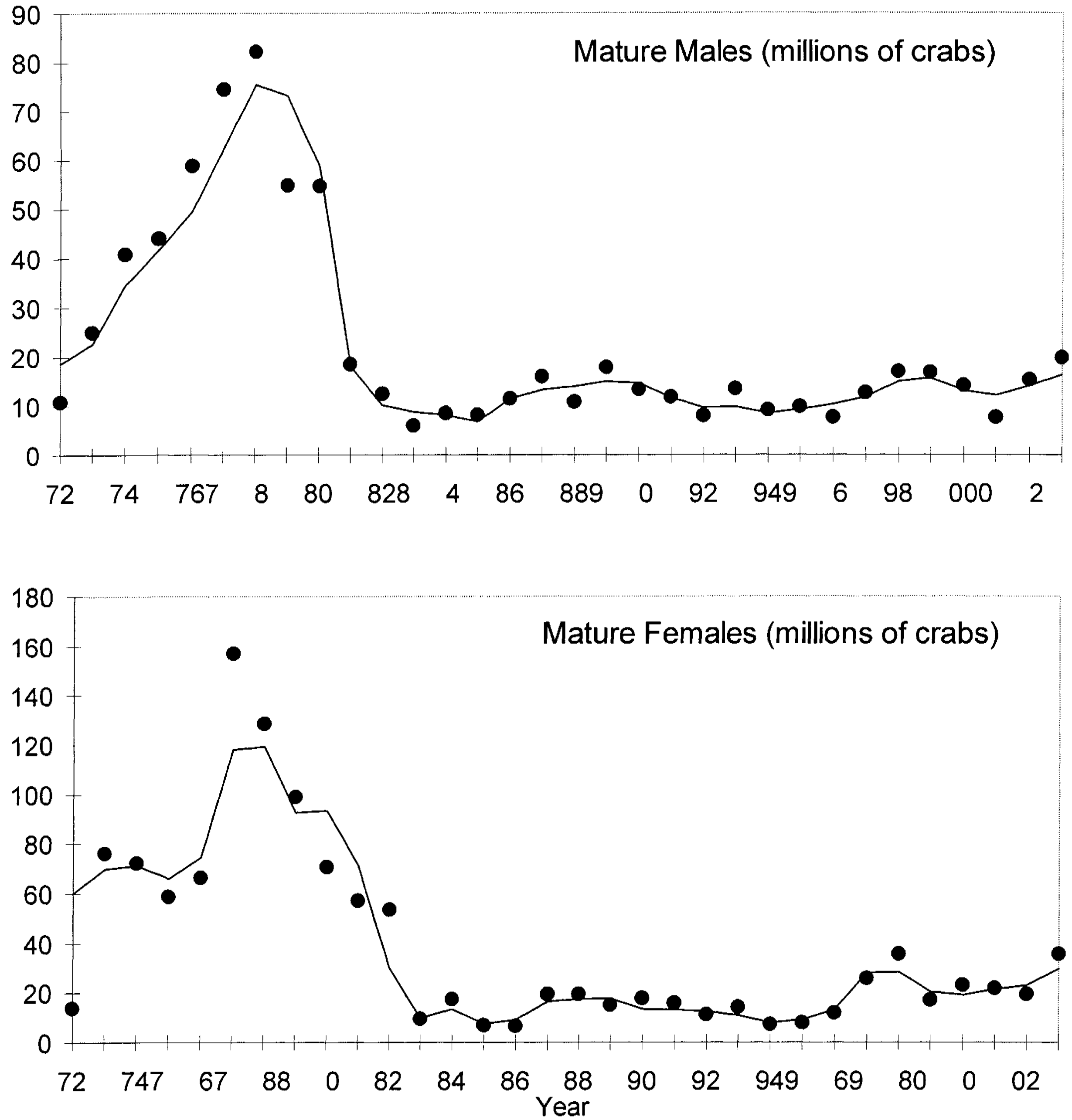

Figure 1. The LBA fit (line) to area-swept estimates (dots) of mature male (top panel) and mature female (bottom panel) Bristol Bay red king crab abundance (millions of crabs), 1972-2003.

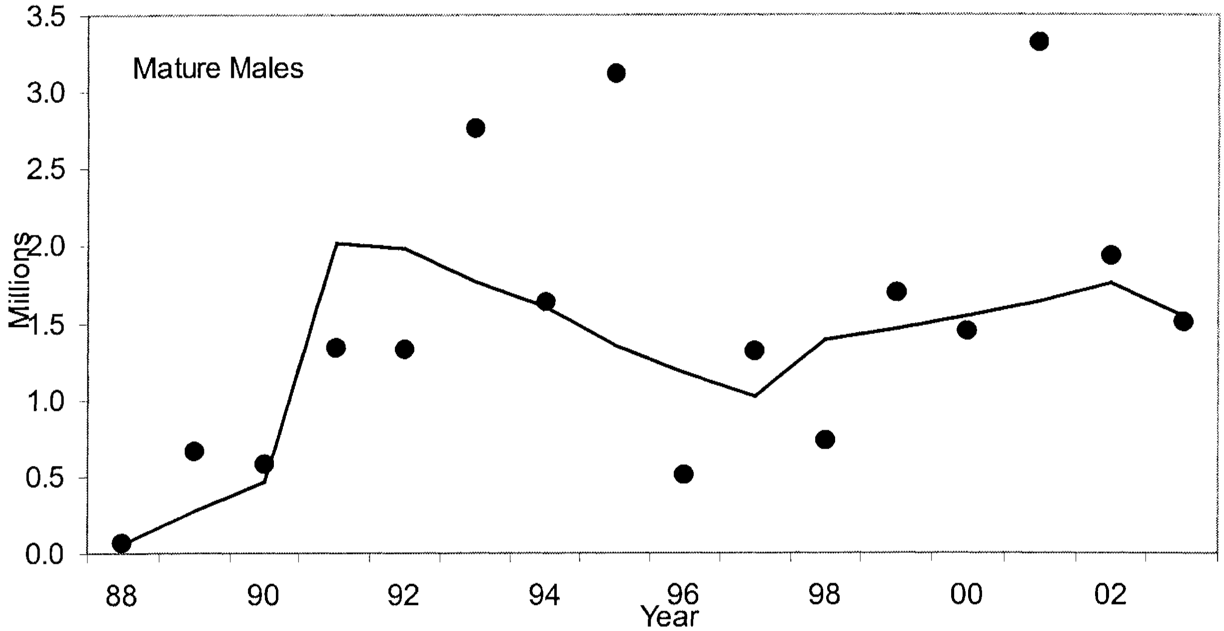

Figure 2. Annual estimates of abundance of mature male Pribilof red king crab. Solid line is the CSA estimate for 1988-2003. Dots are the area-swept estimates for 1978-2003.

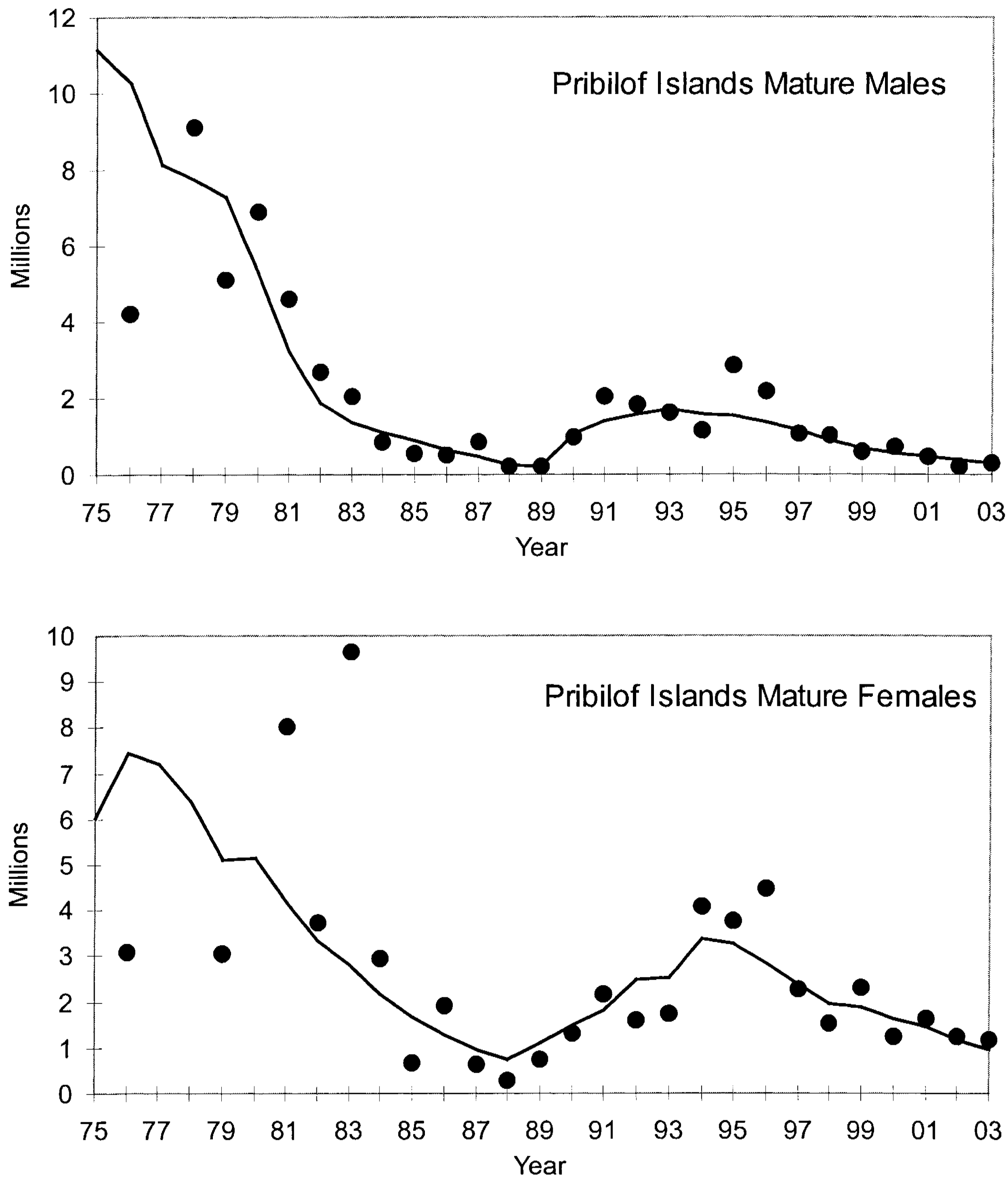

Figure 3. The CSA fit (line) to area-swept estimates (dots) of mature male (top panel) and mature female (bottom panel) Pribilof blue king crab abundance (millions of crabs), 1978-2003.

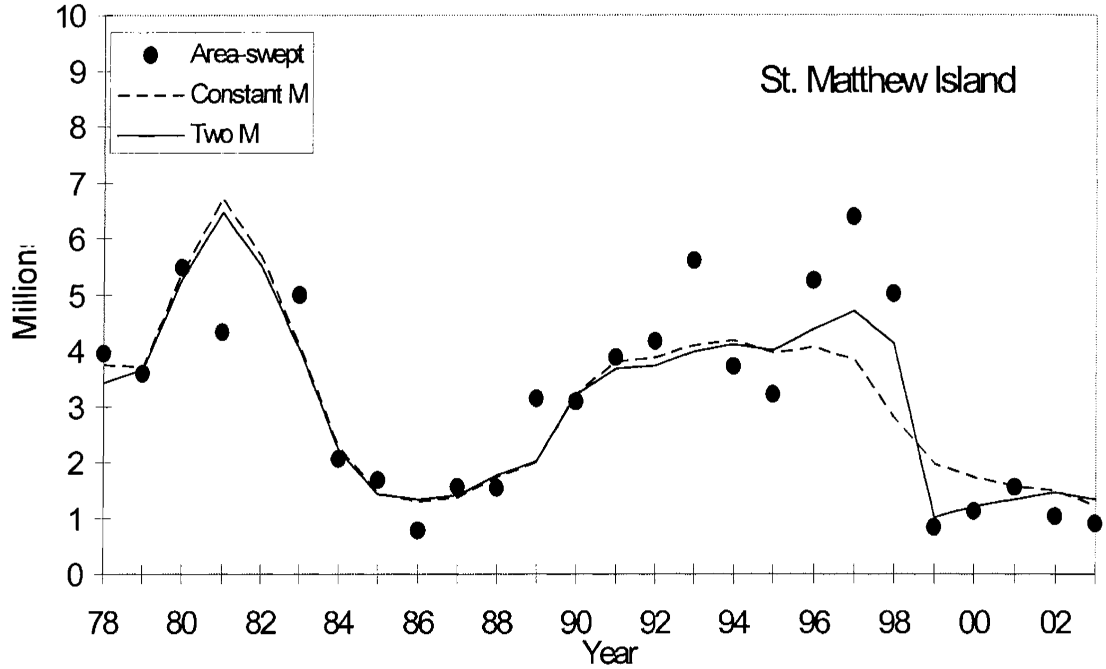

Figure 4. Annual estimates of abundance of mature male St. Matthew Island blue king crab for 1978-2003. Dashed line is the "two-m" catch-survey analysis (CSA) estimate that allows for increased natural mortality between 1998 and 1999. Solid line is the CSA estimate with constant natural mortality. Dots are the area-swept estimates. GHL computations for 2003 use the "two-m" CSA estimate.

DRAFT

CONSIDERATIONS FOR REDEFINING CRAB 'OVERFISHING' AND 'OVERFISHED' THRESHOLDS BASED ON THE PER-RECRUIT SIMULATION STUDIES ON TWO RELATIVELY DATA RICH STOCKS: BRISTOL BAY RED KING CRAB AND BERING SEA SNOW CRAB

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SUMMARY

Size-based per-recruit simulation analyses were carried out using crab specific stock parameters to determine overfishing threshold harvest rates and overfished threshold biomass ratio. The size-based approach incorporated stochastic Beverton-Holt and Ricker stock-recruit models for various biological and fisheries parametric values. Plausible point and a range of values relating to the steepness of the stock-recruit curve near the origin were considered to determine reference points. The threshold and target harvest rates were determined at 100% and 75% of the F_{MSY}, respectively. The threshold total mature biomass ratio was used to estimate the minimum spawning stock biomass. The Bristol Bay red king crab and the Bering Sea snow crab stock parameters were used to estimate the threshold and target reference points. The probability of recruitment failure under target harvest rate was also investigated. Reliable estimates of a number of life history parameters are lacking for both

stocks and further research is needed to fill the gap. Procedures to determine MSY harvest rate and minimum stock size thresholds for king and Tanner crab stocks based on these two stock analyses were suggested.

INTRODUCTION

A length-based per-recruit simulation method to redefine "overfishing" and "overfished" thresholds for BSAI crab stocks has been developed (Siddeek 2002, 2003; Siddeek et al. unpublished). Siddeek used the Mace's (1994) approach in these simulation analyses and estimated threshold harvest rate, $E(F_{MSY})$, effective spawning biomass ratio, $ESB(F_{MSY})/ESB(0)$, and total mature biomass ratio, $SSB(F_{MSY})/SSB(0)$. The threshold harvest rate could be used as the "overfishing" level while the threshold total mature biomass ratio could be used to calculate MSST as the "overfished" status. Siddeek's 2002 report details the evolution of crab 'overfishing' and "overfished' definitions and set the stage for redefining these thresholds. But the analytical procedure in that report assumed a number of simplifications - size invariant fishing and handling mortality, deterministic recruitment – and estimated the threshold harvest rate of legal sized crabs at the time of fishing, whereas actual guideline harvest level (GHL) is determined at the survey time using harvest rate applied to mature male crab abundance. Siddeek's 2003 report is the refinement on the previous report adding the pot size selectivity to fishing mortality. In this report, a further modification was done with selectivity of retained and discarded catches included in the analysis. Furthermore, recruitment failure under suggested target harvest rate as a result of depensation (Allee effect) was also evaluated. The Bristol Bay red king crab and Bering Sea snow crab stock parameters (Zheng et al. 1995a, b; Zheng 2003a, b; Turnock 2003) were used in estimating target and threshold values to redefine crab "overfishing" and "overfished" definitions.

CURRENT MANAGEMENT STRATEGY

The management of fisheries in the U.S. exclusive economic zone is based on the Magnuson-Stevens Fishery Conservation and Management Act, which mandates precautionary management to attain near MSY-producing stock and exploitation levels on a long-term basis. The stock status determination criteria are definitions of overfishing (on F scale) and overfished conditions (on B scale) intended for use by the councils and the National Marine Fisheries Service to monitor stock condition. If F exceeds the overfishing level, then the stock is declared to be subject to overfishing, and if the stock declines below the overfished biomass level, then the stock is declared overfished, and management actions in the form of reducing F or rebuilding plans must be implemented (Restrepo et al. 1998).

The U.S. federal government through the North Pacific Fishery Management Council (NPFMC), and the State of Alaska jointly manages the Bering Sea and Aleutian Islands (BSAI) crab stocks, whereas the State of Alaska solely manages the Gulf of Alaska and Southeast Alaska crab stocks. For the BSAI crab stocks, the NPFMC (1999) defines the overfishing level by a constant fishing mortality MSY-Control Rule equating F_{MSY} to M. Because of the lack of plausible M estimates for each crab stock, an M of 0.2 for king crab and 0.3 for the *Chionoecetes* species group has been adopted. The M estimate was derived using Hoenig's (1983) formula relating M to longevity. The NPFMC defines the "overfished" status by the minimum stock size threshold (MSST), which is equal to half of the MSY stock size. The MSY stock size is estimated as the average total mature stock biomass observed over the 15-year period from 1983 to 1997, which is regarded as ecologically stable.

In addition to federal management regulations, the Alaska Department of Fish and Game (ADF&G) has developed harvest strategies for king and Tanner crab stocks in selected fisheries of the Bering Sea and Gulf of Alaska. The harvest strategies aim at keeping sufficient spawning biomass for stock productivity by controlling the removal of mature males. Harvest rate and GHL are determined for each exploitable portion of a stock, and threshold stock size level (mainly of mature portion) and threshold GHL for a few stocks are also estimated for assessing stock viability and manageability under continued fishing. The BSAI crab fishery is managed by sex (male-only), size, and season restrictions with a GHL determined from mature male stock abundance. In addition, fishery performance within a season is monitored, and if the fishery is expected to exceed the GHL before the declared closure date, then the season is ended by an ADF&G Commissioner's emergency order. Single-sex harvest has been in effect since the late 1940s to protect mature females for reproduction. Specific fishing seasons are set to avoid harvesting crab during mating and molting (soft-shell) periods. To avoid overharvest of legal males within the GHL, a maximum harvest of 60% of the estimated abundance of exploitable legal male king crabs (and 58% for snow crab) is enforced (Pengilly and Schmidt 1995). Incidental mortality of crabs in other fisheries (trawl, pot, and dredge) is reduced by enforcing maximum allowable crab bycatch thresholds, which is calculated as a percentage (of the crab abundance) in those fisheries and closed areas (NPFMC 2001).

This report is restricted to the analysis of Federal crab harvest management threshold definitions (NPFMC 1999) using two data rich BSAI crab stocks: Bristol Bay red king crab and Bering Sea snow crab.

ESTIMATION OF "OVERFISHING" AND "OVERFISHED" THRESHOLDS AND TARGET HARVEST RATE

Materials and Methods:

The notations used are defined in Appendix A.

Bristol Bay Red King Crab:

To initiate the reference point estimation procedure, the initial sex ratio was set at 1:1 (male:female) and 1000 crabs were assigned to each sex. The subsequent number of progeny (i.e., total prerecruit1 males and class1 females) produced by spawners (through a stock-recruitment (S-R) model) was equally divided between new shell immature and mature components of each sex. The number of prerecruit1 male crabs was distributed within each 5 mm interval of the 95-129 mm CL range by the gamma probability model with a mean and a beta parameter (Table 1). The number of class1 female crabs was also distributed within each 5 mm interval of the 90-119 mm CL range using the gamma probability model with a mean and a beta parameter (Table 1). The subsequent growth increment of both sexes at each molt was calculated using a gamma probability model with size specific means and constant betas (Table 1) to determine proportion of crabs falling into each size bin as a result of growth. Plausible cohort life span, which depends on the M value (I assumed a 3% survival by end of cohort's life), was determined for each sex for standardization of per-recruit analysis.

Bering Sea Snow Crab:

To initiate the reference point estimation procedure, the initial sex ratio was set at 1:2 (male:female) and 500 crabs were assigned to prerecruit1 males and 1000 crabs to class1 females. With the likelihood of terminal molt at maturity of males in the Bering Sea (see Turnock, 2003), the number of male crabs falling into the prerecruit1 size category would be much lower than that of females falling into its class1 size group (Bernard Sainte-Marie, DFO, Canada, personal information; Siddeek et al. unpublished) (Table 5). The subsequent number of progeny (i.e., total prerecruit1 males and class1 females) produced by spawners (through a S-R model) was equally divided between new shell immature and mature components of each sex. The number of prerecruit1 male crabs was distributed within each 5 mm interval of the 72-101 mm CW range by the normal probability model with a mean (mid value of the prerecruit1 size range) and a standard deviation (prerecruit1 size range / 6) (Table 5). The number of class1 female crabs was also distributed within each 5 mm interval of the 50-59 mm CW range using the normal probability model with a mean and standard deviation estimated similarly (Table 5). Normal probability model was used for snow crab recruit distributions because appropriate beta parameters were not available for this size range. The subsequent growth increment of both sexes at each molt was calculated using a gamma probability model with size specific mean and constant beta values (Table 5) to determine proportion of crabs falling into each size bin as a result of growth. Plausible cohort life span, which depends on the M value, was determined for each sex for standardization of per-recruit analysis.

Simulation Procedure:

The simulations considered fixed natural mortality (M), handling mortality (h), and mating ratio values, a randomly variable S-R steepness parameter (τ), a molt probability model in addition to the growth increment model, a maturity probability model, retained and discarded catch size selectivity (in the pot fishery) models, a fixed bycatch (BYM), a fixed fishing period (δ), a fixed survey to fishing period (T), and a sex specific weight-length relationship. Two types of simulations were performed:

First, initial number of crabs (prerecruit1 males and class1 females) were generated from a stochastic form of the Beverton-Holt stock–recruitment (S-R) and Ricker S-R models with a plausible set of overall recruitment variation (σ^2) and autocorrelation (ρ) to simulate a 100-year fishing history at different F levels for a plausible single τ value. The mean yield at each F was determined from which the F_{MSY} and related reference points were estimated. The F_{MSY} was the F that produced the highest mean yield. The point estimate of $E(F_{MSY})$, and mean and standard deviation of $ESB(F_{MSY})/ESB(0)$, and $SSB(F_{MSY})/SSB(0)$, were determined for the 100 year fishery period. The sensitivity of reference points to changes in values of M, h, mating ratio, and type of spawner participant (female or combined sexes as the variable in the S-R model) were investigated using these point estimate and mean values.

Second, 200 τ values were randomly selected from 0.05-0.5 to generate 200 S-R curves of Beverton-Holt and Ricker types, estimated recruits by the S-R curves, perturbed the estimated recruits similarly as before, and reference points were estimated following the same procedure described previously. In addition, the 2.5% and 97.5% percentiles, mean, and standard deviation of reference points were estimated from 200 different S-R curves.

Individual reference point values were also investigated at fixed τ, M, and mating ratio values to select precautionary reference points. Simulations were performed using Fortran 6.6 with IMSL library routines. The derivation of simulation formulas are explained in Siddeek (2003) and Siddeek et al. (unpublished) and important formulas are provided in Appendix B

RESULTS

Bristol Bay Red King Crab:

Table 2 provides different sets of M values considered for the red king crab per-recruit analysis. An M of 0.2 for males and 0.35 for females were recently used by Zheng (2003a) for the same size categories considered in the present analysis. Fig.1 depicts the distribution of mature crab threshold harvest rate for 200 randomly selected τ values for these M values under intermediate molt probability level (Zheng 1995b). The distribution is skewed to the right with a mode around 0.15. The 2.5 – 97.5 percentile interval of mature crab threshold harvest rate was 0.07–0.24 with a mean of 0.14 (standard deviation, ±0.05) and 0.08-0.26 with a mean of 0.15 (±0.05) for more probable set of M values: male M = 0.2, female M = 0.35 (Zheng 2003a), and male M = 0.23, female M = 0.47 (Zheng et al. 1995b), respectively (Table 3).

Mature male threshold harvest rate levels were slightly higher under the low molt probability level than under the high molt probability level. The trends in threshold harvest rates of retained catch and mature males were similar. Hence, among the harvest rates, only mature male threshold harvest rate estimated under an intermediate molt probability level is discussed here. For a set of M of 0.2 (male) and 0.35 (female), as the mating ratio increased from 1:1 to 1:3, the mature male threshold harvest rate increased from 0.12 to 0.16, mean $ESB(F_{MSY})/ESB(0)$ ratio increased from 0.49 to 0.62, but mean $SSB(F_{MSY})/SSB(0)$ ratio decreased from 0.63 to 0.56 (Table 4). When only females were considered as spawners, the mature male threshold harvest rate slightly increased from 0.14 to 0.15 at the plausible mating ratio 1:2. As the handling mortality was increased from 0% to 50% the mature male harvest rate was reduced from 0.15 to 0.13 for the same set of M. There were very slight changes in the threshold mean nominal total mature biomass ratio for the above changes in parameters (Table 4). Reducing M to 0.2 slightly increased the mature male harvest rate (0.14 to 0.15) and reduced the effective total spawning biomass ratio (0.56 to 0.47), but increased the total mature biomass ratio (0.59 to 0.66). Increasing M to 0.23 (male) and 0.47 (female) had the opposite effect (Table 4). Among all scenarios, high mean yields were obtained for higher mating ratio, female only spawners, and low M (Table 4), but the standard deviations were high (nearly 100% of the mean).

Fig. 2. depicts the observed 25-year recruit abundances from LBA analysis (Zheng 2003a) fitted to a portion of the 100-year simulated initial abundances. The simulated abundances were generated using a harvest rate corresponding to 75%F_{MSY}. The best fitting region was chosen by a minimization procedure. Although the units are different the trend is comparable in the chosen part of the 100-year fishery. The ESB trends with an 8 year time-lag was also comparable (Fig. 3).

Bering Sea Snow Crab:

Table 6 provides the set of M values considered for the snow crab per-recruit simulations. Turnock (2003) used an M of 0.3 among a series of M values for the base model fitting. I have chosen this value and a set of M = 0.3 for immature and 0.5 for mature crabs, as the most probable M for reference point estimation. The latter set was also considered because of evidences emerging in support of terminal molt at maturity of both sexes. Turnock established a Beverton-Holt S-R model for the snow crab, but I used both the Beverton-Holt and Ricker models with variable τ values to investigate the trend in reference points under different S-R curves.

Fig. 4 depicts the distribution of mature male crab threshold harvest rate for 200 randomly selected τ values for the above two sets of M values for the two types of S-R models. The distributions under a single M value of 0.3 were narrower than those under separate M values for immature and mature crabs. The Beverton-Holt S-R relationship provided lower values of reference points than those of Ricker (Table 7). The 2.5 – 97.5 percentile interval of mature male threshold harvest rates were 0.05–0.12 and 0.07-0.19 with means of 0.09 (±0.02) and 0.14 (±0.04), respectively, for a single M value of 0.3 and a set of M values of 0.3 for immature crab and 0.5 for mature crab under Beverton-Holt S-R model. The 2.5 – 97.5 percentile interval of mature male threshold harvest rates under the Ricker S-R model were 0.05–0.15 and 0.10-0.23 with means of 0.10 (±0.03) and 0.16 (±0.05), respectively for the two sets of M values.

Table 8 provides the trends in reference points for various scenarios of snow crab stock parameters. The trends in reference points were similar to those described under red king crab. Non-terminal molt hypothesis was also considered in this Table. The retained catch threshold harvest rate was higher, but the mature male threshold harvest rate was lower under terminal molt assumption than those under the non-terminal molt hypothesis. Siddeek et al. (unpublished) considered a variable mating ratio to estimate effective spawning biomass for the Bering Sea and Canadian snow crab stocks. Under this scenario, the mating ratio (male:female) for primiparous prerecuit1 crab was 1:4, primiparous postrecruit crab was 1:9, multiparous prerecruit1 crab was 1:3 and multiparous postrecruit crab was 1:6. (Bernard Sainte-Marie, DFO, Canada, personal communication). This set of mating ratio produced a slightly higher threshold harvest rate than those obtained under a constant 1:3 ratio for the same M (Table 8).

Fig 5. shows the observed 25-year total mature biomasses from the length-based analysis (Turnock 2003) fitted to a portion of the 100-year simulated total mature biomasses. The total mature biomasses were simulated using a harvest rate corresponding to 75% F_{MSY}. The fitting region was chosen by a minimization procedure. The fitting was not as good as that of the red king crab. There are a number of reasons for the lack of fit: (a) Simulated biomasses were created with a constant equilibrium target harvest rate whereas the actual biomasses may have fluctuated due to variable fishing mortality over the years (this is applicable to the red king crab data as well). (b) The τ estimate, similar to that of the red king crab, was arbitrarily chosen due to absence of an established stock-recruitment model. (c) Different size ranges have been considered in the two analyses for total mature crab abundance estimation.

Since the S-R relationship has not been established for the snow crab stock at the time of this analysis, variable τ values within a plausible range were considered for determining mature male crab threshold harvest rate and threshold total mature biomass ratio under Ricker spawner-recruit relationship with a mating ratio of 1:3 and a variable mating ratio for different sets of M values (Table 9). At a middle τ value of 0.25, the threshold harvest rate ranged from 0.08 to 0.18 and the mean threshold total mature biomass ranged from 0.56 to 0.63.

DISCUSSION

The Ricker stock-recruitment model has been established for the Bristol Bay red king crab (Zheng et al. 1995b). Turnock (2003) fitted a Beverton-Holt S-R model to Bering Sea snow crab. However, unlike the Bristol Bay king crab, the snow crab S-R model is yet to be firmly established. To explore the trends in threshold reference points, $E(F_{MSY})$, $ESB(F_{MSY})/ESB(0)$, and $SSB(F_{MSY})/SSB(0)$, the length-based simulations considered two well-known S-R models: Beverton-Holt (Beverton and Holt 1957) and Ricker (Ricker 1954) with a likely τ range of 0.05–0.50. However, major conclusions for the red king crab were made based on the established Ricker S-R model (Zheng et al. 1995b). Random variation in recruitment was introduced to the S-R models for both stocks using an overall recruitment noise of 0.7 and an autocorrelation parameter of 0.6. This set of values of recruitment errors has been observed in the Bristol Bay red king crab S-R model (Zheng et al. 1995b). Plausible reference points were chosen at selected M and τ values. The τ value depends on the S-R parameter and the estimate of effective spawning biomass-per-recruit (ESB/R) at F = 0. The virgin ESB/R estimate depends on M and the mating ratio; so, the τ value changes with changes in any of the above parameters.

The mating ratio, which is used to estimate the effective spawning biomass has a profound effect on recruitment. A middle value of 1:2 was used as the base model for the Bristol Bay red king crab simulations (Zheng et al. 1995a; Paul and Paul 1997). For the

Bering Sea snow crab, a mating ratio of 1:3 and a variable mating ratio (Siddeek et al. unpublished) were used. The abundance of newshell mature males during the first year of molting was disregarded from total mature biomass calculation. There is evidence from the Canadian snow crab stock (Bernard Sainte-Marie, DFO, Canada, personal communication) as well as from the Bering Sea red king crab stock (Braxton Dew, National Marine Fisheries Service, Seattle, personal communication) that newly molted males do not mate when they are in the softshell condition.

For the Bering Sea snow crab stock, there are some evidences emerging in support of males attaining terminal molt at maturity similar to their female counterparts (Turnock 2003). So, majority of the scenarios considered in this report were for the assumption of terminal molt at maturity of both sexes. Under this assumption, the harvest rate of retained catch at the fishing time was high, but with a low harvest rate of equal number of mature male crabs at the survey time. This was expected because of declining abundance of marketable size crabs due to terminal molt of mature males as well as death due to natural mortality by the time of the fishery, nearly half year after the survey was completed.

The GHL recommendations based on purely biomass-based policy will be sensitive to changes in virgin and current biomass estimates (Clark 2002). However, in this report F_{MSY} based threshold harvest rates, and spawning and mature biomass ratios were estimated by a simulation procedure that incorporated a biomass-per-recruit analysis and a S-R relationship and used life history parameters independent of the actual biomass estimate, thus avoiding those types of errors. These reference points could be used as possible management procedures, especially for data and analysis poor crab stocks. Precise estimates of reference points by this method depend on good estimates of natural mortality, handling mortality, bycatch mortality, mating ratio, and specific S-R relationships. In the application of this method to the Bristol Bay red king crab and the Bering Sea snow crab stocks, some of these parameters were taken directly from published information, were simply educated guesses (e.g. mating ratio for snow crab and

M for both stocks), or considered a range of values. Greater effort should be devoted to determine reliable estimates of these parameters.

CONCLUSIONS AND SUGGESTIONS ON REFERENCE POINT ESTIMATION PROCEDURES FOR KING AND TANNER CRABS

1. Threshold and Target Harvest Rate:

(a) The mature male crab threshold harvest rate ranged from 0.12 to 0.16 and the target harvest rate ranged from 0.1 to 0.13 for different values of M for the Bristol Bay red king crab (Table 10). If the fishery were prosecuted with the constant target harvest rate, recruitment failure (i.e., zero recruitment) at the standing SSB < 5% of virgin SSB would be nearly zero, 7-8% at SSB < 10% of virgin SSB, and 13-18% at SSB < 15% of virgin SSB. Fredrick and Peterman (1995) considered 5% virgin SSB as a biological thresholds for some fish stocks. However, "Allee effect" on crab stocks has not been investigated. With the assumption of 5% safety threshold mature biomass level, the above two ranges of mature male harvest rate are safe to be considered as threshold and target harvest rates respectively for the Bristol Bay red king crab stock.

(b) Similar type of length-based simulations can be performed on other king crab stocks with sufficient amount of biological and fishery information available (e.g., St. Matthew Islands and Pribilof Islands blue king crab (see, a separate analysis of this type carried out on Pribilof Islands blue king crab stock (Siddeek, 2003)) and obtain stock specific threshold and target harvest rates. On the other hand, for data poor king crab stocks, the Bristol Bay red king crab results could be used as a first approximation for harvest management until sufficient data have been gathered to undertake this type of simulation.

(c) The mature male crab threshold harvest rate ranged from 0.11 to 0.18 and the target harvest rate ranged from 0.1 to 0.16 for different values of M for the Bering Sea snow crab under terminal molt at maturity of both sexes assumption (Table 10). The recruitment failures under those target harvest rates were lower than those of the red king crab stock for the comparable sets of conditions (Table 10). It is more likely that the mating ratio is variable and values within the above range, but towards the upper level, are safe to be considered as threshold and target harvest rates respectively for the Bering Sea snow crab stock.

(d) If the assumption of terminal molt at maturity of both sexes is not accepted at this point in time, the mature male threshold harvest rate of 0.18 and the mature male target harvest rate of 0.14 can be considered for the snow crab stock harvest management. Under this target harvest rate, the recruitment failure is low, similar to those seen under the terminal molt at maturity assumption (Table 10).

(e) As mentioned in (b), similar type of simulations can be performed on *C. bairdi* to determine the threshold and target harvest rates. On the other hand, for lesser known Tanner crab stocks with limited data, the snow crab results can be used as a first approximation for harvest management until sufficient data have been accumulated for this type of analysis.

2. MSST

(a) Estimation of MSST depends on identifying a virgin total mature biomass, SSB(0), and then an MSY producing total mature biomass, SSB(F_{MSY}). It is estimated using Restrepo et al.'s (1998) default formula:

MSST = c SSB(F_{MSY}) where c = max (1–M, 0.5)

Since most likely average M values will be lower than 0.5, the MSY biomass multiplication factor will be higher than 0.5. For example, if we consider an average M value of 0.275 (average of 0.2 and 0.35) for the Bristol Bay red king crab, the biomass multiplication factor c is 0.725, and for the snow crab with an average M of 0.3, c = 0.7.

If a virgin total mature biomass estimate is available (One way to estimate the virgin total mature biomass is to calculate an average value of the top 5% of total mature biomasses in the historical data series.), estimating $SSB(F_{MSY})$ is straightforward from the best estimate of $SSB(F_{MSY})/SSB(0)$ ratio. It ranged from 0.59 to 0.62 for the red king crab at plausible M values and 0.61 to 0.62 for the snow crab under specified target harvest rates (Table 10). So, virgin total mature biomass can be multiplied by an approximate ratio of 0.6 to get the $SSB(F_{MSY})$ value for both species. Then, MSST = estimated c times the estimated SSB (F_{MSY}). An MSST calculation procedure is described in Siddeek (2003).

(b) The above approach can be followed to determine MSST of other king and Tanner crab stocks with reasonable amount of biological and fishery information available (e.g., St. Matthew Islands and Pribilof Islands blue king crab (see, a separate analysis of this type carried out on Pribilof Islands blue king crab stock (Siddeek, 2003) and Bering Sea *C. bairdi*). On the other hand, for data poor stocks, either Bristol Bay red king crab or Bering Sea snow crab results, which depend on the species group (king crab or Tanner crab group), could be used initially for harvest management until sufficient data have been gathered to undertake this type of simulation.

3. $F_{x\%spr}$

(a) If the crab biomass estimates are unavailable or unreliable, $F_{x\%spr}$ (F that maintains the total mature biomass-per-recruit at an x percent of the virgin total mature biomass-per-recruit) method can be used to determine the threshold and target harvest rates. The threshold total mature biomass ratio was 0.58-0.59 and that of the target ratio was 0.62 for the Bristol Bay red king crab at plausible sets of M values under intermediate molt probability level. The corresponding sets of values for the snow crab stock under terminal molt hypothesis were 0.59-0.6 and 0.61-0.62, respectively. Approximately, a threshold harvest rate equivalent to $F_{59\%}$ and a target harvest rate equivalent to $F_{62\%}$ may be considered appropriate for both stocks.

(b) The total mature biomass ratio can be estimated for other king and Tanner crab stocks with moderate amount of biological and fishery information using the same simulation procedure, and $F_{x\%spr}$ based harvest rate reference points can be determined. On the other hand, for data poor stocks, a threshold harvest rate equivalent to $F_{59\%}$ and a target harvest rate equivalent to $F_{62\%}$ may be considered as a first approximation for harvest management until sufficient data have been gathered to under take this type of simulation.

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Table 1. Input stock parameters (base values) for Bristol Bay red king crab for reference point estimation. CL = carapace length.

Parameter	Male		Female		Remarks
	Prerecruit1	Recruit & Postrecruit	Class1	Class2	
Size range (mm CL)	95-129	130-169	90-119	120-139	Zheng et al. (1995a)
Natural mortality, M	0.2	0.2	0.35	0.35	Zheng (2003a)
Handling mortality rate, h	0.20		0.20	0.20	Kruse et al. (2000),
Bycatch mortality, BYM	0.01	0.01	0.01	0.01	Siddeek (2002)
Mean fishing period ,1996-02 (yr^{-1}), δ		0.0110			Current estimate
Mean lapsed time between mid survey and start of fishing period (yr^{-1}),1996-02, T		0.3542			Current estimate
Growth increment linear model, a, b	13.14, 0.018		16.49, -0.097		Zheng et al. (1995a), Kruse et al. (2000)
Growth increment gamma probability model: beta	0.519		0.931		Zheng et al. (1995b)
Recruitment gamma probability model: mean, beta	107, 1.885[a]		97, 0.313[a]		[a]Zheng et al. (1995b)
Maturity probability: logistic a, b	$5.734*10^{13}$, -0.29469		$1.262*10^{11}$, -0.29625		Least square fit to Otto's maturity data (unpublished)
Molt Probability: reverse logistic a, b	20584.94, 0.077 (low); 295159.6, 0.089 (intermediate); 358930.1, 0.082 (high)		Probability = 1		Zheng et al. (1995b)
Pot selectivity probability: retained - single logistic a, b	0.66438, 137.50334 (retained)		Constant selectivity = 0.255		Least square fit to Zheng's summary of data (unpublished)
Discards- double logistic a, b, c, d	0.07456,113.30948, 0.59615, 137.18722				
Mating ratio (male:female) :		1:2	1:2		Preliminary mid value from Zheng et al. (1995a)
Weight-length model (g-mm): a, b	0.0003614, 3.16[a]		0.02286, 2.2234[b]		[a]Balsiger (1974), [b]Zheng et al. (1995a)

Table 2. Natural mortality (M), mating ratio, and the corresponding Tau values determined from Ricker autocorrelated stock-recruitment parameters of total spawners (Zheng et al. 1995b) for the Bristol Bay red king crab. Tau was estimated from effective spawning biomass-per-recruit (ESB/R) at F = 0 and the stock-recruitment parameter (Mace 1994).

	Male	Female	Mating Ratio	Tau	Reference
M	0.2[a]	0.35[a]	1:1	0.16[b]	[a]Zheng (2003a), [b]Mace (1994)
M	0.2	0.35	1:2	0.22	
M	0.2	0.35	1:3	0.28	
M	0.2	0.2	1:2	0.13	
M	0.2	0.2	1:3	0.14	
M	0.23[c]	0.47[c]	1:2	0.32	[c]Zheng et al. (1995b)
M	0.23	0.47	1:3	0.41	

Table 3. Comparison of 2.5 to 97.5 percentiles, mean, and standard deviation of threshold reference point (RP) estimates for Bristol Bay red king crab for 200 randomly selected Tau values within 0.05-0.5 and 100 perturbation-derived number of recruits for a 100-year fishing period at each F level. The recruits were generated from the Ricker stock-recruitment (S-R) model with total effective spawning biomass determined from (male: female) 1:2 mating ratio and perturbed with a recruitment standard deviation (σ_e) of 0.7 and an autocorrelation (ρ) of 0.6. A handling mortality of 0.2, mean fishing period of 0.011 yr, mean elapsed time between survey and fishing period of 0.3542 yr, and bycatch mortality of 0.01 were used. Note: mean: mean RP for 200 Taus; mean of mean: mean of 100 mean RPs for 200 Taus, in which each of 100 mean RPs was estimated for a 100 year fishing period.

Natural mortality	Male: 0.2 Female: 0.35	Male: 0.23 Female: 0.47
Retained catch $E(F_{MSY})$:		
2.5% - 97.5%	0.09 – 0.37	0.12 – 0.42
mean (standard deviation)	0.20 (0.08)	0.23 (0.09)
Mature $E(F_{MSY})$ at the survey time:		
2.5% - 97.5%	0.07 – 0.24	0.08 – 0.26
mean (standard deviation)	0.14 (0.05)	0.15 (0.05)
$ESB(F_{MSY})/ESB(0)$:		
2.5% - 97.5%	0.47 – 0.68	0.47 – 0.69
mean of mean (standard deviation of mean)	0.56 (0.05)	0.58 (0.06)
$SSB(F_{MSY})/SSB(0)$:		
2.5% - 97.5%	0.56 – 0.66	0.56 – 0.65
mean of mean (standard deviation of mean)	0.60 (0.03)	0.59 (0.02)

Table 4. Comparison of threshold reference points for various scenarios for Bristol Bay red king crab assuming an established Ricker stock-recruitment (S-R) relationship (Zheng et al. 1995b) with an intermediate molt probability level and an appropriate Tau value. The mean and standard deviation were estimated from 100 perturbed recruit abundances with a standard deviation of 0.7 and an autocorrelation of 0.6. A constant instantaneous bycatch mortality of 0.01 was assumed. Figures in bold refer to changes in input parameter values, and values inside parentheses are standard deviations. T= male plus female. The M values are specified with a letter M (for males) and F (for females).

Spawner participants	T	T	T	**F**	T	T	T	**F**	T	**F**
M	0.2 M 0.35 F	0.2 M 0.35 F	0.2 M 0.35 F	0.2 M 0.35 F	0.2 M 0.35 F	0.2 M 0.35 F	**0.23 M** **0.47 F**	**0.23 M** **0.47 F**	**0.2 M** **0.2 F**	**0.2 M** **0.2 F**
Mating ratio (male:female)	1:2	**1:1**	**1:3**	1:2	1:2	1:2	1:2	1:2	1:2	1:2
Tau	0.22	**0.16**	**0.28**	0.22	0.22	0.22	**0.32**	**0.32**	**0.13**	**0.13**
h	0.2	0.2	0.2	0.2	**0.0**	**0.5**	0.2	0.2	0.2	0.2
Retained $E(F_{MSY})$	0.20	0.17	0.22	0.22	0.22	0.18	0.17	0.19	0.21	0.22
Mature $E(F_{MSY})$	0.14	0.12	0.16	0.15	0.15	0.13	0.12	0.14	0.15	0.16
Mean $ESB(F_{MSY})/ESB(0)$	0.56 (0.36)	0.49 (0.35)	0.62 (0.36)	0.53 (0.35)	0.54 (0.35)	0.57 (0.36)	0.62 (0.36)	0.59 (0.36)	0.47 (0.35)	0.44 (0.34)
Mean $SSB(F_{MSY})/SSB(0)$	0.59 (0.36)	0.63 (0.35)	0.56 (0.36)	0.58 (0.36)	0.59 (0.36)	0.59 (0.36)	0.58 (0.36)	0.57 (0.36)	0.66 (0.35)	0.65 (0.35)
Mean Yield (t) for a carrying capacity of 2000 initial abundance of crabs	0.92 (1.01)	0.85 (0.94)	0.97 (1.07)	0.95 (1.05)	1.0 (1.10)	0.82 (0.90)	0.75 (0.82)	0.78 (0.86)	0.93 (1.02)	0.96 (1.06)

Table 5. Input stock parameters (base values) for Bering Sea snow crab for reference point estimation. CW = carapace width.

Parameter	Male		Female		Remarks
	Prerecruit1	Recruit & Postrecruit	Class1	Class2	
Size range (mm CW)	72-101	102-129	50-59	60-99	Siddeek et al. (unpublished)
Natural mortality, M	0.3	0.3	0.3	0.3	NPFMC (1999)
Handling mortality rate, h	0.25		0.25	0.25	Zheng et al. (2002)
Bycatch mortality, BYM	0.01	0.01	0.01	0.01	Siddeek (2002)
Mean fishing period ,1995-02 (yr^{-1}), δ		0.1303			Current estimate
Mean lapsed time between mid survey and start of fishing period (yr^{-1}),1995-02,T		0.544			Current estimate
Growth increment linear model, a, b	8.421, 0.106		4.475, 0.164		Zheng et al. (2002)
Growth increment gamma probability model: beta	0.500		0.500		Turnock (2003)
Recruitment normal probability model: mean, standard deviation	86.5, 5.0		54.5, 1.7		Current analysis
Maturity probability: logistic a, b	0.119999, 88.00018		0.162815, 48.7665		Least square fit to Turnock's data (unpublished)
Molt Probability: immature male, reverse logistic a, b	0.047798, 145.941599		Probability = 1		Turnock (2003)
Mature male and female under Terminal molt assumption	Probability = 0		Probability = 0		
Pot selectivity: retained (new shell) - logistic a, b	0.241425, 105.457267		-		Least square fit to Turnock's data (unpublished)
Retained (old shell) -logistic a, b	0.230523,110.118991		-		
Discards- logistic a, b	0.163985, 102.043690		0.288254367, 64.94821057		
Mating ratio (male:female) :		1:3	1:3		Siddeek et al. (unpublished)
Weight-length model (g-mm): a, b	0.00023, 3.12948		0.00253, 2.56427		Somerton (1981)

Table 6. Natural mortality (M) values considered in the simulations for the Bering Sea snow crab.

Natural Mortality	Male	Female	Reference
M	0.2	0.2	A scenario considered by Turnock (2003)
M	0.3	0.3	NPFMC (1999)
M	0.35	0.56	Somerton (1981), Zheng (2003b) for non-terminal molt assumption
M	0.53	0.56	Zheng (2003b) for terminal molt assumption
M	0.3[a], 0.5[b]	0.3, 0.5	a: immature crab, b: mature (terminally molted) crab

Table 7. Comparison of 2.5 to 97.5 percentiles, mean, and standard deviation of threshold reference point (RP) estimates for Bering Sea snow crab for 200 randomly selected Tau values within 0.05-0.5 and 100 perturbation-derived number of recruits for a 100- year fishing period at each F level. The recruits were generated from the Beverton-Holt and Ricker stock-recruitment (S-R) models with total effective spawning biomass determined from (male: female) 1:3 mating ratio and perturbed with a recruitment standard deviation (σ_e) of 0.7 and an autocorrelation (ρ) of 0.6. Terminal molt at maturity of both sexes were assumed in the analysis. A handling mortality of 0.25, mean fishing period of 0.1303 yr, mean elapsed time between survey and fishing period of 0.544 yr, and bycatch mortality of 0.01 were used. Note: mean: mean RP for 200 Taus; mean of mean: mean of 100 mean RPs for 200 Taus, in which each of 100 mean RPs was estimated for a 100 year fishing period.

Stock-recruitment model	Beverton-Holt	Beverton-Holt	Ricker	Ricker
Natural mortality	Male: 0.3 Female: 0.3	Immature: 0.3 Mature: 0.5	Male: 0.3 Female: 0.3	Immature: 0.3 Mature: 0.5
Retained catch $E(F_{MSY})$:				
2.5% - 97.5%	0.22 – 0.65	0.22 – 0.74	0.22 – 0.91	0.30 – 0.93
mean (standard deviation)	0.43 (0.15)	0.50 (0.17)	0.55 (0.22)	0.61 (0.21)
Mature $E(F_{MSY})$ at the survey time:				
2.5% - 97.5%	0.05 – 0.12	0.07 – 0.19	0.05 – 0.15	0.10 – 0.23
mean (standard deviation)	0.09 (0.02)	0.14 (0.04)	0.10 (0.03)	0.16 (0.05)
$ESB(F_{MSY})/ESB(0)$:				
2.5% - 97.5%	0.48 – 0.53	0.45 – 0.52	0.51 – 0.62	0.49 – 0.62
mean of mean (standard deviation of mean)	0.50 (0.02)	0.48 (0.02)	0.57 (0.03)	0.55 (0.04)
$SSB(F_{MSY})/SSB(0)$:				
2.5% - 97.5%	0.50 – 0.55	0.49 – 0.56	0.54 – 0.66	0.52 – 0.68
mean of mean (standard deviation of mean)	0.53 (0.02)	0.52 (0.02)	0.60 (0.04)	0.60 (0.04)

Table 8. Comparison of threshold reference points for various scenarios for Bering Sea snow crab assuming a Ricker stock-recruitment (S-R) relationship with total spawners and a Tau value of 0.25. The mean and standard deviation were estimated from 100 perturbed recruit abundances with a standard deviation of 0.7 and an autocorrelation of 0.6. A constant instantaneous bycatch mortality of 0.01 was assumed. Figures in bold refer to changes in input parameter values, and values inside parentheses are standard deviations. The M values are specified with a letter M (for males) and F (for females). Var. = different mating ratios for primiparous and multiparous female spawners (Siddeek et al. unpublished).

M	0.3 M 0.3 F	0.3 M 0.3 F	0.3 M 0.3 F	0.3 M 0.3 F	0.3 M 0.3 F	0.3 M 0.3 F	**0.3 Immature 0.5 Mature**	**0.2 M 0.2 F**	**0.53 M 0.56 F**	**0.35 M 0.56 F Non-Terminal Molt**
Mating ratio (male:female)	1:3	**1:1**	**1:2**	**Var.**	1:3	1:3	1:3	1:3	1:3	1:3
h	0.25	0.25	0.25	0.25	**0.0**	**0.5**	0.25	0.25	0.25	0.25
Retained $E(F_{MSY})$	0.58	0.53	0.53	0.65	0.87	0.43	0.66	0.48	0.76	0.25
Mature $E(F_{MSY})$	0.11	0.10	0.10	0.12	0.12	0.09	0.18	0.08	0.16	0.18
Mean $ESB(F_{MSY})/ESB(0)$	0.56 (0.36)	0.53 (0.35)	0.55 (0.36)	0.61 (0.36)	0.61 (0.36)	0.56 (0.36)	0.54 (0.35)	0.57 (0.36)	0.60 (0.36)	0.46 (0.34)
Mean $SSB(F_{MSY})/SSB(0)$	0.59 (0.36)	0.59 (0.36)	0.59 (0.36)	0.59 (0.36)	0.64 (0.35)	0.58 (0.36)	0.59 (0.36)	0.56 (0.36)	0.63 (0.35)	0.57 (0.36)
Mean Yield (t) for a carrying capacity of 1500 initial abundance of crabs	0.06 (0.07)	0.06 (0.06)	0.06 (0.07)	0.06 (0.07)	0.07 (0.08)	0.05 (0.06)	0.05 (0.06)	0.08 (0.08)	0.04 (0.04)	0.07 (0.08)

Table 9. Comparison of mature male threshold harvest rate and mean total mature biomass ratio at different Tau and M values for Bering Sea snow crab assuming a Ricker stock-recruitment (S-R) relationship with total spawners. The means were estimated from 100 perturbed recruit abundances with a standard deviation of 0.7 and an autocorrelation of 0.6. A constant handling mortality of 0.25 and an instantaneous bycatch mortality of 0.01 were used. Note: The results are for terminal molt at maturity of both sexes except the last set of results.

	Mature Male Crab Threshold Harvest Rate				Mean Threshold Total Mature Biomass Ratio			
Tau	0.15	0.25	0.35	0.45	0.15	0.25	0.35	0.45
M: 0.2 male, 0.2 female; mating ratio: 1:3	0.10	0.08	0.06	0.05	0.59	0.56	0.57	0.57
M: 0.3 male, 0.3 female; mating ratio: 1:3	0.13	0.11	0.09	0.07	0.62	0.59	0.55	0.54
M: 0.3 male, 0.3 female; mating ratio: variable	0.14	0.12	0.10	0.09	0.61	0.59	0.58	0.54
M: 0.3 mature, 0.5 immature; mating ratio: 1:3	0.20	0.18	0.13	0.10	0.64	0.59	0.58	0.56
M: 0.3 mature, 0.5 immature; mating ratio: variable	0.21	0.18	0.15	0.11	0.63	0.60	0.56	0.56
M: 0.53 male, 0.56 female; mating ratio: 1:3	0.18	0.16	0.14	0.12	0.66	0.63	0.60	0.57
M: 0.35 male, 0.56 female (non-terminal molt of mature males); mating ratio: 1:3	0.23	0.18	0.10	0.10	0.63	0.57	0.61	0.50

Table 10. Comparison of mature male crab target harvest rate at the survey time, $E(75\%F_{MSY})$, and mean total mature biomass ratio, $SSB(75\%F_{MSY})/SSB(0)$, at 75% F_{MSY} for plausible mating ratio (male:female) and M values, and the probability of recruitment failure (zero recruits) during a 100 year fishing period under those equilibrium target harvest rate rules due to depensatory effects (Allee Effect) when the standing stock total mature biomass is below a certain percentage (5, 10, or 15%) of the virgin total mature biomass (SSB(0)) for Bristol Bay red king crab and Bering Sea snow crab stocks. Terminal molt at maturity of both sexes were assumed in the snow crab analysis except the last set of results. Threshold values (estimated at F_{MSY}) are given in parentheses.

	Target Mature Male $E(75\%F_{MSY})$	$SSB(75\%F_{MSY})/SSB(0)$	Probability of Recruitment Failure at: SSB < 5% SSB(0)	SSB < 10% SSB(0)	SSB < 15% SSB(0)
Bristol Bay red king crab:					
M: 0.2 male, 0.35 female -					
mating ratio 1:2	0.11 (0.14)	0.62 (0.59)	0.0	0.08	0.15
mating ratio 1:3	0.13 (0.16)	0.59 (0.56)	0.01	0.08	0.18
M: 0.2 male, 0.2 female -					
mating ratio 1:2	0.12 (0.16)	0.69 (0.65)	0.0	0.08	0.14
M: 0.23 male, 0.47 female -					
mating ratio 1:2	0.10 (0.12)	0.62 (0.58)	0.0	0.07	0.13
Bering Sea snow crab:					
M: 0.3 male, 0.3 female -					
mating ratio 1:3	0.10 (0.11)	0.61 (0.59)	0.0	0.02	0.09
mating ratio variable	0.11 (0.12)	0.61 (0.59)	0.0	0.03	0.11
M: 0.3 immature, 0.5 mature					
- mating ratio 1:3	0.16 (0.18)	0.62 (0.59)	0.0	0.02	0.08
mating ratio variable	0.16 (0.18)	0.62 (0.60)	0.0	0.02	0.08
M: 0.35 male, 0.56 female,					
Non-terminal molt –	0.14 (0.18)	0.63 (0.57)	0.0	0.02	0.08
mating ratio 1:3	0.14 (0.18)	0.63 (0.59)	0.0	0.02	0.08
mating ratio variable					

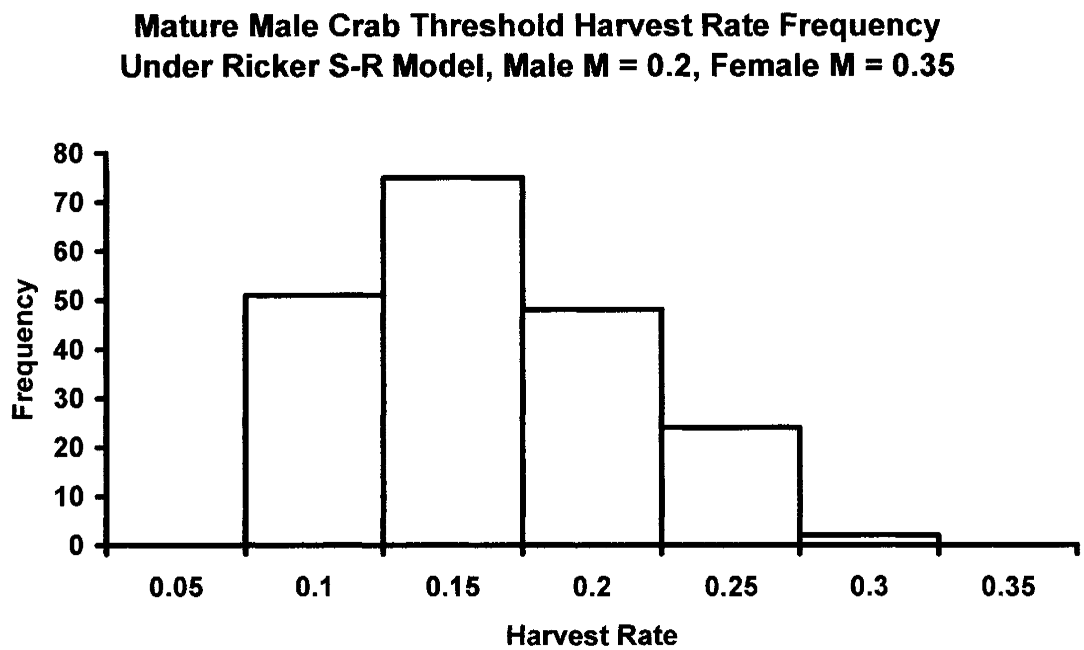

Fig. 1. Frequency distribution of mature male crab threshold harvest rate from 200 randomly selected Tau between 0.05 and 0.5 for the Bristol Bay red king crab. The harvest rates were generated by the stochastic Ricker stock-recruitment model. A mating ratio (male:female) of 1:2, male M of 0.2, female M of 0.35, h of 0.2, and BYM of 0.01 were used in the simulations.

Observed and Ricker S-R Model Simulated Initial Abundances

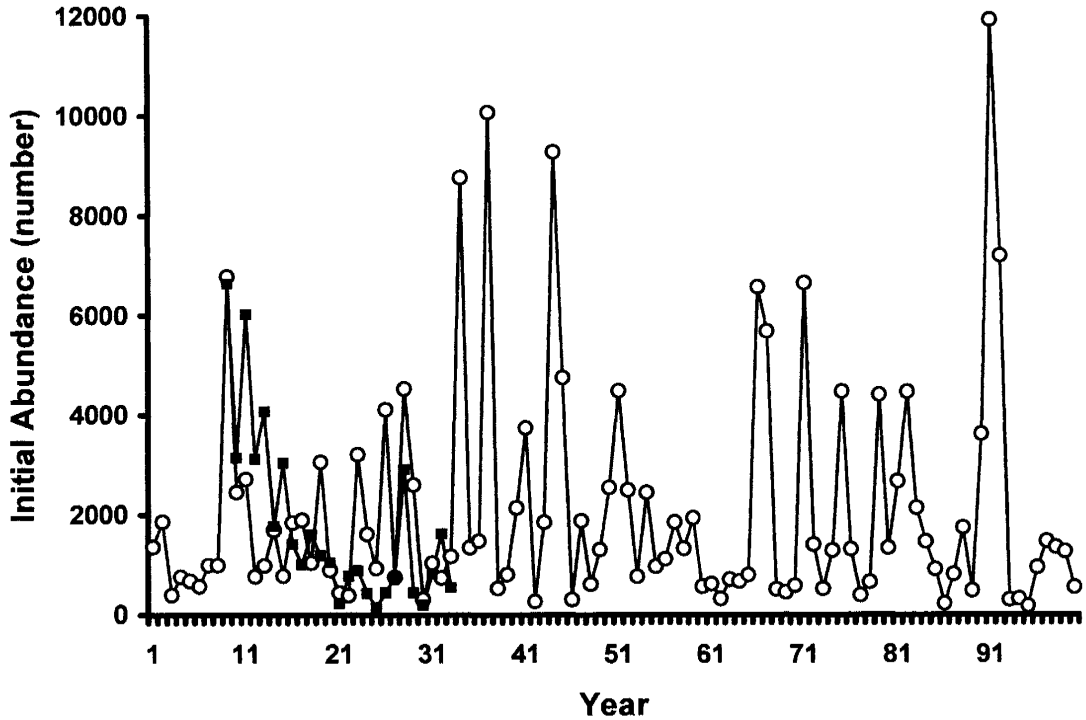

Fig. 2. Simulated 100 year initial abundances (open circle) superimposed on actual prerecruit total abundances (filled square) of Bristol Bay red king crab during 1978-2002 . The abundances were generated by the stochastic Ricker S-R model with Tau = 0.22, retained catch E(75%F_{MSY}) = 0.1564, and a mating ratio (male:female) of 1:2. A male M of 0.2, a female M of 0.35, an h of 0.2, and a BYM of 0.01 were used in the simulations.

Observed and Ricker S-R Model Simulated ESB

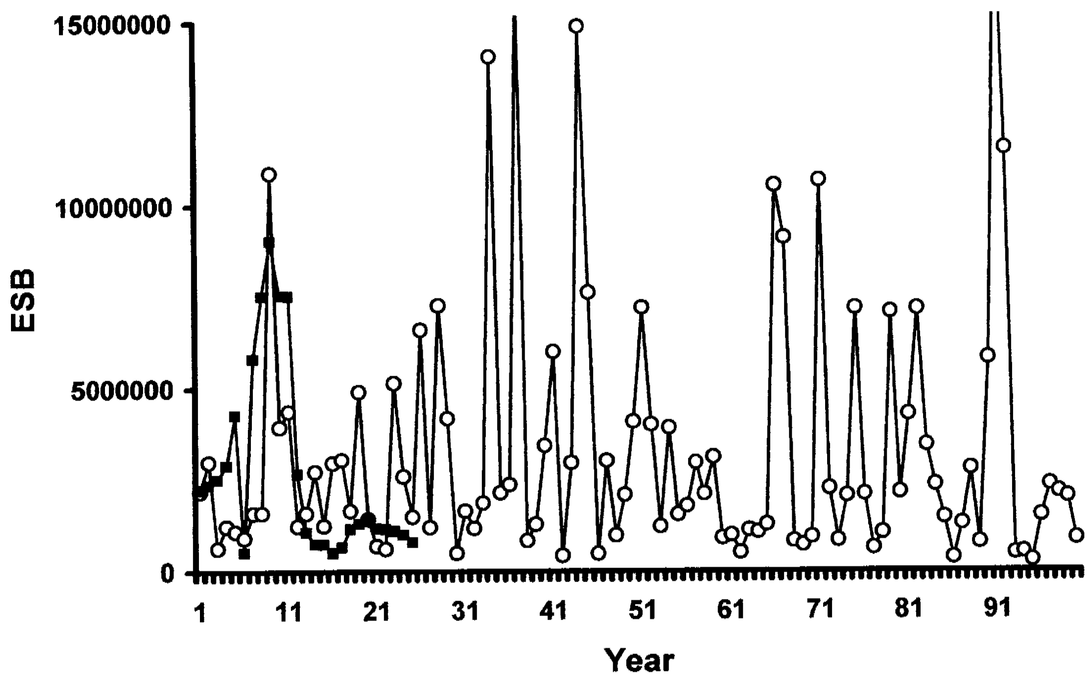

Fig. 3. Simulated 100 year effective spawning biomasses (ESB in g)) (open circle) superimposed on actual ESB (in 10s pounds)(filled square) of Bristol Bay red king crab during 1970-1994 (8 year lag). The abundances were generated by the stochastic Ricker S-R model with Tau = 0.22, retained catch E(75%FMSY) = 0.1564, and a mating ratio (male:female) of 1:2. A male M of 0.2, a female M of 0.35, an h of 0.2, and a BYM of 0.01 were used in the simulations.

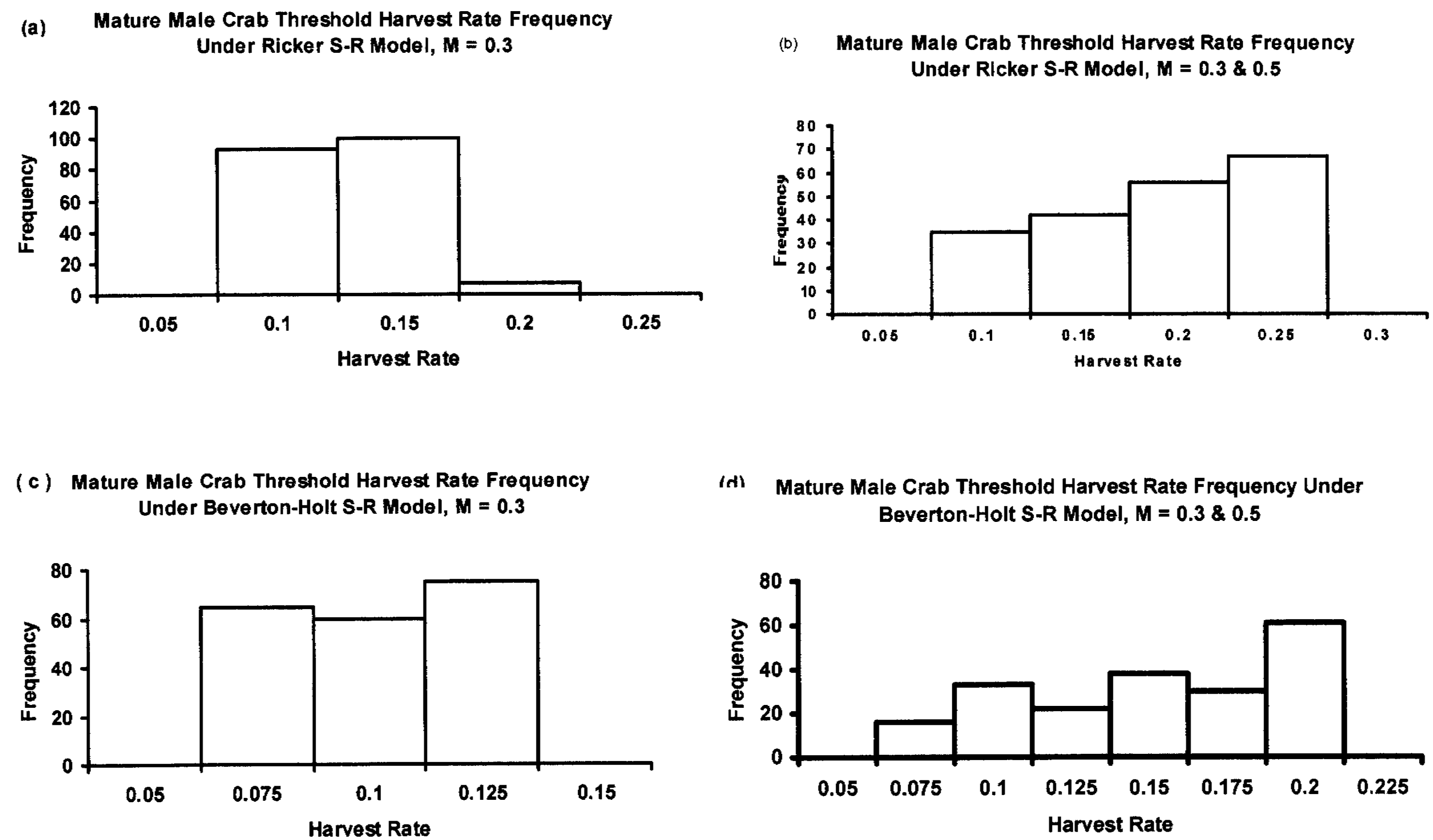

Fig. 4. Frequency distributions of mature male crab threshold harvest rate from 200 randomly selected Tau values between 0.05 and 0.5 for the Bering Sea snow crab. The harvest rates were generated by the stochastic Ricker and Beverton-Holt stock-recruitment (S-R) models under terminal molt at maturity of both sexes. (a) and (c): M =0.3; (b) and (d): immature crab M = 0.3, mature crab M = 0.5. A mating ratio (male:female) of 1:3, h of 0.25, and BYM of 0.01 were used in all simulations.

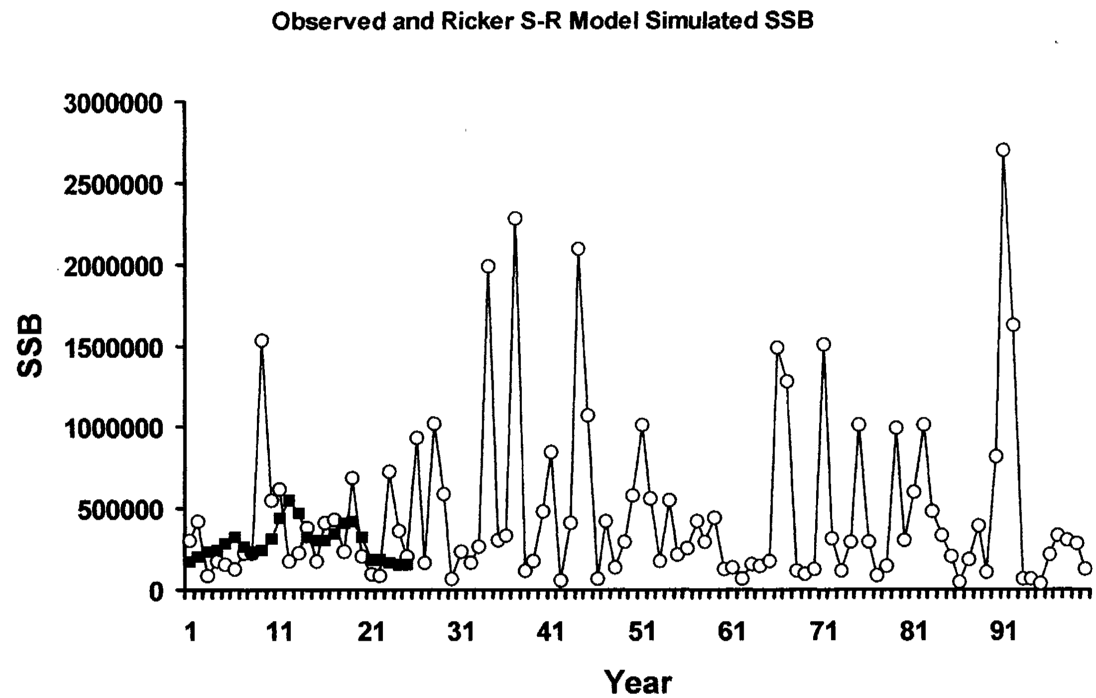

Fig. 5. Simulated 100 year total mature biomasses (SSB in g)) (open circle) superimposed on actual SSB (in 1000 tonnes)(filled square) of Bering Sea snow crab during 1978-2002. The abundances were generated by the stochastic Ricker S-R model under terminal molt of mature crab assumption with Tau = 0.25, retained catch E(75%F_{MSY}) = 0.4852, and a mating ratio (male:female) of 1:3. An M of 0.3, an h of 0.25, and a BYM of 0.01 were used in the simulations.

Appendix A: List of notations used in the text, tables, and appendices

R = total number of prerecruit-1 and class-1 progenies produced by effective spawning stock biomass corresponding to fishing mortality F, ESB,

R_{max} = maximum R, set to 1500 for snow crab and 2000 for red king crab per-recruit analysis,

$(ESB/R)_F$ and $(ESB/R)_{F=0}$ = effective spawning stock biomass-per-recruit corresponding to a fishing mortality F and F = 0, respectively,

$(ESB/R)_{ESB=0}$ = effective spawning stock biomass-per-recruit determined as the reciprocal of the slope at the origin of the stock-recruitment (S-R) curve,

h = mortality rate due to handling of discarded catch,

$HM1_{l'}$ = instantaneous handling mortality of male at size l',

$HM2_{l'}$ = instantaneous handling mortality of female at size l',

BYM = constant annual instantaneous bycatch mortality,

δ = duration of average fishing period as a fraction of a year (handling and fishing mortality occur during this time period, hence HM and annual fishing mortality values are scaled to this period),

$E(F_{MSY})$ = exploitation rate corresponding to F_{MSY}, equivalent to threshold harvest rate,

τ = a parameter estimated from a spawning biomass-per-recruit ratio, which influences the steepness near the origin and overall shape of the S-R curve; it is also denoted by Tau in the report,

$P_{l',l}$ = probability of crabs in a size group l' growing into a size group l,

ESB(F), $ESB(F_{MSY})$, and ESB(0) = effective spawning stock biomass corresponding to a fishing mortality F, F_{MSY}, and F = 0 on legal males, respectively,

SSB(F), $SSB(F_{MSY})$, and SSB(0) = nominal (unadjusted for male to female mating ratio) total mature stock biomass corresponding to a fishing mortality F, F_{MSY}, and F = 0 on legal males, respectively,

T = time elapsed between the mid survey period (i.e., start of a biological year) and start date of a fishing period as a fraction of a year,

c_t = sum of catches in all size groups of legal males in a cohort in number corresponding to a fishing mortality F in year t,

y_t = sum of catches in all size groups of legal males in a cohort in weight corresponding to a fishing mortality F and year t,

C = sum of c_t through the cohort life span (i.e., stock catch in number),

Y = sum of y_t through the fishable life span (i.e., stock catch in weight), ,

α, β, γ, and θ = parameters in the S-R models,

ρ = recruitment autocorrelation parameter,

σ_e = standard deviation of recruitment noise in the S-R model.

APPENDIX B. Some formulas (for details, refer to Siddeek (2003))

The following assumptions were made in the simulations:

1. Mortality takes place immediately after growth.
2. Instantaneous bycatch mortality, BYM, is constant and independent of size, sex, and shell condition.
3. Instantaneous natural mortality, M, is independent of shell condition.
4. Instantaneous fishing mortality, F, and handling mortality, HM, are size dependent. Different selectivities for retained and discarded catch.
5. Recruits generated from S-R models for per-recruit analysis have a constant sex ratio.

Male cohort dynamics:

Prerecruit1:

$$N_{1,t+1} = \sum_{l'=1}^{1} [N_{l',t} \; moltprob_{l'} \times \; proportion\,grow_{l',1}] e^{-(M + HM1_{l'}\delta + BYM)}$$

Recruit and post recruit:

$$N_{1,t+1} = \sum_{l'=1}^{p} [N^{pre}{}_{l',t} \; moltprob_{l'} \times \; proportion\,grow_{l',1}] e^{-(M + HM1_{l'}\delta + BYM)} \; + \sum_{l'=p+1}^{l} [N^{post}{}_{l',t} \; moltprob_{l'} \; \times proportion\,grow_{l',1}] e^{-(Fs_{l'}\delta + M + BYM)}$$

Note: mature, immature, old, and new shell cohort abundances were calculated separately; so, N may refer to any category (see specific formulas in Siddeek (2003)).

Female cohort dynamics:

The same set of formulas is used for female cohort abundance estimation by setting F to 0.

Retained male catch:

$$c_t = \sum_{j=p+1}^{p+q} \frac{Fs_j}{(Fs_j + M + BYM)} N_{j,t} \, e^{-M\,T} (1 - e^{-(Fs_j + M + BYM)\delta})$$

and the corresponding catch in weight is

$$y_t = \sum_{j=p+1}^{p+q} \frac{Fs_j}{(Fs_j + M + BYM)} N_{j,t} W_j e^{-M\,T} (1 - e^{-(Fs_j + M + BYM)\delta})$$

Then, the total retained catch (*C* in number and Y in weight) for an average life span of the cohort (i.e., the stock catch) is

$$C = \sum_{t=1}^{lifespan} c_t \qquad \text{and} \qquad Y = \sum_{t=1}^{lifespan} y_t$$

MSY level fishing mortality and harvest rates on legal males and mature males:

Y is maximized to obtain F_{MSY} by varying F value for a given set of M, HM, BYM, T, and δ values. The corresponding retained male harvest rate at the time of the fishery is estimated at F_{MSY} as

$$\text{Retained } E(F_{MSY}) = \frac{C}{\sum_{t=1}^{lifespan} \sum_{j=p+1}^{p+q} (N_{j,t}\, e^{-M\,T})}$$

and the corresponding mature male harvest rate at the middle of the survey time is estimated as

$$\text{Mature } E(F_{MSY}) = \frac{C}{\sum_{t=1}^{lifespan} \sum_{j=a}^{p+q} (N_{j,t})}$$

where N_{jt} refers to mature male abundance at the middle of the survey time period and 'a' refers to the lowest maturity size bin.

The stochastic form of the two S-R models, formulas to estimate S-R model parameters, τ (Tau), and number of recruits are provided below:

$$R = \frac{ESB(F)}{\alpha + \beta * ESB(F)} e^{\varepsilon_t - \sigma^2_{\varepsilon_t}/2} \qquad \text{(Beverton and Holt 1957)}$$

$$R = \gamma * ESB(F)\, e^{-\theta * ESB(F)} e^{\varepsilon_t - \sigma^2_{\varepsilon_t}/2} \qquad \text{(Ricker 1954)}$$

where

$\varepsilon_t = \rho \times \varepsilon_{t-1} + e_t$ and $e_t \sim \mathrm{N}(0, \sigma_e^2)$

ε_t is set to $Z\,\sigma_{\varepsilon t}$ where $Z \sim N(0, 1)$, and

$$\sigma_{\varepsilon_t}^{\,2} = \frac{\sigma_e^{\,2}}{1-\rho^2}$$

$$\tau = \frac{(ESB/R)_{ESB=0}}{(ESB/R)_{F=0}}$$

where $(ESB/R)_{ESB=0}$ equals α for the Beverton and Holt S-R model and $1/\gamma$ for the Ricker S-R model. Therefore,

$$\alpha = \tau\,(ESB/R)_{F=0}$$ for the Beverton and Holt S-R model

$$\gamma = \frac{1}{\tau\,(ESB/R)_{F=0}}$$ for the Ricker S-R model

and

$$R(F) = \frac{(ESB/R)_F - \alpha}{\beta\,(ESB/R)_F}$$ (Beverton and Holt 1957)

and

$$R(F) = \frac{\ln(\gamma\,(ESB/R)_F)}{\theta\,(ESB/R)_F}$$ (Ricker 1954)

Auxiliary models:

Weight-carapace size relationship:

$$W_l = \left(\frac{1}{CL_{up} - CL_{low}}\right)\left(\frac{a}{b+1}\right)\left(CL_{up}^{\,b+1} - CL_{low}^{\,b+1}\right)$$

(for estimating a mean weight W_l in a carapace size interval l, Beyer (1987))
where,

$$W = a\,CL^b$$

CL_{up} and CL_{low} = upper and lower size limits, respectively, of a carapace size interval, and a and b are model parameters.

Handling mortality of discards:

The $HMi_{l'}$ ($i = 1$ for males and $i = 2$ for females) at carapace size interval l' is defined as a function of $F \times s_{l'}$, ignoring M and BYM as follows:

$$1 - e^{-HMi_{l'}\delta} = h\,(1 - e^{-F s_{l'} \delta})$$

Therefore,

$$HMi_{l'} = -\frac{1}{\delta} ln(1 - h(1 - e^{-F s_{l'} \delta}))$$

Note: F accounts for legal and sublegal catches, but only an h proportion of discarded crabs (male and female) eventually die as a result of handling and throwing them back to sea. The selectivity, $s_{l'}$, used here is the discard selectivity.

$P_{l',l}$ determination:

Annual growth increment (x) was assumed to have a gamma distribution and recruits to have either a gamma or a normal distribution.

The gamma distribution is,

$$P_{l',l} = \frac{\int_{l_1'-\tau_l}^{l_2'-\tau_l} gamma(x / \alpha_l, \beta) dx}{\sum_{l'=1}^{n} \int_{l_1'-\tau_l}^{l_2'-\tau_l} gamma(x / \alpha_l, \beta) dx}$$

$$gamma(x / \alpha_l, \beta) = \frac{x^{\alpha_l - 1} e^{-\frac{x}{\beta}}}{\beta^{\alpha_l} \Gamma(\alpha_l)}$$

The normal probability model is,

$$P_{l',l} = \frac{\int_{l'_1-\tau_l}^{l'_2-\tau_l} e^{\frac{-(x-\bar{l})^2}{2\sigma^2}} dx}{\sum_{l'=1}^{n} \int_{l_1-\tau_{l'}}^{l_2-\tau_{l'}} e^{\frac{-(x-\bar{l})^2}{2\sigma^2}} dx},$$

where

n = total number of carapace size intervals available in a cohort for $P_{l',l}$ estimation,

l'_1 and l'_2 = lower and upper limits, respectively, of the receiving size class l',

β = a parameter of the gamma distribution,

$\alpha_l = G_l / \beta$ where G_l is the mean growth increment in size class l, estimated from a linear relationship between growth increment and premolt size,

$\bar{l}$ = overall mean size of prerecruit1/class1.

Pot selectivity:

Different logistic functions were used to estimate retained and discarded catch pot selectivity (s_l)

$$s_l = \frac{1}{1+e^{-a(l-b)}}$$

where a and b are model parameters and l is the size.

A double logistic function was used for the Bristol Bay red king crab discarded catch selectivity (s_l)

$$s_l = \frac{1}{1+e^{-a(l-b)}} \frac{1}{1+e^{c(l-d)}}$$

where a, b , c, and d are model parameters and l is the size.

Molt probability:

Reverse logistic function was used for molt probability (mm_l)

$$mm_l = 1 - \frac{1}{1+e^{-a(l-b)}}$$

where a and b are model parameters and l is the size. Molt probability is set to 1.0 or 0 under certain scenarios (see the text for explanation).

Maturity probability:

A logistic function was used for maturity probability (a_l)

$$a_l = \frac{1}{1+\mathrm{e}^{-a(l-b)}}$$

where a and b are model parameters and l is the size.

2003 Stock Assessment and Fishery Evaluation Report
King and Tanner Crab Fisheries in the
Bering Sea and Aleutian Islands

Executive Summary

The annual stock assessment and fishery evaluation (SAFE) report is a requirement of the North Pacific Fishery Management Council's *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP)*, and a federal requirement [50 CFR Section 602.12(e)]. The SAFE summarizes the current biological and economic status of fisheries, guideline harvest levels (GHL), and analytical information used for management decisions or changes in harvest strategies. The report is assembled by the crab plan team with contributions from the State of Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS), and is available to the public and presented to the Council on an annual basis. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the NMFS web page at www.fakr.noaa.gov and the Alaska Department of Fish and Game (ADF&G) Westward Region we page at www.cf.adfg.state.ak.us/region4/rgn4home.htm .

Status of Annually Surveyed Crab Stocks

Table 1. MSST, 2003 spawning biomass (SB), sustained yield (SY), and 2003/2004 guideline harvest level (GHL) estimates for BSAI king and Tanner crab stocks. Estimated values are in millions of pounds.

Stock	MSST	2003 SB	2003 SY	2003/2004 GHL
Bristol Bay red king	44.8	178.1	35.7	15.7
Pribilof Islands red king	3.3	14.5	2.9	0
Pribilof Islands blue king	6.6	4.1	.8	0
St Matthew blue king	11.0	12.8	2.6	0
EBS Tanner	94.8	100.8	30.2	0
EBS snow	460.8	306.2	91.9	20.8

Table 1 provides summary information on the basic elements of stock condition for the six stocks that are surveyed annually by NMFS. The Federal requirements for determining the status of the stocks are the minimum stock size threshold (MSST) and the maximum fishing mortality threshold (MFMT). These requirements are contained in the FMP and outlined in the following section, overfishing parameters. The MSST is 50% of the mean total spawning biomass (SB = total biomass of mature males and females, also known as TMB = total mature biomass) for the period 1983-1997, upon which the maximum sustainable yield (MSY) was based. A stock is overfished if the SB is below the MSST. The MFMT is represented by the sustainable yield (SY) in a given year, which is the MSY rule applied to the current SB (the MSY control rule is $F = 0.2$ for king crabs, and $F = 0.3$ for Tanner and snow crabs). Overfishing occurs if the harvest level exceeds the SY in one year. GHLs are developed from joint NMFS and ADF&G assessment of stock conditions based on harvest strategies developed by ADF&G. Figures 1-6 show each crab stock's spawning biomass and catch history relative to overfishing.

As well as the Federal requirements, survey results for five stocks (Pribilof blue king crab, St. Matthew blue king crab, Bristol Bay red king crab, eastern Bering Sea Tanner crab, and eastern Bering Sea snow crab) are compared to thresholds established in State of Alaska harvest strategies and regulations. ADF&G uses these thresholds to determine if a fishery should be opened and to calculate the GHL. Please refer to the attached report "Executive Summary: Status of King Crab Stocks in the Eastern Bering

Sea in 2002" (Vining, et al 2002) for more detail on the population estimation methods for Bristol Bay red king crab, Pribilof Islands red and blue king crab, and St. Matthew blue king crab.

Bering Sea Tanner crab (*Chionoecetes bairdi*):

The 2003 survey estimate of spawning biomass increased to 100.8 million pounds from the 2002 estimate of 69.4 million pounds, which was essentially unchanged from the 2001 estimate (67.7 million pounds). In 2003, this stock increased above the MSST (94.8 million pounds spawning biomass) for the first time in six years.

The fishery was closed in 1997 due to near-record low stock abundance in the 1997 NMFS survey and extremely poor performance in the 1996 fishery. The Council adopted a rebuilding plan for this stock in October 1999. NMFS approved the rebuilding plan in June 2000 (65 FR 38216). The fishery has remained closed under the rebuilding harvest strategy since 1999. ADF&G will reopen the fishery when the female biomass is above the threshold and the fishery GHL is above the minimum identified in the rebuilding harvest strategy. Given the 2003 survey data, this stock is not expected to be above the "rebuilt" level (MSY biomass, defined in the FMP as 189.6 million pounds of total mature biomass) in 2004.

Estimated abundance in 2003 of molting mature males is 10.3 million animals (71% greater than the estimate for 2002). Estimates for abundance of mature-sized

Table 2. Threshold Values in State of Alaska Harvest Strategies for Bering Sea King and Tanner Crabs and Guideline Harvest Levels (GHLs) for 2003/2004 season.

Pribilof blue king crab

Stock threshold for fishery opening	2003 estimate
0.77 million crab, males >119-mm CL	.291 million crab [a]

St. Matthew blue king crab

Stock threshold for fishery opening	2003 estimate
2.9 million lbs, males >104 - mm CL	5.4 million lbs [a]

Exploitation rate on mature males (>104-mm CL)
0, when $B_M < 2.9$ million lbs
$[(B_M-2.9)/8.7]*0.1+0.1$, when $B_M \geq 2.9$ million lbs and $B_M < 11.6$ million lbs
0.2, when $B_M \geq 11.6$ million lbs
where B_M = biomass of males >104-mm CL.

GHL threshold for fishery opening	GHL for 2003 season
2.5 million lbs	Fishery closed

Bristol Bay red king crab

Stock threshold for fishery opening	2003 estimate
8.4 million crab, females>89 - mm CL and	29.69 million crab [b]
14.5 million lbs effective spawning biomass	60.70 million lbs [b]

Exploitation rate
10% when ESB is between 14.5 and 34.75 million lbs.
12.5% when ESB is between 34.75 and 55 million lbs.
15 % when ESB is at or above 55 million lbs

GHL threshold for fishery opening	GHL for 2003 season
4 million lbs	15.713 million lbs

Eastern Bering Sea Tanner crab (*bairdi*)

Stock threshold for fishery opening	2003 estimate
21 million lbs, females > 79 - mm CW	20.8 million lbs [c]

Exploitation rate on molting mature males
0, when B_F <21 million lbs
0.1, when $B_F \geq 21$ million lbs and B_F <45 million lbs
0.2, when $B_F \geq 45$ million lbs
where B_F = biomass of females >79 - mm CW.

GHL threshold for fishery opening	GHL for 2003 season
4 million lbs	Fishery closed

Eastern Bering Sea snow crab (*opilio*)

Stock threshold for fishery opening	2003 estimate
230.4 million lbs of spawning biomass (SB)	306.2 million lbs [c]

Exploitation rate on mature male biomass
0, when SB < 230.4 million lbs
0.1+(SB-230.4)(0.125/691.2), when SB≥230.4 million lbs and SB<921.6 million lbs
0.225, when SB≥921.6 million lbs

GHL threshold for fishery opening	GHL for 2003 season
15 million lbs	20.8 million lbs

[a] Catch-survey analysis estimate
[b] Length-based analysis estimate
[c] Area swept estimate

males and mature-sized females also show increases from 2002 to 2003; 44% greater than the 2002 estimate for mature-sized males and 52% greater than the 2002 estimate for mature-sized females. Abundance of exploitable legal males is, at 3.1 million animals, only slightly above the point estimate for 2002, however.

Although a sign of recruitment of males and females in the 1999 survey (a size-frequency mode at 80 to 90-mm CW) disappeared in the 2000 and 2001 surveys, the two size modes indicating juveniles recruiting to the stock in the 2001 survey track well into the 2002 data. These two juvenile size modes that first appeared in earlier survey data have continued to track well into the 2003 data. The 2001 survey data showed a new, large mode representing small (30-mm CW) juveniles that tracked to a mode at roughly 40-mm CW in the 2002 data and has apparently tracked to a mode of approximately 60-mm CW in the 2003 data. A mode of small (30-mm CW) juveniles that appeared in the 1999 survey tracked through to a mode at roughly 60-65 mm CW in 2002. That mode has apparently tracked to a mode at approximately 75-80 mm CW in the 2003 data; in the case of females, this mode has begun to contribute to the mature-sized female component in 2003. That these modes have tracked well for the last 3 years provides some confidence that there has been recruitment to the surveyed population. The amplitude of the modes tends to decrease with successive years, and it remains to be seen how much these modes will contribute to stock rebuilding as they grow into the mature- and legal-size classes.

Harvest Strategy: The Tanner crab fishery has thresholds against which survey data must be compared (Table 2; ADF&G 1999): one for a fishery opening, and a minimum GHL to assure manageability. The minimum stock threshold for a fishery opening is 21 million pounds of females > 79-mm carapace width (CW). The 2003 estimate for Tanner crab females > 79-mm CW is below the threshold at 20.8 million pounds. Hence, the fishery was closed for the 2003 season. When the female biomass is above the threshold, the GHL will be based on a harvest rate of 10% on molting mature males when the biomass of females >79 mm CW is <45.0 million pounds. When the biomass of females >79 mm CW is ≥45.0 million pounds, the harvest rate on molting mature males is increased to 20%. The legal harvest rate cap will be 50% of exploitable legal males. The first year the stock is above the female threshold, the GHL is reduced by one-half the value as computed by this rule. The minimum GHL for a fishery is 4 million pounds for the general (that is, "non-CDQ") fishery east of 168° W longitude to ensure manageability.

Bering Sea snow crab (*Chionoecetes opilio*):

Snow crab spawning biomass in 2003 is estimated to be 306.2 million pounds. This stock is below the MSST of 406.8 million pounds, with an estimated SB that is the fourth lowest on record; estimated SB for 2003 exceeds only the estimates for 1985, 1986, and 1999. The SB estimated for 2003 (306.2 million pounds) is comparable to SB estimated in 2002 (313.3 million pounds), but is only 54% of the 571 million pounds that was estimated for SB in 2001. SB estimated for 2003 is only slightly higher than the estimate for 1999 (283.3 million pounds) that resulted in the "overfished" declaration. Estimated mature male biomass decreased to 82% of that estimated for 2002 (222.7 million pounds) and to 61% of that estimated 2001 (302 million pounds). This stock remains in a depressed condition and is unlikely to be estimated above the currently defined B_{MSY} in the next year; it is uncertain if it will be estimated above the thresholds that would allow for a commercial harvest in the 2005 season under the current FMP and harvest strategy.

Size frequency distributions from the 2003 survey show modes representing new-shell males and females centered at 40-50 mm CW that indicate some recruitment to the stock not apparent in the 2002 survey or the 1999 survey. However, similar signs of recruitment to the stock in the 2000 and 2001 proved ephemeral, disappearing in the 2002 survey and not reappearing in the 2003 survey. A size-based assessment model for EBS snow crab estimates recruitment to the stock in 2003 to be high relative to that during 1995-2002, but low relative to that for the period 1979-1994.

The estimated abundance of males ≥4in CW in 2003 (65-million animals) has also declined from an estimated 78 million animals in 2001 and an estimated 76 million animals in 2002. Fifty-four percent of the estimated males ≥4-inches CW were from the Western Subdistrict. The percentage of new-shell males ≥4-in CW from the 2003 survey (approximately 70%) is comparable to the 2002 estimate but higher than that for the 1999-2001.

The GHL of 20.831 million pounds in the 2004 season represents 6.8% of the estimated SB and 11.4% of the estimated mature male biomass in 2003. At an average of 1.27 pounds per crab, the 20.831 million pound harvest would represent 16.403 million males. A harvest of 16.403 million males corresponds to 5% of the estimated mature male abundance (368 million animals), 36% of the abundance of new-shell males ≥4-in CW, and 25% of the abundance of all males ≥4-in CW estimated from the 2003 survey. The percentage of males ≥4-in CW that are in new-shell condition in this year's survey has no impact on the determination of the 2004 GHL under the harvest strategy.

Harvest Strategy: The harvest strategy adopted by the Alaska Board of Fisheries in March 2002 was used to estimate the GHL for 2004. The harvest strategy determines a GHL for snow crabs by the application of four rules: a minimum stock threshold for a fishery opening; a maximum exploitation rate on mature male biomass; a 58% cap on the removals of "exploitable legal males", and a minimum GHL for fishery opening of 15 million pounds.

<u>Stock threshold for fishery opening</u>. The threshold level for opening the fishery is 230.4 million pounds of SB, or one-half of MSST. The fishery is closed if the stock is below that threshold level. If SB is above the 230.4 million-pound threshold for a fishery opening, the GHL is computed as a function of the FMP's definitions for MSY biomass and overfishing rate and the estimated SB, the mature male biomass (MMB), and the "exploited legal male abundance". The GHL is constrained by a maximum exploitation rate on MMB and a maximum harvest rate on "exploited legal males."

<u>Maximum exploitation of mature male biomass</u>. Under current FMP definitions for MSY biomass (B_{MSY} = 921.6 million pounds SB) and overfishing rate (F_{MSY} =0.3), the maximum exploitation rate on MMB, E_{MMB}, is determined as a function of SB as

- E_{MMB} = 0.1 + (TMB-230.4)•(0.125/691.2), for TMB ≥ 230.4 million pounds, but < 921.6 million pounds,
  and
- E_{MMB} = 0.225, for TMB ≥ 921.6 million pounds.

The maximum for a GHL_{max} is determined by

$GHL_{max} = E_{MMB} \bullet MMB$.

The SB benchmarks, 921.6 and 230.4 million pounds, for determining the exploitation rate are the MSY biomass (B_{MSY}) and MSST for eastern Bering Sea snow crab as specified in the FMP; 921.6 million pounds is B_{MSY} and 230.4 million pounds is one-half the MSST. Overfishing is avoided under this harvest strategy by applying an exploitation rate <30% only to the mature male biomass portion of the SB. Avoidance of overfishing is further assured by a maximum exploitation rate on mature male biomass of 75% of 30% -- when the SB reaches or exceeds B_{MSY}. When the SB falls below B_{MSY}, but exceeds MSST, the exploitation rate reduces linearly with decreasing SB until to a value of 10% when SB

= one-half MSST. When SB is below one-half MSST, the directed snow crab fishery is closed.

58% maximum harvest rate on exploited legal male abundance. The harvest strategy also specifies that a maximum of 58% of the "exploited legal male abundance" may be harvested. "Exploited legal male abundance" is defined as the estimated abundance of all new-shell legal males ≥4.0-in (102-mm) CW plus a percentage of the estimated abundance of old-shell legal males ≥4.0-in CW. The percentage of estimated old-shell male abundance used to compute exploited legal male abundance is determined from the expected fishery selectivity for old-shell males relative to new-shell males; males in old-shell, very-old-shell and very-very-old-shell condition are included as old-shell males in this definition. Legal size for the fishery is 3.1-in CW (including spines) in regulation, but the "industry standard" for retention and processing has been 4.0-in CW. To protect from excessive harvest of the component of the legal males that are ≥4-in CW, the targeted number of males ≥4.0-in CW for commercial harvest is capped at 58% of the exploited legal male abundance. That cap is applied to the exploited legal male abundance, rather than to the unadjusted estimated abundance of all males ≥4-in CW, to account for the fishery's selectivity for legal crab in new-shell condition. Expected fishery selectivity for old-shell males can be estimated from historic fishery and preseason survey data and from preseason information on processing standards from the crab industry.

If GHL_{max} as computed by the exploitation rate applied to MMB results in a harvested number of males ≥4-in CW that is greater than 58% of the exploitable legal male abundance, the final GHL must be adjusted downward from GHL_{max}. Hence, the 58% harvest cap on exploitable legal male abundance can constrain the final GHL determined for the season below GHL_{max}.

15 million pound minimum GHL. The fishery season will not be opened if the GHL for the general, non-CDQ, fishery is less than 15 million pounds. The minimum GHL addresses the inability to adequately manage the fishery towards a low GHL under the current fleet size, pot limit conditions, in-season data collection, and end-of-season gear requirements.

Application of Harvest Strategy for 2004 GHL: The GHL computed for the 2004 season is 20.831 million pounds. After removal of the 7.5% CDQ allocation (1.562 million pounds), the GHL remaining for the general fishery in 2004 (19.269 million pounds) is above the minimum of 15.0 million-pounds for a fishery opening. Details on the GHL computation are provided below.

Under the harvest strategy and with TMB at 306.2 million pounds, the maximum exploitation rate on mature male biomass (MMB) is

$$
\begin{aligned}
&(0.1 + (\text{TMB}-230.4)\bullet(0.125/691.2)) \\
&= (0.1 + (306.2-230.4)\bullet(0.125/691.2)) \\
&= 11.37\%.
\end{aligned}
$$

The 11.37% exploitation rate multiplied by the estimated MMB (183.2 million pounds) gives the maximum GHL:

$$
\begin{aligned}
&0.1137\bullet\text{MMB} \\
&= 0.1137\bullet183.2 \text{ million pounds} \\
&= 20.831 \text{ million pounds.}
\end{aligned}
$$

A GHL of 20.831 million pounds for the 2004 season would not result in a harvest exceeding 58% of "exploited legal males abundance," even if the harvest was composed exclusively of new-shell crabs ≥4-in CW. New-shell males account for 70%-73% of the number of males ≥4-in CW estimated from the 2003 survey, or approximately 46 million animals. Average weight of males ≥4-in CW estimated from the survey is 1.27 pounds. A harvest of 20.831 million pounds, at an average weight of 1.27 pounds per crab, represents a harvest of 16.403 million animals, which is roughly 36% of the estimated number of new-shell males ≥4-in CW. That is, even if we defined "exploited legal males" for the 2004 season as only new-shell males ≥4-in CW, the 58% harvest rate cap on exploited legal males has no effect on the GHL computation for the 2004 season.

Bristol Bay red king crab (*Paralithodes camtschaticus*):

Estimated SB for 2003 (178.1 million pounds) increased from the 2002 estimate of 129.9 million pounds, and increased over 50% from the 2001 estimate (88.0 million pounds). Estimated SB for 2003 is over 50% higher than the B_{MSY} stock level defined in the FMP (89.6 million pounds). Hence there are no expectations for this stock to approach its MSST of 44.8 million pounds in the near future.

The 2003 mature female abundance is estimated to be 29.69 million female crabs >89 mm CL and effective spawning biomass (ESB) estimated at 60.70 million pounds. Therefore, this stock was estimated to be above the threshold for a fishery opening of 8.4 million female crabs >89 mm CL and 14.5 million pounds ESB. With ESB estimated to be above the 55 million pound threshold, a 15% exploitation rate on mature males was used to determine the GHL of 15.713 million pounds (14.535 million pound GHL for the general commercial fishery and 1.178 million pounds harvest limit for the CDQ fishery) . Length-based analysis (LBA) estimates indicate that the abundance of the mature portion of the stock has been essentially stable relative to 2001. Based on the 2003 LBA data, the ESB increased by 27% between 2002 and 2003. Mature male abundance increased 16% over the 2002 estimate and legal male abundance increased by 26%.

Indications from the 2002 survey data of future recruitment to the mature female size class and to the mature male size class continues to be evident in the 2003 survey data. That indication is given by the large mode for both males and females between 85 and 90 mm CL in the 2003 data. The mode of juvenile-sized females seen in the 2002 data has apparently contributed to the abundance of mature-sized females in 2003. That mode should continue to provide new recruitment to mature-sized females in 2004. For males, that mode may begin to provide some new recruitment to the mature male size class in 2004 and should provide increased recruitment to mature-sized males in 2005.

Pribilof Islands red king crab (*Paralithodes camtschaticus*):

The 2003 SB estimate from the survey was 14.5 million pounds, a continuing decrease from the 2002 estimate of 18.1 million pounds, and the 2001 survey SB estimate of 25.5 million pounds. This stock, however, presents particular problems to the NMFS trawl survey in providing reliable levels of precision in stock estimates. Abundance estimates for the Pribilof red king crab stock have fluctuated widely and unpredictably since the early 1990s, but precision of estimates is so poor that this stock can only be considered stable within the limits of the precision afforded by the assessment data. If the stock is stable, the actual level at which it is stable is unknown. NMFS estimates for total mature biomass in 2003 place this stock well above the MSST defined in the FMP (3.3 million pounds of spawning biomass). There are questions, however, whether the MSST defined for this stock is appropriate for "prevailing ecological conditions".

ADF&G CSA and NMFS area-swept estimates for mature-sized males in 2003 are slightly lower than for 2002 (1.755 million crabs in 2002 as compared to 1.545 million in 2003 for the CSA estimates; 1.816 million in 2002 as compared to 1.298 million in 2003 for the area-swept estimates). The low precision for these estimates, however, precludes any conclusion on trend in abundance of mature males. The CSA estimate for legal males in 2003 (1.433 million) is comparable to that for 2002 (1.371 million). The NMFS area swept estimate for legal males in 2003 (1.251 million) is lower than for 2002 (1.799 million), but the 95% confidence interval of +/- 130% disallows any meaningful conclusions on trend. What is noteworthy in the 2003 data is that few sublegal males were captured during the 2003 survey; the NMFS area-swept estimate for sublegal males in 2003 is 0.047 million, as compared to an estimate of 1.251 million legal males. Poor representation of sublegal males in the 2003 and 2002 surveys provide low expectations for recruitment to the legal or mature male stock in the near future. The 2003 survey data, coupled with results from 2002, suggests that the two-fold increase in mature stock in the area-swept estimates between 2000 and 2001 was likely due to survey error in 2001. CSA point estimates of mature male abundance show an increasing trend from 1.021 million males since 1997 to, perhaps, a leveling out at approximately 1.5 million in 2002-2003. However, the 95% confidence interval for the 2003 mature male CSA estimate (0.709 million to 2.381 million) includes each of the point estimates for mature male abundance in 1991-2002. Such poor precision in abundance estimates makes it impossible to draw any conclusions on the reality of apparent trends or on the current status of the stock. At the level of precision that abundance is estimated, the mature male stock can be considered stable during 1999-2003. However, given the poor indications for recruitment, mature male abundance would be expected to decline with or without a fishery over the next several years; that decline may have already began between 2002 and 2003.

The Pribilof red king crab fishery is prosecuted concurrent with the Pribilof blue king crab. No formal harvest strategy has been developed for this stock. The stock has been closed to fishing since 1999 due to imprecision of abundance estimates and concerns about bycatch of blue king crab.

This fishery will remain closed for the 2003 season due to concerns about bycatch effects on blue king crab and the poor precision of red king crab abundance estimates. The Pribilof District blue king crab stock is below threshold for a fishery opening and the estimate of total mature biomass for the Pribilof blue king crab stock provided by NMFS is below the MSST defining an "overfished" condition. The Magnuson-Stevens-Act is clear in its direction to managers of federal FMP fisheries to protect "overfished" stocks from fishing mortality that can impair stock rebuilding. There is no observer data available to estimate bycatch rates for blue king crab in a directed red king crab fishery. The timing and area covered by the NMFS EBS trawl survey is not sufficient to determine potential distributional overlap of blue and red king crab during the commercial season. However, fish ticket data from past Pribilof king crab fisheries indicate the potential for bycatch of blue king crab during a directed fishery on the Pribilof red king crab stock. Uncertainty on stock abundance and trends for Pribilof blue king crab is so great and past fishery performance has been so poor that managers and analysts cannot determine a GHL for Pribilof red king crab that could be achieved without the risk of a prolonged season that would increase the potential for blue king crab bycatch. Aside from the concerns for blue king crab bycatch, the lack of a formal harvest strategy for Pribilof red king crab, the uncertainty on stock conditions, and poor fishery performance in past fisheries also raises concerns for the Pribilof red king crab stock when attempting to determine an appropriate GHL.

Pribilof Islands blue king crab (*Paralithodes platypus*):

The 2003 survey estimate of SB was 4.1 million pounds, a decrease from the 2002 SB estimate of 4.5 million pounds, and the 2001 survey estimate of 7.0 million pounds. This stock remains below the MSST of 6.6 million pounds. Hence, NMFS declared the stock overfished. The Council is developing a rebuilding plan for this stock. Although poor precision in abundance estimates makes year-to-year comparisons difficult, the trend in estimates since the mid-1990s indicates that this stock remains depressed and below MSST in 2003. Estimates of abundance for all male classes are low there is no indication that stock conditions are improving.

Under the existing harvest strategy developed for the Pribilof blue king crabs, fisheries are not opened unless the stocks exceed a threshold level of abundance (Pengilly and Schmidt 1995). The thresholds established for Pribilof Islands blue king crab is 0.77 million males > 119-mm carapace length (CL). Mature male abundance for 2003 is estimated at 0.291 million. The fishery has been closed since 1999 because the stock did not exceed the threshold level of abundance. Therefore, this population is declining in the absence of directed fishing pressure and in the absence of any bycatch during the Pribilof red king crab fishery; the Pribilof red king crab fishery has also remained closed since 1999. It is also worth noting that bycatch in trawl fisheries has not occurred due to the Pribilof trawl closure area. There is no evidence from this year's survey results that recruitment to the mature or legal male stock will occur in the near future.

<u>**St. Matthew blue king crab**</u> (*Paralithodes platypus*):

The 2003 SB estimate from the survey was 12.8 million pounds, an increase of over 50% from the 2002 estimate (4.7 million pounds), and value above the MSST. This stock is above the MSST (11.0 million pounds of SB) for the first time in five years. Estimated SB increased from 5.2 million pounds in 2000 to 9.0 million pounds in 2001, but dropped to 4.7 million pounds in 2002. Such erratic trends for this stock may reflect the low precision of the spawning biomass estimate. Low precision in estimation is due to the low number of tows that blue king crab are captured in during the trawl survey in the St. Matthew Island area; in that situation, only a few tows can have a large influence on the point estimate. Estimation of SB is particularly sensitive to the survey catch of mature females.

Total mature biomass would need to double from the 2003 estimate to 22.0 million pounds for the stock to be considered "rebuilt"; data from the 2003 survey do not provide any expectations for such an increase in the near-term future. This stock remains at a depressed level comparable to that seen in the mid-1980s. The low catch of blue king crab during each of the 1999-2002 trawl surveys makes it unlikely that the estimated stock condition is attributable to survey error; instead, it supports the hypothesis that natural mortality was higher than normal between the 1998 and 1999 surveys. The 1999-2003 CSA estimates of mature male abundance suggests some stability at this low level. However, given the low precision of estimates, no definitive statements on stock trends can be made.

There is a small indication that stock conditions are improving is that at least some small crabs were taken during the 2003 survey. The NMFS area-swept estimate for number of males <105 mm CL in 2003 (1.387 million) exceeds that for mature-sized (≥105 mm CL) in 2003 (0.824 million) by nearly 70%. Nonetheless, the low precision of estimates (95% confidence interval for the estimate of males < 105 mm CL is +/- 142 of the point estimate) suggests that we should adopt a "wait-and-see" attitude on this hopeful sign.

The fishery has been closed since 1999 and will remain closed in 2003. Although the stock is above the threshold for a fishery opening, the GHL of 0.685 million pounds computed according to the fishery harvest strategy is far below the minimum GHL of 2.5 million pounds that is considered manageable.

ADF&G developed the rebuilding harvest strategy for the St. Matthew Island blue king crab fishery that the Board adopted in March 2000. The harvest strategy includes four components: a stock threshold, a minimum GHL, variable mature harvest rates, and a cap on legal male harvest rate. A stock abundance threshold was set to promote rebuilding and prevent against future instances of stock declines to "overfished" status. A minimum GHL was chosen because small GHLs are not manageable given the current size of the fishing fleet. A maximum legal harvest rate cap was set to prevent high removal rates of legal crabs when most mature males are sublegal size such as would be the case when a strong year class has yet to recruit to the fishery. The harvest strategy is closely based on NMFS technical guidance for implementing precautionary harvest strategies and rebuilding plans of Restrepo et al. (1998). The harvest strategy is detailed in the ADF&G report "Overview of Stock Assessment and Recommended Harvest Strategy for St. Matthew Island Blue king Crabs" (Zheng and Kruse 2000).

The harvest strategy's four components are as follows:

1) A minimum stock threshold of 2.9 million lbs of mature male (105 mm carapace length) biomass. This is 25% of the equivalent mature male biomass capable of producing maximum sustainable yield (Bmsy=11.6 million lbs).

2) The GHL is determined by directed mature male harvest rates of: (1) 0 when mature male biomass (B) < 2.9 million lbs, (2) $[(B-2.9)/8.7]*0.1+0.1$ when $11.6 > B \geq 2.9$ million lbs, and (3) 0.2 when $B \geq 11.6$ million lbs.

3) The harvest rate on legal males is capped at 40%.

4) The minimum GHL for a fishery opening is 2.5 million pounds.

Crab Stocks With No Annual Survey

Stock status for the following stocks is unknown due to no survey biomass estimates: Pribilof Islands golden king crab (*Lithodes aequispinus*); Saint Lawrence Island blue king crab; Northern District golden king crab; Western Aleutian Tanner crab *(C. bairdi*); Aleutian Islands (AI) scarlet king crab (*Lithodes couesi*); Bering Sea triangle Tanner crab (*Chionoecetes angulatus*); Eastern AI triangle Tanner crab; Eastern AI grooved Tanner crabs (*Chionoecetes tanneri*); Western AI grooved Tanner crabs and Bering Sea grooved Tanner crabs. The permit fisheries for the species identified in Table 3 are by ADF&G commissioner's permit only with observer requirements. Estimation of MSST for these stocks is not possible at this time because of insufficient data on the basic stock abundance. The ADF&G Gulf of Alaska Marine Resource Assessment Survey is a triennial trawl survey east of 170°W that provides some information on EAI red king crab and EAI Tanner crab.

Table 3. 2002/2003 Guideline harvest levels (GHL), status of the fishery, and MSY estimates for BSAI king and Tanner crab stocks not annually surveyed. Estimated values are in millions of pounds.
(NA indicates that insufficient data exists at this time to estimate the value)

Stock	GHL	Fishery/Season	MSY
WAI (Adak) red king	0.5	10/25	1.5
EAI (Dutch Harbor) red king	0	closed	NA
Norton Sound red king	.248	6/15-9/3:11/15-5/15	0.5
St Lawrence blue king	NA	permit	0.1
AI golden king	5.7	8/15	15.0
Pribilof Is. golden king	0.15	permit	0.3
St. Matthew golden king	0.015	permit	0.3
AI scarlet king	NA	permit	NA
EBS scarlet king	NA	permit	NA
EAI Tanner	0	closed	0.7
WAI Tanner	0	closed	0.4
EAI angulatus	NA	permit	1.0
EBS angulatus	NA	permit	0.1
EAI tanneri	.05 to 0.2	permit	1.8
EBS tanneri	.05 to 0.2	permit	1.5
WAI tanneri	NA	permit	0.2

Aleutian Islands red king crab: WAI (Adak or Petrel Bank) and EAI (Dutch Harbor). The GHL for the eastern portion is based on the results of surveys performed by ADF&G on a triennial basis; the most recent survey was performed in 2003. Few red king crabs have been caught in surveys of the eastern Aleutians since 1995. The eastern portion has been closed since 1983. Historically, the GHL for the western portion has been based on the most recent fishery performance. The western portion was closed for the 1996/97 and 1997/98 seasons due to poor performance and poor signs of recruitment during the 1995/96 season. The western portion was reopened for limited exploratory fishing in some areas in 1998/99. Based on the results of the 1998/99 season, the fishery in the western portion was closed in 1999/2000. In 1999 the Crab Plan Team identified the need for standardized surveys in areas of historical production prior to reopening the fishery in the western portion; prior to that meeting, the western portion had not been surveyed since 1977. A cooperative ADF&G-Industry pot survey was performed in the Petrel Bank-Semisopochnoi Island area under the provisions of a permit fishery in January-February and November of 2001. Results of those surveys show high densities of legal crabs within limited portions of the surveyed area. Survey catches of females and prerecruit sized males were not as strong. Based on results of the 2001 surveys and recommendations from ADF&G and the public, the Alaska Board of Fisheries adopted pot limits, and modified the season opening date. A GHL of 0.5 million pounds was set for the 2002-03 season in the Petrel Bank area. Because only relative abundance information is available, ADF&G monitored the fishery utilizing inseason CPUE . The management goal is to maintain a fishery CPUE of at least 10-legal crabs per pot. The 2002-03 fishery in the Petrel Bank area of the WAI harvested 505,000 pounds. The fishing CPUE was 18. Based on fishery performance, ADF&G has announced a 0.5 million pound GHL for the 2003-04 fishery.

In order to assess red king crab in other portions of the western AI, during November 2002, a survey was conducted between 172° W long., and 179° W long. (area around Adak, Atka, and Amila Islands). The survey of these waters yielded very few red king crab. That area will remain closed until further notice.

Norton Sound red king crab: The Norton Sound red king crab legal male abundance is estimated from the triennial trawl survey. The 2002 ADF&G trawl survey estimated 2.3 million pounds of legal crab, a decrease from the 1999 survey estimate of 4.3 million pounds of legal male crab. This decrease in abundance was the result of weak recruitment over the previous three years. Recruitment is anticipated to be stronger over the next three years. Only the trawl survey conducted in 1996 produced a smaller biomass estimate. The Norton Sound crab fishery operates in the summer and in the winter. The legal male abundance remained in a range that allowed a harvest rate of 8% to be applied to the 2002 legal biomass estimate. The 2003 GHL was 253,000 lbs, based on the triennial trawl survey stock abundance estimates. The open access fishery was open July 1 by regulation and was closed by emergency order on August 13, 2003. The open access goal was 234,000 lbs, and the harvest was 253,284 lbs. The CDQ portion opened June 15, 2003 and closed June 28, 2003. Because the open access harvest exceeded their allocation, the CDQ fishery reopened on August 15, 2003 after the readjusting their allocation. The CDQ fishery closed for the second time on August 24, 2003. Total harvest for the CDQ fisheries was 13,923 pounds. ADF&G never set a GHL for the winter fishery which ran Nov 15, 2002 until May 15, 2003.

Aleutian Islands golden king crab (Eastern Aleutian Islands and Western Aleutian Islands golden king crab stocks): A standardized triennial pot survey for golden king crab in a portion of the eastern Aleutian Islands (in the vicinity of Amukta, Chagulak, and Yunaska Islands) was initiated in 1997. Results from the 2002 survey of that area indicate that catch per unit effort (CPUE) of legal male crabs has dropped by roughly one-third from the 1997 CPUE, whereas female and pre-recruit male CPUEs remained roughly stable at their 1997 levels. Analysis of 1996-2002 golden king crab fishery performance and observer data from the entire area east of 174° W longitude, on the other hand, indicate that the golden king crab stock has remained stable in that larger area. The 2003-04 GHL for the Aleutian Islands has again been set at 5.7 million pounds, with 2.7 million pounds for the area west of 174°W, and 3.0 million pounds for the area east of 174°W. The pot survey was again conducted in July 2003, but information is not yet available.

Eastern Aleutian Islands *C. bairdi* Tanner crab: The fishery has been closed since 1995 due to declining stock size estimated from surveys and poor fishery performance. In the 2000 survey, prerecruit and recruit sized Tanner crabs declined from the 1999 survey in the Eastern Aleutian District. Tanner crab abundance in the eastern Aleutian Islands remains below levels observed in the early 1990s. The Alaska Board of Fisheries recently implemented individual and overall fishery pot limits. In 2003 ADF&G and industry conducted a pot survey of limited portions of the Eastern Aleutians district, results are pending. A decision on the 2004 fishing is expected in November 2003.

Overfishing Parameters

The FMP identifies the following overfishing definitions to provide objective and measurable criteria for identifying when the BSAI crab fisheries are overfished or overfishing is occurring, as required by the Magnuson-Stevens Fishery Conservation and Management Act. Table 4 provides the MSST, MSY, OY and maximum fishery mortality threshold (MFMT) control rule estimates for the BSAI king and Tanner crab stocks. The Crab Plan Team will reevaluate these estimates every five years or when environmental conditions indicate a regime shift.

Table 4. MSST, MSY, OY, and the MFMT estimates for BSAI king and Tanner crab stocks. Estimated values are in millions of pounds.
(NA indicates that insufficient data exists at this time to estimate the value)

Stock	MSST	MSY	OY range	MFMT
WAI (Adak) red king	NA	1.5	0 - 1.5	0.2
Bristol Bay red king	44.8	17.9	0 - 17.9	0.2
EAI (Dutch Harbor) red king	NA	NA	NA	0.2
Pribilof Islands red king	3.3	1.3	0 - 1.3	0.2
Norton Sound red king	NA	0.5	0 - 0.5	0.2
Pribilof Islands blue king	6.6	2.6	0 - 2.6	0.2
St Matthew blue king	11.0	4.4	0 - 4.4	0.2
St Lawrence blue king	NA	0.1	0 - 0.1	0.2
Aleutian Is. golden king	NA	15.0	0 - 15.0	0.2
Pribilof Is. golden king	NA	0.3	0 - 0.3	0.2
St. Matthew golden king	NA	0.3	0 - 0.3	0.2
Aleutian Is. scarlet king	NA	NA	NA	0.2
EBS scarlet king	NA	NA	NA	0.2
TOTAL king crab		**43.9**	**0 - 43.9**	
E. Aleutian Is. Tanner	NA	0.7	0 - 0.7	0.3
EBS Tanner	94.8	56.9	0 - 56.9	0.3
W. Aleutian Is. Tanner	NA	0.4	0 - 0.4	0.3
TOTAL Tanner crab		**58.0**	**0 - 58.0**	
EBS snow	460.8	276.5	0 - 276.5	0.3
TOTAL snow crab		**276.5**	**0 - 276.5**	
E. Aleutian Is. angulatus	NA	1.0	0 - 1.0	0.3
EBS angulatus	NA	0.3	0 - 0.3	0.3
E. Aleutian Is. tanneri	NA	1.8	0 - 1.8	0.3
EBS tanneri	NA	1.5	0 - 1.5	0.3
W. Aleutian Is. Tanneri	NA	0.2	0 - 0.2	0.3
TOTAL other Tanners		**4.8**	**0 - 4.8**	

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available. Proxy stocks are used for BSAI crab stocks where insufficient scientific data exists to estimate biological reference points and stock dynamics are inadequately understood. MSY for crab species is computed on the basis of the estimated biomass of the mature portion of the male and female population or total spawning biomass (SB) of a stock. A fraction of the

SB is considered sustained yield (*SY*) for a given year and the average of the *SY*s over a suitable period of time is considered the MSY.

Overfishing and Overfished: The term "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce MSY on a continuing basis. Overfishing is defined for king and Tanner crab stocks in the BSAI management area as any rate of fishing mortality in excess of the maximum fishing mortality threshold, F_{msy}, for a period of 1 year or more. Should the actual size of the stock in a given year fall below the minimum stock size threshold, the stock is considered overfished. If a stock or stock complex is considered overfished or if overfishing is occurring, the Secretary will notify the Council to take action to rebuild the stock or stock complex.

MSY control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. The MSY control rule for king and Tanner crabs is the mature biomass of a stock under prevailing environmental conditions, or proxy thereof, exploited at a fishing mortality rate equal to a conservative estimate of natural mortality. Sustainable yield (SY) in a given year is the MSY rule applied to the current spawning biomass. Overfishing occurs if the SY is exceeded for one year or more.

MSY stock size is the average size of the stock, measured in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof. It is the stock size that would be achieved under the MSY control rule. It is also the minimum standard for a rebuilding target when remedial management action is required. For king and Tanner crab, the MSY stock size is the average mature biomass observed over the past 15 years, from 1983 to 1997.

Maximum fishing mortality threshold (MFMT) is defined by the MSY control rule, and is expressed as the fishing mortality rate. The MSY fishing mortality rate F_{msy} = M, is a conservative natural mortality value set equal to 0.20 for all species of king crab, and 0.30 for all *Chionoecetes* species.

Minimum stock size threshold (MSST) is whichever is greater: one half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold. The minimum stock size threshold is expressed in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof.

Management Programs

Community Development Quota Crab Fisheries

The Magnuson-Stevens Act mandates that the Council and NMFS establish a Community Development Quota (CDQ) program under which a percentage of the total allowable catch for Bering Sea and Aleutian Island crab fisheries is allocated to the CDQ program (16 U.S.C. 1855 (i)(1)(A)). The Council and NMFS deferred management authority of the BSAI king and Tanner crab fisheries, including the CDQ fisheries, to the State, with federal oversight. The State/Federal cooperative management regime established in the FMP specifies three categories of management measures, which provide the framework for Federal/State management of the crab fisheries, including the determination of the GHLs and fishery seasons. Additionally, the FMP authorizes the State to allocate the crab CDQ reserve among CDQ groups and to manage crab harvesting activity of the BSAI CDQ groups (§8.1.4.2 of the FMP).

Table 5. 2003-2005 CDQ program percent allocation by group.

Fishery	APICDA	BBEDC	CBSFA	CVRF	NSEDC	YDFDA
Bristol Bay red king crab	17	19	10	18	18	18
Pribilof red & blue king	0	0	100	0	0	0
St. Matthew blue king	50	12	0	12	14	12
Norton Sound red king	0	0	0	0	50	50
Tanner crab	10	19	19	17	18	17
Snow crab	8	20	20	17	18	17

Table 6. 2003/2004 CDQ reserve (in pounds).

Fishery	CDQ
Bristol Bay red king crab	1,178,000
Pribilof red & blue king	0
St. Matthew blue king	0
Norton Sound red king	19,800
Tanner crab	0
Snow crab	1,562,000

Sixty-five communities along the Bering Sea are eligible for the CDQ program. These villages aligned into six CDQ groups: Aleutian Pribilof Island Community Development Association (APICDA), Bristol Bay Economic Development Corporation (BBEDC), Central Bering Sea Fishermen's Association (CBSFA), Coastal Villages Regional Fund (CVRF), Norton Sound Economic Development Corporation (NSEDC), and Yukon Delta Fisheries Development Association (YDFDA). The CDQ reserve is 7.5% of the GHL for the following Bering Sea fisheries: Bristol Bay red king crab, Pribilof red and blue king crab, Norton Sound red king crab, snow crab, and Tanner crab. ADF&G divides the 7.5% reserve among the six CDQ groups.

Table 7: Crab Licenses Limitation Program: number of licenses issued as of May 2003

Number of crab licenses: 320 (56 of which are interim licenses)

Number of crab licenses with specific endorsements, by crab fishery:

Endorsement	Licenses	Interim	Total
Aleutian Is. golden king	27	11	38
Aleutian Is. red king	26	11	37
EBS Tanner	254	54	308
Bristol Bay red king	250	52	302
Norton Sound king	60	3	63
Pribilof Is. king	110	26	136
St. Matthew Is. blue king	165	34	199

Notes: A crab license may contain more than one endorsement. EBS Tanner endorsements included both snow crab (*C. opilio*) and Tanner crab (*C. bairdi*).

License Limitation Program

Fishing under the crab

license limitation programs (LLP) began in January 2000. The goal of the LLP is to limit access to the crab fisheries to the historic participants or to people who purchase licenses from historic participants. Owners of vessels must have a valid LLP license in order to participate in the BSAI crab fisheries. NMFS issued licenses based on fishing history during a general qualifying period, with area/species endorsements based on additional qualifying periods for each species by area, and a recent qualifying period. Licenses also limit the size of the vessel deployed under the license. Interim licenses were also issued to any applicant that had a valid moratorium qualification for crab in 1999. Interim licenses are temporary and the total numbers of licenses will decrease as interim licenses either are denied or licenses granted. Interim licenses are issued if any part of a person's claim is contested. Also, the number of licenses may change as a result of a small number of new licenses issued from late filed claims.

American Fisheries Act Crab Sideboards

In 1998, Congress passed the American Fisheries Act (AFA) to establish a new allocation scheme for the BSAI pollock fishery. The AFA required harvest restrictions (commonly known as "sideboards") on the pollock fishermen who received exclusive harvesting privileges under the AFA to protect the interests of fishermen who are not directly benefited by the AFA. The sideboards for the AFA vessels to participate in the crab fisheries are as follows.

Under regulations implementing the AFA, an AFA vessel is ineligible to participate in any BSAI crab fishery unless that specific vessel participated in a specific crab fishery during certain qualifying years. AFA vessel permits could be endorsed for the Bristol Bay red king crab, snow crab, *C. bairdi* Tanner crab, St. Matthew blue king crab, Pribilof Islands king crab, Aleutian Islands red king crab, and Aleutian Islands golden king crab fisheries. To participate in a BSAI crab fishery, the operator of an AFA vessel would have to have a valid LLP license for that crab fishery as well as an AFA vessel permit containing an endorsement for that crab fishery.

In addition to the historic participation requirements, there is a cap on the amount of Bristol Bay red king crab and *C. bairdi* Tanner crab that the AFA vessels can harvest. The Bristol Bay red king crab harvest cap is based on the aggregate 5-year (1991-1997, excluding 1994-1995) weighted average share. Under this cap, AFA vessels may harvest up to 10.96% of the regular commercial GHL, which equals 1,593,036 pounds for the 2003 fishery. The amount of the harvest cap may change if the number of AFA vessels with Bristol Bay red king crab endorsements changes. An aggregate harvest cap will be established for *C. bairdi* Tanner crab once the stock rebuilds. This harvest cap will be based on the aggregate historic catch of the endorsed *C. bairdi* Tanner crab vessels for 1995-1996. Management and implementation of these crab harvest cap sideboards is deferred to the State of Alaska.

Table 8: Participation requirements for AFA catcher vessels to determine eligibility to harvest crab species. An AFA vessel must have participated in the directed crab fishery below during the participating years listed in order to be eligible to participate in that fishery in the future.

Fishery	Participating years
Bristol Bay red king	Made landings of BSAI king or Tanner crab species in 1996, 1997, ***or*** on or before February 7, 1998
St. Matthew blue king	1995, 1996, ***or*** 1997
Pribilof Islands king	1995, 1996, ***or*** 1997
Aleutian Is. golden king	1997/1998 ***and*** 1998/1999
Aleutian Is. red king	1995/1996 ***and*** 1998/1999
Snow crab	Made landing in each of four or more years from 1988-1997
C. bairdi Tanner	1995 ***or*** 1996

Table 9: Number of AFA vessels eligible to harvest crab and 2003 harvest cap for AFA vessels, by crab fishery:

Fishery	AFA Endorsements	2003 Harvest Cap
Aleutian Is. golden king	0	-
Aleutian Is. red king	0	-
C. bairdi Tanner	28	NA
Bristol Bay red king	41	1,593,036 pounds
Snow crab	6	-
Pribilof Is. king	2	-
St. Matthew Is. blue king	1	-

Note: NA indicates a harvest cap is not applicable because the fishery is closed for 2003.

Capacity Reduction Program

NMFS is developing regulations to implement a capacity reduction program (a.k.a. buyback program) for the BSAI crab fisheries, excluding Norton Sound, pursuant to Section 144(d) of Public Law 106-554 (section 144), as amended by Public Law 107-20. NMFS published the proposed rule on December 12, 2002 (67 FR 76329), but has yet to publish the final rule. Section 144 mandates a specific capacity reduction program. The objective of the program is to permanently remove harvesting capacity from the BSAI crab fisheries by permanently reducing the number of license limitation program licenses issued pursuant to the FMP. The action is necessary because the BSAI crab fisheries are over capitalized. The program will: 1) prevent certain crab vessels from fishing again anywhere in the world; 2) revoke the crab LLP licenses based on the vessels' fishing history; 3) revoke any NMFS issued non-crab licenses that the vessels' owners hold; and, 4) revoke the vessels' fishing histories upon which NMFS based the licenses to be revoked.

BSAI Crab Bycatch

prepared by David Witherell and Diana Stram, NPFMC staff

What is bycatch?

Bycatch of crab occurs in the directed crab pot fisheries and other fisheries, including groundfish and scallop fisheries. In the crab fisheries, crab bycatch includes females of target species, sublegal males of target species, and non-target crab. In all other fisheries, crabs are a prohibited species, so every crab caught incidentally is considered bycatch.

How many crabs are taken as bycatch?

The following tables show the numbers of crab taken as bycatch in these fisheries.

Bycatch of *C. opilio* crabs (numbers of crab) in Bering Sea fisheries, 1994-2002.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	scallop dredge	Total
1994	53,082,564	12,351,899	130,228	34,866	65,599,557
1995	48,734,000	5,165,555	230,233	0	54,129,788
1996	56,570,785	3,643,612	267,395	104,836	60,586,628
1997	75,005,446	5,276,208	554,103	195,345	81,031,102
1998	51,591,453	4,122,648	549,139	232,911	56,496,151
1999	47,093,200	1,544,747	269,778	150,421	49,058,146
2000	5,020,800	2,207,279	270,000	105,602	7,603,681
2001	6,123,100	1,293,143	215,000	68,458	7,699,701
2002	15,823,300	n/a	n/a	n/a	n/a

Bycatch of St. Matthew blue king crabs (numbers of crab) in Bering Sea fisheries, 1994-2002.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	scallop dredge	Total
1994	3,848,080	1,193	6	0	3,849,279
1995	confidential	2,725	47	0	n/a
1996	1,699,333	168	574	0	1,700,075
1997	confidential	8	187	0	n/a
1998	confidential	0	774	0	n/a
1999	n/a	0	4,983	0	n/a
2000	54,300	0	n/a	0	n/a
2001	1,300	0	n/a	0	n/a
2002	600	n/a	n/a	n/a	n/a

Bycatch of Bristol Bay red king crabs (numbers of crab) in Bering Sea fisheries, 1994-2002.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	scallop dredge	Total
1994	18,600	280,096	927	22	299,645
1995	0	44,934	3,257	0	48,191
1996	605,000	30,967	75,675	0	711,642
1997	985,000	50,711	25,579	0	1,061,290
1998	4,593,800	42,003	7,017	146	4,642,966
1999	957,800	84,709	8,968	1	1,026,178
2000	1,701,000	70,787	39,754	2	1,653,542
2001	2,419,100	58,552	19,000	0	2,496,652
2002	1,677,800	n/a	n/a	n/a	n/a

Bycatch of *C. bairdi* crabs (numbers of crab) in Bering Sea fisheries, 1994-2002.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	scallop dredge	Total
1994	19,003,200	2,496,761	48,221	245,000	21,793,182
1995	15,897,300	2,212,181	87,674	0	18,197,155
1996	4,588,000	1,836,031	279,560	17,000	6,930,591
1997	4,865,900	1,917,736	50,218	28,000	6,861,854
1998	4,293,800	1,477,816	46,552	36,000	5,854,168
1999	1,995,100	901,619	43,220	n/a	n/a
2000	491,000	1,002,074	140,453	53,614	1,539,141
2001	626,400	950,331	80,000	48,718	1,705,449
2002	1,282,600	n/a	n/a	n/a	n/a

Do all these crabs die?

Crab Fisheries

Some crabs taken as bycatch die due to handling mortality. Several laboratory and field studies have been conducted to determine mortality caused by handling juvenile and female crab taken in crab fisheries. There are a variety of effects caused by handling, ranging from sublethal (reduced growth rates, molting probabilities, decreased visual acuity from bright lights, and vigor) to lethal effects. Studies have shown a range of mortality due to handling based on gear type, species, molting stage, number of times handled, temperature, and exposure time (Murphy and Kruse 1995). Handling mortality may have contributed to the high natural mortality levels observed for Bristol Bay red king crab in the early 1980's (65% for males and 82% for females), that along with high harvest rates, may have resulted in stock collapse (Zheng et al. 1995). However, another study concluded that handling mortality from deck impacts and temperature was not responsible for the decline on the red king crab fishery (Zhou and Shirley 1995, 1996).

Byersdorfer and Watson (1992, 1993) examined red king crab and Tanner crab taken as bycatch during the 1991 and 1992 red king crab test fisheries. Instantaneous handling mortality of red king crab was <1% in 1991, and 11.2% in 1992. Stevens and MacIntosh (1993) found average overall mortality of 5.2% for red king crabs and 11% for Tanner crabs on one commercial crab vessel. Authors recommend these results be viewed with caution, noting that experimental conditions were conservative; mortality in the fishery might be higher. Mortality for red king crab held 48 hours was 8% (Stevens and MacIntosh 1993, as cited in Queirolo et al. 1995). A laboratory study that examined the effects of multiple handling indicated that mortality of discarded red king crabs was negligible (2%), although body damage increased with handling (Zhou and Shirley 1995).

Delayed mortality due to handling does not appear to be influenced by method of release. In an experiment during a test fishery, red king crab thrown off the deck while the vessel was moving versus those gently placed back into the ocean had no differences in tag return rates (Watson and Pengilly 1994). Handling methods on mortality have been shown to be non-significant in laboratory experiments with red king crab (Zhou and Shirley 1995, 1996) and Tanner crab (MacIntosh et al. 1996). Although handling did not cause mortality, injury rates were directly related to the number of times handled.

Mortality of crabs is also related to time out of water and air temperature. A study of red king crabs and Tanner crabs found that crabs exposed to air exhibited reduced vigor and righting times, feeding rates (Tanner crabs), and growth (red king crabs) (Carls and O'Clair 1989). For surviving females, there was no impact on survival of eggs or larvae. Cold air resulted in leg loss or immediate mortality for Tanner crabs, whereas red king crabs exhibited delayed mortality that occurred during molting. A relationship was developed to predict mortality as the product of temperature and duration of exposure (measured as degree hours). Median lethal exposure was -8oC for red king crab and -4.3oC for Tanner crab. For example, if crabs were held on deck for 10 minutes and it was -23oC (10 degrees below zero Fahrenheit) outside, about 15% of the king crab and 50% of the Tanner crab would die of exposure. Because BSAI crab fisheries occur from November through March, cold exposure could cause significant handling mortality to crabs not immediately returned to the ocean. Zhou and Shirley (1995) observed that average time on deck was generally 2 to 3 minutes, and they concluded that handling mortality was not a significant source of mortality for red king crab.

Further research has indicated that windchill may be an important mortality factor. In 1997, a laboratory study examined the effects of cold windchill temperature on mortality, limb loss, and activity (righting response) for sublegal sized male Tanner crabs (Zhou and Kruse, 1998, Shirley 1998). The study found significant inverse relationships between windchill and crab mortality, limb loss, and activity. Crabs were exposed to combinations of temperatures and wind speeds for a duration of 5 minutes, then placed in seawater tanks and held for 7 days. Zhou and Kruse (1998) found that virtually all crabs died when exposed to windspeeds greater than 7.7 m/s (15 nautical miles per hour) and air temperatures less than -10.4°C (13.3oF). Stronger winds, even at warmer temperatures (but still below freezing), can have the same effect. Shirley (1998) reported that 50% of the crabs died in windchill temperatures of -11°C (this windchill temperature can result from air temperatures of 21°F and wind speeds of 30 nautical miles per hour). He concluded that "The effects of windchill on sublegal Tanner crabs is dramatic, and undoubtedly results in decreased recruitment to adult stocks".

On the other hand, there is evidence from the fishery itself that windchill during the snow crab fishery may not be as important a mortality factor as would be expected from the laboratory study on Tanner crabs (Shirley 1998) and prevailing weather conditions. The primary evidence in this regard is the low rate of deadloss that occurs during the snowcrab fishery. The snow crabs that are delivered to processors are generally subjected to the similar windchill exposures before being sorted on deck and deposited into the holding tank as are non-legal snow crabs and Tanner crabs before they are sorted and discarded. Data collected by onboard observers during the 1999 snow crab fishery indicate that bycatch crabs generally are not exposed to the air longer than the retained catch (D. Tracy, ADF&G, pers. comm). Laboratory experiments found that snow crabs were more sensitive than either Tanner crabs (Shirley 1998) or red king crabs (Shirley 1999) and experienced 100% to 40% mortality at windchill values from -16°C to -10°C. Snow crab males were exposed to wind speeds from 8 to 16 m/s and air temperatures from -2 to -10°C for 5 minutes (corresponding to 16 to 32 mph and 28 to 14°F, respectively). Reduced exposure time significantly reduced mortality. Limb loss was variable, but pronounced at windchill values below -10°C. Coordination of crabs (measured as an ability to right themselves) was impaired after all but the least severe treatment; concern for the crabs ability to avoid predation after exposure is warranted (Warrenchuk 2001; Warrenchuk and Shirley, 2002).

Because snow crabs are typically kept in holding tanks for one to three weeks prior to offloading at processors (R. Morrison, ADF&G, pers. comm.), high rates of deadloss would be expected in the deliveries if on-deck wind chill exposure resulted in mortality rates comparable to those experienced by Tanner crabs in the laboratory study. Commercial catch statistics from the 1990 through 1998 snow crab seasons, however, indicate that the annual deadloss averaged only 1.3% of the total delivered snow crabs and ranged from 0.7% to 2.0%. Such low rates of deadloss, despite the low temperatures and high winds that can occur in the Bering Sea during the snow crab fishery, may be reflective of features of fishing vessels and fishing practices that serve to protect captured and sorted crabs from windchill exposure. Shelter decks, storm walls, use of totes, and leeward alignment of vessels during gear retrieval, for example, would tend to protect crabs from windchill exposure during sorting. However, these low rates of dealoss are averages from throught the season. Higher rates of deadloss may be found in crab deliveries made during periods following more severe weather conditions. Additionally, observer data collected during the 1998 and 1999 snow crab seasons indicate that sorted bycatch typically is returned to the sea in less time than the 5 minutes that crabs were exposed to windchill during the laboratory study (D. Tracy, ADF&G, pers. comm). Data on limb autotomies collected from bycatch Tanner crabs by onboard observers during the 1999 snow crab season also indicate that the effects of windchill in practice is less than that predicted from laboratory studies and prevailing weather. Examination of 1,718 bycaught *bairdi* prior to discarding during the 1999 season indicates a limb autotomy rate of only 0.3% -- well below the limb autotomy rates observed in the laboratory study for windchills associated with high mortality rates. In summary, although it has been conclusively shown that windchill can effect high rates of mortality in Tanner crabs, there is also evidence that exposure of captured crabs to such windchill may not be common during actual fishing.

Retained crab mortality (evidenced by deadloss) is circumspect as a predictor of bycatch mortality. No relationship exists between windchill and reported deadloss. Since a relationship between windchill and mortality was clearly observed in the lab (Warrenchuk & Shirley,2002), retained crabs may not be subject to the same level of stress as bycatch crabs. Bycatch crabs are exposed longer than retained crabs as most crews prioritize sorting of retained crabs (Tracy and Byersdorfer 2000). Retained crabs are dropped only a short distance directly into the holding tanks, while non-retained crabs may be thrown over the side of the vessel or swept along the deck into scuppers, which results in rougher and more prolonged handling. Also, non-retained crabs are smaller and may lose heat quicker than retained crabs. Smaller crabs have a greater surface area to volume ratio and less thermal mass (Shirley 1999). Smaller juvenile Tanner crabs were more sensitive to cold aerial exposure than larger adults (Carls and O'Clair 1995) and adult Tanner crabs were more sensitive to exposure and windchill than larger red king crabs (Carls and O'Clair 1990; Shirley 1999). Mortality of non-retained snow crab during the 1998 fishery was estimated to be from 3.6% (windchill model) to 19.6% (temperature/windspeed model) (Warrenchuk and Shirley, accepted for publication).

Trawl Fisheries

The effect of crab bycatch on crab stocks is somewhat tempered by survival of discarded crabs. There have been numerous studies conducted 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 acute 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 other analyses, the estimated mortality rate of trawl bycaught red king crab and Tanner crab was 80% (NPFMC 1993, 1995).

Other Groundfish Fisheries

Some crabs are caught incidentally by non-trawl gear in pursuit of groundfish, and a portion of these crabs die. No field or laboratory studies have been made to estimate mortality of crab discarded in these fisheries. However, based on condition factor information from the trawl survey, mortality of crab bycatch has been estimated and used in previous analyses (NPFMC 1993). Discard mortality rates for red king crab were estimated at 37% in longline fisheries and 37% in pot fisheries. Estimated bycatch mortality rates for Tanner crab were 45% in longline fisheries and 30% in pot fisheries. No observations had been made for snow crab, but mortality rates are likely similar to Tanner crab. In the analysis made for Amendment 37, a 37% mortality rate was assumed for red king crab taken in longline fisheries and an 8% rate for pot fisheries. Observer data on condition factors collected for crab during the 1991 domestic fisheries suggested lower mortality of red king crab taken in groundfish pot fisheries. Bycatch mortality rates used in the analysis of Amendment 37 (NPFMC 1996) for snow crabs were 45% in longline fisheries and 30% in pot fisheries.

Scallop Fishery

Observations from scallop fisheries across the state suggest that mortality of crab bycatch is low relative to trawl gear due to shorter tow times, shorter exposure times, and lower catch weight and volume. For crab taken as bycatch in the Gulf of Alaska weathervane scallop fishery, Hennick (1973) estimated that about 30% of Tanner crabs and 42% of the red king crabs bycaught in scallop dredges were killed or injured. Hammerstrom and Merrit (1985) estimated mortality of Tanner crab at 8% in Cook Inlet. Kaiser (1986) estimated mortality rates of 19% for Tanner crab and 48% for red king crab bycaught off Kodiak Island. Urban el al. (1994) reported that in 1992, 13-35% of the Tanner crab bycaught were dead or moribund before being discarded, with the highest mortality rate occurring on small (<40 mm cw) and large (>120 mm cw) crabs. Delayed mortality resulting from injury or stress was not estimated. Mortality in the Bering Sea appears to be lower than in the Gulf of Alaska, in part due to different sizes of crab taken. Observations from the 1993 Bering Sea scallop fishery indicated lower bycatch mortality of red king crab (10%), Tanner crab (11%) and snow crab (19%). As with observations from the Gulf of Alaska, mortality appeared to be related to size, with larger and smaller crabs having higher mortality rates on average than mid-sized crabs (D. Pengilly, ADF&G, unpublished data). Immediate mortality of Tanner crabs from the 1996 Bering Sea scallop fishery was 12.6% (Barnhart and Sagalkin 1998). Delayed mortality was not estimated. In the analysis made for Amendment 41, a 40% discard mortality rate (immediate and delayed mortality combined) was assumed for all crab species.

So what are the population impacts of bycatch?

By applying mortality rates estimated from scientific observations to the number of crabs taken as bycatch, it is possible to estimate the relative impacts of bycatch on crab populations. Discard mortality rates have been established in previous analysis (NPFMC 1999), and may be species or fishery specific. Bycatch mortality rates in trawl, dredge, and fixed gear fisheries for all crab species were set at 80% , 40%, and 20% respectively. For crab fisheries, mortality rates were averaged across different fisheries. Rates used were 24% for *C. opilio*, 20% for *C. bairdi*, and 8% for blue king crab and red king crab.The following tables show the resulting discard mortality estimates, the estimated population size based on the NMFS trawl survey, and the percentage of the population removed due to bycatch mortality.

Total bycatch (numbers) mortality of red king crab in all fisheries in the Bristol Bay area, 1994-2001, and current years survey abundance estimate.

Year	Bycatch mortality	Abundance (millions)	Bycatch as %
1994	225,759	33.9	0.67
1995	35,599	33.9	0.11
1996	88,309	53.3	0.17
1997	124,485	75.1	0.17
1998	402,568	75.6	0.52
1999	144,161	46.7	0.22
2000	200,661	50.0	0.40
2001	244,169	44.2	0.55

Total bycatch (numbers) mortality of blue king crab in all fisheries in the St. Matthew area, 1994-2001, and current years survey abundance estimate.

Year	Bycatch mortality	Abundance (millions)	Bycatch as %
1994	308,802	5.9	5.23
1995	conf	5.6	*
1996	136,196	10.0	1.36
1997	conf	10.0	*
1998	conf	8.4	*
1999	997	1.7	0.06
2000	n/a	1.7	*
2001	n/a	2.9	*

Total bycatch mortality (numbers) of *C. bairdi* crab in all fisheries in the Bering Sea, 1994-2001, and current years survey abundance estimate.

Year	Bycatch mortality	Abundance (millions)	Bycatch as %
1994	5,905,693	192.0	3.08
1995	4,966,740	189.9	2.62
1996	2,449,137	175.6	1.39
1999	2,528,612	159.0	1.59
1998	2,064,723	156.5	1.32
1999	n/a	349.5	*
2000	949,394	219.2	0.43
2001	921,032	600.1	0.15

Total bycatch mortality (numbers) of *C. opilio* in all fisheries in the Bering Sea, 1994-2001, and current years survey abundance estimate.

Year	Bycatch mortality	Abundance (millions)	Bycatch as %
1994	22,661,327	9,445.9	0.24
1995	15,874,651	8,655.3	0.18
1996	16,587,291	5,424.9	0.31
1997	22,411,232	4,107.5	0.55
1998	15,883,059	3,233.3	0.49
1999	11,349,869	1,401.0	0.81
2000	3,067,056	3,241.2	0.09
2001	2,589,299	3,861.3	0.07

What about unobserved mortality?

In addition to those crabs that are captured as bycatch, fishing activities can also cause crab mortality in ways that cannot be directly observed. A summary of these potential unobserved mortalities are discussed below.

Crab Fishery

Catching mortality is ascribed to those crabs that enter a pot and are eaten by other pot inhabitants before the pot is retrieved. Catching mortality likely occurs during the molting period, when crabs are more susceptible to cannibalism. Most crab fisheries are set to occur outside of the molting season, and catching mortality in these fisheries may be limited to octopus or large fish entering a pot. Because no evidence of crab is left in the pot, these mortalities remain unassessed.

Mortality is also caused by ghost fishing of lost crab pots and groundfish pots. Ghost fishing is the term used to describe continued fishing by lost or derelict gear. The impact of ghost fishing on crab stocks remains unknown. It has been estimated that 10% to 20% of crab pots are lost each year (Meyer 1971, Kruse and Kimker 1993). Based on skipper interviews, about 10,000 pots were estimated lost in the 1992 Bristol Bay red king, and Bering Sea Tanner and snow crab fisheries (Tracy 1994). Fewer pots are expected to be lost under pot limit regulations and shorter seasons. Bob Schofield, a major crab pot manufacturer, testified at the January 1996 Council meeting that he was making fewer pots since inception of the pot limit. He estimated that 6,461 pots were replaced in 1995. It is not known how long lost pots may persist and continue to fish, or just litter the bottom.

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

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

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

Another very minor source of human induced crab mortality is direct gear impacts. Direct gear impacts result from a pot landing on the ocean floor when it is being set, presumably damaging any crab on which it lands. With reasonable assumptions, direct gear impacts are only a very minor source of mortality, however. An estimate of this impact can be derived by multiplying the number of pot lifts, the area they occupy, and relative crab density within areas fished in the Bering Sea. Assuming that pots land on different areas after each lift, and crab pots are set non-randomly over areas with relatively high density of crabs in directed fisheries, the total number of crab impacted can be roughly estimated. For 1993 the red king crab fishery, assuming a density of 5,000 red king crab of all sizes per square mile (density data from Stevens et al. 1998), a maximum of about two thousand red king crab were impacted (NPFMC 1996). Similarly, a maximum of 9,000 Tanner crabs (assuming 10,000 crab/mile2) and 110 thousand snow crabs (assuming 75,000 crab/mile2) were impacted by direct gear impacts in respective crab fisheries in 1993. It is not known what proportion of these crab die when a crab pot lands on them.

Trawl Gear

Not all crabs in the path of a trawl are captured. Some crab pass under the gear, or pass through the trawl meshes. Non-retained crabs may be subject to mortality from contact with trawl doors, bridles, footrope, or trawl mesh, as well as exposure to silt clouds produced by trawl and dredge gear. Only a few studies have been conducted to estimate catchability of crabs by trawl gear, and these studies are summarized below.

In one experiment to measure non-observable mortality, 169 red king crabs were tethered in the path of an Aleutian combination trawl (Donaldson 1990). The trawl was equipped with a footrope constructed of 14 inch bobbins spaced every 3 feet, separated by 6.5 inch discs. Thirty-six crabs (21.3%) were recovered onboard the vessel in the trawl. Divers recovered 46.2% of the crabs not captured by the trawl. Another 32.5% were not recovered but assumed to have interacted with the trawl. Of the 78 crabs not retained in the trawl, but captured by divers, only 2.6% were injured. If all injured crabs die, the non-observable mortality rate for trawl gear on red king crabs is estimated at 2.6% (Donaldson 1990). It should be noted that hard shelled crabs were used in this experiment; higher impacts would be expected if softshelled crabs were tested. Additionally, some areas have had higher intensity of bottom trawling than other areas, thus potentially exposing some crabs to multiple interactions with trawl gear.

In 1995, NMFS used underwater video cameras to observe the interaction of trawl gear with king and Tanner crabs (Craig Rose, NMFS, unpublished data). The experiment was conducted in Bristol Bay in an area with large red king crabs and Tanner crabs. Three types of trawl footropes were examined and they are as follows: a footrope with 3-4 foot lengths of 6" discs separated by 10" discs (called disc gear), a footrope with 24" rollers (tire gear), and an experimental float/chain footrope with the groundgear suspended about 8" off the seafloor. For disc gear, preliminary analysis indicated that all red king crab encountered entered the trawl and about 76% of the Tanner crabs were caught. Tire gear captured fewer king crabs (42%) and Tanner crabs (1%). The float/chain gear did not catch any of the crabs encountered. At the December 1995 Council meeting, excerpts of the NMFS video were shown to the Council and public. Trawl industry representatives testified that groundgear used to harvest finfish in this area depended on target species and bottom type, with tire gear type footropes used in hard bottom areas, and disc type gear used on smooth bottom areas. Testimony also indicated that variability existed in groundgear used among vessels, but that on average, most gear used in Bristol Bay trawl fisheries would be comprised of groundgear with discs or rollers larger than the disc gear tested and smaller than the tire gear tested.

The NMFS underwater video observations were further analyzed to determine the proportion of red king crab that were injured by passage under bottom trawl footropes (Rose 1999). Injury rates of 5% to 10% were estimated for crabs that encountered, but were not captured, in the center section of the trawl.

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ANNUAL MANAGEMENT REPORT FOR THE COMMERCIAL AND SUBSISTENCE SHELLFISH FISHERIES OF THE ALEUTIAN ISLANDS, 2002/2003

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ALEUTIAN ISLANDS KING CRAB MANAGEMENT AREA

Description of Area

The Aleutian Islands king crab Registration Area O has as its eastern boundary the longitude of Scotch Cap Light (164° 44' W. long.), its western boundary the Maritime Boundary Agreement Line as that line is described in the text of and depicted in the annex to the Maritime Boundary Agreement between the United States and the Union of Soviet Socialist Republics signed in Washington, June 1, 1990, and as that Maritime Boundary Agreement Line is depicted on *NOAA Chart #513* (6 Edition, February 23, 1991) and *NOAA Chart #514* (6 Edition, February 16, 1991), adopted by reference [UNITED STATES-RUSSIA CONVENTION LINE OF 1867], and its northern boundary a line from the latitude of Cape Sarichef (54° 36 N. lat.) to 171° W. long., north to 55° 30' N. lat., and west to the Maritime Boundary Agreement Line [UNITED STATES-RUSSIA CONVENTION LINE OF 1867] (Figure 1-1). Area O encompasses both the waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles).

ALEUTIAN ISLANDS RED KING CRAB

Historical Background

Historically, the red king crab *Paralithodes camtschaticus* resource in the Aleutian Islands was harvested in two registration areas. The Adak Registration Area consisted of those waters in the Aleutian Islands west of 171° W long. while the Dutch Harbor Registration Area encompassed waters east of 171° W long. (Figure 1-2). In addition, as the fleet moved westward, a third Registration Area (Area S) was established for the waters around Amchitka Island and the Petrel Bank. Area S was created in 1967 and was merged into Area R in 1978 (ADF&G 1991). In March of 1996, the Alaska Board of Fisheries (BOF) established the Aleutian Islands king crab Registration Area (Area O) by combining the existing Dutch Harbor and Adak Registration Areas. The BOF adopted this change to improve management of the increasingly important golden king crab *Lithodes aequispinus* stocks in the Aleutian Islands. Combining the Adak and Dutch Harbor Areas was not expected to impact management of red king crabs in the Aleutian Islands (ADF&G 1999a).

Domestic fisheries for red king crabs in both the Adak and Dutch Harbor Registration Areas began in 1961, with effort and harvest increasing rapidly in both areas. The Adak Area reached a peak harvest of 21 million pounds in 1964/65, while maximum production of 33 million pounds in the Dutch Harbor Area was reached in 1966/67 (Table 1-1, Figure 1-3). Fluctuating harvest levels from one year to the next characterized the fisheries in the Dutch Harbor and Adak areas, and by the 1982/83 season the Dutch Harbor fishery had declined to a harvest of 430,000 pounds. Commercial fishing for red king crabs in the Dutch Harbor Area was closed on an annual basis after the 1982/83 season. The Adak fishery remained open through the 1995/96 season when only 39,000 pounds were harvested. After the 1995/96 season the fishery was closed for several years. Portions of the area were opened during the 1998/99, 2000/01, and 2001/02 seasons in order to assess the status of red king crab stocks. In 2002/03 the Petrel Bank portion of Area O was reopened to commercial fishing with a guideline harvest level (GHL) of 500,000 pounds. The Aleutian Islands red king crab fishery had a maximum fishery value of nearly $20 million in the 1980/81 season (Table 1-2).

Observers have been required on all crab catcher-processor vessels since 1988 and on catcher vessels targeting red and golden king crabs in the Aleutian Islands since 1995. Observer coverage on golden king crab vessels provides red king crab bycatch data from that fishery, although red king crab bycatch in golden king crab gear is minimal due to the limited overlap in distribution of the two species. Observer coverage provides data on retained and non-retained crabs as well as information related to fishing patterns.

In 1996 and 1997, a catcher-processor vessel was permitted to target red king crabs on the Petrel Bank during directed golden king crab fishing. The goals of this project were to enumerate, tag, and collect biological data from all red king crabs captured and to recapture tagged individuals. During this two-year period, a total of 926 crabs were tagged along the north side of Amchitka Island and along the south side of Semisopochnoi Island. Of the tagged crabs, 440 were legal males and 160 were females; 89% of legal crabs were new shell. Recovery efforts yielded 15 tagged crabs, 6 of which were legal males. While the tagging was too limited to provide quantitative stock assessment data, it did provide some information related to migration, molting cycle, and seasonal distribution (Byersdorfer 1998).

In order to assess the status of red king crab stocks in portions of the Aleutian Islands where the department has gained little recent abundance information, a limited commercial fishery was opened on November 1, 1998, in two areas of the Aleutian Islands with the provision that crabs not harvested be tagged and released. In addition, vessel operators were required to document all red king crab fishing activities in a pilot house log book. East of 179° W long., a GHL of 5,000 pounds was established and west of 179° E long., a GHL of 10,000 pounds was set; these GHLs were set using historic catch information. Closed waters included the Petrel Bank, or the area between 179° E long. and 179° W long. The department did not open the Petrel Bank area in 1998/99 since prior efforts had provided some population data from that area (Byersdorfer 1998).

Three vessels registered to harvest red king crabs in the Aleutian Islands during the 1998/99 season, but only one recorded any landings. The GHL was not reached in either open area and the fishery was closed by emergency order on July 31, 1999. Observers were required on all vessels participating in the 1998/99 fishery.

In order to address concerns for red king crab abundance in the Petrel Bank area, a survey was conducted in January/February and November, 2001. Due to budget constraints, the survey was designed so fishers could retain and sell all legal male red king crabs captured to cover survey expenses. The commissioner's permit specified stations to be fished, soak times and effort levels. Capture of red king crabs from both of the 2001 surveys in the Petrel Bank area indicated healthy levels of legal males. CPUE (catch per unit of effort, defined as number of legal crabs per pot lift) for the combined surveys was 28. Survey CPUEs are not directly comparable to previous commercial fishery CPUEs because pot lifts in prior commercial fisheries were not conducted in a systematic manner and may have occurred in different fishing locations (Bowers et al. 2002). Sublegal male and female CPUE for the combined surveys was one and two, respectively.

Size frequency data from the 2001 surveys were comparable to the size composition that was found in catches prior to the 1995/96 fishery closure. The size frequency indicates that approximately 80% of the sampled legal-size crabs were post recruits. Of the crabs sampled 77% were new-shell. From 1990 to 1994, CPUE and bycatch of sublegal crabs greatly declined. Similar to the surveys conducted in the mid 1990s, very few sublegal crabs were captured during the 2001 surveys.

The surveys conducted in 2001 indicate that legal male abundance has increased since the fishery was closed, however, red king crab female and sublegal abundance remains low. Given the legal male abundance, a limited commercial fishery on the Petrel Bank was opened during the 2002/03 season with a GHL of 500,000 pounds. With current effort levels, this is considered the minimum GHL that can be managed inseason. Because of the uncertainty in the status of sublegal and female red king crab and to provide for overall stock protection, the department will close the fishery prior to achieving the GHL if legal male CPUE drops below 10 crab/pot. Establishing a low GHL with a moderate CPUE threshold level should help prevent the stock from declining to levels seen in the mid-90s. Trends in fishery performance will be used to evaluate future GHLs and having a defined threshold for closing the fishery will permit clearer understanding of the management strategy. Prior to opening a commercial fishery in other portions of the western Aleutians, the department will need to conduct surveys similar to those performed on the Petrel Bank.

In addition to commercial fisheries, long-standing subsistence and sport fisheries have targeted red king crabs in the vicinity of Unalaska Island. To gather subsistence harvest data, the department has periodically required fishers to obtain a harvest permit and log sheet. Historically, few of the permits were returned and the program was discontinued in 1994. On average, 15 permits were returned per year. The reported average annual harvest was 135 king crabs.

To address conservation concerns for the eastern Aleutian Islands red king crab stock, the BOF took action at the March 1999 meeting regarding the subsistence and sport king crab fisheries in that portion of the Aleutian Islands between 168° and 164° 44' W long. Regulations were adopted by BOF that closed the sport fishery and reduced the daily bag limit of subsistence king crabs from six to one per person per day. BOF also adopted regulations requiring that subsistence king and Tanner crab fishers operating in the Aleutian Islands between 168° and 164° 44' W long. obtain a subsistence permit before fishing.

In 2001, ADF&G issued 199 subsistence permits and harvest logsheets, of which 152, or 76%, were returned. The returned permits accounted for a harvest of 1,119 king crabs (Table 1-3). Estimates generated from the subsistence harvest logsheets indicate that approximately 1,465 king crabs were taken with harvest ranging from zero to 62 king crabs per permit. The majority of subsistence-caught king crabs were taken in the south channel of Iliuliuk Harbor and adjacent to the landfill, with peak king crab harvest occurring in June and July. These harvest figures are substantially less than estimates generated by a 1994 survey of 15.1% of households in Unalaska, where 6,892 king crabs were estimated to have been taken (ADF&G 1999b).

2002/2003 Commercial Fishery

The Aleutian Islands king crab Registration Area O opened to commercial fishing for red king crabs by emergency order at NOON Alaska daylight time, October 25, 2002. The fishery occurred in the Petrel Bank area, which is defined as those waters of king crab Registration Area O west of 179° W long., east of 179° E long., and north of 51° 45' N lat. Based on historic catch information and results from the 2001 Petrel Bank pot surveys, the department established a GHL of 500,000 pounds.

Preseason registrations were received from 35 vessels and based on this number, pot limits were set at 33 pots for vessels less than or equal to 125 feet in overall length, and 42 pots for vessels greater than 125 feet in overall length. Thirty-three vessels participated in the Petrel Bank red king crab fishery. The fleet pulled 3,782 pots, an average of 115 pots per vessel.

Fishing effort was heavily concentrated on the west side of the Petrel Bank, just north of Semisopochnoi Island. CPUE for the Petrel Bank was 18 legal crabs per pot lift and legal crabs averaged 7.4 pounds. The closure announcement was made at 8:00 AM on October 27 providing five hours advance notice to the fleet.

Area O was closed to commercial fishing for red king crabs by emergency order at 1:00 PM Alaska standard time, October 27, 2002, 50 hours after it opened. Final harvest numbers indicate that 505,642 pounds of red king crabs were landed (Table 1-1). Red king crabs were purchased by four shore-based processors in Dutch Harbor, one in Akutan, one in King Cove, one in Adak and one catcher-processor. Exvessel price averaged $6.51 per pound and the 2002 Petrel Bank fishery had a total value of over $3.28 million (Table 1-2).

2002 Subsistence Fishery

In 2002, ADF&G in Dutch Harbor issued 230 subsistence permits and harvest logsheets, of which 123, or 53.5%, were returned. The returned permits accounted for a harvest of 879 king crabs (Table 1-3). Estimates generated from the subsistence harvest logsheets indicate that approximately 1,644 king crabs were taken with harvest ranging from zero to 76 king crabs per permit. The majority of the king crabs were taken in Captain's Bay and adjacent to the spit in Iliuliuk Bay, with peak harvest occurring in June.

Fishery Management and Stock Status

Western Aleutian Islands pot surveys conducted from 1975 to 1977 provided CPUE, fecundity, and relative abundance information of red king crabs (ADF&G 1978). Pot surveys were conducted on an annual basis in the Dutch Harbor Area until 1990 when trawl surveys were implemented to survey larger areas in a more timely fashion and to reduce gear selectivity inherent to pot fishing activities (Urban 1992). In the late 1970s, GHL ranges were established using a blend of pot survey results and fisheries data. Historic fishery GHLs set in the late 1970s ranged from 8.0 million to 26 million pounds for Dutch Harbor and from 0.5 million to 3.0 million pounds in Adak (ADF&G 1978). GHLs were often modified inseason based on fishery performance.

Most shellfish research in the Aleutian Islands has been directed at crab stocks inhabiting the eastern Aleutian Islands. Bottom trawl surveys of the waters around Unalaska Island were conducted in 1991, 1994, 1995, 1999, and 2000. Recent bottom trawl surveys have not captured many king crabs. In 1995, only two red king crabs were caught, thus no population estimate could be generated. During the 1999 survey, 72 red king crabs were caught, one of which was a legal male. All others were pre-recruit males and small females captured in a single tow made in Kalekta Bay (Worton 2000). This catch, while encouraging, does not appear to constitute a rebuilding event. The eastern Aleutian Islands were again surveyed by bottom trawl during the summer of 2000 and a single red king crab was captured (Worton 2001), indicating that the red king crab population in the eastern Aleutian Islands remains severely depressed.

A vessel may be registered to fish in the commercial red king crab and golden king crab fisheries concurrently; however, only single line pots may be operated in areas open to red king crab fishing and only longline pots may be operated in areas open to golden king crab fishing. Likewise, red king crab may only be retained from single line pots and golden king crab may only be retained from longline pots. Golden king crab fisheries in the Aleutian Islands are not restricted by pot limits. In the Petrel Bank red king crab fishery no more than 1,250 total pots may be operated by the fleet.

In November of 2002 the department conducted a survey similar in design to the Petrel Bank surveys of 2001 in the area between 172° W long. and 179° W long. The survey area was developed in consultation with Industry and focused on areas of historic red king crab abundance in the Adak, Atka, and Amlia Islands areas that have been closed to commercial red king crab fishing since the 1998/99 season and had not been previously surveyed. The survey had a total of 116 stations that were divided between state-waters (56 stations) and federal-waters (60 stations).

Ten vessels surveyed a total of 61 stations composed of 1,085 pot lifts. Survey catches were poor and only four legal males were captured during the entire survey. Due to poor survey catches and high operation costs, many vessels were unable to fulfill their survey commitment and only 34% of the survey was completed. The portion of the survey that was completed indicates that the red king crab stocks around Adak, Atka, and Amlia Islands continue to be severely depressed. Therefore, the department does not expect a commercial red king crab fishery to open in this area in the near future (Granath 2003).

ALEUTIAN ISLANDS GOLDEN KING CRAB

Historic Background

The golden king crab *Lithodes aequispinus* fishery in the Aleutian Islands has never failed to open due to low stock abundance, making it unique among Westward Region king crab fisheries. Golden king crabs inhabit depths greater than where other commercially exploited king crabs are typically found (Blau et al. 1996). The depths and steep bottom topography of the inter-island passes inhabited by golden king crabs necessitate the use of longline rather than single-pot gear. No other major king crab fisheries in Alaska exist where longline pot gear is the only legal gear type.

Historically, golden king crabs were taken as incidental harvest during red king crab fisheries in the Adak (Area R) and Dutch Harbor (Area O) Registration Areas. One landing of golden king crabs was reported from the Adak Area during the 1975/76 season, but directed fishing for golden king crabs did not occur in either management area until the 1981/82 season (ADF&G 1984). From the 1981/82 season until the 1996/97 season, the golden king crab resource in the Aleutian Islands was harvested in two directed fisheries occurring in the Adak and Dutch Harbor Registration Areas.

During the 1981/82 season, 14 vessels landed 1.2 million pounds of golden king crabs in 76 deliveries from the Adak Area (Table 1-4). By the following season, harvest had reached 8.0 million pounds with 99 vessels participating in the fishery. Between 1981 and 1995, an average of 49 vessels participated in the Adak golden king crab fishery, harvesting an average of 6.9 million pounds annually. Peak harvest in the Adak fishery occurred during the 1986/87 season when 12.8 million pounds of golden king crabs were harvested for an exvessel value of $37.6 million (Table 1-5). No stock assessment of the golden king crab population was performed in the Adak Area and initially the fishery was managed based on size, sex, and season restrictions. Catches were monitored inseason (ADF&G 1999a) and after the initial fishery, harvest levels were set based on harvest expectations generated from catch in prior seasons (ADF&G 1983). The majority of golden king crabs harvested in the Adak Area were taken in the North Amlia and Petrel Bank Districts; however, significant harvest also occurred in the Western Aleutian District (Figure 1-2).

From the 1981/82 season to the 1995/96 season, average weight of golden king crabs harvested in the Adak Area fishery declined from 5.5 to 4.2 pounds and CPUE declined from 10 to five legal crabs per pot pull (Figure 1-4). In July 1985, BOF adopted a regulation reducing the minimum legal size for golden king crabs from 6.5 to 6.0 inches in carapace width (CW). Decreasing the legal size for golden king crabs in this area resulted in an expected decrease in average weight of legal crabs harvested after 1985/86 and increased catch during the 1985/86 and 1986/87 seasons. This regulation change did not, however, reverse the trend of slowly declining catch rates in the area west of 171° W long.

Initial catches of golden king crabs in the Dutch Harbor Area were similar to those observed in the Adak Area fishery (ADF&G 1984). Harvest was incidental to the red king crab fishery and effort in the fishery only increased as red king crab stocks decreased in abundance. Six vessels harvested approximately 116,000 pounds of golden king crabs during the 1981/82 Dutch Harbor red king crab season (Table 1-4). By the following season, 49 vessels were participating in the directed golden king crab fishery, harvesting 1.2 million pounds. Between 1981 and 1995, an average of 18 vessels harvested approximately 1.5 million pounds of golden king crabs annually (Figure 1-5). Peak golden king crab harvest in the Dutch Harbor Area occurred during the 1995/96 season when 2.0 million pounds were harvested for an exvessel value of $5.2 million (Table 1-5). The Dutch Harbor Area harvest was primarily from the Islands of Four Mountains and Yunaska Island area (Figure 1-1).

In general, average weight of golden king crabs harvested in the Dutch Harbor Area declined during the period from 1981 to 1995, ranging from a high of 7.6 pounds in the 1983/84 season to 4.1 pounds during the 1992/93 season (Figure 1-5). CPUE has slowly declined throughout the history of this fishery, reaching a peak of 14 legal crabs per pot during the 1984/85 season and declining to 6 crabs during the 1994/95 season. The golden king crab stock in the Dutch Harbor Area was not surveyed for abundance prior to 1991 and the fishery was managed based on a historical average catch of 1.5 million pounds annually (ADF&G 1999a). In 1984, BOF adopted an ADF&G staff proposal to lower the legal size for golden king crabs in the Dutch Harbor Area from 6.5 inches to 6.0 inches CW and to establish the area as a permit fishery.

At its March 1996 meeting, BOF chose to restructure management of king crabs in the Aleutian Islands. Formerly, the Aleutian Islands king crab populations had been managed using the Adak and Dutch Harbor Registration Areas that were established for red king crab fisheries. However, during the 1970s and 1980s, red king crab fisheries declined in the Aleutian Islands while the golden king crab fishery gained increasing importance. Consequently, BOF felt that king crab management areas in the Aleutian Islands should be re-designated to more accurately reflect current golden king crab stock distribution and patterns in fishing effort. BOF, therefore, elected to replace the Adak and Dutch Harbor Areas with the newly created Aleutian Islands Registration Area O and directed ADF&G to manage the golden king crab stocks in the areas east and west of 174° W long. as two distinct stocks. It also stipulated that a conservative management plan be initiated and that all vessels registered for the fishery continue to carry an onboard observer for all of their fishing activities.

In 1996, when the initial golden king crab fishery in the new king crab Registration Area O occurred, a GHL of 3.2 million pounds was established for the area east of 174° W long. and 2.7 million pounds for the area west of 174° W long. Compared to the combined Adak and Dutch Harbor Area fisheries from prior years, there was reduced effort and harvest during the 1996/97 fishery. Eighteen vessels harvested 5.9 million pounds, down from 28 vessels taking 6.9 million pounds in 1995/96. This reduction in effort was likely due to the departure of vessels for the 1996 Bristol Bay red king crab season, which re-opened to commercial fishing for the first time since 1993. The eastern portion of Area O closed by emergency order on December 25, with a harvest of 3.3 million pounds, while the western portion was open for the entire registration year with a harvest of 2.6 million pounds.

During the 1996/97 fishery, the harvest rate east of 174° W long. was six legal crabs per pot pull with an average weight of 4.5 pounds per crab. Most fishing effort was concentrated in the area around Yunaska Island and the Islands of Four Mountains with some effort in the Seguam and Amukta Pass areas (Figure 1-2). In the portion of Area O west of 174° W long., fishery performance was six legal crabs per pot pull with an average weight of 4.2 pounds per crab (Table 1-4). Most harvest occurred between Amchitka Pass and Buldir Island. The 1996/97 golden king crab fishery in the Aleutian Islands had an estimated exvessel value of $12.5 million (Table 1-5).

Since the 1996/97 season, effort and harvest in the Aleutian Islands east of 174° W long have remained relatively stable. During the 1997/98 season, 13 vessels harvested 3.5 million pounds in an 84-day season. CPUE averaged seven legal crabs per pot lift and harvested crabs averaged 4.5 pounds each. The fishery west of 174° W long. has experienced greater variability in catch and effort. During the 1997/98 season, eight vessels participated in the fishery and harvested 2.4 million pounds. The GHL west of 174° W long. was not reached and subsequently the fishery was not closed. The fleet averaged seven legal crabs per pot lift with landed crabs averaging 4.3 pounds each. The 1997/98 Aleutian Islands golden king crab fishery had an exvessel value of $12.5 million.

Prior to the 1998/99 season, the Aleutian Islands golden king crab GHL east of 174° W long. was reduced from 3.2 million pounds to 3.0 million pounds. Fishery performance trends and data from tag recoveries indicated that the 200,000 pound GHL reduction for the area east of 174° W long. was necessary in order to comply with the overfishing definition specified in the Fishery Management Plan (FMP) for the king and Tanner crab fisheries of the Bering Sea and Aleutian Islands (NPFMC 1998).

The 1998/99 fishery east of 174° W long. was similar to the prior two fisheries. Fourteen vessels registered and harvested 3.2 million pounds in a 68-day season. The catch accrued at a rate of nine legal crabs per pot lift with landed crabs averaging 4.4 pounds each. West of 174° W long., effort declined significantly from the prior two seasons. A fleet of three vessels harvested 1.7 million pounds, or 63% of the GHL. The fleet averaged 12 legal crabs per pot lift with landed crabs averaging 4.1 pounds each. The 1998/99 fishery had an exvessel value of $9.3 million, the lowest in 14 years.

In July 1999, BOF adopted a regulation to move the Registration Area O golden king crab fishery from September 1 to August 15 in order to accommodate fishers that participate in both the golden king and Bristol Bay red king crab (BBRKC) fisheries. The BBRKC fishery opening date had been moved from November 1 to October 15, which reduced the amount of fishing time available to the golden king crab fleet prior to the Bristol Bay opening. The change in opening date for Area O was designed to provide adequate fishing time for the golden king crab fleet to harvest the GHL east of 174° W long. prior to the opening of the BBRKC fishery.

In 2000/01, the fishery east of 174° W long. continued the stable trend seen in the previous four years. Fifteen vessels registered and harvested 3.1 million pounds. The CPUE was 10 legal crabs per pot, with a 4.5-pound average weight per crab. West of 174° W long., a fleet of 12 vessels harvested 2.9 million pounds. The CPUE was seven legal crabs per pot, while the average weight per crab was 4.1 pounds. With an exvessel value of just under $19.5 million, the 2000/01 season was the most valuable golden king crab fishery in six years (Table 1-5).

The Aleutian Islands golden king crab fishery long term trend in fishing effort is a decline in the number of vessels registered per season with increasing number of pots registered per vessel (Figure 1-6). With the adoption of longline gear in 1986, vessels became more specialized in fishing for golden king crabs and were able to more efficiently operate gear. In recent years, with shorter Bristol Bay red king and Bering Sea snow crab fisheries, those longline vessels that also fish in the Bering Sea have increased their effort in the Aleutian Islands. While the total number of vessels registered remained relatively constant, the amount of time relative to other crab fisheries that these vessels spend fishing in the Aleutian Islands has increased, resulting in shorter golden king crab fisheries.

2001/2002 Fishery

The 2001/02 Aleutian Islands golden king crab fishery opened at 12:00 NOON August 15 with a GHL of 5.7 million pounds, 3.0 million pounds of which was apportioned to the area east of 174° W long. and 2.7 million pounds apportioned to the area west of 174° W long. Twenty-one vessels participated in the fishery and landed 5.89 million pounds. The fleet averaged eight legal crabs per pot lift, the same as the 2000/01 CPUE, and landed crabs averaged 4.2 pounds each, a slight decrease from the prior season.

East of 174° W long.

The commercial fishery for golden king crabs in the Aleutian Islands east of 174° W long. began with 19 vessels registered. The fleet registered 12,927 pots, or 680 pots per vessel, a 25% increase from the 2000/01 fishery when 9,703 pots, or 646 pots per vessel, were registered. Most fishing effort occurred in the vicinity of Seguam and Amukta passes and in the Yunaska Island and Islands of Four Mountains area. Catch rates were highest in Seguam Pass and around Yunaska Island yielding up to 21 legal crabs per pot lift, compared to 16 crabs per pot lift in this area the previous season (Table 1-6, Figure 1-7). The average catch rate for the entire eastern portion was 12 legal crabs per pot lift, an increase from 10 legal crabs per pot lift in 2000/01. The average weight of legal crabs was 4.4 pounds, a slight decrease from the 2000/01 season, with the largest crabs encountered around the Islands of Four Mountains (170° W long.) (Table 1-6).

The fleet harvested 3.16 million pounds of golden king crabs in approximately four weeks of fishing. Landings averaged approximately 850,000 pounds per week. Three shore-based plants in Dutch Harbor and one in Adak processed golden king crabs from the eastern Aleutian Islands. Exvessel price paid for live, whole crabs was $3.30 per pound, leading to a fishery value of $10.3 million. A fishery closure announcement was issued to the fleet on September 5, providing the fleet with five days advance notice of the September 10 closure. In comparison, the fleet required two weeks less time in 2001/02 to harvest a product volume similar to that taken during the 2000/01 season.

West of 174° W long.

Fishing effort west of 174° W long. was limited to two vessels until after the closure of the eastern Aleutian Islands golden king and Bristol Bay red king crab fisheries when an additional seven vessels registered. The fleet registered 8,491 pots, or 943 pots per vessel. Western Aleutian Islands effort decreased slightly from the 2000/01 level when 12 vessels registered and fished 8,910 pots, or 743 pots per vessel. Harvest occurred primarily around the Delarof Islands, Kiska Island, the Petrel Bank, and Buldir Reef (Table 1-6). Weekly catch rates ranged from two to 15 legal crabs per pot lift and averaged seven, which was similar to the 2000/01 season. Catch rates were highest around the Delarof Islands (178°30' W long.) and the Petrel Bank (179°30' E long.), while the average weight of legal crabs was 4.0 pounds (Figure 1-7).

The fleet harvested 2.7 million pounds of golden king crabs west of 174° W long. Landings averaged approximately 89,558 pounds per week with a maximum weekly landing of 240,000 pounds. Three shore-based processors in Dutch Harbor and one in Adak paid fishers approximately $2.93 per pound for live, whole crabs, yielding a fishery exvessel value of $7.9 million. A fishery closure announcement was issued to the fleet on March 22, giving fishers eight days advance notice of the March 30 closure. This was the second year in a row that the western Aleutian Islands golden king crab fishery was closed by emergency order because the GHL was met. All prior western Aleutian Islands golden king crab fisheries have remained open until the regulatory closure.

2002/2003 Fishery

The 2002/03 Aleutian Islands golden king crab fishery opened at 12:00 NOON August 15 with a GHL of 5.7 million pounds, 3.0 million pounds of which was apportioned to the area east of 174° W long. and 2.7 million pounds apportioned to the area west of 174° W long. Twenty-two vessels participated in the fishery and landed 5.37 million pounds. The fleet averaged nine legal crabs per pot lift, slightly higher than the prior season, and landed crabs averaged 4.2 pounds each which is the same as the 2001/02 season.

East of 174° W long.

The commercial fishery for golden king crabs in the Aleutian Islands east of 174° W long. began with 19 vessels registered. The fleet registered 11,834 pots, or 623 pots per vessel, an eight percent decrease from the 2001/02 fishery when 12,927 pots, or 680 pots per vessel, were registered. Most fishing effort occurred in the vicinity of Seguam and Amukta passes and in the Yunaska Island area. Catch rates were highest in Seguam Pass and around Yunaska Island yielding up to 16 legal crabs per pot lift, compared to 21 crabs per pot lift in this area the previous season (Table 1-7, Figure 1-8). The average catch rate for the entire eastern portion was 12 legal craps per pot lift, the same as in the 2001/02 season. The average weight of legal crabs was 4.4 pounds, the same as the 2001/02 season, with the largest crabs encountered around the Islands of Four Mountains (170° W long.) (Table 1-7).

The fleet harvested 2.77 million pounds of golden king crabs in approximately three weeks of fishing. Landings averaged approximately 877,000 pounds per week. Three shore-based plants in Dutch Harbor and one in Adak processed golden king crabs from the eastern Aleutian Islands. Exvessel price paid for live, whole crabs ranged from $3.30 to $3.40 per pound, leading to a fishery value of $9.39 million. A fishery closure announcement was issued to the fleet of September 2, providing the fleet with five days advance notice of the September 7 closure.

West of 174° W long.

Fishing effort west of 174° W long. was limited to three vessels until after the closure of the eastern Aleutian Islands golden king and Bristol Bay red king crab fisheries when an additional three vessels registered. The fleet registered 6,225 pots, or 1,038 pots per vessel. Western Aleutian Islands effort decreased slightly from the 2001/02 level when nine vessels registered and fished 8,491 pots, or 943 pots per vessel. Harvest occurred primarily around the Petrel Bank, Buldir Island, and the Delarof Islands (Table 1-7). Weekly catch rates ranged from six to 12 legal crabs per pot lift and averaged seven, which was similar to the past three seasons. Catch rates were highest around the Delarof Islands (178° 30' W long.) and the Petrel Bank (179° 30' E long.), while the average weight of legal crabs was 4.0 pounds (Figure 1-8).

The fleet harvested 2.6 million pounds of golden king crabs west of 174° W long. Landings averaged approximately 91,000 pounds per week with a maximum weekly landing of 172,932 pounds. Golden king crabs were purchased/processed by one catcher-processor and by two shore-based processors, one in Dutch and one in Adak. Fishers were paid approximately $3.50 per pound for live, whole crabs, yielding a fishery value of $9.13 million. A fishery closure announcement was issued to the fleet on February 28, giving fishers over one week advance notice of the March 8 closure. This was the third season in a row that the western Aleutian Islands golden king crab fishery was closed by emergency order because the GHL was met.

Fishery Management and Stock Status

The Aleutian Islands golden king crab fishery is managed using two sources of inseason fishery data. Processors report landed catch to ADF&G weekly or more frequently as requested. These reports are the primary source of inseason harvest information. Observers stationed on each vessel participating in the fishery report average weight and catch rate information that is used in conjunction with landed catch to develop inseason projections of fishery length.

The department surveyed a small portion of the golden king crab habitat in the Aleutian Islands during the summer of 1997 (Blau et al. 1998). Prior to that, the department performed the only survey of this area in 1991 (Blau and Pengilly 1994). Only a small portion of the area in which golden king crabs are commercially important is currently surveyed. Mark-recapture data from the 1997 survey suggested that the commercial fishery was annually removing a minimum of 20% of the legal male crabs present in the area surveyed. The FMP for king and Tanner crabs in the Bering Sea and Aleutian Islands specifies that the golden king crab stock in the Aleutian Islands is considered overfished when fishing mortality (F) exceeds 0.2 (NPFMC 1998). A fishing rate of F=0.2 corresponds to an annual mature male removal rate of approximately 18%.

During the 1997/98 season, the GHL of 3.2 million pounds in the area east of 174° W long. was exceeded by approximately 300,000 pounds. Therefore, to maintain a long-term average harvest at 3.2 million pounds, the 1998/99 GHL in this area was reduced to 3.0 million pounds (D. Pengilly, ADF&G, Kodiak, personal communication).

The stations surveyed in 1997 were surveyed again in 2000. Tag recovery rates changed only slightly even though approximately one-third fewer crabs were tagged in 2000 than in 1997. Harvest rates as indicated by tag returns in the 2000/01 season were similar to those in 1997/98. Shell-age composition data indicated the stock is healthy, while size composition of the retained catch has changed very little (Watson and Gish 2002).

Even though the harvest rates are at or near the allowable maximum in some areas, the Aleutian Islands golden king crab population is believed to be healthy. Portions of the stock occur at depths greater than those fished. Additionally, the area surveyed receives more fishing pressure than many other areas in the entire Aleutian Islands, so golden king crabs in other less heavily fished locales may have a lower harvest rate. In order to operate their gear more efficiently, fishers tend to utilize the shallowest waters in which crabs may be found in abundance. Distribution of legal males extends to depths greater than those fished, so the entire depth range distribution of legal males is not exploited. Recent fishery data also indicates that the stock is healthy. Average size of crabs harvested has remained nearly constant for the last six seasons. Average weight has been between 4.2 and 4.4 pounds per crab for the last eight years. Catch per unit of effort has also been stable and has been above the 10-year average during the last three seasons. All this information suggests that the 3.0 million-pound GHL has provided a stable fishery and protects against overfishing as defined in the FMP. Currently, the department intends to survey the area around Amukta and Yunaska Islands every three years, with the next survey scheduled for the summer of 2003.

In the Aleutian Islands west of 174° W long., no surveys are conducted. The 2.7 million pound GHL has been in effect since the 1996/97 season and was determined on the basis of the preceding 5-year average harvest in the waters west of 174° W long. Fishery and observer data do not demonstrate a compelling reason to change the GHL from 2.7 million pounds as fishery statistics have not markedly changed since it was developed in 1996/97.

ALEUTIAN ISLANDS SCARLET KING CRAB

Historic Background

Scarlet king crabs *Lithodes couesi* are currently harvested under authority of a permit issued by the commissioner of ADF&G and authorized in 5 AAC 34.082. PERMITS FOR *LITHODES COUESI* KING CRAB. These permits are usually issued in conjunction with an Aleutian Islands golden king crab registration. Scarlet king crabs are typically found in waters deeper than 200 fathoms and have been taken as incidental harvest in the golden king crab and deepwater Tanner crab fisheries in the Aleutian Islands. Limited directed fishing has occurred; however, exploratory fishing does not indicate that a large biomass is present. Since 1992, annual harvest of scarlet king crabs in the Aleutian Islands has ranged from less than 5,000 pounds to a peak of nearly 63,000 pounds in 1995, when eight vessels made 21 landings. Exvessel value was at a maximum in 1995 when the fishery was worth approximately $110,000 (Table 1-8). Since 1996, effort and harvest in this fishery have been minimal and catch information has been confidential in all years except 1997 when 6,700 pounds were harvested. When BOF combined the Adak and Dutch Harbor king crab Registration Areas to create Area O, management of scarlet king crabs was not impacted (ADF&G 1999a).

2002 Fishery

In 2002, only two vessels registered to fish for scarlet king crabs in the Aleutian Islands, therefore all harvest information is confidential.

Fishery Management and Stock Status

No surveys are conducted, nor are any estimates of population abundance made for scarlet king crabs in the Aleutian Islands; consequently, stock status and distribution are not well known. Scarlet king crab males larger than or equal to 5½ inches in CW may be taken as incidental harvest under the conditions of a commissioner's permit. No directed fishing for scarlet king crabs is anticipated prior to adoption of a plan for new and developing fisheries by the BOF. Future directed fisheries for scarlet king crabs would be conducted in accordance with the provisions of that plan. Observer coverage on each vessel registered for the king crab fisheries of the Aleutian Islands has provided biological information that will be used by the department to develop future management measures for scarlet king crab.

EASTERN ALEUTIAN TANNER CRAB DISTRICT

Description of Area

The Eastern Aleutian Tanner crab District encompasses all waters of Registration Area J between the longitude of Scotch Cap Light at 164° 44' W long., west to 172° W long., and south of the latitude of Cape Sarichef at 54° 36' N lat. (Figure 1-9). Area J encompasses both waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles).

TANNER CRAB

Historic Background

The Eastern Aleutian District has not supported harvests of Tanner crabs *Chionoecetes bairdi* as large as those recorded in other districts of Area J. Tanner crabs are found only in a few major bays and inlets of the eastern Aleutians and the directed fishery was relatively small in volume and geographically limited until the late 1970s. The fishery began in Akutan and Unalaska Bays and subsequently expanded to include all areas of known Tanner crab distribution in the Eastern Aleutian District. Harvest of Tanner crabs over the last 26 years has typically remained under one million pounds per year. Only in the three consecutive seasons from 1976/77 to 1978/79 did the harvest exceed one million pounds, reaching a peak of 2.5 million pounds in the 1977/78 season (Table 1-9). Vessel participation was low in 1973/74, with only six vessels registered and reached a high of 31 in 1982 when the fishery was in decline. Vessel participation declined in 1991 to five vessels and consequently the harvest reached a low of 50,038 pounds. The Eastern Aleutian Islands Tanner crab fishery reached a maximum exvessel value of approximately $950,000 in 1977/78 and 1989 (Table 1-10). Commercial fishing for Tanner crabs has not been permitted in the Eastern Aleutian District since 1994 due to low stock abundance.

Subsistence harvest limit reductions applied to the Eastern Aleutian Islands red king crab fishery in 1999 were not applied to Tanner crabs. However, the permit and reporting requirements for subsistence harvest were reinstated. Between 1988 and 1994, an average of 15 subsistence permits per year were returned and accounted for approximately 121 Tanner crabs annually. A survey of 15.1% of Unalaska households in 1994 generated an estimated total subsistence Tanner crab harvest of 10,957 crabs (ADF&G 1999c). ADF&G staff issued 179 subsistence permits in 1999, of which 80 were returned. Returned permits accounted for a Tanner crab harvest of 1,430 crabs and the estimated total harvest was 3,200 crabs (Table 1-3). The majority of Tanner crab harvest occurred in Illiuliuk and Captain's Bays. Tanner crab harvest peaked in early July and continued until the permits expired on January 31.

In 2001, out of the 199 subsistence permits and harvest logsheets issued, 152, or 76%, were returned. The returned permits accounted for a harvest of 1,688 Tanner crabs (Table 1-3). Estimates generated from the subsistence harvest logsheets indicate that approximately 2,210 Tanner crabs were taken and harvest ranged from zero to 207 Tanner crabs per permit. The majority of Tanner crabs was taken in Unalaska Bay and adjacent to the landfill. Tanner crab were harvested throughout the year with peak catches occurring in June.

2002/2003 Commercial Fishery

The Tanner crab fishery in the Eastern Aleutian District was not opened during the 2002 season due to low stock abundance.

2002 Subsistence Fishery

In 2002, ADF&G in Dutch Harbor issued 230 subsistence permits and harvest logsheets, of which 123, or 54%, were returned. The returned permits accounted for a harvest of 2,296 Tanner crabs (Table 1-3). Estimates generated from the subsistence harvest logsheets indicate that approximately 4,293 Tanner crabs were taken and harvest ranged from zero to 359 Tanner crabs per permit. The majority of Tanner crabs were taken adjacent to the landfill and in Captain's Bay and Iliuliuk Bay, with the greatest number harvested in May although catch continued throughout the year.

Fishery Management and Stock Status

In 2002 the BOF adopted new management measures for the Eastern Aleutian Tanner crab District including pot limits, fishing hours and reporting requirements. A total of 300 pots are allowed in the fishery with no more than 50 pots per vessel. Pots may be operated to take Tanner crab only from 8:00 am until 5:59 pm with a soak time of 14 hours from 6:00 pm until 7:59 am. Fishers must report daily the number of pot lifts, number of crab retained and any other information considered necessary for the management and conservation of the fishery.

Prior to 1990, sporadic pot surveys were utilized to generate a Tanner crab abundance index in the eastern Aleutian Islands (Urban 1992). The pot surveys were not utilized to generate a GHL; instead they were used to monitor trends in abundance and recruitment. Pot surveys and fishery data were used to establish harvest levels of zero to 250,000 pounds (ADF&G 1983b). Since 1990, trawl surveys have been used to estimate abundance and are used in conjunction with fishery data for management purposes.

Trawl surveys in 1990 and 1991 indicated that a surplus of 100,000 pounds of Tanner crabs was available for harvest. Commercial fisheries that opened in 1991 and 1992 based on those surveys resulted in legal male harvest rates of approximately 33%. A 1994 trawl survey of the same location revealed an 87% decrease in abundance of Tanner crabs since 1991. Results of the 1994 survey prompted the department to issue an emergency order closing the 1995 season (ADF&G 1999a). A trawl survey conducted by the department in 1995 indicated that the abundance of Tanner crabs had increased slightly over the 1994 level, but was still well below levels observed on the 1990 and 1991 surveys. The 1995 survey found an increase in juvenile male and immature female crabs. However, the abundance of legal male crabs was still very low (Urban 1996); thus, the fishery closure was extended.

A trawl survey conducted in 1999 indicated that the biomass of Tanner crabs in the eastern Aleutian Islands had increased. Abundance increases were recorded for all size classes, with females and large males showing the greatest change. Female abundance more than doubled from the 1995 survey estimate to 2.2 million crabs, and male crab abundance increased nearly four-fold to just over 4.0 million crabs of which approximately 0.4 million were legal size. The majority of the recruitment was observed in Akutan, Unalaska, and Makushin Bays (Worton 2000).

Because encouraging recruitment was noted during the 1999 trawl survey, the department surveyed the eastern Aleutian Islands again in 2000. Much of the recruitment observed in Akutan Bay in 1999 was not encountered in 2000; thus Tanner crab abundance declined (Worton 2001). The next trawl survey of the eastern Aleutian Islands is planned for the summer of 2003.

A commissioner's-permit survey using pot gear, similar in design to the pot surveys for red king crab in the western Aleutians, will be conducted in the eastern Aleutian District during January/February of 2003. The survey will focus on areas of historic Tanner crab abundance in Unalaska Bay, Beaver Inlet and Akutan Bay. The pot survey includes areas that are inaccessible to the trawl survey and will provide the department with measures of relative abundance of Tanner crab in those areas. Results from the pot survey will be used in conjunction with trawl survey data to evaluate the condition of the Tanner crab stock.

GROOVED TANNER CRAB

Historic Background

In a manner similar to other deep-water crab fisheries in the Aleutian Islands, the first harvest of grooved Tanner crabs *Chionoecetes tanneri* in the Eastern Aleutian District occurred in the early 1980s as incidental harvest in the Dutch Harbor golden king crab fishery. Directed fishing for this species did not begin until 1993, when one vessel participated in a fishery that lasted from July until December. The grooved Tanner crab fishery in the Eastern Aleutian District typically occurred between March and December. Peak harvest in the Eastern Aleutian District occurred in 1995 when seven vessels landed approximately 850,000 pounds (Table 1-11).

Limited data has been collected regarding the abundance, distribution, and stock status of deep-water crab species in the Bering Sea and Aleutian Islands. During the 1993 season, the department utilized data collected by onboard observers to restrict harvest to males of five inches or greater CW. In 1994, pursuant to permit provisions described in 5 AAC 35.511. PERMITS FOR TANNERI AND ANGULATUS TANNER CRAB IN REGISTRATION AREA J, the department required that vessels registered for this fishery carry an observer for all of their fishing activities. Data collected by observers has documented bycatch as well as fishing practices and has aided the department in developing further management measures.

In 1997, the department established GHLs for grooved Tanner crabs in the Eastern Aleutian, Bering Sea, and Alaska Peninsula Districts where most historical harvests had occurred. Harvest levels in this fishery were derived using catch information from previous seasons and data collected by onboard observers. A GHL of 200,000 pounds was established for each of the aforementioned areas, while smaller harvest levels of 100,000 pounds were established for the Kodiak and Western Aleutian Districts to allow for exploratory fishing. In addition, the department required that all pots be equipped with at least two escape rings of 4.5 inches minimum diameter (ADF&G 1999a).

2002 Fishery

No vessels registered to harvest grooved Tanner crabs in the Eastern Aleutian District during 2002.

Fishery Management and Stock Status

The grooved Tanner crab population in the Eastern Aleutian District is not surveyed; consequently, no estimates of population abundance are available for this stock. Fishery data from the mid 1990s is the primary source of information regarding abundance and stock status. Catch per unit of effort declined from 15 legal crabs per pot lift in 1993 to 2 in 1996 and catches decreased from over 850,000 pounds in 1995 to 106,000 pounds in 1996. In addition, fishing effort was concentrated in three statistical areas immediately to the south of Unalaska Island. This information indicates that at least in the area historically fished, the population was heavily exploited.

Given poor fishery performance and declining harvests of the mid 1990s, the department reevaluated deepwater Tanner crab harvest levels in 2000. A GHL range of 50,000 to 200,000 pounds was established for the Eastern Aleutian District. The GHL was set as a range to provide greater flexibility for inseason management and to better inform the public of the department's management goals for the fishery. The fishery will be managed so that the upper end of the GHL range is reached only when catch rates similar to, or greater than those documented prior to the harvest declines of the mid 1990s are observed. In addition to new GHL requirements, the department specified that four 4.5-inch escape rings be placed on the lower third of each pot and required that pots be fished over multiple depth strata. Observers required on all vessels registered for the fishery will collect biological and fishery data.

TRIANGLE TANNER CRAB

Historic Background

In the Eastern Aleutian District triangle Tanner crab *Chionoecetes angulatus* is harvested under a permit authorized in 5 AAC 35.511. PERMITS FOR TANNERI AND ANGULATUS TANNER CRAB IN REGISTRATION AREA J. Triangle Tanner crabs were incidentally harvested in the eastern Aleutian grooved Tanner crab fishery, where the species has occurred in small numbers. Prior to 1995 and the beginning of the directed fishery, no harvest of triangle Tanner crabs was reported on fish tickets; however, shellfish observers stationed on board vessels participating in the grooved Tanner crab fishery observed small numbers of triangle crabs harvested in 1994 (ADF&G 1999a). Two vessels targeted triangle Tanner crabs in the Eastern Aleutian District during the 1995 and 1996 seasons, thus harvest information from those fisheries is confidential (Table 1-12). From 1997 to 2001, no vessels registered to harvest triangle Tanner crabs in the eastern Aleutian District.

2002 Fishery

No vessels registered to harvest triangle Tanner crabs in the Eastern Aleutian District during 2002.

Fishery Management and Stock Status

Surveys of population abundance are not conducted for triangle Tanner crabs; thus the status of this stock is unknown. Because of the paucity of population level data for this species and the history of the fishery, additional fishing for triangle Tanner crabs in the Eastern Aleutian District will be limited to incidental harvest during the grooved Tanner crab fishery. Vessels registered to fish for grooved Tanner crabs will be permitted to harvest triangle Tanner crabs at up to 50% of the weight of the target species. This harvest level is consistent with the historic development of the fishery and allows retention of a deepwater species that is believed to have a high mortality rate when taken incidentally in pot gear.

WESTERN ALEUTIAN TANNER CRAB DISTRICT

Description of Area

The Western Aleutian District of Registration Area J includes all waters west of 172° W long., east of the United States-Russia Maritime Boundary Line of 1991, and south of 54° 36' N lat. (Figure 1-9). Area J encompasses both waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles).

TANNER CRAB

Historic Background

Harvest of Tanner crabs *Chionoecetes bairdi* from the Western Aleutian District has, in general, been incidental to the directed red king crab fishery in that area. Commercial harvest has ranged from a high of over 800,000 pounds during the 1981/82 season to less than 8,000 pounds in 1991/92 (Table 1-13). No commercial harvest of Tanner crabs has occurred in the Western Aleutian District since 1995/96. The Western Aleutian District Tanner crab fishery reached a maximum value of just over $1 million in the 1981/82 season (Table 1-14). Tanner crab abundance in the Western Aleutian District is probably limited by available habitat. Most of the historical harvest occurred within a few bays in the vicinity of Adak and Atka Islands.

2002/2003 Fishery

The Western Aleutian District Tanner crab fishery has a regulatory opening date of November 1, however, the fishery was closed during the 2002/03 season. The fishery was not opened because there is no BOF approved management plan in place, nor has sufficient population data been collected to develop a GHL.

Fishery Management and Stock Status

No stock assessment surveys are conducted for Tanner crabs in the Western Aleutian District; thus no population estimates are available. Stock status is currently unknown. Historic fisheries were managed using GHLs set from commercial catch data (ADF&G 1985).

GROOVED TANNER CRAB

Historic Background

In the Western Aleutian District, harvest of grooved Tanner crab first occurred in conjunction with the developing golden king crab fishery in the Adak king crab management area during the late 1970s. Effort in this fishery has been minimal with two or fewer vessels participating during most years. Only in 1995 did significant fishing effort occur, when six vessels harvested approximately 146,000 pounds of grooved Tanner crabs (Table 1-15).

To prevent overharvest of this population where little abundance information is available, the ADF&G restricted harvest to males of five inches or greater CW in 1993. In addition, beginning in 1994, and according to provisions provided in 5 AAC 35.511 PERMITS FOR TANNERI AND ANGULATUS TANNER CRAB IN REGISTRATION AREA J, all vessels registered for the fishery were required to carry an onboard observer for all of their fishing activities. Using information collected by onboard observers and historic catch information, the department established GHLs for grooved Tanner crabs in the Western Aleutian District in 1997. The GHL was set at 100,000 pounds; this level was believed to be adequate to allow for exploratory fishing and incidental harvest (ADF&G 1999a). Since 1997, the department has reevaluated harvest levels for deepwater Tanner crabs. Because commercial fishing for grooved Tanner crabs in the Western Aleutian District has only occurred during four seasons and no survey data is available, confidence was not as high in the GHL for this district as in other districts where grooved Tanner crab harvest has occurred. In order to prevent overharvest of this stock, no GHL was set in 2000 when new deepwater Tanner crab GHLs were announced and the fishery will remain closed until further notice.

In addition to harvests of *C.bairdi* and grooved Tanner crab, fishers have anecdotally reported incidental triangle Tanner crab catch in the grooved Tanner crab and golden king crab fisheries in the Western Aleutian District. There have not been any landings of triangle Tanner crab from this area and there is currently no fishery.

2002 Fishery

The Western Aleutian District was not open to commercial fishing for grooved Tanner crabs in 2002.

Fishery Management and Stock Status

No stock assessment surveys have been conducted for grooved Tanner crabs in the Western Aleutian District; therefore, no estimates of population abundance are available. Fishery data from the mid 1990s indicates that the western Aleutian Islands may not support grooved Tanner crab populations as large as the eastern Aleutian Islands and the Bering Sea. Commercial fishery data from the mid 1990s indicates that neither catch nor CPUE were large when compared to those observed in other districts.

ALEUTIAN DISTRICT DUNGENESS CRAB

Description of Area

The Aleutian District for Dungeness crab *Cancer magister* management includes all waters of Registration Area J west of the longitude of Scotch Cap Light (164° 44' W long.), south of the latitude of Cape Sarichef (54° 36' N lat.), and east of the United States-Russia Maritime Boundary Line of 1991 (Figure 1-10). Area J encompasses both waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles).

Historic Background

Islands in the Aleutian Chain are separated by deep passes with swift currents and are closely bordered on the north by the Aleutian Basin and to the south by the Aleutian Trench. Dungeness crabs inhabit bays, estuaries, and other shallow water habitats, areas that are sparse and widely dispersed in the Aleutian Islands. Therefore, populations of Dungeness crabs are small and fishing effort has been low within the district.

The Aleutian District Dungeness crab fishery has occurred primarily as a small-vessel, summer fishery in the vicinity of Unalaska Island. Some larger-vessel effort has occurred in other locales within the district, but fishing in these areas has been sporadic throughout the history of the fishery. Interest and activity in this fishery has been erratic from year to year, with the first reliable reports of harvest made in 1970. Since 1974, harvests have ranged from no landings, to a peak of over 91,000 pounds in 1984/85 (Table 1-16). Four vessels operated that year, with over 80% of their catch coming from Unalaska and Makushin Bays. In addition to commercial harvest, Dungeness crabs have also been taken in subsistence and sport fisheries occurring in the vicinity of Unalaska Island. Subsistence harvest reports returned to ADF&G between 1988 and 1994 indicate that Dungeness harvests were larger than those documented for both red king *P.camtschaticus* and Tanner crabs *C.bairdi.* On average, 15 harvest reports were returned per year and Dungeness harvest averaged 686 crabs per year with a range of five to 1,906 crabs per family per year (ADF&G 1999c). No estimate of current Dungeness harvest by sport or subsistence users is available, but it is believed to be small.

2002/2003 Fishery

The 2002/03 Aleutian District Dungeness crab fishery opened by regulation at 12:00 NOON on May 1, 2002, and closed by regulation at 12:00 NOON on January 1, 2003. Only one vessel registered for the fishery, thus all harvest information is confidential.

Fishery Management and Stock Status

The Aleutian Islands Dungeness crab fishery is managed using size, sex, and season restrictions. Only male Dungeness crabs six and one-half inches (165 mm) or greater in carapace width may be retained in the Aleutian District from 12:00 NOON May 1 to 12:00 NOON January 1. No stock assessment work has been performed and limited biological and fishery data have been collected through dockside sampling. The status of this species in the Aleutian Islands is unknown, but the resource is believed to be limited due to the lack of suitable habitat.

ALEUTIAN DISTRICT SHRIMP

Description of Area

The Aleutian District of Registration Area J, as described for shrimp, includes all Bering Sea and Pacific Ocean waters west of the longitude of Cape Sarichef at 164° 55' W long. and east of the United States-Russia Maritime Boundary Line of 1991 (Figure 1-11). Area J encompasses both waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles). The Aleutian District includes four sections: Unalaska Bay, Makushin Bay, Usof Bay, and Beaver Inlet.

Historic Background

Commercial fishing for shrimp in the Aleutian District began in the 1960s with Russian and Japanese participation. Most harvests occurred northwest of the Pribilof Islands, with some harvests as large as 30,000 metric ton per year. In 1972 a domestic trawl fishery began targeting northern shrimp *Pandalus borealis* in the vicinity of Unalaska Island. Catch and effort increased and harvest peaked in 1977/78 at 6.8 million pounds (Table 1-17). Sharp declines in catches after 1978 led to a reduction in season length. Between 1983 and 1991 no fishing occurred; however, in 1992 four catcher-processors targeted shrimp northwest of the Pribilof Islands. Low concentrations of shrimp were located and all four vessels departed the fishery after making a total of six landings for 72,133 pounds. Since 1992, interest in fishing for shrimp in the Aleutian District has remained at a very low level, several vessels registered to fish, but made no landings. In 1999, the first commercial harvest of shrimp in the Aleutian District occurred since 1992. Only two vessels registered for the fishery; therefore, catch information is confidential. Initial catches were composed primarily of northern shrimp. As the fishery progressed, sidestriped shrimp *Pandalopsis dispar* became the dominant species in the catch. The fishery was closed on July 9 because ADF&G did not possess adequate information regarding the abundance and distribution of these species and it was not possible to prosecute the fishery in accordance with 5 AAC 39.210. MANAGEMENT PLAN FOR HIGH IMPACT EMERGING FISHERIES.

2002 Fishery

The 2002 fishery did not open because there was insufficient information on shrimp stock abundance and distribution.

Fishery Management and Stock Status

ADF&G has obtained limited population information for the shrimp stocks of the Aleutian Islands. The last extensive commercial activity occurred in the 1970s and trawl surveys conducted by ADF&G and NMFS do not target shrimp. Consequently, ADF&G does not possess information to develop a management plan or conduct a commercial fishery. Fishers have expressed interest in collaborating with ADF&G on a stock assessment survey, but funding constraints have limited such endeavors. Once BOF has adopted a plan for new and developing fisheries, a collaborative survey may be one step in the creation of a sustainable, well-managed fishery. In 2000, NMFS performed a pilot deep-sea trawl survey of the continental slope. Sidestriped shrimp was the most abundant shrimp species, found primarily on the continental slope of the Bering Sea east of Zhemchug Canyon at an average depth of 214 fathoms. Although information obtained on shrimp was sparse, NMFS has plans to conduct the surveys biennially, which may provide more detailed data on shrimp abundance, distribution, and habitat.

ALEUTIAN DISTRICT MISCELLANEOUS SHELLFISH SPECIES

Description of Area

The Aleutian Islands portion of miscellaneous shellfish Registration Area J, includes all waters south of the latitude of Cape Sarichef (54° 36' N lat.), west of the longitude of Scotch Cap Light (164° 44' W long.), and east of the United States-Russia Maritime Boundary Line of 1991 (Figure 1-12). Area J encompasses both waters of the Territorial Sea (0-3 nautical miles) and waters of the Exclusive Economic Zone (3-200 nautical miles). Area J is not divided into districts.

Introduction

Shellfish species included in this section are those which have been harvested in relatively small amounts compared to the commercial king and Tanner crab fisheries which occur in the Aleutian Islands. Miscellaneous shellfish species include hair crabs, sea urchins, sea cucumbers, snails, *Paralomis multispina* (cherry) crab, and octopi. Prior to 1999, it was ADF&Gs policy to register vessels for exploratory fishing in these new and emerging fisheries under authority of a commissioner's permit described in 5 AAC 38.062. PERMITS FOR OCTOPI, SQUID, KOREAN HAIR CRAB, SEA URCHINS, SEA CUCUMBERS, SEA SNAILS, CORAL, AND OTHER MARINE INVERTEBRATES. Typically, permit conditions were general and not fully developed on an individual species basis. Fisheries for these species were conducted without prior knowledge of stock abundance or distribution and no harvest limits were established. To allow for the orderly development and regulation of expanding fisheries, BOF adopted 5 AAC 39.210. MANAGEMENT PLAN FOR HIGH IMPACT EMERGING FISHERIES, which delineated criteria that must be met in order for a high impact emerging fishery to occur. In addition, BOF will be considering a plan for new and developing fisheries that will provide a framework to be employed by resource harvesters in the development of new fisheries.

2002 Fisheries

Octopus

In 2002, there was no directed fishing for octopi, although it is permitted in the Aleutian Islands under the authority of a commissioner's permit. Incidental harvest may also be retained on a commercial entry fisheries commission (CFEC) card at up to 20% of the weight of the target species. In 2002, out of the 109 vessels registered for incidental harvest, 56 made 186 landings of octopi totaling 96,585 pounds from the Aleutian Islands (Table 1-18). At-sea discards totaled 68,751 pounds. The majority of retained octopi were utilized for bait (93%), while the rest was sold to processors as live product (3%) or for use as fishmeal (4%). Octopus landings were made by vessels targeting Pacific cod or other groundfish species using pot gear (97%), longline gear (2.7%) and trawl gear (<1%).

Sea Cucumber and Sea Urchin

In September, ADF&G issued a news release announcing the GHL for sea cucumbers and sea urchins in the Westward Region. The 2002 season opened under a commissioner's permit with a GHL of 5,000 pounds each in the Aleutian Islands, eviscerated product for sea cucumbers and whole animal weight for sea urchins. The small GHLs were established to permit conservative commercial exploration of areas that lacked historic harvest data and to allow ADF&G to collect critical information for future management purposes. However, no vessels or divers registered or fished for either of these fisheries in the Aleutian Islands in 2002.

Other Miscellaneous Shellfish Species

No vessels were registered for any other miscellaneous shellfish species in the Aleutian Islands in 2002.

Fishery Management and Stock Status

No surveys of abundance for octopi have been performed in the Aleutian Islands; thus, no population data is available. ADF&G has not developed a management plan for this species. In addition to incidental harvest which is limited to 20% of the weight of the target species, directed fishing may also occur under the authority of a commissioner's permit. A fishing logbook is required for the directed fishery and only pots or dive gear may be used. Stock assessment work has not been performed for other miscellaneous shellfish species in the Aleutian Islands and until such work has been performed and a BOF approved management plan has been adopted, only limited fisheries for these species will be allowed.

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Table 1-1. Aleutian Islands, Area O, red king crab commercial fishery data, 1960/1961 - 2002/2003.

		Number of				Pots		Average		
Season	Locale	Vessels[a]	Landings	Crabs[b]	Harvest[b,c]	Lifted	CPUE[d]	Weight[c]	Length[e]	Deadloss[c]
1960/61	East of 172°	NA	NA	NA	NA	NA	NA	NA	NA	NA
	West of 172°	4	41	NA	2,074,000	NA	NA	NA	NA	NA
	TOTAL									
1961/62	East of 172°	4	69	NA	533,000	NA	NA	NA	NA	NA
	West of 172°	8	218	NA	6,114,000	NA	NA	NA	NA	NA
	TOTAL		**287**		**6,647,000**					
1962/63	East of 172°	6	102	NA	1,536,000	NA	NA	NA	NA	NA
	West of 172°	9	248	NA	8,006,000	NA	NA	NA	NA	NA
	TOTAL		**350**		**9,542,000**					
1963/64	East of 172°	4	242	NA	3,893,000	NA	NA	NA	NA	NA
	West of 172°	11	527	NA	17,904,000	NA	NA	NA	NA	NA
	TOTAL		**769**		**21,797,000**					
1964/65	East of 172°	12	336	NA	13,761,000	NA	NA	NA	NA	NA
	West of 172°	18	442	NA	21,193,000	NA	NA	NA	NA	NA
	TOTAL		**778**		**34,954,000**					
1965/66	East of 172°	21	555	NA	19,196,000	NA	NA	NA	NA	NA
	West of 172°	10	431	NA	12,915,000	NA	NA	NA	NA	NA
	TOTAL		**986**		**32,111,000**					
1966/67	East of 172°	27	893	NA	32,852,000	NA	NA	NA	NA	NA
	West of 172°	10	90	NA	5,883,000	NA	NA	NA	NA	NA
	TOTAL		**983**		**38,735,000**					

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Table 1-1. (Page 2 of 6)

Season	Locale	Number of Vessels[a]	Number of Landings	Number of Crabs[b]	Harvest[b,c]	Pots Lifted	CPUE[d]	Average Weight[c]	Average Length[e]	Deadloss[c]
1967/68	East of 172°	34	747	NA	22,709,000	NA	NA	NA	NA	NA
	West of 172°	22	505	NA	14,131,000	NA	NA	NA	NA	NA
	TOTAL		**1,252**		**36,840,000**					
1968/69	East of 172°	NA	NA	NA	11,300,000	NA	NA	NA	NA	NA
	West of 172°	30	NA	NA	16,100,000	NA	NA	NA	NA	NA
	TOTAL				**27,400,000**					
1969/70	East of 172°	41	375	NA	8,950,000	72,683	NA	NA	NA	NA
	West of 172°	33	435	NA	18,016,000	115,929	NA	6.5	NA	NA
	TOTAL		**810**		**26,966,000**	**188,612**				
1970/71	East of 172°	32	268	NA	9,652,000	56,198	NA	NA	NA	NA
	West of 172°	35	378	NA	16,057,000	124,235	NA	NA	NA	NA
	TOTAL		**646**		**25,709,000**	**180,433**				
1971/72	East of 172°	32	210	1,447,692	9,391,615	31,531	46	7	NA	NA
	West of 172°	40	166	NA	15,475,940	46,011	NA	NA	NA	NA
	TOTAL		**376**		**24,867,555**	**77,542**				
1972/73	East of 172°	51	291	1,500,904	10,450,380	34,037	44	7		
	West of 172°	43	313	3,461,025	18,724,140	81,133	43	5.4	NA	NA
	TOTAL		**604**	**4,961,929**	**29,174,520**	**115,170**	**43**	**5.9**		
1973/74	East of 172°	56	290	1,780,673	12,722,660	41,840	43	7.1	NA	NA
	West of 172°	41	239	1,844,974	9,741,464	70,059	26	5.3	148.6	NA
	TOTAL		**529**	**3,625,647**	**22,464,124**	**111,899**	**32**	**6.2**		

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Table 1-1. (Page 3 of 6)

Season	Locale	Number of Vessels[a]	Number of Landings	Number of Crabs[b]	Harvest[b,c]	Pots Lifted	CPUE[d]	Average Weight[c]	Average Length[e]	Deadloss[c]
1974/75	East of 172°	87	372	1,812,647	13,991,190	71,821	25	7.7		
	West of 172°	36	97	532,298	2,774,963	32,620	16	5.2	148.6	NA
	TOTAL		**469**	**2,344,945**	**16,766,153**	**104,441**	**22**	**7.1**		
1975/76	East of 172°	79	369	2,147,350	15,906,660	86,874	25	7.4		
	West of 172°	20	25	79,977	411,583	8,331	10	5.2	147.2	NA
	TOTAL		**394**	**2,227,327**	**16,318,243**	**95,205**	**23**	**7.3**		
1976/77	East of 172°	72	226	1,273,298	9367965[f]	65,796	19	7.4		
	East of 172°	38	61	86,619	830458[g]	17,298	5	9.6	NA	NA
	West of 172°				FISHERY CLOSED					
	TOTAL		**287**	**1,359,917**	**10,198,423**	**83,094**	**16**	**7.5**		
1977/78	East of 172°	33	227	539,656	3658860[f]	46,617	12	6.8		
	East of 172°	6	7	3,096	25557[h]	812	4	8.3	NA	NA
	West of 172°	12	18	160,343	905,527	7,269	22	5.7	152.2	NA
	TOTAL		**252**	**703,095**	**4,589,944**	**54,698**	**13**	**6.5**		
1978/79	East of 172°	60	300	1,233,758	6,824,793	51,783	24	5.5	NA	NA
	West of 172°	13	27	149,491	807,195	13,948	11	5.4	NA	1,170
	TOTAL		**327**	**1,383,249**	**7,631,988**	**65,731**	**21**	**5.5**		
1979/80	East of 172°	104	542	2,551,116	15,010,840	120,554	21	5.9	NA	NA
	West of 172°	18	23	82,250	467,229	9,757	8	5.7	152	24,850
	TOTAL		**565**	**2,633,366**	**15,478,069**	**130,311**	**20**	**5.9**		
1980/81	East of 172°	114	830	2,772,287	17,660,620[f]	231,607	12	6.4	NA	NA
	East of 172°	54	120	182,349	1,392,923[h]	30,000	6	7.6		
	West of 172°	17	52	254,390	1,419,513	20,914	12	5.6	149	54,360
	TOTAL		**1,002**	**3,209,026**	**20,473,056**	**282,521**	**11**	**6.4**		

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Table 1-1. (Page 4 of 6)

Season	Locale	Number of Vessels[a]	Number of Landings	Number of Crabs[b]	Harvest[b,c]	Pots Lifted	CPUE[d]	Average Weight[c]	Average Length[e]	Deadloss[c]
1981/82	East of 172°	92	683	741,966	5,155,345	220,087	3	6.9	NA	NA
	West of 172°	46	106	291,311	1,648,926	40,697	7	5.7	148.3	8,759
	TOTAL		**789**	**1,033,277**	**6,804,271**	**260,784**	**4**	**6.6**		
1982/83	East of 172°	81	278	64,380	431,179	72,924	1	6.7		
	West of 172°	72	191	284,787	1,701,818	66,893	4	6.0	150.8	7,855
	TOTAL		**469**	**349,167**	**2,132,997**	**139,817**	**3**	**6.1**		
1983/84	East of 172°				FISHERY	CLOSED				
	West of 172°	106	248	298,948	1,981,579	60,840	5	6.6	157.3	3,833
	TOTAL	**106**	**248**	**298,948**	**1,981,579**	**60,840**	**5**	**6.6**	**157.3**	**3,833**
1984/85	East of 171°				FISHERY	CLOSED				
	West of 171°	64	113	206,751	1,367,672	50,685	4	6.6	155.1	0
	TOTAL	**64**	**113**	**206,751**	**1,367,672**	**50,685**	**4**	**6.6**	**155.1**	**0**
1985/86	East of 171°				FISHERY	CLOSED				
	West of 171°	35	89	162,271	906,293	32,478	5	5.6	152.2	6,120
	TOTAL	**35**	**89**	**162,271**	**906,293**	**32,478**	**5**	**5.6**	**152.2**	**6,120**
1986/87	East of 171°				FISHERY	CLOSED				
	West of 171°	33	69	126,146	712,243	29,189	4	5.6	NA	500
	TOTAL	**33**	**69**	**126,146**	**712,243**	**29,189**	**4**	**5.6**	**NA**	**501**
1987/88	East of 171°				FISHERY	CLOSED				
	West of 171°	71	109	211,712	1,213,933	43,433	5	5.7	148.5	6,900
	TOTAL	**71**	**109**	**211,712**	**1,213,933**	**43,433**	**5**	**5.7**	**148.5**	**6,900**
1988/89	East of 171°				FISHERY	CLOSED				
	West of 171°	73	156	266,053	1,567,314	64,374	4	5.9	153.1	557
	TOTAL	**73**	**156**	**266,053**	**1,567,314**	**64,374**	**4**	**5.9**	**153.1**	**557**

-Continued-

Table 1-1. (Page 5 of 6)

Season	Locale	Number of Vessels[a]	Number of Landings	Number of Crabs[b]	Harvest[b,c]	Pots Lifted	CPUE[d]	Average Weight[c]	Average Length[e]	Deadloss[c]
1989/90	East of 171°				FISHERY CLOSED					
	West of 171°	56	123	196,070	1,118,566	54,513	4	5.7	151.5	759
	TOTAL	**56**	**123**	**196,070**	**1,118,566**	**54,513**	**4**	**5.7**	**151.5**	**759**
1990/91	East of 171°				FISHERY CLOSED					
	West of 171°	7	34	146,903	828,105	10,674	14	5.6	148.1	0
	TOTAL	**7**	**34**	**146,903**	**828,105**	**10,674**	**14**	**5.6**	**148.1**	**0**
1991/92	East of 171°				FISHERY CLOSED					
	West of 171°	10	35	165,356	951,278	16,636	10	5.7	149.8	0
	TOTAL	**10**	**35**	**165,356**	**951,278**	**16,636**	**10**	**5.7**	**149.8**	**0**
1992/93	East of 171°				FISHERY CLOSED					
	West of 171°	12	30	218,049	1,286,424	16,129	13	6.0	151.5	5,000
	TOTAL	**12**	**30**	**218,049**	**1,286,424**	**16,129**	**13**	**6.0**	**151.5**	**5,000**
1993/94	East of 171°				FISHERY CLOSED					
	West of 171°	12	21	119,330	698,077	13,575	9	5.8	154.6	7,402
	TOTAL	**12**	**21**	**119,330**	**698,077**	**13,575**	**9**	**5.8**	**154.6**	**7,402**
1994/95	East of 171°				FISHERY CLOSED					
	West of 171°	20	31	30,337	196,967	18,146	2	6.5	157.5	1,430
	TOTAL	**20**	**31**	**30,337**	**196,967**	**18,146**	**2**	**6.5**	**157.5**	**1,430**
1995/96	East of 171°				FISHERY CLOSED					
	West of 171°	4	12	6,880	38,941	2,205	3	5.7	153.6	235
	TOTAL	**4**	**12**	**6,880**	**38,941**	**2,205**	**3**	**5.7**	**153.6**	**235**
1996/97					FISHERY CLOSED					
1997/98					FISHERY CLOSED					

-Continued-

Table 1-1. (Page 6 of 6)

Season	Locale	Number of Vessels[a]	Landings	Crabs[b]	Harvest[b,c]	Pots Lifted	CPUE[d]	Average Weight[c]	Length[e]	Deadloss[c]
1998/99	West of 174°	3	6	749	5,900	102	7	7.9	NA	0
2000/2001[i]	Petrel Bank[j]	1	3	11,257	76,792	498	23	6.8	161.0	0
2001/2002[k]	Petrel Bank[j]	4	5	22,080	153,961	700	32	7.0	159.5	82
2002/2003	Petrel Bank[j]	33	35	68,300	505,642	3,782	18	7.4	162.4	1,311

[a] Many vessels fished both east and west of 171° W long., thus total number of vessels reflects registrations for entire Aleutian Islands.
[b] Deadloss included.
[c] In pounds.
[d] Number of legal crabs per pot lift.
[e] In millimeters.
[f] Split season based on 6.5 inch minimum legal size.
[g] Split season based on 8 inch minimum legal size.
[h] Split season based on 7.5 inch minimum legal size.
[i] January/February Petrel Bank survey (fish ticket harvest code 15).
[j] Those waters of king crab Registration Area O between 179° E long., 179° W long., and north of 51°45' N lat.
[k] November Petrel Bank survey (fish ticket harvest code 15).

Table 1-2. Aleutian Islands, Area O, red king crab fishery economic performance data, 1973/74 - 2002/03. No economic data available prior to 1973.

Season		Exvessel Price Per Pound	Season Total
1973/74	East of 172°	$0.65	$8,269,729
	West of 172°	NA	NA
1974/75	East of 172°	$0.37	$5,176,740
	West of 172°	$0.35	$971,237
1975/76	East of 172°	$0.42	$6,680,797
	West of 172°	$0.38	$156,402
1976/77	East of 172°[a]	$0.64	$5,995,497
	East of 172°[b]	$0.79	$656,061
	West of 172°	FISHERY CLOSED	
1977/78	East of 172°[a]	$0.99	$3,622,271
	East of 172°[c]	$1.35	$34,502
	West of 172°	$1.36	$1,231,517
1978/79	East of 172°	$1.35	$9,213,471
	West of 172°	$1.23	$992,850
1979/80	East of 172°	$0.90	$13,509,756
	West of 172°	$0.68	$317,716
1980/81	East of 172°[a]	$1.02	$18,013,832
	East of 172°[c]	$1.03	$1,434,711
	West of 172°	$0.92	$1,305,952
1981/82	East of 172°	$2.30	$11,617,293
	West of 172°	$2.01	$3,314,341
1982/83	East of 172°	$3.43	$1,478,944
	West of 172°	$3.44	$5,854,254
1983/84	East of 172°	FISHERY CLOSED	
	West of 172°	$3.43	$6,796,816
1984/85	East of 172°	FISHERY CLOSED	
	West of 172°	$2.10	$2,872,111
1985/86	East of 172°	FISHERY CLOSED	
	West of 172°	$2.15	$1,948,530

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Table 1-2. (page 2 of 2)

Season		Exvessel Price Per Pound	Season Total
1987/88	East of 172°	FISHERY CLOSED	
	West of 172°	$4.00	$4,855,732
1988/89	East of 172°	FISHERY CLOSED	
	West of 172°	$5.00	$7,836,570
1989/90	East of 172°	FISHERY CLOSED	
	West of 172°	$4.20	$4,697,977
1990/91	East of 172°	FISHERY CLOSED	
	West of 172°	$4.00	$3,312,420
1991/92	East of 172°	FISHERY CLOSED	
	West of 172°	$3.00	$2,853,834
1992/93	East of 172°	FISHERY CLOSED	
	West of 172°	$5.05	$6,496,441
1993/94	East of 172°	FISHERY CLOSED	
	West of 172°	$3.87	$2,701,558
1994/95	East of 172°	FISHERY CLOSED	
	West of 172°	$5.50	$1,083,319
1995/96	East of 172°	FISHERY CLOSED	
	West of 172°	$2.81	$109,424
1996/97 - 1997/98		FISHERY CLOSED	
1998/99	West of 174°	CONFIDENTIAL	
1999/2000 - 2001/02		FISHERY CLOSED	
2002/03	Petrel Bank[d]	$6.51	$3,283,195

[a] Split season based on 6.5 inch minimum carapace length
[b] Split season based on 8.0 inch minimum carapace length
[c] Split season based on 7.5 inch minimum carapace length
[d] Those waters of king crab Registration Area O between 179°E long., 179°W long., and north of 51°45'N lat.

Table 1-3. Eastern Aleutian Islands, west of Scotch Cap Light and east of 168° W long., subsistence king and Tanner crab harvest, 1999 - 2002.

				Harvest[a]			
Year	Number of Permits Issued	Number of Permits Returned	Percentage Returned	King crab reported	King crab estimated	Tanner crab reported	Tanner crab estimatec
1999	179	80	44.7	786	1,759	1,430	3,200
2000	192	56	29.2	314	1,077	467	1,601
2001	199	152	76.4	1119	1,465	1,688	2,210
2002	230	123	53.5	879	1,644	2,296	4,293

[a] Harvest estimate from Unalaska Bay (no reported harvest on permits from any other area).

Table 1-4. Aleutian Islands golden king crab commercial fishery data, 1981/82 - 2002/03 seasons.

		Number of				Number of Pots			Average		
Season	Locale	Vessels[a]	Landings	Crabs[b]	Harvest[b,c]	Registered	Lifted	CPUE[d]	Weight[c]	Length[e]	Deadloss[c]
1981/82	East of 172° W.	6	16	22,666	115,715	0	2,906	8	5.1	158	8,752
	West of 172° W.	14	76	217,700	1,194,046	2,647	24,627	9	5.5	160	22,064
	TOTAL		**92**	**240,458**	**1,319,761**	**2,647**	**27,533**	**9**	**5.4**		**30,816**
1982/83	East of 172° W.	49	136	227,471	1,184,971	NA	29,369	8	5.2	158	47,479
	West of 172° W.	99	501	1,509,001	8,006,274	13,111	150,103	10	5.3	158	220,743
	TOTAL		**637**	**1,737,109**	**9,191,245**	**13,111**	**179,472**	**10**	**5.3**		**268,222**
1983/84	East of 172° W.	47	132	238,353	1,810,973	4,514	29,595	8	7.6	NA	45,268
	West of 172° W.	157	1,002	1,534,909	8,128,029	17,406	226,798	7	5.3	NA	171,021
	TOTAL		**1,134**	**1,773,262**	**9,939,002**	**21,920**	**256,393**	**7**	**5.6**		**186,289**
1984/85	East of 171° W.	13	67	327,440	1,521,142	1,394	24,044	14	4.6	161	70,362
	West of 171° W.	38	85	643,597	3,180,095	5,270	64,777	10	4.9	157	125,073
	TOTAL		**152**	**971,274**	**4,701,237**	**6,664**	**88,821**	**11**	**4.8**		**195,435**
1985/86	East of 171° W.	13	67	410,977	1,968,213	1,479	34,287	12	4.7	156	38,663
	West of 171° W.	49	386	2,052,048	11,124,759	7,057	202,401	10	5.4	151	5,304
	TOTAL		**453**	**2,463,025**	**13,092,972**	**8,536**	**236,688**	**10**	**5.3**		**43,967**
1986/87	East of 171° W.	17	71	400,389	1,869,180	1,575	37,585	11	4.7	NA	9,510
	West of 171° W.	62	525	2,923,947	12,798,004	12,958	392,185	7	4.4	150	276,736
	TOTAL		**596**	**3,324,336**	**14,667,184**	**14,533**	**429,770**	**8**	**4.4**		**286,246**
1987/88	East of 171° W.	22	77	299,734	1,383,198	3,591	43,017	7	4.6	150	24,210
	West of 171° W.	46	386	1,908,989	8,001,177	10,687	267,705	7	4.2	147	165,415
	TOTAL		**463**	**2,208,723**	**9,324,375**	**14,278**	**310,722**	**7**	**4.2**		**189,625**
1988/89	East of 171° W.	21	57	323,695	1,545,113	4,215	40,869	8	4.8	154	22,960
	West of 171° W.	74	455	2,165,508	9,080,196	23,627	280,732	8	4.2	149	122,251
	TOTAL		**512**	**2,489,203**	**10,625,309**	**27,842**	**321,604**	**8**	**4.3**		**145,211**

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Table 1-4. (Page 2 of 3)

Season	Locale	Number of				Number of Pots			Average		
		Vessels[a]	Landings	Crabs[b]	Harvest[b,c]	Registered	Lifted	CPUE[d]	Weight[c]	Length[e]	Deadloss[c]
1989/90	East of 171° W.	13	70	424,067	1,852,249	5,635	43,345	10	4.4	151	17,421
	West of 171° W.	64	505	2,520,786	10,162,400	14,724	324,153	8	4.0	149	100,724
	TOTAL		**575**	**2,944,853**	**12,014,649**	**20,359**	**367,498**	**8**	**4.1**		**118,145**
1990/91	East of 171° W.	16	58	384,885	1,718,848	5,225	54,618	7	4.3	148	42,800
	West of 171° W.	13	167	1,312,116	5,250,687	7,380	160,960	8	4.0	145	176,583
	TOTAL	**24**	**235**	**1,697,001**	**6,969,535**	**12,605**	**214,578**	**8**	**4.1**		**219,383**
1991/92	East of 171° W.	11	50	335,647	1,447,732	3,760	40,604	8	4.3	148	45,100
	West of 171° W.	16	206	1,511,751	6,254,409	7,635	192,949	8	4.1	145	96,848
	TOTAL	**20**	**256**	**1,847,398**	**7,702,141**	**11,395**	**233,553**	**8**	**4.2**		**141,948**
1992/93	East of 171° W.	10	44	330,159	1,375,048	4,222	37,718	9	4.1	148	37,200
	West of 171° W.	18	130	1,198,169	4,916,149	8,236	165,503	7	4.1	147	104,215
	TOTAL	**22**	**174**	**1,528,328**	**6,291,197**	**12,458**	**203,221**	**8**	**4.1**		**141,415**
1993/94	East of 171° W.	4	14	217,788	915,460	2,334	22,490	10	4.2	149	7,324
	West of 171° W.	21	147	1,102,541	4,635,683	11,970	212,164	5	4.2	148	165,358
	TOTAL	**21**	**161**	**1,320,329**	**5,551,143**	**14,304**	**234,654**	**6**	**4.2**		**172,682**
1994/95	East of 171° W.	14	45	384,353	1,750,267	7,378	67,537	6	4.6	148	29,908
	West of 171° W.	34	247	1,539,866	6,378,030	15,604	319,006	5	4.1	150	242,065
	TOTAL	**35**	**292**	**1,924,219**	**8,128,297**	**22,982**	**386,543**	**5**	**4.2**		**271,973**
1995/96	East of 171° W.	17	42	431,867	1,993,980	10,325	65,030	7	4.6	150	14,676
	West of 171° W.	25	139	1,134,274	4,896,926	14,213	226,463	5	4.2	147	338,223
	TOTAL	**28**	**181**	**1,566,141**	**6,890,906**	**24,538**	**291,493**	**5**	**4.4**		**352,899**
1996/97	East of 174° W.	14	70	725,452	3,262,516	NA	113,460	6	4.5		156,857
	West of 174° W.	13	100	618,498	2,591,720	NA	100,340	6	4.2		78,973
	TOTAL	**18**	**170**	**1,343,950**	**5,854,236**	**11,080**	**213,800**	**6**	**4.4**	**147**	**235,830**

-Continued-

Table 1-4. (Page 3 of 3)

		Number of				Number of Pots			Average		
Season	Locale	Vessels[a]	Landings	Crabs[b]	Harvest[b,c]	Registered	Lifted	CPUE[d]	Weight[c]	length[e]	Deadloss[c]
1997/98	East of 174° W.	13	74	780,609	3,501,054	10,100	106,403	7	4.5	147	131,480
	West of 174° W.	8	160	569,550	2,444,628	4,690	86,811	7	4.3	148	79,525
	TOTAL	**15**	**234**	**1,350,159**	**5,945,682**	**10,100**	**193,214**	**7**	**4.4**	**147**	**211,005**
1998/99	East of 174° W.	14	55	740,011	3,247,863	8,365	83,378	9	4.4	148	82,113
	West of 174° W.	3	44	409,531	1,691,385	1,930	35,920	12	4.1	146	21,218
	TOTAL	**16**	**99**	**1,149,542**	**4,939,248**	**10,295**	**119,298**	**10**	**4.3**	**147**	**103,331**
1999/00	East of 174° W.	16	60	709,332	3,069,886	9,514	79,129	9	4.3	147	67,574
	West of 174° W.	15	113	676,558	2,768,902	10,564	101,040	7	4.1	147	104,675
	TOTAL	**17**	**173**	**1,385,890**	**5,838,788**	**20,078**	**180,169**	**8**	**4.2**	**147**	**172,249**
2000/01	East of 174° W.	15	50	704,702	3,134,079	9,703	71,551	10	4.5	147	55,999
	West of 174° W.	12	100	705,613	2,884,682	8,910	101,239	7	4.1	145	53,158
	TOTAL	**17**	**150**	**1,410,315**	**6,018,761**	**18,613**	**172,790**	**8**	**4.3**	**146**	**109,157**
2001/02	East of 174° W.	19	45	725,297	3,158,179	12,927	62,325	12	4.4	147	49,523
	West of 174° W.	10	90	684,631	2,730,249	8,491	105,219	7	4.0	145	43,505
	TOTAL	**21**	**134**	**1,409,928**	**5,888,428**	**15,307**	**167,544**	**8**	**4.2**	**146**	**93,028**
2002/03	East of 174° W.	19	43	644,236	2,821,851	11,834	52,037	12	4.4	N/A	55,425
	West of 174° W.	5	72	664,915	2,640,951	5,495	95,581	7	4.0	N/A	32,467
	TOTAL	**21**	**115**	**1,309,151**	**5,462,802**	**17,329**	**147,618**	**9**	**4.2**		**87,892**

[a] Many vessels fished both east and west of 174 W, thus total number of vessels reflects registrations for entire Aleutian Islands.
[b] Deadloss included
[c] In pounds
[d] Number of legal crabs per pot lift.
[e] In millimeters, from observer bycatch database.

Table 1-5. Aleutian Islands golden king crab fishery economic performance data, 1981/82 - 2002/03 seasons.

Year		Value		Season Length	
		Exvessel[a]	Total[b]	Days	Dates
1981/82	East of 172° W.	$2.05	$0.22	75	11/01-01/15
	West of 172° W.	$2.06	$2.41	227	11/01-06/15
	Total	**$2.06**	**$2.63**		
1982/83	East of 172° W.	$3.00	$3.41	105	11/01-02/15
	West of 172° W.	$3.01	$23.43	166	11/01-04/15
	Total	**$3.01**	**$26.85**		
1983/84	East of 172° W.	$3.05	$5.38	105	11/01-02/15
	West of 172° W.	$2.92	$23.23	157	11/10-04/15
	Total	**$2.94**	**$28.62**		
1984/85	East of 171° W.	$1.35	$1.96	229	07/01-02/15
	West of 171° W.	$2.00	$6.11	240	11/10-07/08
	Total	**$1.79**	**$8.07**		
1985/86	East of 171° W.	$2.00	$3.86	121	07/01-10/31
	West of 171° W.	$2.50	$27.80	288	11/01-08/15
	Total	**$2.43**	**$31.66**		
1986/87	East of 171° W.	$2.85	$5.30	182	07/01-12/31
	West of 171° W.	$3.00	$37.56	288	11/01-08/15
	Total	**$2.98**	**$42.86**		
1987/88	East of 171° W.	$2.85	$3.87	62	07/01-09/02
	West of 171° W.	$3.00	$23.51	289	11/01-08/15
	Total	**$2.98**	**$27.38**		
1988/89	East of 171° W.	$3.00	$4.57	93	09/01-12/04
	West of 171° W.	$3.20	$28.66	288	11/01-08/15
	Total	**$3.17**	**$33.23**		
1989/90	East of 171° W.	$3.50	$6.42	104	09/01-12/15
	West of 171° W.	$3.00	$30.18	288	11/01-08/15
	Total	**$3.08**	**$36.61**		
1990/91	East of 171° W.	$3.00	$5.03	68	09/01-11/09
	West of 171° W.	$3.00	$15.22	288	11/01-08/15
	Total	**$3.00**	**$20.25**		
1991/92	East of 171° W.	$2.00	$2.81	74	09/01-11/15
	West of 171° W.	$2.50	$15.39	289	11/01-08/15
	Total	**$2.41**	**$18.20**		

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Table 1-5. (Page 2 of 2)

Year		Value Exvessel[a]	Value Total[b]	Season Length Days	Season Length Dates
1992/93	East of 171° W.	$2.50	$3.30	76	09/01-11/17
	West of 171° W.	$2.05	$9.86	288	11/01-08/15
	Total	**$2.15**	**$13.16**		
1993/94	East of 171° W.	$2.15	$1.95	212	09/01-03/31
	West of 171° W.	$2.50	$11.18	288	11/01-08/15
	Total	**$2.44**	**$13.13**		
1994/95	East of 171° W.	$4.00	$6.88	57	09/01-10/28
	West of 171° W.	$3.33	$20.43	288	11/01-08/15
	Total	**$3.48**	**$27.31**		
1995/96	East of 171° W.	$2.60	$5.15	38	09/01-10/09
	West of 171° W.	$2.10	$9.57	289	11/01-08/15
	Total	**$2.25**	**$14.72**		
1996/97	East of 174° W.	$2.23	$6.93	115	09/01-12/25
	West of 174° W.	$2.23	$5.60	365	09/01-08/31
	Total	**$2.23**	**$12.53**		
1997/98	East of 174° W.	$2.25	$7.58	84	09/01-11/24
	West of 174° W.	$2.10	$4.96	365	09/01-08/31
	Total	**$2.19**	**$12.54**		
1998/99	East of 174° W.	$1.87	$5.92	68	09/01-11/07
	West of 174° W.	$2.04	$3.41	365	09/01-08/31
	Total	**$1.92**	**$9.33**		
1999/00	East of 174° W.	$3.26	$9.78	55	09/01-10/25
	West of 174° W.	$3.09	$8.23	348	09/01-8/14
	Total	**$3.15**	**$18.01**		
2000/01	East of 174° W.	$3.50	$10.77	40	08/15-09/24
	West of 174° W.	$3.09	$8.75	286	08/15-05/28
	Total	**$3.33**	**$19.52**		
2001/02	East of 174° W.	$3.30	$10.26	26	08/15-09/10
	West of 174° W.	$2.93	$7.87	227	08/15-03/30
	Total	**$3.16**	**$18.13**		
2002/03	East of 174° W.	$3.30	$9.13	23	08/15-09/07
	West of 174° W.	$3.50	$9.13	205	08/15-03/08
	Total	**$3.38**	**$18.26**		

[a] Average price per pound.
[b] In millions of dollars.

Table 1-6. Aleutian Islands golden king crab catch by statistical area, 2001/2002 season.

Locale	Statistical area	Number of Landings	Number of Crab[a]	Harvest[a,b]	Pots lifted	Average CPUE[c]	Average Weight[b]	Deadloss[b]
Islands of Four Mts.	695238	6	36,770	173,828	4,472	8.22	4.73	2,001
	695239	4	4,733	20,473	314	15.07	4.33	507
	695301	6	17,052	80,082	3,682	4.63	4.70	1,120
	695302	6	12,594	53,538	1,025	12.29	4.25	1,567
Yunaska Island	705200	12	60,598	264,086	4,642	13.05	4.36	3,067
	705232	14	187,513	806,107	10,280	18.24	4.30	11,834
	705300	8	45,027	196,313	3,453	13.04	4.36	4,153
Amukta Pass	715130	6	7,037	30,238	704	10.00	4.30	566
	715202	12	78,458	333,465	6,064	12.94	4.25	4,538
	715231	10	43,586	175,989	3,845	11.34	4.04	3,050
Seguam Pass	725130	4	1,537	6,829	466	3.30	4.44	110
	725201	13	112,125	492,613	8,697	12.89	4.39	8,599
	725203	5	8,837	37,350	425	20.79	4.23	594
	725230	7	14,959	64,530	1,331	11.24	4.31	859
Kanaga Island	775131	27	24,121	93,300	3,430	7.03	3.87	942
Delarof Islands	785102	23	44,041	162,569	5,397	8.16	3.69	2,420
Petrel Bank	795200	37	38,927	163,156	6,397	6.09	4.19	2,250
	795230	19	16,038	65,017	2,213	7.25	4.05	636
	805201	35	40,104	164,395	4,358	9.20	4.10	2,514
Kiska Island	825132	9	3,977	16,114	828	4.80	4.05	167
	825201	19	24,184	98,988	4,760	5.08	4.09	1,478
	825202	10	9,452	39,105	2,382	3.97	4.14	902
	825203	11	5,045	20,790	733	6.88	4.12	306

-Continued-

Table 1-6. (Page 2 of 2)

		Number of				Average		
Locale	Statistical area	Landings	Crab[a]	Harvest[a,b]	Pots lifted	CPUE[c]	Weight[b]	Deadloss[b]
Buldir Reef	835130	16	13,624	56,493	2,296	5.93	4.15	714
	835200	21	28,001	116,785	5,271	5.31	4.17	2,614
	845130	15	21,760	90,475	3,880	5.61	4.16	3,139
	855200	14	17,327	71,661	3,302	5.25	4.14	1,792
Other[d]		433	499,171	2,022,765	73468	5.50	4.09	31110

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot lift.
[d] Combination of statistical areas in which landings were made by fewer than three vessels.

Table 1-7. Aleutian Islands golden king crab catch by statistical area, 2002/2003 season.

		Number of				Average		
Locale	Statistical area	Landings	Crab[a]	Harvest[a,b]	Pots lifted	CPUE[c]	Weight[b]	Deadloss[b]
Islands of Four Mts.	695200	5	15,434	67,229	1,388	11.12	4.36	632
	695239	6	3,306	14,735	465	7.11	4.46	154
	695301	7	25,553	119,581	2,901	8.81	4.68	1,897
Yunaska Island	705200	16	97,884	402,032	6,384	15.33	4.11	9,054
	705232	15	176,086	771,789	11,251	15.65	4.38	15,503
	705233	3	5,591	24,242	399	14.01	4.34	903
	705300	7	31,240	143,157	2,696	11.59	4.58	2,321
Amukta Pass	715202	11	45,092	197,411	4,102	10.99	4.38	3,657
	715231	8	34,764	136,539	3,471	10.02	3.93	2,357
Seguam Pass	725201	13	83,432	366,474	6,564	12.71	4.39	6,142
	725230	7	15,585	70,362	1,661	9.38	4.51	1,652
Adak Island	765132	3	237	992	79	3.00	4.19	13
	765144	16	5,422	21,527	918	5.91	3.97	175
	765203	7	1,783	6,980	392	4.55	3.91	65
	765204	10	3,630	14,752	541	6.71	4.06	99
Tanaga/Kanaga Islands	775131	27	20,643	77,464	3,100	6.66	3.75	792
	775133	15	5,186	21,276	1,400	3.70	4.10	270
	775134	9	4,657	18,634	995	4.68	4.00	187
	775135	6	2,076	7,823	280	7.41	3.77	72
	775137	9	3,573	13,600	868	4.12	3.81	168
Delarof Islands	785131	20	46,538	170,355	5,340	8.71	3.66	1,979
Petrel Bank	805201	29	40,709	168,555	5,347	7.61	4.14	359
Other[d]		524	640,733	2,627,313	87076	6.69	4.15	39441

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot lift.
[d] Combination of statistical areas in which landings were made by fewer than three vessels

Table 1-8. Aleutian Islands scarlet king crab fishery data, 1992 - 2002.

Year	Area	Number of Vessels	Number of Landings	Number of Crabs[a]	Harvest[a,b]	Pots lifted	Value Ex-vessel[c]	Value Total[d]	Average Weight[b]	Average CPUE[e]	Deadloss[b]
1992	Dutch Harbor					NO LANDINGS					
	Adak					CONFIDENTIAL					
1993	Dutch Harbor					NO LANDINGS					
	Adak					NO LANDINGS					
1994	Dutch Harbor					CONFIDENTIAL					
	Adak	6	10	6,624	21,308	7,520	$1.76	$0.02	3.2	<1	10,829
	Total	7	10	6,624	21,308	7,520	$1.88	$0.02	3.1	<1	10,829
1995	Dutch Harbor	3	3	6,270	13,871	5,706	$2.18	$0.03	2.2	1	1,755
	Adak	6	18	19,544	49,126	15,046	$1.82	$0.09	2.5	1	2,066
	Total	8	21	25,814	62,997	20,752	$1.89	$0.11	2.4	1	3,821
1996	Dutch Harbor	3	10	10,190	20,924	10,247	$1.78	$0.03	2.0	1	3,990
	Adak	4	13	10,133	24,076	19,170	$1.80	$0.04	2.4	<1	1,861
	Total	7	23	20,323	45,000	29,417	$1.79	$0.07	2.2	<1	5,851
1997	Aleutian Islands	3	12	2,698	6,720	21,217	$1.40	$0.01	2.5	<1	408
1998	Aleutian Islands	7				CONFIDENTIAL					
1999	Aleutian Islands	2				CONFIDENTIAL					
2000	Aleutian Islands	2				CONFIDENTIAL					
2001	Aleutian Islands	2				CONFIDENTIAL					
2002	Aleutian Islands	2				CONFIDENTIAL					

[a] Deadloss included.
[b] In pounds.
[c] Price per pound.
[d] Millions of dollars.
[e] Number of legal crabs per pot lift.

Table 1-9. Eastern Aleutian District Tanner crab fishery data, 1973/74 - 2002.

	Number of					Average		
Season	Vessels	Landings	Crabs	Harvest[a,b]	Pots lifted	Weight[b]	CPUE[c]	Deadloss[b]
1973/74	6	14	210,539	498,836	NA	2.4	60	0
1974/75				CONFIDENTIAL				
1975/76	8	13	219,166	534,295	4,646	2.4	47	0
1976/77	12	35	544,755	1,239,569	9,640	2.3	57	0
1977/78	15	198	1,104,631	2,494,631	29,855	2.3	37	0
1978/79	20	174	542,081	1,280,115	18,618	2.4	20	0
1979/80	18	107	352,819	886,487	18,040	2.4	20	NA
1981	29	119	264,238	654,514	21,771	2.4	12	NA
1982	31	138	332,260	739,694	30,109	2.2	11	NA
1983	23	107	250,774	547,830	22,168	2.1	11	NA
1984	16	91	104,761	239,585	11,069	2.3	9	NA
1985	6	56	71,918	165,529	5,620	2.3	13	NA
1986	9	37	73,187	167,339	10,244	2.3	7	NA
1987	7	63	71,338	160,292	5,294	2.2	13	NA
1988	19	130	129,468	309,918	11,011	2.4	12	NA
1989	12	109	144,746	326,396	14,685	2.2	10	NA
1990	10	75	73,269	171,785	6,858	2.3	11	0
1991	5	27	21,511	50,038	1,849	2.3	12	0
1992	4	29	42,096	98,703	2,963	2.3	14	0
1993	7	34	51,441	118,609	3,530	2.3	15	0
1994	8	120	71,962	166,545	6,323	2.3	11	40
1995-2002				FISHERY CLOSED				

[a] Deadloss included beginning 1980.
[b] In pounds.
[c] Number of legal crabs per pot lift.

Table 1-10. Eastern Aleutian District Tanner crab fishery economic performance data, 1973/74 - 2002.

	Date		Value	
Season	Opened	Closed	Ex-vessel[a]	Total[b]
1973/74	1-Oct	31-Jul	NA	
1974/75	18-Jan	15-Oct	NA	
1975/76	20-Jan	15-Oct	$0.20	$0.11
1976/77	7-Nov	15-Jun	$0.30	$0.38
1977/78	1-Nov	15-Jun	$0.38	$0.95
1978/79	1-Nov	15-Jun	$0.52	$0.67
1979/80	1-Nov	15-Jun	$0.52	$0.46
1981	15-Jan	15-Jun	$0.58	$0.38
1982	15-Feb	15-Jun	$1.25	$0.92
1983	15-Feb	15-Jun	$1.20	$0.66
1984	15-Feb	15-Jun	$0.98	$0.23
1985	15-Jan	15-Jun	$1.30	$0.22
1986	15-Jan	15-Jun	$1.50	$0.25
1987	15-Jan	15-Jun	$2.00	$0.32
1988	15-Jan	10-Apr	$2.10	$0.65
1989	15-Jan	7-May	$2.90	$0.95
1990	15-Jan	9-Apr	$1.85	$0.32
1991	15-Jan	31-Mar	$1.25	$0.06
1992	15-Jan	31-Mar	$1.75	$0.18
1993	15-Jan	31-Mar	$1.70	$0.20
1994	15-Jan	31-Mar	$2.35	$0.39
1995-2002		FISHERY CLOSED		

[a] Price per pound.
[b] Millions of dollars.

Table 1-11. Eastern Aleutian District grooved Tanner crab fishery data, 1993 - 2002.

	Number of					Average			Value	
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Pots lifted	Weight[b]	CPUE[c]	Deadloss[b]	Exvessel[d]	Total[e]
1993					CONFIDENTIAL					
1994	3	27	426,230	759,239	38,106	1.8	11	19,474	$1.73	$1.3
1995	7	51	494,522	850,427	75,259	1.7	6	28,338	$1.57	$1.3
1996	3	24	55,593	106,071	24,199	1.9	2	7,659	$1.00	$1.0
1997-2000					NO LANDINGS					
2001					CONFIDENTIAL					
2002					NO LANDINGS					

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot lift.
[d] Price per pound.
[e] Millions of dollars.

Table 1-12. Eastern Aleutian District triangle Tanner crab fishery data, 1993 - 2002.

	Number of					Average			Value	
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Pots lifted	Weight[b]	CPUE[c]	Deadloss[b]	Exvessel[d]	Total[e]
1993						NO LANDINGS				
1994						NO LANDINGS				
1995	2					CONFIDENTIAL				
1996	2					CONFIDENTIAL				
1997-2000						NO LANDINGS				
2001	1					CONFIDENTIAL				
2002						NO LANDINGS				

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot lift.
[d] Price per pound.
[e] Millions of dollars.

Table 1-13. Western Aleutian District Tanner crab fishery data, 1973/74 - 2002/03.

Year	Number of Vessels	Number of Landings	Crabs[a]	Harvest[a,b]	Pots lifted	Average Weight[b]	CPUE[c]	Deadloss[b]
1973/74	7	12	31,079	71,887	2,390	2.3	13	NA
1974/75					CONFIDENTIAL			
1975/76					CONFIDENTIAL			
1976/77					NO LANDINGS			
1977/78	6	7	103,190	237,512	2,700	2.3	38	NA
1978/79	6	9	84,129	197,244	4,730	2.3	18	0
1979/80	10	12	147,843	337,297	5,952	2.3	25	NA
1980/81	9	23	95,102	220,716	7,327	2.3	13	0
1981/82	17	43	364,164	838,697	21,910	2.3	17	6,470
1982/83	61	125	225,491	488,399	40,450	2.2	6	7,662
1983/84	31	86	171,576	384,146	20,739	2.2	8	200
1984/85	31	41	75,009	163,460	13,416	2.2	6	1,000
1985/86	15	30	98,089	206,814	7,999	2.1	12	0
1986/87	8	24	19,874	42,761	10,878	2.1	2	200
1987/88	15	37	63,545	141,390	7,453	2.2	9	200
1988/89	36	77	69,280	148,997	18,906	2.1	4	233
1989/90	12	30	22,937	48,746	6,204	2.1	4	3,810
1990/91	5	21	6,901	14,779	1,309	2.1	5	125
1991/92	8	8	3,483	7,825	986	2.2	4	NA
1992/93					CONFIDENTIAL			
1993/94					NO LANDINGS			
1994/95					NO LANDINGS			
1995/96					CONFIDENTIAL			
1996/97 - 2002/03					FISHERY CLOSED			

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot pull.

Table 1-14. Western Aleutian District commercial Tanner crab fishery economic data 1973/74 - 2002/03.

Year	Value	
	Exvessel[a]	Total
1973/74	NOT AVAILABLE	
1974/75	CONFIDENTIAL	
1975/76	CONFIDENTIAL	
1976/77	NO LANDINGS	
1977/78	$ 0.38	$90,255
1978/79	$ 0.53	$104,539
1979/80	$ 0.52	$175,394
1980/81	$ 0.54	$119,187
1981/82	$ 1.30	$1,081,895
1982/83	$ 1.27	$610,536
1983/84	$ 0.95	$364,749
1984/85	$ 1.30	$211,198
1985/86	$ 1.40	$289,540
1986/87	$ 1.50	$63,842
1987/88	$ 2.10	$296,499
1988/89	$ 1.00	$148,764
1989/90	$ 1.00	$44,936
1990/91	$ 1.25	$18,318
1991/92	$ 1.00	$7,825
1992/93	CONFIDENTIAL	
1993/94	NO LANDINGS	
1994/95	NO LANDINGS	
1995/96	CONFIDENTIAL	
1996/97 - 2002/03	FISHERY CLOSED	

[a] Price per pound.

Table 1-15. Western Aleutian District grooved Tanner crab fishery data, 1992 - 2002.

				Value		Average		
Year	Harvest[a,b]	Vessels	Pots lifted	Exvessel[c]	Total[d]	Weight[b]	CPUE[e]	Deadloss[b]
1992				CONFIDENTIAL				
1993				NO LANDINGS				
1994				CONFIDENTIAL				
1995	145,795	6	17,749	$1.52	$0.195	1.9	4	17,190
1996				CONFIDENTIAL				
1997-1998				NO LANDINGS				
1999-2002				FISHERY CLOSED				

[a] Deadloss included.
[b] In pounds.
[c] Price per pound.
[d] Millions of dollars.
[e] Number of legal crabs per pot lift.

Table 1-16. Aleutian District Dungeness crab fishery data, 1974 - 2002.

Year	Season Dates	Number of Vessels	Number of Landings	Number of Crabs[a]	Harvest[a,b]	Pots Lifted	Average Weight[b]	Average CPUE[c]	Price per Pound
1974	01/01-12/31	3	13	24,459	60,517	3,399	2.4	8	NA
1975	01/01-12/31				CONFIDENTIAL				
1976/77	05/01-01/01				NO LANDINGS				
1977/78	05/01-01/01				NO LANDINGS				
1978/79	05/01-01/01				CONFIDENTIAL				
1979/80	05/01-01/01				CONFIDENTIAL				
1980/81	05/01-01/01				NO LANDINGS				
1981/82	05/01-01/01				NO LANDINGS				
1982/83	05/01-01/01				CONFIDENTIAL				
1983/84	05/01-01/01				CONFIDENTIAL				
1984/85	05/01-01/01	4	50	40,128	91,739	13,555	2.3	3	$1.35
1985/86	05/01-01/01	4	19	8,590	17,830	1,706	2.1	5	NA
1986/87	05/01-01/01				CONFIDENTIAL				
1987/88	05/01-01/01	5	43	13,247	26,627	2,987	2	4	$0.95
1988/89	05/01-01/01	6	45	10,814	22,634	2,581	2.1	4	$0.90
1989/90	05/01-01/01	4	31	5,165	11,124	2,078	2.1	2	$0.90
1990/91	05/01-01/01	3	11	8,379	17,365	1,345	2.1	6	$0.90
1991/92	05/01-01/01	4	14	3,654	7,412	732	2	5	$1.25
1992/93	05/01-01/01	4	13	2,854	5,649	555	2	5	$0.83
1993/4	05/01-01/01	5	12	3,448	7,531	797	2.2	4	$0.78
1994/95-2000/01	05/01-01/01				NO LANDINGS				
2001/02	05/01-01/01				CONFIDENTIAL				
2002/03	05/01-01/01				CONFIDENTIAL				

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs per pot lift.

Table 1-17. Aleutian District trawl shrimp fishery data, 1972 - 2002.

	Date		Number of				Value	
Season	Opened	Closed	Vessels	Landings	Tows	Harvest[a]	Exvessel[b]	Fishery[c]
1972	1/1	12/1	CONFIDENTIAL					
1973	1/1	12/1	CONFIDENTIAL					
1974	1/1	12/1	7	88	721	5,749,407	NA	NA
1975	1/1	12/1	4	14	54	467,196	NA	NA
1976	1/1	12/1	8	66	689	3,670,609	$0.07	$0.26
1977/78	2/1	3/1	7	93	1,372	6,800,393	$0.12	$0.82
1978/79	4/1	3/1	7	74	1,007	4,946,350	$0.15	$0.74
1979/80	4/1	2/1	7	68	799	3,292,049	$0.20	$0.66
1980	3/1	12/1	4	60	711	2,454,829	$0.23	$0.56
1981	3/1	12/1	6	45	551	2,185,326	$0.22	$0.48
1982	5/1	6/1	CONFIDENTIAL					
1983-1991			NO LANDINGS					
1992	1/1	12/1	4	6	94	72,133	NA	NA
1993-1998			NO LANDINGS					
1999	1/1	7/9	2	CONFIDENTIAL				
2000-2002			FISHERY CLOSED					

[a] In pounds.
[b] Price per pound.
[c] In millions of dollars.

Table 1-18. Aleutian Islands miscellaneous shellfish fishery data, 1996 - 2002.

Year	Fishery	Number of Vessels	Number of Landings	Number of Pots Pulled	Harvest[a]
1996	Octopus	35	119	17,800	62,214
	Sea Urchins	6	15[b]		3,701
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		
1997	Octopus[c]	38	107		73,472
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina				
1998	Octopus		CONFIDENTIAL		
	Octopus[c]	24	75		29,360
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		
1999	Octopus[c]	34	95		115,322
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		
2000	Octopus[c]	31	91		21,265
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		
2001	Octopus[c]	25	51		13,097
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		
2002	Octopus[c]	56	186		96,585
	Sea Urchins		NO LANDINGS		
	Sea Cucumbers		NO LANDINGS		
	Hair Crab		NO LANDINGS		
	Snails		NO LANDINGS		
	Paralomis multispina		NO LANDINGS		

[a] In pounds. Deadloss included.
[b] Dives.
[c] Octopus bycatch.

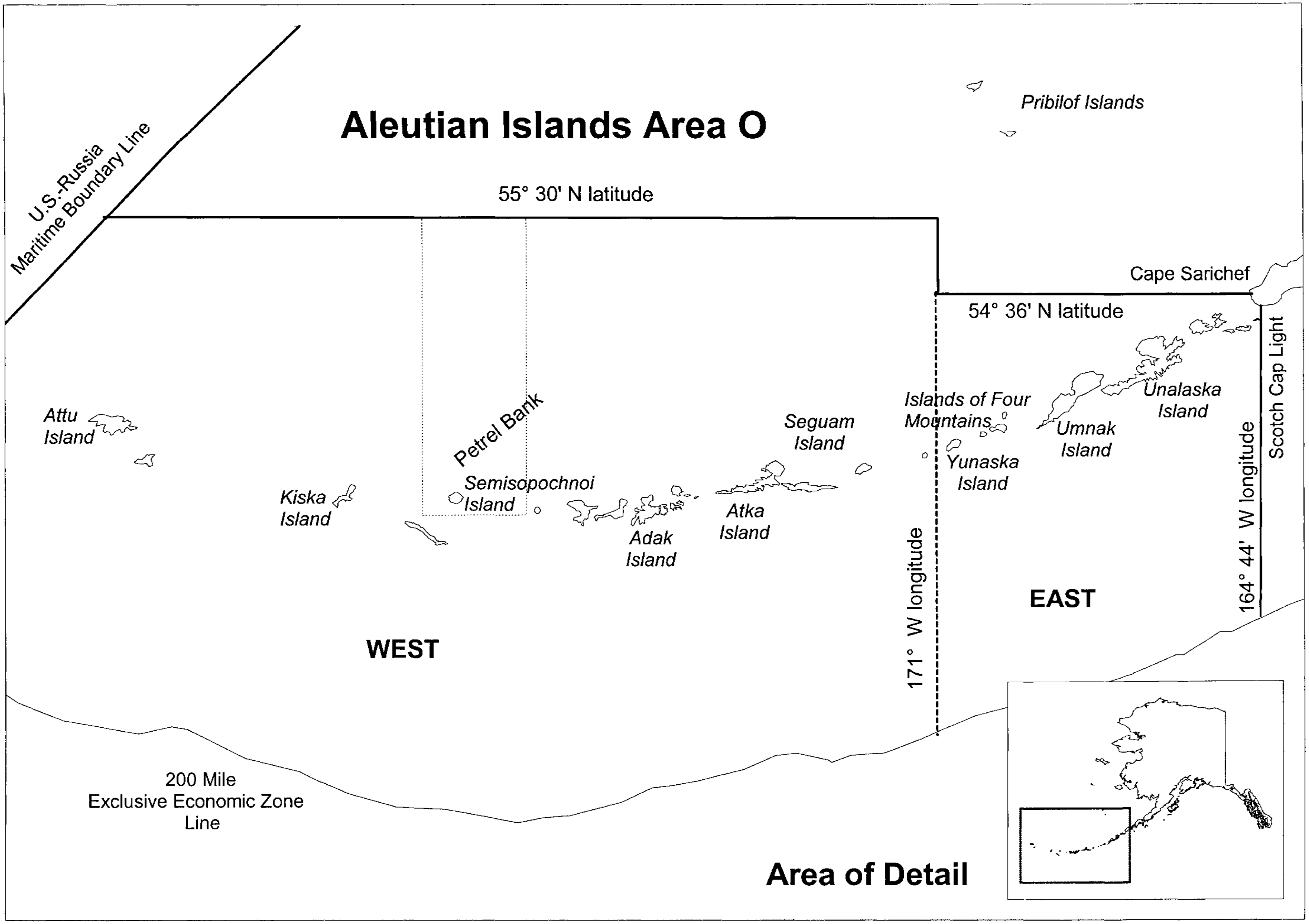

Figure 1-1. Aleutian Islands, Area O, king crab management area.

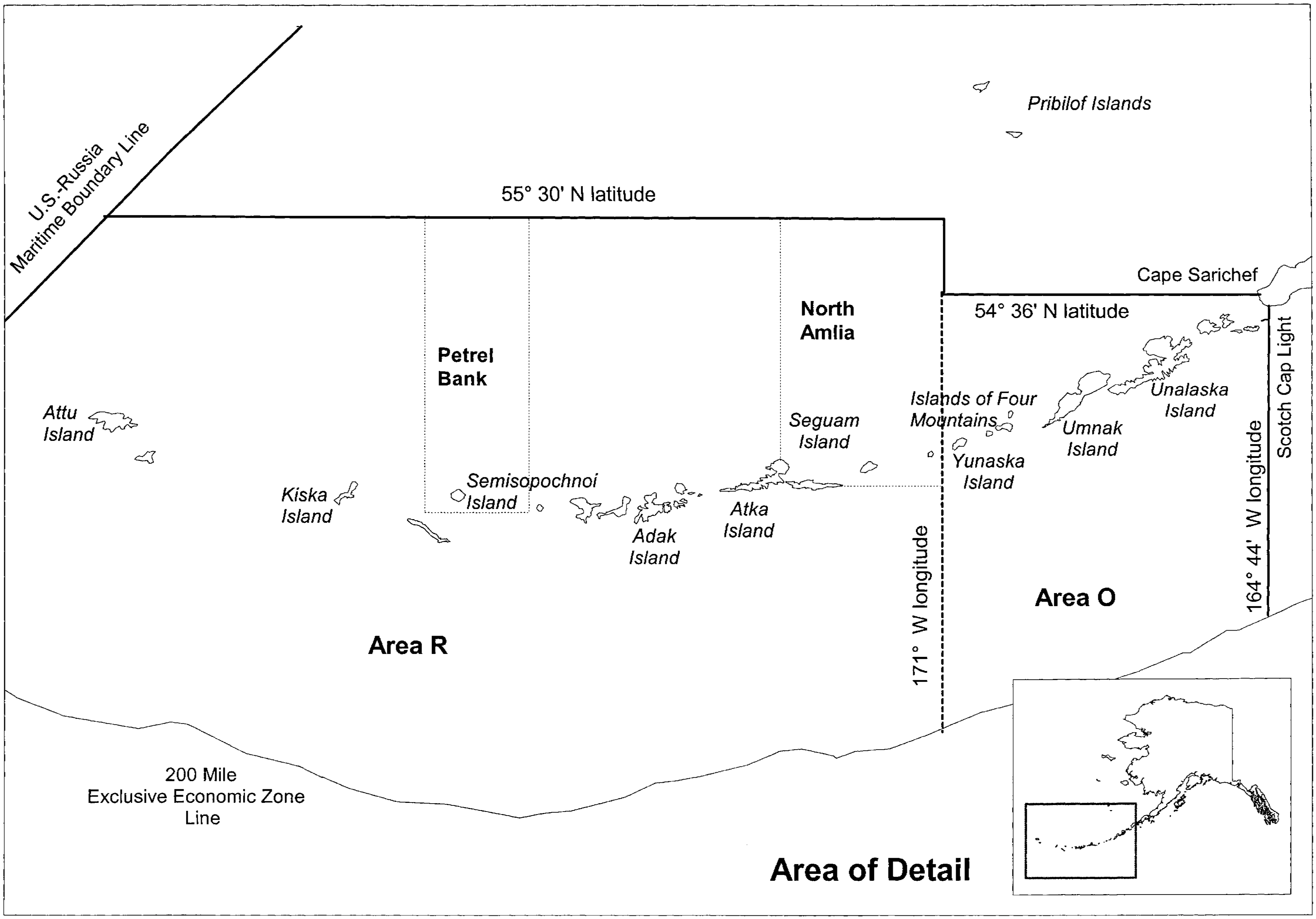

Figure 1-2. Adak (Area R) and Dutch Harbor (Area O) king crab Registration Areas and Districts 1981/82 – 1996/97.

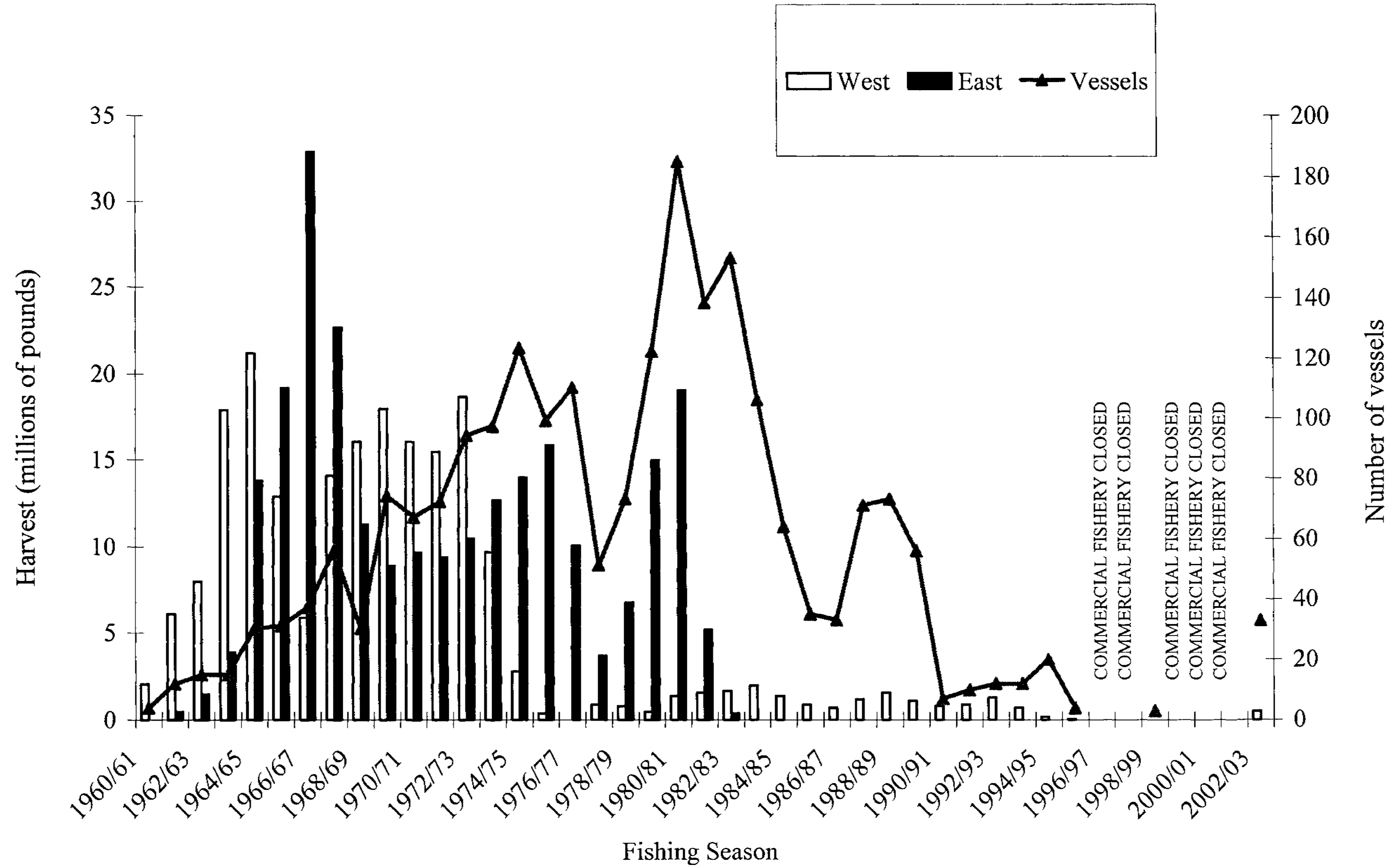

Figure 1-3. Aleutian Islands red king crab fishery harvest and effort, 1960/61 – 2002/03.

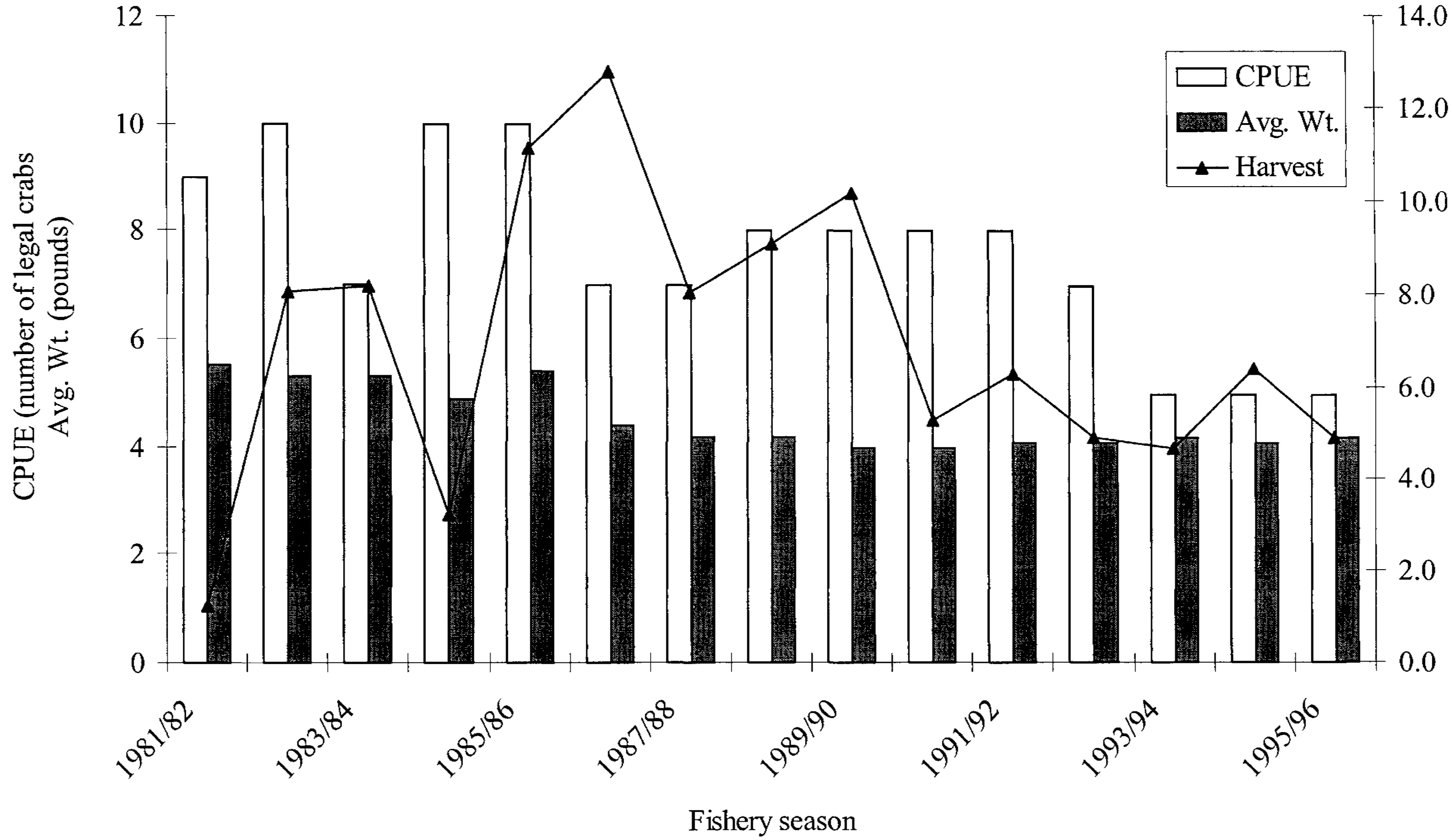

Figure 1-4. Adak Area golden king crab fishery harvest, fishery performance and average weight data, 1981/82 - 1995/96 seasons.

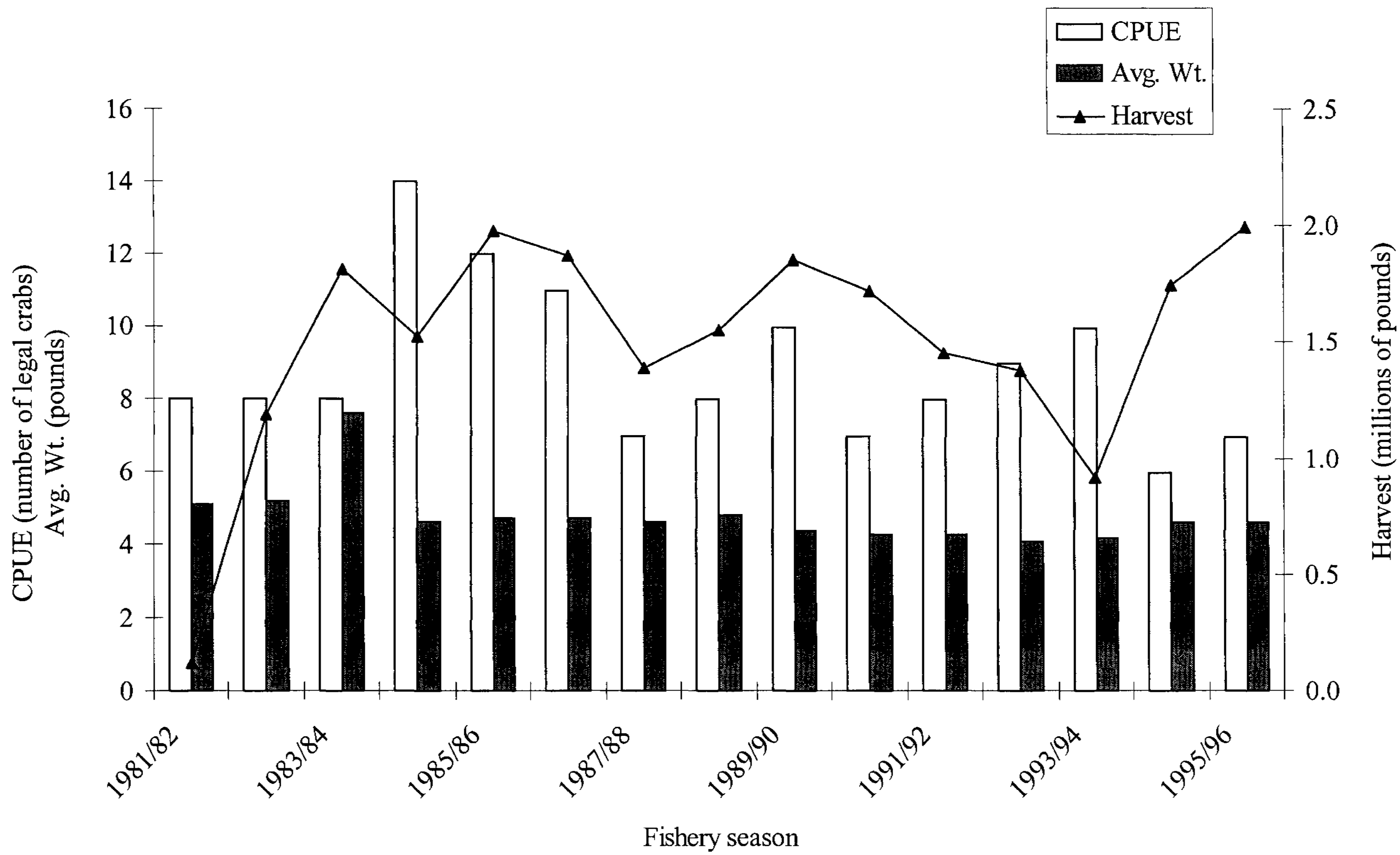

Figure 1-5. Dutch Harbor Area golden king crab fishery harvest, fishery performance and average weight data, 1981/82 - 1995/96 seasons.

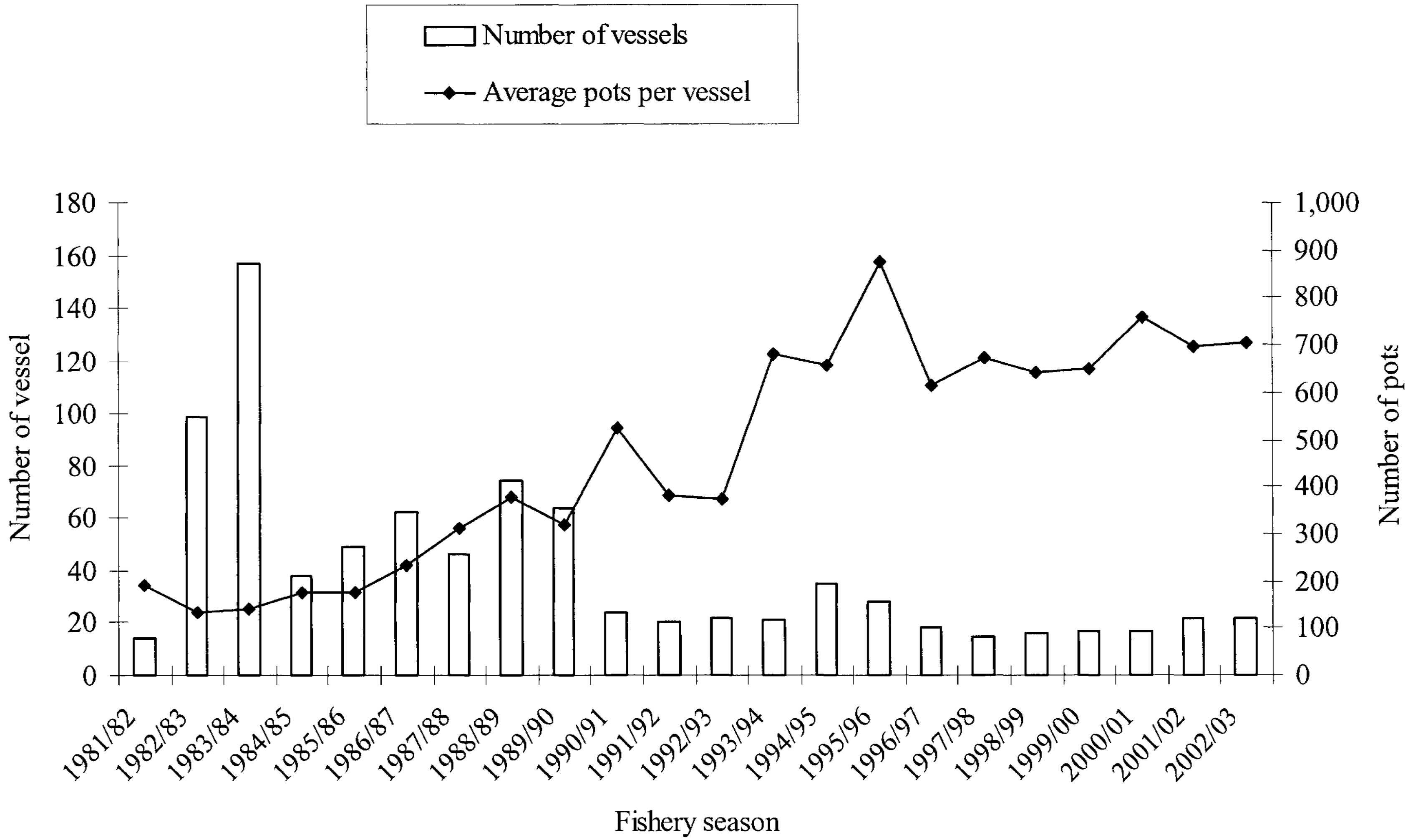

Figure 1-6. Aleutian Islands golden king crab fishery vessel registrations and average number of pots per vessel 1981/82 - 2002/2003.

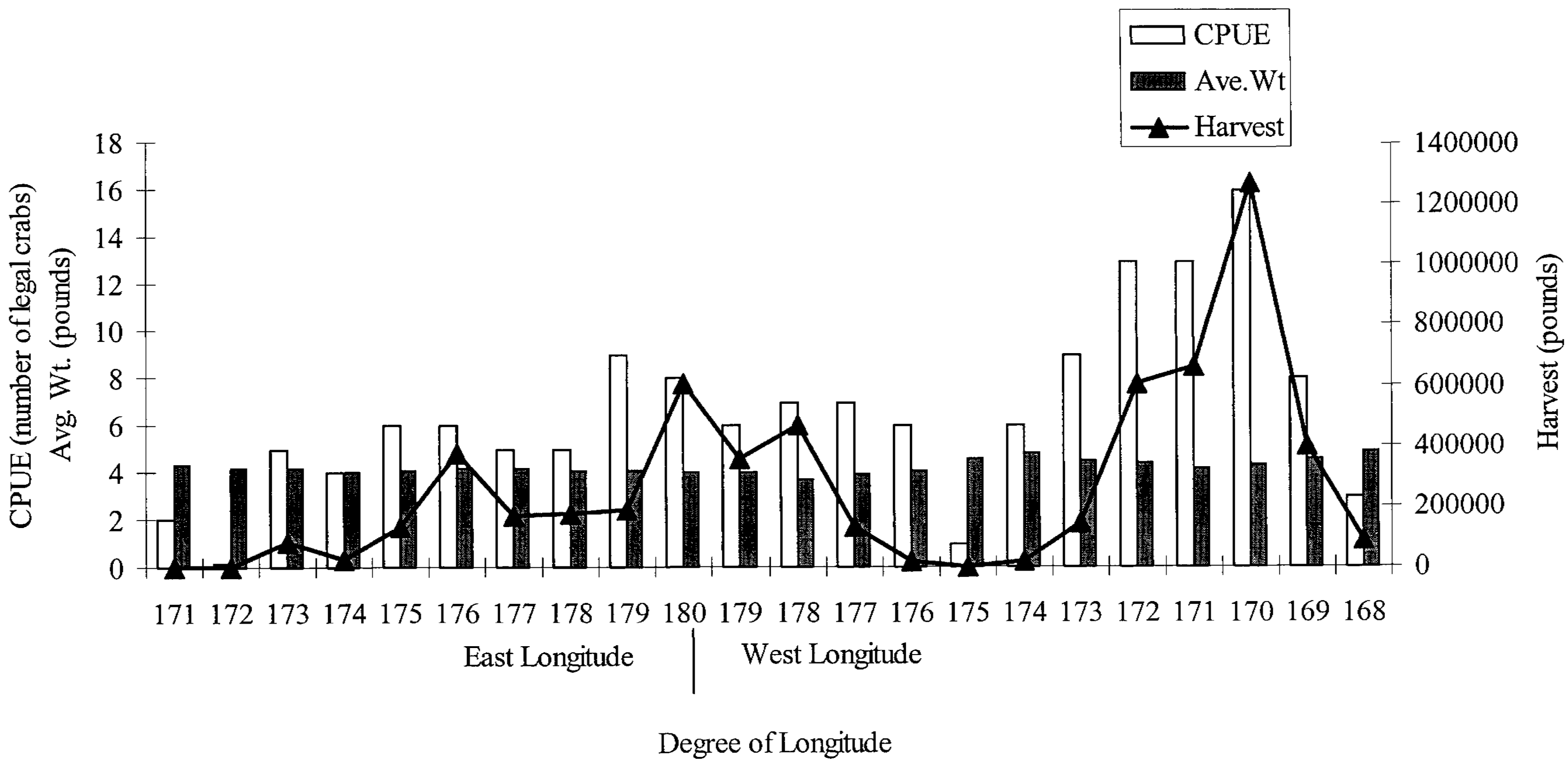

Figure 1-7. Aleutian Islands golden king crab fishery harvest, catch per unit of effort and average weight data by degree of longitude, 2001/2002.

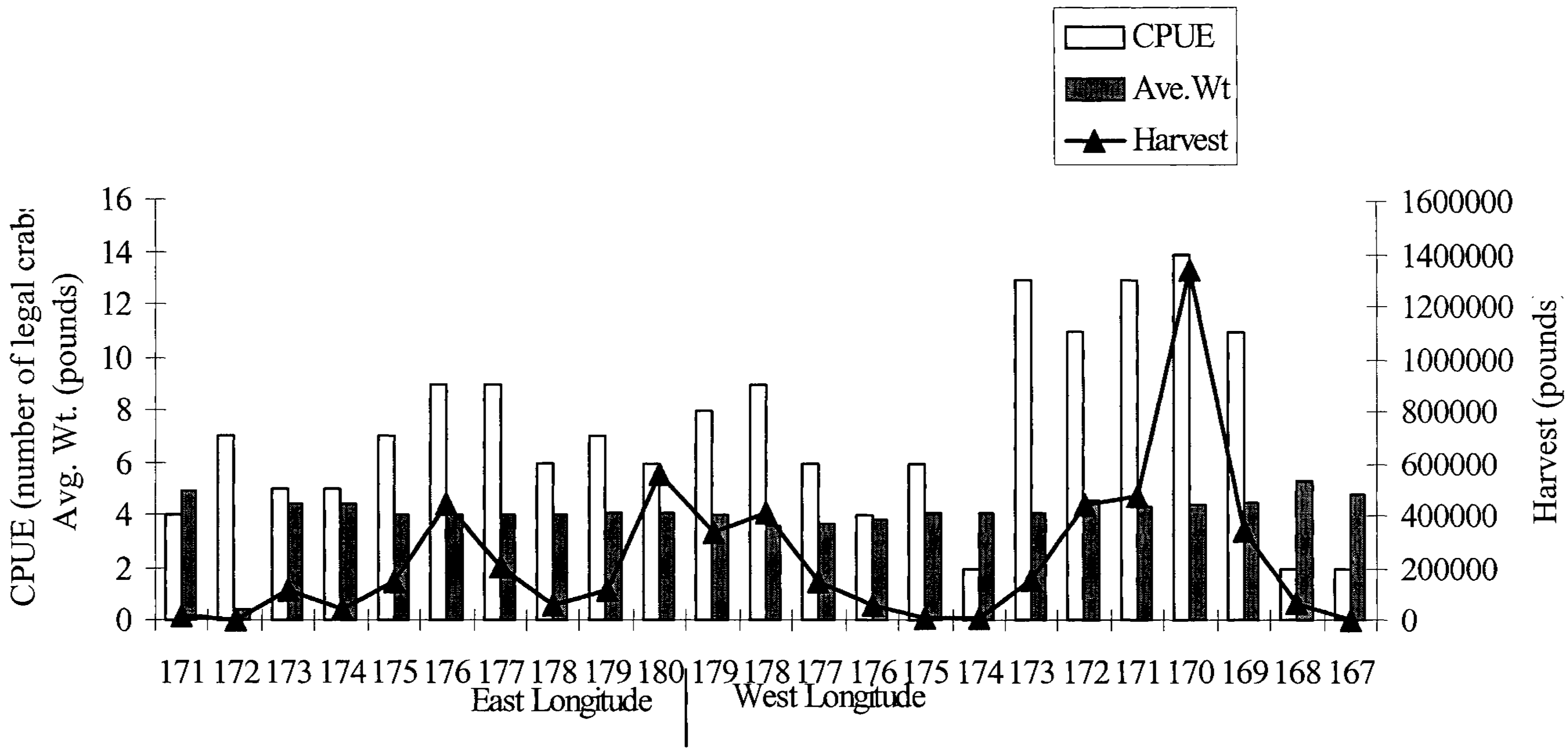

Figure 1-8. Aleutian Islands golden king crab fishery harvest, catch per unit of effort and average weight data by degree of longitude, 2002/2003.

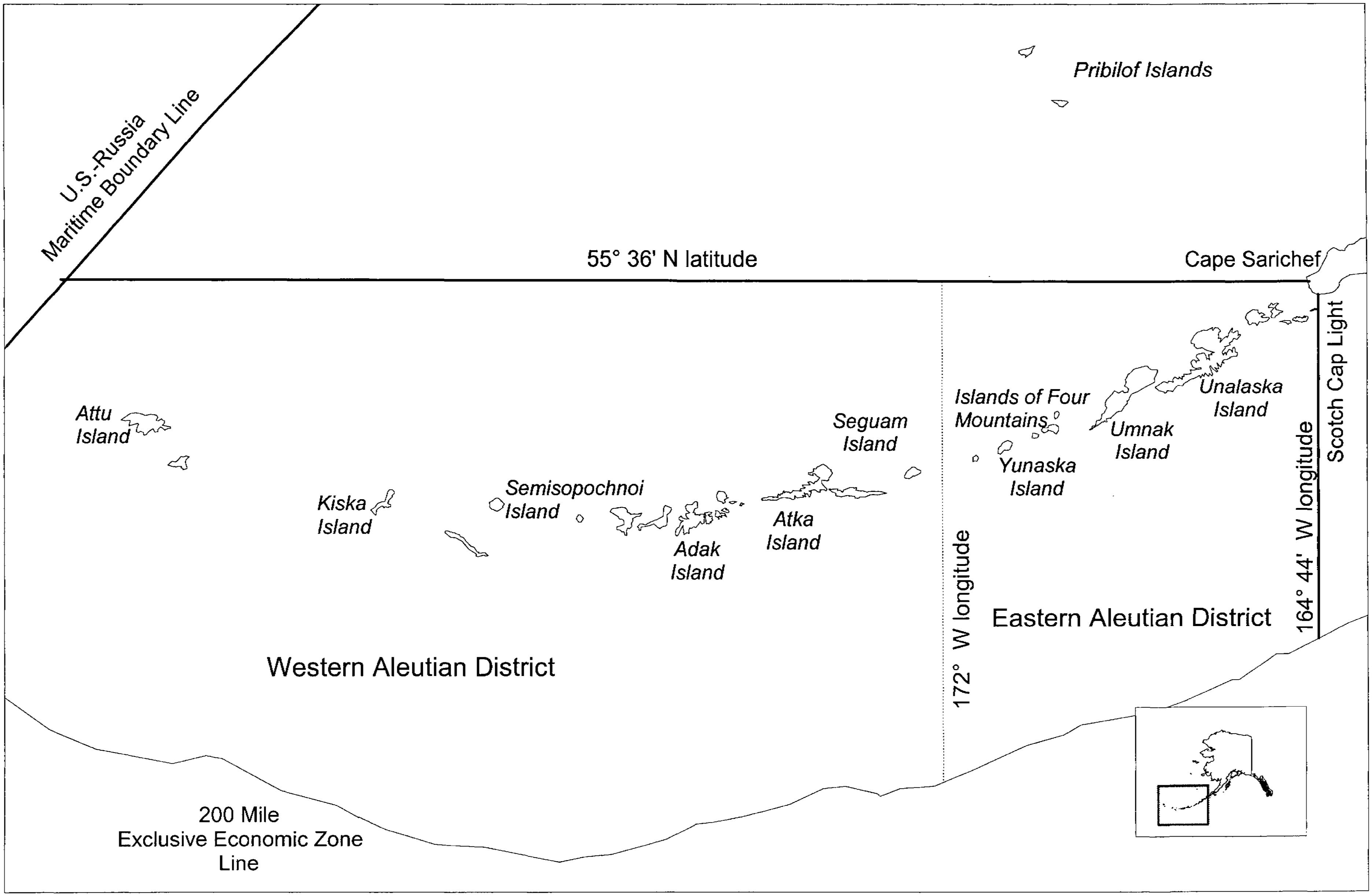

Figure 1-9. Eastern and Western Aleutian Districts of Tanner crab Registration Area J.

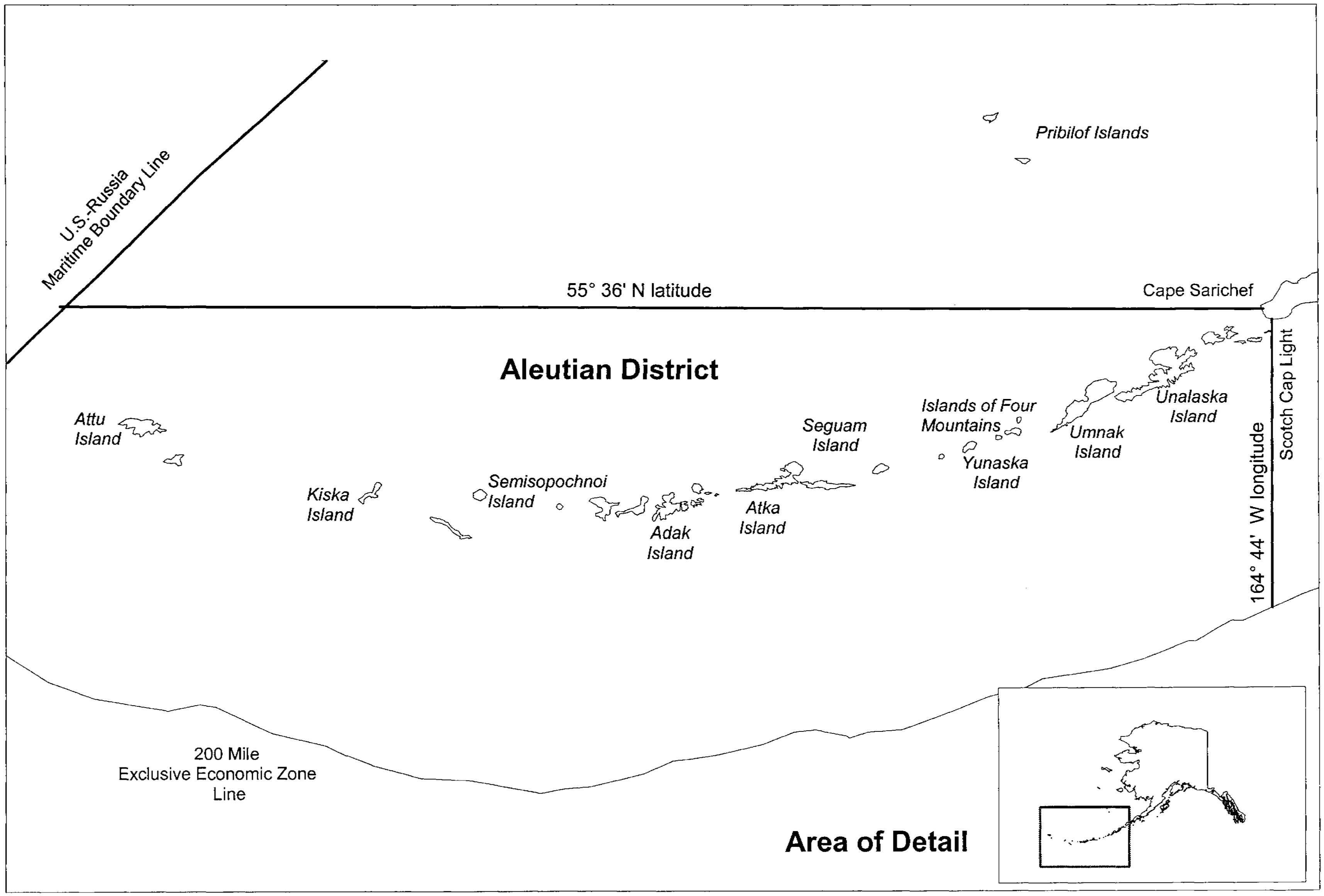

Figure 1-10. Aleutian District for Dungeness crab management.

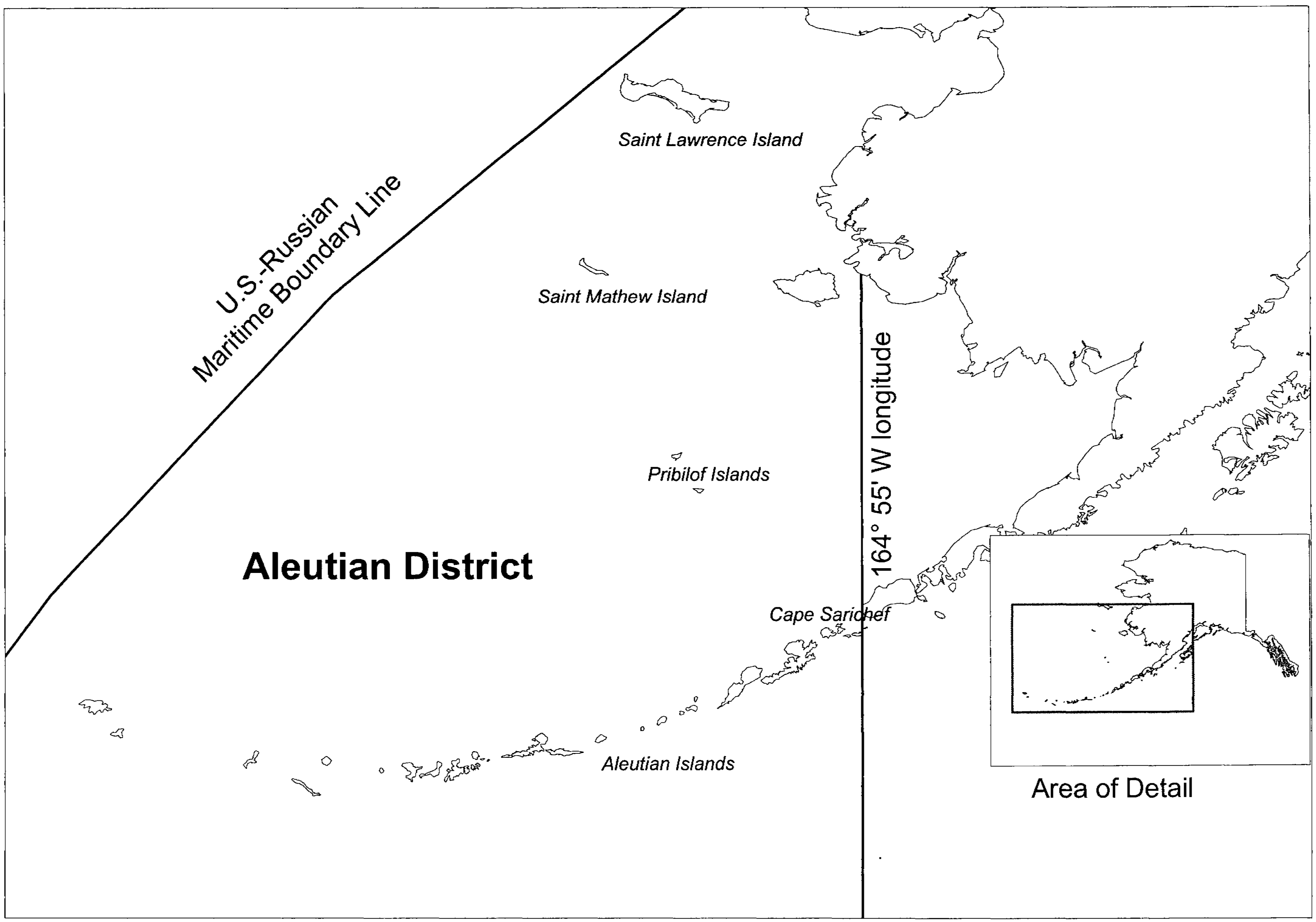

Figure 1-11. Aleutian District for shrimp management.

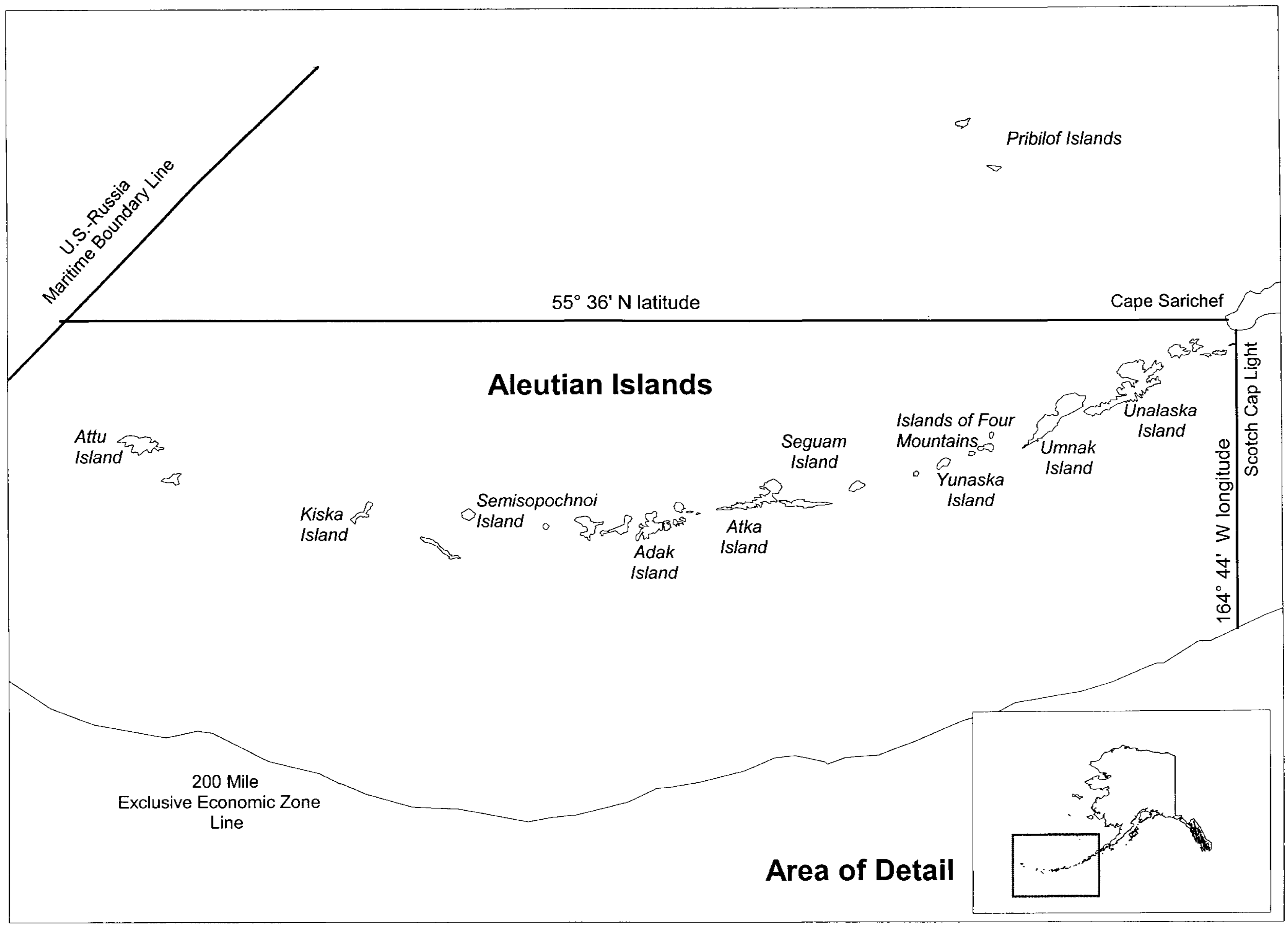

Figure 1-12. Aleutian Islands portion of miscellaneous shellfish Registration Area J.

KING CRAB REGISTRATION AREA T
BRISTOL BAY

Description of Area

King crab Registration Area T (Bristol Bay) includes all waters of the Territorial Sea (0-3 nautical miles from shore) and all waters of the Exclusive Economic Zone (3-200 nautical miles from shore) north of the latitude of Cape Sarichef (54° 36' N lat.), east of 168° W long., and south of the latitude of Cape Newenham (58° 39' N lat.) (Figure 2-1).

Historic Background

Commercial fishing for red king crabs *Paralithodes camtschaticus* in the Bering Sea began with Japanese harvests in 1930. The Japanese fishery ended in 1940 and resumed again from 1953 until 1974. The Russian king crab fleet operated in the eastern Bering Sea from 1959 through 1971. U.S. fishers entered the eastern Bering Sea fishery with trawl gear in 1947. Effort and catches declined in the 1950s with no catch being reported in 1959. A period of low fluctuating catches followed through 1966 before the domestic fishery expanded to full-scale in the late 1970s.

The red king crab fishery in the eastern Bering Sea traditionally harvested crabs from waters north of Unimak Island and the Alaska Peninsula from Cape Sarichef to Port Heiden. With the decline of king crab stocks in other areas of the state, U.S. effort in the eastern Bering Sea increased beginning in 1968 with a peak harvest of 129.9 million pounds in 1980 (Table 2-1, Figure 2-2). Since 1980, king crab stocks throughout Alaska, including Bristol Bay, have declined sharply and have not recovered to pre 1980 levels, leading to closures of the Bristol Bay red king crab (BBRKC) fishery in 1983, 1994 and 1995. From 1980 to 2001, economic value of the BBRKC fishery ranged from $8.9 million in 1982 to a high of $115.3 million in 1980 (Table 2-2, Figure 2-3). Exvessel price ranged from $0.90 per pound in 1980 to a high of $6.26 per pound in 1999.

In 1980, the BOF defined that portion of the Bering Sea south of Cape Newenham and east of 168° W. long. as the Bristol Bay King Crab Registration Area T, and the area was designated an exclusive registration area. During any king crab registration year (June 28 through June 27), vessels registering for and fishing in this area are prohibited from fishing in any other exclusive or super-exclusive king crab registration areas. Only non-exclusive areas (Area Q and O) may be fished once a vessel is registered in Area T.

The NMFS has conducted annual trawl abundance index surveys of the eastern Bering Sea since 1968. This multi-species (crab and groundfish) survey is conducted during the summer months and the resulting area-swept estimates of abundance are published annually. In 1983, NMFS trawl survey of the Bering Sea indicated a record low number of legal male crabs and the lowest total king crab population ever recorded. Small female crabs carrying fewer eggs and high predator abundance were also noted. Consequently, the fishery was closed for the 1983 season. The fishery reopened in 1984 and catches slowly increased to over 20.3 million pounds in 1990. Due to the large number of catcher-processors and floating-processors in the fishery and the inability of the

Alaska Department of Fish and Game (ADF&G) to monitor these catches, an onboard observer program was initiated in 1988. Fishing effort increased dramatically from 89 vessels in 1984 to over 300 vessels in 1991 (Table 2-1, Figure 2-3). The number of pots fished by the fleet also increased, with almost 90,000 pots registered for the 1991 fishery, compared to just under 22,000 pots registered in 1984.

Due to the increased number of pots, the BOF established a 250-pot limit enforced through a buoy sticker program, which was implemented for the 1992 BBRKC fishery. This measure was intended to improve manageability of the fishery by extending the length of the season as well as reducing the potential for pot loss.

Immediately following the 1992 BBRKC fishery, the 250-pot limit was repealed by NMFS. This action was due to inconsistencies with provisions of the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP), mandating application of pot limits in a nondiscriminatory manner. In the spring of 1993, the BOF adopted new regulations, setting pot limits based on overall vessel length. For the BBRKC fishery, vessels in excess of 125 feet in overall length were limited to 250 pots and vessels 125 feet and under in overall length were allowed a maximum of 200 pots. These pot limits were administered through a buoy tag program from the Dutch Harbor and Kodiak ADF&G offices.

Voluntary daily vessel reports received via single side band (SSB) radio and marine telex have been used to manage the BBRKC fishery since 1993. That season ran for 9 days and the total harvest was 14.6 million pounds, approximately 2.2 million pounds less than the 16.8 million pounds harvest guideline.

Results of the NMFS 1994 summer trawl survey of the Eastern Bering Sea indicated declines in all size-classes of both male and female red king crabs in the Bristol Bay area. Compared to observations made during the 1993 survey, the abundance index of large male crabs declined 25%. Based on the 1994 survey results, large female abundance was estimated at 7.5 million crabs, which was below the minimum threshold of 8.4 million crabs necessary to allow a fishery. Consequently, the BBRKC fishery was not open for the 1994 season.

Due to potential measurement errors in the area-swept trawl abundance estimates, ADF&G developed a length-based analysis (LBA) model for estimating population abundance. This method, used for the first time prior to the 1995 season, incorporates a variety of data sources including dockside sampling and observer collected data, as well as data collected on the annual NMFS survey. The LBA is less susceptible to year-to-year variations in factors unrelated to population abundance (i.e. oceanographic conditions, changes in species distribution and subsequent availability to the survey gear) and is therefore more likely to produce an accurate estimate of abundance. Analysis of the 1995 NMFS survey using the LBA model indicated no significant difference in the abundance of mature male and female red king crabs from estimates made from the 1994 survey (Zheng et al. 1995). Based on these combined results, the BBRKC fishery remained closed for the 1995 season.

Due to the depressed nature of the BBRKC population, the BOF, at their March 1996 meeting adopted a revised harvest strategy to promote stock rebuilding. One of the most significant changes to the harvest strategy was a reduction in the exploitation rate of mature male crabs from 20% down to 10% at levels below where the stock is considered rebuilt (55 million pounds of effective spawning biomass (ESB)), or 15% when the stock is considered rebuilt.

Results from the LBA incorporating the 1996 NMFS survey data indicated increased abundance in all size classes of males and females compared to the 1995 estimate (Zheng et al. 1996). Of major importance was an increase in the number of large females in 1996 to 10.2 million crabs, which was well above the threshold of 8.4 million large female crabs necessary to allow a fishery. This was a significant increase relative to the prior two years where fishery closures were due to insufficient numbers of large female crabs. Based on a 10% mature male exploitation rate, the 1996 guideline harvest level (GHL) was set at 5.0 million pounds. The 1996 fishery lasted four days and a total of 8.4 million pounds were harvested, exceeding the GHL by 68%.

Stemming from ADF&Gs inability to adequately manage this fishery at low GHL levels, the BOF held a special meeting in August of 1997 implementing new pot limits and vessel preseason registration requirements. Also adopted were regulations that extended the tank inspection window for the BBRKC fishery from 24 to 30 hours and allowed fishers to leave baited pots on the fishing grounds when a fishery closure announcement is made with less than 24-hours of advance notice. New pot limits were based on vessel overall length, the preseason GHL, and the number of vessels preseason registered for the fishery. These new pot limit regulations were adopted with a sunset provision of December 31, 1998, to provide for revaluation at the 1999 BOF meeting.

The LBA using the 1997 NMFS survey data indicated that while all components of the BBRKC crab stock increased from levels observed in 1996 (Zheng et al. 1997), ESB was below the 55 million pound threshold necessary to allow a 15% harvest rate. Therefore, a 10% mature male exploitation rate was used, generating a general fishery GHL of 7.0 million pounds for the 1997 season. Based on the GHL and number of vessels that filed a preseason registration, pot limits were set at 100 and 125 pots for small and large vessels, respectively. The 1997 fishery lasted four days and a total of 8.8 million pounds were harvested. The 1997 harvest exceeded the GHL by 24% largely due to extremely high fishery performance in the final hours of the fishery.

Analysis of the 1998 NMFS survey data indicated the abundance of pre-recruit male red king crabs increased by 85%, resulting in an increase in the fishable stock of mature male crabs for the 1998 season. The abundance of large females (>89 mm carapace length) increased by 42% (Stevens et al. 1998). Effective spawning biomass was estimated to be over 55 million pounds, resulting in a 15% harvest rate on mature male crabs. The GHL for the 1998 general fishery was 15.8 million pounds. Because the GHL was in excess of 12 million pounds, the preseason registration requirement was waived and pot limits were set at 200 for vessels less than or equal to 125 feet in length and 250 for vessels greater than 125 feet in length. Total harvest in the 1998 fishery, which lasted five days, was 14.3 million pounds.

At the March 1999 meeting, the BOF made permanent the interim management measures that were adopted in the fall of 1997. The BOF also passed anti-prospecting regulations that were amended in 2000. The regulations prohibit vessels from participating in the Bristol Bay king crab fishery if they have operated pot, longline, or trawl gear in that portion of Registration Area T north of 55° 30' N lat. and east of 164° W long. during the 30 days prior to the king crab season. However, a provision was made for vessels trawling in a directed pollock fishery in Area T north of 55° 30' N lat. and east of 164° W long. during the 14 days prior to the red king crab season. In order for these vessels to participate in the BBRKC fishery, they must deliver to an offshore processor or carry a NMFS approved observer for the entire 14 days prior to the opening. The BOF also adopted a regulation that moved the opening date of the commercial red king crab fishery in Bristol Bay from November 1 to October 15. The change to an earlier opening was intended to improve fleet and industry efficiency by reducing the hiatus between the BBRKC fishery and the Bering Sea king crab fisheries, opening on September 15.

The LBA including the 1999 NMFS survey data indicated that while the abundance of legal and mature male red king crabs in Bristol Bay increased, all other classes decreased from the 1998 level: small males by 57%, pre-recruit males by 27%, and large females by 7% (Zheng and Kruse 1999). The LBA estimates resulted in an ESB of 47.0 million pounds. By applying an exploitation rate of 10% to the mature male population, a general fishery GHL of 10.1 million pounds was set. The 1999 season lasted five days, with a total harvest of 11.1 million pounds.

Length based analysis including the 2000 NMFS survey data indicated that the abundance of almost all size-classes of the Bristol Bay red king crab stock decreased from levels observed in 1999. Small males increased by 192%, but all others decreased: pre-recruit males by 23%, mature males by 14%, and legal males by 3%. Large females also decreased by 10% (Zheng and Kruse 2000). The 2000 ESB was estimated to be 39.9 million pounds, a decrease of 11% compared to 1999. At 39.9 million pounds, ESB is above the threshold for a fishery opening with a 10% exploitation rate on mature males. The 10% exploitation rate on mature males resulted in a general fishery GHL of 7.7 million pounds. The 2000 fishery opened at 4:00 PM on October 16 after a 24-hour delay to allow strong winds in the Bristol Bay area to diminish. A total of 239 catcher-only vessels and 7 catcher-processors participated. However, only 244 vessels made landings. A total of 7.55 million pounds of red king crabs was harvested in the 4.2-day fishery, which was closed by emergency order at 9:00 PM on October 20.

Results of the NMFS stock assessment survey and LBA in 2001 gave an estimated ESB of 40.6 million pounds and a mature male abundance estimate of nearly 11 million crabs. When the harvest strategy was applied to these estimates, a GHL of 7.15 million pounds was produced using a 10% exploitation rate applied to the mature male abundance estimate. The 2001 fishery opened at 4:00 PM on October 15 with 232 vessels registered. The fishery closed at 11:59 PM on October 18 after approximately 7.8 million pounds were harvested.

American Fisheries Act

The American Fisheries Act (AFA), passed in 1998 by Congress, gave pollock fishers exclusive fishing privileges in the Bering Sea/Aleutian Islands (BSAI) pollock fishery. To protect the interests of fishers not directly benefited by the AFA, sideboards were established for AFA boats qualified to participate in BSAI crab fisheries. To implement the sideboards, the BOF developed a management plan, which specified that ADF&G will manage AFA vessels with a harvest cap equally apportioned between all AFA qualified vessels or through a cooperative fishery when 100% of

AFA qualified participants agree to the cooperative. The harvest cap specified by the AFA was implemented for the first time in the 2000 BBRKC fishery.

Of the 239 catcher-only vessels that participated in the 2000 BBRKC fishery, 25 participated under AFA sideboards. The AFA vessels fished in a cooperative manner with a fixed harvest cap of 10.96% of the general fishery GHL, or 0.85 million pounds. Post-season production reports show that AFA vessels harvested approximately 0.72 million pounds or 84.7% of their cap.

During the 2001 BBRKC fishery, 31 vessels participated under the AFA sideboards and fished in a cooperative manner. The fleet harvested 0.70 million pounds of a 0.72 million pound cap. Most of the vessels fishing under the AFA sideboards in 2001 were not constrained by the cap.

2002 Fishery

NMFS survey and LBA results for 2002 indicate that the stock is above the fishery threshold with an estimated abundance of 18.6 million mature females and an estimated ESB of 37.7 million pounds. Both of these estimates represent slight decreases from those generated in 2001. Since ESB was estimated to be less than 55.0 million pounds the harvest strategy specifies an exploitation rate of 10% on mature males. Given an estimated mature male abundance of 14.3 million crabs and an average weight of 6.5 pounds per legal crab, the 2002 GHL was set at 9.27 million pounds with 0.71 million pounds allocated to the Community Development Quota fishery.

Preseason vessel registration was required prior to 5:00 PM, September 24, 2002. Based on the 244 preseason vessel registrations received prior to that deadline and the 8.56 million pound general fishery GHL, pot limits were set at 100 pots for vessels less than or equal to 125 feet in overall length and 125 pots for vessels greater than 125 feet in overall length. In addition, preseason vessel registrations were used to select catcher vessels to carry onboard observers during the fishery; 23 catcher vessels were selected. Six catcher processors and one floating processor registered for the fishery. Based on preseason effort levels and catch rate data from recent BBRKC fisheries, the department chose to manage the 2002 fishery through inseason catch reports from fishers rather than with a closure announced prior to the opening. As part of the inseason management process, the department advised the fleet that catch updates would be made daily at noon and 9:00 PM and that the department would attempt to provide the fleet with 24-hours advance notice of the closure announcement, but given the small GHL, less than 24-hours advance notice was possible.

During the week preceding vessel registration, department staff consulted with United States Coast Guard (USCG) search and rescue personnel and National Weather Service (NWS) forecasters regarding a potential weather-related delay in season opening. NWS staff did not forecast storm force winds in the operational area of vessels that would be travelling to the Bristol Bay red king crab fishing grounds from Dutch Harbor, Akutan, King Cove or False Pass, nor were storm force winds forecast for the time period October 15-18. USCG personnel did not foresee that current or forecast weather conditions would hamper a search and rescue mission immediately before or during the first 18 hours of the fishery, thus the season was not delayed.

Vessel hold and gear inspections as part of the "quick registration" process began October 8 in Dutch Harbor and King Cove and October 9 in Akutan and False Pass. Vessel registration began at 10:00 AM, October 14. A total of 242 vessels registered for the fishery which began at 4:00 PM, October 15. Intent to participate in the volunteer catch reporting program was received from 130 vessel operators. Observers on 30 additional vessels contributed daily catch reports as well. Catch reports were first received at 6:00 PM October 15, however these reports represented only the first two hours of the season and no catch was reported.

By 6:00 PM October 16, catch rate was approximately 20 legal crabs per pot lift, the fleet pulled approximately 15,000 pots in the preceding twelve hours and the cumulative harvest had reached 2.2 million pounds (Table 2-3). By 6:00 AM October 17, catch rates had decreased slightly to 18 legal crabs per pot lift and effort was reduced to 9,500 pot pulls for the previous 12 hours. The 6:00 PM report on October 17, indicated that the catch rate was approximately 22 legal crabs per pot lift, and that the fleet pulled 12,500 pots in the previous twelve hours. The cumulative catch was 5.1 million pounds by the non-AFA fleet. Based on catch reports received through the evening of the 17th and the most recent 12-hour harvest, the department issued a news release at 8:00 PM October 17 stating that the GHL would be met and that the fishery would close at NOON October 18, 2002. Ninety seven vessel operators participated in the inseason management process by providing at least one catch report during the fishery.

After the closure announcement, catch reports received from the non-AFA fleet on the 18th indicated that catch per unit of effort remained at nearly 19 legal crabs per pot lift and that approximately 27,000 pots were pulled by the non-AFA fleet in the final 18 hours of the fishery. The general fleet harvest projection including the AFA fleet portion based on inseason reports received after the closure announcement was approximately 9.4 million pounds. Actual harvest was 8,856,828 pounds.

Since less than 24-hours advance notice of the closure was provided, the fleet was permitted to leave baited pots on the grounds for up to ten days following the closure. Despite the relatively short 16-hour advance notice of the closure provided by the department, the majority of the fleet were able to unbait, or remove their pots from the grounds prior to the closure.

Performance of the 31 vessels participating under the AFA cap in the general fishery was slightly better than those in the non-capped portion of the fleet. Vessels operating under the AFA cap had an average CPUE of 23 legal crabs, compared to a CPUE of 20 legal crabs for the remainder of the fleet. The slightly higher CPUE may be due to the fact that AFA vessels pulled an average of 200 pots per vessel during the fishery while the average uncapped vessel pulled 296 pots. AFA vessels reported catch information to a private fleet manager every six hours. Vessels fished in the "olympic manner" until 80% of the cap was reached. Catch-rates for the AFA fleet increased throughout the fishery and reached 29 legal crabs per pot lift at midnight on October 17th (Table 2-4). The AFA fleet was estimated to have harvested 80% of the AFA cap by 1:45 PM, October 17 and the fleet manager issued a not to exceed limit of 419 crabs per vessel to the fleet at that time. Twenty seven of the AFA vessels were constrained by the not to exceed limit and stopped fishing prior to the closure. Several of the participating vessels exceeded the individual limits, however the AFA fleet remained under the cap and harvested 917,676 pounds, or 97.6% of the 939,842 pound cap.

The 2002 Bristol Bay red king crab fishery at 68 hours in length was the shortest on record and with a seasonal CPUE at 20 legal crabs had the highest seasonal catch-rate since 1980. Catch-rates were highest between 56° and 57° N lat. and east of 163° W long (Table 2-5). In general, the highest catch-rates during the 2002 fishery occurred to the east of the most productive areas in the 2001 fishery.

Landed king crabs averaged 6.4 pounds per crab, representing a 0.1 pound per crab decrease from the 2001 fishery average weight and the average weight used during the inseason fishery management and GHL setting processes. The slight decrease in average weight is consistent with survey estimates indicating improved recruitment to the legal size-class. Fishers were paid an average price of $6.14 per pound by shore plants in Dutch Harbor, Akutan, King Cove, Sand Point and Kodiak. In addition, one floating-processor and two catcher-processors purchased crabs after the season. The 2002 Bristol Bay red king crab fishery had an exvessel value of $54.2 million, a substantial increase from the 2001 exvessel value of $37.2 million (Table 2-2).

Weather conditions during the 2002 Bristol Bay red king crab fishery were relatively benign. No vessels or lives were lost, nor were any major injuries reported. A single vessel reported losing power after setting gear on October 15 and was not able to make a landing.

ADF&G personnel contacted approximately 76% of Bristol Bay red king crab vessel operators for postseason interviews. Biological data were collected from the majority of these deliveries. Size data indicated that the majority (61%) of the harvest was composed of recruit sized crabs. In 2001, 54% of the catch was composed of recruits. Landed red king crabs averaged 151 mm in carapace length which is the same as in 2000 and 2001 (Table 2-6).

The Department of Public Safety (DPS) stationed personnel in all ports where Bristol Bay red king crabs were landed and cited three vessel operators for possession of undersized crabs. DPS seized 6,647 pounds of illegal king crabs valued at approximately $41,000.

Prior to the 2002 general red king crab fishery in Bristol Bay, ADF&G conducted cost recovery fishing on a chartered vessel. This cost recovery fishery, which harvested and sold approximately 25,000 pounds of red king crabs (Table 2-7), worth approximately $160,000 (Table 2-8), is an ongoing program used to collect funds to conduct research on Bering Sea shellfish and to fund pre-season practical examinations for new observers. In addition, further cost recovery fishing took place after the general fishery and an additional 71,000 pounds of red king crabs worth approximately $460,000 were taken to fund onboard observers.

Stock Status

The status of the Bristol Bay red king crab stock and fishery are evaluated through the use of abundance based thresholds. When the total mature biomass (TMB) of red king crabs in Bristol Bay falls below the 44.8 million pound minimum stock size threshold (MSST), the stock is considered overfished. In 2002, the TMB of red king crabs in Bristol Bay was estimated to be 129.9 million pounds, which is well above the maximum sustained yield (MSY) value of 89.6 million pounds TMB. Relative to federal FMP (NPFMC 1998) and state harvest strategy reference points and thresholds, the Bristol Bay red king crab population is healthy, but relative to historic abundance the stock remains at low levels.

The state harvest strategy for Bristol Bay red king crabs establishes three thresholds that must be met prior to a fishery opening. The first is a threshold abundance level of 8.4 million mature females, the second is an ESB threshold of 14.5 million pounds of ESB and the third is a minimum GHL threshold of 4.0 million pounds. Length based analysis estimates for 2002 show the stock to be above both the mature female abundance threshold at 18.6 million females and the ESB threshold at 37.7 million pounds of ESB. Mature female abundance and ESB decreased slightly from the 2001 level.

Both legal and pre-recruit males increased substantially in abundance over the 2001 level. At 9.5 million crabs, legal male abundance is 30% greater than the previous 20-year average (Stevens, et al. 2002). Strong recruitment experienced in 2002 resulted in a slightly lower average weight and average size during the 2002 fishery. Given recent survey trends, modest increases in mature female abundance, ESB and legal male abundance should be expected in 2003 and it is likely that fishery thresholds will be met and the stock will be above MSST.

KING CRAB REGISTRATION AREA Q
BERING SEA

Description of Area

The Bering Sea king crab Registration Area Q has as its southern boundary a line from 54° 36' N lat., 168° W long., to 54° 36' N lat., 171° W long., to 55° 30' N lat., 171° W. long., to 55° 30' N lat., 173° 30' E long., as its northern boundary the latitude of Point Hope (68° 21' N lat.), as its eastern boundary a line from 54° 36' N lat., 168° W long., to 58° 39' N lat., 168° W long., to Cape Newenham (58° 39' N lat.), and as its western boundary the United States-Russia Maritime Boundary Line of 1991 (Figure 2-4). Area Q is divided into the Pribilof District, which includes waters south of Cape Newenham, and the Northern District, which incorporates all waters north of Cape Newenham. The Northern District is subdivided into three sections: the Saint Matthew Island Section, which includes waters north of Cape Newenham and south of Cape Romanzof; the Norton Sound Section, which includes all waters north of Cape Romanzof, south of Cape Prince of Wales, and east of 168° W long; and the Saint Lawrence Island Section, which encompasses all remaining waters of the district. Registration Area Q includes waters of both the Territorial Sea (0-3 nautical miles from shore) and the Exclusive Economic Zone (3-200 miles from shore).

PRIBILOF DISTRICT RED AND BLUE KING CRAB

Historic Background

The king crab fishery in the Pribilof District began in 1973, when vessels targeted blue king crabs *Paralithodes platypus* in the vicinity of Saint George and Saint Paul Islands. The first reported catch in this area was 1.3 million pounds taken by eight vessels between July 1973 and October 1974. The average weight of crabs harvested was 7.3 pounds and catch per unit effort (CPUE, defined as catch per pot pull), was 26 crabs. By the 1980/1981 season, fishing effort had increased to 110 vessels, which harvested 11.0 million pounds, the highest catch on record. However, by that time the fishery CPUE dropped to nine crabs per pot and continued declining to a low of two crabs per pot by the end of the 1986/1987 season. Consequently, the harvest dropped to 260,000 pounds, taken by 16 vessels (Table 2-9). Due to this six-year decline in harvest and concurrently low annual population estimates, the blue king crab fishery was closed beginning with the 1988/1989 season and remained closed until 1995 (Figure 2-5).

In 1993, the NMFS summer trawl survey of the Bering Sea indicated a marked increase in the abundance of red king crabs *Paralithodes camtschaticus* around the Pribilof Islands. Although no threshold abundance level for opening the fishery was established for Pribilof District red king crabs, survey results indicated a harvestable surplus of legal-sized male crabs. Consequently, a red king crab fishery in the Pribilof District opened for the first time in September 1993. A harvest of 2.6 million pounds was taken from a guideline harvest level (GHL) of 3.4 million pounds. In 1994, the Pribilof District was again opened to the commercial harvest of red king crabs, and 104 vessels harvested 1.3 million pounds.

In 1995, an increase in blue king crab abundance and a continued harvestable surplus of red king crabs resulted in a combined red and blue king crab GHL of 2.5 million pounds. Subsequent declines in red and blue king crab abundance over the next three years resulted in a combined GHL for 1998 of 1.25 million pounds (Table 2-10). Poor fishery performance during that time resulted in annual harvests below the fishery GHL. From 1999 to 2001, blue king crab abundance continued to decline and the Pribilof fishery remained closed.

In 1993, the BOF adopted regulations that set pot limits based on overall vessel length for all king crab fisheries in the Bering Sea. In the Pribilof District, pot limits were established at 50 for vessels over 125 feet overall length and at 40 for vessels 125 feet overall length or less.

Since 1993, season lengths have ranged from six to 14 days (Table 2-10). This compares to the eight-year period from 1980-1988 when season length ranged from 10 to 86 days. Due to shorter seasons since 1993, the Pribilof District fishery has been managed in season using vessel catch reports. Reports are received via single side band radio every 24 hours, or marine satellite telex every 12 hours and are used to calculate CPUE and daily harvest. Inseason management of the fishery allows the department to base management decisions on actual, real-time fishery performance and to respond to changes in catch rates caused by weather, crab abundance and effort.

The economic value of the Pribilof District red king crab fishery peaked at $13.0 million in 1993 with an exvessel price of $4.98 per pound, the second highest on record. The value of the Pribilof District blue king crab fishery peaked at $13.6 million in 1981/1982, with an exvessel price of $1.50 per pound. Since 1995, the exvessel price of red or blue king crabs has not exceeded $3.37 per pound. Total value of the fishery declined from $6.8 million in 1995 to $2.4 million in 1998 (Table 2-10, Figure 2-6). The historic average weight of red king crabs in the Pribilof District is 7.8 pounds, slightly larger than the average weight of 7.5 pounds for blue king crabs (Table 2-9).

2002 Fishery

The blue king crab fishery in the Pribilof District remained closed for the 2002 season due to a continued decline in blue king crab abundance below the threshold level of abundance required for a fishery opening. Due to significant uncertainty surrounding estimated red king crab abundance and concerns for blue king crab bycatch in a directed red king crab fishery, the red king crab fishery also remained closed for the 2002 season. Poor fishery performance in the late 1990s added to concerns over the health of the red and blue king crab stocks.

Stock Status

The population of blue king crabs in the Pribilof District remains at its lowest level since 1985. Comparing survey results from 2001 to 2002, the abundance index for legal (≥ 135 mm carapace length (CL)) males decreased by 50% from 0.4 to 0.2 million crabs, pre-recruit (110-134 mm CL) males declined 84% from 0.1 to 0.02 million crabs, and large (≥ 90 mm CL) females dropped 23% from 1.6 to 1.2 million crabs (Stevens et al. 2002). Overall, the population abundance remains low and there appears to be little or no recruitment. The Pribilof blue king crab stock was declared overfished in September 2002.

The abundance index for large female red king crabs in the Pribilof District decreased considerably by 89% from 4.0 million crabs in 2001 to 0.4 million in 2002, while abundance of pre-recruit males decreased by 99% from 2.5 million crabs in 2001 to 0.02 million in 2002. The stock was declared overfished in September of 2002. Legal male red king crabs remained the same from 2001 to 2002 at 1.8 million crabs. However, because portions of the study area are untrawlable and the crabs are highly concentrated, estimates of red king crab abundance are considered imprecise.

SAINT MATTHEW ISLAND SECTION BLUE KING CRAB

Historic Background

The commercial blue king crab fishery in the Saint Matthew Island Section of the Northern District was first executed in 1977, resulting in a commercial harvest of 1.2 million pounds. In 1978, the catch increased to almost 2.0 million pounds (Table 2-11). Catches decreased in 1979 and 1980 due to lack of effort. In 1981, several vessels returned to the Saint Matthew Island Section during the

Norton Sound Section fishery. Catches were good, and after the Norton Sound Section closed, additional vessels moved into the Saint Matthew Section, taking 4.6 million pounds of blue king crabs. Catch and effort increased to a peak harvest of 9.5 million pounds in 1983 when 164 vessels participated. In subsequent seasons, catches remained at or below 4.7 million pounds (Figure 2-7).

NMFS trawl surveys from 1983 to 1998 in the Saint Matthew Island Section of the Northern District indicated a harvestable surplus of blue king crabs ranging from 1.7 to 8.0 million pounds. In 1998, the legal male abundance decreased by 21%, resulting in a GHL of 4.0 million pounds. The 1998 season closed before the GHL was attained due to poor fishery performance and observer information indicating a relatively high incidental capture rate of sublegal males and female crabs. The 1998 CPUE was seven crabs per pot lift, the second lowest CPUE on record. The 1998 season, which was managed based on inseason catch reports, lasted 11 days, the longest since a 17-day opening that occurred in 1983, when 9.5 million pounds were harvested (Table 2-12). The actual harvest of 2.9 million pounds equaled the harvest projected from inseason catch reports (Table 2-13). From 1999 to 2001, abundance estimates for the Saint Matthew blue king crab stock were low and the fishery remained closed because harvest strategy abundance thresholds were not met.

In 1993, BOF adopted regulation changes and moved the opening date of the Saint Matthew king crab fishery from September 1 to September 15 (Table 2-14), concurrent with the king crab fishery in the Pribilof District. This action was taken to improve effort distribution between the Pribilof and Saint Matthew areas, thereby reducing the number of vessels participating in each fishery. Differential pot limits, established in 1993 for the Saint Matthew Island Section, limited vessels over 125 feet overall length to 75 pots and vessels 125 feet overall length or less to a maximum of 60 pots.

The exvessel price for Saint Matthew blue king crab during the last open season, in 1998, averaged $1.87 per pound, the lowest on record since 1984 and 1985, when fishers received $1.75 and $1.60 per pound, respectively. Total value for this fishery peaked in 1983 with $25.8 million, and since 1994, has not been higher than $15.0 million (Table 2-12). In contrast, the number of vessels participating has generally increased, from 87 in 1994 to 131 in 1998 (Figure 2-8). Average weight per crab has ranged from 4.0 to 5.0 pounds, fluctuating with the percentage of recruits entering the fishery each year. The average weight per crab during the last fishery, in 1998, was 4.7 pounds (Table 2-11).

2002 Fishery

The 2002 Saint Matthew Island Section blue king crab fishery remained closed because the GHL calculated from the harvest strategy was below the minimum GHL threshold specified in regulation.

Stock Status

Based on the 2002 NMFS survey, the abundance index for legal male blue king crabs decreased from 1.1 million crabs in 2001 to 0.6 million in 2002. Abundance of pre-recruit male blue king crabs decreased from 0.6 million crabs in 2001 to 0.2 million in 2002. Large female blue king crab abundance decreased from 0.2 million crabs in 2001 to 0.1 million in 2002 (Stevens et al. 2002). Total mature biomass (TMB), defined as the biomass of all mature males and females, for the Saint Matthew Island blue king crab stock in 2002 was estimated at 4.7 million pounds, below the minimum stock size threshold (MSST) of 11.0 million pounds established for this stock. This is the third year in a row that this stock has fallen below the MSST. As defined by the Bering Sea and Aleutian Islands King and Tanner Crab Fishery Management Plan and the Magnuson-Stevens Fishery Conservation and Management Act, this fishery is considered overfished and a rebuilding plan was adopted in 2000 (NPFMC 2000).

Stocks listed as overfished are not deemed rebuilt until TMB increases to or above the maximum sustainable yield biomass, which is twice the MSST, or 22.0 million-pounds TMB for the Saint Matthew Island blue king crab stock. Based on the 2002 survey results, the TMB would have to increase four-fold for the stock to be considered rebuilt. Data from the survey does not support any prospects for such an improvement in the near-term.

PRIBILOF DISTRICT GOLDEN KING CRAB

Historic Background

Golden king crabs *Lithodes aequispina* are found in only a few deep canyons in the Bering Sea District and have never sustained large harvests when compared to other Bering Sea king crab fisheries. As with many other crab fisheries in the Bering Sea, the fishery for golden king crabs was pioneered by foreign fishing fleets. A domestic fishery developed during the 1982/83 season after BOF directed ADF&G to open and close fishing for golden king crabs in the Pribilof District by emergency order (ADF&G 1984). By the 1984 season, BOF directed ADF&G to manage the Area Q golden king crab fishery under authority of a commissioner's permit that allowed the fishery to develop and expand into new areas (ADF&G 1985).

The first domestic harvest of golden king crabs in the Bering Sea occurred in June of 1982 when two vessels fished in the Pribilof District. Effort increased to 10 vessels during the following season with a harvest of nearly 70,000 pounds. The size limit for golden king crabs in the Pribilof District was reduced from six and one-half inches to five and one-half inches in 1983. Subsequently, effort in the Pribilof District peaked during the 1983/84 season when 50 vessels harvested 860,000 pounds of golden king crabs. From 1984 to 1992, no more than two vessels participated each year in the fishery. Since the 1983/84 season, harvest has not exceeded 350,000 pounds annually (Table 2-15). The Pribilof District golden king crab fishery reached a maximum exvessel value of just over $1 million in 1995, while the highest price fishers received per pound was $3.81 in 1994 (Table 2-16). During the last 9 years in the Pribilof District fishery an average of five vessels have annually harvested an average of 166,000 pounds. Catch per unit of effort (CPUE) has averaged seven legal crabs per pot lift with an average weight of 4.0 pounds. Most harvest in the Pribilof District has occurred in the area immediately to the south of the Pribilof Island group.

At its March 1993 meeting, BOF developed pot limits for all king crab fisheries in the Bering Sea. Current pot limits in the Pribilof District are set at 40 pots for vessels 125' or less in length and 50 pots for vessels greater than 125' in length.

In 2000, the Pribilof district golden king crab fishery opened with a GHL of 150,000 pounds, which was 50,000 pounds less than the 1999 harvest level. The adjustment was made to better comply with guidelines specified in the Fisheries Management Plan (FMP) for the king and Tanner crab fisheries of the Bering Sea and Aleutian Islands. The FMP specifies the GHL to be set at 50% of the maximum sustained yield (MSY) level of 300,000 pounds of male and female golden king crabs from the Pribilof District (NPFMC 1998). Seven vessels harvested 130,000 pounds in 2000. The GHL was not reached; thus the fishery remained open until the end of the year. In 2001, six vessels harvested 146,000 pounds and for the only time except 1999, the fishery was closed by emergency order because the GHL was achieved (Table 2-16).

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

2002 Fishery

The 2002 fishery opened January 1 with a GHL of 150,000 pounds, and closed by emergency order on May 14. Fishing effort began in mid-January and peaked in mid-March when 4 vessels harvested 35,413 pounds in one week. The total harvest was 150,434 pounds (Table 2-15). CPUE averaged 6 legal crabs per pot lift, a decrease from the CPUE of eight during the 2001 fishery. Weekly landings averaged approximately 16,000 pounds per week. Landed crabs averaged 4.3 pounds per crab, the same as for the 2001 season. Most of the 2002 harvest occurred immediately to the south of Saint George Island (Table 2-17). Three shore-based plants in Dutch Harbor paid the fleet an average of $3.10 per pound for live crabs. The 2002 Pribilof District golden king crab fishery had a total fishery value of $438,000, which was just $9,000 more than the 2001 fishery value (Table 2-16).

Stock Status

The golden king crab population in the Bering Sea is not currently surveyed and no estimate of abundance has been made. There are currently no plans to survey this population, nor has a formal harvest strategy been developed. Population size is believed to be limited by the amount of available habitat in the Bering Sea.

NORTHERN DISTRICT GOLDEN KING CRAB

Historic Background

A domestic fishery for golden king crabs in the Saint Matthew Island Section of the Northern District also began in the 1982/83 season. Effort and harvest in the Northern District has been sporadic. Since the initial fishery, harvest has only been documented during nine seasons. Harvest peaked during the 1987 season when 11 vessels harvested over 424,000 pounds. Since 1988, no more than 4 vessels have participated during any season (Table 2-18). The majority of the golden king crab harvest in the Northern District has occurred west of Saint Matthew Island. There has been no documented harvest of golden king crabs from either the Saint Lawrence Island or Norton Sound Sections.

At its March 1993 meeting, BOF developed pot limits for all king crab fisheries in the Bering Sea. Current pot limits in the Northern District are set at 60 pots for vessels 125' or less in length and 75 pots for vessels greater than 125' in length. These pot limits are significantly lower than the average number of pots fished per vessel in the Aleutian Islands golden king crab fishery, which has no pot limits in place. The Northern District fishery has never been closed by emergency order (Table 2-19).

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

2002 Fishery

The fishery opened January 1 with a GHL of 10,000 to 20,000 pounds, and closed December 31, 2002. No vessels registered to fish for golden king crabs in the Northern District of Area Q during 2002.

Stock Status

The golden king crab population in the Bering Sea is not currently surveyed and no estimate of abundance has been made. There are currently no plans to survey this population, nor has a formal harvest strategy been developed. Population size is believed to be limited by the amount of available habitat in the Bering Sea.

BERING SEA SCARLET KING CRAB

Historic Background

Scarlet king crabs *Lithodes couesi* are harvested under authority of a permit issued by the commissioner of ADF&G authorized in 5 AAC 34.082 PERMITS FOR *LITHODES COUESI* KING CRAB. Harvest of scarlet king crabs in the Bering Sea has primarily occurred as incidental harvest in the grooved Tanner crab *Chionoecetes tanneri* and golden king crab fisheries. Although vessels first registered to fish for Bering Sea scarlet king crabs in 1992, no commercial landings occurred prior to 1995. In 1995, four vessels harvested 26,684 pounds (Table 2-20) and were paid an exvessel price of $2.12 per pound. Only two vessels participated in 1996, consequently all catch information is confidential. No vessels registered to fish for scarlet king crabs from 1997 to 1999. A single vessel was permitted to retain scarlet king crabs as incidental harvest during the grooved Tanner crab fishery in 2000 and 2001. Since less than three vessels participated, the harvest information is confidential. Scarlet king crab incidental harvest was permitted at a rate of 5% of the weight of the target species.

2002 Fishery

No vessels registered to retain scarlet king crabs as incidental harvest in any 2002 fisheries.

Fishery Management and Stock Status

No annual abundance estimates are available for scarlet king crab stocks, nor have any stock assessment surveys been conducted. Onboard observers have been required on most vessels targeting deepwater crab species since 1994 and have collected information detailing the size and sex composition of the retained and non-retained scarlet king crab and bycatch species. This information will be used to help develop management measures for these deepwater crab stocks in the future. Currently, ADF&G does not intend to register any vessels to fish directly for scarlet king crabs in the Bering Sea pending BOF adoption of a plan for the development of new fisheries. Any additional directed fishing for scarlet king crabs will be conducted in accordance with that plan. Retention of scarlet king crabs captured in other deepwater crab fisheries will be permitted at low levels.

BERING SEA TANNER CRAB MANAGEMENT DISTRICT

Description of Area

The Bering Sea District of Tanner crab Registration Area J includes all waters of the Bering Sea north of Cape Sarichef at 54° 36' N lat. and east of the U.S.-Russia Maritime Boundary Line of 1991. This district is divided into the Eastern and Western Subdistricts by a line at 173° W long.

The Eastern Subdistrict is further divided at the latitude of Cape Romanzof and 168° W long. into the Norton Sound section to the east and the General Section to the west (Figure 2-9).

BERING SEA TANNER CRAB

Historic Background

The first reported catches of Tanner crabs *Chionoecetes bairdi* occurred in 1968, incidental to the harvest of red king crabs *Paralithodes camtschaticus* in Bristol Bay. In 1974, a directed Tanner crab fishery began. Harvest peaked at 66.6 million pounds during the 1977/78 season (Table 2-21 and Figure 2-10). In the fall of 1978, the NMFS predicted sharp declines in Tanner crab abundance beginning with the 1978/79 fishing season. As anticipated, Tanner crab stocks declined, and by 1984, the commercial harvest fell to 1.2 million pounds. Further stock declines led to a fishery closure during the 1986 and 1987 seasons.

In 1992, in an effort to slow the harvest rate to provide sufficient time for inseason management of the Tanner crab fishery, the BOF adopted regulations which restricted all participating vessels to fishing a maximum of 250 pots. In 1993, in order to comply with federal law regarding application of pot limits in a nondiscriminatory manner, differential pot limits based on vessel length were implemented. Vessels 125 feet or under in overall length were limited to a maximum of 200 pots, while vessels longer than 125 feet in overall length were limited to a maximum of 250 pots.

Also in 1993, BOF adopted regulations that opened and closed that portion of the Eastern Subdistrict east of 168° W long. to Tanner crab fishing concurrent with the regulatory opening and emergency order closure of the Bristol Bay red king crab fishery. If sufficient GHL remained to be taken, the BOF mandated a reopening of the Eastern Subdistrict between 163° and 173° W long. for the directed Tanner crab fishery 10 days after the closure of the Bristol Bay red king crab fishery. In the event the Bristol Bay red king crab fishery failed to open, the portion of the Eastern Subdistrict west of 163° W long. would open to a directed Tanner crab fishery on November 1. These BOF actions were based on observer bycatch data and historic harvest patterns which indicated the majority of female king crab bycatch in the Bristol Bay red king crab and Bering Sea Tanner crab fisheries came from waters east of 163° W long.

During the 1994 and 1995 seasons, the Bristol Bay red king crab fishery did not open due to low stock abundance. As a result, the Tanner crab fishery opened on November 1 in that portion of the Eastern Subdistrict west of 163° W long. The commercial Tanner crab harvest in 1994 was 7.8 million pounds; in 1995 the harvest declined to 4.2 million pounds (Table 2-22).

The guideline harvest level (GHL) for the 1996 Tanner crab fishery was 8.4 million pounds (Table 2-23). Due to poor fishery performance, the fishery was closed before the GHL was reached; a total of 1.8 million pounds was harvested. The average size of crabs harvested in 1996 was 152 mm in carapace width (CW). This compares to an average of 149 mm CW observed in 1995. The percentage of new-shell crabs harvested in 1996 decreased to 47 percent from 59 percent observed in the 1995 harvest (Table 2-24).

Based on poor fishery performance in 1996 and results from the 1997 NMFS survey indicating significant declines in most segments of the Tanner crab population (Stevens et al. 1998a), the Bering Sea Tanner crab fishery remained closed for the 1997 season. The 1998 NMFS survey indicated further declines in Tanner crab abundance and the fishery did not open in 1998. Abundance of large male and female Tanner crabs continued to decline to the lowest level in the history of the survey (Stevens et al. 1998b). Because the stock fell below the minimum stock size threshold (MSST) established in the Fishery Management Plan (FMP) for this fishery, the stock was declared overfished by NMFS in 1998, necessitating the establishment of a rebuilding plan.

At the March 1999 BOF meeting, a revised harvest strategy was adopted as part of a comprehensive Bering Sea Tanner crab rebuilding plan. The harvest strategy for the Eastern Subdistrict specifies a threshold of 21.0 million pounds of mature female biomass which, for management purposes, are females ≥ 80 mm CW. No directed crab fishery is prosecuted when female biomass is below that threshold. When the mature female biomass is between 21.0 million and 45.0 million pounds, a maximum harvest rate of 10% is applied to "molting mature males", or those mature male crabs likely to continue to grow, defined as 100% of new-shell and 15% of old-shell males greater than 112 mm CW. When the mature female biomass is above 45.0 million pounds the harvest rate is set at a maximum of 20% of molting mature males.

When establishing a GHL, no more than 50% of the exploitable legal-size male abundance may be harvested. Exploitable legal-size male abundance is 100% of new shell and 32% of old-shell male crabs greater than 140 mm CW. Separate GHLs are calculated for the areas east and west of 166° W long. The minimum fishery threshold is 4.0 million pounds. If the fishery is not opened because it did not meet threshold requirements, the fishery may reopen the following season if a GHL of at least 8.0 million pounds is calculated through the harvest strategy, but only half of the GHL may be taken that year. If the fishery remains closed because the GHL is calculated to be greater than 4.0 million pounds, but less than 8.0 million pounds, the fishery may reopen the following year if the calculated GHL is at least 4.0 million pounds. This safeguard was established to protect against survey bias in the year following a closure due to low stock abundance.

Pre-recruit crab abundance began increasing in 1998 and 1999, but this trend reversed in 2000 and 2001. In addition, the stock remained below fishery threshold level established in the harvest strategy and the area was closed from 1999 to 2001.

2002 Fishery

Harvest strategy thresholds were not met in 2002. Consequently, the Bering Sea Tanner crab fishery remained closed for the 2002 season.

Stock Status

The abundance of *C. bairdi* Tanner crabs continues to be below levels to allow for a fishery. Comparing NMFS survey results from 2001 to 2002, the abundance index for legal males increased 10% from 6.3 to 6.9 million crabs. Pre-recruit males decreased by 13% from 17.3 to 15.1 million crabs, while large females also showed a similar decrease, from 13.2 to 11.3 million crabs. The reproductive population estimate continues to be below the minimum stock size threshold (MSST) in 2002 and the stock is considered to be in the overfished level of abundance (Stevens et al. 2002).

BERING SEA SNOW CRAB

Historic Background

The first commercial landings of snow crabs Chionoecetes opilio from the Bering Sea were recorded in 1977, incidental to the harvest of Tanner crabs. In 1981, a reduction in the Tanner crab harvest resulted in increased snow crab harvest. The harvest of snow crabs fell from 52.8 million pounds in 1981 to 26.1 million by 1983 (Table 2-25, Figure 2-11). In 1984, harvest increased slightly, and in 1985, 66 million pounds were landed. In 1986, the harvest increased to 98.0 million pounds. The commercial catch continued to increase annually to a high of 328.6 million pounds in 1991. Although stocks began to decline, the harvest of snow crabs remained over 100 million pounds through the 1994 season. In 1996, the harvest declined to 65.7 million pounds, the lowest in the preceding eleven seasons. The guideline harvest level (GHL) more than doubled in 1997 to 117.0 million pounds and the fleet harvested 119.5 million pounds. In the 1998 general fishery, 229 vessels harvested 243.3 million pounds. Twenty one vessels in the Community Development Quota (CDQ) fishery, first implemented in 1998, harvested an additional 8.9 million pounds of snow crabs.

The NMFS stock assessment survey in 1998 indicated that the estimate of large male snow crabs declined by 17% from the prior year's survey, resulting in a general fishery GHL of 186.2 million pounds. Two hundred and forty one vessels landed 184.5 million pounds during the 1999 general fishery, that ended on March 22. An additional 9.67 million pounds were harvested by 23 vessels in the CDQ fishery, which occurred after the general fishery.

In 1999, the surveyed stock was 60% of the minimum stock size threshold, defined as half the long term average mature biomass established in the Federal Fishery Management Plan (FMP) for Bering Sea and Aleutian Islands King and Tanner Crab. In response to significant stock declines, ADF&G initially reduced the 58% exploitation rate on 102 mm carapace width (cw) and larger male snow crabs by 50%. The revised 29% exploitation rate would still have resulted in a removal rate from the estimated mature biomass close to the long-term average. Thus, in accordance with NMFS guidelines for stock rebuilding, the harvest rate was reduced by an additional 25% to 22%, which also took into consideration handling mortality during the fishery and high natural mortality during the 6-month hiatus between the survey and the fishery opening. This reduction in exploitation rate resulted in a GHL of 28.5 million pounds for the 2000 season. Of this total, 2.1

million pounds (7.5%) was allocated to the CDQ fishery, resulting in a 26.4 million pound GHL for the general fishery.

The 2000 snow crab fishery was scheduled to open by regulation at noon on January 15. However, by early January, a significant portion of the fishing grounds were ice covered. The ADF&G and industry had concerns about potential gear conflicts and gear loss due to sea ice and vessel interactions because of the limited fishing area. ADF&G was also concerned with the handling effects and the potential for increased handling mortality and limb loss of captured crabs in a derby-style fishery under extreme weather conditions. ADF&G received input from representatives of the crab industry and the majority indicated a desire to delay the season. The United States Coast Guard (USCG) was also in favor of delaying the season due to vessel safety concerns during severe vessel icing conditions. On January 7, ADF&G announced by news release that the fishery would be delayed and would not open prior to April 1, and that two weeks advance notice would be provided to industry prior to an opening. On March 7, ADF&G issued a news release defining criteria that would be used to open the fishery. These criteria, developed with input from industry, specified that at least 50% of the fishing grounds had to be ice free at the time of the opening, and that the ice edge at 167° W long. could be no further south than 58° N lat. On March 15, ADF&G issued a news release indicating opening criteria had been met and that the fishery would open at noon on April 1.

The 2000 general fishery opened at noon on April 1 and closed at noon on April 8 (Table 2-26). A total of 229 vessels, including nine catcher processors, registered and received tank inspections in Akutan, Dutch Harbor, King Cove and Saint Paul Island. In addition, five floating processors registered to purchase and process crabs on the grounds during the fishery. In 1999, 241 vessels, including 10 catcher-processors, participated along with 11 floating processors.

Due to the relatively small GHL, management of the 2000 fishery was based on daily inseason reports from fishers. A total of 75 vessel operators or 34% of the fleet reported numbers of pots fished and number of crabs retained daily. Reports were received via marine telex and over single side band radio every 24 hours and were used to generate inseason estimates of harvest.

Catch projections indicated that the daily harvest ranged from less than 0.2 million pounds on the first day of the fishery to over eight million pounds on the final day of the season. The projected harvest based on inseason reports, was estimated to be 31.3 million pounds. The actual harvest of 30.8 million pounds exceeded the 26.4 million pound GHL by 17%.

Daily catch per unit of effort (CPUE), in numbers of retained crabs per pot pull, ranged from 31 on the first reporting day to 149 on the day prior to the closure. Projected CPUE based on inseason reports was 129. The actual CPUE for the 2000 fishery, based on post season fish ticket analysis, was 137. Overall fishery CPUE for the 1999 fishery was 158 retained crabs per pot.

Based on inseason reports, fishers made a total of 170,064 pot pulls throughout the course of the seven day 2000 fishery. The average number of pot pulls per day was 24,700 and ranged from 2,241 on the first day of the fishery to 43,905 on the day of the closure. In comparison, the 1999 fishery lasted 66 days and the average number of pots pulled per day was 13,621.

Harvest from the Eastern Subdistrict was 20.9 million pounds from 217 landings, or 68% of the total harvest. In recent years the majority of the harvest had occurred in the Eastern Subdistrict.

Total harvest from the Western Subdistrict was 9.8 million pounds from 91 landings. The majority of the Eastern Subdistrict harvest came from six statistical areas surrounding the Pribilof Islands. The majority of the harvest in the Western Subdistrict came from four statistical areas along the 100 fathom contour, between 173° and 174° W long. In both subdistricts the majority of the harvest came from areas which have, in recent years, contributed the majority of the harvest.

Analysis of observer and dockside sampling data indicated an average weight of 1.3 pounds for crabs landed during the 2000 fishery. New-shell crabs made up 95.2% of the harvest. In 1999, new-shell crabs made up 97.7% of the harvest and the overall average weight was 1.3 pounds. Crabs under 102 mm CW made up 8.3 percent of the 2000 harvest. This compares to 23.3, 21.1, 9.7 and 13.7% of crabs less than 102 mm CW harvested during the 1996, 1997, 1998 and 1999 seasons, respectively.

The exvessel price for snow crabs harvested in the 2000 fishery was two-tiered due to concerns for higher than normal old-shell crabs expected in the catch. Fishers were offered $1.85 per pound for clean, new-shell crabs and $1.00 per pound for old-shell, dirty or dark crabs. Fishers reported encountering high percentages of old-shell crabs in the first two days of the fishery, but thereafter located areas which contained predominantly new-shell animals. As a result, less than 10% of crabs landed were old-shell animals. Based on an average exvessel price of $1.81 per pound, the 2000 snow crab fishery was worth $55.1 million. This compares to an exvessel price of $0.88 per pound and an overall fishery value in excess of $161 million in 1999.

The 2001 Bering Sea snow crab *C. opilio* general fishery opened by regulation at noon on January 15 and closed by emergency order at 11:59 PM on February 14. The fleet harvested 23,382,046 pounds, or 92% of the 25.3 million pound GHL.

Analysis of the 2000 National Marine Fisheries Service summer trawl survey of the Eastern Bering Sea indicated a 19% decrease in the abundance of large (≥ 102 mm cw) male crabs from numbers observed during the 1999 survey. However, small (< 102 mm cw) male and large (≥ 50 mm cw) female abundance increased 100% and 212%, respectively. Due to the large increase in both small male and large female abundance, the spawning biomass, currently estimated at 472.7 million pounds, is slightly above the minimum stock size threshold of 460.8 million pounds.

In the spring of 2000, the BOF adopted a harvest strategy specifying a stepped harvest rate on mature male crabs that is dependant on estimated spawning biomass and that would rebuild the stock. The rebuilding plan specifies an exploitation rate of 16.875% of the mature male biomass when the spawning biomass is between 460.8 and 921.6 million pounds, resulting in a GHL for the 2001 season of 27.3 million pounds with 25.3 available to the general fishery and 2.0 million pounds allocated to the CDQ fishery.

A total of 207 vessels, including 7 catcher-processors participated in the 2001 fishery. Because of lengthy price negotiations, most catcher vessels did not begin fishing until 4:00 PM on February 3. As a result, harvest for the first 18 days of the season, 2.2 million pounds, was taken almost entirely by catcher-processor vessels. Catch projections based on inseason reports indicate that daily harvest ranged from less than 60,000 pounds reported on January 17 to over 2.7 million pounds reported on February 12 and February 14. The closure announcement, made over single side band radio and distributed by email and fax, was released to the public at 6:30 PM on February 12, providing the fleet with 54 hours advance notice of the closure. Based on the inseason reports through February 12, it appeared that the 25.3 million pound GHL would be reached by the closure, however, fleet efficiency was reduced by poor weather that developed after the closure announcement was made. As a result, catch projections based on reports received after the fishery closure indicated that the total harvest would fall short of the GHL at approximately 23.0 million pounds.

The average exvessel price per pound in 2001 was $1.53, resulting in a total fishery value of $32.1 million, a significant decrease from the 2000 fishery value of $55.1 million.

Weather conditions in the Bering Sea throughout the 2001 fishery were very unfavorable. Several storms, some generating hurricane force winds, combined with large tides to produce extremely dangerous sea conditions. Several vessels lost wheelhouse windows and experienced other structural damaged caused by large waves. No vessels or lives were lost during the 2001 fishery. Sea ice was not a major concern in 2001, and the main ice pack remained north of Saint Matthew Island throughout the fishery.

2002 Fishery

The 2002 Bering Sea snow crab general fishery opened by regulation at NOON on January 15 and closed by emergency order at NOON on February 8. Total harvest was 30,322,501 pounds, which exceeds the general fishery guideline harvest level (GHL) of 28.5 million pounds by 1.82 million pounds (6.4%).

Analysis of the 2001 National Marine Fisheries Service summer trawl survey of the Eastern Bering Sea indicated a 2% increase in the abundance of large (≥ 102 mm cw) male crabs when compared to the 2000 survey. Pre-recruit (71-101 mm cw) male and large (≥ 50 mm cw) female abundance increased 114% and 3%, respectively. The total mature biomass of snow crab in the Bering Sea is estimated to be 571.0 million pounds which is above the minimum stock size threshold of 460.8 million pounds.

Given the estimated total mature biomass of 571.0 million pounds and current harvest strategy requirements, the GHL was set using a 16.875% exploitation rate. The calculated GHL of 51.0 million pounds constituted a harvest greater than 50% of the estimated exploitable legal male abundance and thus, according to harvest strategy requirements was adjusted down to not exceed 50% of the exploitable legal male abundance. The resultant 2002 Bering Sea snow crab GHL was 30.82 million pounds with 28.51 million pounds available to the general fishery. The remaining 2.31 million pounds were allocated to the CDQ fishery. Approximately 61% of the four inch and greater carapace width males encountered during the 2001 survey had old shells.

Preseason vessel registration was required for all vessels participating in the 2002 Bering Sea snow crab fishery. By the 5:00 PM December 24, 2001 deadline, 201 vessels filed preseason registrations. An additional vessel filed for late registration and was permitted to enter the fishery. Observer coverage was assigned based on the number of catcher vessels that filed preseason registrations. Ten catcher vessels and eight catcher-processors carried observers during the 2002 Bering Sea snow crab fishery.

The quick registration process began January 9 with preseason tank inspections in Dutch Harbor, Akutan, King Cove and False Pass. Preseason tank inspections are never provided in Saint Paul. However, tank inspections are conducted in Saint Paul 24 hours prior to the fishery opening. Poor weather prevented ADF&G staff from reaching Saint Paul until January 15, thus those vessels intending to register in Saint Paul were registered by personnel in Dutch Harbor via fax. In the four other tank inspection locations, the fleet was registered on January 13. The tank inspection process was also used to enlist vessel operators in the inseason catch reporting program. Over 50% of the fleet volunteered to report effort and catch data daily during the fishery. The actual number of vessel operators reporting to the department was approximately 70 for most of the fishery.

During the week preceding vessel registration, department staff consulted with USCG search and rescue personnel and National Weather Service (NWS) forecasters regarding a potential weather-related delay in season opening. NWS staff did not forecast storm force winds in the operational area of vessels that would be travelling to the snow crab fishing grounds from Dutch Harbor, Akutan, King Cove, Saint Paul or False Pass, nor were storm force winds forecast for the time period January 15-17. USCG personnel did not foresee that current or forecast weather conditions would hamper a search and rescue mission immediately before or during the first 48 hours of the fishery, thus the season was not delayed.

A total of 191 vessels, including eight catcher-processors, participated in the 2002 fishery. Three floating processors also registered and purchased crabs on the grounds during and after the fishery. A total of five shore-based processors in Dutch Harbor, two in Saint Paul, one in King Cove and two in Kodiak also purchased and processed snow crabs. In addition, two catcher processor vessels purchased snow crabs from catcher vessels after the fishery. In 2001, a total of 207 vessels, including 7 catcher-processors were tank inspected. Three floating processors and 10 shore-based processors purchased crabs in 2001. The fleet registered 33,028 pots for the 2002 fishery and purchased 37,807 buoy tags. The fleet utilized 40,379 pots during the 2001 fishery.

The fleet spent January 15 and 16 deploying gear and less than 1.0 million pounds total were taken on those days. By January 18, the fleet had harvested 2.1 million pounds and was pulling approximately 15,000 pots per day for a CPUE of 71 and a daily harvest rate of 1.3 million pounds. Daily harvest and CPUE peaked on January 19 when the fleet harvested 2.0 million pounds with a CPUE of 101. CPUE and harvest declined steadily for the remainder of the fishery. By early February fleet size had diminished to less than 180 vessels and less than 30,000 pots were being fished. Vessels left the snow crab fishery prior to the closure to participate in other fisheries. Reports received through 6:00 AM February 7 indicated that in the prior 24 hours, the fleet harvested 1.1 million pounds and pulled approximately 15,600 pots for a CPUE of 57 and a cumulative harvest of nearly 26.0 million pounds (Table 2-27). Given this catch rate, the department issued a news release at noon on February 6 announcing that the 2002 Bering Sea snow crab fishery would close at noon on February 8. Based on inseason catch reports received from approximately 34% of the fleet, the total harvest for the 2002 snow crab fishery was 28.1 million pounds and the fleet pulled approximately 320,000 pots for a CPUE of 68 crabs per pot lift (Table 2-27). In 2001, the fleet harvested 23.4 million pounds and pulled approximately 177,000 pots for a CPUE of 97 crabs per pot lift. Actual CPUE for the 2002 fishery based on fish ticket data is 76 crabs per pot lift (Table 2-25).

The average weight of crabs landed during the 2002 fishery was 1.3 pounds, a slight decrease from the 2001 average weight of 1.4 pounds (Table 2-28). There was no difference in average weight between crabs harvested in the Eastern and Western Subdistricts (Table 2-29). In 2001, crabs harvested in the Eastern Subdistrict were 0.1 to 0.15 pounds heavier than those harvested west of 173° W long. Similar to 2001, the 2002 harvest was evenly split between the Eastern and Western Subdistricts, a contrast to the fisheries of the late 1990s when the majority of the harvest occurred in the Eastern Subdistrict. In 2002, the Western Subdistrict CPUE was nearly 40% greater than the CPUE observed east of 173° W long., a trend that continued from the 2001 fishery.

Unlike the 2001 fishery, in 2002 the Bering Sea snow crab fleet voted to accept a price offer prior to the beginning of vessel registration on January 13. The fleet voted to accept $1.40 per pound for new-shell crabs that were four inch and greater carapace width. As the fishery progressed, some fishers experienced difficulty in finding grounds containing a high percentage of new-shell crabs. Approximately 31% of landed crabs had old shells (Table 2-30). As a result, processors offered a second price of $0.90 to $1.00 per pound for old-shell crabs that were four inch and greater carapace width. Given this price structure, the 2002 Bering Sea snow crab fishery had an estimated exvessel value of $44 million (Table 2-31).

In addition to old-shell crabs that were delivered, onboard observers and fishers reported that up to 30% of legal crabs caught were being discarded at sea due to shell condition. During the 2001 fishery, approximately 20% of the legal snow crabs that were caught were not retained and 4.8% of snow crabs landed had old shells.

Due to the protracted length of the 2002 fishery, most vessels made one or two landings prior to the closure of the fishery. By the fishery closure, approximately 66% of the harvest had already been processed, thus post season processing delays experienced in 2001 were reduced. Processing was completed by February 17. Two processors operating under sideboards of the AFA were constrained by their processing caps; none were constrained in 2001.

Weather conditions in the Bering Sea during the 2002 fishery did not significantly hamper the fleet, however heavy freezing spray slowed production in late January and early February. Like the 2001 fishery, no vessels or lives were lost in 2002. Unlike the 2001 fishery, sea ice was a significant factor throughout the season. Sea ice forced most of the fleet to remain below 59° N lat. and thus a significant portion of the stock could not be fished. In addition, sea ice forced fishers to move gear more frequently. Post season, sea ice covered some gear stored north of 56° 30' N lat.

ADF&G personnel or observers contacted approximately 80% of snow crab vessel operators for data collection interviews. Biological data were collected from the majority of these deliveries. The Department of Public Safety (DPS) stationed personnel in all ports where snow crabs were landed except King Cove and cited two vessel operators for possession of Tanner crabs during a closed season. DPS seized approximately 3,500 pounds of illegal Tanner crabs valued at approximately $4,900.

Stock Status

The Bering Sea snow crab stock fell below the minimum stock size threshold and was declared overfished in 1999. Since 1999, snow crab abundance in the Bering Sea has fluctuated. Both the 2000 and 2001 NMFS surveys estimated the total snow crab population to be in excess of 3.0 billion crabs. The 2002 estimate was substantially lower at approximately 1.5 billion crabs. In 2002, large male snow crab abundance was estimated to be 76.1 million crabs, a 2% decrease from the 2001 level. Despite only a nominal decrease in large male abundance, pre-recruit males and large females decreased 12% and 67% respectively.

Sixty percent of large males were found in the Eastern Subdistrict in 2002; in 2000 and 2001, 46% of large males were found west of 173° W long. In 1999, 70% of the large male snow crab abundance was recorded in the Eastern Subdistrict. Thirty five percent of large males were classified as having old shells, compared to 63% in 2001.

Pre-recruit males decreased in abundance 12% to 248 million crabs. The strong size-frequency mode centered at 60-70 mm cw that was first observed in 2000 as 50-60 mm cw crabs has dissipated significantly. The 2002 small male (< 78 mm cw) abundance estimate is the third lowest ever. Large females decreased in abundance 67% to 500,000 crabs, the fourth lowest estimate ever (Stevens et al. 2002).

Federal Fishery Management Plan and state harvest strategy requirements reference the total mature snow crab biomass which is defined as the biomass of all mature male and female snow crabs. In 2001 the total mature biomass of snow crabs in the Bering Sea was estimated to be 571 million pounds, a 21% increase over the 2000 level of 473 million pounds, but well below the Federal FMP defined rebuilt level of 921.6 million pounds. In 2002, total mature biomass (TMB) decreased to 313 million pounds. TMB must remain above 230.4 million pounds in order for a fishery to occur.

Relative to FMP criteria, the Bering Sea snow crab stock remains below the rebuilt level. The recruitment observed in 2000 and 2001 does not appear to have contributed significantly to stock rebuilding, however it helped sustain small commercial harvests that otherwise may not have been possible. The current pre-recruit and large male size classes may be capable of sustaining a harvest in 2004, however it is difficult to predict if TMB will be adequate to meet the harvest strategy threshold for opening the fishery.

BERING SEA GROOVED TANNER CRAB

Historic Background

In 1988, BOF established a special permit season for deepwater Tanner crabs. However, no commercial harvest of grooved Tanner crabs *Chionoecetes tanneri* from the Bering Sea occurred until 1992. In 1993, ADF&G restricted the harvest to male crabs with a CW of 127 mm (5 inches) or greater. Six vessels harvested just less than 660,000 pounds. The following year, differential pot limits, based on vessel size, were applied to vessels fishing for deepwater Tanner crabs in the Bering Sea. Effort and landings consequently decreased as four vessels harvested slightly over 300,000 pounds (Table 2-32).

At the March 1995 meeting, BOF determined that pot limits should not apply to the deepwater permit fisheries of the Westward Region. Effort increased significantly that year when eight vessels harvested over one million pounds with a fishery value exceeding $1.3 million. Since 1995, the number of vessels registered for Bering Sea District grooved Tanner crab has not exceeded three vessels for any season. Catch per unit effort was highest in 1994 at 11 legal crabs per pot lift and declined to three in 1996. Harvests decreased from over 1,000,000 pounds in 1995 to 107,000 pounds in 1996. There were no vessels registered to fish grooved Tanner crabs in the Bering Sea District from 1997 to 1999, while only one vessel registered in 2000 and 2001. Historically, fishing effort has been concentrated in a few statistical areas immediately south of Saint George Island.

In 1997, ADF&G set GHLs for grooved Tanner crabs that were based on prior harvest information. In the past, the Bering Sea, Alaska Peninsula, and Eastern Aleutian Districts supported the largest catches of grooved Tanner crabs. A GHL of 200,000 pounds was established for each of these districts. A GHL of 100,000 pounds was established in the Kodiak and Western Aleutian Districts to allow for exploratory fishing. Additionally, due to industry concerns about viability of undersized and female deepwater crabs released at sea, ADF&G began to require a minimum of two escape rings per pot with a minimum inside ring diameter of 4.5 inches.

Given fishery performance and declining harvests of the mid-1990s, the department reevaluated deepwater Tanner crab harvest levels in 1999. A GHL range of 50,000 to 200,000 pounds was established for the Bering Sea District. The GHL was set as a range to provide greater flexibility for inseason management and to better inform the public of the department's management goals for the fishery. The fishery will be managed so that the upper end of the GHL range is reached only when catch rates similar to, or greater than those documented prior to the harvest declines of the mid 1990s are observed. In addition to new GHL requirements, the department specified that four 4.5" escape rings be placed on the lower third of each pot and required that pots be fished over multiple depth strata. Since 1994, observers have been required on each vessel registered for the fishery and will collect biological and fishery data.

2002 Fishery

No vessels registered to fish for grooved Tanner crabs in the Bering Sea during the 2002 season.

Stock Status

The grooved Tanner crab population in the Bering Sea District is not surveyed; subsequently, no estimates of population abundance are available for this stock. Fishery data from the mid-1990s is the primary source of information regarding abundance and stock status. Based on this information, the population appears to have been heavily exploited, at least in the area historically fished.

BERING SEA TRIANGLE TANNER CRAB

Historic Background

Historically, triangle Tanner crabs *Chionoecetes angulatus* were taken as incidental harvest in the grooved Tanner crab fishery. Vessel operators have verbally reported retention of triangle Tanner crabs before 1994. To obtain biological information on grooved Tanner crabs, ADF&G implemented 100% onboard observer coverage in 1994. That year, onboard observers documented a single incidence of triangle Tanner crab bycatch, but prior to 1995, this species had not been commercially harvested. In 1995, four vessels registered to retain triangle Tanner crabs, and they harvested over 49,000 pounds for a total fishery value of $50,000. In 1996, 2000, and 2001, only one vessel delivered triangle Tanner crabs as incidental harvest each year. No vessels registered to fish triangle Tanner crabs in the Bering Sea District from 1997 to 1999 (Table 2-33).

Due to the lack of stock abundance data for this species and the nature of the historical fishery, additional fishing for triangle Tanner crabs in the Bering Sea District will be limited to incidental harvest during the grooved Tanner crab fishery. Vessels registered to fish for grooved Tanner crabs will be permitted to harvest triangle Tanner crabs at up to 50% of the weight of the target species as incidental harvest. This harvest level is consistent with the historic development of the fishery and allows retention of a deepwater species that is believed to have high bycatch mortality.

2002 Fishery

No vessels registered to retain triangle Tanner crabs in the Bering Sea District in 2002.

Stock Status

Surveys of population abundance are not conducted for triangle Tanner crabs in the Bering Sea; thus the status of this stock is unknown. There are currently no plans to survey this population.

MISCELLANEOUS SHELLFISH SPECIES
BERING SEA

Description of Area

The Bering Sea portion of Registration Area J, as described herein for miscellaneous shellfish, includes all Bering Sea waters of both the Territorial Sea (0-3 nautical miles from shore) and the Exclusive Economic Zone (3-200 miles from shore) north of the latitude of Cape Sarichef at 54° 36' N lat. and east of the United States-Russia Maritime Boundary Line of 1991 (Figure 2-12).

Introduction

Miscellaneous shellfish species include hair crabs *Erimacrus isenbeckii*, green sea urchins *Strongylocentrotus droebachiensis*, red sea cucumbers *Parastichopus californicus*, snails *Neptunea* and *Buccinum*, octopus *Octopus dofleini*, and cherry crabs *Paralomis multispina*, a deepwater crab closely related to king crabs. These species have been harvested in relatively small amounts compared to the commercial king and Tanner crab fisheries in the Bering Sea. Prior to 1999, it was ADF&G policy to allow commercial fishing for miscellaneous shellfish species under authority of a commissioner's permit described in 5 AAC 38.062. PERMITS FOR OCTOPI, SQUID, HAIR CRAB, SEA URCHINS, SEA CUCUMBERS, SEA SNAILS, CORAL, AND OTHER MARINE INVERTEBRATES. Typically, permit conditions were general and not fully developed on an individual species basis. Fisheries for miscellaneous shellfish species occurred without prior knowledge of stock abundance or distribution and no harvest limits were established. To better regulate these types of fisheries, ADF&G and BOF are formulating a plan for new and developing fisheries. Prior to the adoption of this plan, ADF&G will only register vessels for those fisheries with an established GHL, or when sufficient data is available to develop a conservative GHL.

Those species of current or historic interest in the Bering Sea include cherry, hair and Dungeness crabs *Cancer magister*, octopus, and snails. North Peninsula District shrimp do not fall under the miscellaneous species category, but are included in this report due to low or infrequent annual harvests. The fishery for shrimp in the Bering Sea District is described in a separate report.

Bering Sea Hair Crabs

Description of Area

The Bering Sea hair crab fishery is prosecuted in an area that includes all waters north of 54° 36' N lat., south of 60° N lat., east of the United States-Russia Maritime Boundary Line of 1991, and west of 168° W long. (Figure 2-13). There is no formal hair crab registration area established in regulation; rather, the fishing area is set using the terms of a commissioner's permit.

Historic Background

The fishery for hair crabs in the Bering Sea was pioneered by the Japanese fleet during the 1960s and first commercially exploited by the U. S. fleet in 1979. In its early years, the domestic hair crab season was opened by emergency order concurrent with the Bering Sea Tanner crab fishery. During the 1980 BOF meeting, a year-long season was established within a three-mile area of the Pribilof Islands. In 1984, under conditions of a commissioner's permit issued by ADF&G, the year-round hair crab fishery was expanded in the Bering Sea District. Between 1979 and 1992, however, the majority of hair crabs landed was reported as incidental catch in the Bering Sea Tanner crab fisheries.

Beginning in the fall of 1993, under the terms of the Commissioner's Permit, all vessels fishing for hair crabs were required to carry an observer during all fishing activities (ADF&G 1996). In 1994, hair crab pots were defined by BOF as pots with a rigid tunnel opening in the top of the pot, with a tunnel perimeter not to exceed 26 inches and a base that does not exceed 48 inches in any one direction. Legal retention of hair crabs is permitted only from hair crab pots.

In 1996, due to a steady increase in the number of vessels participating in this fishery, the Alaska Legislature authorized the Commercial Fisheries Entry Commission to regulate vessel licenses in the Bering Sea hair crab fishery. Vessel qualification was based on participation in at least one of the qualifying years from 1992 to 1995. Licenses were issued to 23 vessels for those waters beyond five nautical miles of Saint George and Saint Paul Islands. Also included in this legislation were provisions which allow any vessel 58 feet and under to fish within five nautical miles of Saint George and Saint Paul Islands. In addition, it was the intent of the Legislature, expressed in the moratorium, that BOF maintain 100% observer coverage on all vessels participating in the Bering Sea hair crab fishery. However, ADF&G exempted vessels under 44 feet in length from mandatory observer coverage because of observer safety considerations (ADF&G 1998).

Observers provide catch and effort reports that are expanded into harvest estimates. Their data, along with information collected from vessel operators and processors, allow ADF&G to manage the Bering Sea hair crab fishery in season. Catch reports from processors are used to verify estimates generated from observer data. Reports from fishers provide information regarding distribution of crabs, gear conflicts, weather, and other fishing conditions.

Participation and harvest in the Bering Sea hair crab fishery has varied greatly over the history of the U. S. fishery. Effort and harvest reached a peak of 67 vessels and 2.4 million pounds in 1980 when the fishery was prosecuted as an incidental harvest fishery during the Tanner crab season (Table 2-34 and Figure 2-14). Between 1985 and 1990, effort was minimal due to low stock abundance. Since the 1996 moratorium, effort has remained at 19 or fewer vessels and in 2000 only three vessels made landings. In the 1990s, harvest reached a peak of 2.3 million pounds in the 1993/94 season. Total fishery value peaked in 1995 at $5.7 million (Table 2-35). Since 1995, both effort and GHL have been declining. During the 2000 season, only 1,500 pounds of hair crabs were harvested, for a total fishery value of $5,000.

Since the establishment of the year-round permit fishery in the Bering Sea in 1984, average weight and catch per unit effort (CPUE, defined as the number of legal crabs retained per pot) have also fluctuated significantly. The highest CPUE of 10 crabs per pot was recorded in 1991, while CPUE dropped to less than one crab per pot during the spring 1993 and 2000 seasons. Average weight of retained hair crabs was highest during the early years of the U.S. fishery at 2.1 pounds, but decreased to 0.9 pound in 1991. In the late 1990s, the average weight of retained hair crabs has remained around 1.6 pounds (Table 2-34).

Beginning in 1993, the hair crab fishing season opening date was set at November 1, which conflicted with the Bristol Bay red king crab fishery. In 1998, ADF&G solicited comments from industry regarding a new opening date. A consensus was reached that the fishery would open 10 days after the closure of the Pribilof District or Saint Matthew Island Section king crab fisheries, whichever closed later. The fishery opened on October 8 in 1998. In 1999, BOF changed the Bristol Bay red king crab season opening to October 15; thus the hair crab fishery was again in conflict. Consensus was reached with industry to conduct the fishery 10 days after the closure of the Bristol Bay red king crab fishery. Subsequently, in 1999 and 2000, the hair crab season opened on October 30.

The GHL for Bering Sea hair crabs is established using results of the NMFS Bering Sea trawl survey. Since there are no registration areas, districts, or sections established in regulation for hair crabs, survey results are described in terms of Bering Sea king crab registration areas, districts and sections (Figure 5-4). Because confidence in the results of this survey is relatively low, a 20% fishery exploitation rate has been used to determine the GHL. Male hair crabs ≥3.25" in CW are defined as legal crabs in the commissioner's permit for this fishery.

Historically, the majority of legal-sized male hair crabs has been found in the vicinity of the Pribilof Islands during the trawl survey, while fishery harvest has occurred primarily in the area east of Saint Paul Island. During the 1999 survey, however, 65% of the large male hair crab population in the Bering Sea was found in the Northern District instead of the traditional Pribilof District. Subsequently, in 2000, the Pribilof District was closed to commercial hair crab fishing due to low stock abundance, and for the first time, a directed hair crab fishery was opened in the Northern District of king crab Registration Area Q. Given the experimental nature of the fishery, the low abundance of small male crabs found during the 2000 survey, the relative size of the stock, and lack of fishery data from the Northern District, the harvest rate was set conservatively at 10% of the estimated large male hair crab abundance. In 2001, as a result of low stock abundance, the Bering Sea was closed to hair crab fishing.

2002 Fishery

The 2002 Bering Sea hair crab fishery was closed in both the Northern and Pribilof Districts due to low stock abundance.

Stock Status

The abundance index for large male hair crabs declined from 1981 to 1992, increased from 1992 to 1995, and decreased again from 1995 to 1999. The 2002 NMFS trawl survey of the eastern

Bering Sea indicated that the abundance of large male hair crabs has increased by 17% over the 2001 level to 2.1 million crabs (Stevens et al. 2002). However, population trends observed during the last six years and weak performance of recent commercial fisheries indicate that the Bering Sea hair crab population remains low. Total estimated female and small male hair crab abundance has never been estimated with precision from the eastern Bering Sea trawl survey. In general, the biology and habitat usage of hair crabs makes them difficult to survey with trawl gear. Large male abundance is thought to be better estimated because recruitment trends can be followed in the survey results.

Bering Sea Octopus

The last directed fishery for octopus in the Bering Sea occurred in 1995, with areas fished covering both Aleutian Islands and Bering Sea waters. Less than three vessels made landings; therefore, the harvest information is confidential. Since 1995, all reported harvests in the Bering Sea have been incidental harvest. Any vessel registered for groundfish in the Westward Region using a miscellaneous finfish permit may retain octopus bycatch by up to 20% of the weight of the target species. During the 2002 season, 109 vessels registered for octopus incidental harvest in the Bering Sea/Aleutian Islands area. Seventy of these vessels made 185 landings with 39,466 pounds of octopus reported. Another 16,713 pounds was discarded at sea (Table 2-36). Sixty-four percent (25,302 pounds) of the landed octopus was retained for bait, 33% was sold as food fish, 2% was used for fishmeal, and 1% was discarded on shore. During the 2002 season, 93% of the octopus bycatch was caught with pot gear, 4% with non-pelagic bottom trawl gear, and the remainder with longline gear.

Cherry Crabs

Fishing for cherry crabs is managed under the terms of a commissioner's permit. Although one vessel was registered to fish for cherry crabs in 1995, no commercial harvest was reported. One vessel, for which landings are confidential, participated in the 1996 fishery. No vessels registered or fished for cherry crabs in the Bering Sea District from 1997 through 2002.

Sea Cucumbers and Sea Urchins

In 2001, ADF&G issued a news release announcing the GHL for red sea cucumbers and green sea urchins in the Westward Region. The 2001 season was opened October 1 under a commissioner's permit with a GHL of 5,000 pounds each, eviscerated product for red sea cucumbers and whole animal weight for green sea urchins, in the Bering Sea Area. The small GHLs were established to permit conservative commercial exploration of areas that lacked historic harvest data and to allow ADF&G to collect critical information for future management purposes (Ruccio and Jackson 2000). No commercial harvest of either species occurred in the Bering Sea District in 2001.

In 2002, the GHL for the Bering Sea Area (excluding Saint George Island) was again set at 5,000 pounds each, eviscerated product for red sea cucumbers and whole animal weight for green sea urchins. A separate guideline harvest range of 30,000 to 60,000 pounds was established for the Saint George Island green sea urchin fishery based on abundance and marketing factors. Only one diver harvested green sea urchins in the Saint George Island area; therefore, all harvest information is confidential.

Snails

Historic Background

Commercial fishing for snails in the Bering Sea began with the Japanese in 1971 and continued until 1987, however little information is available from this early fishery. In 1977, the Japanese began providing records to the United States concerning fisheries occurring inside the U.S. Exclusive Economic Zone (EEZ), as mandated by the Fishery Conservation and Management Act of 1976 (MacIntosh 1979). NMFS recorded 14 vessels participating in 1971, five vessels in 1972, no vessels in 1973, and six vessels in 1974. There was no fishing activity in 1975 and 1976. In 1977, records indicate that participation in the fishery increased to three vessels (MacIntosh 1980). In the 1980s all fishing was conducted by catcher-processor vessels. The majority of the retained catch during this early fishery was composed of the Pribilof Neptune snail *Neptunea pribiloffensis*. Smaller components of the retained catch were composed of *Buccinum angulossum* and *B. scalariforme* (MacIntosh 1980). Exvessel value was $242 thousand in 1977, increasing to $1.3 million by 1979. Russian vessels began fishing for snails in the same area in 1989.

The Foreign Fisheries Observer Program assigned observers to Japanese catcher-processors in the years 1984-1987 and later to Russian vessels in 1989. The Russian venture only lasted one year with minimal return. Gear used during the early foreign fishery was converted Tanner crab pots. Pots were long-lined in depths from 100 to 150 fathoms. Data from the Foreign Fisheries Observer Program showed the Japanese vessels pulled an average of 2,779 pots per day with an average soak time of 50 hours while the Russian vessels averaged just 1,219 pot lifts per day with an average soak time of 80 hours.

The U.S. fishery began in 1992 when two vessels registered to fish for snails. One vessel harvested snails as incidental harvest in the Tanner crab *Chionoecetes bairdi* fishery and the second participated in a directed fishery for snails after the June closure of the hair crab fishery. Fishing for snails was limited to waters of the Bering Sea District west of 168° W long. from 1994 to 1996. In 1997, snail fishing was limited to waters west of 164° W long.

Observer coverage was required as a condition of the commissioner's permit issued in 1993 under 5 AAC 39.210 (h) MANAGEMENT PLAN FOR HIGH IMPACT EMERGING FISHERIES. Minimal crab bycatch was observed in the area west of 168° W long. Bycatch of legal sized blue king crabs *Paralithodes platypus* and red king crabs *P. camtschaticus* was less than one animal per pot. Female snow crabs *C. opilio* had the highest incidence of bycatch at one animal per pot (Tracy 1995).

Observer coverage was not required again until 1997 when two vessel operators expressed interest in fishing east of 168° W longitude. Vessels were restricted to grounds west of 164° W long. and north of 54° 36' N latitude. These restrictions were conditions of the permit issued under 5 AAC 38.062 PERMITS FOR OCTOPI, SQUID, HAIR CRAB, SEA URCHINS, SEA CUCUMBERS, SEA SNAILS, CORAL, AND OTHER MARINE INVERTEBRATES. There was no bycatch of red or blue king crabs; however, bycatch of Tanner crabs was observed. An estimated 17,300 female and 2,100 sublegal male Tanner crabs, in addition to 57,600 sublegal snow crabs, were captured in the 192,000 pots pulled.

In the 1997 fishery, average CPUE was 16 snails per pot, equal to the CPUE from vessels fishing northwest of the Pribilof Islands in the 1996 fishery. The majority of the catch for the 1997 season was composed of the genera *Neptunea* and *Buccinum*. Catches increased from 313,000 pounds in 1993 to 3,570,000 pounds in 1996 and then declined to 932,000 pounds in 1997 (Table 2-37 and Figure 2-15). The value of the fishery increased from $125 thousand in 1993 to over $1.05 million in 1996 and then dropped to $308 thousand in 1997 (Table 2-38). From 1998 to 2001, no snails were harvested from the Bering Sea.

2002 Fishery

No vessels registered to harvest snails from the Bering Sea in 2002.

Stock Status

The NMFS eastern Bering Sea trawl survey provides distribution and relative abundance information on Bering Sea snail populations. However, differential catchability of various species of snails makes accurate population estimates difficult.

NORTH PENINSULA DISTRICT

Description of Area

The North Peninsula District for shrimp management includes all Bering Sea waters of both the Territorial Sea (0-3 nautical miles from shore) and the Exclusive Economic Zone (3-200 miles from shore) east of the longitude of Cape Sarichef at 164° 55'30" W long. (Figure 2-16). The North Peninsula District for management of Dungeness crabs includes all waters of both the Territorial Sea (0-3 nautical miles from shore) and the Exclusive Economic Zone (3-200 miles from shore) north of the latitude of Cape Sarichef at 54° 36' N lat. (Figure 2-17).

Shrimp

No vessels have registered for the North Peninsula District pot or trawl shrimp fishery since 1994. Currently, shrimp fishing is not permitted in this district due to a lack of data concerning the shrimp stocks.

Dungeness Crabs

Fishing effort for the North Peninsula Dungeness crab fishery has been sporadic, with few vessels participating. Most of this fishery occurred primarily north of Unimak Island. In 1995 six vessels made 19 deliveries for a harvest of 134,407 pounds. Catch information from 1996 to 1998 is confidential, as less than three vessels participated in each of those years. The average annual harvest in the three-year period from 1996-1998 was approximately 48,000 pounds. No vessels registered to fish for Dungeness crabs in the North Peninsula District in 1999. One vessel, for which landings are confidential, participated in the 2000 fishery. No vessels registered to fish for Dungeness crabs in 2001. In 2002, three vessels registered to fish for Dungeness crabs and harvested less than 22,000 pounds (Table 2-39).

Stock Status

There is no population data available to determine the status of the North Peninsula Dungeness crab stock. This fishery is managed using size, sex, and season restrictions. Currently in this District only male Dungeness crabs with a shoulder width 6-1/2" or larger may be taken between 12:00 noon May 1 through 12:00 noon October 18.

BERING SEA/ALEUTIAN ISLANDS COMMUNITY DEVELOPMENT QUOTA CRAB FISHERIES

Description of Area

The Bering Sea, for Community Development Quota (CDQ) fisheries, encompasses all waters of the Exclusive Economic Zone (3-200 nautical miles from shore) and Territorial Sea (0-3 nautical miles) north of Cape Sarichef (54° 36' N lat.), south of Cape Prince of Wales (65° 49' N lat.), and east of the U.S.-Russia Convention Line of 1867, including the waters of Bristol Bay. For those CDQ fisheries managed by the ADF&G Westward Region, Cape Romanzof (61° 49' N lat.) is the northern boundary (Figure 2-18).

CDQ Program Background

The North Pacific Fishery Management Council (NPFMC) established the CDQ Program in 1992. In 1995 the council included Bering Sea crab in the CDQ Program. The BOF adopted regulations for the Bering Sea/Aleutian Islands king and Tanner crab CDQ fisheries in 1997, and those fisheries started in 1998. The State of Alaska manages the CDQ Program and ADF&G manages the crab CDQ fisheries.

There are 65 coastal Bering Sea communities eligible for the CDQ Program. These communities are aligned into six CDQ organizations and are collectively referred to as CDQ groups. The groups are Aleutian Pribilof Island Community Development Association (APICDA), Bristol

Bay Economic Development Corporation (BBEDC), Central Bering Sea Fishermen's Association (CBSFA), Coastal Villages Regional Fund (CVRF), Norton Sound Economic Development Corporation (NSEDC), and Yukon Delta Fisheries Development Association (YDFDA).

The CDQ groups are non-profit entities, which may have for-profit subsidiaries. Each group submits comprehensive plans on the intended use of the CDQ funds, which vary widely between groups, but most are fishing-related investments, scholarships, training, employment services, and other projects which are intended to benefit the communities and regions the CDQ groups represent. The groups are buying equity in fishing vessels which will harvest crab in both CDQ and general fisheries.

The CDQ groups receive allocations for the following Bering Sea crab fisheries: Norton Sound red king crab *Paralithodes camtschatica*, Bristol Bay red king crab, Pribilof red and blue king crab *Paralithodes platypus*, St Matthew blue king crab, Bering Sea snow crab *Chionoecetes opilio*, and Bering Sea Tanner crab *Chionoecetes bairdi*. To be eligible as CDQ crab fisheries, the fisheries must have an established guideline harvest level (GHL) and be managed under the Fishery Management Plan for Bering Sea/Aleutian Islands king and Tanner crabs (FMP). The CDQ allocation is based on the total harvest of each Bering Sea FMP crab species. The annual CDQ percentages for crab were phased in over a three-year period (3.5% of the total fishery harvest for 1998, 5.0% for 1999, and reaching a maximum of 7.5% for 2000 and subsequent years). The individual CDQ group allocation percentage varies in each fishery (Table 2-40). The value of the above fisheries to the CDQ groups is estimated to be 20-30% of the exvessel fishery value to the CDQ fleet. This report addresses all of the above fisheries except the Norton Sound CDQ red king crab fishery.

Fishery History

The CDQ groups were required to submit fishery plans to the department prior to each fishery. Plans included names of participating vessels and operators, vessel information regarding safety and communications, intended processor and location, method of attaining but not exceeding the allocation, and if a cooperative effort, the method for apportioning with deadloss and overages.

All CDQ crab fisheries have been subsequent to the general fisheries, and all CDQ vessels participated in the prior general fishery. Before vessels are allowed to register for the CDQ fishery, ADF&G must generate an accurate estimate of the general fish harvest. Fishers were required to obtain buoy tags for all gear fished, and if required, an onboard observer. At the time of registration all gear on board the vessel must be tagged with CDQ pot tags; all gear in the water had to be tagged before being deployed in the fishery. Additionally, all gear had to be in compliance with the closure requirements of the general fishery.

1998

The allocation for 1998 was 3.5% of the total harvest of red king crab, blue king crab and snow crab. All six CDQ groups participated in those fisheries during the year; however, not all groups participated in each fishery. No Tanner crab fishery occurred due to low stock abundance.

Twenty vessels made 86 deliveries for a total harvest of 8.85 million pounds in the CDQ snow crab fishery (Table 2-41). The fishery value was $4.7 million (Table 2-42). All six CDQ groups participated in the CDQ snow crab fishery. One group exceeded their allocation by a small amount. This group, however, paid another CDQ group not to harvest their total allocation, and thereby insured that the overall CDQ allocation was not exceeded.

Five CDQ groups participated in the St. Matthew Island Section CDQ blue king crab fishery and two vessels harvested the allocation, thus catch information is confidential. One vessel and group participated in the Pribilof District king crab CDQ fishery, thus harvest in that fishery is also confidential. Five CDQ groups participated in the Bristol Bay CDQ red king crab fishery. Although fish tickets indicated that product was delivered to three companies, the information is confidential because one company custom processed for another.

Onboard observers were required during all fishing operations. Observers documented fishing practices and collected biological data during periods outside of the normal fishery seasons. Additionally, the onboard observers provided data in fisheries where at-sea sampling has been minimal. Data obtained from observers deployed during CDQ king crab fisheries indicated no appreciable difference in fishing strategy as compared to the general fishery, while the same may not be true for the snow crab fishery. The industry-preferred minimum size is four inches carapace width for snow crab. Compared to the general fishery, an increased rate of crabs over four inches carapace width was observed during the CDQ snow crab fishery, indicating a possible change in fishing practices.

Regulations pertaining to the CDQ fisheries authorize a harvest prior to the general fishery; however, the department did not allow a CDQ harvest before the general fishery during the first year. A full understanding of the impact of these new fisheries and adequate staff to handle the increased management burden was needed before allowing CDQ fisheries to occur prior to the general fisheries. The department's intent was to allow CDQ groups to harvest part of their allocation before the general fishery during the second and subsequent years of the program. This would have allowed CDQ groups to harvest part of their 1999 allocation of snow crab in the fall of 1998. The NMFS determined that the CDQ regulatory language did not allow for a harvest of the allocation outside of the calendar year to which it was assigned. The intent of NMFS was not to impede ADF&G management of the CDQ crab fisheries. The federal CDQ regulations were revised, but not in time for any harvest of the 1999 allocation of snow crab to occur in the fall of 1998.

1999

BOF agreed to address an agenda change request at the March 1999 meeting to consider a proposal to prohibit any CDQ harvest prior to the general fishery. Representatives of processors and non-CDQ fishers contended that CDQ crabs on the market prior to the general fishery would be detrimental to the value of the general fishery. The board directed the CDQ, non-CDQ and processor representatives to reach a compromise, and adopted the compromise into regulation. The new regulations allow a CDQ king or Tanner crab fishery prior to the general fishery only when the GHL is 50 million pounds or more, and a maximum of 30% of the CDQ allocation may be harvested preseason.

The CDQ allocation for 1999 was 5.0% of the total harvest of Bering Sea king and Tanner crabs. Six CDQ groups participated in the Bering Sea snow crab fishery; 23 vessels made 104 deliveries for a total harvest of 9.67 million pounds. Observer coverage was reduced in the CDQ snow crab fishery from one observer per vessel to one per CDQ group. This level of coverage, based on the number of vessels in the 1998 fishery, was considered adequate to obtain biological sampling goals set forth by the department. An objective to have at least one trip on each vessel covered by an observer was not met. An increase in the number of participating vessels, erroneous start dates and non-cooperation on the part of some vessel operators resulted in 13% of the fleet without an observed trip. Two vessels transferred their observer while at sea, in direct violation of their permit conditions. The observer was involved with the decision to make the transfer; therefore, no legal action was taken against the vessel operators. One group slightly exceeded their allocation.

The department changed permitting procedures after the allocation was exceeded in the snow crab fishery for two consecutive years. Permits for CDQ fisheries were previously issued only to vessels fishing for the groups. These permits were issued before the actual allocation was established, and therefore did not reference the CDQ group's harvest allocation. Permits were henceforth to be issued to each CDQ group, initially stating the group allocation percentage and followed by an addendum with the actual allocation in pounds. The vessels were to be issued a permit that referred to the group permit and the associated allocation.

Five CDQ groups participated in the Bristol Bay CDQ red king crab fishery. Although fish tickets indicated that product was delivered to three companies, the information is confidential because one company custom processed for another. Observer coverage remained at one observer per vessel. This level of coverage was under the anticipated level needed to attain the goal one sampling trip on each vessel during the short fishery.

Data obtained from observers deployed during CDQ king crab fisheries indicated no noteworthy difference in fishing strategy as compared to the general fishery. The high discard rate of crabs over four inches observed during the 1998 CDQ snow crab fishery was also observed during the 1999 fishery. Data collected by observers and dockside samplers in the general fishery and by observers during the 1999 CDQ fishery showed no substantial difference in average carapace width of harvested snow crab. Fish ticket data show no appreciable difference in average weight. Observer debriefings and analysis of logbook data from unobserved effort show that the discard of four-inch and larger crab in the CDQ fishery is primarily due to the high occurrence of epibionts. This fishery follows the general fishery; thus fewer marketable crabs are available for harvest.

2000

The CDQ allocation for 2000 was 7.5% of the total harvest of Bristol Bay red king crab and Bering Sea snow crab. The CDQ groups continued to submit fishery plans to the department prior to each fishery. All CDQ fishing activity occurred subsequent to the general fishery. All CDQ vessels participated in the general fishery, and all permit and registration requirements previously stated were still in effect.

Although fish tickets indicated that product was delivered to three companies, the harvest information is confidential because one company custom processed for another for both the Bristol Bay red king crab and Bering Sea snow crab CDQ fisheries.

In 2000 the observer coverage was increased in the CDQ snow crab fishery from one observer per group to two per group. This level of coverage was necessary to obtain the biological sampling goals set forth by the department. Observer coverage remained at one observer per vessel for the Bristol Bay red king crab fishery. Observers continued to collect biological data and documented fishing practices of the CDQ fleet.

2001

The allocation for both the 2001 CDQ Bering Sea snow crab and Bristol Bay red king crab fisheries was 7.5% of the total harvest. All six CDQ groups participated in both fisheries. All CDQ fishing activity occurred subsequent to the general fishery.

Although fish tickets indicated that product was delivered to three companies, the harvest information is confidential because one company custom processed for another for both the Bristol Bay red king crab and Bering Sea snow crab CDQ fisheries.

Observer coverage in the 2001 CDQ snow crab fishery was two for each group, the same as in the 2000 fishery. This compares to one observer per group in 1999 and to one observer per vessel in 1998. This level of coverage allowed for all trips to be observed. During the 2001 CDQ Bristol Bay red king crab fishery, only one observer was required per group. In previous years, all CDQ vessels for this fishery were required to carry on board observers. With this level of coverage, four vessels were without an observer. During both fisheries, observers collected biological data, provided inseason harvest rates to the department, and documented fishing practices of the CDQ fleet.

2002

Bering Sea CDQ Snow Crab Fishery

The 2002 Bering Sea CDQ snow crab fishery occurred subsequent to the general snow crab fishery. The 2002 CDQ allocation was 7.5 percent of the total snow crab commercial harvest. Based on inseason processor reports and hailed weights for the general fishery, the CDQ allocation was 2,458,565 pounds. All six CDQ groups participated in the fishery. The percent allocated to each group ranged from 10-19%. Percentages allocated to each group are determined by a percentage set forth for these CDQ groups by the Alaska Department of Community and Economic Development.

Eleven vessels participated in the fishery. Data from fish tickets show that those vessels made 33 deliveries for a harvest of 2,399,716 pounds including deadloss, approximately 98% of the allocation. One group exceeded their allocation.

Permits were issued to each CDQ group prior to the closure of the general fishery on February 8. The permit stated the group's allocation, listed the vessel(s) requested by the group and authorized by ADF&G to participate in the fishery, and stated that those vessels must comply with requirements such as dates of operation, pot limits, buoy tags, and observer coverage. Vessel registration could begin noon February 11, 72 hours after the closure of the general fishery. CDQ groups were notified of their preliminary allocation February 11. The 72-hour delay allows the department sufficient time to obtain harvest estimates from the general fishery and announce the initial allocation for each CDQ group. Final allocations were announced February 25. During the fishery, five of the groups received amended allocations resulting from poundage transfers. Three groups requested to transfer part of their allocation to two other groups. Reasons for these transfers include a group being unable to harvest their entire allocation prior to the end of the season or vessels not fishing to the end of the season. Transfers were approved through the Alaska Department of Community and Economic Development.

The first vessel registered on February 15 and the last on April 24. Deliveries began March 1 with the final delivery made June 5. The biological closure for the 2002 season was May 15. ADF&G received a request from one group to extend the season by two weeks. The group claimed that due to poor weather and sea ice conditions at the beginning of the CDQ fishery, and the fact that they were fishing with one vessel, they would not be able to harvest their allocation prior to May 15. ADF&G approved the request to extend the season to midnight, May 31; however, if department observers began to notice a high proportion of molting crabs or the numbers of molting crab increased significantly, the season could have closed prior to May 31.

Average exvessel price per pound in the 2002 CDQ snow crab fishery was $1.33 (Table 2-42), less than the general fishery where the price per pound was $1.49. The fishery value to the fleet was approximately $3.1 million, and the estimated value to the CDQ groups was 20-30% of the CDQ fleet fishery value.

The average number of legal male crab per pot pull (catch per unit effort or CPUE) was 99, higher than the CPUE of 76 for the general fishery, but was consistent with the 2001 CDQ fishery which had a CPUE of 98. The average soak time during the CDQ fishery was 51 hours compared to a soak time of 38 hours during the general fishery, which probably accounts for the higher CPUE. Average weight of crabs in the CDQ fishery was 1.3 pounds, the same as the general fishery. Catches were landed at three shorebased processors, located in Dutch harbor, Akutan, and St. Paul. No floater-processors operated during the CDQ fishery.

Observer coverage in the 2002 fishery was two for each group, the same coverage employed since 2000. With this level of coverage, all but one vessel had continuous observer coverage. One group utilized 3 vessels. One of these vessels which was carrying an observer dropped out of the fishery, and that observer transferred to the group's third vessel. Observers collected biological data, provided inseason harvest rates to the department, and documented fishing practices of the CDQ fleet. This season, observers on six of the vessels were instructed to take brailer weights instead of biological data during the offload. Brailer data from one vessel recorded 446 pounds of crab over what the fish ticket reflected, and data from a second vessel recorded 2,204 pounds of crab less than what the fish ticket reflected; however that could have been due to a missed brailer. There were no significant weight differences from the other vessels where only brailer weights were taken.

Saint Matthew Island Section CDQ Blue King Crab Fishery

No CDQ harvest of Saint Matthew Island Section blue king crab occurred in 2002 due to closure of the commercial fishery.

Pribilof District CDQ Red And Blue King Crab Fishery

No CDQ harvest of Pribilof District red or blue king crab occurred in 2002 due to closure of the commercial fishery.

Bristol Bay CDQ Red King Crab Fishery

The 2002 Bristol Bay CDQ red king crab fishery allocation based on inseason processor reports and hailed weights from the general fishery, was 714,239 pounds. All six CDQ groups participated in this fishery. Overall harvest and value for this fishery is confidential because only two processors purchased the CDQ harvest.

Permits were issued to each CDQ group prior to the closure of the general fishery on October 18. The permit stated the group's preliminary allocation, which is determined by a percentage set forth for each CDQ group by the Alaska Department of Community and Economic Development. The permit listed the vessel(s) requested by the group and authorized by ADF&G to participate in the fishery, and stated that those vessels must comply with requirements such as dates of operation, pot limits, buoy tags, and observer coverage. Vessel registration could begin at 12:00 noon October 21, 72 hours after closure of the general fishery. Four vessels registered on October 21, four registered October 22, two of which were registered in Akutan; one registered October 24, and the last vessel registered October 29. The final fishery allocations were announced October 25. Deliveries began October 27, and the final delivery was made November 7. All CDQ groups were under their allocation.

The average number of legal male crab per pot pull (CPUE) was 30, higher than the CPUE of 22 for the general fishery, but similar to the 2001 CDQ fishery which had a CPUE of 29. The average soak time during the CDQ fishery was 57 hours compared to a soak time of 21 hours during the general fishery. This probably accounts for the higher CPUE. Average weights of crabs in the CDQ fishery was 6.7 pounds, compared to an average weight of 6.4 for the general fishery. Two of the groups used three vessels to harvest their allocation and the remaining four groups used one vessel each.

Prior to 2001, all CDQ vessels for this fishery were required to carry onboard observers. During the 2001 and 2002 seasons, only one observer was required per CDQ group. Based on this coverage, four vessels were without observer coverage. During the fishery observers collected biological data, provided inseason harvest rates to the department, and documented fishing practices of the CDQ fleet.

Bering Sea CDQ Tanner Crab Fishery

No CDQ harvest of Tanner crab occurred during 2002 due to closure of the commercial fishery.

BERING SEA KING AND TANNER CRAB BUOY IDENTIFICATION PROGRAM

Introduction and Background

Early 1990s Bering Sea and Aleutian Islands (BSAI) crab fisheries were characterized by increased fishing effort, decreased guideline harvest levels (GHL), and shorter fishing seasons than prior years. In response to these changes, the BSAI crab industry submitted a petition regarding pot limits to the BOF. The petition was supported by data from the ADF&G indicating impaired conservation and management during low GHL fisheries due in part to the amount of gear fishing on the grounds. On March 20, 1991 the BOF proposed an agenda change request regarding this issue and subsequently adopted BSAI pot limit regulations. Effective August 1, 1992 these regulations limited the number of pots a vessel may operate while harvesting BSAI king *Paralithodes* and *Lithodes*, and Tanner *Chionoecetes* crabs. The buoy identification program was created to help implement these regulations and as per Alaska State statute designed to be completely self-supportive by generating funds.

Buoy identification stickers were first implemented during 1992 Bristol Bay red king crab *P. camtschaticus* season, but were temporarily suspended due to product failure. Pot limit requirements for Bering Sea Tanner crab fisheries remained in effect until repealed by National Marine Fisheries Services on November 30, 1992. According to the Fishery Management Plan for Bering Sea /Aleutian Island King and Tanner Crab, pot limit regulation is a category II measure (NPFMC 1998b). Category II measures may be adopted at the state level but are subject to the federal appeal process and must adhere to national standards requiring regulation application to be nondiscriminatory. Consequently, in February 1993 BOF passed differential pot limit regulations. Each fishery has specific pot limits based on vessel overall length (OL) (Table 2-43). Vessels in excess of 125 feet OL are entitled to operate the maximum number of pots allowed for a fishery, and vessels 125 feet or less in OL may fish 80% of the maximum pot limit. Further differential pot limit regulations for the Bristol Bay red king crab fishery were adopted on an interim basis August 27, 1997. The regulations created an 11-tier pot limit system dependent on fishery GHL and anticipated fleet size. The tiered system was made permanent March 1999.

Implementation

Beginning with 1992-1993 Bristol Bay king and Bering Sea Tanner crab seasons, ADF&G leased additional office space and employed a Fish and Wildlife Technician III to administer the buoy identification program. Regulations providing implementation of the buoy identification program are stated in Alaska Statute 16.05.050. POWERS AND DUTIES OF THE COMMISSIONER and Alaska Statute 16.05.632. IDENTIFICATION OF SHELLFISH POTS OR BUOYS, OR BOTH, USED IN THE TAKING OF KING CRAB AND REQUIREMENTS FOR BUOYS.

By May 1993 heavy-duty, self-locking, nylon, zip tie tags had taken the place of buoy stickers. After use in several fisheries, numerous quality control problems and industry complaints prompted ADF&G to initiate trial tests of other manufactured tags. Eventually, a new style buoy tag was procured which required an independent means of attachment. The Alaska Department of Fish and Game initially supplied zip ties for tag attachment at no additional charge, but dispersal was discontinued due to high failure rates. Consequently, industry is now responsible for tag attachment. The new tags were first issued in September 1998 and continue to be used.

Replacement Tags

Buoy tag replacement issues were resolved during the initial BOF meeting regarding pot limits. Regulations were written based on concerns from the Division of Fish and Wildlife Protection regarding prosecution of cases involving replacement tags. Specifics regarding replacement tag sales are included in 5 AAC 34.826. (b) KING CRAB POT MARKING REQUIREMENTS FOR REGISTRATION AREA T, 5 AAC 34.926. (b) KING CRAB POT MARKING REQUIREMENTS FOR REGISTRATION AREA Q, and 5 AAC 35.526. (b) TANNER CRAB POT MARKING REQUIREMENTS FOR REGISTRATION AREA J.

Between the 1994 Bristol Bay red king crab and Bering Sea Tanner crab fisheries, and prior to 1995 snow crab *C. opilio* season, the Dutch Harbor ADF&G office received input from fishers concerned with tag replacement regulations. At the time, vessels delivering to remote areas such as King Cove or Saint Paul were unable to obtain replacement tags without travel to Dutch Harbor. Some vessel operators felt the cost of travelling to Dutch Harbor with three crewmembers was prohibitive to obtaining replacement tags and would promote illegal fishing.

During 1998-1999 seasons, stakeholders reiterated buoy tag replacement issues. In response to these concerns ADF&G began allowing permit holders to file an official affidavit in Saint Paul or King Cove, however ADF&G personnel must be available for verification. This change was implemented prior to 2000 Bering Sea snow crab fishery.

Buoy Identification Tag Refunds

Since the inception of the tag program, refunds for buoy tags have not been offered because the $2.00 fee per tag covers administrative and program implementation costs. However, during the 2001 Bering Sea snow crab fishery, two buoy tag refunds were issued as per 15 AAC 116.120. REFUND OF LICENSE FEES.

Requests for buoy identification tag refunds may be procured only through ADF&G Headquarters in Juneau. To request a refund, the following information must be sent by the tag administrator to administrative staff in Kodiak: name, address, and social security number of the permit holder, vessel name and ADF&G number, a copy of the check used for original payment, number of tags purchased/returned, the imprinted sequential tag numbers, return date of unused, complete set of tags and person who received the tags, budget code for refunding, and a statement from the permit holder explaining the refund request All refund requests are out of the tag program administrator's jurisdiction and will be evaluated by ADF&G Headquarters in Juneau.

Vessel Length Verification

The tiered pot limit regulations are based in part on vessel OAL. These measurements are outlined in 5 AAC 34.825 (j) LAWFUL GEAR FOR REGISTRATION AREA T and 5 AAC 35.525 (f) LAWFUL GEAR FOR REGISTRATION AREA J. In order to obtain the maximum number of buoy tags allotted per fishery all vessels with OL in excess of 125 feet must present valid, original or notarized, U.S. Coast Guard or certified marine surveyor documentation, showing the vessel's OL. The permit holder is required to show OL documentation the first time buoy tags are purchased, and when any change in vessel OL occurs. The ADF&G office in Dutch Harbor has an established list of 98 vessels with documented OL in excess of 125 feet.

Administration of the Buoy Identification Program

Bering Sea buoy tags are issued from the ADF&G offices in Kodiak and Dutch Harbor for an administrative fee of $2.00 per tag. Tags are issued to the holder of a valid, fishery specific, Commercial Fisheries Entry Commission interim use permit card. An authorized agent may be issued tags if an affidavit is signed by the permit holder and filed with ADF&G in Dutch Harbor. Also upon request, ADF&G Dutch Harbor office will send buoy tags through the U.S. Mail, via priority mail with insurance and return receipt. Due to potential weather delayed mail service, the deadline for mail request is generally two to three weeks prior to the opening of each fishery. The deadline is announced in fishery specific news releases regarding pot limits.

2002 Buoy Tag Sales

Several of the Bering Sea crab fisheries were not opened due to low stock levels. The Pribilof Island red king and blue king crab *P. platypus*, Saint Matthew Island blue king crab, and Bering Sea Tanner crab *C. bairdi* fisheries were closed in 2002. Tags for these fisheries are stored in Dutch Harbor ready for issue when needed (Table 2-44).

The department purchased 62,500 tags for the 2002 Bering Sea snow crab fishery. Tag sales for this fishery are as follows: from Dutch Harbor 147 vessels purchased 29,639 tags (25 were mail requests) and in Kodiak 45 vessels purchased 8,394 tags. One hundred ninety two vessels purchased 38,033 tags and 36 replacement tags were issued for 38,069 total tags. Eleven vessels purchased 2,235 tags for the 2002 Bering Sea snow crab CDQ fishery. No replacement tags were issued.

Nine vessels purchased tags for 2002 Pribilof District golden king crab *L. aequispinus* fishery, 320 tags were sold and 7 replacements issued, for a total of 327 tags. There was no fishing effort in 2002 for either the Northern District, Saint Matthew Island Section golden king crab fishery or South Peninsula grooved Tanner *C. tanneri* crab.

There were no tags procured for the 2002 Bristol Bay red king crab, the department used inventory tags. Tag sales for this fishery are as follows: from Dutch Harbor 191 vessels purchased 20,705 tags (26 were mail requests), in Kodiak 51 vessels purchased 5,205 tags, plus one replacement tag issued. Two hundred forty two vessels purchased 25,910 tags and 103 replacement tags were issued for 6,013 total tags. Ten vessels purchased 1,088 tags for the 2002 Bristol Bay red king crab Community Development Quota (CDQ) fishery. No replacement tags were issued.

On October 25, 2002, the Petrel Bank portion of Area O was open to commercial harvest of red king crab. Inventory tags were used for this fishery. No more than 1,250 total pots may be used during this fishery. Therefore, based on a preseason registration number of 35, pot limits were designated as 33 pots for vessels less than or equal to 125 feet in OL and 42 pots for vessels over 125 feet in OL. Thirty-three vessels purchased 1,179 tags and one replacement tag was issued.

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Table 2-1. Bristol Bay commercial red king crab harvest data, 1966-2002.

	Number of				Number of Pots			
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Registered	Pulled	CPUE[c]	Deadloss[b]
1966	9	15	140,554	997,321		2,720	52	
1967	20	61	397,307	3,102,443		10,621	37	
1968	59	261	1,278,592	8,686,546		47,496	27	
1969	65	377	1,749,022	10,403,283		98,426	18	
1970	51	309	1,682,591	8,559,178		96,658	17	
1971	52	394	2,404,681	12,955,776		118,522	20	
1972	64	611	3,994,356	21,744,924		205,045	19	
1973	67	441	4,825,963	26,913,636		194,095	25	N/A
1974	104	605	7,710,317	42,266,274		212,915	36	N/A
1975	102	592	8,745,294	51,326,259		205,096	43	1,639,483
1976	141	984	10,603,367	63,919,728		321,010	33	875,327
1977	130	1,020	11,733,101	69,967,868		451,273	26	730,279
1978	162	926	14,745,709	87,618,320		406,165	36	1,273,037
1979	236	889	16,808,605	107,828,057		315,226	53	3,555,891
1980	236	1,251	20,845,350	129,948,463	78,352	567,292	37	1,858,668
1981	177	1,026	5,307,947	33,591,368	75,756	542,250	10	711,289
1982	90	255	541,006	3,001,210	36,166	141,656	4	95,834
1983				FISHERY CLOSED				
1984	89	137	794,040	4,182,406	21,762	112,556	7	35,601
1985	128	130	796,181	4,174,953	30,117	85,003	9	6,436
1986	159	230	2,099,576	11,393,934	32,468	178,370	12	284,127
1987	236	311	2,122,402	12,289,067	63,000	220,871	10	120,388
1988	200	201	1,236,131	7,387,795	50,099	153,004	8	23,537
1989	211	287	1,684,706	10,264,791	55,000	208,684	8	81,334

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Table 2-1. (Page 2 of 2)

	Number of				Number of Pots			
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Registered	Pulled	CPUE[c]	Deadloss[b]
1990	240	331	3,120,326	20,362,342	69,906	262,131	12	116,527
1991	302	324	2,630,446	17,177,894	89,068	227,555	12	119,670
1992	281	289	1,196,958	8,043,018	68,189	205,940	6	9,000
1993	292	361	2,261,287	14,628,639	58,881	253,794	9	133,442
1994				FISHERY CLOSED				
1995				FISHERY CLOSED				
1996	196	198	1,249,005	8,405,614	39,461	76,433	16	24,166
1997	256	265	1,315,969	8,756,490	27,499	90,510	15	13,771
1998	274	284	2,140,607	14,233,063	56,420	141,707	15	53,716
1999	257	268	1,812,403	11,090,930	42,403	146,997	12	44,132
2000	246	256	1,166,796	7,546,145	26,352	98,694	12	76,283
2001	230	238	1,196,040	7,786,420	24,571	63,242	19	57,294
2002	242	254	1,377,922	8,856,828	25,833	68,328	20	32,177

[a] General fishery only. Deadloss included.
[b] In pounds.
[c] Number of legal crab retained per pot pull.

Table 2-2. Bristol Bay commercial red king crab economic performance data, 1980-2002.

Year	GHL[a]	Value		Season Length	
		Exvessel	Total[b]	Days	Dates
1980	70-120	$0.90	$115.3	40	09/10-10/20
1981	70-100	$1.50	$49.3	91	09/10-12/15
1982	10-20[c]	$3.05	$8.9	30	09/10-10/10
1983		FISHERY CLOSED			
1984	2.5- 6.0	$2.60	$10.8	15	10/01-10/16
1985	3.0-5.0	$2.90	$12.1	8	09/25-10/02
1986	6.0-13.0	$4.05	$45.0	13	09/25-10/07
1987	8.5-17.7	$4.00	$48.7	12	09/25-10/06
1988	7.5	$5.10	$37.6	8	09/25-10/02
1989	16.5	$5.00	$50.9	12	09/25-10/06
1990	17.1	$5.00	$101.2	12	11/01-11/13
1991	18	$3.00	$51.2	7	11/01-11-08
1992	10.3	$5.00	$40.2	7	11/01-11/08
1993	16.8	$3.80	$55.1	9	11/01-11/10
1994		FISHERY CLOSED			
1995		FISHERY CLOSED			
1996	5	$4.01	$33.6	4	11/01-11/05
1997	7	$3.26	$28.5	4	11/01-11/05
1998	15.8	$2.64	$37.4	5	11/01-11/06
1999	10.1	$6.26	$69.1	5	10/15-10/20
2000	7.7	$4.81	$36.0	4	10/16-10/20[d]
2001	6.6	$4.81	$37.5	3.3	10/15-10/18
2002	8.6	$6.14	$54.2	2.8	10/15-10/18

[a] General fishery only. In millions of pounds.
[b] Millions of dollars.
[c] Inseason revision to 4.7 million pounds.
[d] Delayed start due to weather.

Table 2-3. 2002 Bristol Bay commercial red king crab inseason catch and effort projections for the non-AFA fleet based on 12-hour reports to ADF&G.

October Date	Report Hour	Potlifts	Catch[a, b]	Cummulative Catch[a, b]	Number of Crabs	CPUE[c]	Number of vessels reporting
16	12	2,774	193,754	193,754	29,808	11	66
16	24	15,429	2,011,214	2,204,968	309,418	20	69
17	36	9,521	1,087,047	3,292,015	167,238	18	53
17	48	12,448	1,798,045	5,090,060	276,622	22	58
18	60	16,330	2,095,251	7,185,312	322,346	20	30
18	72	11,193	1,292,053	8,477,364	198,777	17	9
Total		67,694	8,477,364	8,477,364	1,304,210	19	

[a] In pounds.
[b] Based on 6.5 pound average weight.
[c] Number of legal crab retained per pot pull.

Table 2-4. 2002 Bristol Bay commercial red king crab catch and effort projections for the AFA fleet, based on inseason vessel reports to the AFA fleet manager.

October Date	Report Hour	Potlifts	Catch[a, b]	Cummulative Catch[a, b]	Number of Crabs	CPUE[c]	Percentage of cap harvested
16	6	912	115,694	115,694	17,799	20	12.3
16	12	1,092	185,777	301,470	28,581	26	32.1
17	18	719	135,447	436,917	20,838	29	46.5
17	24	595	106,659	543,576	16,409	28	57.8
17	30	1,121	181,935	725,511	27,990	25	77.6
Total[d]		4,439	725,511	578,689	111,617	25	77.6

[a] In pounds.
[b] Based on 6.5 pound average weight.
[c] Number of legal crab retained per pot pull.
[d] "Olympic" portion of AFA fishery only.

Table 2-5. Bristol Bay commercial red king crab catch by statistical area, 2002.

Statistical	Number of			Pots	Average		
Area	Landings	Crab[a]	Harvest[a,b]	Lifted	CPUE[c]	Weight[b]	Deadloss[b]
615601	3	22,968	150,935	780	29	6.6	1,441
615630	35	182,305	1,154,843	7,439	25	6.3	6,633
615700	4	4,279	27,583	315	14	6.4	36
625600	70	279,408	1,784,704	13,200	21	6.4	2,688
625630	95	365,384	2,328,374	17,964	20	6.4	11,235
635530	7	10,974	69,020	694	16	6.3	47
635600	87	316,516	2,074,697	17,122	18	6.6	4,950
635630	60	167,323	1,082,296	9,194	18	6.5	4,815
645600	4	3,139	21,651	219	14	6.9	0
Other[d]	6	25,626	162,725	1,401	18	6.3	332
Total	371	1,377,922	8,856,828	68,328	20	6.4	32,177

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crab retained per pot pull.
[d] Combination of statistical areas from which less than three vessels made landings.

Table 2-6. Bristol Bay commercial red king crab harvest composition by fishing season, 1973-2002.

Season	Percent Recruit	Percent Postrecruit[a]	Size Limit[b]	Average Weight (pounds)	Average Length (mm)	% Old Shell
1973	63	37	6¼	5.6		
1974	60	40	6¼	5.5		
1975	21	79	6¼[c]	5.7		
1976	56	44	6½	6.0	148	27.4
1977	67	33	6½	5.9	148	13.0
1978	75	25	6½	5.9	147	6.9
1979	47	53	6½	6.4	152	10.4
1980	44	56	6½	6.2	151	11.0
1981	14	86	6½[d]	6.3	151	47.4
1982	68	32	6½	5.5	145	24.6
1983		FISHERY CLOSED				
1984	59	41	6½	5.2	142	26.5
1985	66	34	6½	5.2	142	25.8
1986	65	35	6½	5.4	142	25.5
1987	77	23	6½	5.8	145	19.0
1988	59	41	6½	6.0	147	15.1
1989	58	42	6½	6.1	148	17.7
1990	49	51	6½	6.5	152	14.7
1991	44	56	6½	6.5	152	12.1
1992	33	67	6½	6.7	153	22.3
1993	33	67	6½	6.5	152	15.2
1994		FISHERY CLOSED				
1995		FISHERY CLOSED				
1996	31	69	6½	6.7	153	24.3
1997	28	72	6½	6.7	152	11.0
1998	40	60	6½	6.7	152	19.1
1999	72	28	6½	6.1	148	6.3
2000	65	35	6½	6.5	151	16.3
2001	54	46	6½	6.5	151	22.3
2002	61	39	6½	6.4	151	22.2

[a] Legal sized old and new shell greater than 153mm carapace length defined as postrecruits.
[b] Minimum carapace width in inches.
[c] 6½ inches after 11/01.
[d] 7 inches after 10/20

Table 2-7. Bristol Bay red king crab cost-recovery harvest data, 1990-2002.

	Number of			Number of	Average		
Year[a]	Landings	Crabs[b]	Harvest[b,c]	Pots Pulled	CPUE[d]	Weight[c]	Deadloss[c]
1990	3	9,567	80,701	870	16	5.9	24,540
1991	2	30,351	205,851	518	62	6.4	12,817
1992	1	11,213	74,089	670	17	6.3	3,000
1993	1	8,384	53,200	464	18	6.3	800
1994	1	14,806	93,336	732	21	6.0	4,500
1995	2	14,123	80,158	564	26	5.5	2,339
1996	3	15,390	107,955	355	44	6.9	1,918
1997	4	21,698	154,739	658	37	6.3	18,040
1998	2	22,230	188,176	738	36	7.0	32,564
1999	2	12,438	79,765	698	18	6.4	165
1999[e]	2	16,930	106,179	541	31	6.3	245
2000[f]	2	14,196	86,218	702	20	6.1	347
2001[e]	3	17,605	120,435	597	29	6.8	138
2002[e]	2	14,528	96,221	277	52	6.6	181

[a] All cost recovery from 1990-1998 was conducted to fund the Bering Sea and Aleutian Islands shellfish research program.
[b] Deadloss included.
[c] In pounds.
[d] Number of legal crab retained per pot pull.
[e] Bering Sea and Aleutian Islands shellfish research and observer program cost recovery.
[f] Bering Sea and Aleutian Islands shellfish research program cost recovery.

Table 2-8. Bristol Bay red king crab cost-recovery economic performance data, 1990-2002.

Year[a]	Harvest[b]	Value		Charter dates	Total charter length[c]
		Exvessel	Total		
1990	56,161	$5.10	286.4	8/7-9/7	30
1991	193,034	$3.75	723.9	9/2-10/7	35
1992	71,089	$5.24	372.5	10/8-10/23	15
1993	52,400	$6.57	344.3	8/20-9/20	31
1994	88,836	$5.21	462.8	9/25-10/25	30
1995	77,819	$6.65	517.5	8/1-8/31	31
1996	106,037	$4.53	480.4	8/1-8/31	31
1997	136,699	$3.55	485.2	7/25-8/21	28
1998	155,612	$3.25	505.7	8/1-8/28	28
1999	79,600	$6.02	478.8	9/25-10/11	17
1999[d]	105,934	$6.32	669.5	9/25-10/11,10/25-11/10	34
2000[e]	85,871	$5.82	499.8	9/20-10/04	15
2001[d]	120,297	$5.18	623.1	9/22-10/10, 10/23-11/8	36
2002[d]	96,040	$6.45	619.5	9/23-10/9, 10/17-10/27	27

[a] All cost recovery from 1990-1998 was conducted to fund the Bering Sea and Aleutian Islands shellfish research program.
[b] Deadloss not included. In pounds.
[c] In days.
[d] Bering Sea and Aleutian Islands shellfish research and observer program cost recovery.
[e] Bering Sea and Aleutian Islands shellfish research program cost recovery.

Table 2-9. Pribilof District commercial red and blue king crab catch statistics, 1973/74 - 2002.

	Number of			Harvest[b]	Number of Pots			Average		
Year[a]	Vessels	Landings	Crabs[b]	(pounds)	Registered	Pulled	CPUE[c]	Weight (pounds)	Length[d] (mm)	Deadloss (pounds)
1973/74	8	13	174,420	1,276,533		6,814	26	7.3	N/A	0
1974/75	70	101	908,072	7,107,294		45,518	20	7.8	157.8	0
1975/76	20	54	314,931	2,433,714		16,297	19	7.7	159.1	0
1976/77	47	113	855,505	6,611,084		71,738	12	7.7	158.1	0
1977/78	34	104	807,092	6,456,738		106,983	8	7.9	158.9	159,269
1978/79	58	154	797,364	6,395,512		101,117	8	8.1	159.3	63,140
1979/80	46	115	815,557	5,995,231		83,527	10	7.7	155.9	284,555
1980/81	110	258	1,497,101	10,970,346	31,636	167,684	9	7.3	155.7	287,285
1981/82	99	312	1,202,499	9,080,729	25,408	176,168	7	7.6	158.2	250,699
1982/83	122	281	587,908	4,405,353	34,429	127,728	5	7.5	159.8	51,703
1983/84	126	221	276,364	2,193,395	36,439	86,428	3	7.9	159.9	4,562
1984/85	16	25	40,427	306,699	3,122	15,147	3	7.6	155.5	0
1985/86	26	49	77,607	532,735	6,038	23,483	3	6.9	146.5	7,500
1986/87	16	25	36,988	258,939	4,376	15,800	2	7.0	N/A	5,450
1987/88	38	68	95,131	701,337	9,594	40,507	2	7.4	152.7	9,910
1988/89-92/93					F I S H E R Y	CLOSED				
1993[f]	112	135	380,217	2,607,634	4,860	35,942	11	6.9	154.4	0
1994[f]	104	121	167,520	1,338,953	4,675	28,976	6	8.0	162.1	2,929
1995[f]	117	151	107,521	871,173		33,531	3	8.1	162.5	15,316
1995[g]	119	152	172,987	1,267,454		34,721	5	7.3	N/A	46,263
1995[h]	127	162	280,508	2,138,627	5,400	37,643	8	NA		61,579
1996[f]	66	90	25,383	200,304		29,425	<1	7.9	161.0	319
1996[g]	66	92	127,676	937,032		30,607	4	7.3	153.1	14,997
1996[h]	66	92	153,059	1,137,336	2,730	30,607	3	7.4		15,316

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Table 2-9. (Page 2 of 2)

Year[a]	Number of Vessels	Landings	Crabs[b]	Harvest[b] (pounds)	Number of Pots Registered	Pulled	CPUE[c]	Average Weight (pounds)	Length[d] (mm)	Deadloss (pounds)
1997[f]	53	110	90,641	756,818		28,458	3	8.4	164.3	18,807
1997[g]	51	105	68,603	512,374		27,652	3	7.5	163.6	16,747
1997[h]	53	110	159,244	1,269,192	2,230	30,400	5	8.0		35,554
1998[f]	57	84	68,129	510,365		23,381	3	7.5	158.8	8,703
1998[g]	57	83	68,513	516,996		22,965	3	7.5	156.1	22,289
1998[h]	57	84	136,642	1,027,361	2,398	23,381	3	7.5		30,992
1999-2002					F I S H E R Y	CLOSED				

[a] Blue king crab, 1973 - 1988.
[b] Deadloss included.
[c] Number of legal crabs retained per pot pull.
[d] Carapace length.
[f] Red king crab.
[g] Blue king crab.
[h] Blue and red king crab fisheries combined.

Table 2-10. Guideline harvest level (GHL), economic performance and season length summary of the commercial red and blue king crab fishery, in the Pribilof District, 1980/81 - 2002.

		Value		Season Length	
Year[a]	GHL[b]	Exvessel	Total[c]	Days	Dates
1980/81	5.0-8.0	$0.90	$9.6	60	09/15-11/15
1981/82	5.0-8.0	$1.50	$13.6	47	09/10-10/28
1982/83	5.0-8.0	$3.05	$13.4	15	09/10-09/25
1983/84	4.0[d]	$3.00	$6.6	10	09/01-09/11
1984/85	0.5-1.0	$2.50	$0.1	15	09/01-09/16
1985/86	0.3-0.8	$2.90	$1.4	26	09/25-10/21
1986/87	0.3-0.8	$4.05	$1.2	55	09/25-11/20
1987/88	0.3-1.7	$4.00	$2.8	86	09/25-12/20
1988/89-92/93		FISHERY CLOSED			
1993[e]	3.4	$4.98	$13.0	6	09/15-09/21
1994[e]	2.0[d]	$6.45	$8.6	6	09/15-09/21
1995[e]	2.5[g]	$3.37	$2.9	7	09/15-09/22
1995[f]	2.5[g]	$2.92	$3.9	7	09/15-09/22
1996[e]	1.8[g]	$2.76	$0.6	11	09/15-09/26
1996[f]	1.8[g]	$2.65	$2.4	11	09/15-09/26
1997[e]	1.5[g]	$3.09	$2.3	14	09/15-09/29
1997[f]	1.5[g]	$2.82	$1.4	14	09/15-09/29
1998[e]	1.25[g,h]	$2.39	$1.2	13	09/15-09/28
1998[f]	1.25[g,h]	$2.34	$1.2	13	09/15-09/28
1999-2002		FISHERY CLOSED			

[a] Blue king crab, 1980-1988.
[b] Guideline harvest level, millions of pounds.
[c] Millions of dollars.
[d] Set not to exceed.
[e] Red king crab.
[f] Blue king crab.
[g] Combined red and blue king crab.
[h] General fishery only.

Table 2-11. Commercial harvest of blue king crabs in the St. Matthew Island Section, 1977-2002.

	Number of			Harvest[a]	Number of Pots		CPUE[b]	Percent	Average		Deadloss
Year	Vessels	Landings	Crabs[a]	(pounds)	Registered	Pulled		Recruits	Weight (pounds)	Length[c] (mm)	(pounds)
1977	10	24	281,665	1,202,066		17,370	16	7	4.3	130.4	129,148
1978	22	70	436,126	1,984,251		43,754	10	N/A	4.5	132.2	116,037
1979	18	25	52,966	210,819		9,877	5	81	4	128.8	128.8
1980					CONFIDENTIAL						
1981	31	119	1,045,619	4,627,761		58,550	18	N/A	4.4	N/A	53,355
1982	96	269	1,935,886	8,844,789		165,618	12	20	4.6	135.1	142,973
1983	164	235	1,931,990	9,454,323	38,000	133,944	14	27	4.8	137.2	828,994
1984	90	169	841,017	3,764,592	14,800	73,320	11	34	4.5	135.5	31,983
1985	79	103	484,836	2,427,110	13,000	51,606	9	9	5	139	2,613
1986	38	43	219,548	1,003,162	5,600	22,093	10	10	4.6	134.3	32,560
1987	61	62	234,521	1,075,179	9,370	28,440	8	5	4.6	134.1	400
1988	46	46	302,053	1,325,185	7,780	10,160	30	65	4.4	133.3	22,358
1989	69	69	247,641	1,166,258	11,983	30,853	8	9	4.7	134.6	3,754
1990	31	38	391,405	1,725,349	6,000	26,264	15	4	4.4	134.3	17,416
1991	68	69	726,519	3,372,066	13,100	37,104	20	12	4.6	134.1	216,459
1992	174	179	544,956	2,474,080	17,400	56,630	10	9	4.6	134.1	0
1993	92	136	629,874	2,999,921	5,895	58,647	11	6	4.8	135.4	0
1994	87	133	827,015	3,764,262	5,685	60,860	14	60	4.6	133.3	46,699
1995	90	111	666,905	3,166,093	5,970	48,560	14	45	4.8	135	90,191
1996	122	189	661,115	3,080,916	8,010	91,205	7	47	4.7	134.6	36,892
1997	117	166	939,822	4,649,660	7,650	81,117	12	31	4.9	139.5	209,490
1998	131	255	612,346	2,868,965	8,561	89,500	7	46	4.7	135.8	14,417
1999-2002					FISHERY CLOSED						

[a] Deadloss included.
[b] Number of legal crabs retained per pot pull.
[c] Carapace length.

Table 2-12. Guideline harvest level (GHL), economic performance and season length summary of the commercial blue king crab fishery in the St. Matthew Island Section, 1983 - 2002.

Year	GHL[a]	Value		Season Length	
		Exvessel	Total[b]	Days	Dates
1983	8	$3.00	$25.80	17	08/20-09/06
1984	2.0-4.0	$1.75	$6.50	7	09/01-09/08
1985	0.9-1.9	$1.60	$3.80	5	09/01-09/06
1986	0.2-0.5	$3.20	$3.20	5	09/01-09/06
1987	0.6-1.3	$2.85	$3.10	4	09/01-09/05
1988	0.7-1.5	$3.10	$4.00	4	09/01-09/05
1989	1.7	$2.90	$3.50	3[c]	09/01-09/04
1990	1.9	$3.35	$5.70	6	09/01-09/07
1991	3.2	$2.80	$9.00	4	09/16-09/20
1992	3.1	$3.00	$7.40	3[c]	09/04-09/07
1993	4.4	$3.23	$9.70	6	09/15-09/21
1994	3.0	$4.00	$15.00	7	09/15-09/22
1995	2.4	$2.32	$7.10	5	09/15-09/20
1996	4.3	$2.20	$6.70	8	09/15-09/23
1997	5.0	$2.21	$9.80	7	09/15-09/22
1998	4.0[d]	$1.87	$5.34	11	09/15-09/26
1999-2002		FISHERY CLOSED			

[a] Guideline harvest level, millions of pounds.
[b] Millions of dollars.
[c] Actual length - 60 hours.
[d] General fishery GHL.

Table 2-13. Guideline harvest level (GHL), inseason harvest projections and actual commercial harvests for the St. Matthew Island Section blue king crab fishery, 1983 – 2002.

Year	Guideline Harvest Levels[a]	Projected Harvest[a,b]	Actual Harvest[a,c]
1983	8.0	8.0	9.5
1984	2.0 - 4.0	4.0	3.8
1985	0.9 - 1.9	2.0	2.4
1986	0.2 - 0.5	1.0	1.0
1987	0.6 - 1.3	1.3	1.1
1988	0.7 - 1.5	1.5	1.3
1989	1.7	1.7	1.2
1990	1.9	1.9	1.7
1991	3.2	3.2	3.4
1992	3.1	3.1	2.5
1993	4.4	4.4	3.0
1994	3.0	3.0	3.8
1995	2.4	2.4	3.2
1996	4.3	4.3	3.1
1997	5.0	5.0	4.6
1998	4.0[d]	2.9	2.9
1999-2002		FISHERY CLOSED	

[a] Millions of pounds.
[b] Based on inseason catch reports.
[c] Deadloss included.
[d] General fishery only.

Table 2-14. Commercial harvest of blue king crabs by season for the St. Matthew Island Section, 1977-2002.

	Date			Minimum	Price per
Season	Opened	Closed	Harvest[a]	Size[b]	Pound
1977	Jun-07	Aug. 16	1,202,066	5 1/2	$1.00
1978	Jul-15	Sept. 3	1,984,251	5 1/2	$0.95
1979	Jul-15	Aug. 24	210,819	5 1/2	$0.70
1980	Jul-15	Sept. 3	CONFIDENTIAL	5 1/2	CONFIDENTIAL
1981	Jul-15	Aug. 21	4,627,761	5 1/2	$0.90
1982	Aug-01	Aug. 16	8,844,789	5 1/2	$2.00
1983[cd]	Aug-20	Sept. 6[c]	9,506,880[d]	5 1/2	$3.00
1984	Aug-01	Sept. 8	3,764,592	5 1/2	$1.75
1985	Sep-01	Sept. 6	2,427,110	5 1/2	$1.60
1986	Sep-01	Sept. 6	1,003,162	5 1/2	$3.20
1987	Sep-01	Sep-05	1,075,179	5 1/2	$2.85
1988	Sep-01	Sep-05	1,325,185	5 1/2	$3.10
1989	Jan-01	Sep-04	1,166,258	5 1/2	$2.90
1990	Sep-01	Sep-07	1,725,349	5 1/2	$3.35
1991	Sep-16	Sep-20	3,372,066	5 1/2	$2.80
1992	Sep-04	Sep-07	2,474,080	5 1/2	$3.00
1993	Sep-15	Sep-21	2,999,921	5 1/2	$3.23
1994	Sep-15	Sep-22	3,764,262	5 1/2	$4.00
1995	Sep-15	Sep-22	3,166,093	5 1/2	$2.32
1996	Sep-15	Sep-16	3,080,916	5 1/2	$2.20
1997	Sep-15	Sep-22	4,649,660	5 1/2	$2.21
1998	Sep-15	Sep-26	2,868,965	5 1/2	$1.87
1999-2002		FISHERY CLOSED			

[a] In pounds, deadloss included.
[b] Carapace width in inches.
[c] Part of Northern District open until September 20.
[d] St. Lawrence Island harvest of 52,557 lbs. included.

Table 2-15. Pribilof District golden king crab fishery data, 1981/82 - 2002 seasons.

Season	Number of Vessels	Number of Landings	Number of Crabs[a]	Harvest[a,b]	Pots lifted	CPUE[c]	Average Weight[b]	Average Length[d]	Deadloss[b]
1981/82	2				CONFIDENTIAL				
1982/83	10	19	15,330	69,970	5,252	3	4.6	151	570
1983/84	50	115	253,162	856,475	26,035	10	3.4	127	20,041
1984					NO LANDINGS				
1985	1				CONFIDENTIAL				
1986	1				CONFIDENTIAL				
1987	1				CONFIDENTIAL				
1988	2				CONFIDENTIAL				
1989	2				CONFIDENTIAL				
1990					NO LANDINGS				
1991	1				CONFIDENTIAL				
1992	1				CONFIDENTIAL				
1993	5	15	17,643	67,458	15,395	1	3.8	NA	0
1994	3	5	21,477	88,985	1,845	12	4.1	NA	730
1995	7	22	82,456	341,700	9,481	9	4.1	NA	716
1996	6	32	91,947	329,009	9,952	9	3.6	NA	3,570
1997	7	23	43,305	179,249	4,673	9	4.1	NA	5,554
1998	3	9	9,205	35,722	1,530	6	3.9	NA	474
1999	3	9	44,098	177,108	2,995	15	4.0	NA	319
2000	7	19	29,145	127,217	5,450	5	4.4	NA	5,288
2001	6	14	33,723	145,876	4,262	8	4.3	143	8,227
2002	8	20	34,639	150,434	5,464	6	4.3	144	8,984

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs retained per pot pull.
[d] Carapace length in millimeters.

Table 2-16. Pribilof District golden king crab fishery economic performance data, 1991-2002 seasons.

	Value		Season Length	
Season	Exvessel[a]	Fishery	Days	Dates
1991	CONFIDENTIAL		365	1/1-12/31
1992	CONFIDENTIAL		365	1/1-12/31
1993	$2.42	$163,248	365	1/1-12/31
1994	$3.81	$336,252	365	1/1-12/31
1995	$3.12	$1,056,900	365	1/1-12/31
1996	$2.02	$639,532	365	1/1-12/31
1997	$2.23	$387,340	365	1/1-12/31
1998	$2.06	$72,611	365	1/1-12/31
1999	$2.34	$413,686	162	1/1-6/10
2000	$3.22	$392,436	365	1/1-12/31
2001	$3.12	$429,464	105	1/1-4/15
2002	$3.10	$438,495	134	1/1-5/14

[a] Price per pound.

Table 2-17. Pribilof District golden king crab catch by statistical area, 2002.

Statistical area	Number of Landings	Number of Crab[a]	Harvest[a,b]	Pots lifted	Average CPUE[c]	Average Weight[b]	Deadloss[b]
685530	3	3	14	51	0	4.7	0
685600	3	86	390	97	1	4.5	25
695530	5	829	3,658	71	12	4.4	50
695600	20	29,038	125,815	4,866	6	4.3	8,477
705530	6	4,673	20,498	369	13	4.4	432
705600			CONFIDENTIAL				
TOTALS	37	34,629	150,375	5,454	6	4.3	8,984

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crab retained per pot pull.

Table 2-18. Saint Matthew Island Section golden king crab fishery data, 1982/83 - 2002 seasons.

	Number of						Average		
Season	Vessels	Landings	Crabs[a]	Harvest[a,b]	Pots lifted	CPUE[c]	Weight[b]	Length[d]	Deadloss[b]
1982/83	22	30	51,714	193,507	7,825	7	3.7	138	957
1983/84					NO LANDINGS				
1985					NO LANDINGS				
1986					NO LANDINGS				
1987	11	29	101,618	424,394	14,525	7	4.2	142	11,750
1988	11	23	36,270	160,441	11,672	3	4.4	150	14,000
1989	2				CONFIDENTIAL				
1990					NO LANDINGS				
1991					NO LANDINGS				
1992	1				CONFIDENTIAL				
1993					NO LANDINGS				
1994	1				CONFIDENTIAL				
1995	4	4	245	1,200	383	1	4.9	NA	0
1996	1				CONFIDENTIAL				
1997-2000					NO LANDINGS				
2001	1				CONFIDENTIAL				
2002					NO LANDINGS				

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs retained per pot pull.
[d] In millimeters.

Table 2-19. Saint Matthew Island Section golden king crab fishery economic performance data, 1991 - 2002 seasons.

Season	Value		Season Length	
	Exvessel[a]	Total	Days	Dates
1991	NO LANDINGS		365	1/1-12/31
1992	CONFIDENTIAL		365	1/1-12/31
1993	NO LANDINGS		365	1/1-12/31
1994	CONFIDENTIAL		365	1/1-12/31
1995	$3.12	$3,744	365	1/1-12/31
1996	CONFIDENTIAL		365	1/1-12/31
1997-2000	NO LANDINGS		365	1/1-12/31
2001	CONFIDENTIAL		365	1/1-12/31
2002	NO LANDINGS		365	1/1-12/31

[a] Price per pound.

Table 2-20. Registration Area Q scarlet king crab fishery data, 1992 - 2002.

Year	Number of Vessels	Harvest[a,b]	Pots Lifted	Value Exvessel[c]	Value Fishery[d]	Average Weight[a]	Average CPUE[e]	Deadloss[a]
1992-94					NO LANDINGS			
1995	4	26,684	24,551	$2.12	$0.06	2.4	1	465
1996	2				CONFIDENTIAL			
1997- 99					NO LANDINGS			
2000	1				CONFIDENTIAL			
2001	1				CONFIDENTIAL			
2002					NO LANDINGS			

[a] In pounds.
[b] Deadloss included.
[c] Price per pound.
[d] In millions of dollars.
[e] Number of legal crabs retained per pot pull.

Table 2-21. Commercial harvest statistics, by season, for the Bering Sea District Tanner crab fishery, 1969 - 2002.

	Number of			Harvest[a]	Number of Pots			Deadloss
Year	Vessels	Landings	Crab[a]	(pounds)	Registered	Pulled	CPUE[b]	(pounds)
1969	NA	131	353,300	1,008,900		29,800	12	NA
1970	NA	66	482,300	1,014,700		16,400	29	NA
1971	NA	22	61,300	166,100		7,300	8	NA
1972	NA	14	42,061	107,761		4,260	10	NA
1973	NA	44	93,595	231,668		15,730	6	NA
1974	NA	69	2,531,825	5,044,197		22,014	115	NA
1974/75	28	80	2,773,770	7,028,378		38,462	72	NA
1975/76	66	304	8,956,036	22,358,107		141,206	63	NA
1976/77	83	541	20,251,508	51,455,221		297,471	68	NA
1977/78	120	861	26,350,688	66,648,954		516,350	51	218,099
1978/79	144	817	16,726,518	42,547,174		402,697	42	76,000
1979/80	152	804	14,685,611	36,614,315	40,273	488,434	30	56,446
1981	165	761	11,845,958	29,630,492	42,910	559,626	21	101,594
1982	125	791	4,830,980	11,008,779	36,396	490,099	10	138,159
1983	108	448	2,286,756	5,273,881	15,255	282,006	8	60,029
1984	41	134	516,877	1,208,223	9,851	61,357	8	5,025
1985	44	166	1,283,474	3,151,498	15,325	104,707	12	14,096
1986				FISHERY	CLOSED			
1987				FISHERY	CLOSED			
1988	98	248	897,059	2,210,394	38,765	112,334	8	10,724
1989	109	359	2,907,021	7,012,965	43,607	184,892	16	34,664
1990	179	1,032	10,717,924	24,549,299	46,440	711,137	15	87,475
1990/91	255	1,756	16,608,625	40,081,555	75,356	883,391	19	210,769
1991/92	285	2,339	12,924,034	31,796,381	85,401	1,244,633	10	279,741

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Table 2-21. (Page 2 of 2)

	Number of			Harvest[a]	Number of Pots			Deadloss
Year	Vessels	Landings	Crab[a]	(pounds)	Registered	Pulled	CPUE[b]	(pounds)
1992/93	294	2,084	15,265,880	35,130,866	71481	1,200,885	13	343,955
1993/94	296	862	7,235,498	16,891,320	116,039	576,464	13	258,389
1994	183	349	3,351,639	7,766,886	38,670	249,536	13	132,780
1995	196	256	1,877,303	4,233,061	40,827	247,853	8	44,508
1996[c]	196	347	734,296	1,806,077	68,602	149,289	5	14,608
1997 to 2002				FISHERY CLOSED				

[a] Deadloss included.
[b] Number of legal crabs retained per pot pull.
[c] Includes incidental catch with Bristol Bay red king crab and Tanner crab directed fishery totals.

Table 2-22. Bering Sea District Tanner crab commercial catch by subdistrict, 1974/75 - 2002.

		Number of					Average		
Season	Subdistrict[a]	Vessels	Landings	Crab[b]	Harvest[b] (pounds)	Pots Pulled	Weight (pounds)	CPUE[c]	Deadloss (pounds)
1974/75	Southeastern		72	2,526,687	6,504,984	32,275	2.6	78	0
	Pribilofs	28	8	247,083	523,394	3,923	2.1	63	0
	TOTAL		80	2,773,770	7,028,378	38,462	2.5	72	0
1975/76	Southeastern		230	6,682,232	16,643,194	106,445	2.5	63	0
	Pribilofs		74	2,273,804	5,714,913	34,761	2.5	65	0
	TOTAL	66	304	8,956,036	22,358,107	141,206	2.5	63	0
1976/77	Southeastern		437	16,089,057	41,007,736	233,667	2.6	69	0
	Pribilofs		104	4,162,451	10,447,485	63,804	2.5	65	0
	TOTAL	83	541	20,251,508	51,455,221	297,471	2.5	68	0
1977/78	Southeastern		706	21,055,527	53,278,012	408,437	2.5	52	0
	Pribilofs		155	5,210,170	13,152,843	107,913	2.5	48	0
	TOTAL	120	861	26,350,688	66,648,954	516,350	2.5	51	218,099
1978/79	Southeastern		758	15,601,891	39,694,205	356,594	2.5	44	75,400
	Pribilofs		59	1,124,627	2,852,969	46,103	2.5	24	600
	TOTAL	144	817	16,726,518	42,547,174	402,697	2.5	42	76,000
1979/80	Southeastern		789	14,329,889	35,724,003	476,410	2.5	30	56,446
	Pribilofs		15	355,722	890,312	12,024	2.5	30	0
	TOTAL	152	804	14,685,611	36,614,315	488,434	2.5	30	56,446

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Table 2-22. (page 2 of 4)

Season	Subdistrict[a]	Number of Vessels	Number of Landings	Number of Crab[b]	Harvest[b] (pounds)	Pots Pulled	Average Weight (pounds)	Average CPUE[c]	Deadloss (pounds)
1981	Southeastern		674	10,532,007	26,684,956	496,751	2.5	21	97,398
	Pribilofs		87	1,313,951	2,945,536	62,875	2.5	21	4,196
	TOTAL	165	761	11,845,958	29,630,492	559,626	2.5	21	101,594
1982	Southeastern		539	3,825,433	8,812,302	322,634	2.3	12	69,829
	Pribilofs		252	1,005,547	2,196,477	167,465	2.2	6	68,330
	TOTAL	125	791	4,830,980	11,008,779	490,099	2.3	10	138,159
1983	Northern		10	29,478	48,454	5,950	1.7	5	167
	Southeastern		287	1,984,673	4,633,354	192,538	2.3	10	52,879
	Pribilofs		151	272,505	592,073	83,528	2.2	3	6,983
	TOTAL	108	448	2,286,756	5,273,881	282,006	2.3	8	60,029
1984	Southeastern		91	470,181	1,099,142	44,546	2.3	11	4,688
	Pribilofs		43	46,759	109,081	16,811	2.3	3	337
	TOTAL	41	134	516,877	1,208,223	61,357	2.3	8	5,025
1985	Southeastern	38	143	1,278,109	3,139,041	96,976	2.4	13	14,096
	Pribilofs	15	23	5,365	12,457	7,731	2.3	1	0
	TOTAL	44	166	1,283,474	31,513,498	104,707	2.4	12	14,096
1986				F I S H E R Y CLOSED					
1987				F I S H E R Y CLOSED					

-Continued-

Table 2-22. (page 3 of 4)

		Number of					Average		
Season	Subdistrict[a]	Vessels	Landings	Crab[b]	Harvest[b] (pounds)	Pots Pulled	Weight (pounds)	CPUE[c]	Deadloss (pounds)
1988	Eastern	98	248	897,059	2,210,394	112,334	2.5	8	10,724
	Western	0	0	0	0	0	0	0	0
	TOTAL	98	248	897,059	2,210,394	112,334	2.5	8	10,724
1989	Eastern	109	359	2,907,021	7,012,965	184,892	2.4	16	34,664
	Western	0	0	0	0	0	0	0	0
	TOTAL	109	359	2,907,021	7,012,965	184,892	2.4	16	34,664
1990	Eastern		1,105	10,708,996	24,529,165	701,924	2.3	15	87,475
	Western		17	8,928	20,134	9,213	2.3	1	0
	TOTAL	179	1,032	10,717,924	24,549,299	711,137	2.3	15	87,475
1990/91	Eastern	255	1,756	16,608,625	40,081,555	883,391	2.4	19	210,769
	Western	0	0	0	0	0	0	0	0
	TOTAL	255	1,756	16,608,625	40,081,555	883,391	2.4	19	210,769
1991/92	Eastern	285	2,339	12,924,034	31,796,381	1,244,633	2.5	10	279,741
1992/93	Eastern	293	2,011	15,074,084	34,821,043	1,150,834	2.3	13	340,955
	Western	70	96	191,796	309,823	50,051	1.6	4	3,000
	TOTAL	294	2,084	15,265,880	35,130,866	1,200,885	2.3	13	343,955
1993/94	East of 168°[d]	283	347	1,696,430	4,114,949	250,501	2.4	7	103,715
	163° to 173°[e]	261	515	5,539,068	12,776,371	325,963	2.3	17	154,674
	TOTAL	296	862	7,235,498	16,891,320	576,464	2.3	13	258,389

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Table 2-22. (page 4 of 4)

		Number of			Harvest[b]	Pots	Average		Deadloss
Season	Subdistrict[a]	Vessels	Landings	Crab[b]	(pounds)	Pulled	Weight (pounds)	CPUE[c]	(pounds)
1994	163° to 173°	183	349	3,351,639	7,766,886	249,536	2.3	13	132,780
1995	163° to 173°	196	256	1,877,303	4,233,061	247,853	2.3	8	44,508
1996	East of 168°[d]	192	195	393,257	994,776	75,753	2.5	5	8,464
	163° to 173°[e]	135	152	341,039	811,301	73,522	2.4	5	6,144
	TOTAL	196	347	734,296	1,806,077	149,275	2.5	5	14,608
1997 to 2002				FISHERY CLOSED					

[a] Prior to 1988, the subdistricts were: Southeastern, Pribilofs, and Northern (which includes the Norton Sound and General Sections).
[b] Deadloss included.
[c] Number of legal crabs retained per pot pull.
[d] Bycatch in Bristol Bay red king crab fishery.
[e] Directed Tanner crab fishery.

Table 2-23. Economic performance of the Bering Sea District Tanner crab commercial fishery 1979/80 - 2002.

		Value		Season Length	
		Exvessel	Total[b]		
Year	GHL[a]	(per lb.)		Days	Dates
1979/80	28-36	$0.52	$19.0	189	11/01-05/11
1981	28-36	$0.58	$17.2	88	01/15-04/15
1982	12-16	$1.06	$11.5	118	02/15-06/15
1983	5.6	$1.20	$6.2	118	02/15-06/15
1984	7.1	$0.95	$1.1	118	02/15-06/15
1985	3	$1.40	$4.3	149	01/15-06/15
1986		FISHERY CLOSED			
1987		FISHERY CLOSED			
1988	5.6	$2.17	$4.8	93	01/15-04/20
1989	13.5	$2.90	$20.3	110	01/15-05/07
1990[c]	29.5	$1.85	$45.3	89	01/15-04/24
1990/91	42.8	$1.12	$44.5	126	11/20-03/25
1991/92	32.8	$1.50	$47.3	137	11/15-03/31
1992/93	39.2	$1.69	$58.8	137	11/15-03/31
1993[d]	10.7	$1.90	$7.6	10	11/01-11/10
1993/94[e]	9.1	$1.90	$24.0	42	11/20-01/01
1994[e]	7.5	$3.75	$28.5	20	11/01-11/21
1995[e]	5.5	$2.80	$11.7	15	11/01-11/16
1996[d]	2.2	$2.51	$2.5	4	11/01-11/05
1996[e]	6.2	$2.48	$2.0	12	11/15-11/27
1996	8.4	NA	$4.5	16	NA
1997 to 2002		FISHERY CLOSED			

[a] Guideline harvest level, millions of pounds.
[b] Millions of dollars.
[c] Winter fishery.
[d] East of 168° West longitude (incidental to Bristol Bay red king crab).
[e] 163° -173° West longitude (directed fishery).
NA = Not applicable.

Table 2-24. Bering Sea District commercial Tanner crab harvest composition by fishing season, 1972-2002.

Season	Average Weight (pounds)	Average Width (mm)	% New Shell
1972[a]	2.6		
1973[a]	2.5		
1974[a]	2		
1974/75	2.5		
1975/76	2.5		
1976/77	2.5		
1977/78	2.5	152.8	88.0
1978/79	2.5	152.7	95.0
1979/80	2.5	151.4	90.0
1981	2.5	149.4	86.6
1982	2.3	148.8	85.4
1983[b]	2.3	148.8	70.5
1984	2.3	146.5	40.0
1985	2.4	150.0	65.0
1986	FISHERY	CLOSED	
1987	FISHERY	CLOSED	
1988	2.5	143.5	70.2
1989	2.4	149.4	80.8
1990	2.3	148.1	96.5
1990/91	2.4	149.7	95.3
1991/92	2.5	150.4	93.2
1992/93	2.3	148.0	90.5
1993/94	2.4	150.7	93.9
1994	2.3	150.0	92.5
1995	2.3	149.3	58.6
1996[c]	2.5	152.1	46.6
1997 to 2002	FISHERY	CLOSED	

[a] Incidental to the king crab fishery.
[b] Partial Bering Sea closure.
[c] Includes incidental catch with Bristol Bay red king crab and Tanner crab directed fishery totals.

Table 2-25. Bering Sea District commercial snow crab catch data, 1978/79 - 2002.

Year	GHL[a]	Number of Vessels	Number of Landings	Number of Crab[b]	Harvest[b,c]	Pots Pulled	CPUE[d]	Deadloss[c]
1978/79		102	490	22,118,498	32,187,039	190,746	116	759,137
1979/80		134	597	25,286,777	39,572,668	255,102	99	228,345
1981	39.5-91.0	153	867	34,415,322	52,750,034	435,742	79	2,269,979
1982	16.0-22.0	122	803	24,089,562	29,355,374	469,091	51	1,092,655
1983[e]	15.8	109	461	23,853,647	26,128,410	287,127	83	1,324,466
1984[e]	49.0	52	367	24,009,935	26,813,074	173,591	138	798,795
1985[e]	98.0	75	718	52,903,246	65,998,875	372,045	142	1,064,184
1986[e]	57.0	88	992	76,499,123	97,984,539	543,744	141	1,378,533
1987[e]	56.4	103	1,038	81,307,659	101,903,388	616,113	132	978,449
1988[e]	110.7	171	1,285	105,716,337	135,354,637	776,907	136	3,260,020
1989[e]	132.0	168	1,341	112,618,881	149,455,848	663,442	170	1,844,682
1990[e]	139.8	189	1,565	128,977,638	161,821,350	911,613	141	1,796,664
1991[e]	315.0	220	2,788	265,123,960	328,647,269	1,391,583	191	3,464,036
1992	333.0	250	2,763	227,376,582	315,302,034	1,281,796	177	2,325,852
1993	207.2	254	1,836	169,558,842	230,787,000	971,046	175	1,573,952
1994	105.8	273	1,293	114,779,014	149,775,765	716,524	160	1,799,323
1995	55.7	253	869	60,611,411	75,252,677	506,802	117	1,287,169
1996	50.7	234	766	52,912,823	65,712,797	520,651	102	1,333,014
1997	117.0	226	1,127	99,975,539	119,543,024	754,140	133	2,351,555
1998[f]	225.9	229	1,767	186,543,734	243,341,381	891,268	207	2,893,945
1999[f]	186.2	241	1,630	143,296,568	184,529,821	899,043	158	1,828,313
2000[f]	26.4	229	287	23,265,802	30,774,838	170,064	137	338,057
2001[f]	25.3	207	293	17,185,523	23,382,046	176,930	97	429,884
2002[f]	28.5	191	403	23,303,975	30,252,501	307,666	76	582,589

[a] Guideline harvest level in millions of pounds.
[b] Deadloss included.
[c] In Pounds.
[d] Number of legal crabs retained per pot pull.
[e] Partial district and subdistrict closures, see Table 2-26.
[f] General fishery only.

Table 2-26 Bering Sea District snow crab season dates and area closures, 1977/78 - 2002 seasons.

Season	Opened	Closed	Comments
1977/78	09/15/77	09/23/78	Bering Sea District closure[a]
1978/79	11/01/78	09/03/79	Bering Sea District closure[a]
1979/80	11/01/79	08/15/80	Bering Sea District state closure
		09/03/80	Bering Sea District federal closure
1981	01/15/81	09/01/81	Bering Sea District closure[b]
1982	02/15/82	08/01/82	Bering Sea District closure[b]
1983	02/15/83	05/22/83	Bering Sea District closure south of 57°30' N. lat. [b]
		08/01/83	Bering Sea District closure north of 57°30' N. lat. [b]
1984	02/15/84	08/01/84	Bering Sea District closure south of 58° N. lat. [b]
		08/22/84	Bering Sea District closure north of 58° N. lat. to allow an orderly start to king crab season[b]
	09/15/84	12/31/84	Bering Sea District closure north of 58°N. lat. reopened after king season and Bering Sea District closure[b]
1985	01/15/85	05/08/85	Pribilof Subdistrict closure south of 58° N. lat. [b]
		08/01/85	Bering Sea District closure south of 58°39' N. lat. [b]
		08/22/85	Northern Subdistrict closure to allow an orderly start to king crab season[b]
	10/09/85	01/15/86 *	Bering Sea District reopened, except east of 164° W. long. in Southeastern Subdistrict, *fishery was scheduled to close 12/31/85 but did not, it remained open until the start of the 1986 fishery
1986	01/15/86	04/21/86	Southeastern Subdistrict closure west of 164° W long. [b]
		06/01/86	Pribilof Subdistrict closure[b]
		08/01/86	Northern Subdistrict closure east of 175° W. long. [b]
		08/24/86	Northern Subdistrict closure west of 175° W. long. [b]
1987	01/15/87	04/12/87	Southeastern Subdistrict west of 164° W. long., and Pribilof Subdistrict closure
		06/01/87	Northern Subdistrict south of 60°30' N lat. and east of 178° W. long. closure

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Table 2-26. (page 2 of 2)

Season	Opened	Closed	Comments
1987 (cont.)	01/15/87	06/22/87	Northern Subdistrict north of 60°30' N lat. and west of 178° W. long. closure
1988	01/15/88	03/29/88	Bering Sea District closure (Western Subdistrict to assist in an orderly closure)
	05/15/88	06/30/88	Western Subdistrict reopen and closure
1989	01/15/89	03/26/89	Eastern Subdistrict closure
		05/07/89	Western Subdistrict closure
1990	01/15/90	04/09/90	Eastern Subdistrict east of 165° W. long. closure
		04/24/90	Eastern Subdistrict west of 165° W. long. closure
		06/12/90	Western Subdistrict closure
1991	01/15/91	05/05/91	Eastern Subdistrict closure
		06/23/91	Western Subdistrict closure
1992	01/15/92	04/22/92	Bering Sea District closure
1993	01/15/93	03/15/93	Bering Sea District closure
1994	01/15/94	03/01/94	Bering Sea District closure
1995	01/15/95	02/17/95	Bering Sea District closure
1996	01/15/96	02/29/96	Bering Sea District closure
1997	01/15/97	03/21/97	Bering Sea District closure
1998	01/15/98	03/20/98	Bering Sea District closure
1999	01/15/99	03/22/99	Bering Sea District closure
2000	04/01/00	04/08/00	Bering Sea District closure
2001	01/15/01	02/14/01	Bering Sea District closure
2002	01/15/02	02/08/02	Bering Sea District closure

[a] State managed domestic fishery.
[b] Concurrent state and federal date.

Table 2-27. 2002 Bering Sea snow crab fishery inseason harvest and effort projections.

		Projected					
Date	Report Day	Daily CPUE[a]	Pot lifts	Number of crabs	Daily Harvest[b]	Cumulative harvest[b]	Season CPUE[a]
(Jan) 16	1	33	1,268	37,727	49,046	49,046	30
17	2	64	9,596	578,325	751,822	800,868	57
18	3	71	14,588	1,002,182	1,302,837	2,103,704	64
19	4	93	12,880	1,179,097	1,532,826	3,636,531	73
20	5	101	15,800	1,567,394	2,037,612	5,674,143	81
21	6	88	17,266	1,465,891	1,905,658	7,579,801	82
22	7	89	15,357	1,300,191	1,690,248	9,270,049	82
23	8	92	10,682	935,842	1,216,594	10,486,644	83
24	9	80	12,643	986,528	1,282,486	11,769,130	82
25	10	71	15,408	1,056,535	1,373,496	13,142,626	81
26	11	68	13,460	866,600	1,126,580	14,269,206	79
27	12	67	17,881	1,171,245	1,522,618	15,791,824	77
28	13	73	11,757	834,080	1,084,304	16,876,127	77
29	14	82	8,698	711,253	924,629	17,800,757	77
30	15	76	11,790	874,555	1,136,922	18,937,678	77
31	16	75	7,084	544,849	708,303	19,645,981	77
(Feb) 1	17	67	11,942	772,505	1,004,257	20,650,238	76
2	18	68	12,747	835,565	1,086,234	21,736,472	76
3	19	61	14,288	854,960	1,111,448	22,847,920	75
4	20	56	14,245	765,559	995,226	23,843,147	74
5	21	59	12,584	711,608	925,090	24,768,236	73
6	22	57	15,634	883,311	1,148,305	25,916,541	72
7	23	47	15,040	687,467	893,707	26,810,248	70
8	24	41	21,803	829,183	1,077,937	27,888,186	68
9	25	40	5,361	171,757	223,285	28,111,470	68
Totals			319,802	21,624,208	28,111,470		68

[a] Number of legal crabs retained per pot pull.
[b] In pounds.

Table 2-28. Bering Sea District commercial snow crab harvest by season and subdistrict, 1977/78-2002.

Season	Subdistrict	Number of			Harvest[b,c]	Pots	Average	CPUE[d]	Deadloss[c]
		Vessels	Landings[a]	Crab[b]		Pulled	Weight[c]		
1977/78	Southeastern		33	1,063,872	1,439,959	11,560	1.4	92	NA
	Pribilof		5	203,674	276,165	1,687	1.4	121	NA
	TOTAL	15	38	1,267,546	1,716,124	13,247	1.4	96	NA
1978/79	Southeastern	101	476	21,279,794	31,102,832	184,491	1.5	115	659,137
	Pribilof	10	14	838,704	1,084,039	6,225	1.5	135	100,000
	TOTAL	102	490	22,118,498	32,187,039	190,746	1.5	116	759,137
1979/80	Southeastern	133	561	23,199,446	36,406,391	237,375	1.6	98	187,945
	Pribilof	19	36	2,087,331	3,166,777	17,727	1.5	118	40,400
	TOTAL	134	597	25,286,777	39,572,668	255,102	1.6	99	228,345
1981	Southeastern		624	24,498,642	37,866,229	309,304	1.6	79	1,475,078
	Pribilof		243	9,916,617	14,886,705	126,438	1.5	78	794,901
	TOTAL	153	867	34,415,322	52,750,034	435,742	1.5	79	2,269,979
1982	Southeastern		468	10,207,174	13,079,583	257,193	1.3	40	422,979
	Pribilof		335	13,882,388	16,276,421	211,898	1.2	66	669,676
	TOTAL	122	803	24,089,562	29,355,374	469,091	1.2	51	1,092,655
1983	Southeastern		153	3,553,281	4,197,304	94,470	1.2	38	165,298
	Pribilof		239	19,076,553	20,514,000	153,458	1.0	124	1,078,643
	Northern		69	1,223,813	1,417,106	39,199	1.1	31	80,525
	TOTAL	109	461	23,853,647	26,128,410	287,127	1.1	83	1,324,466

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Table 2-28. (page 2 of 5)

Season	Subdistrict	Number of Vessels	Number of Landings[a]	Number of Crab[b]	Harvest[b,c]	Pots Pulled	Average Weight[c]	CPUE[d]	Deadloss[c]
1984	Southeastern		76	3,534,370	3,990,621	33,091	1.1	107	54,678
	Pribilof		230	17,909,096	19,727,493	112,078	1.1	160	708,706
	Northern		61	2,566,469	3,094,960	28,422	1.2	90	35,411
	TOTAL	52	367	24,009,935	26,813,074	173,591	1.1	138	798,795
1985	Southeastern	55	301	21,963,882	27,373,232	158,819	1.4	138	461,001
	Pribilof	60	301	24,089,526	29,804,093	142,937	1.2	169	505,146
	Northern	24	116	6,849,838	8,821,550	70,289	1.3	97	98,037
	TOTAL	75	718	52,903,246	65,998,875	372,045	1.3	142	1,064,184
1986	Southeastern	47	112	8,491,694	10,957,578	63,889	1.3	133	44,755
	Pribilof	80	508	39,851,767	50,525,150	281,337	1.3	142	472,342
	Northern	67	372	28,155,662	36,501,811	198,518	1.3	142	861,436
	TOTAL	88	992	76,499,123	97,984,539	543,744	1.3	141	1,378,533
1987	Southeastern	28	64	4,116,778	5,106,473	24,619	1.2	167	24,619
	Pribilof	94	458	38,604,802	47,676,734	261,337	1.2	148	261,337
	Northern	99	516	38,586,079	49,120,181	330,157	1.2	117	330,157
	TOTAL	103	1,038	81,307,659	101,903,388	616,113	1.2	132	978,449
1988	Eastern	162	770	59,811,702	75,781,258	431,310	1.3	139	775,104
	Western	151	515	45,904,635	58,278,927	335,597	1.3	137	2,484,916
	TOTAL	171	1,285	105,716,337	134,060,185	776,907	1.3	136	3,260,020
1989	Eastern	163	871	77,698,698	104,399,693	391,451	1.3	198	1,128,971
	Western	127	470	34,920,183	45,056,155	271,991	1.3	128	715,711
	TOTAL	168	1,341	112,618,881	149,455,848	663,442	1.3	170	1,844,682

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Table 2-28. (page 3 of 5)

Season	Subdistrict	Number of Vessels	Number of Landings[a]	Number of Crab[b]	Harvest[b,c]	Pots Pulled	Average Weight[c]	CPUE[d]	Deadloss[c]
1990	Eastern	177	956	76,331,829	94,831,897	512,259	1.2	149	1,010,755
	Western	152	659	52,645,809	66,989,453	399,354	1.3	132	785,909
	TOTAL	189	1,565	128,977,638	161,821,350	911,613	1.3	141	1,796,664
1991	Eastern	218	2,013	190,139,612	240,090,666	912,751	1.3	208	1,593,021
	Western	186	867	74,984,348	88,556,603	478,832	1.2	157	1,871,015
	TOTAL	220	2,788	265,123,960	328,647,269	1,391,583	1.2	191	3,464,036
1992	Eastern	250	N/A	217,375,564	302,363,005	1,228,280	1.4	177	2,268,467
	Western	55	N/A	10,001,018	12,939,029	53,516	1.3	187	57,385
	TOTAL	250	2,763	227,376,582	315,302,034	1,281,796	1.4	177	2,325,852
1993	Eastern	251	1,384	110,760,099	151,328,721	675,996	1.4	164	1,108,520
	Western	185	633	58,798,743	79,458,279	295,050	1.4	199	465,432
	TOTAL	254	1,836	169,558,842	230,787,000	971,046	1.4	175	1,573,952
1994	Eastern	220	820	56,012,017	72,008,424	375,928	1.3	149	901,674
	Western	171	586	58,766,997	77,767,341	340,596	1.3	173	897,649
	TOTAL	273	1,293	114,779,014	149,775,765	716,524	1.3	160	1,799,323
1995	Eastern	217	627	32,630,348	39,736,986	313,910	1.2	104	657,051
	Western	153	357	27,981,063	35,515,691	192,892	1.3	145	630,118
	TOTAL	253	869	60,611,411	75,252,677	506,802	1.2	120	1,287,169
1996	Eastern	161	462	23,676,069	28,244,924	252,227	1.2	94	555,118
	Western	146	351	29,236,754	37,467,873	268,424	1.3	109	777,896
	TOTAL	234	766	52,912,823	65,712,797	520,651	1.2	102	1,333,014

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Table 2-28. (page 4 of 5)

Season	Subdistrict	Number of			Harvest[b,c]	Pots	Average	CPUE[d]	Deadloss[c]
		Vessels	Landings[a]	Crab[b]		Pulled	Weight[c]		
1997	Eastern	225	1,040	88,486,602	105,648,771	649,319	1.2	136	2,115,217
	Western	83	164	11,488,937	13,894,253	104,821	1.2	110	236,338
	TOTAL	226	1,127	99,975,539	119,543,024	754,140	1.2	133	2,351,555
1998[e]	Eastern	228	1,724	177,781,444	232,485,209	855,393	1.3	205	2,787,292
	Western	44	88	8,762,290	10,856,172	35,875	1.2	242	106,653
	TOTAL	229	1,767	186,543,734	243,341,381	891,268	1.3	207	2,893,945
1999[e]	Eastern	236	1,386	102,209,222	134,135,696	656,276	1.3	156	1,237,770
	Western	121	388	39,646,982	48,565,812	242,767	1.2	163	590,543
	TOTAL	241	1,630	141,856,204	182,701,508	899,043	1.3	158	1,828,313
2000[e]	Eastern	168	217	15,269,109	20,941,389	110,127	1.4	139	200,748
	Western	82	91	7,996,693	9,833,449	59,937	1.2	133	137,309
	TOTAL	229	287	23,265,802	30,774,838	170,064	1.3	137	338,057
2001[e]	Eastern	163	219	8,877,103	12,575,815	114,044	1.4	78	224,266
	Western	85	115	8,308,420	10,806,231	62,866	1.3	132	205,618
	TOTAL	207	293	17,185,523	23,382,046	176,910	1.4	97	429,884

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Table 2-28. (page 5 of 5)

Season	Subdistrict	Number of			Harvest[b,c]	Pots	Average	CPUE[d]	Deadloss[c]
		Vessels	Landings[a]	Crab[b]		Pulled	Weight[c]		
2002[e]	Eastern	144	274	10,369,137	13,513,988	161,736	1.3	64	296,854
	Western	107	191	12,909,073	16,707,594	145,330	1.3	89	283,716
	TOTAL[f]	191	403	23,303,975	30,252,501	307,666	1.3	76	580,570

[a] Number of subdistrict landings is greater than the total number of landings because a single vessel may fish in several statistical areas.
[b] Deadloss included.
[c] In pounds.
[d] Number of legal crabs retained per pot pull.
[e] General fishery only.
[f] Total harvest includes 30,919 pounds taken from an unidentified statistical area.

Table 2-29. Bering Sea District commercial snow crab catch by statistical area, 2002.

Area	Number of		Harvest[a,b]	Pots	Average		Deadloss[b]
	Landings	Crab[a]		Pulled	CPUE[c]	Weight	
EASTERN SUBDISTRICT AREAS							
665500	5	150,659	209,601	2,410	63	1.39	1,824
665530	4	89,046	87,021	1,379	65	0.98	951
665600	4	36,850	49,093	662	56	1.33	1,418
675500	3	41,902	61,016	167	251	1.46	2,465
675530	19	447,514	620,499	10,222	44	1.39	12,588
675600	32	910,940	1,255,760	15,871	57	1.38	44,285
675630	5	152,541	213,062	3,005	51	1.40	2,850
685530	7	103,172	138,108	2,794	37	1.34	16,256
685600	32	578,069	787,441	11,231	51	1.36	17,524
685630	14	147,852	197,111	3,210	46	1.33	5,213
705600	5	64,251	88,735	1,814	35	1.38	2,519
705630	20	523,340	667,766	9,643	54	1.28	17,615
715600	5	163,104	217,524	2,523	65	1.33	5,284
715630	69	2,336,556	3,025,300	30,461	77	1.29	67,922
715700	27	790,822	1,007,560	12,262	64	1.27	12,053
725600	3	83,182	107,874	1,159	72	1.30	1,956
725630	48	1,023,561	1,306,838	15,278	67	1.28	20,903
725700	46	1,433,806	1,849,018	21,927	65	1.29	37,610
725730	20	415,670	536,758	4,685	89	1.29	6,569
725800	10	338,982	402,789	3,013	113	1.19	8,749
725830	3	189,885	227,307	2,245	85	1.20	3,036
Other[d]	20	347,433	457,807	5,775	60	1.32	7,264
Subtotal	401	10,369,137	13,513,988	161,736	64	1.30	297,864

-Continued-

Table 2-29 (page 2 of 2)

Area	Number of Landings	Number of Crab [a]	Harvest[a,b]	Pots Pulled	Average CPUE[c]	Average Weight	Deadloss[b]
WESTERN SUBDISTRICT AREAS							
735630	5	131,673	158,998	2,101	63	1.21	1,918
735700	24	820,474	1,049,142	9,871	83	1.28	20,820
735730	60	2,918,477	3,778,124	31,817	92	1.29	53,615
735800	103	4,903,203	6,225,088	56,161	87	1.27	104,302
735830	28	903,976	1,142,443	9,807	92	1.26	23,868
745800	41	1,316,913	1,642,976	15,389	86	1.25	26,565
745830	27	1,098,326	1,375,177	11,921	92	1.25	30,101
755830	3	4,871	6,389	292	17	1.31	366
755900	8	66,184	88,038	814	81	1.33	2,522
775930	4	146,692	475,835	1,826	80	3.24	10,575
Other[e]	13	598,284	765,384	5,331	112	1.28	9,064
Subtotal	316	12,909,073	16,707,594	145,330	89	1.29	284,725
Total[f,g]	717	23,303,975	30,252,501	307,666	76	1.30	582,589

[a] Deadloss included.
[b] In pounds.
[c] Defined as catch of legal crabs per pot pull.
[d] Includes 15 statistical areas where less than three vessels made landings.
[e] Includes 17 statistical areas where less than three vessels made landings.
[f] General fishery only.
[g] Total harvest includes 30,919 pounds taken from an unidentified statistical area.

Table 2-30. Bering Sea District commercial snow crab harvest composition by fishing season, 1978/79 - 2002.

Season	Average		Percent new shell	Percent <102 mm cw landed
	Weight (pounds)	Width (mm)		
1978/79	1.5	113.1	83.0	NA
1979/80	1.6	118.1	90.0	NA
1981	1.5	117.0	79.2	NA
1982	1.2	109.4	78.0	NA
1983	1.1	NA	NA	NA
1984	1.1	105.4	78.0	NA
1985	1.3	108.0	80.0	NA
1986	1.3	109.5	73.7	NA
1987	1.2	108.9	84.0	NA
1988	1.3	109.5	71.2	NA
1989	1.3	111.2	85.2	NA
1990	1.3	109.1	97.4	NA
1991	1.2	110.2	95.1	NA
1992	1.4	111.7	97.6	NA
1993	1.4	111.6	92.5	NA
1994	1.3	110.4	93.1	11.3
1995	1.2	108.6	89.6	17.2
1996	1.2	107.5	75.8	19.7
1997	1.2	107.3	96.5	17.3
1998[a]	1.3	111.1	97.0	7.3
1999[a]	1.3	110.3	97.7	8.0
2000[a]	1.3	111.3	95.2	6.5
2001[a]	1.4	111.3	95.2	5.3
2002[a]	1.3	110.4	69.0	12.2

[a] General fishery only.

Table 2-31. Economic performance of the Bering Sea District commercial snow crab fishery, 1979/80 - 2002.

Year	Value		Registered	Season
	Exvessel	Fishery[a]	Pots[b]	Length[c]
1979/80	$0.21	$ 82.50	35,503	307
1981	$0.26	$ 13.10	39,789	229
1982	$0.73	$ 20.70	35,522	167
1983[d]	$0.35	$ 8.70	15,396	120
1984[d]	$0.30	$ 7.80	12,493	320
1985[d]	$0.30	$ 19.50	15,325	333
1986[d]	$0.60	$ 60.00	13,750	252
1987[d]	$0.75	$ 75.70	19,386	158
1988[d]	$0.77	$ 100.70	38,765	120
1989[d]	$0.75	$ 110.70	43,607	112
1990[d]	$0.64	$ 102.30	46,440	148
1991[d]	$0.50	$ 162.60	76,056	159
1992	$0.50	$ 156.50	77,858	97
1993	$0.75	$ 171.90	65,081	59
1994	$1.30	$ 192.40	54,837	45
1995	$2.43	$ 180.00	53,707	33
1996	$1.33	$ 85.60	50,169	45
1997	$0.79	$ 92.60	47,036	65
1998[e]	$0.56	$ 134.65	47,909	64
1999[e]	$0.88	$ 160.78	50,173	66
2000[e]	$1.81	$ 55.09	43,407	7
2001[e]	$1.53	$ 32.12	40,379	30
2002[e]	$1.49	$ 44.20	37,807	24

[a] Millions of dollars.
[b] Includes Tanner crab gear prior to 1992.
[c] In days.
[d] Partial district and subdistrict closures, see Table 2-26.
[e] General fishery only.

Table 2-32. Bering Sea District grooved Tanner crab fishery data, 1992-2002.

Year	Number of Vessels	Number of Crabs[a]	Harvest[a] (Pounds)	Pots Pulled	Exvessel Value	Fishery Value[b]	Average Weight[c]	Average CPUE[d]	Deadloss
1992					CONFIDENTIAL				
1993	6	342,095	658,796	35,650	$0.94	$0.60	1.9	9	71,000
1994	4	165,365	332,454	13,739	$1.20	$0.40	2.0	11	30,585
1995	8	38,313	1,005,721	60,993	$1.40	$1.31	2.1	7	69,177
1996	3	40,849	106,886	14,504	$1.08	$0.10	2.1	3	11,186
1997-1999					NO LANDINGS				
2000	1				CONFIDENTIAL				
2001	1				CONFIDENTIAL				
2002					NO LANDINGS				

[a] Deadloss included.
[b] Millions of dollars.
[c] In pounds.
[d] Number of legal crabs per pot lift.

Table 2-33. Bering Sea District triangle Tanner crab fishery data, 1992-2002.

Year	Number of Vessels	Number of Crabs[a]	Harvest (pounds)	Pots Pulled	Exvessel Value	Fishery Value[b]	Average Weight[c]	Average CPUE[d]	Deadloss
1992-1994					NO LANDINGS				
1995	4	41,914	49,007	22,180	$1.35	$0.05	1.2	1	14,147
1996	1				CONFIDENTIAL				
1997-1999					NO LANDINGS				
2000	1				CONFIDENTIAL				
2001	1				CONFIDENTIAL				
2002					NO LANDINGS				

[a] Deadloss included.
[b] Millions of dollars.
[c] In pounds.
[d] Number of legal crabs per pot lift.

Table 2-34. Bering Sea hair crab fishery data, 1979 - 2002.

	Number of				Pots		Average		
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Registered	Pulled	CPUE[c]	Weight[b]	Deadloss[b]
1979	11	16	2,457	5,213		9,908	<1	2.1	0
1980	9	17	25,417	53,914		14,506	2	2.1	0
1980/81	67	192	1,127,309	2,439,483		172,695	7	2.2	265,369
1981/82	48	159	466,560	932,584		117,518	4	2.0	29,749
1982/83	52	161	575,453	1,211,420		84,346	7	2.1	122,456
1983/84	19	48	200,670	406,538		20,414	10	2.0	28,062
1984[d]	7	26	197,209	396,630		22,392	9	2.0	19,436
1985[d]	3	9	34,410	66,042		3,905	9	2.0	593
1986	3	7	7,289	14,835		4,720	2	2.0	500
1987[e]	2				CONFIDENTIAL				
1988-90[d]					NO LANDINGS				
1991[d]	7	42	441,533	377,708		44,444	10	.9	0
1992[d,e]	9	20	203,758	240,767		38,808	5	1.2	11,495
1992[d,f]	10	47	1,127,948	1,198,590		125,943	9	1.1	65,674
1993[d,e]	4	5	2,347	3,038		9,345	<1	1.3	0
1993/94[d,f,g,h]	19	129	1,936,795	2,331,686		585,913	3	1.2	124,596
1994[d,f]	10	55	897,070	1,199,246	13,350	287,954	3	1.3	49,275
1995[d,f]	21	81	1,485,097	2,059,988	25,750	441,494	3	1.4	73,882

-Continued-

Table 2-34. (Page 2 of 2)

	Number of				Pots		Average		
Year	Vessels	Landings	Crabs[a]	Harvest[a,b]	Registered	Pulled	CPUE[c]	Weight[b]	Deadloss
1996[d]	19	99	485,735	745,804	20,680	410,548	1	1.5	32,495
1997[d]	16	52	420,121	668,096	18,180	211,970	2	1.6	17,522
1998[d]	12	31	188,784	307,739	14,330	128,495	2	1.6	17,392
1999[d]	8	27	139,894	221,656	9,840	92,333	1	1.6	4,677
2000[d]	3	3	1,058	1,546	3,900	3,300	<1	1.5	0
2001-02[d]					FISHERY CLOSED				

[a] Deadloss included.
[b] In pounds.
[c] Number of legal crabs retained per pot pull.
[d] Permit Fishery.
[e] Spring Fishery.
[f] Fall Fishery.
[g] Fishery opened Nov. 1, 1993 and closed April 20, 1994.
[h] Includes seven vessels that landed hair crab incidental to Tanner crab.

Table 2-35. Bering Sea hair crab fishery economic performance data, 1979 - 2002.

		Value		Season	
Year	GHL[a]	Exvessel[b]	Total[c]	Days	Dates
1979		$0.54	$.003	257	04/19-12/31
1980		$0.75	$0.04	244	01/01-08/30
1980/81		$0.80	$1.7	242	11/01-06/30
1981/82		$0.55	$0.5	288	11/01-08/15
1982/83		$0.65	$0.7	297	10/08-08/01
1983/84		$1.20	$0.5	335	08/01-06/30
1984		$1.60	$0.6	184	07/01-12/31
1985		$1.60	$0.1	365	01/01-12/31
1986		$1.15	$0.2	365	01/01-12/31
1987		CONFIDENTIAL		365	01/01-12/31
1988-90		NO LANDINGS		365	01/01-12/31
1991		$3.08	$1.2	365	01/01-12/31
1992		$2.25	$0.5	32	01/01-06/04
1992		$2.46	$2.8	156	10/01-11/01
1993		NA	NA	45	04/01-05/15
1993/94	3.0	$2.42	$5.3	171	11/01-04/20
1994	1.1	$3.55	$4.0	41	11/01-12/12
1995	1.8	$2.87	$5.7	25	11/01-11/26
1996	0.9	$2.65	$1.9	31	11/01-12/02
1997	0.8	$2.97	$1.9	25	11/01-11/25
1998	0.4	$2.70	$0.8	16	10/08-10/23
1999	0.3	$3.20	$0.7	37	10/30-12/07
2000	0.3	$3.84	$0.005	7	10/30-11/05
2001-02		FISHERY CLOSED			

[a] Guideline harvest level, millions of pounds.
[b] Price per pound.
[c] In millions of dollars.

Table 2-36. Bering Sea octopus incidental harvest in groundfish fisheries, 1995-2002.

Year	Number of		Harvest[b]	
	Vessels	Landings[a]	Total[c]	Landed
1995[d]	30	76	17,730	11,967
1996	38	104	27,226	5,337
1997	27	47	12,232	6,997
1998	30	48	9,542	3,855
1999	7	8	6,961	376
2000	50	128	39,944	16,303
2001	62	163	50,947	8,982
2002	70	185	56,179	39,466

[a] All landings incidental to other fisheries.
[b] Numbers from state groundfish fishtickets (Neptune database), in pounds.
[c] Discards at sea included.
[d] The 1995 directed fishery data is confidential, and is not included in this table.

Table 2-37. Bering Sea snail catch statistics by season, 1992 - 2002.

	Number of		Number of Pots				Pounds	
Year	Vessels	Landings	Registered	Pulled	Harvest[a,b]	CPUE[c]	Per Pot[d]	Deadloss[b]
1992				CONFIDENTIAL				
1993	4	10	13,800	44,686	312,876	25	7	NA
1994	4	42	14,850	279,349	2,027,328	21	7.3	62,571
1995	4	38	18,800	262,096	2,352,825	28	9	22,371
1996	5	67	31,300	741,326	3,572,992	16	4.8	62,494
1997	3	17	14,500	191,893	932,048	16	4.9	77,131
1998-2002				NO LANDINGS				

[a] Deadloss included.
[b] In pounds.
[c] Number of snails per pot pull.
[d] Whole weight.

Table 2-38. Bering Sea snail economic performance, 1992 - 2002.

Year	Harvest[a]	Number of		Value	
		Vessels	Landings	Exvessel[b]	Total
1992			CONFIDENTIAL		
1993	312,876	4	10	$0.40	$125,150
1994	1,964,757	4	42	$0.34	$668,017
1995	2,330,454	4	38	$0.30	$699,136
1996	3,510,498	5	67	$0.30	$1,053,149
1997	854,917	3	17	$0.36	$307,770
1998-2002			NO LANDINGS		

[a] In pounds.
[b] Price per pound.

Table 2-39. North Peninsula District Dungeness crab fishery statistics, 1992 - 2002.

	Number of			Pots	Value		Average		
Year	Vessels	Crabs[a]	Harvest[a,b]	Pulled	Exvessel[c]	Total[d]	Weight[b]	CPUE[e]	Deadloss[b]
1992					NO LANDINGS				
1993	2				CONFIDENTIAL				
1994	2				CONFIDENTIAL				
1995	6	63,732	134,407	34,499	$1.32	$0.18	2.1	4	367
1996	1				CONFIDENTIAL				
1997	2				CONFIDENTIAL				
1998	1				CONFIDENTIAL				
1999					NO LANDINGS				
2000	1				CONFIDENTIAL				
2001					NO LANDINGS				
2002	3	11,173	21,871	2,431	$1.78	$0.04	2.0	5	236

[a] Deadloss included.
[b] In pounds.
[c] Price per pound.
[d] Millions of dollars.
[e] Number of legal crabs per pot pull.

Table 2-40. The Community Development Quota (CDQ) Program percent allocation by each participating group.

Fishery	Group[a]					
	APICDA	BBEDC	CBSFA	CVRF	NSEDC	YDFDA
Bristol Bay Red King Crab	18	18	10	18	18	18
Pribilof Red & Blue King Crab	0	0	100	0	0	0
St. Mathew Blue King Crab	50	12	0	12	14	12
Norton Sound Red King Crab	0	0	0	0	50	50
Bering Sea Snow Crab	10	19	19	17	18	17
Bering Sea Tanner Crab	10	19	19	17	18	17

[a] APICDA (Aleutian Pribilof Island Community Development Association).
BBEDC (Bristol Bay Economic Development Corporation).
CBSFA (Central Bering Sea Fishermen's Association).
CVRF (Coastal Villages Region Fund).
NSEDC (Norton Sound Economic Development Corporation).
YDFDA (Yukon Delta Fisheries Development Association).

Table 2-41. The crab Community Development Quota (CDQ) Program fisheries statistics.

Fishery	Allocation[a]	Number of			Harvest[a,b]	Deadloss[a]	CPUE[c]
		Vessels	Landings	Crabs			
			Bristol Bay Red King Crab				
1998			Confidential				
1999			Confidential				
2000			Confidential				
2001			Confidential				
2002			Confidential				
			Pribilof Red King Crab				
1998			Confidential				
1999			Fishery Closed				
2000			Fishery Closed				
2001			Fishery Closed				
2002			Fishery Closed				
			Pribilof Blue King Crab				
1998			Confidential				
1999			Fishery Closed				
2000			Fishery Closed				
2001			Fishery Closed				
2002			Fishery Closed				
			St. Matthew Blue King Crab				
1998			Confidential				
1999			Fishery Closed				
2000			Fishery Closed				
2001			Fishery Closed				
2002			Fishery Closed				
			Bering Sea Snow Crab				
1998	8,886,634	20	86	6,975,242	8,846,977	134,898	174
1999	9,674,326	23	104	7,747,876	9,670,084	92,871	165
2000			Confidential				
2001			Confidential				
2002	2,458,565	11	33	1,873,780	2,399,716	73,168	99
			Bering Sea Tanner Crab				
1998			Fishery Closed				
1999			Fishery Closed				
2000			Fishery Closed				
2001			Fishery Closed				
2002			Fishery Closed				

[a] In pounds.
[b] Includes deadloss.
[c] Defined as legal crabs per pot pull.

Table 2-42. The crab Community Development Quota (CDQ) Program economic overview.

Fishery	Harvest[a]	Exvessel Value	Fishery Value[b]	Average Weight[a]	Pots Registered	Pots Pulled
			Bristol Bay Red King Crab			
1998			Confidential			
1999			Confidential			
2000			Confidential			
2001			Confidential			
2002			Confidential			
			Pribilof Red King Crab			
1998			Confidential			
1999			Fishery Closed			
2000			Fishery Closed			
2001			Fishery Closed			
2002			Fishery Closed			
			Pribilof Blue King Crab			
1998			Confidential			
1999			Fishery Closed			
2000			Fishery Closed			
2001			Fishery Closed			
2002			Fishery Closed			
			St. Matthew Blue King Crab			
1998			Confidential			
1999			Fishery Closed			
2000			Fishery Closed			
2001			Fishery Closed			
2002			Fishery Closed			
			Bering Sea Snow Crab			
1998	8,712,079	$ 0.54	$ 4,704,523	1.3	4,016	39,575
1999	9,577,213	$ 0.85	$ 8,140,631	1.2	5,250	46,490
2000			Confidential			
2001			Confidential			
2002	2,326,548	$ 1.33	$ 3,094,309	1.3	2,100	18,835
			Bering Sea Tanner Crab			
1998			Fishery Closed			
1999			Fishery Closed			
2000			Fishery Closed			
2001			Fishery Closed			
2002			Fishery Closed			

[a] In pounds, live weight only.
[b] CDQ group portion estimated at 20 to 30% of fishery value.

Table 2-43. Pot limits for Bering Sea king and Tanner crab fisheries, 2001-2002.

Fishery	GHL Range (Million Pounds)	Number of Vessels	Pot Limits	
			<= 125'[a]	> 125'[a]
Norton Sound Section king Crab [b]	-	-	40	50
St. Lawrence Island Section king Crab [b]	-	-	40	50
Pribilof Island Section king Crab [b]	-	-	40	50
St. Matthew Island Section king Crab [b]	-	-	60	75
Bering Sea District Tanner Crab [b]	-	-	200	250
Bristol Bay red king Crab [c]	< 4.0	NA	NA	NA
	4.0 to 5.9	< 200	80	100
		200 to 250	60	75
		> 250	60	75
	6.0 to 8.9	< 200	120	150
		200 to 250	100	125
		> 250	100	125
	9.0 to 12	< 200	200	250
		200 to 250	160	200
		> 250	160	200
	> 12	Any	200	250

[a] Vessel Length Overall in feet.
[b] Pot limits independent of number of registered vessels and GHL.
[c] Multi-tiered pot limits effective 1997.

Table 2-44. Number of Bering Sea buoy tags printed and issued by fishery, 2001-2002.

Fishery	Number of Tags Ordered [a]	Tag Sets Issued		Total Sets	Tags Issued		Replct. Tags	Total Tags
		<= 125' [b]	> 125' [b]		<= 125' [b]	> 125' [b]		
South Peninsula grooved Tanner crab	Surplus Tags				NO FISHING EFFORT			
Pribilof red and blue king crab	Tags in Storage				NO COMMERCIAL FISHERY			
Pribilof red and blue king crab CDQ [c]	-				NO COMMERCIAL FISHERY			
Pribilof golden king crab	Surplus Tags	8	0	8	320	0	7	327
St. Matthew blue king crab	Tags in Storage				NO COMMERCIAL FISHERY			
St. Matthew blue king crab CDQ	-				NO COMMERCIAL FISHERY			
St. Matthew golden king crab [d]	Surplus Tags				NO COMMERCIAL FISHERY			
Bristol Bay red king crab	65,000	169	73	242	16,785	9,125	103	26,013
Bristol Bay red king crab CDQ	Surplus Tags	7	3	10	723	365	0	1,088
Bering Sea Tanner Crab	Tags in Storage				NO COMMERCIAL FISHERY			
Bering Sea Tanner Crab CDQ	-				NO COMMERCIAL FISHERY			
Bering Sea snow crab	62,500	127	65	192	22,969	15,064	36	38,069
Bering Sea snow crab CDQ	Surplus Tags	8	3	11	1,485	750	0	2,235
Aleutian Islands red king crab	Surplus Tags	23	10	33	759	420	1	1,180
Totals	127,500	342	154	496	43,041	25,724	147	68,912

[a] Tags ordered in sets of 250, then separated per each fishery's pot limit.
[b] Vessel Length Overall in feet.
[c] Community Development Quota.
[d] Pot limits independent of number of registered vessels and GHL.

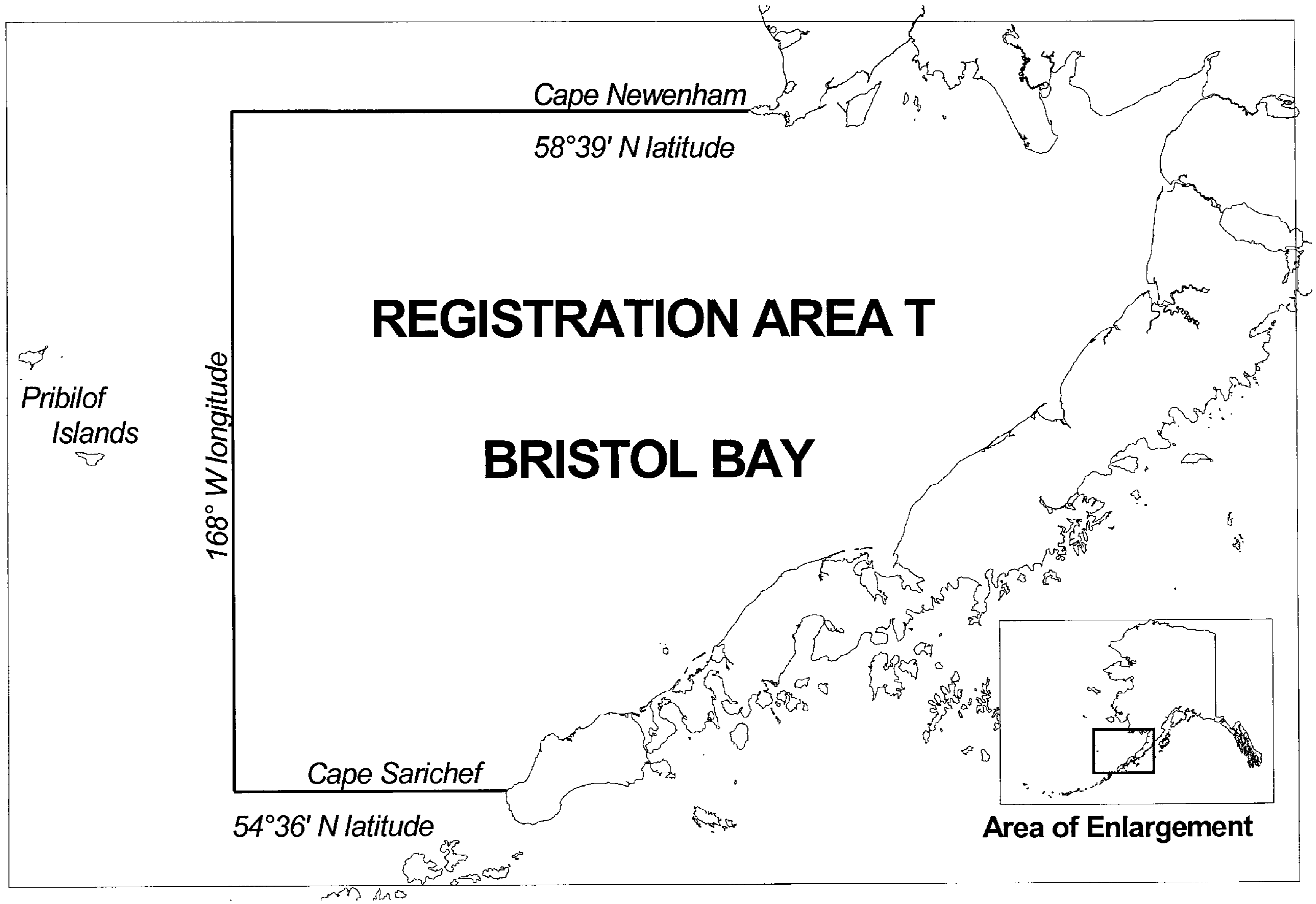

Figure 2-1. King crab Registration Area T (Bristol Bay).

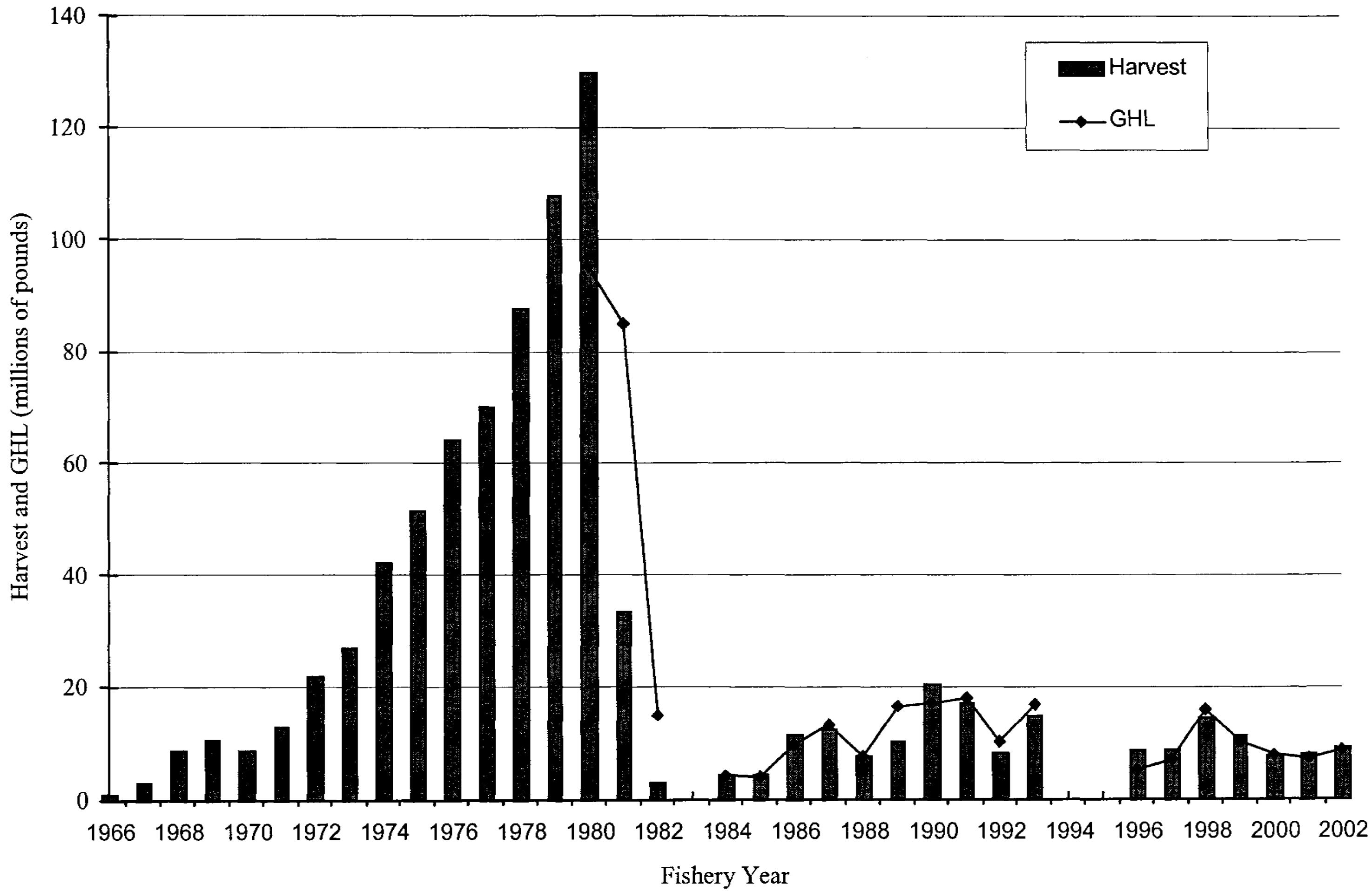

Figure 2-2. Historic Bristol Bay red king crab harvest and guideline harvest levels, 1966-2002.

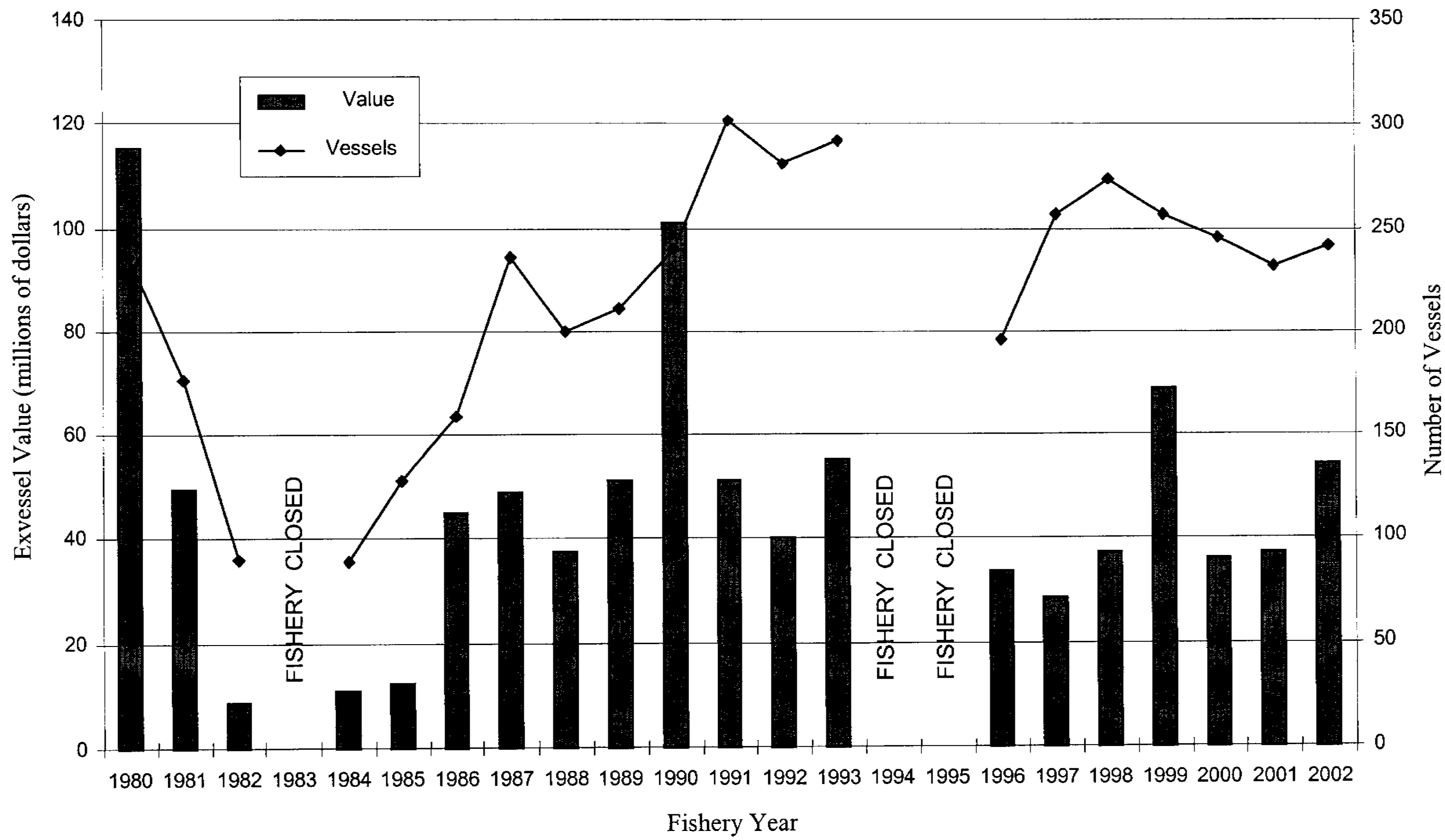

Figure 2-3. Bristol Bay red king crab fishery effort and exvessel value, 1980 - 2002.

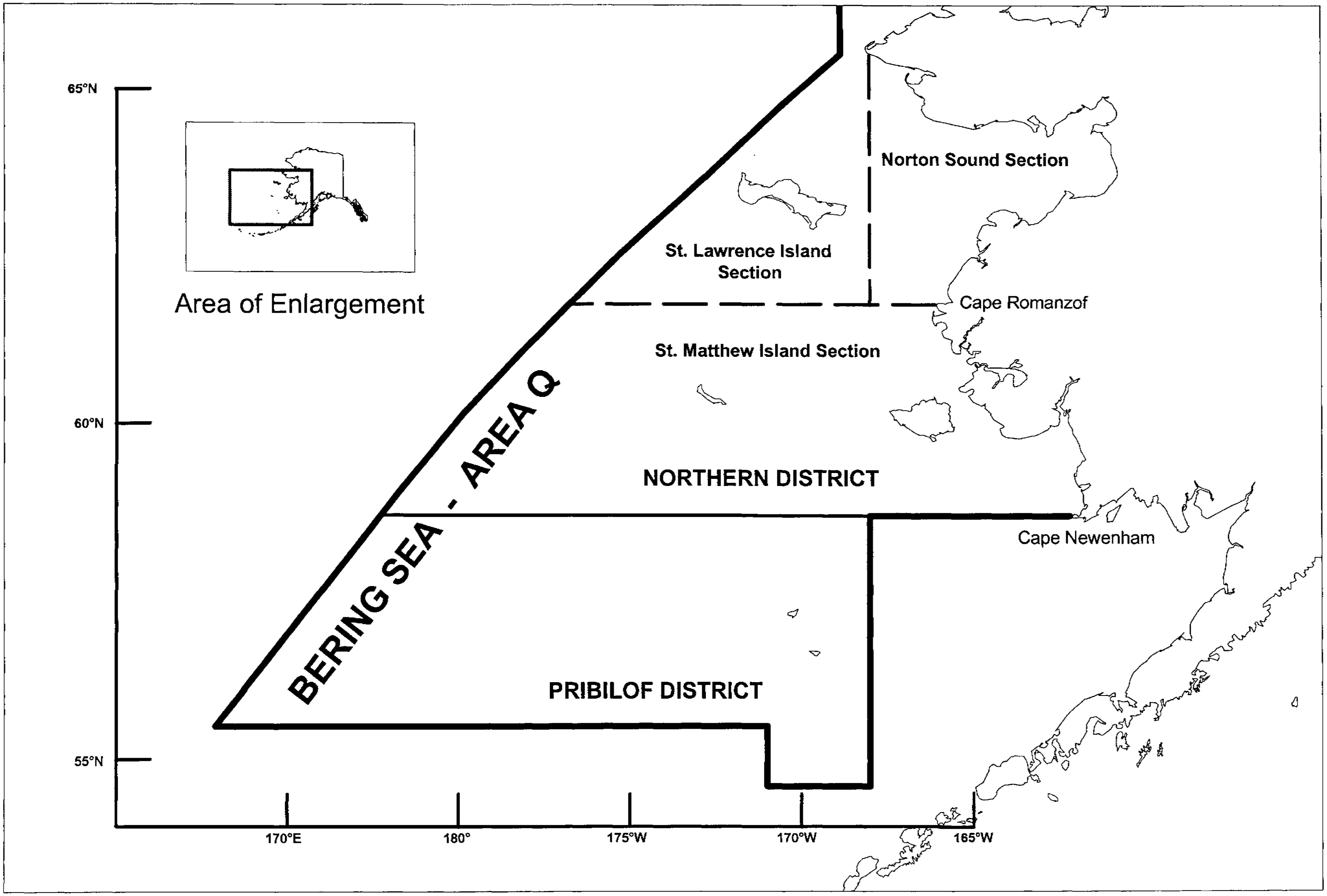

Figure 2-4. King crab Registration Area Q (Bering Sea).

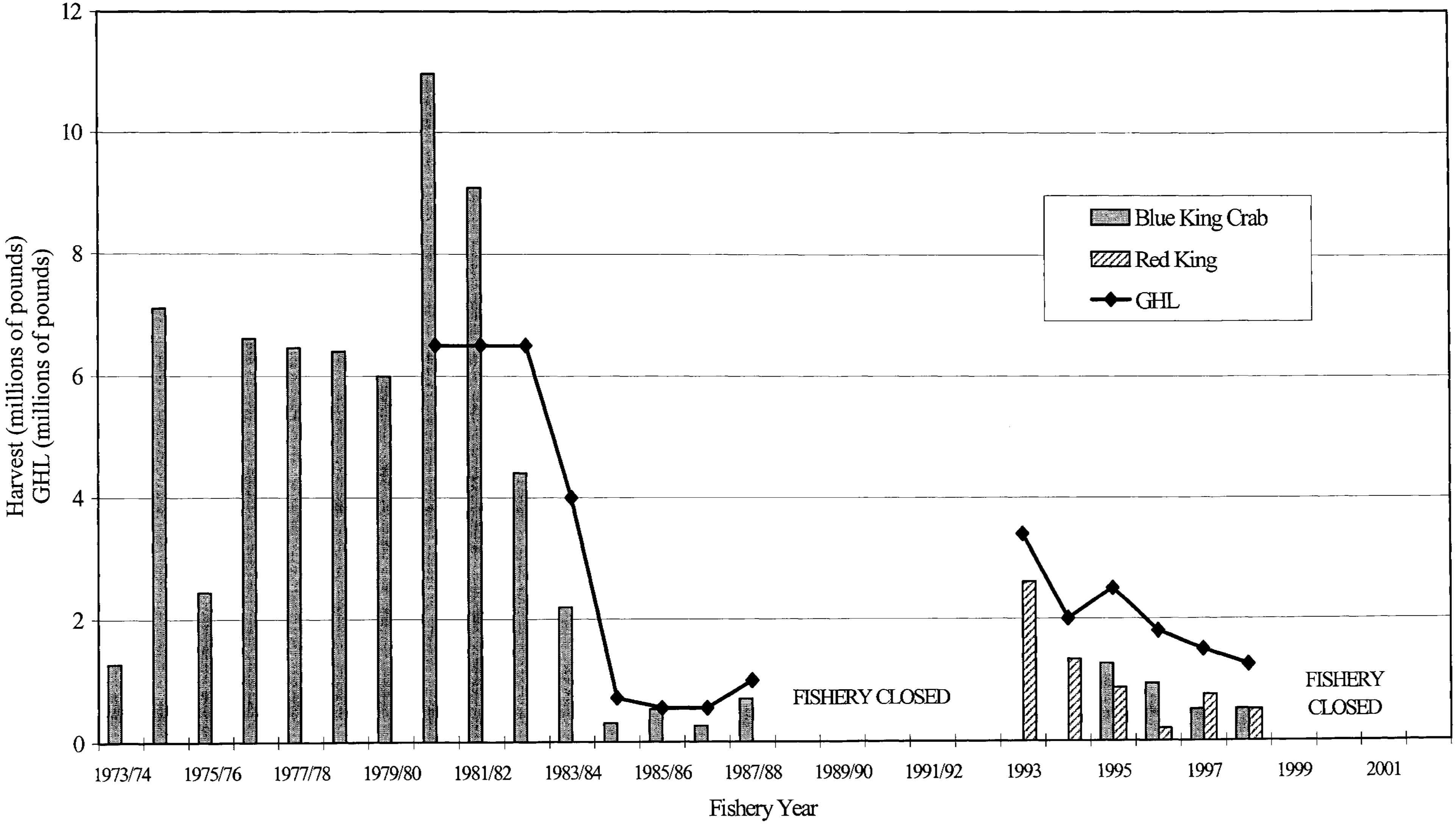

Figure 2-5. Historic red and blue king crab harvest in pounds with guideline harvest level (GHL) for the Pribilof District, 1973 - 2002. GHL for red and blue king crab is combined from 1995 to 1998.

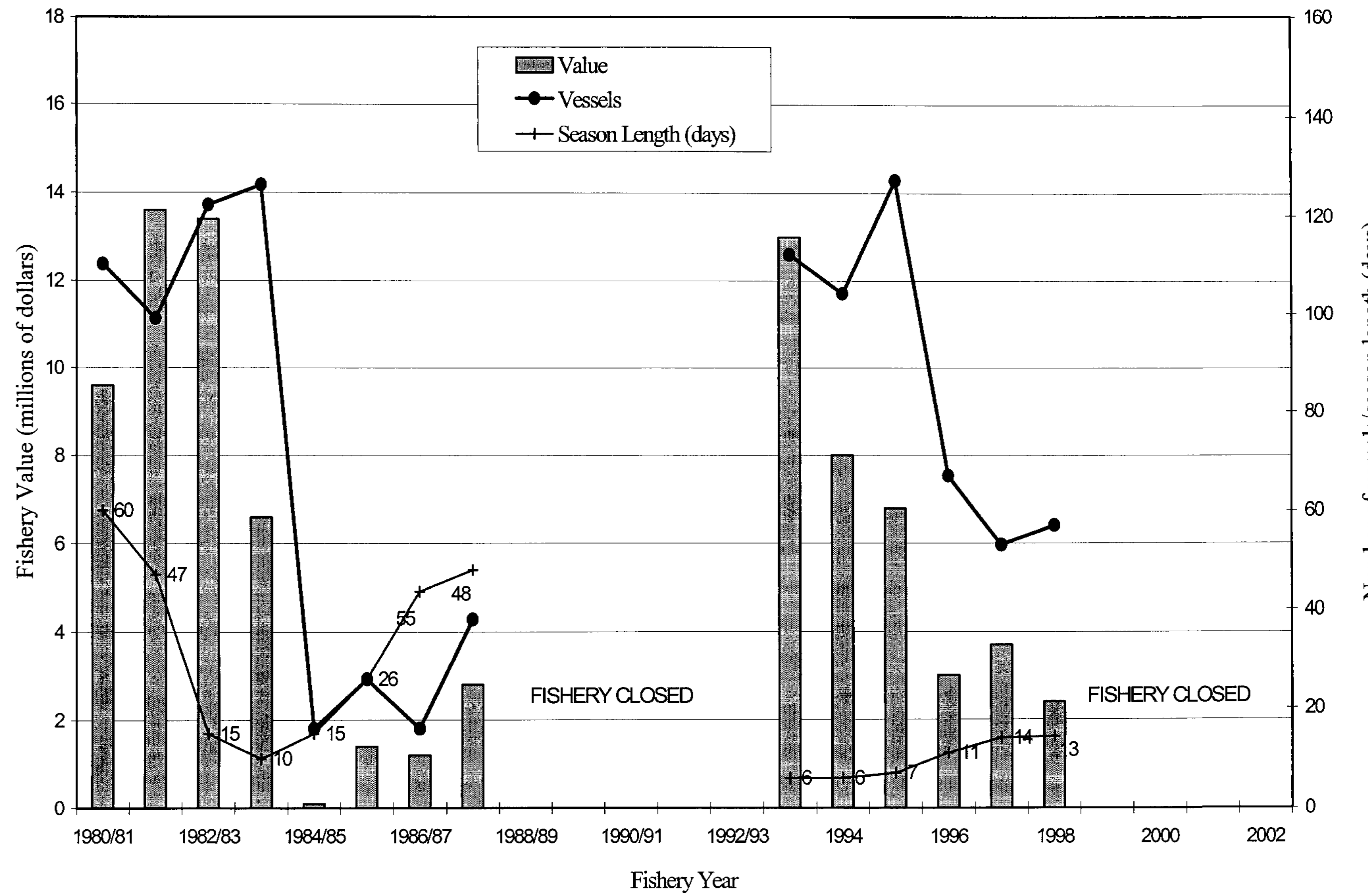

Figure 2-6. Number of vessels, season length, and total fishery value of the Pribilof District king crab fishery, 1980-2002.

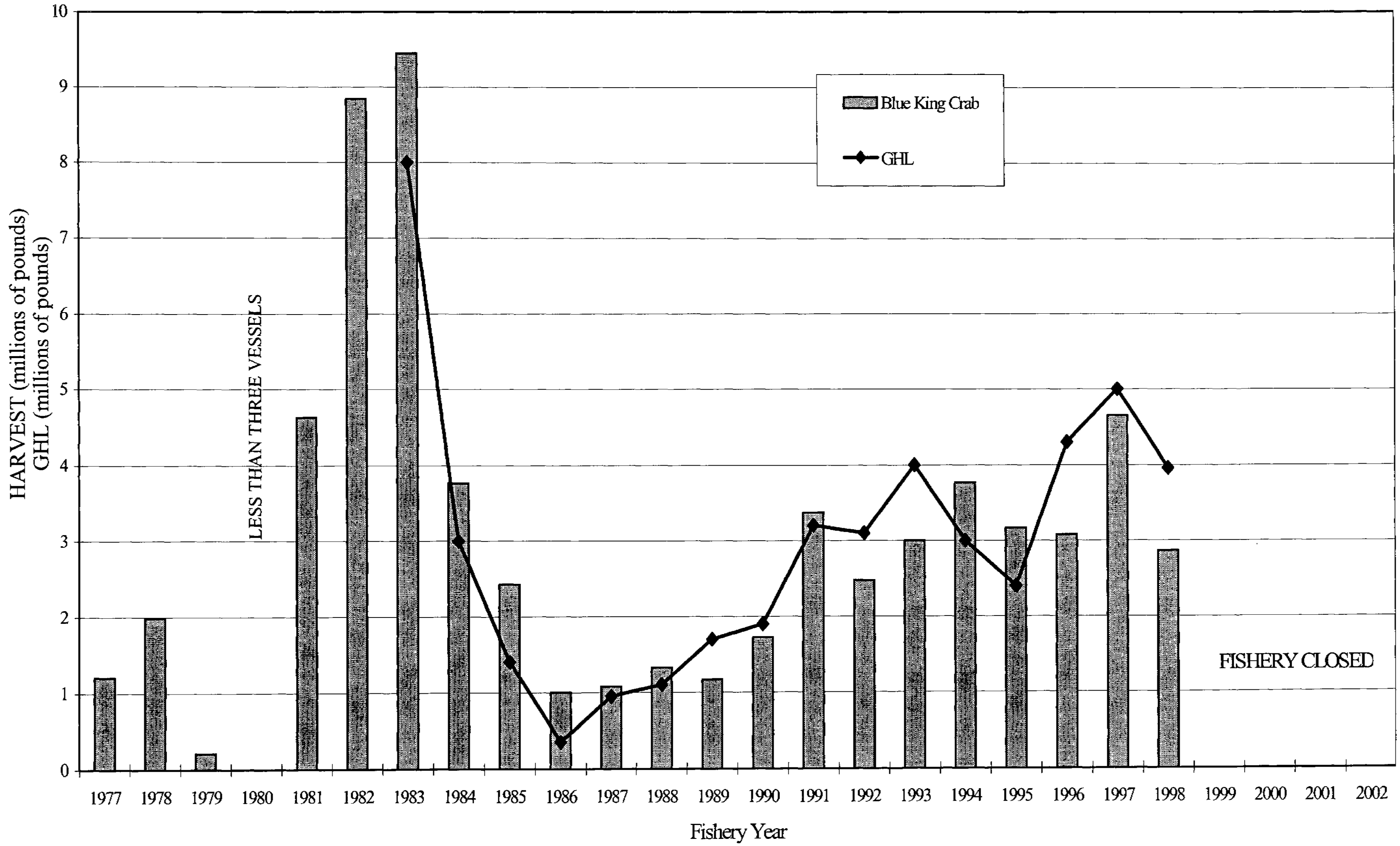

Figure 2-7. Historic blue king crab harvest and guideline harvest level for the Saint Matthew Island Section, 1977-2002.

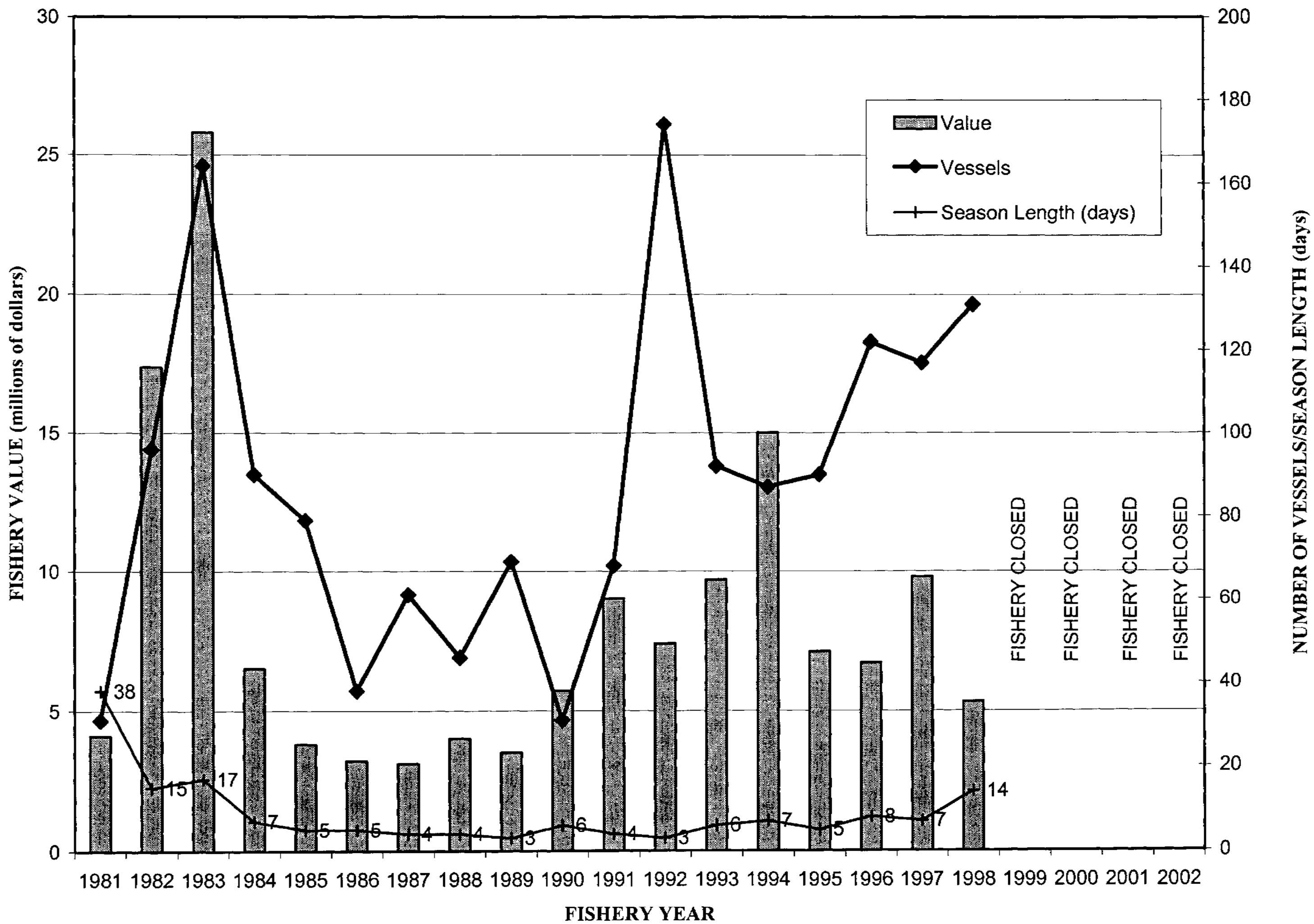

Figure 2-8. Total effort, season length (days) and total fishery value of the St. Matthew Island king crab fishery, 1981 - 2002.

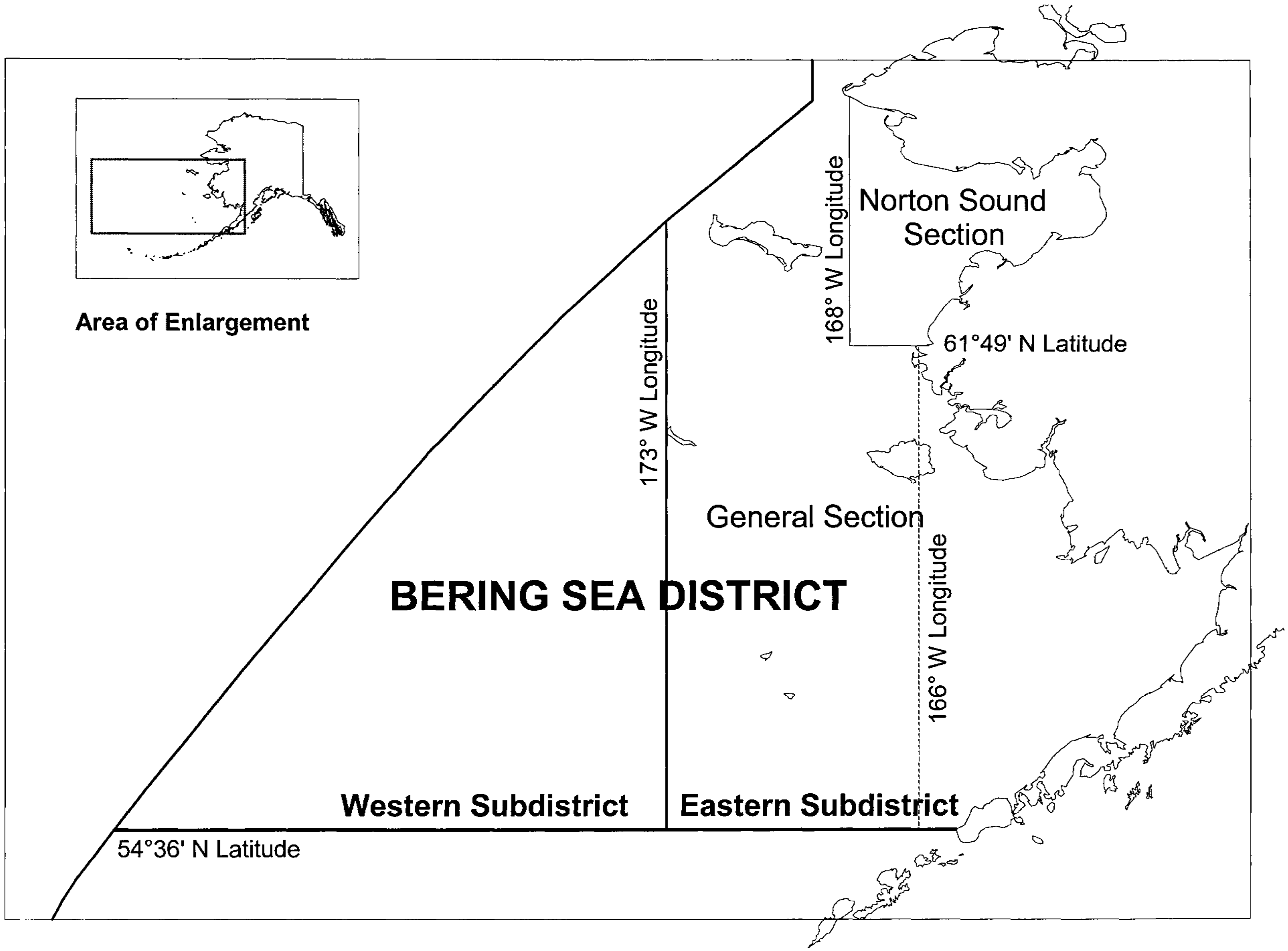

Figure 2-9. Bering Sea District of Tanner crab Registration Area J showing subdistricts and sections.

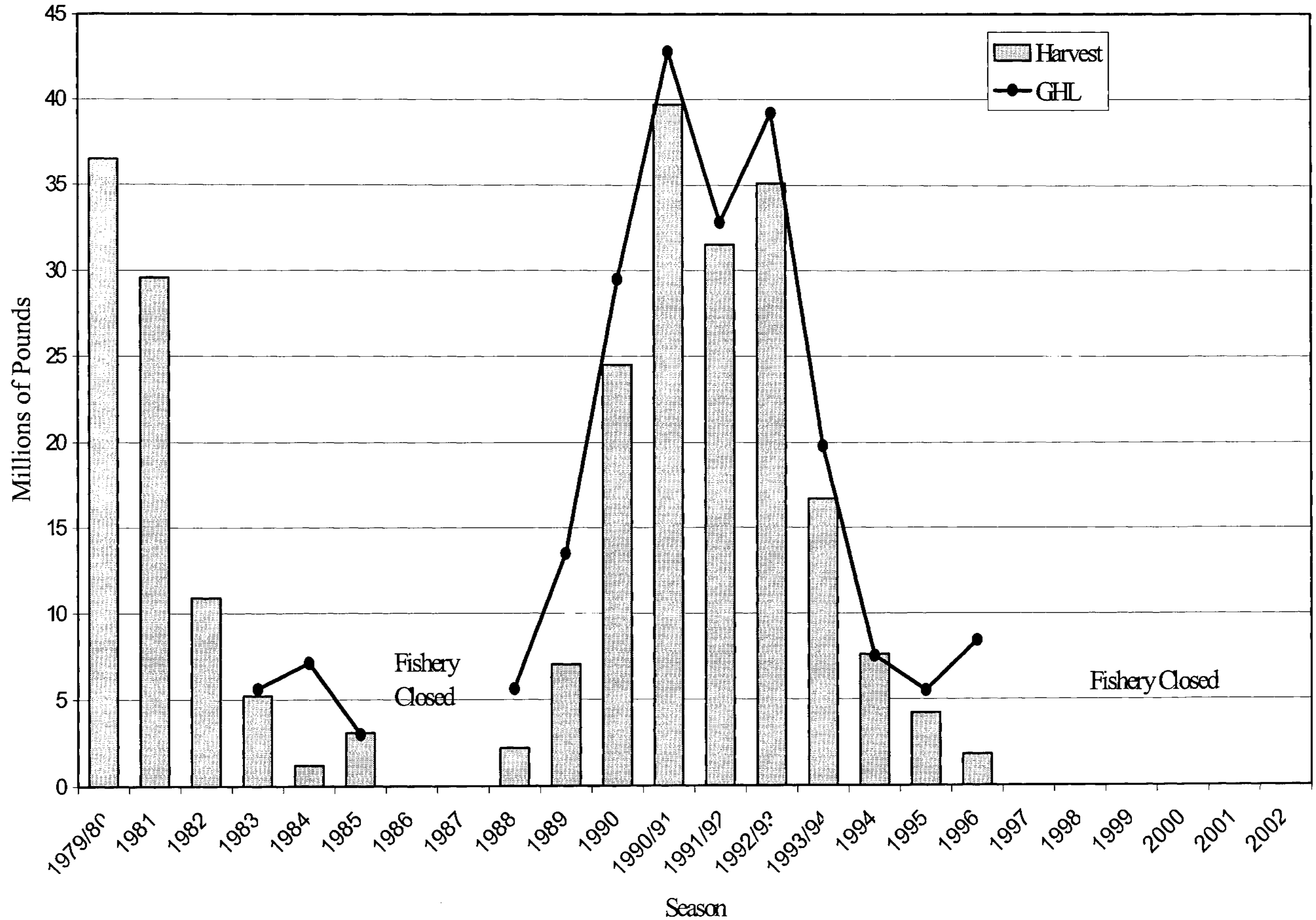

Figure 2-10. Bering Sea Tanner crab harvest and guideline harvest levels, 1979-2002.

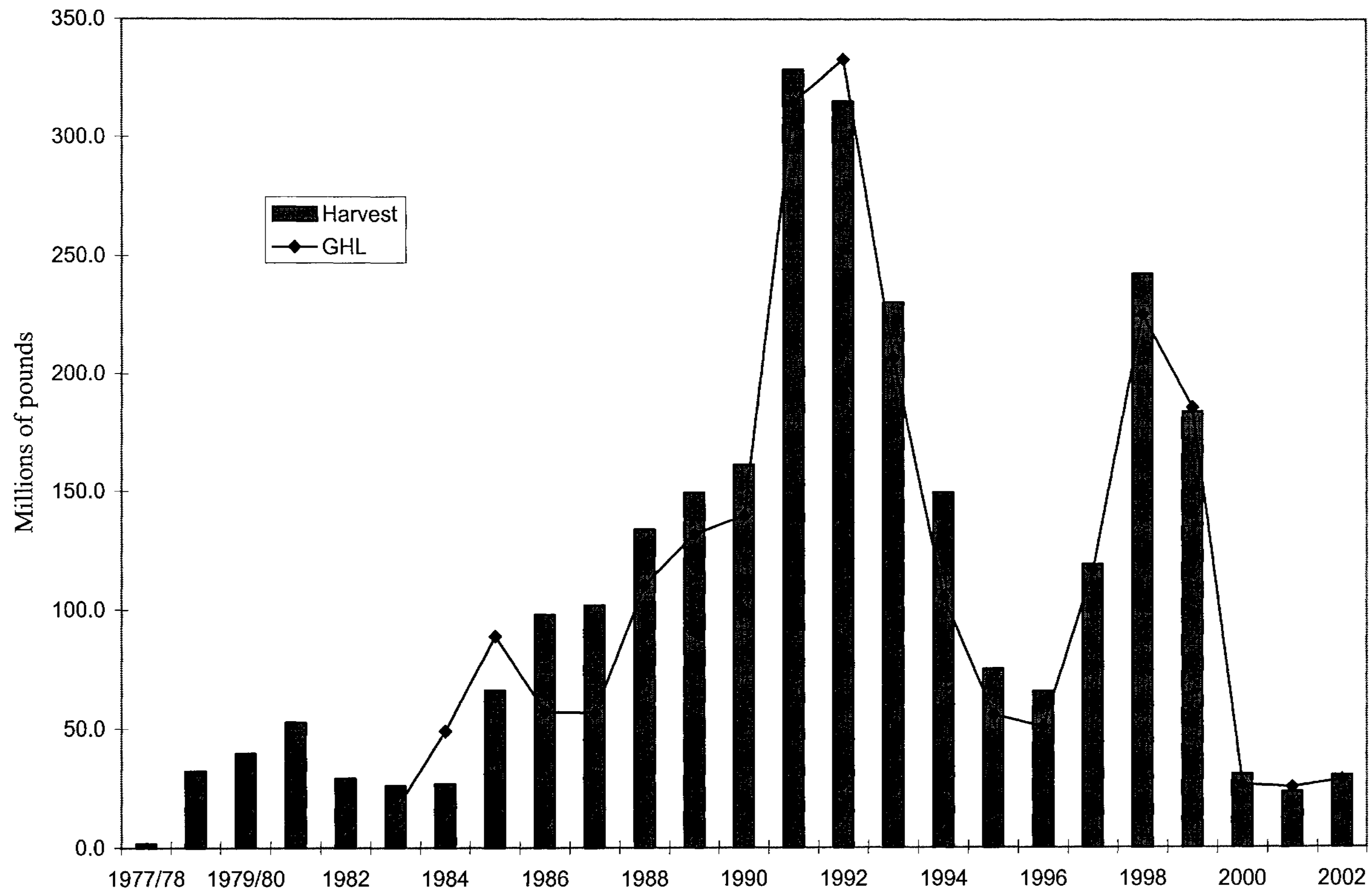

Figure 2-11. Bering Sea snow crab fishery harvest and guideline harvest level, 1977-2002.

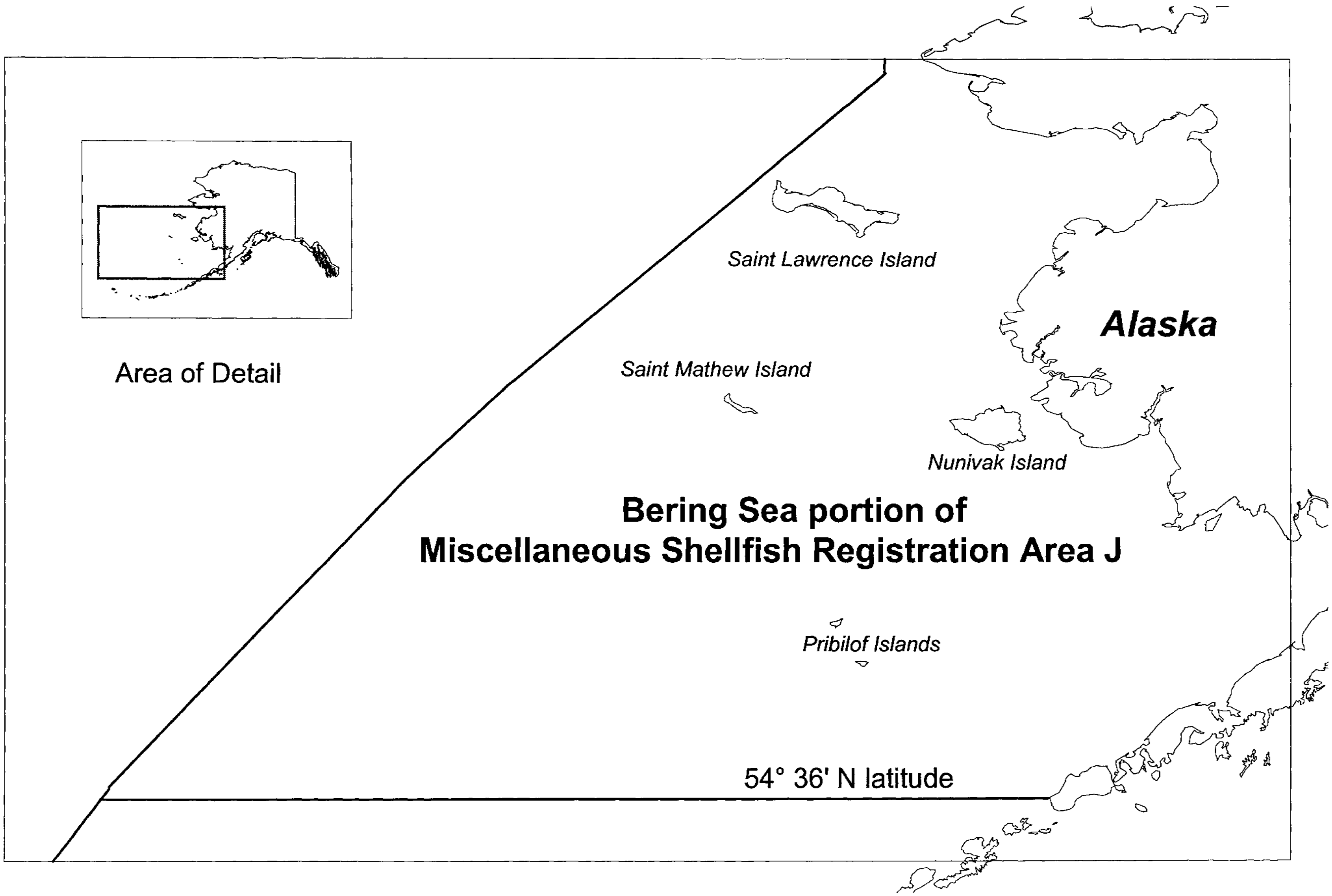

Figure 2-12. The Bering Sea portion of miscellaneous shellfish Registration Area J.

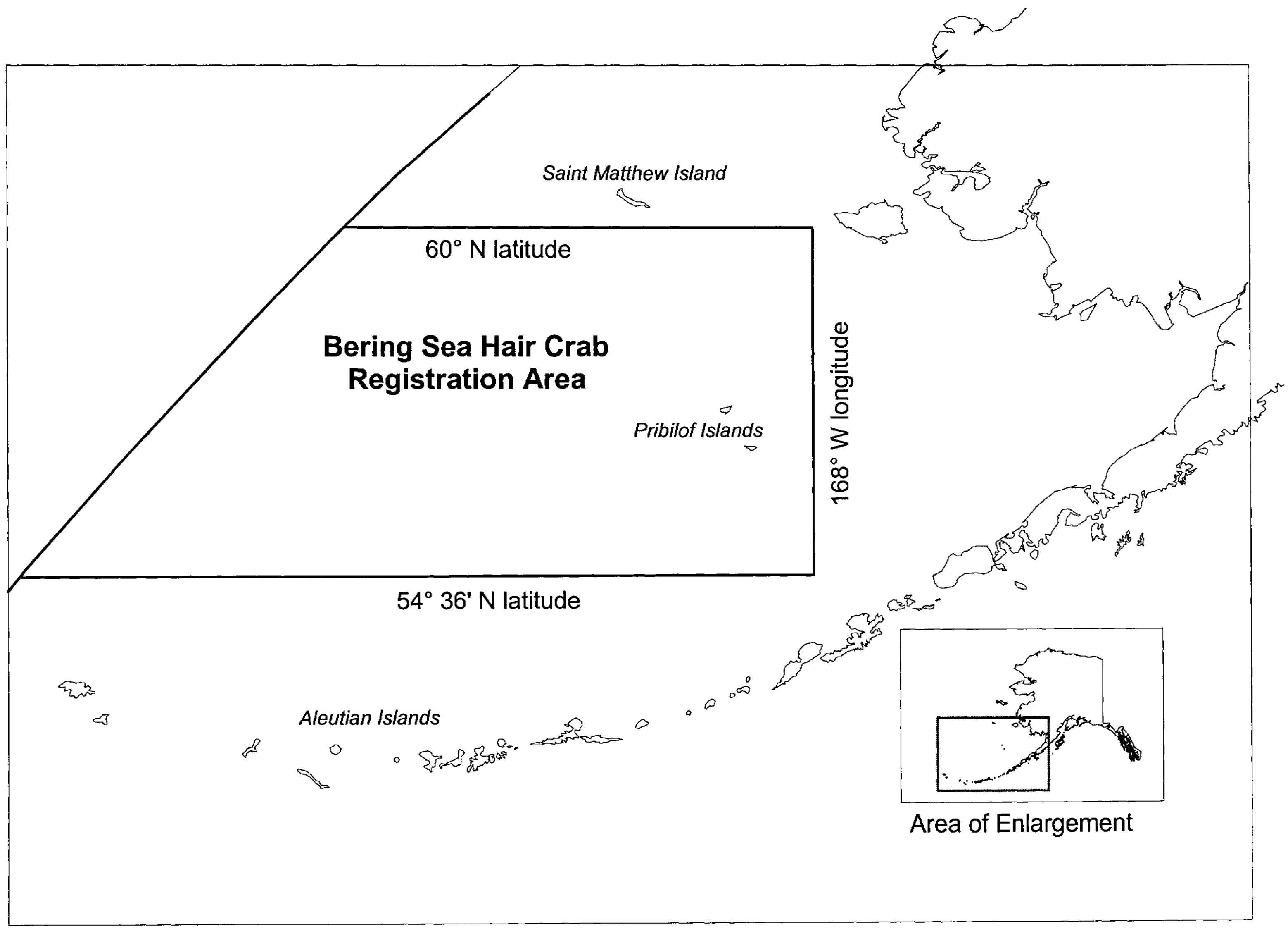

Figure 2-13. Bering Sea hair crab fishing area of miscellaneous shellfish Registration Area J.

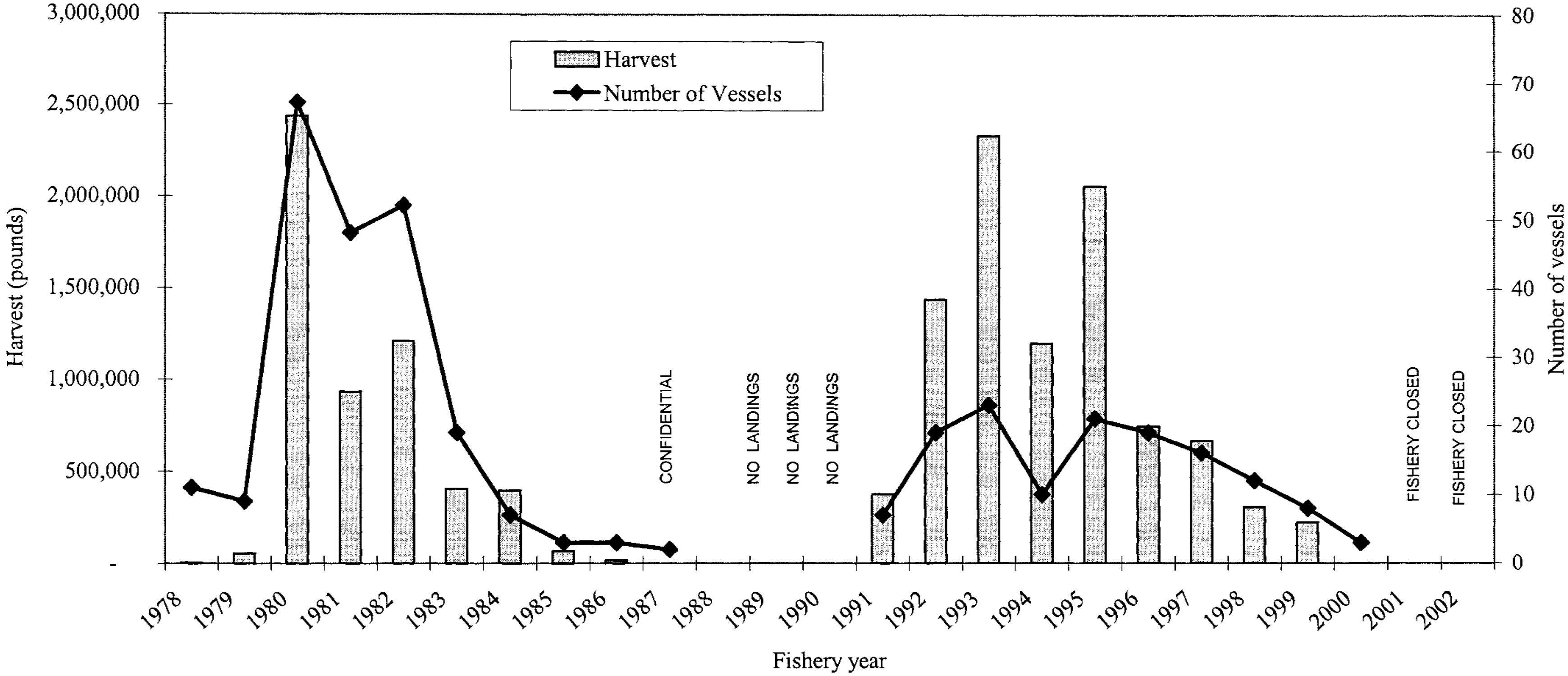

Figure 2-14. Bering Sea hair crab fishery harvest and effort, 1978-2002.

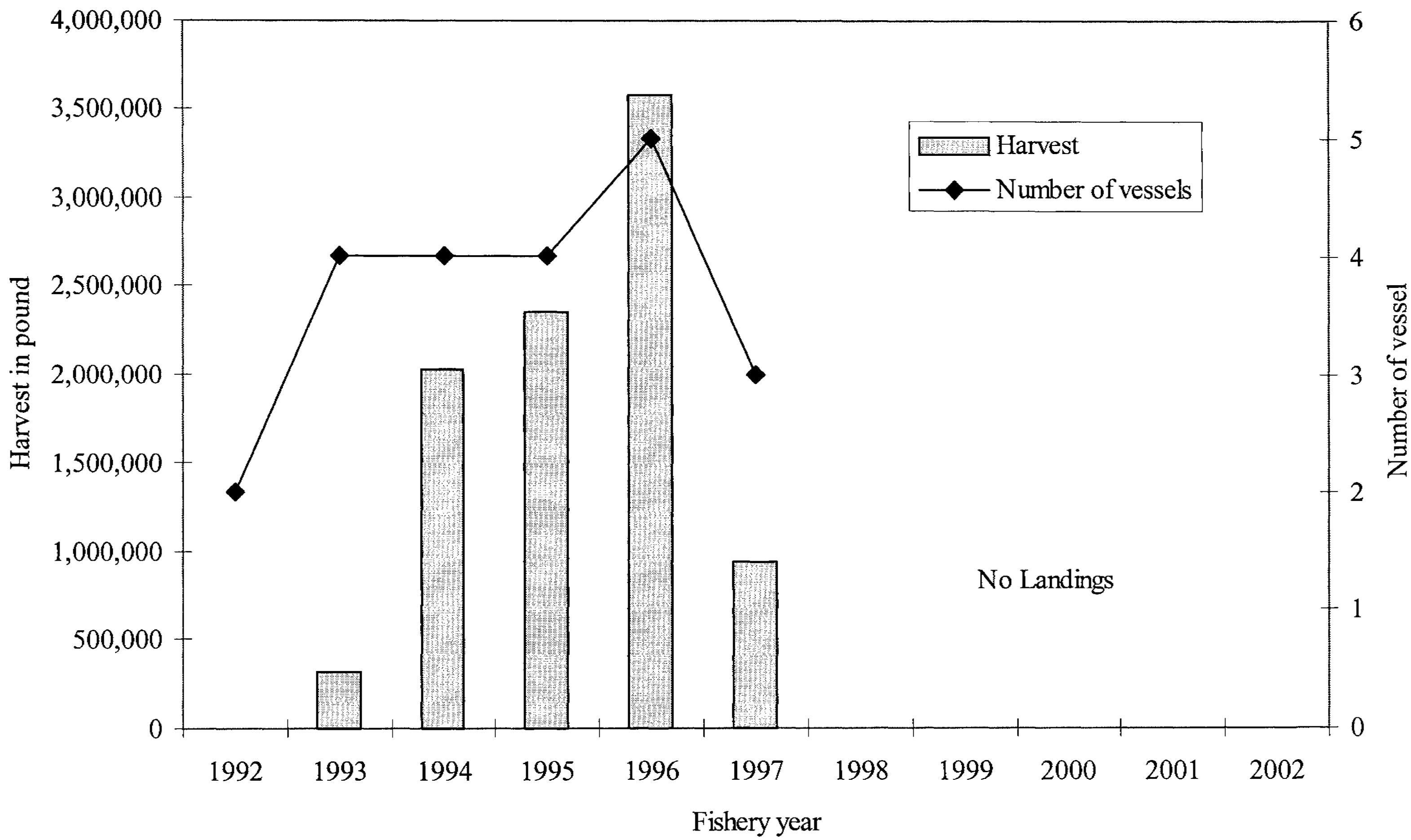

Figure 2-15. Number of vessels and harvest in the Bering Sea snail fishery, 1992 - 2002.

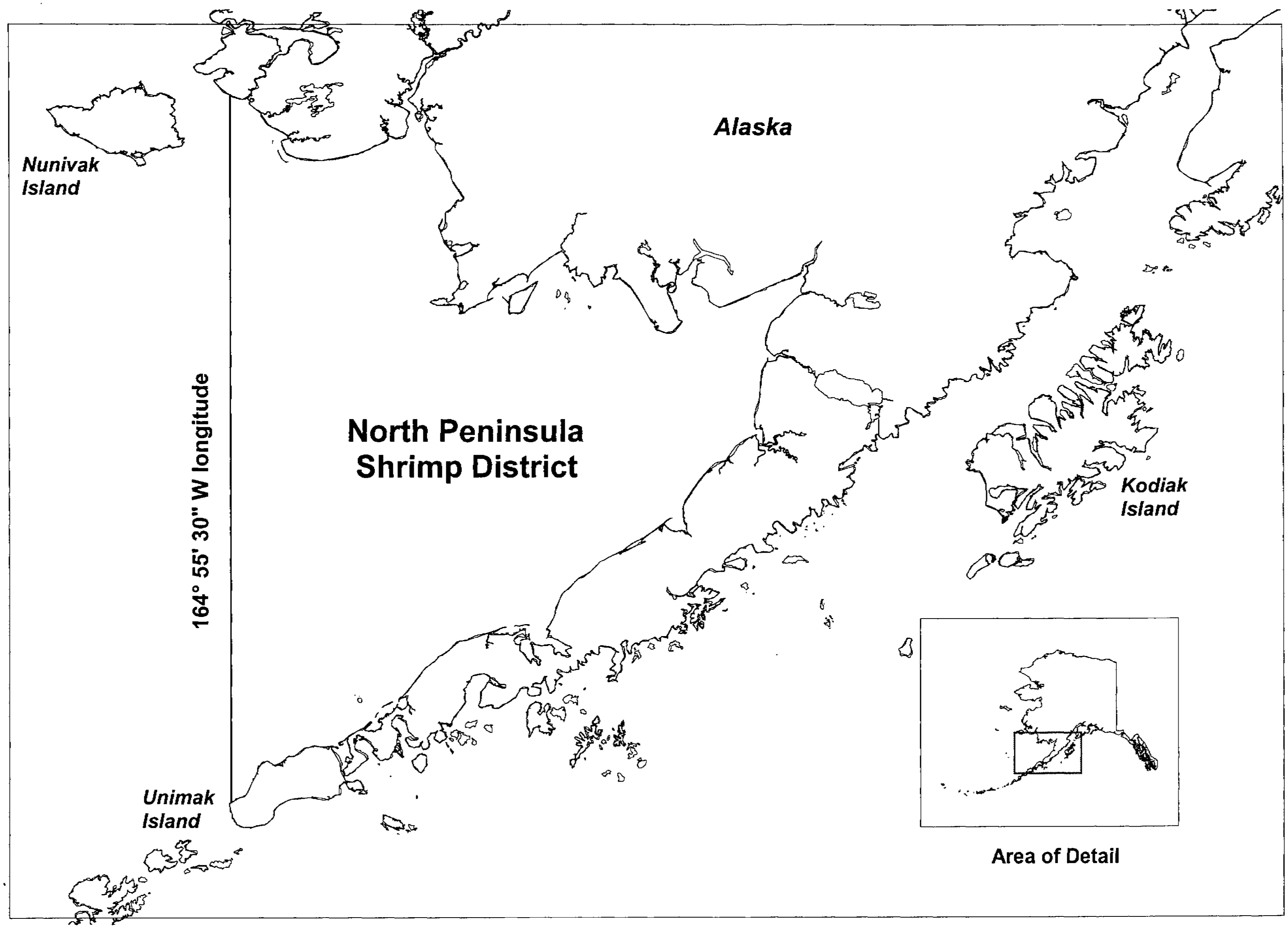

Figure 2-16. The North Peninsula District of shrimp Registration Area J.

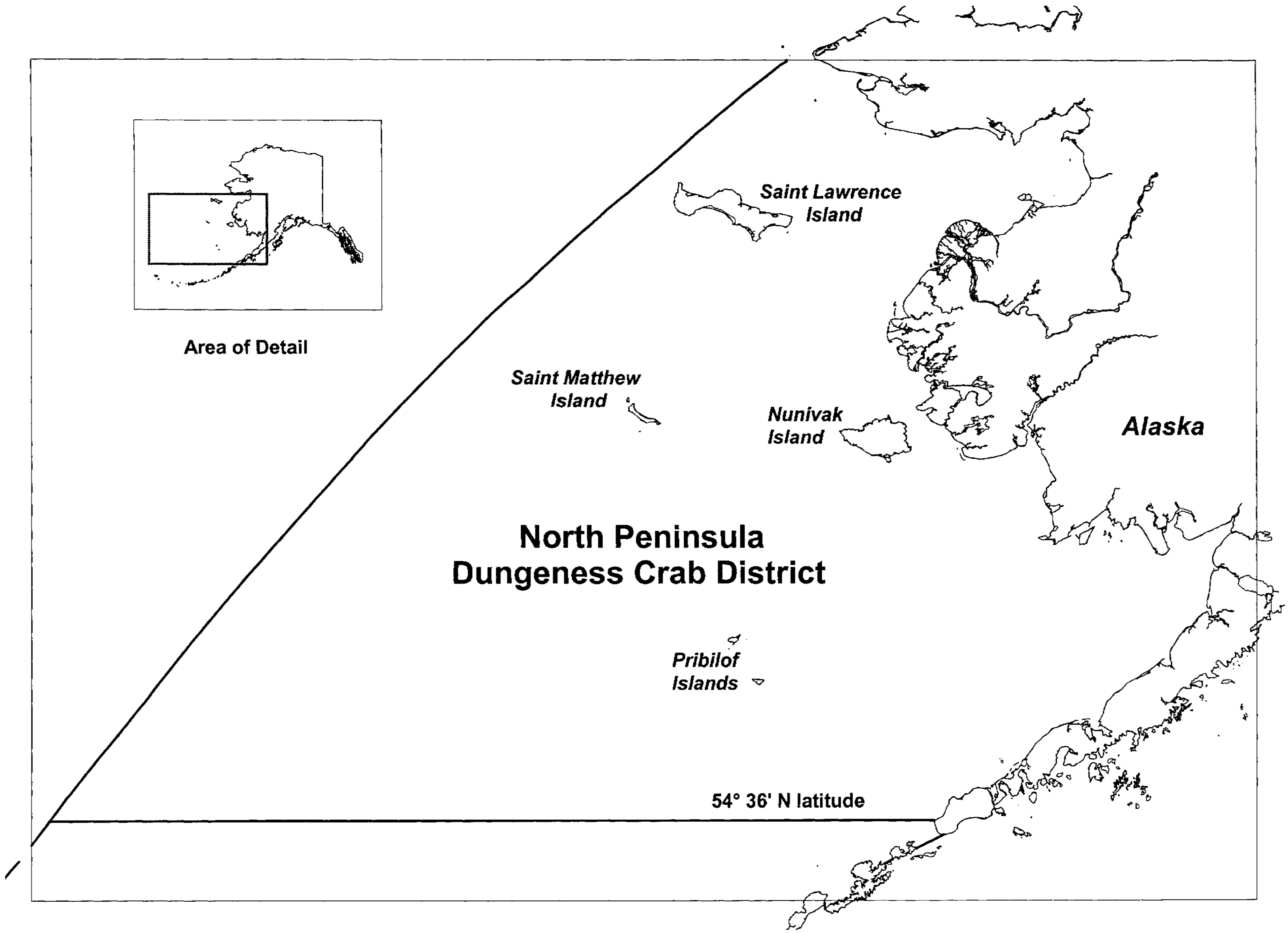

Figure 2-17. North Peninsula District of Dungeness crab Registration Area J.

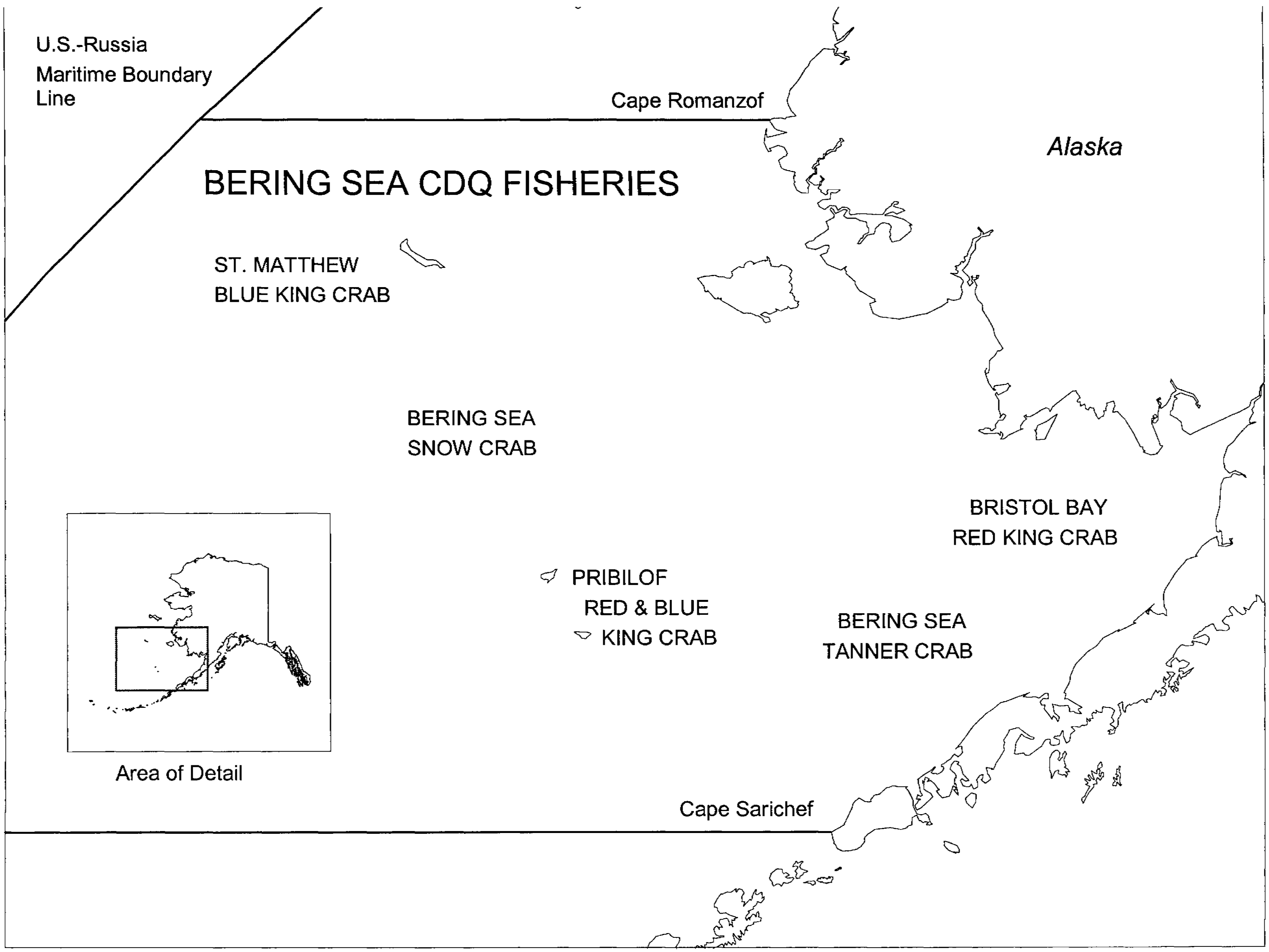

Figure 2-18. Fisheries of the Bering Sea crab Community Development Quota Program managed by the Dutch Harbor staff.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: January 3, 2002

TANK INSPECTIONS AND FISHERY MANAGEMENT FOR THE 2002 BERING SEA SNOW CRAB FISHERY

The 2002 Bering Sea snow crab fishery will open at noon on January 15 with a guideline harvest level (GHL) of 28.51 million pounds. The post-season community development quota is 2.31 million pounds.

Preseason tank inspections will begin on January 8 in Dutch Harbor, King Cove and False Pass, and January 10 in Akutan pending arrival of ADF&G staff in those locations. Quick registration will begin at noon on January 13 in Dutch Harbor, Akutan, King Cove and False Pass. Tank inspections will be available at noon on January 14 in Saint Paul. Fishers are reminded that the holder of a 2002 T91Q or T09Q Bering Sea Tanner crab interim use permit card and the vessel's observer, if required, must be on the vessel at the time of registration and during all fishing operations. In addition, all pots onboard the vessel and in wet storage must be legally configured when the vessel is registered.

ADF&G will manage the 2002 Bering Sea snow crab fishery based on inseason reports from fishers. Reports will be taken once each day. The reporting period will be from 6:00 AM to 6:00 AM of the previous day. Vessels reporting via single side band radio will report at 10:00 AM and vessels reporting via marine telex should report by 8:00 AM. ADF&G personnel will provide catch reporting information and will enlist vessels for daily reporting during preseason tank inspections and quick registration. Vessel operators may also obtain inseason catch reporting information from the ADF&G office in Dutch Harbor. Vessel operators are encouraged to participate in this voluntary reporting program.

Advance notice for the fishery closure will be based on actual and anticipated harvest rates. ADF&G will attempt to provide the greatest advance notice possible, however, the fishery could close on as little as 24-hours advance notice. ADF&G will broadcast the closure announcement on SSB 4125 mHz, by fax and e-mail to all persons and organizations on ADF&G's news release distribution list.

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Buoy tags may be purchased at the Dutch Harbor and Kodiak offices of ADF&G Monday through Friday, 8:00 AM until 4:30 PM. In addition, the ADF&G office in Dutch Harbor will be open for buoy tag sales from 9:00 AM until 4:30 PM on Saturday January 12 and Sunday January 13.

ADF&G, in conjunction with the United States Coast Guard and National Weather Service, will assess weather conditions prior to the start of tank inspections on January 13 for potential weather-related delay of the season opening, based on search and rescue criteria.

Current fishery management plans for the 2002 Bering Sea snow crab fishery providing a brief overview of fishery management and regulations specific to this fishery are available at the Dutch Harbor and Kodiak ADF&G offices.

For further information contact the ADF&G in Dutch Harbor at (907) 581-1239.

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ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
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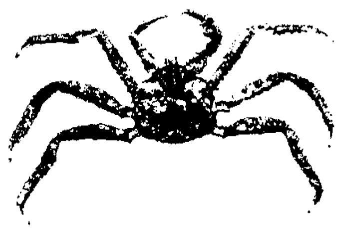


Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: January 13, 2002

SEASON OPENING OF THE 2002 BERING SEA SNOW CRAB FISHERY

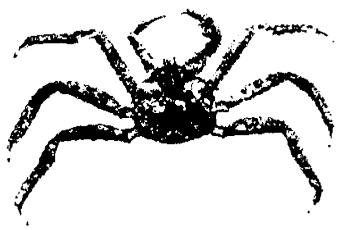
The Alaska Department of Fish and Game, United States Coast Guard and National Weather Service have completed a review of weather conditions surrounding the opening of the Bering Sea snow crab fishery. Current and forecast weather and sea conditions in the operational area of vessels involved in the Bering Sea snow crab fishery have met United States Coast Guard search and rescue criteria and a delay in season opening is not warranted. Fishers are advised that the master of each vessel is responsible for the ultimate safety of the vessel.

As a result, the department will open the Bering Sea snow crab fishery at noon on January 15, 2002. Tank inspections and "quick registration" in Dutch Harbor, Akutan, King Cove and False Pass will begin at noon on January 13, 2002. Tank inspections in Saint Paul will begin at noon on January 14, 2002 pending staff availability and status of the Saint Paul harbor.

For further information contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE



Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: Noon February 6, 2002

CLOSURE OF THE 2002 BERING SEA SNOW CRAB FISHERY

The Bering Sea District will close to commercial fishing for snow crab at noon on February 8, 2002.

The Bering Sea District snow crab fishery was managed using inseason catch reports from fishers. Through 6:00 AM February 6, 2002, the total projected harvest is approximately 26 million pounds. At the current harvest rate, the 28.5 million pound general-fishery guideline harvest level will be reached by noon on February 8, 2002.

At the time of the closure all gear remaining on the fishing grounds must be unbaited with the doors secured fully open. All fishing gear must be in legal long-term wet storage or removed from the grounds within ten days of the closure.

The following landing requirements apply after the closure: Fishers delivering to a floating or shore-based processor in the Pribilof Islands and fishers delivering from the Eastern Subdistrict to Dutch Harbor, Akutan or King Cove must be at their delivery location within 24 hours of the closure. Fishers delivering from the Western Subdistrict to Dutch Harbor, Akutan or King Cove must be at their delivery location within 72 hours of the closure. Fishers delivering to King Cove and ports east of King Cove may request additional travel time by contacting ADF&G in Dutch Harbor within 24 hours of the closure.

For further information contact the Alaska Department of Fish & Game in Dutch Harbor at (907) 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Douglas Pengilly
Regional Research Biologist

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 486-1865
Fax: (907) 486-1824

Date: February 8, 2002

OVERVIEW OF RECOMMENDED HARVEST STRATEGY FOR SNOW CRABS IN THE EASTERN BERING SEA

The Alaska Department of Fish & Game will be recommending changes to the current harvest strategy for the eastern Bering Sea snow crab fishery. The department has prepared a report, "Overview of Recommended Harvest Strategy for Snow Crabs in the Eastern Bering Sea," for public review prior to the March 2002 Alaska Board of Fisheries meeting. The report is available on the department's web page. The file is large and may require several minutes to download.

http://www.cf.adfg.state.ak.us/geninfo/pubs/pubshome.htm#snowcrabs

The Board meeting is scheduled for March 14-21, 2002 at the Hawthorne Suites in Anchorage. The public may provide oral testimony to the Board at the meeting or send written comments to the Board Support Section in Juneau at:

ATTN: BOF COMMENTS
Alaska Department of Fish & Game
Boards Support Section
PO Box 25526
Juneau, AK 99802-5526

For further information, contact the Alaska Department of Fish and Game in Kodiak at (907) 486-1840.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: February 11, 2002

2002 BERING SEA CDQ SNOW CRAB FISHERY ALLOCATIONS

The 2002 general fishery for Bering Sea snow crab closed at noon on February 8, 2002. The department estimates that the general fishery harvest will be 30,261,678 pounds. The 2002 CDQ allocation is 7.5 percent of the total harvest of snow crab. The total harvest is defined as the general fishery harvest plus the CDQ harvest. The CDQ allocation based on the above harvest amount is 2,453,648 pounds. When processing is complete, the department will amend CDQ fishing permits with the final CDQ allocation.

The CDQ groups are to direct fishing operations in a manner not to exceed their specific allocation. All deadloss must be included on the processor report and fish ticket; deadloss will be included in the total harvest for each group.

Allocations for the 2002 Bering Sea CDQ snow crab fishery are as follows:

APICDA	10%	245,365 pounds
BBEDC	19%	466,193 pounds
CBSFA	19%	466,193 pounds
CVRF	17%	417,120 pounds
NSEDC	18%	441,657 pounds
YDFDA	17%	417,120 pounds

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at 907-581-1239.

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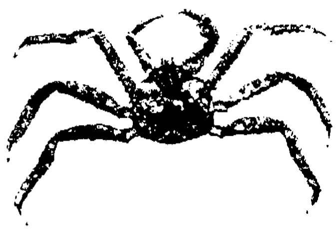
ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE



Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: May 13, 2002
3:00 PM

PRIBILOF DISTRICT CLOSES
TO COMMERCIAL FISHING FOR GOLDEN KING CRABS

The Pribilof District of king crab Registration Area Q (Bering Sea) opened to commercial fishing for golden king crabs at 12:01 AM January 1, 2002 with a guideline harvest level (GHL) of 150,000 pounds. Eight vessels have participated in the fishery since mid-February and two vessels are currently registered. Because less than three vessels are registered, recent harvest information is confidential, however inseason catch reports indicate that the GHL will be reached by 11:59 PM Tuesday, May 14, 2002. Therefore, the Pribilof District will close to commercial fishing for golden king crabs for the remainder of 2002 at 11:59 PM, Tuesday, May 14, 2002.

Vessel operators are reminded that all pots must be unbaited and have doors secured fully open at the time of the closure. All vessels delivering to Dutch Harbor, Akutan, King Cove or the Pribilof Islands must be at their port of delivery within 24 hours of the closure except that vessels delivering to King Cove or ports east of King Cove may request additional delivery time. All pots must be in legal wet storage or removed from the water within 72 hours of the closure.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Mary Schwenzfeier
Shellfish Observer Coordinator
Dutch Harbor

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: July 5, 2002

OBSERVER COVERAGE
FOR THE 2002/2003 BERING SEA – ALEUTIAN ISLANDS CRAB FISHERIES

The Crab Observer Oversight Task Force and the Alaska Department of Fish & Game have developed the following observer coverage schedule for the 2002/2003 crab seasons in the Bering Sea and Aleutian Islands. Observer coverage is either paid directly by the vessel (pay-as–you-go), or funded by cost-recovery proceeds generated by department test fishing. Pre-registration is required in most fisheries prior to the regulatory opening. Pre-registration deadlines are listed below. For fisheries requiring observer coverage without a pre-registration deadline, vessel operators directly contact an observer contractor to procure observer coverage.

Pre-registration facilitates assignment of observers to vessels in fisheries with partial fleet coverage. After the pre-registration deadline, the department will randomly select catcher vessels that will be required to carry an observer during the fishery. The department will obtain and assign observers to the selected vessels prior to the fishery opening. Approximately 10% of the catcher vessels 75-125' overall length (OL) and 10% of the catcher vessels greater than or equal to 125' OL in the Bering Sea king and Tanner crab fisheries will carry observers. Vessels less than 75' OL participating in these fisheries will not be required to carry observers.

Observer coverage is also required for catcher vessels participating in the American Fisheries Act (AFA) crab fisheries for Bristol Bay red king crab and Bering Sea *C. bairdi* Tanner crab. For details on observer coverage in those fisheries contact the department. Observer coverage for the Bering Sea brown king crab fisheries will be 100 percent pay-as-you-go.

Existing observer coverage for at-sea processors participating in any king or Tanner crab fishery, for all vessels in the Aleutian Islands king or Tanner crab fisheries, and for all vessels in the commissioner's permit hair crab and deep-water king and Tanner crab fisheries will remain in

- Continued -

effect under the pay-as-you-go system. Likewise, observer coverage for any vessel in the CDQ and AFA fisheries will be pay-as-you-go.

Fishery	Pre-registration Deadline [1]	Catcher Vessels [2] Observer Coverage	Catcher Vessels [2] Cost-Recovery Funded?	At-sea Processors Observer Coverage	At-sea Processors Cost-Recovery Funded?
St. Matthew blue king	August 24	Partial	YES	100%	NO
Pribilof red & blue king	August 24	Partial	YES	100%	NO
Bristol Bay red king	September 24	Partial	YES	100%	NO
Bering Sea *C. bairdi*	September 24	Partial	YES	100%	NO
Bering Sea *C. opilio*	December 24	Partial	YES	100%	NO
St. Matthew brown king	none	100%	NO	100%	NO
Pribilof brown king	none	100%	NO	100%	NO
Hair crab	none	100%	NO	100%	NO
C. tanneri & C. angulatus	none	100%	NO	100%	NO
Aleutian king crab (red or brown)	none	100%	NO	100%	NO
Paralomis & L. couesi	none	100%	NO	100%	NO

[1] When the pre-registration deadline occurs on a weekend or holiday, the deadline is extended to the next business day.
[2] AFA and CDQ catcher vessels are pay-as-you-go.

In fisheries where the cost of the observer is borne by the vessel, the vessel operator is responsible for arranging for observer coverage before fishing begins. Vessels participating in other shellfish fisheries should contact the department for permit and observer coverage requirements.

For additional information please contact: Mary Schwenzfeier at the Alaska Department of Fish and Game in Dutch Harbor (907-581-1239); Wayne Donaldson in Kodiak (907-486-1842); or the co-chairmen of the Crab Observer Oversight Task Force; Jeff Stephan (907-486-3453) and Arni Thomson (206-547-7560).

-END-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Skip Gish
Division of Commercial Fisheries
Phone: (907) 486-6186
Fax: (907) 486-4191

Westward Region
211 Mission Road
Kodiak, AK 99615

Date: July 31, 2002

ATTENTION BERING SEA CRAB PROCESSORS

SALE OF RED KING CRABS FROM THE BRISTOL BAY AND OBSERVER PROGRAM TEST FISH CHARTERS

The Alaska Department of Fish and Game will tag red king crab in Bristol Bay during late September and early October 2002, during which a number of legal-sized male red king crab will be retained for sale. Although no guarantee on volume can be provided, an estimated harvest of 25,550 pounds is expected. Also, the department will have a cost-recovery charter for Bristol Bay red king crabs after the Bristol Bay general fishery in late October 2002. Although no guarantee on volume can be provided, an estimated harvest of up to 112,500 pounds is expected from the cost-recovery charter. Crabs retained for sale will be 6.5 inches in carapace width or greater (including spines), no allowance as to limb loss or shell condition will be made.

General conditions of the test fish sale will be as follows:

1. The contractor will be required to purchase all live male red king crabs (as described above) delivered to the processing facility at the contracted price/pound.

2. Intended date of delivery of crabs from the tagging charter is October 11. However, the actual delivery date may be earlier, it will be contingent upon the availability of the ADF&G chartered fishing vessel during this time period and the success of cost-recovery fishing toward the harvest goal. In addition, following the establishment of a suitable delivery date a delay in processing may occur if the vessel fails to arrive as scheduled.

3. Approximate time of delivery of crabs from the cost-recovery charter that follows the Bristol Bay general fishery will be the last part of October to the beginning of November and dependent upon success of the cost-recovery fishing.

- continued -

4. Once delivery of cost-recovery crabs has commenced, processing shall be continuous until the entire catch of salable crabs has been offloaded.

5. Shoreside processing facilities offered by qualified bidders must be located in Dutch Harbor/ Unalaska, Akutan, St. Paul, False Pass, King Cove or Port Moller. Bidders offering catcher-processors or floater-processors at a delivery location (at-sea or shoreside) acceptable to ADF&G will also be considered eligible.

6. The contractor must be fully licensed to process crab in the State of Alaska at the time a bid is tendered. A current Intent to Operate must be on file with ADF&G, and a valid 2002 Alaska Fisheries Business License and Alaska Department of Environmental Conservation Seafood Processing Permit must be in possession.

7. Interested processors may bid on either/or both portions of the above.

Additional provisions of the sales contract will be available in an Invitation to Bid (ITB) package issued following formal announcement of a 21-day bidding period. The ITB with be posted on the State of Alaska web page (www.state.ak.us) under the Online Public Notice link. Also, if you wish to receive an ITB for this contract, or require additional information, contact:

Mary Schwenzfeier
Alaska Department of Fish and Game
P.O. Box 920587
Dutch Harbor, AK 99692
Phone: (907) 581-1239
Fax: (907) 581-1572
email: mary_schwenzfeier@fishgame.state.ak.us

Skip Gish
Alaska Department of Fish and Game
211 Mission Rd.
Kodiak, AK 99615
Phone: (907) 486-6186
Fax: (907) 486-4191
email: robert_gish@fishgame.state.ak.us

This notice does not constitute a bid offer.

- END -

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Skip Gish
Division of Commercial Fisheries
Phone: (907) 486-6186
Fax: (907) 486-4191

Westward Region
211 Mission Road
Kodiak, AK 99615

Date: August 5, 2002

Amended News Release
ATTENTION BERING SEA CRAB PROCESSORS

SALE OF RED KING CRABS FROM THE BRISTOL BAY AND OBSERVER PROGRAM TEST FISH CHARTERS

This news release clarifies delivery locations.

The Alaska Department of Fish and Game will tag red king crab in Bristol Bay during late September and early October 2002, during which a number of legal-sized male red king crab will be retained for sale. Although no guarantee on volume can be provided, an estimated harvest of 25,550 pounds is expected. Also, the department will have a cost-recovery charter for Bristol Bay red king crabs after the Bristol Bay general fishery in late October 2002. Although no guarantee on volume can be provided, an estimated harvest of up to 112,500 pounds is expected from the cost-recovery charter. Crabs retained for sale will be 6.5 inches in carapace width or greater (including spines), no allowance as to limb loss or shell condition will be made.

General conditions of the test fish sale will be as follows:

1. The contractor will be required to purchase all live male red king crabs (as described above) delivered to the processing facility at the contracted price/pound.

- continued -

2. Intended date of delivery of crabs from the tagging charter is October 11. However, the actual delivery date may be earlier, it will be contingent upon the availability of the ADF&G chartered fishing vessel during this time period and the success of cost-recovery fishing toward the harvest goal. In addition, following the establishment of a suitable delivery date a delay in processing may occur if the vessel fails to arrive as scheduled.

3. Approximate time of delivery of crabs from the cost-recovery charter that follows the Bristol Bay general fishery will be the last part of October to the beginning of November and dependent upon success of the cost-recovery fishing.

4. Once delivery of cost-recovery crabs has commenced, processing shall be continuous until the entire catch of salable crabs has been offloaded.

5. Shoreside processing facilities offered by qualified bidders located in Dutch Harbor/ Unalaska, Akutan, St. Paul, False Pass, King Cove or Port Moller will be acceptable. Deliveries to catcher-processors, floater-processors or tenders within the operational area referenced above are also acceptable. The operational area specified above corresponds to the operational area for the corresponding vessel charter delivery locations.

6. The contractor must be fully licensed to process crab in the State of Alaska at the time a bid is tendered. A current Intent to Operate must be on file with ADF&G, and a valid 2002 Alaska Fisheries Business License and Alaska Department of Environmental Conservation Seafood Processing Permit must be in possession.

7. Interested processors may bid on either/or both portions of the above.

Additional provisions of the sales contract will be available in an Invitation to Bid (ITB) package issued following formal announcement of a 21-day bidding period. The ITB with be posted on the State of Alaska web page (www.state.ak.us) under the Online Public Notice link. Also, if you wish to receive an ITB for this contract, or require additional information, contact:

Mary Schwenzfeier
Alaska Department of Fish and Game
P.O. Box 920587
Dutch Harbor, AK 99692
Phone: (907) 581-1239
Fax: (907) 581-1572
email: mary_schwenzfeier@fishgame.state.ak.us

Skip Gish
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Kodiak, AK 99615
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email: robert_gish@fishgame.state.ak.us

This notice does not constitute a bid offer.

- END -

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Mary Schwenzfeier
Shellfish Observer Program Coordinator
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Westward Region
211 Mission Road
Kodiak, AK 99615

Date: August 5, 2002

ATTENTION ALL LARGE VESSEL CRAB FISHERS

The Alaska Department of Fish and Game is soliciting bids for a vessel charter to conduct a test fishery on red king crab in Bristol Bay immediately following closure of the Bristol Bay red king crab fishery. The charter will be collecting revenue and information for the onboard observer program. The solicitation of bids is expected to begin in early August.

The length of the charter could be up to 21 days or until cost recovery goals are attained. The charter will require a vessel 100' or greater in overall length (OL), outfitted with and able to safely carry at least 110 commercial red king crab pots, and hold 112,500 pounds of crab in circulating seawater tanks.

Additional provisions of the contract will be available in an Invitation to Bid (ITB) package issued following this formal announcement of the 21-day bidding period. The ITB will be posted on the state of Alaska web page (www.state.ak.us) under the Online Public Notice link. Also, if you wish to receive an ITB for this contract, or require additional information, contact:

Mary Schwenzfeier
Alaska Department of Fish and Game
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Dutch Harbor, AK., 99692
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Fax: (907) 581-1572
email: mary_schwenzfeier@fishgame.state.ak.us

- end -

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Dutch Harbor

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: August 15, 2002

ST. MATTHEW ISLAND SECTION AND PRIBILOF DISTRICT KING CRAB SEASONS

The Alaska Department of Fish & Game and the National Marine Fisheries Service (NMFS) have completed analysis of NMFS trawl survey results for the Pribilof District and St. Matthew Island Section of the Bering Sea. King crab population and biomass estimates for these areas were computed from survey data. Based on survey and modeling results both the St. Matthew blue king crab and the Pribilof red and blue king crab fisheries will remain closed for the 2002 season.

St. Matthew Island Section blue king crab: Survey estimates for St. Matthew blue king crabs indicate continued low abundance of both male and female crabs in all size categories. The estimated stock size of mature crab is 4.7 million pounds, which is below the minimum stock size threshold (MSST) of 11.0 million pounds as defined in the federal FMP. The stock is above the minimum threshold of mature males as defined in the state harvest strategy, 2.9 million pounds. However, the calculated guideline harvest level (GHL) is only 0.721 million pounds, well below the minimum GHL of 2.5 million pounds.

Pribilof District red and blue king crab: Survey results of Pribilof District blue king crabs indicate continued low abundance. The survey estimate for all size classes of blue king crab is lower in 2002 than for 2001. The minimum mature male threshold for a fishery is 770,000 king crabs, and the 2002 survey estimate is 338,000 mature male blue king crabs.

The area-swept estimate of legal red king crabs in the Pribilof District is approximately one half the 2001 estimate. However, the catch-survey analysis indicates that this is not due to an actual

-continued-

abundance decline, but to overestimation by the area-swept estimate for 2001. Given the extremely poor precision in abundance estimate for this stock, stock trends cannot be determined. Due to the continued decline in the blue king crab stock, the high degree of uncertainty surrounding the estimate of red king crab abundance, poor fishery performance of recent years, and concern for blue king crab bycatch, the red and blue king crab fishery in the Pribilof District will remain closed for the 2002 season.

Bristol Bay red king crab: Survey results of Bristol Bay indicate a red king crab fishery will occur in October 2002. However, because analysis of the data is not complete, the Bristol Bay red king crab GHL will be announced on Friday, August 16.

For further details contact the Alaska Dept. of Fish & Game in Dutch Harbor at (907) 581-1239 or in Kodiak, at (907) 486-1840.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
Area Management Biologist
Dutch Harbor

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: August 16, 2002

BRISTOL BAY RED KING CRAB SEASON

The Alaska Department of Fish & Game and the National Marine Fisheries Service (NMFS) have completed analysis of NMFS trawl survey results for Bristol Bay red king crab. King crab population and biomass estimates were computed from survey data. The stock is estimated to be above minimum stock size and mature female abundance thresholds.

The Effective Spawning Biomass (ESB) of the Bristol Bay red king crab stock is estimated at 37.71 million pounds. Based on the 2002 data, ESB declined by 12% between 2001 and 2002 due to a decline in mature female abundance. The estimated number of mature male crabs, however, increased 13% from 2001, based on the 2002 data. Abundance of legal males is estimated to have increased by only 3%. Based on the ESB, a 10 percent exploitation rate is applied to this year's estimate of mature male crabs to derive guideline harvest levels (GHL) for the 2002 season as follows:

Fishery	**GHL (pounds)**	
Bristol Bay red king crab	8,575,202	(general)[1]
Bristol Bay CDQ red king crab	695,287	(CDQ)
	9,270,489	(total)

[1] The North Pacific Fishery Management Council has capped the American Fisheries Act (AFA) vessels to their historic proportion of the Bristol Bay red king crab harvest during the general fishery. The 41 AFA vessels' harvest will be capped at 10.96 percent (939,842 pounds) of the general GHL.

-continued-

The preseason vessel registration deadline to participate in the 2002 general Bristol Bay red king crab fishery is 5:00 p.m. Tuesday, September 24, 2002. Preseason registration forms must be received by the department by the deadline. Preseason registration forms are available on the web at **http://www.cf.adfg.state.ak.us/region4/shellfsh/crabs/02bbrkc_form.pdf** or via fax upon request.

A 2002 Commercial Fisheries Entry Commission permit card for Bristol Bay king crab, listing the vessel's ADF&G number, is required at the time of preseason registration. After the preseason registration deadline the department will announce pot limits, buoy tag sales, and a list of vessels selected to carry an onboard observer.

The following web site is for vessel operators to verify the state's receipt of preregistration: **http://www.cf.adfg.state.ak.us/region4/shellfsh/crabs/02bbrkc_reg.pdf** . This web site is updated three times per week.

Tanner and snow crab: Data analysis for Bering Sea Tanner crab is not complete. Results are expected to be released no later than September 6.

For further details contact the Department in Dutch Harbor at (907) 581-1239 or in Kodiak (907) 486-1840.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

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Division of Commercial Fisheries
Juneau

Division of Commercial Fisheries
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Westward Region
211 Mission Road
Kodiak, AK 99615

Date: August 19, 2002

BERING SEA/ALEUTIAN ISLANDS
ANNUAL CRAB INDUSTRY MEETING

The annual meeting with the Bering Sea/Aleutian Islands (BSAI) crab industry and staff of the National Marine Fisheries Service (NMFS), and the Alaska Department of Fish & Game (ADF&G) will be held in Kodiak, Alaska on Friday September 13, 2002. The annual crab-industry meeting alternates between Alaska and Seattle. When the industry meeting is held in Alaska, the meeting location alternates between Kodiak and Anchorage.

The meeting will be convened at Fishermen's Hall in Kodiak beginning at 9:00 a.m., Alaska Daylight Time. In addition, teleconference sites will be established in Dutch Harbor at the ADF&G office and in Seattle at the Leif Erikson Hall, 2245 N.W. 57th Street (Ballard) in conjunction with the Pacific Northwest Crab Industry Advisory Committee (PNCIAC).

The preliminary agenda is as follows:

1) Industry briefing on Bering Sea snow crab survey results.
   ADF&G is seeking industry input on the recommended quantity of oldshells for completion of the 2003 snow crab GHL.

2) Review status of stocks and GHLs.
   a) Bristol Bay red king crab
   b) St. Matthew and Pribilof Islands king crab
   c) Eastern Bering Sea Tanner crab

For questions regarding the annual Industry meeting, please contact Herman Savikko at (907) 465-6112 or Wayne Donaldson at (907) 486-1842.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

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Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: August 30, 2002

BERING SEA TANNER CRAB SEASON

The Alaska Department of Fish & Game and the National Marine Fisheries Service (NMFS) have completed analysis of NMFS trawl survey results for the Bering Sea District *Chionoecetes bairdi* (Tanner crab) stocks.

The abundance of *C. bairdi* Tanner crab remains below the threshold necessary to allow a fishery. The Alaska Board of Fisheries harvest strategy threshold of mature female Tanner crab for a fishery opening is 21.0 million pounds. The 2002 survey estimated the mature female biomass to be 13.8 million pounds, a slight decrease from the 2001 mature female biomass estimate of 15.5 million pounds. The entire Bering Sea District will remain closed to the harvest of *C. bairdi* Tanner crab for the 2002 season.

Bering Sea snow crab and hair crab: Analysis of snow and hair crab survey data is not complete. Information on snow crab is expected to be available in early September; hair crab information is expected to be available by mid-September.

For further details contact the Alaska Department of Fish & Game in Dutch Harbor at (907) 581-1239 or in Kodiak at (907) 486-1840.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
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Juneau

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Date: September 6, 2002

2003 BERING SEA SNOW CRAB SEASON

The Alaska Department of Fish & Game and the National Marine Fisheries Service (NMFS) have completed analysis of NMFS trawl survey results for the Bering Sea District *Chionoecetes opilio* (snow crab) stock.

The total mature biomass (TMB) of male and female snow crabs in the Bering Sea is estimated to be above the minimum threshold for a fishery opening under the Alaska Board of Fisheries (BOF) harvest strategy. The 2003 snow crab guideline harvest level (GHL) is 25.61 million pounds. Of this total, 1.92 million pounds are available to the Community Development Quota fishery with the remaining 23.69 million pounds available to the general fishery.

Total mature snow crab biomass decreased 45% from the 2001 survey, to 313.3 million pounds, and is below the minimum stock size threshold of 460.8 million pounds. The 2002 TMB is the fourth lowest on record. The decline is due to a 26% decrease in mature male and a 66% decrease in mature female biomass.

The estimated abundance of males greater than 4" carapace width (CW) is 76 million crabs, a slight decrease from the 2001 abundance level of 78 million crabs. Old and very-old shell males constitute 32% of males greater than 4" CW, a decrease from 2001 when 61% of 4" and greater CW male crabs had old or very-old shells.

New regulations adopted by the BOF in March 2002 allow for a Bering Sea snow crab fishery with a general fishery GHL of less than 25 million pounds with reduced pot limits. The 2003 Bering Sea snow crab pot limit will be 100 pots for vessels less than or equal to 125 feet in overall length and 120 pots for vessels greater than 125 feet in overall length.

The regulatory opening date for this fishery is noon on January 15, 2003 in all waters of the Bering Sea District west of 166° W long. The preseason vessel registration deadline to participate in the 2003 Bering Sea snow crab fishery is 5:00 PM December 24, 2002. Preseason registration forms must be received by the department before the deadline. Preseason registration forms are available on the world wide web at http://www.cf.adfg.state.ak.us/region4/shellfsh/crabs/03opilio_form.pdf or via fax upon request. A 2002 or 2003 T09Q of T91Q Commercial Fisheries Entry Commission permit card listing the vessel's ADF&G number is required at the time of preseason registration.

The web site for vessel operators to verify the state's receipt of vessel preseason registration is http://www.cf.adfg.state.ak.us/region4/shellfsh/crabs/03opilio_reg.pdf . This web site is updated three times per week.

Bering Sea hair crab: Analysis of hair crab survey data is not complete. Information on Bering Sea hair crab is expected to be available later in September.

For further details contact the Alaska Department of Fish & Game in Dutch Harbor at (907) 581-1239 or in Kodiak at (907) 486-1840.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

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Date: September 24, 2002

2002 BRISTOL BAY RED KING CRAB POT LIMITS

Bristol Bay king crab fishery preseason registrations were received from 242 vessels by the September 24, 2002 deadline. Based on the 242 preseason vessel registrations and the 8.6 million pound general fishery guideline harvest level, pot limits for the 2002 Bristol Bay red king crab fishery are set at 100 pots for vessels less than or equal to 125 feet length overall, and 125 pots for vessels greater than 125 feet length overall.

Fishers may purchase buoy tags for the 2002 Bristol Bay king crab fishery at the Dutch Harbor and Kodiak ADF&G offices during normal office hours beginning September 25, 2002. In addition, the Dutch Harbor office will open from 9:00 AM to 4:30 PM on Saturday, October 5 and Saturday, October 12 for tag sales. The department will mail buoy tags up to two weeks prior to the fishery. For the Bristol Bay red king crab fishery the cut-off date for mailing tags is October 1, 2002.

The department does not provide zip-ties for attaching buoy tags. It is the responsibility of the fisher to ensure that each pot has a securely attached buoy tag. ADF&G cautions that buoy tags are not designed to withstand the stress of being run through the crab block or similar stress during gear operations. Buoy tags should be secured on the main or trailer buoy in a manner minimizing handing stress.

The department will randomly select catcher vessels to carry onboard observers during the 2002 Bristol Bay red king crab fishery from the list of vessels which filed preseason registrations. Names of selected vessels will be announced in a later news release.

For more information contact the Alaska Department of Fish and Game at 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Mary Schwenzfeier
Shellfish Observer Program Coordinator
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Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: September 27, 2001

Catcher Vessels Selected for Observer Coverage
2002 Bristol Bay Red King Crab Fishery

The following catcher vessels, randomly selected from the Bristol Bay red king crab fishery pre-season vessel registrations, will carry crab observers for the duration of the Bristol Bay general fishery:

Vessels 75 feet to 125 feet

Vessel Name	ADF&G #
Andronica	39926
Big Blue	37241
Aleutian Beauty	32282
Northwind	35733
Early Dawn	00103
Farwest Leader	35683
Maverick	45706
Jennifer A	35277
Alliance	31944
Kevleen K	00960
Viekoda Bay	57971
Alaska Sea	25041
Silver Spray	60860
Island Mist	61791
Alternates	
Alaskan Beauty	08653
Lady Ann	39156

Vessels greater than 125 feet

Vessel Name	ADF&G #
Handler	62436
Ballyhoo	03645
Bulldog	00131
Scandies Rose	35318
Sultan	58039
Exito	54956
Alternates	
Cornelia Marie	59109
Arctic Sea	33696

AFA crab vessels

Vessel Name	ADF&G #
Gladiator	32473
Seadawn	00077
Argosy	38547

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ADF&G or a state-contracted observer company will provide observers for the selected non-AFA catcher vessels. The observer must be on the selected vessel at the time of vessel registration validation on October 14. Selected vessels must provide proof of compliance with United States Coast Guard (USCG) vessel safety requirements. USCG dockside examinations are available in Puget Sound, Kodiak and Dutch Harbor.

Observer salary and travel costs for catcher vessels participating in the general fishery will be provided from cost-recovery funds. Costs for crab observers on the American Fisheries Act (AFA) catcher vessels will be borne by the AFA participants.

Observers will have their own rain gear, boots, gloves, survival suit and personal flotation device (PFD) for working on deck, along with their own bedding and personal items. Some of the regulatory requirements for vessels that carry observers include:

- Provide adequate food and accommodations for the observer equal to those provided for the vessel's crew;
- Provide to the observer daily catch information, including areas fished, number of crab retained, pot locations, number of pots pulled, and other information specified by the department;
- Provide a safe work area, and necessary gear such as 2 to 3 totes for the observer to use at all times to hold the contents of crab pots for sampling;
- Assure observer access to single side band (SSB) radio, fax, telex, or telephone so that catch reports from observers are received at the Dutch Harbor ADF&G office in a timely manner.

-END-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

Contact: Forrest R. Bowers
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Bering Sea/Aleutian Islands

Westward Region
211 Mission Road
Kodiak, AK 99615

Division of Commercial Fisheries
Phone: (907) 581-1239
Fax: (907) 581-1572

Date: October 1, 2002

BRISTOL BAY RED KING CRAB FISHERY
REGISTRATION AND TANK INSPECTION

The Bristol Bay (Registration Area T) red king crab fishery will open at 4:00 PM on October 15. Vessel registration will begin 30 hours prior to the opening, at 10:00 AM on October 14 in Dutch Harbor, False Pass, Akutan and King Cove. ADF&G personnel will not be available in Saint Paul. As part of the "Quick Registration" process, inspection of vessel holding tanks and gear will be available beginning October 7 in Dutch Harbor. Inspections at King Cove will begin October 8, at False Pass October 9 and Akutan October 10 pending staff arrival at those locations.

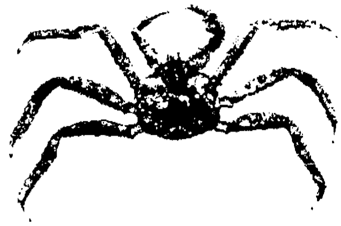
The holder of a 2002 KO9T or K91T interim use permit and the vessel's observer, if assigned, must be on the vessel at the time of registration and during all fishing operations. All crab pots used during the Bristol Bay red king crab fishery must conform to specifications of a king crab pot described in 5 AAC 34.050 and 5 AAC 34.825. Pot limits of 100 and 125 for vessels less than or equal to 125 feet and in excess of 125 feet respectively, are in effect for the 2002 Bristol Bay red king crab fishery. All gear, both on the vessel and in wet storage, within Bristol Bay, must be tagged at the time of tank inspection. Only one buoy tag, valid for the current fishery, may be displayed.

The department is assessing the manageability of the 2002 Bristol Bay red king crab fishery and will announce by Thursday October 10, whether the fishery will be managed inseason or with a closure date announced prior to the opening. In addition, ADF&G, in conjunction with the United States Coast Guard and National Weather Service, will assess weather conditions prior to the season opening for potential weather-related delay, based on search and rescue criteria, at the start of the season .

For more information contact the Alaska Department of Fish and Game at 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE



Frank Rue, Commissioner

Doug Mecum, Director
Division of Commercial Fisheries
Juneau

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Phone: (907) 581-1239
Fax: (907) 581-1572

Date: October 10, 2002

BRISTOL BAY RED KING CRAB FISHERY MANAGEMENT

The Alaska Department of Fish and Game will manage the 2002 Bristol Bay red king crab fishery based on inseason reports from fishers. Reports will be taken every 12 hours at 6:00 AM and 6:00 PM from vessels reporting via marine telex and each 24 hours at 10:00 AM from vessels reporting via single side band radio (SSB). Department personnel will provide inseason catch reporting materials during the tank inspection and registration process as well as at the ADF&G office in Dutch Harbor. Vessel operators are strongly encouraged to participate in the catch reporting program that is essential for effective inseason management.

The department will provide catch updates to the fleet on SSB 4125 kHz at noon and 9:00 PM daily beginning at 9:00 PM on October 16, however a closure announcement could occur at any time. The advance notice for the fishery closure will be based upon actual and anticipated harvest rates. The department will attempt to provide the greatest possible advance notice, however the fishery could close on very short notice. The department will broadcast the closure announcement on SSB 4125 kHz, by fax and e-mail to all persons and organizations on the department's news release distribution list.

Vessel holding tank and gear inspections are currently available in Dutch Harbor, King Cove, Akutan and False Pass. No tank inspections or registrations will be available in Saint Paul. Prior to the season opening, the department in conjunction with the United States Coast Guard and National Weather Service, will evaluate weather conditions immediately preceding and at the start of the season for potential weather-related delay based on search and rescue criteria. For further information please contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

Doug Mecum, Director
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Contact: Forrest R. Bowers
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211 Mission Road
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Phone: (907) 581-1239
Fax: (907) 581-1572

Date: October 17, 2002
8:00 PM

CLOSURE OF THE BRISTOL BAY RED KING CRAB FISHERY

The Alaska Department of Fish and Game announces closure of the Bristol Bay red king crab fishery at 12:00 NOON, Friday, October 18, 2002. This closure applies to all vessels, including those participating in the American Fisheries Act cooperative fishery.

Voluntary catch reports from approximately 40% of the fleet indicate that 5.13 million pounds of red king crabs have been harvested to date. This is in addition to an estimated 940,000 pounds harvested to date by vessels participating under American Fisheries Act sideboards. Reports through 6:00 PM October 17, 2002 indicate that the general fishery guideline harvest level of 8.58 million pounds of red king crabs will be reached by the fishery closure at 12:00 NOON, October 18, 2002.

This announcement does not provide the fleet with 24 hours advance notice of the closure, thus the fleet may leave baited pots on the grounds after the closure. All gear must be placed in legal wet storage or removed from the water within 10 days of the closure.

Following the fishery closure, vessels delivering to Dutch Harbor, Akutan or King Cove must be at their delivery location within 30 hours. Vessels delivering to Adak, Saint Paul or ports east of King Cove are required to contact the Alaska Department of Fish and Game in Dutch Harbor prior to exiting Area T, and provide information regarding final delivery destination, number of crabs on board and estimated time of arrival.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

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Date: October 21, 2002

CDQ ALLOCATION FOR THE 2002 BRISTOL BAY RED KING CRAB FISHERY

Preliminary harvest for the 2002 Bristol Bay red king crab general fishery, based on production records and hailed weights, is 8,822,830 pounds. The final harvest total will not be available for several weeks, but it is not expected to deviate significantly from this estimate.

The 2002 Bristol Bay red king crab CDQ allocation is 7.5 percent of the total harvest of Bristol Bay red king crab. The total harvest is defined as the general fishery harvest plus the CDQ harvest. The CDQ allocation based on the above preliminary harvest amount is 715,366 pounds. The individual group allocations are as follows:

Group	Allocation
APICDA	128,766 pounds
BBEDC	128,766 pounds
CBSFA	71,536 pounds
CVRF	128,766 pounds
NSEDC	128,766 pounds
YDFDA	128,766 pounds

These allocations may be slightly amended as the harvest estimate is refined; the groups will be advised of these amendments by NOON, October 25, 2002. The CDQ groups are to manage their fishing efforts in a manner not to exceed their allocation.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Kevin Duffy, Acting Commissioner

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Date: December 19, 2002

BERING SEA SNOW CRAB BUOY TAG SALES AND PRESEASON REGISTRATION

The 2003 Bering Sea snow crab fishery will open at noon on January 15 with a general fishery guideline harvest level (GHL) of 23.69 million pounds. The post-season community development quota is 1.92 million pounds.

The preseason registration deadline is 5:00 PM, December 24, 2002. A preseason registration must be submitted for each vessel intending to participate in the snow crab fishery. In order for the preseason registration to be valid, the department must be able to verify that a T91Q or T09Q commercial fisheries entry commission permit card has been issued for the vessel. After the preseason registration deadline, ADF&G will randomly select up to 10 percent of catcher vessels to carry an onboard observer.

Buoy tags may be purchased at the Dutch Harbor and Kodiak offices of ADF&G Monday through Friday, 8:00 AM until 4:30 PM. In addition, the ADF&G office in Dutch Harbor will be open for buoy tag sales from 9:00 AM until 4:30 PM on Saturday January 4, Saturday January 11 and Sunday January 12. The department will mail buoy tags up to three weeks prior to the fishery. **For the 2003 Bering Sea snow crab fishery the cut-off date for mailing tags is 5:00 PM, December 24, 2002. Please note that the cut-off date for mailing tags is one week earlier than in previous seasons. This is to allow for recent weather related delays in mail service.**

Fishery information packets for the 2003 Bering Sea snow crab fishery providing a brief overview of fishery management and current regulations will be available by December 31, 2002 at the Dutch Harbor and Kodiak offices of ADF&G. Details of vessel tank inspections, potential weather-related delay of season and inseason management will be available in forthcoming news releases. A list of vessels selected to carry an onboard observer will be available by 5:00 PM December 27, 2002.

For further information contact ADF&G in Dutch Harbor at (907) 581-1239.

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

Frank Rue, Commissioner

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211 Mission Road
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Phone: (907) 581-1239
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Date: March 22, 2002
3:30 PM

CLOSURE OF ALEUTIAN ISLANDS GOLDEN KING CRAB FISHERY WEST OF 174° W LONGITUDE

The Aleutian Islands (Area O) opened to commercial fishing for golden king crabs on August 15, 2001 with guideline harvest levels (GHL) of 3.0 million pounds east and 2.7 million pounds west of 174° W long. That portion of Area O east of 174° W long. closed to commercial fishing on September 10, 2001. Fishing effort west of 174° W long. has fluctuated throughout the season from one to nine vessels, currently six vessels are participating. Weekly harvest has ranged from zero to 240,000 pounds per week and has averaged 73,000 pounds per week since January 1, 2002. Through March 21, 2002, approximately 2.57 million pounds of golden king crabs have been landed from Area O west of 174° W long. and at the current harvest rate, the GHL of 2.7 million pounds will be reached by March 30, 2002, thus the Aleutian Islands golden king crab fishery west of 174° W long. will close to commercial fishing at 11:59 PM March 30, 2002.

All golden king crab pots in Area O west of 174° W long. must be unbaited and have doors secured fully open by the time of the closure. Pots must be in legal wet storage or removed from the water within seven days of the closure. Fishers delivering golden king crabs to processors in Dutch Harbor, Adak, or Akutan must be at their delivery location within 72 hours of the closure. Fishers delivering golden king crabs to King Cove or points east of King Cove may request additional time to reach those ports.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

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Doug Mecum, Director
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Juneau

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Date: July 15, 2002

ALEUTIAN ISLANDS GOLDEN KING CRAB FISHERY OPENS AUGUST 15
GUIDELINE HARVEST LEVELS ANNOUNCED

The 2002/2003 Area O (Aleutian Islands) commercial golden king crab fishery will open at NOON on Thursday, August 15, 2002 with a guideline harvest level of 5.7 million pounds. The fishery will be managed to allow for a harvest of 3.0 million pounds of golden king crabs in the area east of 174° W longitude with the remaining 2.7 million pounds available for harvest west of 174° W longitude. The fishery will be managed inseason using processor production reports, fishery performance data collected by observers stationed on each vessel and reports from fishers.

Vessel registration will begin at NOON on Monday, August 12, 2002 in Dutch Harbor. Vessel tank inspections prior to gear loading will be available beginning at 9:00 AM, Wednesday, August 7, 2002. An observer briefing must be scheduled and an individual holding a Commercial Fisheries Entry Commission 2002 Aleutian Islands king crab interim use permit card (K91O or K09O) must be aboard the vessel when it is registered. At the time of registration, all pots onboard the vessel or in wet storage must be in compliance with current Aleutian Islands commercial golden king crab fishing regulations.

For further information, please contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

- end -

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
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Date: August 19, 2002

PETREL BANK RED KING CRAB FISHERY
GUIDELINE HARVEST LEVEL AND SEASON ANNOUNCED

The Petrel Bank area of the western Aleutian Islands will open for commercial red king crab fishing at noon on October 25, 2002. The Alaska Department of Fish & Game has established a GHL of 500,000 pounds of legal male red king crabs. The Petrel Bank area is defined as those waters of king crab Registration Area O west of 179° W long., east of 179° E long., and north of 51° 45' N lat. Only those waters in the above described area that are 125 fathoms or less in depth will be open to fishing for red king crabs.

The preseason registration deadline is 5:00 PM Friday, October 4, 2002. The aggregate pot limit for the fishery is 1,250 pots total. Vessels less than or equal to 125 feet will be allowed to have 4/5 the number of pots that vessels greater than 125 feet will be allowed. Individual pot limits will be determined based upon preseason registration number of vessels compared to the 1,250 total pot limit. The maximum pot limit per vessel will be 40 pots for vessels less than or equal to 125' in overall length and 50 pots for vessels greater than 125' in overall length. Buoy tags for the fishery will be available for sale in Dutch Harbor and Kodiak beginning October 5, 2002. Buoy tags will not be available in Adak. Each pot must be configured so that 1/3 of one vertical side of the pot consists of 9" or greater stretched mesh webbing.

Vessel registrations and tank inspections will be available in Dutch Harbor, King Cove and Adak beginning at noon on October 22, 2002. Each vessel registered for the fishery must carry an observer during all fishing activities. Observer costs will be borne by the vessel. Vessel operators must provide accurate daily catch information to their observers. Observers will relay catch reports to ADF&G in Dutch Harbor for inseason management of the fishery.

-continued-

NEWS RELEASE August 19, 2002

Observer briefings will be available in Dutch Harbor at the conclusion of the Bristol Bay red king crab fishery. Observer staff will also be available in Adak for a maximum of 20 scheduled briefings between October 18 and 21. All briefings must be scheduled at least 48 hours in advance with the Dutch Harbor observer staff. Briefings will be provided on a first-come, first-serve basis. Observer briefings in Adak may also be available from October 22 until the fishery opens, however staff priority will be conducting registrations and tank inspections during that time. Therefore briefings after October 21 will be available only after other fishery management duties are complete.

Golden king crab fishers participating in the Petrel Bank red king crab fishery are not required to remove golden king crab pots from the water, except from the area that is open to fishing for red king crabs. Pots used to take red king crabs may not be longlined and red king crab may not be harvested from longline gear. In addition, a person or vessel that operates longline, trawl, or pot gear in waters less than 125 fathoms in depth in a commercial, subsistence, personal use, or sport fishery in that portion of the Petrel Bank area open to commercial red king crab fishing 30 days immediately before the scheduled opening date of the commercial red king crab fishery may not participate in the commercial red king crab fishery.

Preseason registration forms must be received by the department by Friday, October 4, 2002. Preseason registration forms are available on the web at **http://www.cf.adfg.state.ak.us/region4/shellfsh/crabs/02petrel_form.pdf** or via fax upon request.

A 2002 Commercial Fisheries Entry Commission permit card for Aleutian Islands king crab, listing the vessel's ADF&G number, is required at the time of preseason registration. After the preseason registration deadline the department will announce pot limits.

The web site for vessel operators to verify the state's receipt of vessel preseason registration is: http://**www.cf.adfg.state.ak.us/region4/shellfsh/crabs/02petrel_reg.pdf** . This web site is updated three times per week.

For additional information, please contact the Alaska Department of Fish & Game in Dutch Harbor (907-581-1239) or in Kodiak (907-486-1840).

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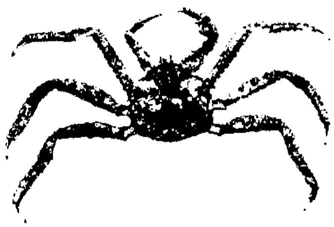

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Date: September 2, 2002
12:00 NOON

EASTERN ALEUTIAN ISLANDS CLOSES TO GOLDEN KING CRAB FISHING

The commercial golden king crab fishery in that portion of Area O (Aleutian Islands) east of 174° W long. will close effective at 11:59 PM on September 7, 2002. Inseason catch reports indicate that the guideline harvest level (GHL) of 3.0 million pounds will be reached by the September 7, 2002 closure.

At the time of the closure, all golden king crab pots east of 174° W long. must be unbaited and have the doors secured open. Within 72 hours of the closure, all golden king crab pots must be legally stored in waters 75 fathoms or less in depth, or be removed from the water. That portion of Area O west of 174° W long. has a GHL of 2.7 million pounds and will remain open until further notice.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

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Date: September 13, 2002

ADAK, ATKA AND AMLIA ISLANDS RED KING CRAB SURVEY

The Alaska Department of Fish & Game (ADF&G) will assess the western Aleutian Islands red king crab stock between 172° W long., and 179° W long. beginning November 1, 2002. The survey will focus on areas of historic red king crab abundance in the Adak, Atka and Amlia Islands areas that have been closed to commercial red king crab fishing since the 1998/99 season and have not been previously surveyed. A commissioner's permit will be issued to all interested and qualified fishers.

The permit will authorize the retention of all legal-size red king crab and will provide a preference in state waters to vessels 90 feet or less in overall length. Vessels greater than 90 feet in overall length may be selected to fish in state waters if no vessels less than 90 feet in overall length apply to fish in a given survey locale. Vessels fishing in federal-waters must hold a federal Bering Sea/Aleutian Islands crab license with Aleutian Islands red king crab endorsement. A confidentiality waiver will be required for each survey vessel to permit the department to report survey information. Participants will be required to arrange for 100% observer coverage paid for by the vessel, fish stations designated by the department, and provide specific biological data on the non-retained portion of the catch.

Survey stations are grouped into four locales: Adak (38 survey stations), North Atka (15 survey stations), North Amlia (21 survey stations) and South Atka-Amlia (25 survey stations). The four locales contain a total of 55 state-waters stations and 44 stations in federal-waters. The Adak locale contains the majority (26) of state-waters stations while each of the other three locales contain nine to 11 each. Fishers applying for the survey should indicate whether they intend to participate in one or more of these specific locales. In addition, fishers should indicate whether

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they intend to participate in state-waters, federal-waters or both. Fishers will be assigned stations from each locale that they apply for. Survey stations will be assigned separately for each locale. Fishers must apply in writing to the department for a commissioner's permit by 5:00 PM October 11, 2002. After the deadline, the department will randomly assign predetermined survey stations by October 15 to each vessel based on the number of applicants and locale preference. Within each locale all fishers will be assigned an equal number of stations to fish. Survey maps and coordinates are available from ADF&G in Dutch Harbor and Kodiak.

Fishers must utilize legal red king crab gear, however large mesh escape panels must be covered, and only two tunnel entrances per pot will be allowed. Vessel operators will record pot location, fish a standardized soak time, and report fishing activity periodically to the department in Dutch Harbor. Because of the survey structure and biological sampling duties involved, vessels should expect to fish fewer pots each day as compared to other commercial fisheries. A portion of the survey will occur outside of state waters; vessels fishing outside of state waters must be federally licensed to harvest red king crab in the Aleutian Islands. All participating fishers must possess a 2002 K91O or K09O Commercial Fisheries Entry Commission interim use permit card.

For additional information or to apply for a commissioner's permit, please contact the Alaska Department of Fish & Game in Dutch Harbor (907-581-1239) or in Kodiak (907-486-1840).

-end-

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE

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Date: October 4, 2002

PETREL BANK RED KING CRAB FISHERY
POT LIMITS AND VESSEL REGISTRATION

The Petrel Bank area of the western Aleutian Islands will open to commercial fishing for red king crab at noon on October 25, 2002 with a guideline harvest level of 500,000 pounds. The Petrel Bank area is defined as those waters of king crab Registration Area O west of 179° W long., east of 179° E long., and north of 51° 45' N lat. Only those waters in the above described area that are 125 fathoms or less in depth will be open to fishing for red king crabs.

Petrel Bank red king crab fishery preseason registrations were received from 35 vessels by the 5:00 PM October 4, 2002 deadline. Based on the 35 preseason vessel registrations, pot limits for the 2002 Petrel Bank red king crab fishery are set at 33 pots for vessels less than or equal to 125 feet length overall, and 42 pots for vessels greater than 125 feet length overall. Buoy tags for the fishery will be available for sale in Dutch Harbor beginning October 5, 2002. The department does not provide zip-ties for attaching buoy tags. It is the responsibility of the fisher to ensure that each pot has a securely attached buoy tag. ADF&G cautions that buoy tags are not designed to withstand the stress of being run through the crab block or similar stress during gear operations. Buoy tags should be secured on the main or trailer buoy in a manner minimizing handing stress.

Vessel registrations and tank inspections will be available in Dutch Harbor, King Cove and Adak beginning at noon on October 22, 2002. "Quick registration" tank inspections prior to gear loading will be available beginning October 18, 2002. Each vessel registered for the fishery must carry an observer during all fishing activities. A K91O interim use permit holder and the vessel's observer must be onboard the vessel at the time of registration. For additional information, please contact the Alaska Department of Fish & Game in Dutch Harbor (907-581-1239) or in Kodiak (907-486-1840).

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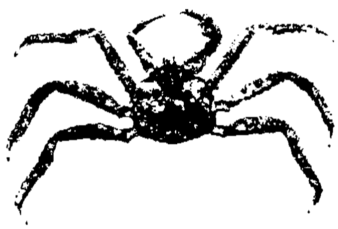
ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE



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Date: October 22, 2002

TIME ZONE FOR PETREL BANK
RED KING CRAB FISHERY MANAGEMENT

King crab Registration Area O (Aleutian Islands) is split into the Hawaii-Aleutian Time Zone (west of 169° 30' W long.) and the Alaska Time Zone (east of 169° 30' W long.). For purposes of managing the Petrel Bank red king crab fishery, the regulatory opening of 12:00 NOON October 25 and all subsequent inseason announcements will be based on the Alaska Time Zone. Fishers are advised that Daylight Savings Time ends on October 27.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
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Date: October 27, 2002
8:00 AM

CLOSURE OF THE PETREL BANK RED KING CRAB FISHERY

The Petrel Bank area of king crab Registration Area O will close to commercial red king crab fishing at 1:00 PM, Sunday, October 27, 2002. Fishers are reminded that Daylight Savings Time ended today, October 27, and that this closure time is based on the Alaska Time Zone.

Inseason reports through 6:00 AM October 27, 2002 indicate that approximately 432,000 pounds of red king crabs have been harvested to date and the guideline harvest level (GHL) of 500,000 pounds will be reached by the fishery closure at 1:00 PM, Sunday, October 27, 2002.

At the time of closure, all red king crab pots must be unbaited and have the doors secured open. Within 72 hours of the closure, all red king crab pots must be legally stored in waters 75 fathoms or less in depth, or be removed from the water.

Following the fishery closure, vessels delivering to Adak, Dutch Harbor, Akutan or King Cove must be at their delivery location within 72 hours. Vessels delivering to ports east of King Cove are required to contact the Alaska Department of Fish and Game in Dutch Harbor prior to exiting Area O, and provide information regarding final delivery destination, number of crabs on board and estimated time of arrival.

For further information, contact the Alaska Department of Fish and Game in Dutch Harbor at (907) 581-1239.

ALASKA DEPARTMENT OF FISH AND GAME
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Date: November 15, 2002

EASTERN ALEUTIAN ISLANDS TANNER CRAB SURVEY

The Alaska Department of Fish & Game (ADF&G) will assess the eastern Aleutian Islands Tanner crab (*C. bairdi*) stock utilizing a test fishery between 165° W long., and 167° W long. beginning January 15, 2003. The survey will focus on areas of historic Tanner crab abundance in the Unalaska, Akutan and Akun Island areas that have been closed to commercial Tanner crab fishing since the 1994 season. A commissioner's permit will be issued to all fishers who are able to fulfill the survey guidelines.

The permit will authorize the retention of all legal-size Tanner crab captured while fishing designated survey stations. In Unalaska Bay, vessel length is restricted to a maximum of 58 feet; there are no length restrictions for the other survey areas. A confidentiality waiver will be required for each vessel operator, to allow the department to report survey information. Participants will be required to coordinate their fishing activity with the availability of the Dutch Harbor ADF&G staff who will be placed onboard the vessel to collect biological data on the retained and non-retained portions of the catch and to document fishing practices.

Survey stations are grouped into four locales: A-Unalaska Bay (7 survey stations), B-Beaver Inlet (5 survey stations), C-outer Unalaska Island (8 survey stations) and D-Akutan/Akun (5 survey stations). The four locales contain a total of 25 stations and historic pot survey sites are present in 18 of the survey stations. Fishers will be required to set three pots in each historic survey site (stations may contain one to four historic survey sites). The remaining pots may be set in the designated stations at the discretion of the vessel operator. Letters of interest for the survey should indicate whether fishers intend to participate in one or more of these specific locales (A,B,C and/or D). Fishers will be assigned stations from each locale that they apply for.

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Survey stations will be assigned separately for each locale. Fishers must apply in writing to the department for a commissioner's permit by 5:00 PM December 16, 2002. After the deadline, the department will randomly assign predetermined survey stations by December 20 to each vessel based on the number of applicants and locale preference. Within each locale all fishers will be assigned an equal number of stations to fish. Survey maps and coordinates are available from ADF&G in Dutch Harbor or Kodiak.

Fishers must utilize square pots with a minimum size of 5'x 5', large mesh escape panels must be covered, and only two tunnel entrances per pot will be allowed. Vessel operators will record pot location, fish a standardized soak time of between 24 and 48 hours, and report fishing activity periodically to the department in Dutch Harbor. Because of the survey structure and biological sampling duties involved, vessels should expect to fish fewer pots each day as compared to other commercial fisheries. All participating fishers must possess a 2003 T91O or T09O Commercial Fisheries Entry Commission interim use permit card.

For additional information or to apply for a commissioner's permit, please contact the Alaska Department of Fish & Game in Dutch Harbor (907-581-1239) or in Kodiak (907-486-1840).

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Stock Assessment of eastern Bering Sea snow crab

Benjamin J. Turnock
National Marine Fisheries Service
September 24, 2003

SUMMARY

A size based model was developed for eastern Bering Sea snow crab (*Chionoecetes opilio*) to estimate population biomass and harvest levels. Model estimates of mature biomass of snow crab increased from the early 1980's to a peak in 1990 of about 2,002 million lbs. Biomass declined in the late 1990's to about 626 million lbs. in 1999. The stock was declared overfished in 1999 because the survey estimate of mature biomass was below the minimum stock size threshold (MSST). Model estimates of mature biomass continued to decline after 1999 and were estimated at 502 million lbs. in 2003. Survey biomass estimates were lower in the mid-1980's than current survey estimates, however, 2003 model estimates are at historic lows.

Catch has followed survey abundance estimates of large males, since the survey estimates have been the basis for calculating the GHL (Guideline harvest level for retained catch). Retained catches increased from about 6.7 million lbs at the beginning of the directed fishery in 1973 to a peak of 328 million lbs in 1991, declined, then increased to another peak of 243 million lbs in 1998. Catch in the 2000 fishery was reduced to 33.5 million lbs due to the low abundance estimated by the 1999 survey.

A harvest strategy was developed using a simulation model previous to the development of the current model (Zheng et al. 2002). Estimated discard (mostly undersized males and old shell males) in the directed pot fishery has averaged about 33% of the retained catch biomass since 1992 when observers were first placed on crab vessels. Discards prior to 1992 were estimated based on fishery selectivities estimated for the period with observer data.

Six model scenarios were run using M=0.2, 0.25 and 0.3 for each of two assumptions about discard mortality. The base model fit the observed discard catch from 1992 to 2003 closely, while the other scenario allows the model to estimate higher levels of discard to better fit for the lower biomass of old shell mature males observed from the survey. Fmsy, Bmsy and the resulting catch estimates depend on the model scenario used, the steepness and R0 parameters of the spawner recruit curve, the assumptions about which males take part in mating, and the mating ratio (number of females that a male can fertilize in one mating season).

The stock is estimated to be between 39% and 54% of Bmsy in 2003 depending on the model scenario. The total catch (retained plus discard mortality) for the 2004 season is

estimated between 14.5 and 21.7 million lbs and the 2004 retained catch (GHL) is estimated at 10.7 to 16.6 million lbs depending on the model scenario. The 2004 GHL using the mature male survey biomass (161 mill lbs) is estimated at 17.1 mill lbs, if the value of F from the harvest control rule is used as an exploitation rate. Total catch (retained plus discard mortality) would be estimated at 21.4 mill lbs.

Conservation concerns are that the stock is at its lowest level historically and that recruitment has been low for the past nine years. The stock is expected to decline in the future given past low recruitments. Survey biomass estimates were below the MSST in 1999, and have declined in the last two years (2002 and 2003). Higher estimates of M result in higher GHLs, which may drive the stock to lower levels, if M is overestimated. The level of discard mortality is also uncertain, which if underestimated will result in GHLs that are too high.

INTRODUCTION

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. In the Bering Sea, snow crabs are common at depths less than about 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.

CATCH HISTORY

Snow crabs were harvested in the Bering Sea by the Japanese from the 1960s until 1980 when the Magnuson Act prohibited foreign fishing. Retained catch in the domestic fishery increased in the late 1980's to a high of about 328 million lbs in 1991, declined to 65 million lbs in 1996, increased to 243 million lbs in 1998 then declined to 33.5 million lbs in the 2000 fishery (Table 1, Figure 1). Due to low abundance and a reduced harvest rate, retained catches remained low and were 32.7 million lbs in the 2002 fishery (36.2 million lbs total catch) and 28.3 million lbs of retained catch in 2003.

Discard from the directed pot fishery was estimated from observer data since 1992 and ranged from 11% to 64% (averaged about 33%) of the retained catch of male crab biomass (Table 1). Female discard catch is very low and not a significant source of mortality. Trawl discard mortality was estimated at about 5.1 million lbs in 1974 then declined to less than 1 million lbs from 1976 to 1991. In 1992 trawl discard mortality was about 9 million lbs, then declined to about 2 to 3 million lbs until 1998, when it declined to below 1 million lbs. Most discard for the period 1997 to 2002 in groundfish fisheries came from the (in order of catch) yellowfin sole trawl fishery, flathead sole trawl fishery, Pacific cod bottom trawl fishery, rock sole trawl fishery and the pacific cod hook and line and pot fisheries.

Size frequency data and catch per pot have been collected by observers on snow crab fishery vessels since 1992. Observer coverage was 10% on catcher vessels larger 125 ft (since 2001), and 100% coverage on catcher processors (since 1992). In the 2002 fishery about 0.5% of the total pot lifts were observed (Neufeld and Barnard 2003).

Several modifications to pot gear have been introduced to reduce bycatch mortality. In the 1978/79 season, pots used in the snow crab fishery first contained escape panels to prevent ghost fishing. Escape panels consisted of an opening with one-half the perimeter of the tunnel eye opening laced with untreated cotton twine. No escape mechanisms for undersized crab were required until the 1997 season when at least one-third of one vertical surface had to contain not less than five-inch stretched mesh webbing or have no less than four circular rings of no less than three and three-quarter inches inside diameter. In the 2001 season the escapement for undersize crab was increased to at least eight escape rings of no less than four inches placed within one mesh measurement from the bottom of the pot, with four escape rings on each side of the two sides of a four-sided pot, or one-half of one side of a the pot must have a side panel composed of not less than five and one-quarter stretched mesh webbing. The size of the cotton laced panel to prevent ghost fishing was increased in 1991 to at least 18 inches in length.

ABUNDANCE AND EXPLOITATION TRENDS

Survey Biomass

Abundance is estimated from the annual Bering Sea bottom trawl survey conducted by NMFS (e.g., Stevens et al. 2000 for design and methods). Since 1989, the survey has sampled stations farther north than previous surveys. In 1982 the survey net was changed resulting in a change in catchability. Juvenile crabs tend to occupy more inshore northern regions (up to about 63 degrees N) and mature crabs deeper areas to the south of the juveniles (Zheng et al. 2001).

The total mature biomass estimated from the survey declined to a low of 180 million lbs in 1985, increased to a high of 1,657 million lbs in 1991, then declined to 294 million lbs in 1999, when the stock was declared overfished (Table 2 and Figure 2). The mature biomass increased in 2000 and 2001, mainly due to a few large catches of mature females. The 2002 survey estimate of mature biomass was 314 million lbs and in **2003, 262 million lbs**. The total mature biomass includes mature females and morphometrically mature males. The term mature for male snow crab will be used here to mean morphometrically mature. Morphometric maturity for males refers to a change in chelae height, after which males are assumed to be effective at mating. Males are functionally mature at smaller sizes than when they become morphometrically mature.

Harvest rates

The Harvest rate used to set the GHL (Guideline harvest level of retained crab only) previous to 2000 was 58% of the number of male crab over 101 mm estimated from the survey (Snow crab rebuilding plan, 2000). The legal size limit for snow crab is 78 mm, however, the fishery generally accepts animals greater than 101 mm. The GHL divided by the survey abundance of male crab >101 mm was close to 58% for most years (Figure 5). In 2000, due to the decline in abundance and the declaration of the stock as overfished, the harvest rate was reduced to 20% of male crab over 101 mm.

The actual retained catch typically exceeded the GHL, resulting in exploitation rates for the retained catch (using survey numbers) ranging from about 60% to 100% for most years. The actual exploitation fraction is calculated using the abundance for male crab over 101 mm estimated from the survey data reduced by the natural mortality from the time of the survey until the fishery occurs, which has been around 7 months since the late 1980's. The actual exploitation rate for the total catch (retained plus discard mortality), using the observed survey biomass, ranged from about 20% to over 100% (Figure 5). Catches were greater than the abundance estimates from the survey because some crabs are retained that are less than 102 mm, discard mortality of small crabs is also included, and survey catchability may be less than 1.0. The exploitation fraction using the total catch divided by the mature male biomass estimated from the model ranged from 10% to 60% (Figure 6). The exploitation fraction estimated by dividing the total catch by the model estimate of the crabs over 101 mm ranged from about 15% to 95% (Figure 6). The total exploitation rate was greater than 70% for 1989 to 1994 and 1998 to 1999 (year when fishery occurred).

The current harvest strategy uses a retained crab harvest rate on the mature male biomass of 0.1 at a total mature biomass greater than ½ MSST (230 million lbs), increasing linearly to 0.225 when biomass is equal to or greater than Bmsy (921.6 million lbs) (Zheng 2002). Bmsy was estimated as the average total mature biomass (males and females) estimated from the survey for the years 1983 to 1997. MSST was estimated as 50% of the Bmsy value (460 million lbs). The GHL is actually set as the number of retained crab allowed in the harvest, which is calculated by dividing the GHL in lbs by the average weight of a male crab > 101 mm. If the GHL in numbers is greater than 58% of the estimated number of new shell crabs greater than 101 mm plus 25% of the old shell crab greater than 101 mm, the GHL is capped at 58%. If natural mortality is 0.3, then the realized exploitation rate cap for the retained catch is 70%, when the fishery occurs 7 months after the survey.

Survey Size Composition

Carapace width is measured on snow crab and shell condition noted. Snow crab cannot be aged at present (except by radiometric aging of the shell since last molt), however, shell condition has been used as a proxy for age. Shell condition is recorded as soft shell (SC1) (less than three months from molting), new shell (SC2) (three months to one year from molting), old shell (SC3) (one year to several years from molting), very old shell (SC4) (greater than one year, but unknown age), and very very old shell (SC5) (greater than one year, but unknown age). Radiometric aging of shells from terminal molt male crabs (after the last molt of their lifetime) has recently shed light on how shell condition relates to age, which will be discussed in a later section (Nevissi et al 1995 and Orensanz unpub. Data).

There were two periods of high recruitment indicated by the survey estimates of male abundance by size; in the mid-1980's and early 1990's (Figures 3 and 4).

ANALYTIC APPROACH

Data Sources

Catch data and size frequencies of retained crab from the directed snow crab pot fishery from 1978 to the 2003 season were used in this analysis. Observers were placed on directed crab fishery vessels starting in 1990. However, reliable size frequency data on the total catch (retained plus discarded) in the directed crab fishery were available from 1992 to 2003. Total discarded catch was estimated from observer data from 1992 to 2003(Table 1). The discarded male catch was estimated for 1978 to 1991 in the model using the estimated fishery selectivities based on the observer data for the period 1992 to 2003. The discard catch estimate was multiplied by the assumed mortality of discards from the pot fishery. In the model presented here mortality of discarded crab is assumed to be 100%. The following table contains the various data components used in the model,

Data component	Years
Retained male crab pot fishery size frequency by shell condition	1978-2002 (Year when fishery actually occurred)
Discarded male and female crab pot fishery size frequency	1992-2002
Trawl fishery bycatch size frequencies by sex	1990-2002
Survey size frequencies by sex and shell condition	1978-2003
Retained catch estimates	1978-2003
Discard catch estimates from snow crab pot fishery	1992-2003 estimated from observer data
Trawl bycatch estimates	1973-2003
Total survey biomass estimates and coefficients of variation	1978-2003

Model Structure

The model structure was developed following Fournier and Archibald's (1982) methods, with many similarities to Methot (1990). The model was implemented using automatic differentiation software developed as a set of libraries under C++(ADModel Builder).

ADModel Builder can estimate a large number of parameters in a non-linear model using automatic differentiation software extended from Greiwank and Corliss(1991) and developed into C++ class libraries. This software provides the derivative calculations needed for finding the objective function via a quasi-Newton function minimization routine(e.g., Press et al. 1992). The model implementation language (ADModel Builder) gives simple and rapid access to these routines and provides the ability to estimate the variance-covariance matrix for all parameters of interest.

Details of the population dynamics and estimation equations, description of variables and likelihood equations are presented in Appendix A (Tables A.1, A.2 and A.3). The population dynamics equations, incorporating the growth transition matrix and molting probabilities are similar to other size based crab models (Zheng et al. 1995 and 1998). There were a total of 276 parameters estimated in the model (Table A.4). The 78 fishing mortality parameters (one set for the male catch, one set for the female discard catch, and one set for the trawl fishery bycatch) estimated in the model were constrained so that the estimated catch fit the observed catch closely. There were 51 recruitment parameters estimated in the model, one for the mean recruitment, 25 for females and 25 for males, which were constrained to be similar. There were 55 fishery selectivity parameters, 50 of which were length at 50% selected parameters to allow changing fishery selectivities by year.

Molting probabilities for mature males and females were fixed at 0 resulting in mature animals ceasing to growth when they mature. Molting probabilities were fixed at 1.0 for immature females and were estimated for immature males. The intercept and slope of the linear growth function of postmolt relative to premolt size were estimated in the model (Table A.5). A gamma distribution was used in the growth transition matrix with the beta parameters estimated for male and females.

The model separates crabs into mature, immature, new shell and old shell, and male and female for the population dynamics. The model estimate of survey biomass is fit to the total observed survey biomass time series. The model fits the size frequencies of the survey by new and old shell, immature and mature, and by sex. The model fits the size frequencies for the pot fishery catch by new and old shell and by sex.

Crabs over 25 mm CW (carapace width) were included in the model. There are 22 size bins of 5 mm each, from 25-29 mm to 130-135mm. In this report the term size as well as length will be considered synonymous with CW. Recruitment to the model was estimated separately for males and females. Recruits were distributed in the first few size bins using a two parameter gamma distribution with the parameters estimated in the model. Eighty-eight parameters were estimated for the initial population size composition of new and old shell males and females in 1978. Recruitment for males and females was constrained to be similar by adding a penalty to the likelihood. No spawner-recruit relationship was used in the population dynamics part of the model. Recruitment parameters were estimated in the model to fit the data.

The survey occurs in summer each year, however, in the model, the time of the survey is considered to be the start of the year (July). This results in the start of the year being July instead of January. The directed snow crab pot fishery has occurred generally in the winter months (January to February) over a short period of time, however in the early years the fishery occurred over a longer time period. The mean time of the fishery weighted by the catch was estimated for each year and the fishing mortality applied all at once at the mean time for that year. Natural mortality is applied to the population from the time the survey occurs until the fishery occurs, then catch is removed. After the fishery occurs, growth and recruitment take place (in spring), with the remainder of the natural mortality.

Weight - Size

The weight (kg) – size (mm) relationship was estimated from survey data, where weight = a* $size^b$. Female a= 0.00000253, b=2.56472, male a= 0.00000023, b=3.12948 (Figure 7).

Maturity

Maturity for females was determined by visual examination during the survey and used to determine the fraction of females mature by size for each year. Female maturity was determined by the shape of the abdomen, by the presence of brooded eggs or egg remnants. The average maturity curve has a 50% value of about 49 mm with a slope of 0.16 (Figure 8).

Morphometric maturity for males is determined by chela height measurements, which are available starting from the 1989 survey (Otto 1998). The number of males with chela height measurements has varied between about 3,000 and 7,000 per year. In this report a mature male refers to a morphometrically mature male.

One maturity curve for males was estimated and applied to all years in the model. A two-parameter logistic function was used that fit the fraction mature for larger new shell males well, resulting in size at 50% mature for new shell males of 88 mm CW with a slope of 0.12 (Figure 9). The average fraction mature for old shell males was used as the maturity curve for all years for old shell males. Maturity for old shell males is zero below 40 mm, increases from 83% at 45 mm to 95% at 115 mm.

Selectivity

Selectivity curves for the retained and total fishery catch were estimated as two-parameter ascending logistic curves. Fishery selectivities for new and old shell males are allowed to change by year by estimating one mean size at 50% selectivity parameter, with deviations for each year from 1978 to 2002. The yearly parameters are constrained by a penalty that results in a smooth trend in the parameters over time (Figures 10 and 11). The selectivities for the survey and trawl bycatch were estimated with two-parameter, ascending logistic functions. Survey selectivities were estimated using a two parameter logistic function that was equal for both males and females. Separate survey selectivities were estimated for the period 1978 to 1981, 1982 to 1988, and 1989 to the present. The maximum selectivity was fixed at 1.0. The separate selectivities were used due to the change in catchability in 1982 from the survey net change, and the addition of more survey stations to the north of the survey area after 1988.

Selectivities were estimated the same for new shell and old shell males for the total catch (retained plus discarded mortality) and separately for new and old shell for the retained catch. The probability of retaining crabs by size and shell condition was estimated as an ascending logistic function. The selectivities for the retained catch were estimated by multiplying the retention curve by the selectivities for the retained plus discarded size compositions.

Survey selectivities have been estimated for Bering Sea snow crab from underbag trawl experiments (Somerton and Otto 1999) (Figure 12). A bag underneath the regular trawl was used to catch animals that escaped under the footrope of the regular trawl. The selectivity was estimated to be 50% at about 74 mm, 0.73 at 102 mm, and reached about 0.88 at the maximum size in the model of 135 mm.

Growth

Very little information exists on growth for Bering Sea snow crab. Tagging experiments were conducted on snow crab in 1980 with recoveries occurring in the Tanner crab (*Chionoecetes bairdi*) fishery in 1980 to 1982 (Mcbride 1982). All tagged crabs were males greater than 80mm CW, which were released in late may of 1980. Forty-nine tagged crabs were recovered in the Tanner crab fishery in the spring of 1981 of which only 5 had increased in carapace width. It is not known if the tags inhibited molting or resulted in mortality during molting. One crab was recovered after 15 days in the 1980 fishery, which apparently grew from 108 mm to 123 mm carapace width. One crab was recovered in 1982 after almost 2 years at sea that increased from 97 to 107 mm.

Growth data from 14 male crabs collected in March of 2003 that molted soon after being captured were used to estimate a linear function between premolt and postmolt width (Lou Rugolo unpublished data, Figure 13). The crabs were measured when shells were still soft because all died after molting, so measurements are probably underestimates of postmolt width (Rugolo, pers. com.). However, growth appears to be greater than growth of some North Atlantic snow crab stocks (Sainte-Marie 1995). Growth from the 1980 tagging of snow crab was not used due to uncertainty about the effect of tagging on growth. No growth measurements exist for Bering sea snow crab females. North Atlantic growth data indicate growth is slightly less for females than males.

Growth was modeled using a linear function to estimate the mean width after molting given the mean width before molting (Figure 14),

$$\mathrm{Width}_{t+1} = a + b^{*}\,\mathrm{width}_{t}$$

The parameters a and b estimated from the observed growth data for Bering sea snow crabs were used as prior means for the growth parameters estimated in the model. Crab were assigned to 5mm width bins using a gamma distribution with mean equal to the growth increment by sex and length bin and a beta parameter (which determines the variance),

$$Gr_{s,l \to l'} = \int_{l'-2.5}^{l'+2.5} Gamma(\alpha_{s,l}, \beta_s)$$

Where Gr is the growth transition matrix for sex, s and length bin l. The Gamma distribution is,

$$g(x \mid \alpha_{s,l}, \beta_s) = \frac{x^{\alpha_{s,l}-1} e^{-\frac{x}{\beta_s}}}{\beta^{\alpha_{s,l}} \Gamma(\alpha_{s,l})} \quad .$$

Natural Mortality

Natural mortality is one of the most important parameters in a population dynamics model, and may have a large influence on optimal harvest rates. Natural mortality estimated in a population dynamics model may have high uncertainty and be correlated with other parameters, and therefore is usually fixed. However, a large portion of the uncertainty in model results (e.g. current biomass), will be due to uncertainty in natural mortality. The ability to estimate natural mortality in a population dynamics model is limited and depends on the how the true value varies over time as well as other factors (Fu and Quinn 2000, Schnute and Richards 1995).

In previous models, natural mortality has been assumed to be 0.3 for males and females, which would indicate a maximum age of about 14 years (Table 4)(Hoenig 1983)(Crab FMP). A maximum age of 20 years would result from an M of about 0.21 (HOenit 1983). However, ISES uses a 5% rule for deriving a value of natural mortality, which would result in an M of 0.2 for a maximum observed age of 15 years (Anthony 1982). A natural mortality of 0.3 results in about 5% of animals remaining after 10 yrs of age. Research is currently underway to assess a method using lipofuscin for age determination (Se-Jong, et al. 1999). A maximum age of about 13 years for females and 19 years for males has been hypothesized for North Atlantic snow crab by Comeau, et al (1998) based on size frequency analysis and growth data. Sainte-Marie, et al (1995) estimated an age of about 9 years for a 95 mm male snow crab and 11 years for a 131 mm crab for a different sub-population of Atlantic snow crab than Comeau, et al (1998) using size frequency analysis and growth data. A maximum time at large of 7 years for tag returns of mature male snow crab in the North Atlantic has been recorded since tagging started about 1993 (Sainte-Marie, pers. comm.). Otto (1998) estimated natural mortality of male snow crab based on survey data and retained catches to be greater than 1.0. Otto (1998) overestimates M because the method assumed no time lapse between the survey and the fishery removals (during which natural mortality would be occurring), no bycatch mortality, survey selectivities were 1.0, and that shell condition is an accurate indicator of age since last molt (new shell less than one year, old shell crabs more than one, but less than two years from molting), and that new and old shell crabs were accurately categorized by shell condition. Zheng (unpub) investigated natural mortality of Bering Sea snow crab using a modeling approach, accounting for natural mortality between the time of the survey and the fishery. The snow crab fishery generally occurs over a short time span, about 7 months after the survey. Estimates of natural mortality ranged from 0.0 to 0.97, depending on assumptions made for molting probabilities, growth per molt and survey selectivities (Zheng unpub.).

A range of natural mortality rates were considered due to the range of maximum ages from the various studies cited above. The instantaneous natural mortality rate was assumed to be 0.2, 0.25 or 0.3 for all crabs for various model scenarios.

Zheng et al. (1998) estimated natural mortality and bycatch mortality together to be about 0.5 for male and female Bering Sea Tanner crab (Chionecites bairdi) in a population dynamics model. He did not estimate bycatch mortality separately, but, natural mortality would have been less than the reported 0.5. Somerton (1981) estimated natural mortality for male Tanner crab less than commercial size to be 0.35. M was estimated to be between 0.13 and 0.28 for commercial size male Tanner crab (Somerton 1981).

Orensanz (unpub.) used radiometric techniques to estimate shell age from last molt (Table 4). The total sample size was 21 male crabs (a combination of Tanner and snow crab) from a collection of 105 male crabs from various hauls in the 1992 and 1993 NMFS Bering sea survey. Representative samples for the 5 shell condition categories were collected that made up the 105 samples. The oldest looking crab within shell conditions 4 and 5 were selected from the total sample of SC4 and SC5 crabs to radiometrically age (Orensanz, pers comm.). Shell condition (SC5) crab (very, very old shell) had a maximum age of 6.85 years (s.d. 0.58, 95% CI approximately 5.69 to 8.01 years). The average age of 6 crabs with SC4 (very old shell) and SC5, was 4.95 years. The range of ages was 2.70 to 6.85 years for those same crabs. Given the small sample size, crabs older than the maximum age of 7 to 8 years may be expected in the population. SC2 animals (new shell) were 0.33 to 1.07 years old (mean 0.69 yrs (8.2 months)). This indicates that either some animals molted just after the survey (C.I. for 1.07 is, 0.49 to 1.66), or some animals that did not molt the year before were misclassified as new shell animals. If there is misclassification, then new shell animals may be overestimated, and old shell animals (SC3) underestimated. However, there may also be overlap in age for old shell animals. The average age of soft shell crab (SC1) was 0.15 yrs, if the SC1 and SC2 animals are combined (as it is for estimating new shell animals for harvest purposes) the average age is lower than for SC2 alone (mean = 0.42 yrs). However, the SC3 (old shell) animals were 0.85 to 1.1 years old (mean 1.02 yrs). There was only one animal between 1.1 years and 4.2 years old, which was a SC5 crab, 2.7 years old. Some overlap of ages would be expected between SC3, and SC4 and SC5 animals, between age 1 and 4 years, which did not occur in the sample, probably due to the small sample size.

Male animals during the mid to late 1980's were subjected to increasing exploitation with the maximum catch occurring in 1991. The maximum age in the sample of 6.85 years would be the result of fishing mortality as well as natural mortality. Using this maximum age would result in an upper bound on natural mortality. If crabs mature at about age 6 to 8, then adding another 7 or 8 years would give a maximum total age of about 13 to 16 years. However, due to exploitation occurring at the same time, the maximum age that would occur due to M alone would be greater than 13 to 16 years.

Molting probability

Female and male snow crab have a terminal molt to maturity. Many papers have dealt with the question of terminal molt for Atlantic Ocean mature male snow crab (e.g., Dawe, et al 1991). A laboratory study of morphometrically mature male Tanner crab, which were also believed to have a terminal molt, found all crabs molted after two years (Paul and Paul 1995). Bering Sea male snow crab appear to have a terminal molt based on recent data on hormone levels (Sherry Tamone, per. comm.) and findings from molt stage analysis via setagenesis (Lou Rugolo, pers. comm.). The models presented here have a terminal molt for both males and females.

Male Tanner and snow crabs that do not molt (old shell) may be important in reproduction. Paul, et al (1995) found that old shell mature male Tanner crab out-competed new shell crab of the same size in breeding in a laboratory study. Recently molted males did not breed even with no competition and may not breed until after about 100 days from molting (Paul, et al 1995). Sainte-Marie(2002) states that only old shell males take part in mating for North Atlantic snow crab. If molting precludes males from breeding for a three month period, then males that are new shell at the time of the survey (June to July), would have molted during the preceding spring (March to April), and would not have participated in mating. The fishery targets new shell males, resulting in those animals that molted to maturity and to a size acceptable to the fishery of being removed from the population before the chance to mate. Animals that molt to maturity at a size smaller than what is acceptable to the fishery may be subjected to fishery mortality from being caught and discarded before they have a chance to mate.

Crabs in their first few years of life may molt more than once per year, however, the smallest crabs included in the model are probably 3 or 4 years old and would be expected to molt annually.

The growth transition matrix was applied to animals that grow, resulting in new shell animals. Those animals that don't grow become old shell animals. Animals that are classified as new shell in the survey are assumed to have molted during the last year. The assumption is that shell condition (new and old) is an accurate measure of whether animals have molted during the previous year. The relationship between shell condition and time from last molt needs to be investigated further. Additional radiometric aging for male and female snow crab shells is planned for 2003-2004, to improve the estimate of radiometric ages from Orensanz (unpub. data).

RESULTS

Six model scenarios were run, three with discard catch mortality estimated higher than the observed discards, and three with discard catch mortality closely fit to the observed discard mortality(base model). The three scenarios within each discard catch scenario were for M of 0.2, 0.25, and 0.3. The base model runs fit the observed discards closely with an average discard a little higher than the observed average of 44% of the retained catch. The high discard catch scenario resulted in better fits to the old shell mature male length frequencies and to the mature male survey biomass. The average discard was about 75% of the retained catch, ranging from 22% to 136% of the retained catch compared to the observed discard average of 33%. The higher mortality of smaller mature male crabs due to discarding may be the reason why fewer old shell mature male crab are observed from the survey that are expected in the base model. The fishery for snow crabs occurs in winter when low temperatures and wind may result in freezing of discard crabs on deck before they are returned to the sea. Short term mortality may occur due to exposure, which has been demonstrated in laboratory experiments Zhou and Kruse (1998) and Shirley(1998), where 100% mortality occurred under temperature and wind conditions that may occur in the fishery. Even if damage did not result in short term mortality, immature crabs that are discarded may experience mortality during molting some time later in their life.

Model estimates in Tables 1 to 3 and Table 6 and in Figures 2 through 38 are from the base model with M=0.3. Parameter estimates for the base model with M=0.3 and in Table 6. The total mature biomass increased from about 721 mill lbs (328 mt) in 1978 to the peak biomass of 2,002 mill lbs (910 mt) in 1990. Biomass declined sharply after 1996 to about 502 mill lbs (228 mt) in 2003 (Table 3 and Figure 2). Mature biomass estimated by the model is currently the lowest level estimated from 1978 to the present. The model is constrained by the population dynamics structure, including natural mortality, the growth and selectivity parameters and the fishery catches. Given the population dynamics structure and the parameters used, the model cannot account for the catches removed from the population unless population biomass is larger than observed from the survey. The low observed survey abundance in the mid-1980's were followed by an abrupt increase in the survey abundance of animals in 1987, which followed through the population and resulted in the highest catches recorded in the early 1990's. The model cannot fit the low survey abundance estimates in the mid-1980's, fit the high survey abundance in the 1990's, and extract the catches that occurred in the early 1990's. Average discard catch mortality for 1978 to 2003 was estimated to be about 44% of the retained catch a little higher than the observed discards from 1992 to 2003 (33%) (Table 1 and Figure 15). During the last four years (2000 to 2003 fishery seasons) model estimates of discard mortality averaged 34% of the retained catch. Estimates of discard mortality ranged from 14% of the retained catch to 69% of the retained catch.

Mature male and female biomass show similar trends (Table 3 and Figures 16 and 17). Mature male biomass was about the same from 2002 (198 mill lbs) to 2003 (204 mill lbs), while survey biomass decreased (216 mill lbs to 161 mill lbs). Mature female biomass was similar for 2002 (285 mt) and 2003 (299 mt). Mature female biomass observed from the survey was also similar for 2002 (98 mill lbs) and 2003 (101 mill lbs).

Fishery selectivities and retention curves were estimated using ascending logistic curves (Figure 10, 11 and 18). Selectivities for trawl bycatch were estimated as ascending logistic curves (Figure 19). Plots of model fits to the survey size frequency data are presented in Figures 20 to 26.

Survey selectivities for the period 1978 to 1981 were estimated at 50% at about 38 mm and reached 100% at about 70mm (Figure 12). This indicates that the survey net was more efficient than the present survey net. Survey selectivities for the period 1982 to 1988 were estimated at 50% at about 70 mm and reached about 90% at 130 mm. These selectivities were the best fit determined by the model, which are close to the values estimated by Somerton and Otto (1998). Survey selectivities for the period 1989 to the present were estimated at 60% at about 25 mm and reached about 95% 130 mm. The survey selectivities are multiplied by the population numbers by length to estimate survey numbers for fitting to the survey data. Molting probabilities for immature males declined from 100% at 25 to 60 mm, to about 60% at 130 mm (Figure 27)

The estimated number of males > 101mm follows the observed survey numbers except in the early to mid 1980's when catches were close to or exceeded the survey estimates of males > 101 mm (Figure 28).

Two main periods of high recruitment were estimated by the model, in 1985-86 and in 1991-1993 (Figure 29). Recruits are 25mm to about 50 mm and may be 3 or 4 years old (Figure 30, although age is unknown). Low recruitments were estimated from 1994 to the present.

The size at 50% selected for the pot fishery varied between 93 mm and 105 mm for most years, and was about 103.5 mm in 2003 for males (Figure 11). Retention for old shell males was less than for new shell males (Figure 18 and 10). The fishery generally targets new shell animals with clean hard shells and all legs intact. Mortality of discarded crabs was assumed to be 100% in the model. The fits to the fishery size frequencies are in figures 31 through 35. Fits to the trawl fishery bycatch size frequency data are in figures 36 and 37.

Harvest Strategy and Guideline Harvest Levels

Siddeek (2003) used a size based model to simulate spawning biomass using a Beverton and Holt spawner recruit curve with a range for the steepness parameter from about 0.33 to 0.83 (which he parameterized as an extinction parameter), M=0.3, mating ratios between 1 and 3 (the number of females that can be fertilized by 1 male) and only old shell males mating, for Bering sea and North Atlantic snow crab. The exploitation rate at maximum yield for the retained catch for male crabs over 101 mm was estimated as 0.43

for North Atlantic snow crab with a terminal molt, and at 0.24 for Bering sea snow crab without a terminal molt and with using the lower North Atlantic growth rates.

Fmsy and Bmsy for Bering sea snow crab was estimated using the model presented here. Effective spawning biomass was estimated the same as Siddeek(2003), assuming only old shell males take part in mating and mating ratio is 2. If the numbers of old shell mature males (NMM_O) at the time mating occurs (accounting for natural mortality and removing the catch from the numbers at survey time) is less than the numbers of mature females (NMF) at the time mating occurs, divided by the mating ratio ($\eta = 2$), then the female mature biomass (fspbio) is reduced to estimate effective female spawning biomass (efspbio),

$$efspbio = fspbio * \frac{NMM_O * \eta}{NMF}$$

If the number of old shell mature males at mating time is more than the numbers of mature females at the time mating occurs, divided by the mating ratio (2), then effective female spawning biomass is estimated to be equal to female spawning biomass, and the male mature biomass is reduced to estimate effective male spawning biomass,
If the numbers of old shell mature males (NMM_O) at the time mating occurs (accounting for natural mortality and removing the catch from the numbers at survey time) is more than the numbers of mature females (NMF) at the time mating occurs, divided by the mating ratio ($\eta = 2$), then the male mature biomass (mspbio) is reduced to estimate effective male spawning biomass (emspbio),

$$emspbio = mspbio * \frac{\frac{NMF}{\eta}}{NMM_O}$$

The effective female spawning biomass is added to the effective male spawning biomass to obtain total effective spawning biomass.

The parameters of the Beverton and Holt spawner recruit curve (steepness and R0) were estimated in a model separate from the population dynamics model using effective spawning biomass and recruits estimated from the population dynamics model for 1978 to 2003 (Figure 38),

$$\mathrm{Re}\,cruits = \frac{(0.8 * R0 * h * \gamma_0)}{0.2 * \gamma_0 * R0 * (1 - h) + (h - .2) * \gamma_c}$$

γ_c is effective total spawning biomass, γ_0 is effective total spawning biomass per recruit at F=0, R0 is the recruitment that would occur when the stock is at the effective spawning biomass for F=0, and h is the steepness parameter (Gabriel et al. 1989, Dorn 2002). Steepness is the proportion of R0 that recruits when the stock is reduced to 20% of the unfished effective total spawning biomass. When steepness is 1.0, recruits are independent of stock biomass, when steepness is at the lower limit (0.2) recruits linearly increase with stock biomass.

A normal prior distribution was used for the steepness parameter with a mean of 0.52 (the steepness estimated for Bristol Bay red king crab, Siddeek, pers. comm.) and a relatively large standard deviation of 0.6. A normal prior distribution was also used for the R0 parameter (the recruitment at B0) with a mean equal to the average model recruitment and a cv of 0.6.

Harvest strategy simulations are reported by Zheng et al. (2002) based on a model with structure and parameter values different than the model presented here. The harvest strategy by Zheng et al. (2002) was developed for use with survey biomass estimates and was applied to survey biomass estimates to calculate the 2003 fishery GHL. Bmsy was estimated using the average total mature survey biomass for 1983 to 1997. MSST was estimated as ½ Bmsy. The harvest strategy consists of a threshold for opening the fishery (MSST=230.4 million lbs of total mature biomass(TMB) (0.25*Bmsy), a minimum GHL of 15 million lbs for opening the fishery, and rules for computing the GHL.

Under current FMP (Fishery Management Plan) definitions for MSY biomass (B_{MSY} = 921.6 million pounds TMB) and overfishing rate (F_{MSY} =M=0.3), the fishing mortality rate to apply to current mature male biomass (MMB), is determined as a function of TMB as,

$$F = \frac{0.75 * Fmsy * \left[\frac{TMB}{Bmsy} - \alpha \right]}{(1-\alpha)}$$

for TMB ≥ 0.25*Bmsy and TMB<Bmsy, where α = -0.35, and,

- F = (Fmsy * 0.75) = 0.225, for TMB ≥ Bmsy, and F = 0 for TMB < 0.25*Bmsy.

The maximum for a GHL_{max} is determined by using the F determined from the control rule as an exploitation rate on mature male biomass at the time of the survey,

- GHL_{max} = F•MMB.

The F determined from the harvest control rule was used as an exploitation rate on mature male biomass instead of as a fishing mortality rate for the 2003 fishery. The use of the equation, GHL = F*MMB, assumes that fishery selectivities were 1.0 for all mature male crabs and that the mature male biomass at the time of the survey is equal to the average over the year and that fishing mortality and natural mortality occur simultaneously throughout the year. However, the biomass at the time the survey occurs is after growth and recruitment occurs and before the fishery, resulting in the maximum in the year. The convention of setting Fmsy = M is for setting the instantaneous fishing mortality rate at M, not the exploitation rate on the stock. For example, if Fmsy = M =

0.3, then the F to apply when TMB is at or above Bmsy would be 0.225 to obtain the total catch (retained plus discard). The exploitation rate corresponding to F = 0.225 would be (F *(1-exp(-Z))/Z) = 0.175, where Z=M+F, if the fishery and natural mortality occur simultaneously throughout the year. This results in an overestimation of the exploitation rate and the GHL by about 28.5%. The exploitation rate corresponding to a pulse fishery would be 0.167 on MMB at the time of the survey for an F = 0.225, an overestimation of 34.7%. If F = 0.1 (the value when TMB is at 25% Bmsy) the exploitation rate would be 0.079 on MMB at the time of the survey, a 26.6% overestimation of the GHL.

The use of value of the harvest control rule as an exploitation rate on mature male biomass at the time of the fishery is consistent with the harvest strategy simulations (Zheng et al 2002), however, it still underestimates the true exploitation rate and cannot be compared to Fmsy, for example to determine overfishing.

There is a 58% maximum harvest rate on exploited legal male abundance. Exploited legal male abundance is defined as the estimated abundance of all new shell legal males >=4.0-in (102 mm) CW plus a percentage of the estimated abundance of old shell legal males >=4.0-in CW. The percentage to be used is determined using fishery selectivities for old shell males.

The existing harvest control rule is used here with estimates of Bmsy and Fmsy from the current model and α = -0.25 (Figure 39). An α = -0.25 results in an F of 40% of the maximum F at 25% of Bmsy, the same as in the existing harvest strategy (Zheng et al 2002). The above formulation of the harvest control rule is the same as that used for North Pacific groundfish, except a value of 0.05 is used instead of -0.25 (BSAI SAFE 2002). Using a value of 0.05 as is used for groundfish means F will be zero at when current biomass is 5% of Bmsy. The slope of the control rule is less for snow crab resulting in a relatively higher F than the groundfish control with α = 0.05, until current biomass is below 0.25 Bmsy, when F would be 0 for snow crab, but would still be greater than 0 for the groundfish rule (Figure 39). For the groundfish rule the maximum F applied when biomass is at or above Bmsy depends on the amount of information available about Fmsy.

The catch is estimated by the following equation,

$$catch = \sum_{s}\sum_{l} (1-e^{-(F*Sel_{s,l})})w_l N_{s,l}\, e^{-M*.62}$$

Where $N_{S,l}$ is the 2003 numbers at length(l) for mature males by shell condition(s) at the time of the survey estimated from the population dynamics model, M is natural mortality, 0.62 is the time elapsed (in years) from when the survey occurs to the fishery, F is the value estimated from the harvest control rule using 2003 total mature biomass, and w_l is weight at length. $Sel_{S,l}$ are the fishery selectivities by length and shell condition for the total catch (retained plus discard) or for the retained catch estimated from the population dynamics model averaged over the last three years (2001 to 2003 fishery seasons) (Figure 14).

Fmsy and 2004 catches as well as other reference points were estimated for each of the six scenarios (Table 6). The Fmsy (full selection F) ranged from 0.47 to 0.73. The 2004 GHL was generally lower for the high discard model (11.3 to 12.4 mill lbs) than the base model (10.7 to 16.6 mill lbs). Fmsy increased and Bmsy decreased with increasing M.

For comparison, the GHL using the estimates of Fmsy = M = 0.3 and Bmsy = 921.6 mill lbs was calculated using 2003 survey biomass estimates. The survey biomass estimate for total mature biomass in 2003 was 262 mill lbs and mature male biomass was 161 mill lbs. The F for 2004 estimated from the harvest control rule with Fmsy = 0.3, Bmsy = 921.6 mill lbs and α = -0.35, was 0.106.

Using the F = 0.106 as an exploitation rate as has been used previously (F * MMB at survey time) would result in the 2004 GHL = 17.1 mill lbs. Total catch (retained plus discard mortality) would be estimated at 21.4 mill lbs using the same percent discard as estimated for the base model with M=0.3. If the value 0.106 is used as a fishing mortality value, then the exploitation rate would be 0.101 on MMB at the time of the fishery (133.7 mill lbs) which would result in a 2004 GHL of 13.5 mill lbs.

Conservation concerns

- The Bering Sea snow crab model estimate of 2003 mature biomass is currently at its lowest level over the 25 year time period from 1978 to 2003.

- Survey biomass estimates have declined from a peak in 1991 to below 50% Bmsy in 1999 and additionally have declined over the past two years.

- Recruitment has been at low levels for the last 9 years (since 1994). The stock is expected to decline in the future due to the low recruitment.

- There is uncertainty in discard mortality due to low coverage of total pot lifts and only 10% coverage of catcher vessels which only started in 2001. Higher discard mortality would necessitate lower retained catches.

- The natural mortality value is uncertain. Lower natural mortality results in lower GHL. If M is overestimated, the resulting higher GHL may drive the stock to lower levels, instead of rebuilding the stock.

Research Needs

Research is needed to improve our knowledge of snow crab life history and population dynamics to reduce uncertainty in the estimation of current stock size, stock status and optimum harvest rates.

Tagging programs need to be initiated to estimate longevity and migrations. Studies and analyses are needed to estimate natural mortality. Additional sampling of crabs that are close to molting is needed to estimate growth for immature males and females.

The lower number of mature old shell male crabs in the observed survey compared to what are expected in the model needs to be reconciled. Harvest rates and status of the stock are highly dependent on what the discrepancy is due to. The differences could be due to higher fishery discard mortality, higher natural mortality of mature animals, differential catchability of new and old shell animals in the survey, or the estimation of when maturity occurs, which determines when animals stop growing and subsequently move from new shell to old shell animals. In addition, the assignment of crabs to new and old shell condition used in the survey data may not be an accurate measure of time from the last molt.

Increased observer coverage is needed on catcher vessels in the directed snow crab fishery to improve estimates of discards. Field studies are needed to estimate mortality of discards in the winter snow crab pot fisheries where freezing temperatures and wind chill are important factors.

Some method of aging crab needs to be developed. Current research is being conducted using lipofuscin to age crabs and continued radiometric aging of shells of mature crabs is also being conducted (results may be available the end of 2004). However, at this time it is not known if the lipofuscin method will be successful, and radiometric aging is time consuming, so only small numbers of animals can be aged at present. Aging methods will provide information to assess the accuracy of assumed ages from assigned shell conditions (i.e. new, old, very old, etc), which have not been verified, except with the 21 radiometric ages reported here from Orensanz (unpub data).

Which males are effective at mating and how many females they can successfully mate with in a mating season is critical to population dynamics and optimum harvest rates. At the present time it is assumed that when males reach morphometric maturity they stop growing and they are effective at mating. Field studies are needed to determine how morphometric maturity corresponds to male effectiveness in mating. In addition the uncertainty associated with the determination of morphometric maturity (the measurement of chelae height and the discriminate analysis to separate crabs into mature and immature) needs to be analyzed and incorporated into the determination of the maturity by length for male snow crab.

Preliminary laboratory studies indicate that male crabs have a terminal molt to maturity. The determination of the relationship between carapace size of males and terminal molt is critical to stock assessment. If this laboratory study does not result in an estimation of the relationship between carapace size and terminal molt, additional studies will be necessary.

The experiment to estimate catchability of the survey trawl net needs to be repeated with larger sample sizes to allow the estimation of catchability by length, sex and shell condition for snow crab (and Tanner crab). This is needed to determine if the number of mature old shell crabs in the observed survey (which are lower than expected in the model) are due to mortality (fishery discard or natural mortality) or due to lower catchability in the trawl survey.

Female opilio in waters less than 1.0 deg C and colder have been determined to be biennial spawners in the Bering sea (Lou Rugolo, pers. comm.). Future recruitment may be affected by the fraction of biennial spawning females in the population as well as the estimated fecundity of females, which may depend on water temperature.

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Table 1. Catch (1,000s of lbs) for the snow crab pot fishery and groundfish trawl bycatch. Retained catch for 1973 to 1981 contain Japanese directed fishing. Discarded catch is the total estimate of discards which assumes 100% mortality. Discards from 1992 to 2002 were estimated from observer data.

Year fishery occurred	retained catch(1,000s of lbs)	Observed Discard male catch	Retained + discard male catch	Model estimate of male discard	Discard female catch	Year of trawl bycatch	trawl bycatch
1973	6,711					1973	30,046
1974	5,033					1974	41,582
1975	8,250					1975	16,096
1976	10,050					1976	6,975
1977	16,284					1977	4,722
1978-79	52,272			7,132	73	1978	5,422
1979-80	75,025			11,342	91	1979	4,331
1980-81	66,933			25,440	81	1980	3,150
1982	29,355			19,488	46	1981	1,314
1983	26,128			13,909	62	1982	535
1984	26,813			10,129	44	1983	689
1985	65,999			37,910	43	1984	732
1986	97,984			62,553	44	1985	628
1987	101,903			51,182	96	1986	2,699
1988	135,355			65,186	139	1987	8
1989	149,456			68,802	148	1988	968
1990	161,821			54,311	192	1989	1,124
1991	328,647			148,265	204	1990	860
1992	315,302	96,214	402,897	216,425	234	1991	9,401
1993	230,787	124,865	355,652	120,788	481	1992	4,552
1994	149,776	38,922	188,698	54,243	321	1993	2,892
1995	75,253	29,436	104,689	31,922	232	1994	3,219
1996	65,713	42,104	107,817	38,003	63	1995	1,794
1997	119,543	54,391	173,934	56,743	277	1996	2,063
1998	243,342	41,982	294,171	102,730	22	1997	2,884
1999	194,000	34,158	228,358	92,183	26	1998	2,146
2000	33,500	3,790	37,081	5,588	2	1999	788
2001	25,256	4,537	29,794	6,384	2	2000	611
2002	32,722	13,824	46,546	14,208	2	2001	
2003	28,307	9,938	38,245	13,836	2	2002	

Table 2. Observed and model estimated survey biomass, numbers(millions of crab) and observed survey male, female and total spawning biomass(millions of lbs).

Year	Observed survey biomass	estimated survey biomass	observed survey numbers	estimated survey numbers	Observed survey male mature biomass	Observed survey female mature biomass	Observed survey total mature biomass	Observed number of males > 101mm (millions)
1978	1,008	1,067	4,645	5,652	398.6	273.0	671.6	163.4
1979	1,967	1,220	12,895	6,894	443.9	584.9	1,028.9	169.1
1980	1,524	1,272	8,006	6,722	315.7	733.8	1,049.5	109.0
1981	932	1,245	4,477	5,932	200.7	391.8	592.5	45.4
1982	1,177	696	4,576	2,372	334.1	411.2	745.3	65.0
1983	888	764	3,375	2,583	319.0	260.2	579.2	71.5
1984	736	794	2,690	2,541	375.3	118.5	493.9	154.2
1985	279	801	916	2,619	162.4	17.4	179.8	78.2
1986	465	930	2,464	4,139	174.1	45.8	219.9	80.0
1987	1,683	1,145	10,056	5,277	372.0	365.7	737.7	141.9
1988	1,570	1,335	7,313	5,203	443.1	451.9	895.0	167.3
1989	2,179	2,424	9,724	9,879	604.1	825.6	1,429.7	175.4
1990	2,223	2,420	7,454	8,172	1,025.0	529.6	1,554.6	407.2
1991	2,489	2,010	10,844	6,755	1,006.6	650.3	1,656.9	466.6
1992	1,420	1,540	7,431	6,331	507.0	376.1	883.0	251.4
1993	1,618	1,434	11,465	8,127	334.5	416.3	750.7	140.8
1994	1,491	1,485	10,056	8,311	282.5	387.9	670.4	80.3
1995	1,680	1,542	8,708	6,660	360.2	514.1	874.3	69.0
1996	1,686	1,552	6,067	5,372	642.7	362.6	1,005.3	170.1
1997	1,434	1,384	4,289	4,227	762.7	322.7	1,085.4	308.5
1998	988	977	3,353	3,359	512.6	237.6	750.2	244.0
1999	376	672	1,274	3,015	200.4	93.4	293.8	92.2
2000	687	634	3,609	2,926	187.6	307.2	494.8	75.6
2001	920	607	4,030	2,601	255.7	258.9	514.6	79.4
2002	480	575	1,594	2,271	216.0	98.3	314.3	73.5
2003	485	589	2,494	2,573	160.5	101.1	261.7	61.2

Table 3. Model estimates of population biomass, population numbers, male, female and total mature biomass(million lbs) and number of males greater than 101 mm in millions.

Year	Biomass (million lbs 25mm+)	numbers (million crabs 25mm+)	female mature biomass	male mature biomass	total mature biomass	Number of males >101mm (millions)	Recruitment (millions, 25 mm to 50 mm)
1978	1,155	7,505	352	370	721	110.3	
1979	1,307	8,273	397	424	821	133.8	2,768
1980	1,334	7,574	537	384	921	101.0	1,517
1981	1,292	6,541	506	384	890	76.4	1,013
1982	1,346	6,501	463	504	967	116.6	1,705
1983	1,445	7,410	418	616	1,034	179.5	2,632
1984	1,477	7,011	353	655	1,008	198.5	1,554
1985	1,509	7,214	344	628	972	170.3	2,115
1986	1,957	13,227	352	621	973	154.5	8,025
1987	2,492	16,227	531	657	1,188	164.5	6,569
1988	2,768	14,113	865	724	1,589	152.3	2,264
1989	2,902	12,569	844	967	1,811	192.9	2,314
1990	2,847	10,260	709	1,293	2,002	329.9	1,140
1991	2,361	8,500	616	1,140	1,757	309.6	1,341
1992	1,835	8,135	592	751	1,343	209.2	2,390
1993	1,756	10,731	594	522	1,116	134.0	5,036
1994	1,829	10,865	638	448	1,085	93.6	3,096
1995	1,863	8,461	648	549	1,198	110.6	516
1996	1,835	6,730	560	760	1,320	181.2	562
1997	1,614	5,276	446	859	1,305	246.7	451
1998	1,148	4,249	343	607	950	163.2	641
1999	809	3,891	291	335	626	69.3	990
2000	765	3,781	263	302	565	62.6	928
2001	729	3,328	235	287	522	57.7	552
2002	686	2,886	198	285	484	57.1	459
2003	704	3,332	204	299	502	69.2	1,230

Table 4. Radiometric ages for male crabs for shell conditions 1 through 5.

				Radiometric age	
Shell Condition	description	sample size	Mean	minimum	maximum
1	soft	6	0.15	0.05	0.25
2	new	6	0.69	0.33	1.07
3	old	3	1.02	0.92	1.1
4	very old	3	5.31	4.43	6.6
5	very very old	3	4.59	2.7	6.85

Table 5. Natural mortality estimates for Hoenig (1983) and the 5% rule given the oldest observed age.

	Natural Mortality	
oldest observed age	Hoenig (1983) empirical	5% rule
10	0.42	0.3
15	0.28	0.2
17	0.25	0.18
20	0.21	0.15

Table 6. Estimated reference points, fishing mortality and catch for 2004 Bering Sea snow crab fishery for the base model and the model with high discard mortality with M of 0.2, 0.25, and 0.3. Biomass is in millions of lbs.

	High discard			Base Model		
	M=0.3	M=0.25	M=0.2	M=0.3	M=0.25	M=0.2
Fmsy (overfishing)(full selection F)	0.556	0.537	0.469	0.731	0.693	0.540
F maximum (0.75*Fmsy)	0.417	0.403	0.352	0.548	0.520	0.405
Exploitation rate for total catch at Fmsy on MMB at time of the fishery	0.146	0.145	0.147	0.148	0.137	0.121
Exploitation rate for retained catch at Fmsy on MMB at time of the fishery	0.093	0.088	0.093	0.108	0.098	0.082
B0 total mature biomass at survey time	2,062	2,401	2,790	1,764	1,985	2,328
Bmsy total mature biomass at survey time	1,094	1,241	1,336	928	1027	1184
MSST total mature biomass at survey time (1/2 Bmsy)	547	621	668	464	513	592
MSY total catch	105	120	137	90	94	99
MSY retained catch	67	73	87	66	67	67
2003 model estimate of total mature biomass at survey time	494	519	523	502	537	551
Percent of Bmsy for 2003 model estimate of total mature biomass at survey time	45%	42%	39%	54%	52%	47%
R0 (billion crabs)	2.66	2.37	2.36	2.32	2.03	1.74
Steepness	0.52	0.548	0.562	0.51	0.52	0.51
F 2004 fishery	0.234	0.215	0.180	0.347	0.322	0.233
Male mature biomass at time of fishery	233	240	244	248	265	268
2004 total catch(discard + retained)	18.4	17.2	16.4	21.7	19.2	14.5
2004 retained catch (GHL)	12.4	11.3	11.3	16.6	14.5	10.7
2004 total catch/male mature biomass at time of fishery	0.079	0.072	0.067	0.088	0.072	0.054
2004 retained catch/male mature biomass at time of fishery	0.053	0.047	0.046	0.067	0.055	0.040
Total negative log likelihood	2,520	2,641	2,777	2,683	2,857	3,105
Survey biomass likelihood	582	614	687	616	676	752
Survey length frequency likelihood	925	999	1,079	983	1,086	1,229
fishery length frequency likelihood (males retained and males discarded)	934	978	976	942	935	928

Table 7. Parameters values for base model run with M=0.3.

Female intercept (a) growth	11.68
Male intercept(a) growth	8.870618
Female slope(b) growth	1
Male slope (b) growth	1.174247
Mean length of recruits	40.5961
Beta for gamma distribution of recruits	4.392741
Beta for gamma distribution female growth	0.5
Beta for gamma distribution male growth	0.5
Immature male molting probability slope	0.049819
Immature male molting probability length at 50% molting	140.2407
Fishery selectivity total new and old shell slope	0.201464
Fishery selectivity retention curve new shell slope	0.29146
Fishery selectivity retention curve new shell length at 50%	96.69101
Fishery selectivity retention curve old shell slope	0.190831
Fishery selectivity retention curve old shell length at 50%	106.3621
Pot Fishery discard selectivity female slope	0.287142
Pot Fishery discard selectivity female length at 50%	65.17544
Trawl Fishery selectivity female slope	0.058486
Trawl Fishery selectivity female length at 50%	118.786
Trawl Fishery selectivity male slope	0.036509
Trawl Fishery selectivity male length at 50%	120
Survey Q 1978-1981	1
Survey 1978-1981 length at 95% selected	51.78245
Survey 1978-1981 length at 50% selected	32.76457
Survey Q 1982-1988	1
Survey 1982-1988 length at 95% selected	150
Survey 1982-1988 length at 50% selected	70.78486
Survey Q 1989-present	1
Survey 1989-present, length at 95% selected	127.7942
Survey 1989-present length at 50% selected	0.00

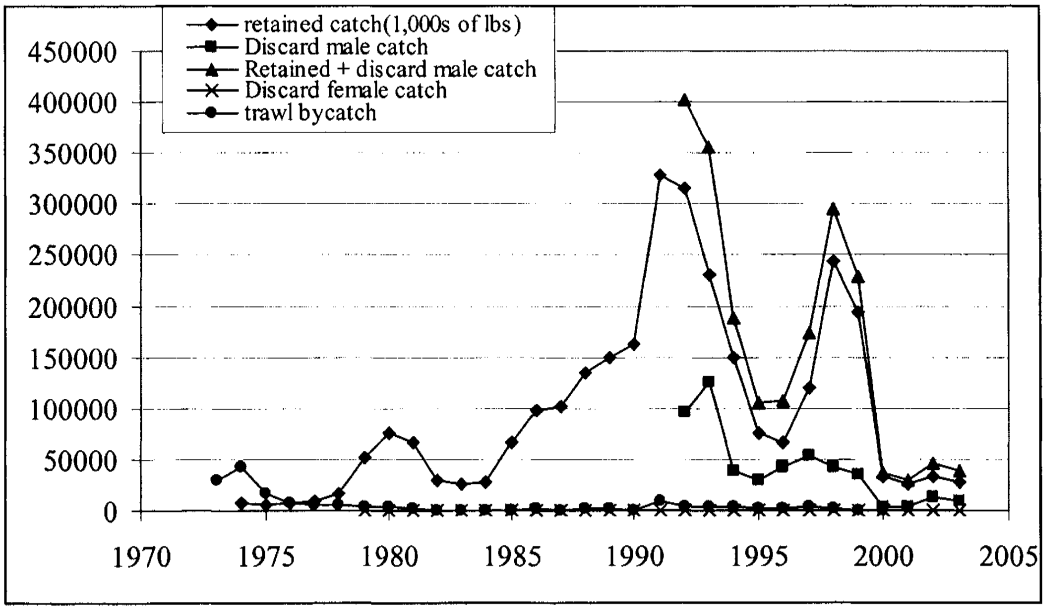

Figure 1. Catch (1,000s lbs) from the directed snow crab pot fishery and groundfish trawl bycatch. Retained and total catch are males only, female catch is the discard mortality from the directed pot fishery and trawl is male and female bycatch from groundfish trawl fisheries.

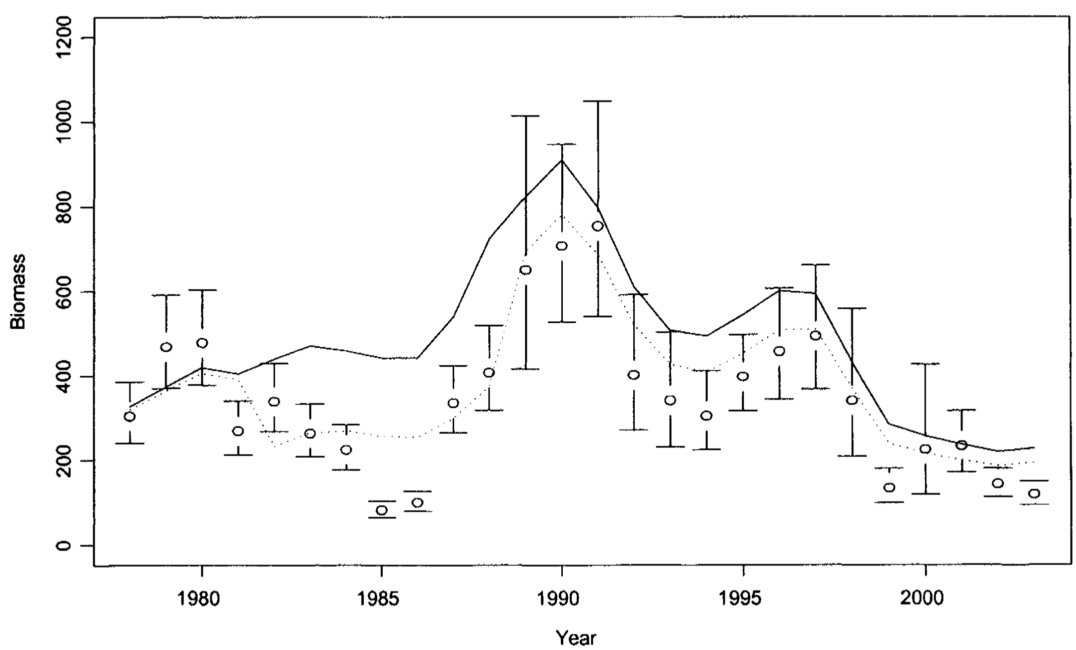

Figure 2. Population total mature biomass (metric tons, solid line), model estimate of survey mature biomass (dotted line) and observed survey mature biomass with approximate lognormal 95% confidence intervals.

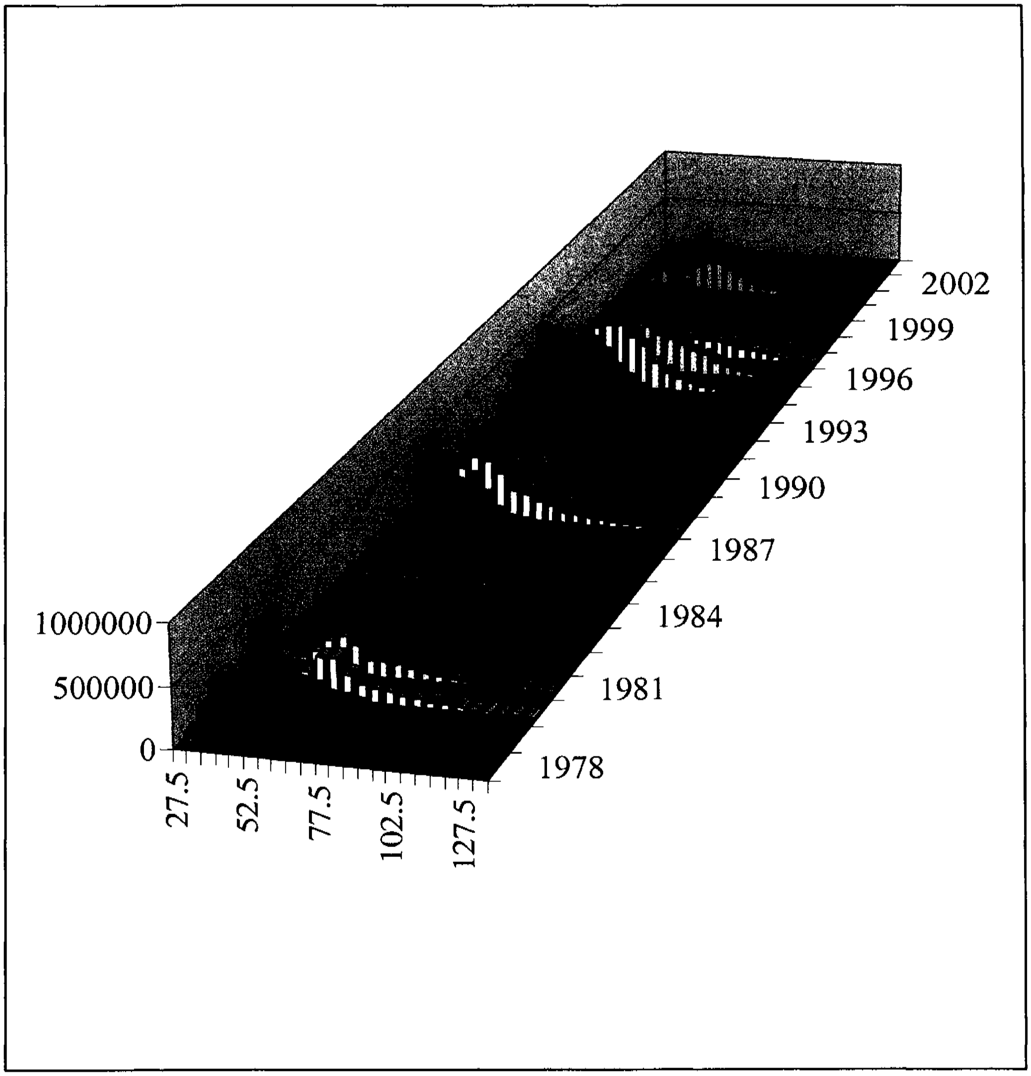

Figure 3. Observed survey numbers by carapace width and year for male snow crab.

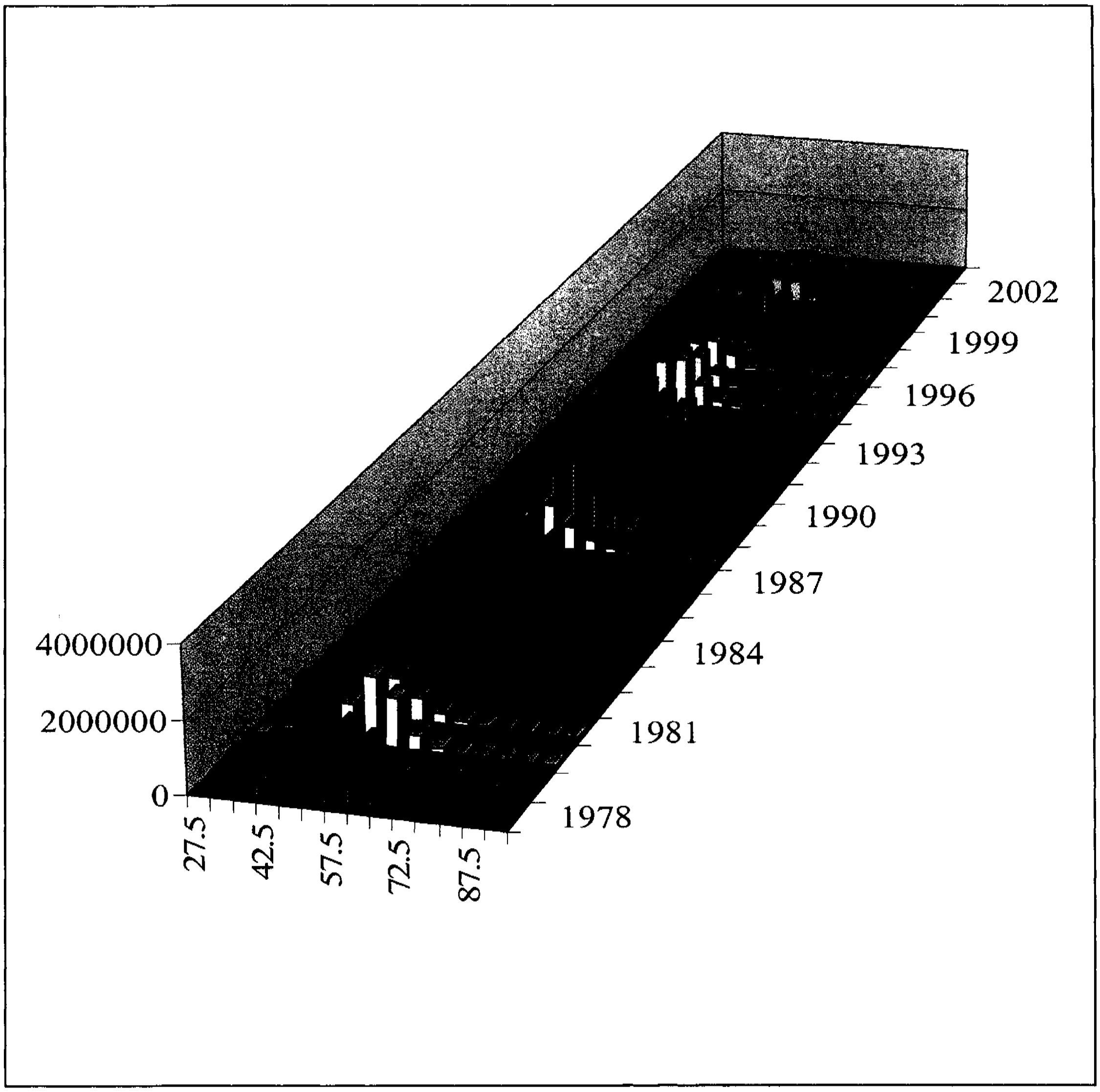

Figure 4. Observed survey numbers by carapace width and year for female snow crab.

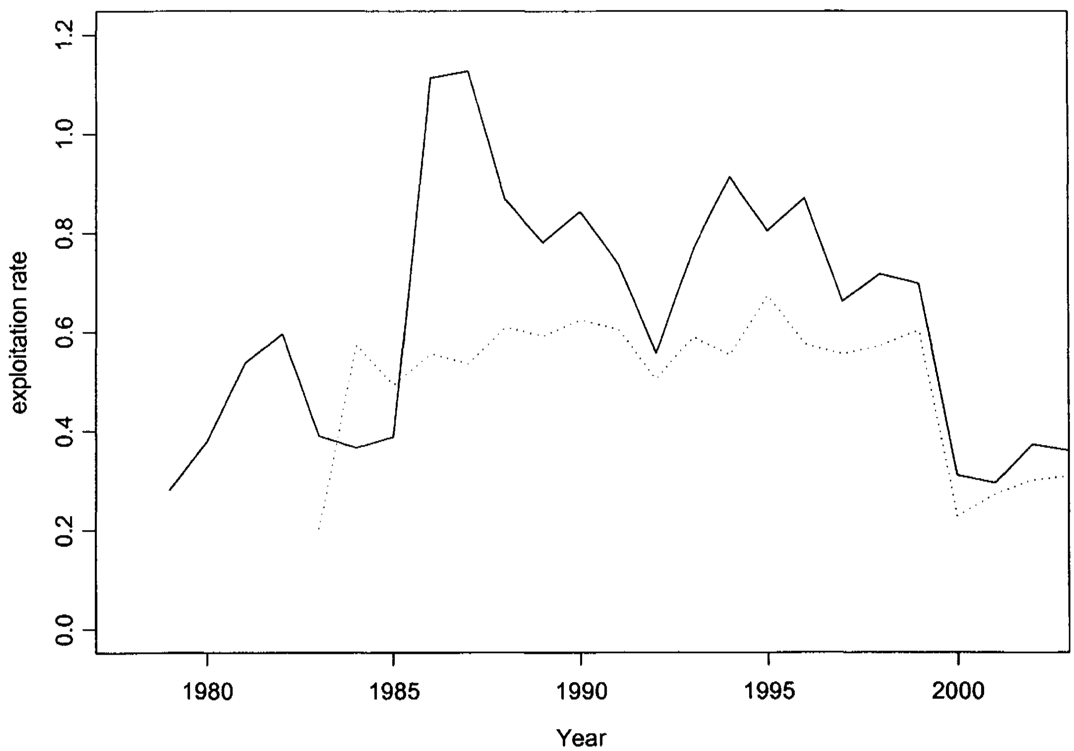

Figure 5. Exploitation rate estimated as the preseason GHL divided by the survey estimate of large male biomass (>101 mm) at the time the survey occurs (dotted line). The solid line is the retained catch divided by the survey estimate of large male biomass at the time the fishery occurs. Year is the year the fishery occurred.

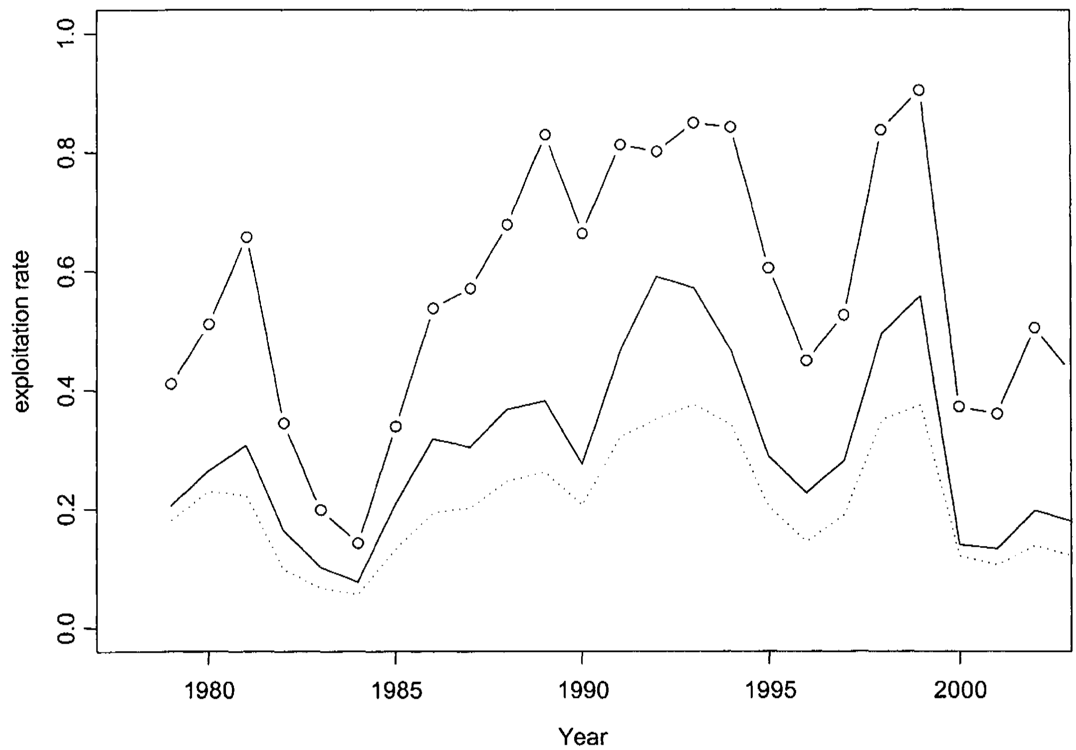

Figure 6. Exploitation fraction estimated as the catch biomass (total or retained) divided by the mature male biomass from the model at the time of the fishery (solid line and dotted line). The exploitation rate for total catch divided by the male biomass greater than 101 mm is the solid line with dots. Year is the year of the fishery.

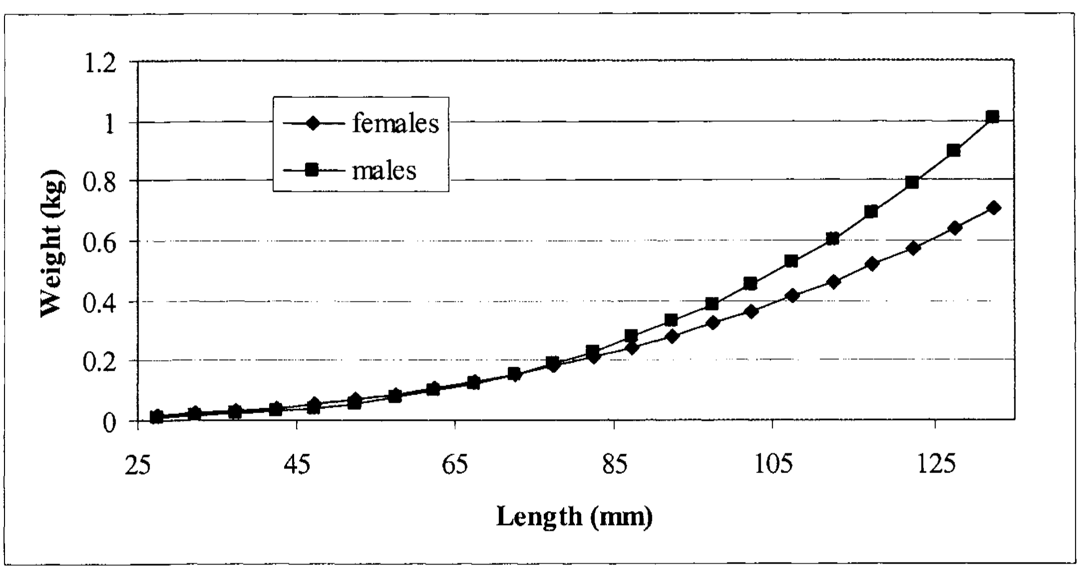

Figure 7. Weight (kg) – size (mm) relationship for male and female snow crab.

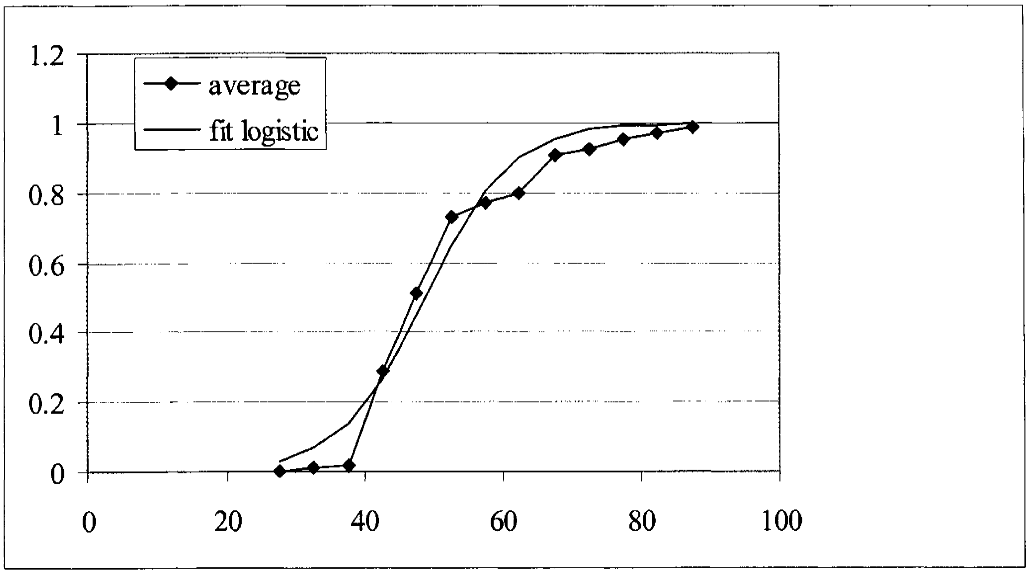

Figure 8. Average maturity for females from the survey 1978 to 2000 (not used in the model). Females were determined to be mature or immature based on visual examination in the survey. Line labeled logistic has a slope of 0.163 and size at 50% of 48.8 mm for comparison only.

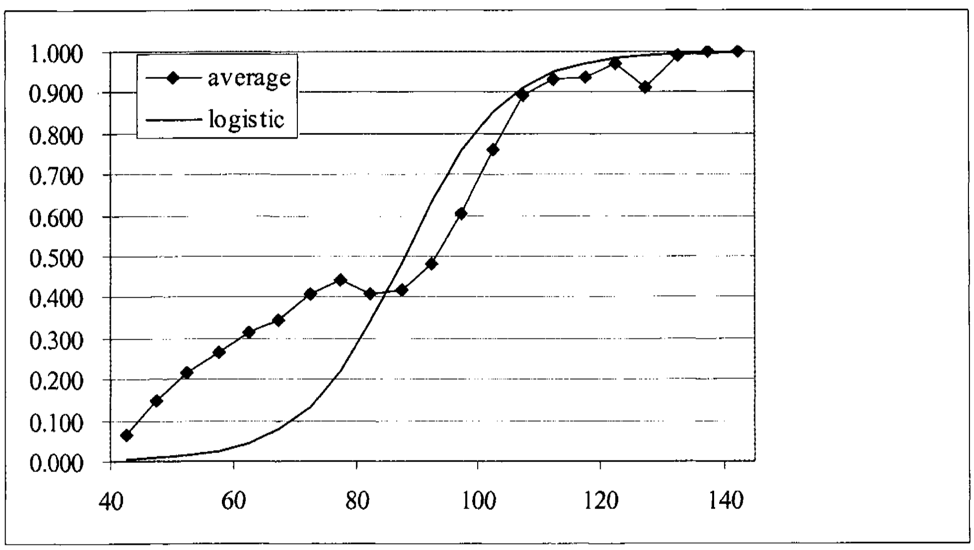

Figure 9. Maturity curve for new shell males. Line labeled average is the average maturity for new shell males from the survey 1989 to 2000. Line labeled logistic is the curve used in the model (slope 0.12, size at 50% 88.0mm).

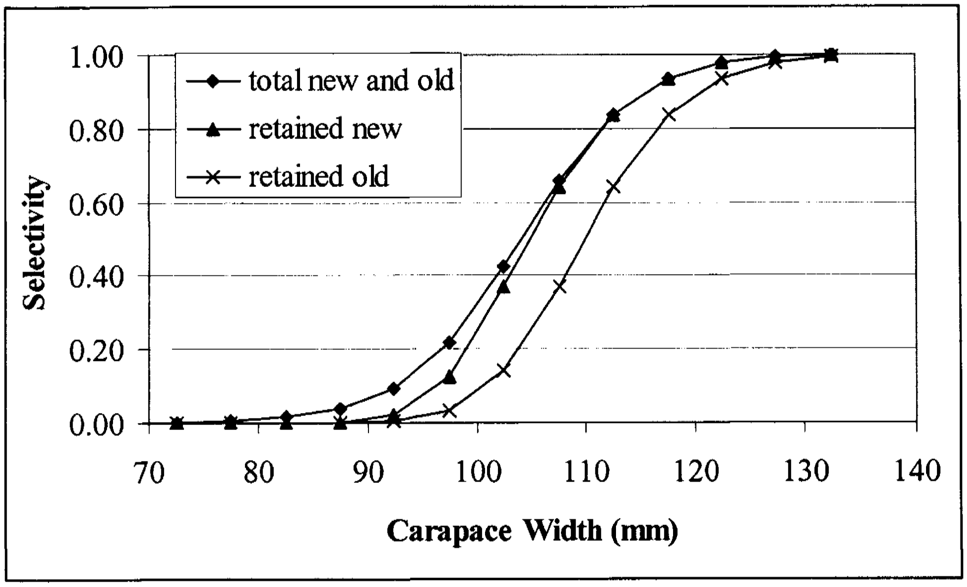

Figure 10. Selectivity curves for total catch (discard plus retained, new and old shell the same) and retained catch of male snow crab by new and old shell condition averaged over the last three years (2001 to 2003 fishery seasons).

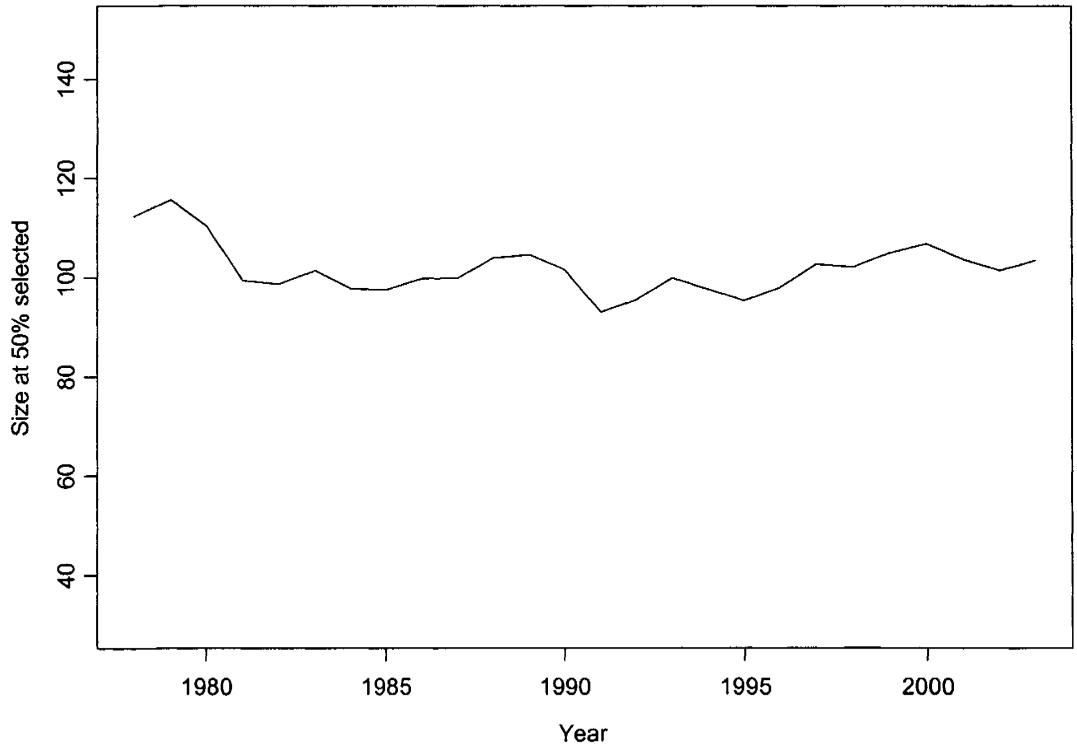

Figure 11. Size at 50% selected parameter for pot fishery selectivities of male crab 1978 to 2003.

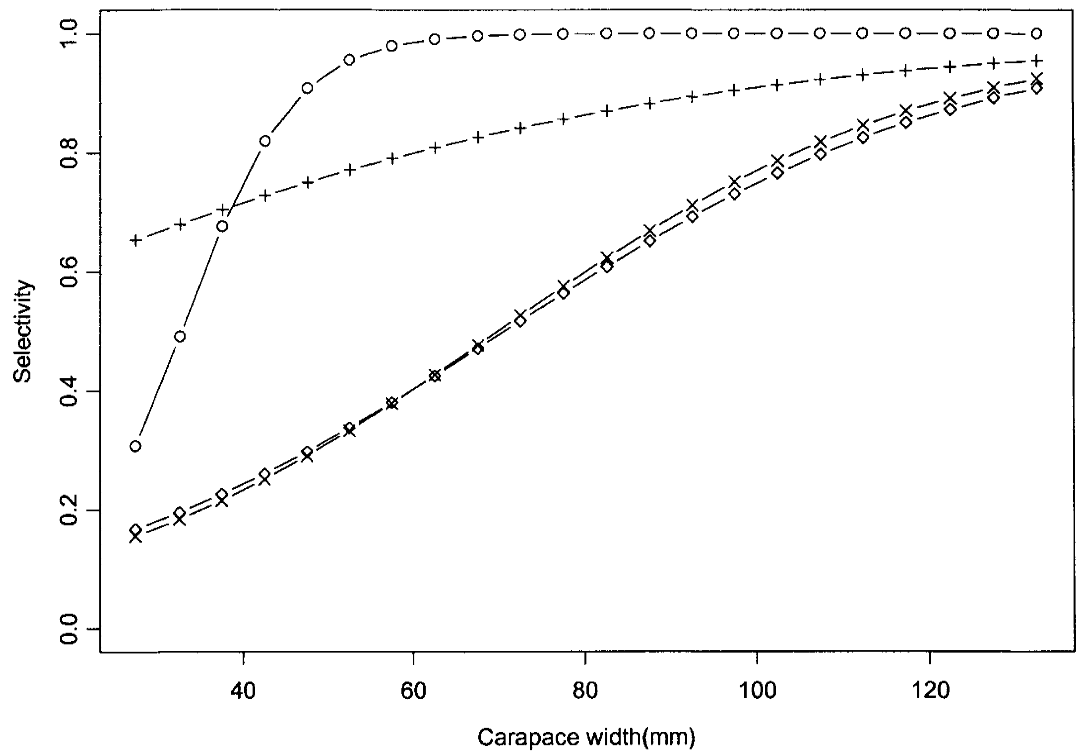

Figure 12. Survey selectivity curves for female and male snow crab estimated by the model for 1978-1981(solid line with circles), for 1982 to 1988 (solid line with diamonds), and 1989 to present (solid line with pluses). Survey selectivities estimated by Somerton and Otto (1998) are the solid line with crosses.

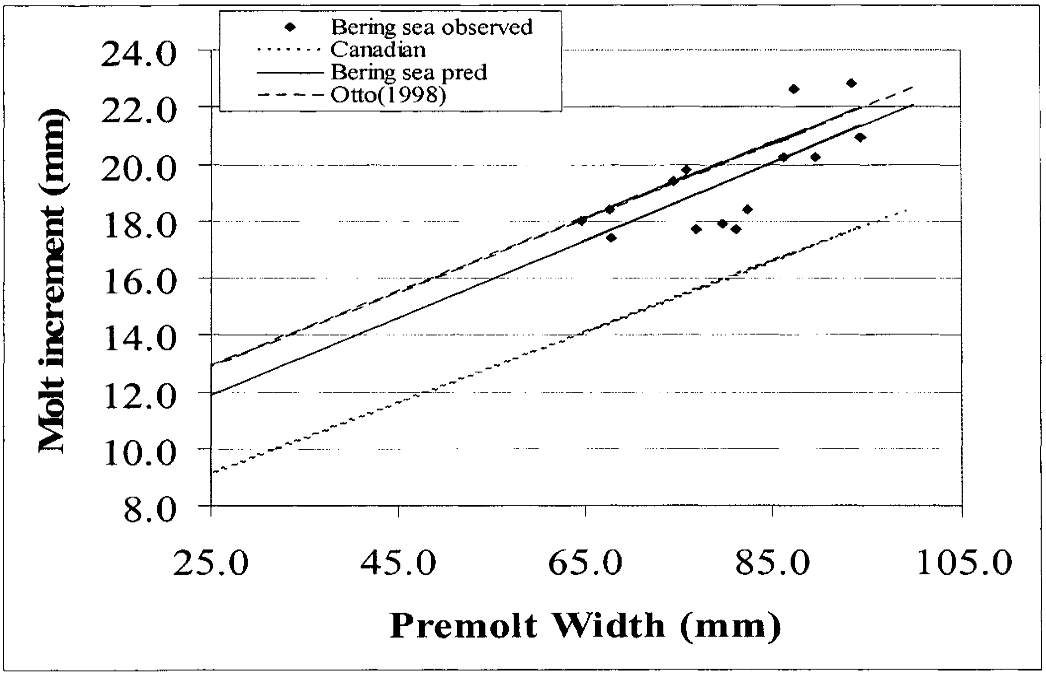

Figure 13. Growth increment as a function of premolt size for male snow crab. Points labeled Bering sea observed are observed growth increments from Rugolo (unpub data). The line labeled Bering sea pred is the predicted line from the Bering sea observed growth, which is used as a prior for the growth parameters estimated in the model. The line labeled Canadian is estimated from Atlantic snow crab (Sainte-Marie data). The line labeled Otto(1998) was estimated from tagging data from Atlantic snow crab less than 67 mm, from a different area from Sainte-Marie data.

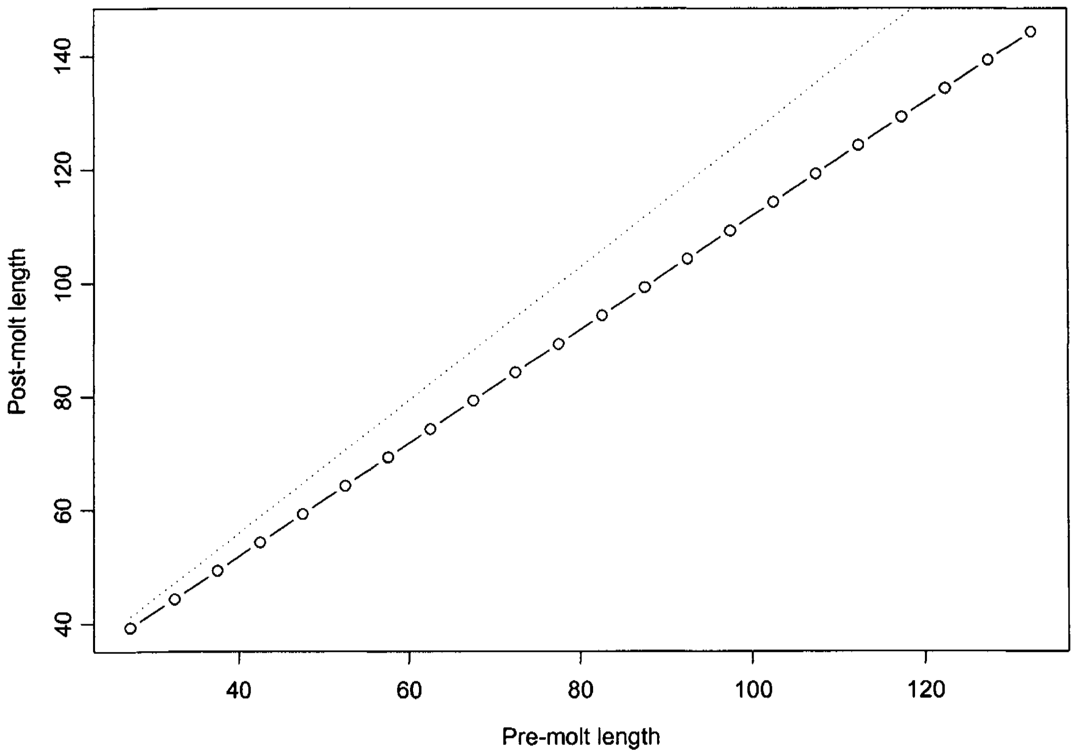

Figure 14. Growth(mm) for male(dotted line) and female snow crab (solid line with circles) estimated from the model.

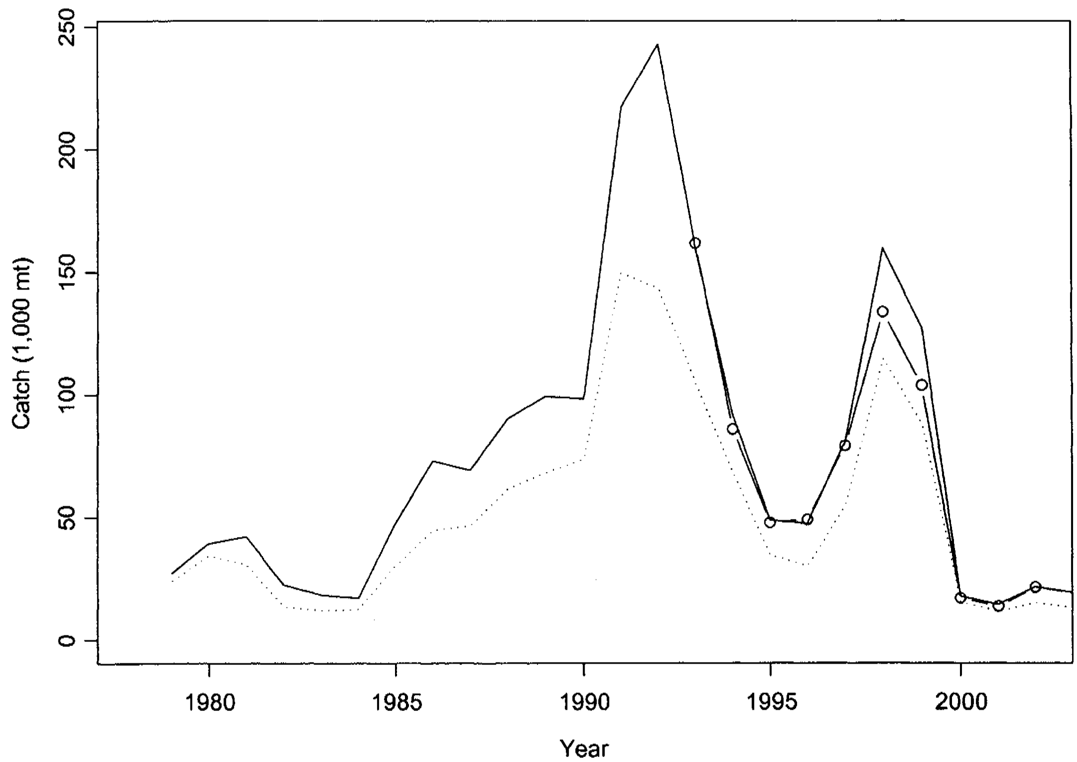

Figure 15. Estimated total catch(discard + retained) (solid line), observed total catch (solid line with circles) and observed retained catch (dotted line) for 1978 to 2003 fishery seasons.

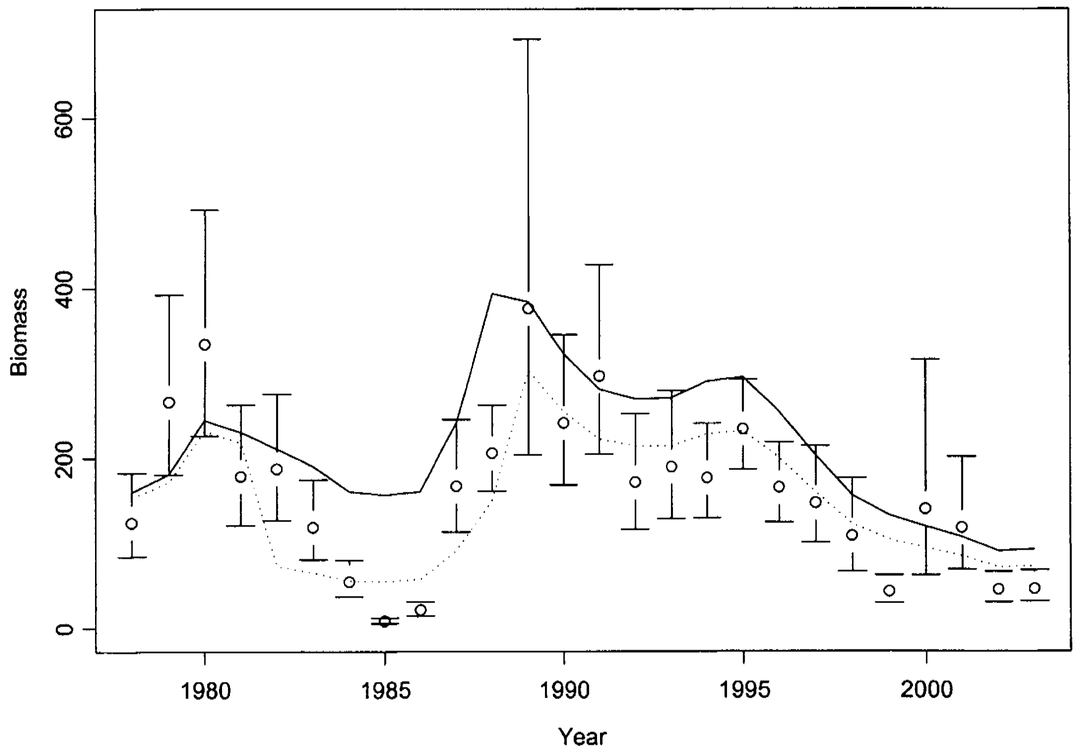

Figure 16. Population female mature biomass (metric tons, solid line), model estimate of survey female mature biomass (dotted line) and observed survey female mature biomass with approximate lognormal 95% confidence intervals.

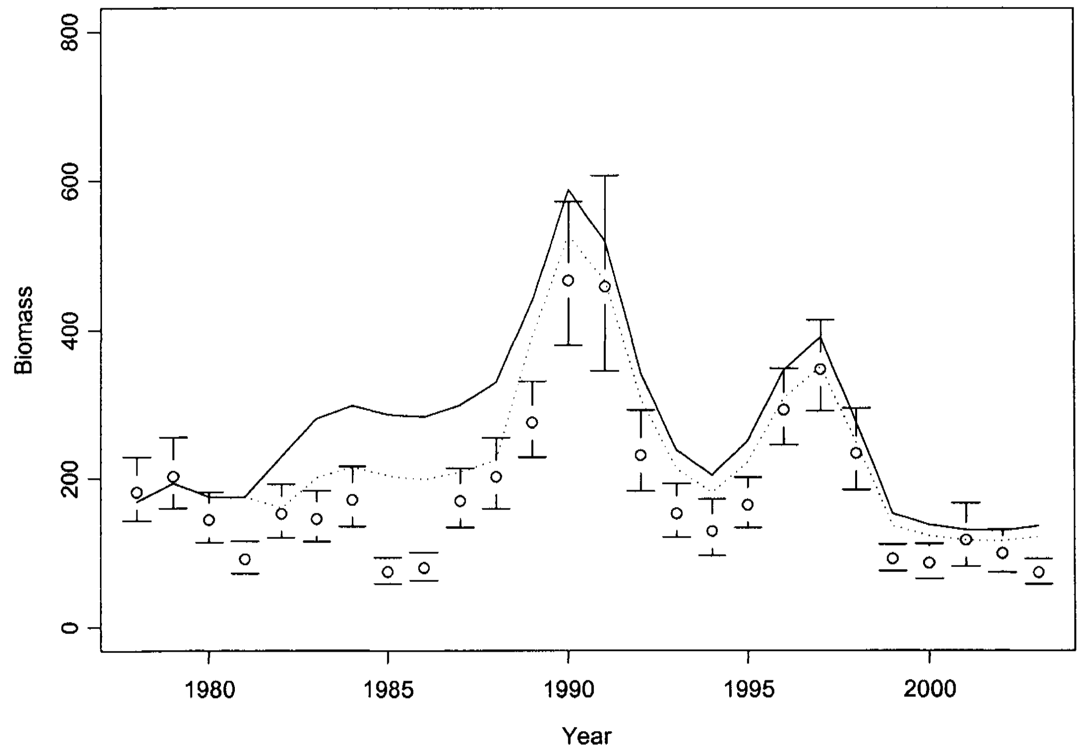

Figure 17. Population male mature biomass (metric tons, solid line), model estimate of survey male mature biomass (dotted line) and observed survey male mature biomass with approximate lognormal 95% confidence intervals.

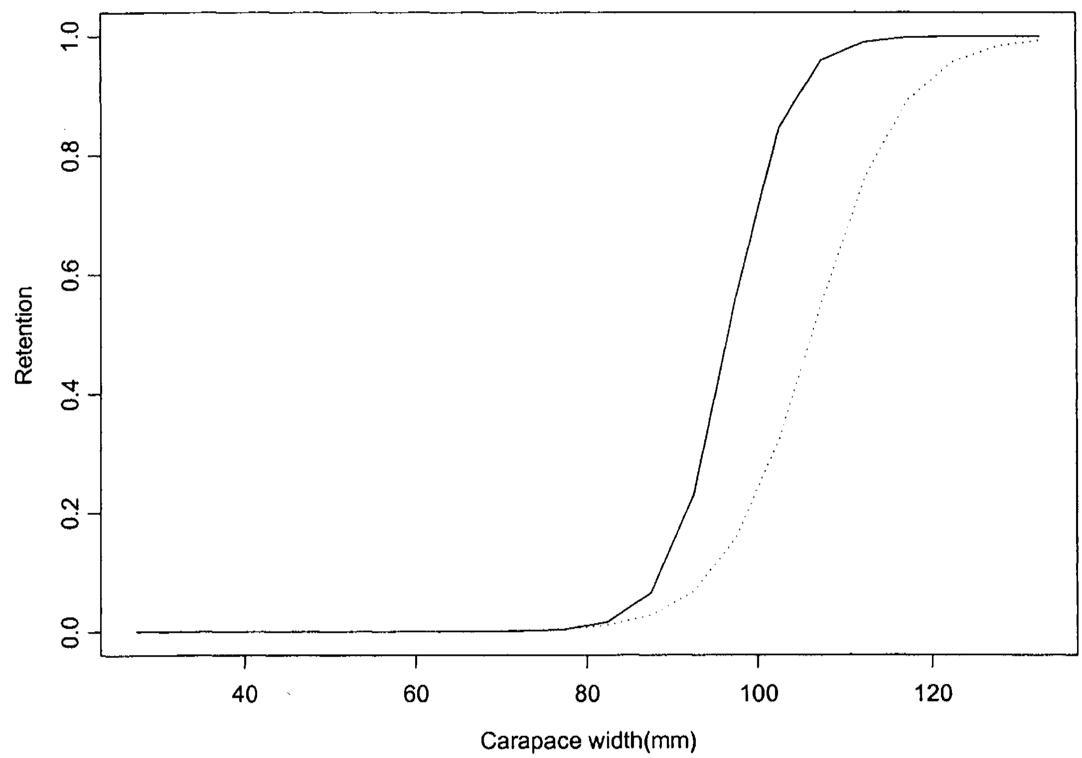

Figure 18. Model estimated fraction of the total catch that is retained by size for new(solid line) and old(dotted line) shell male snow crab.

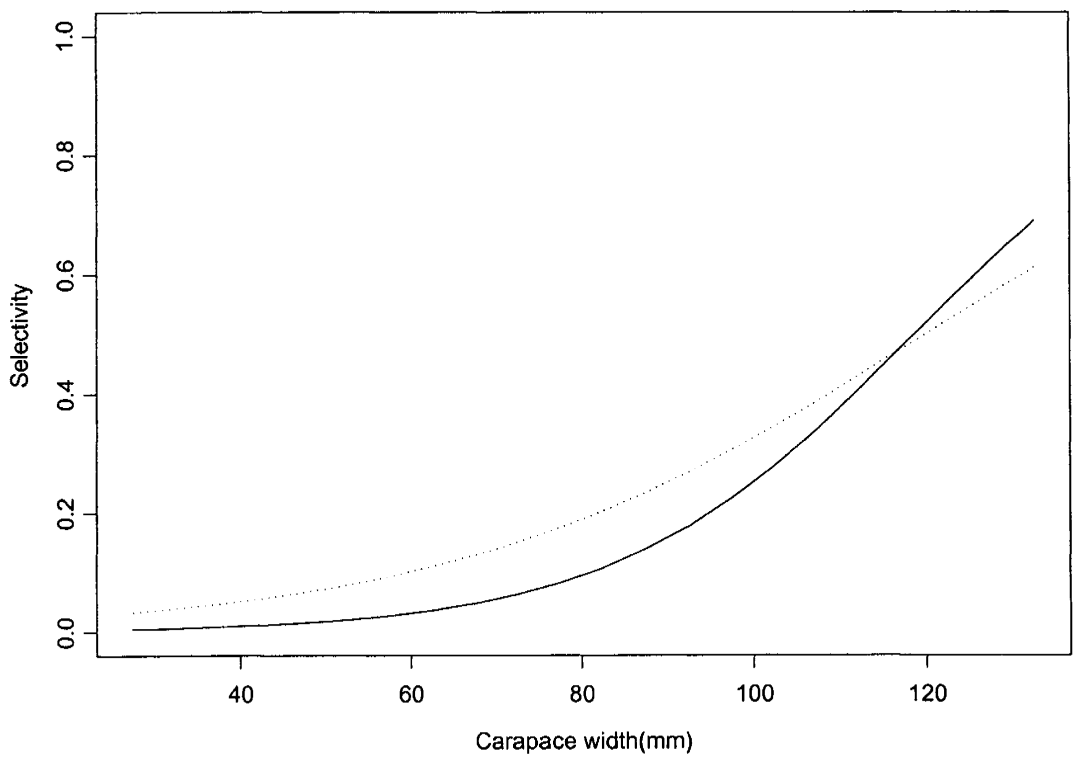

Figure 19. Selectivity curves estimated by model for the trawl fishery discard for females(solid line) and males(dotted line).

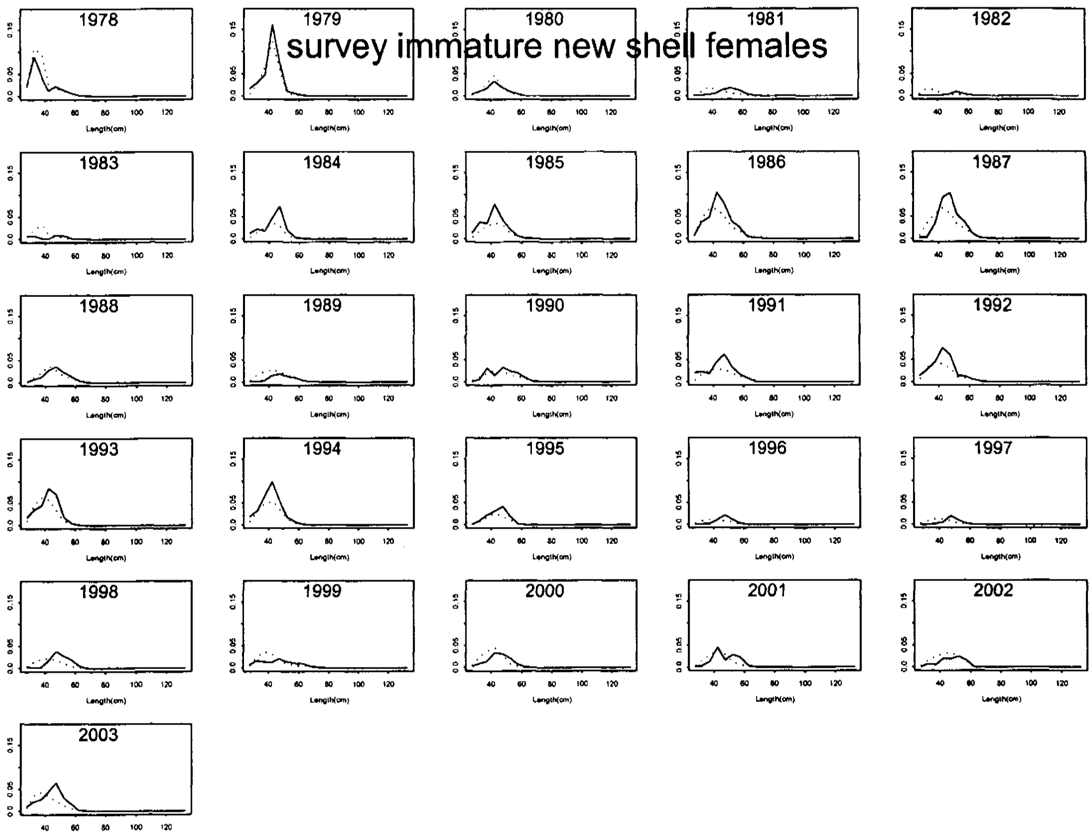

Figure 20. Model fit to the survey immature female new shell size frequency data. Dotted line is the model fit.

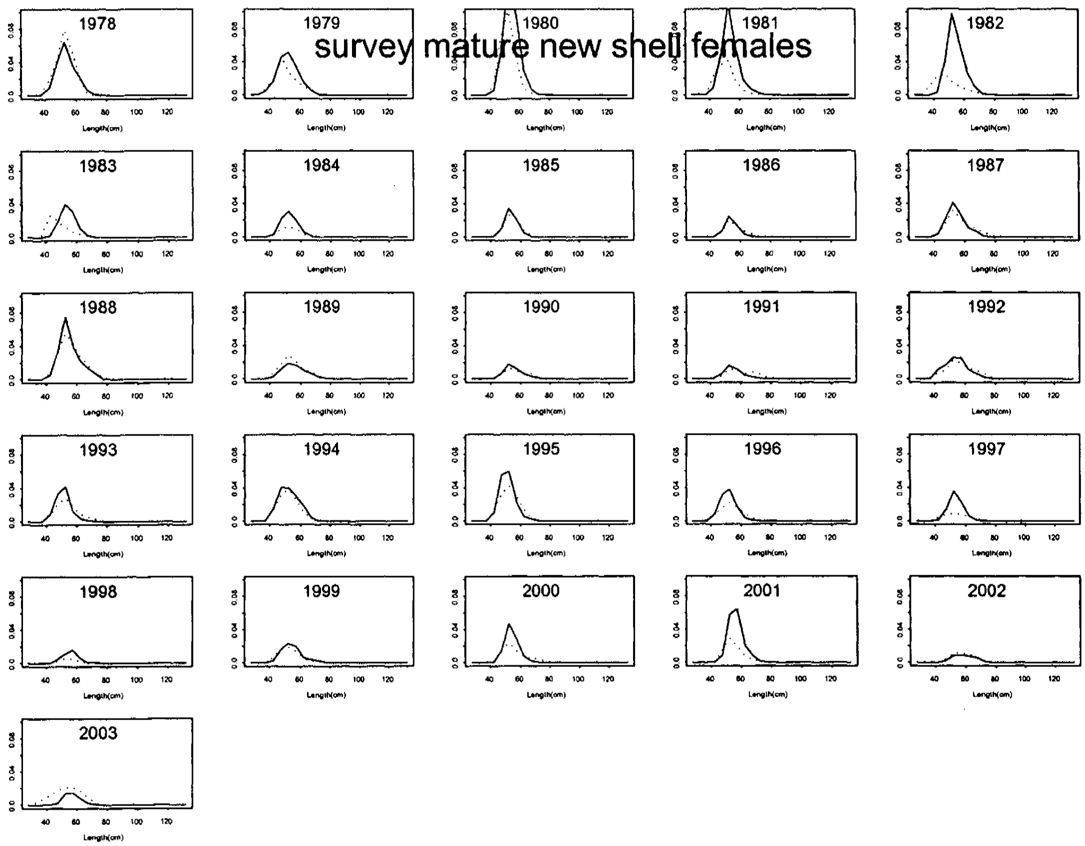

Figure 21. Model fit to the mature survey female new shell size frequency data. Dotted line is the model fit.

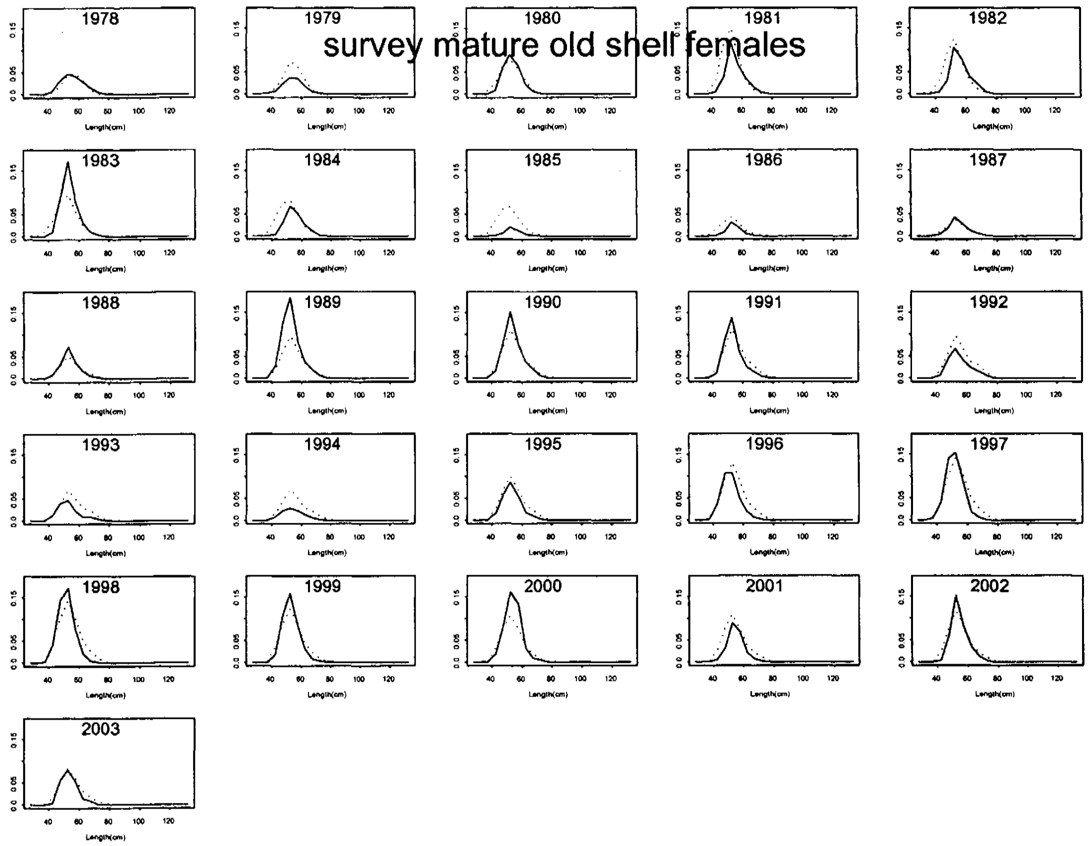

Figure 22. Model fit to the mature survey female old shell size frequency data. Dotted line is the model fit.

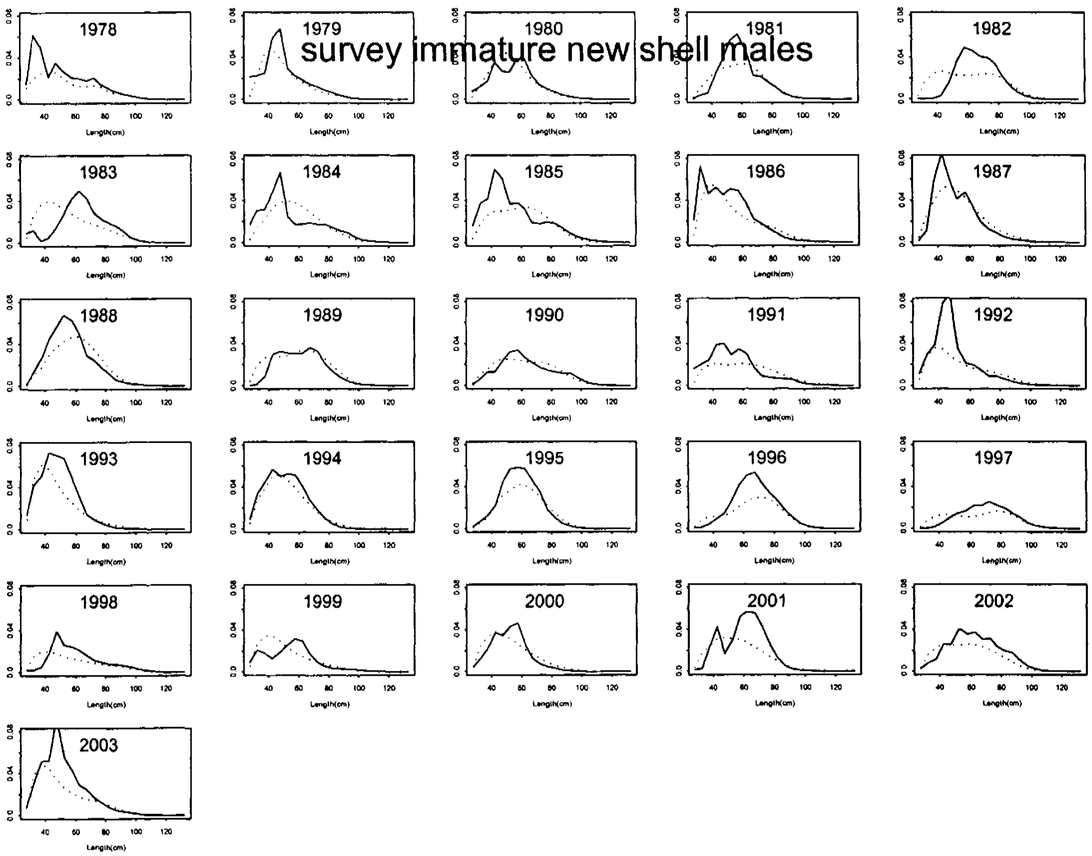

Figure 23. Model fit to the immature survey male new shell size frequency data. Dotted line is the model fit.

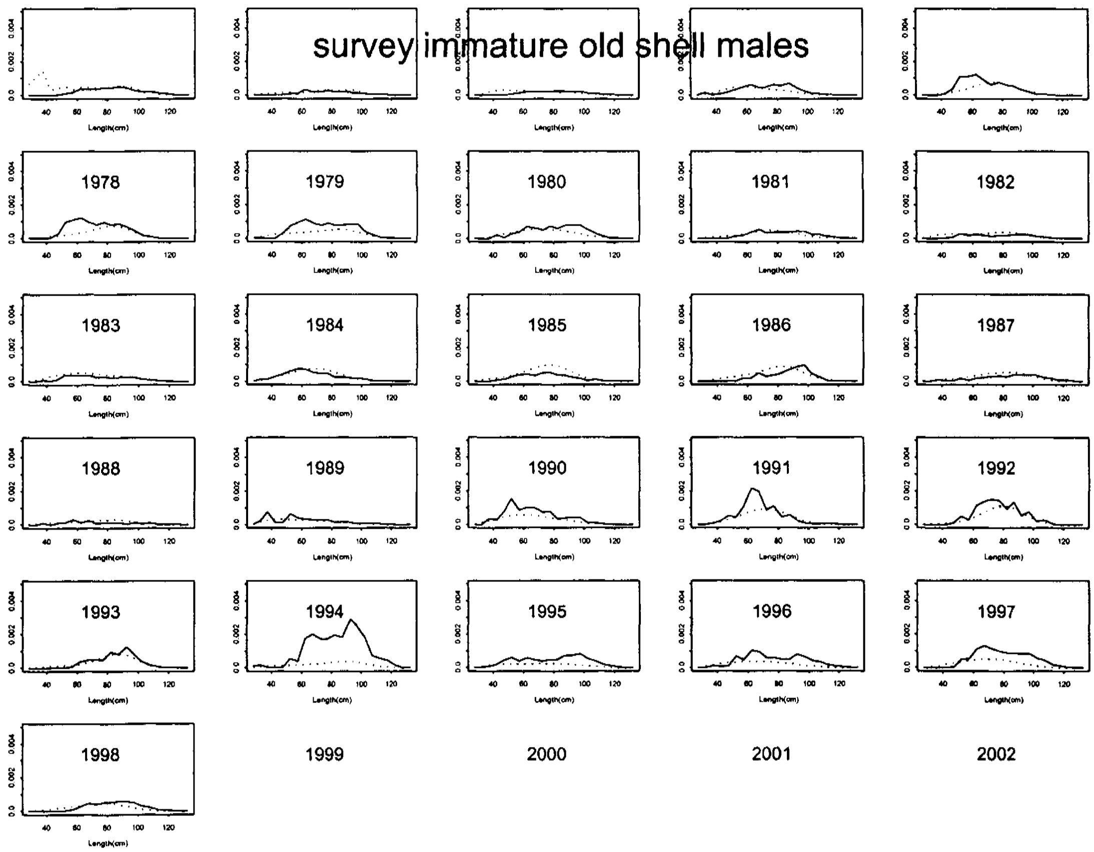

Figure 24. Model fit to the immature survey male old shell size frequency data. Dotted line is the model fit.

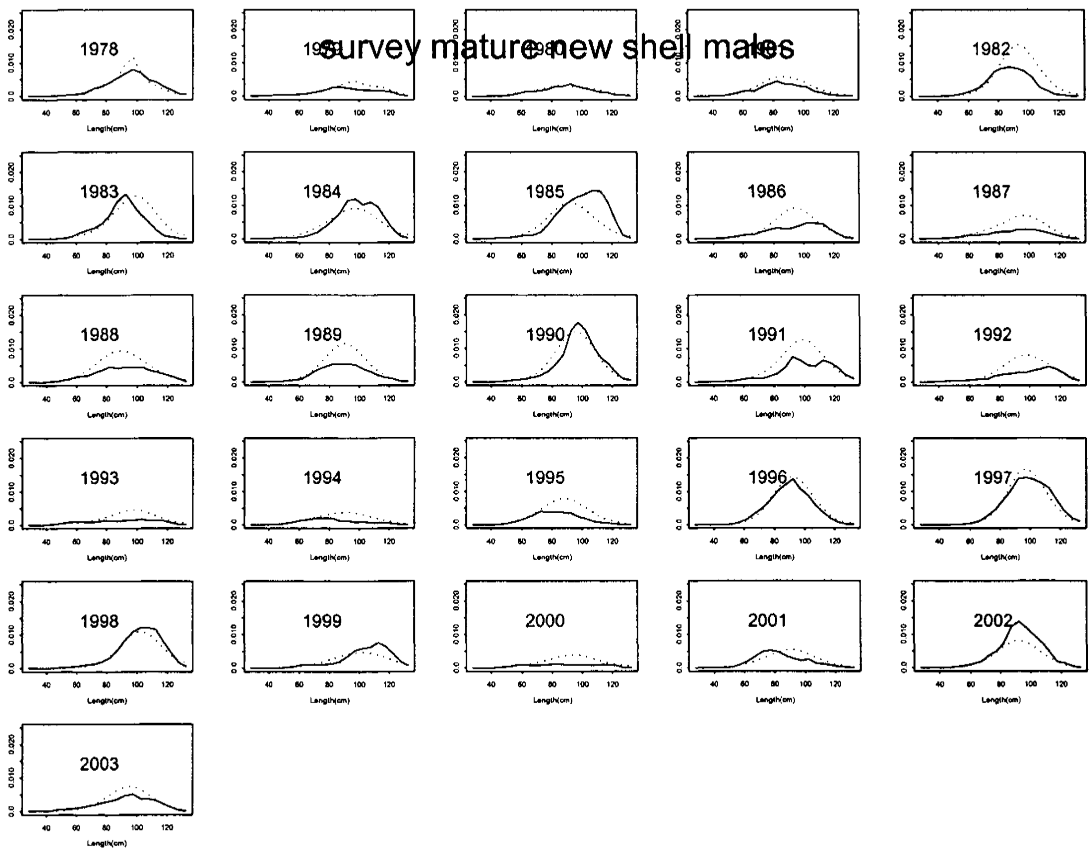

Figure 25. Model fit to the mature survey male new shell size frequency data. Dotted line is the model fit.

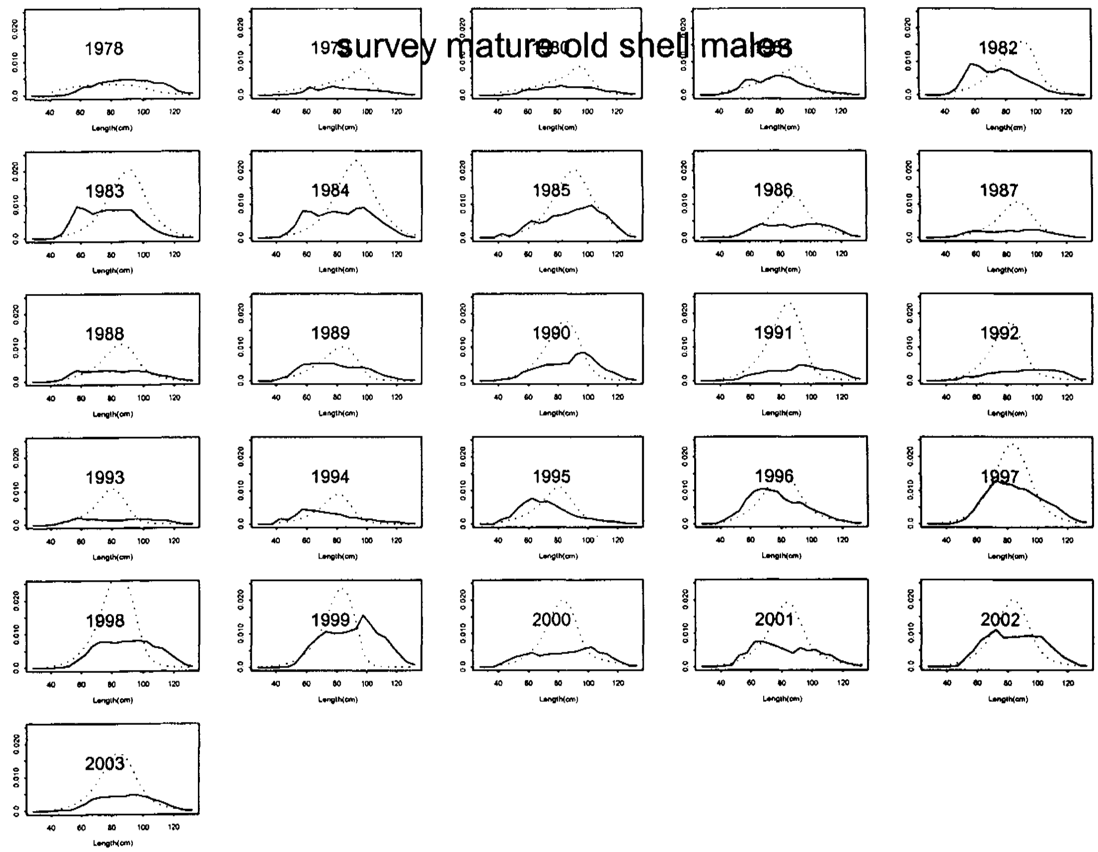

Figure 26. Model fit to the mature survey male old shell size frequency data. Dotted line is the model fit.

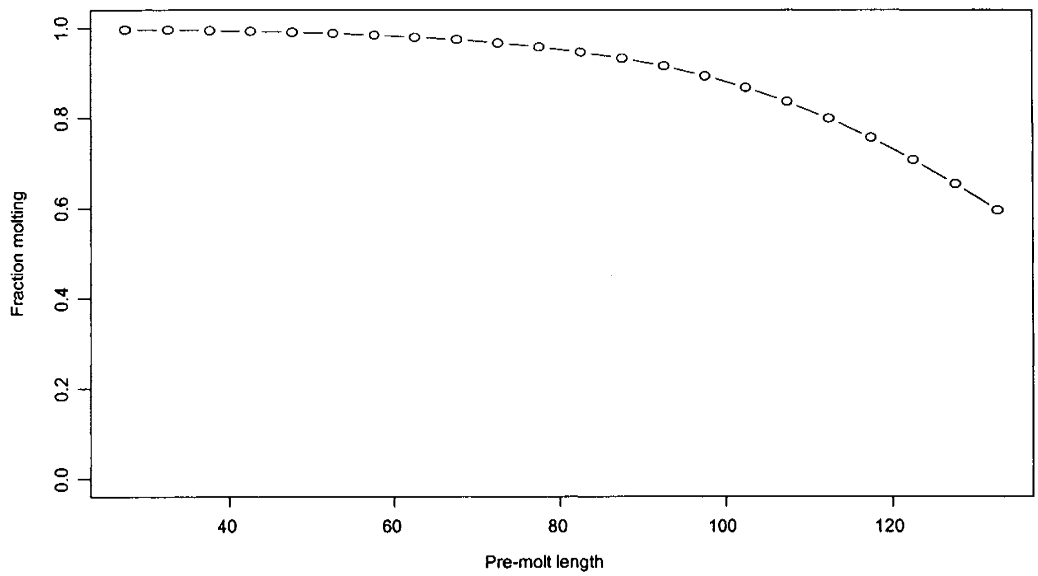

Figure 27. Molting probabilities for immature male crabs.

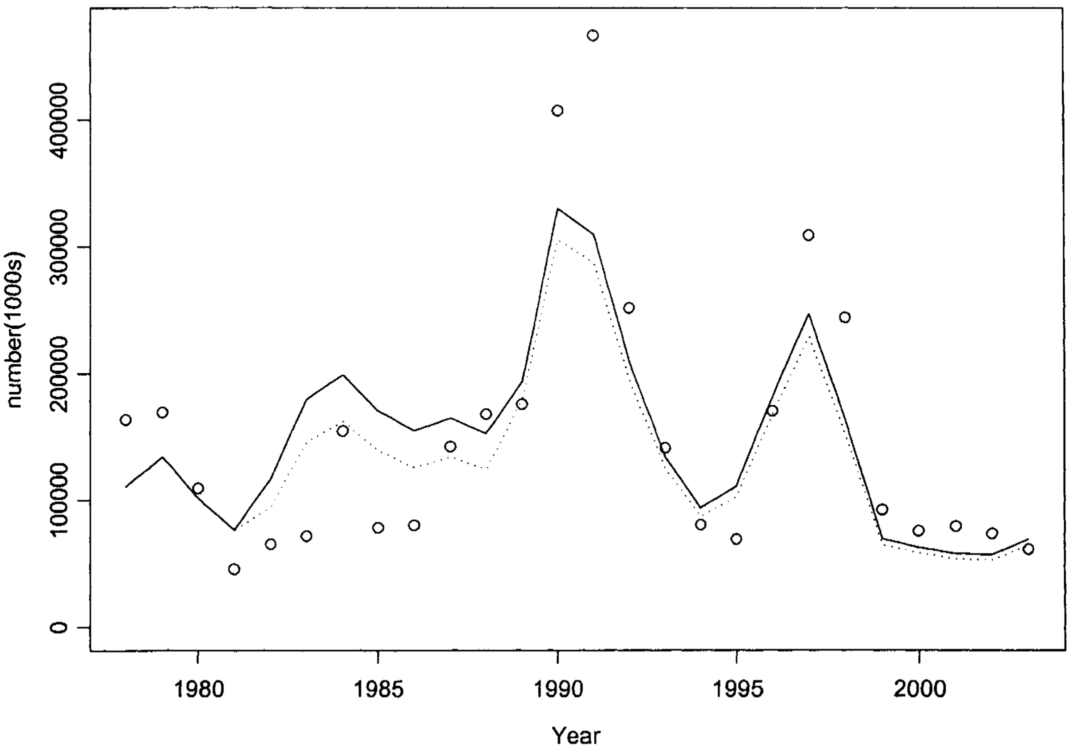

Figure 28. Observed survey numbers of males >101mm (solid line with dots) and model estimates of the population number of males >101mm (dotted line).

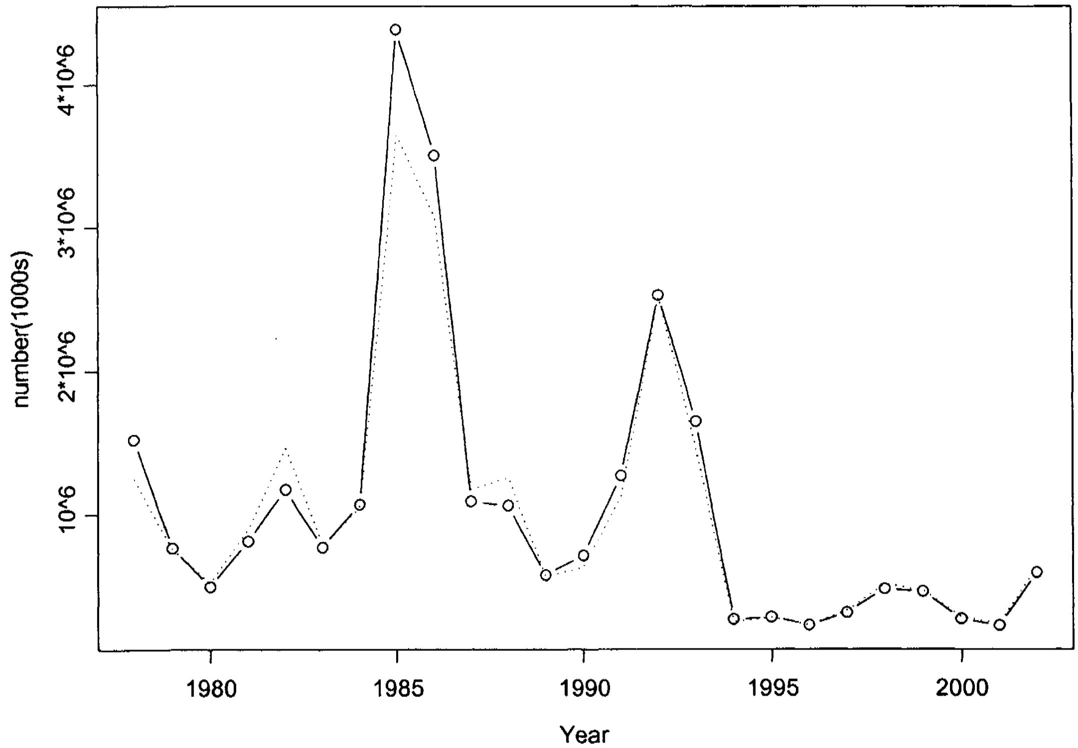

Figure 29. Recruitment to the model of male (dotted line) and female (solid line with dots) crab 25 mm to 50 mm.

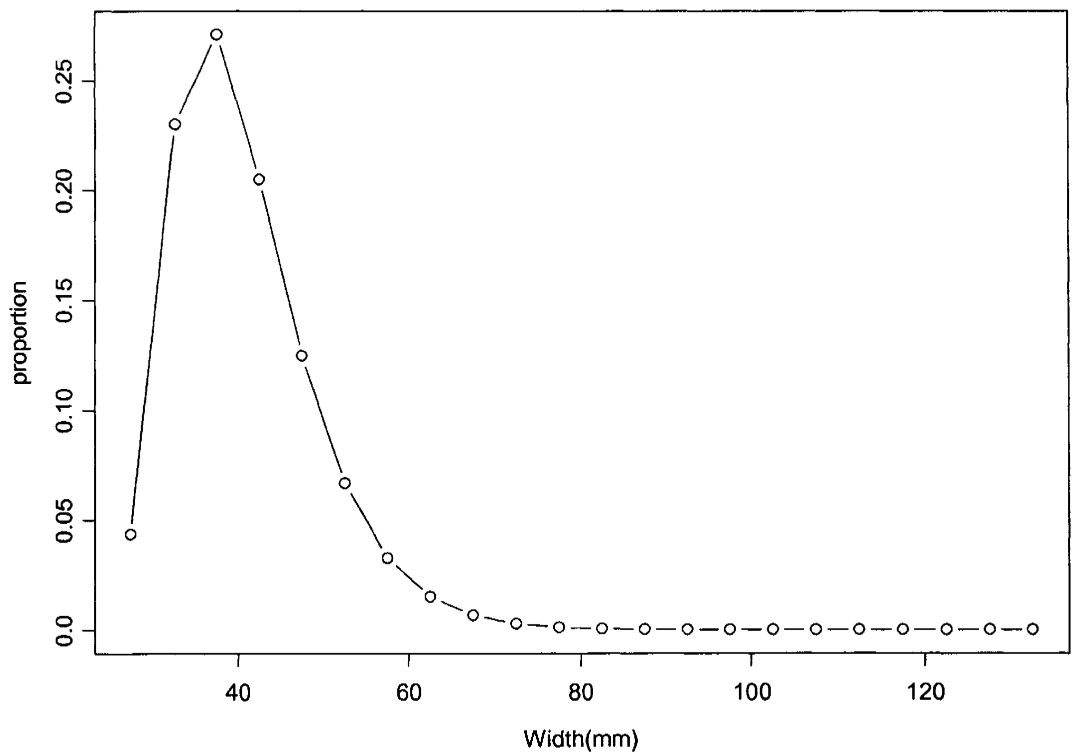

Figure 30. Distribution of recruits to length bins estimated by the model.

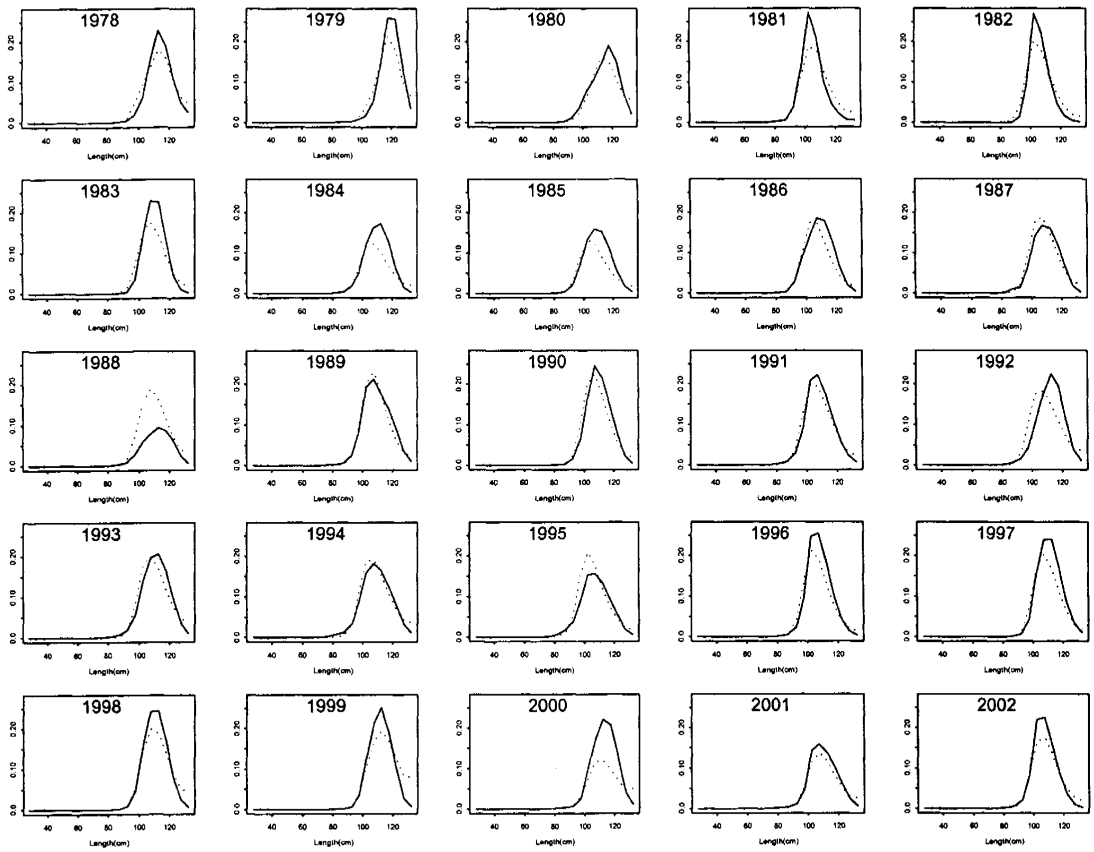

Figure 31. Model fit to the retained male new shell size frequency data. Dotted line is the model fit. Year is the survey year.

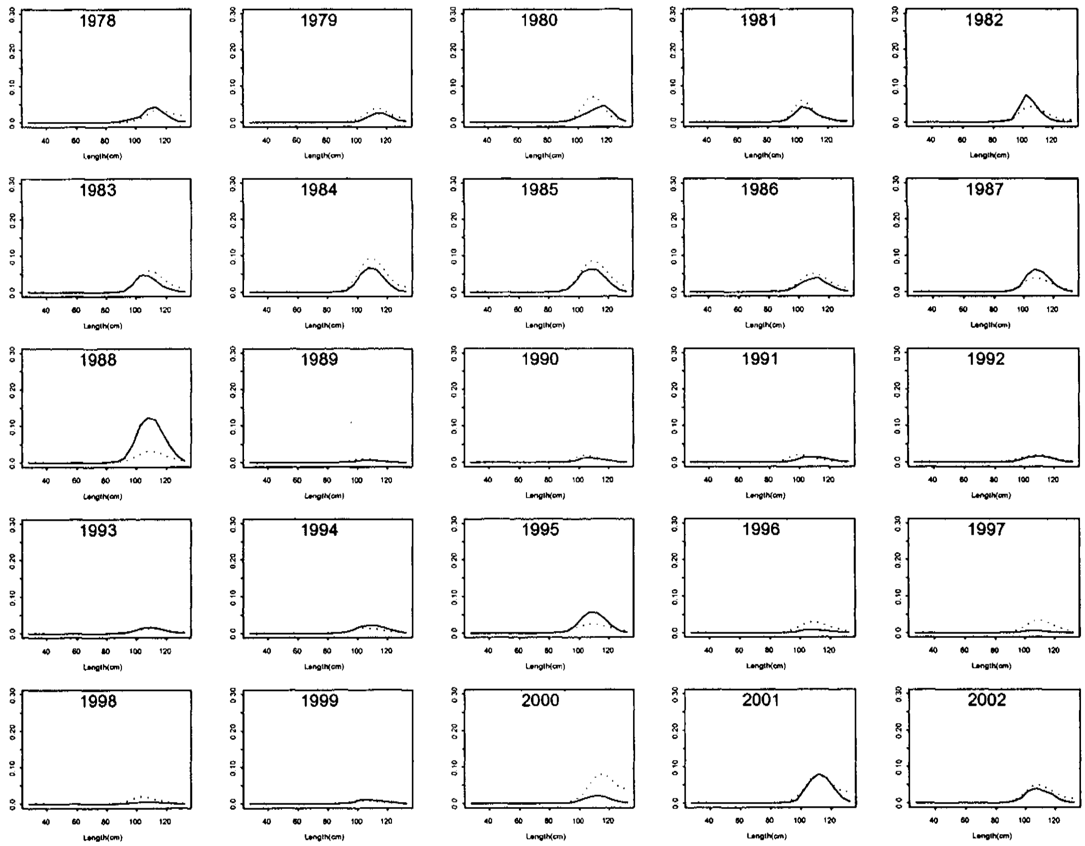

Figure 32. Model fit to the retained male old shell size frequency data. Dotted line is the model fit.

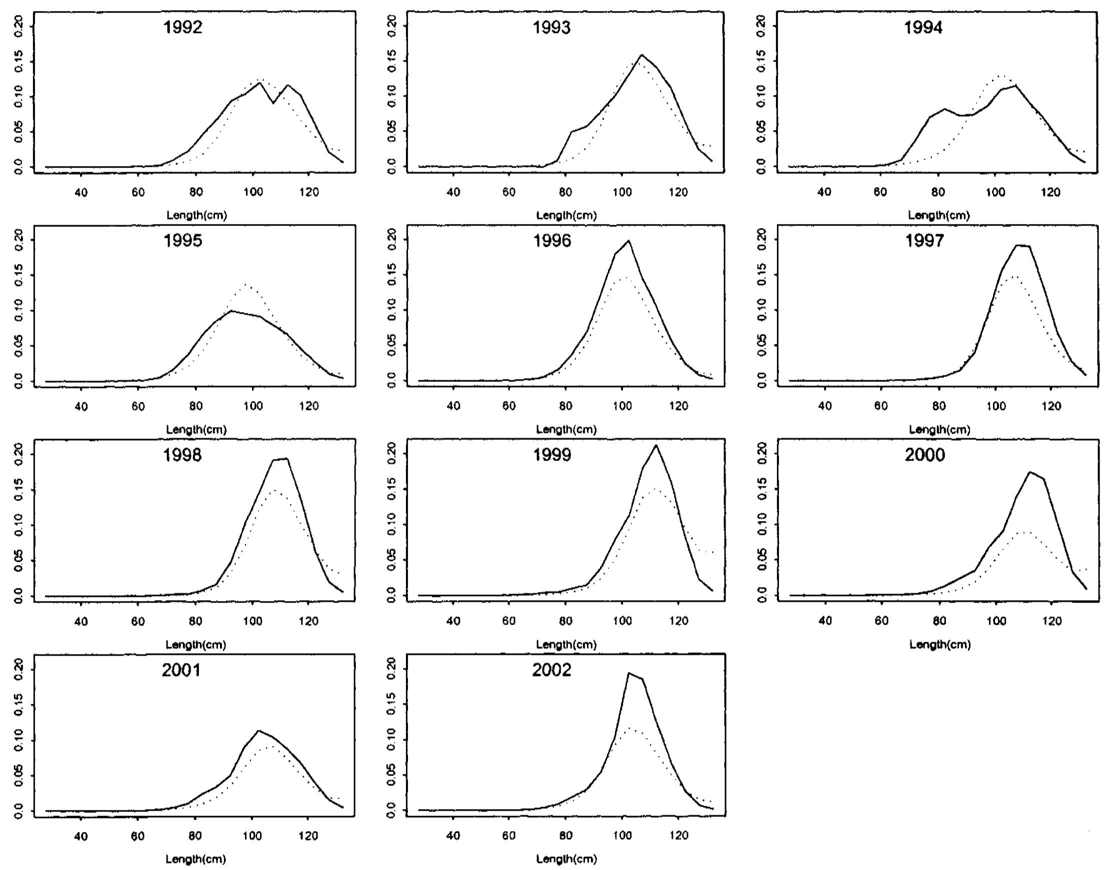

Figure 33. Model fit to the total (discard plus retained) male new shell size frequency data. Dotted line is the model fit.

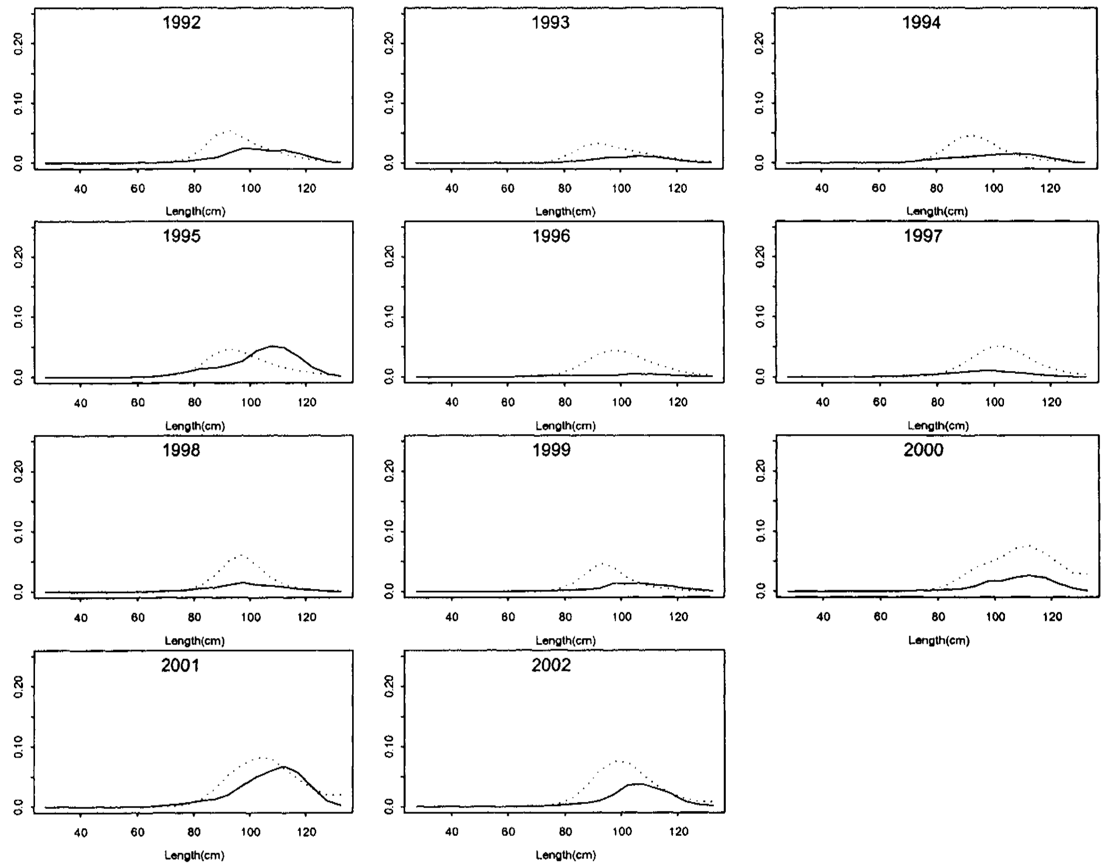

Figure 34. Model fit to the total (discard plus retained) male old shell size frequency data. Dotted line is the model fit.

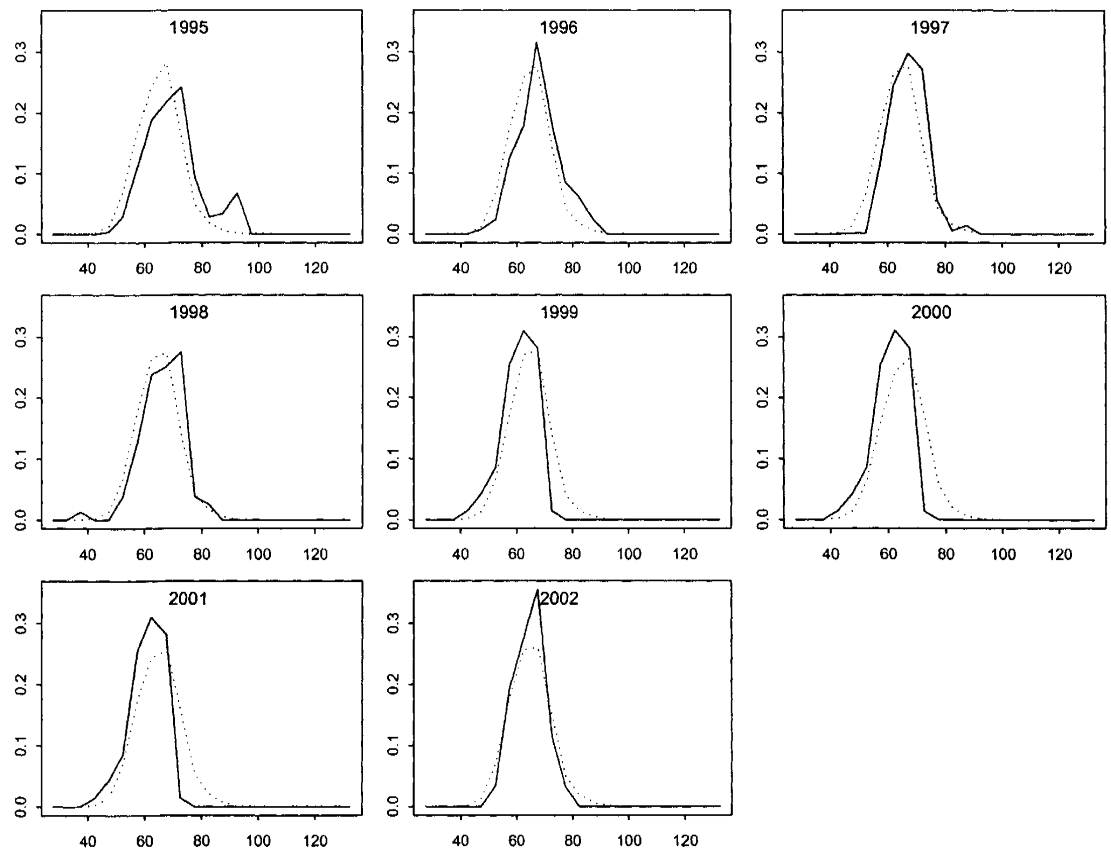

Figure 35. Model fit to the discard female size frequency data. Dotted line is the model fit.

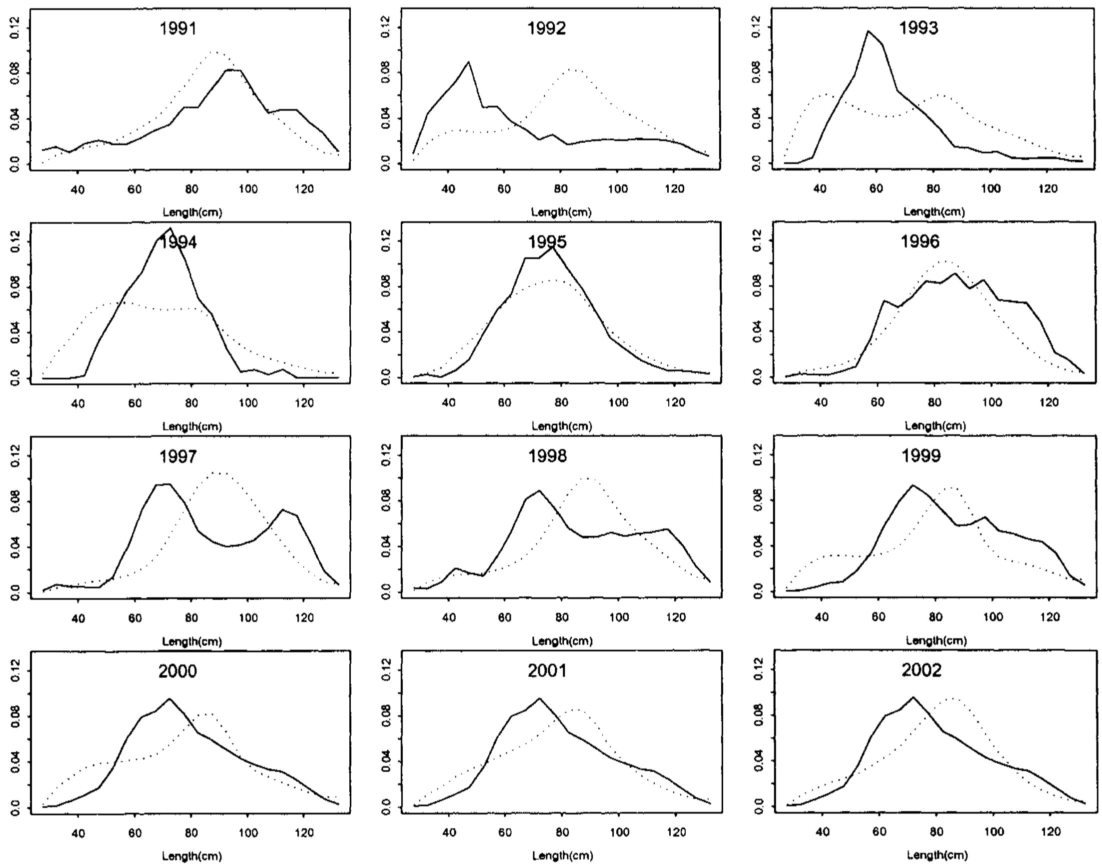

Figure 36. Model fit to the groundfish trawl discard male size frequency data. Dotted line is the model fit.

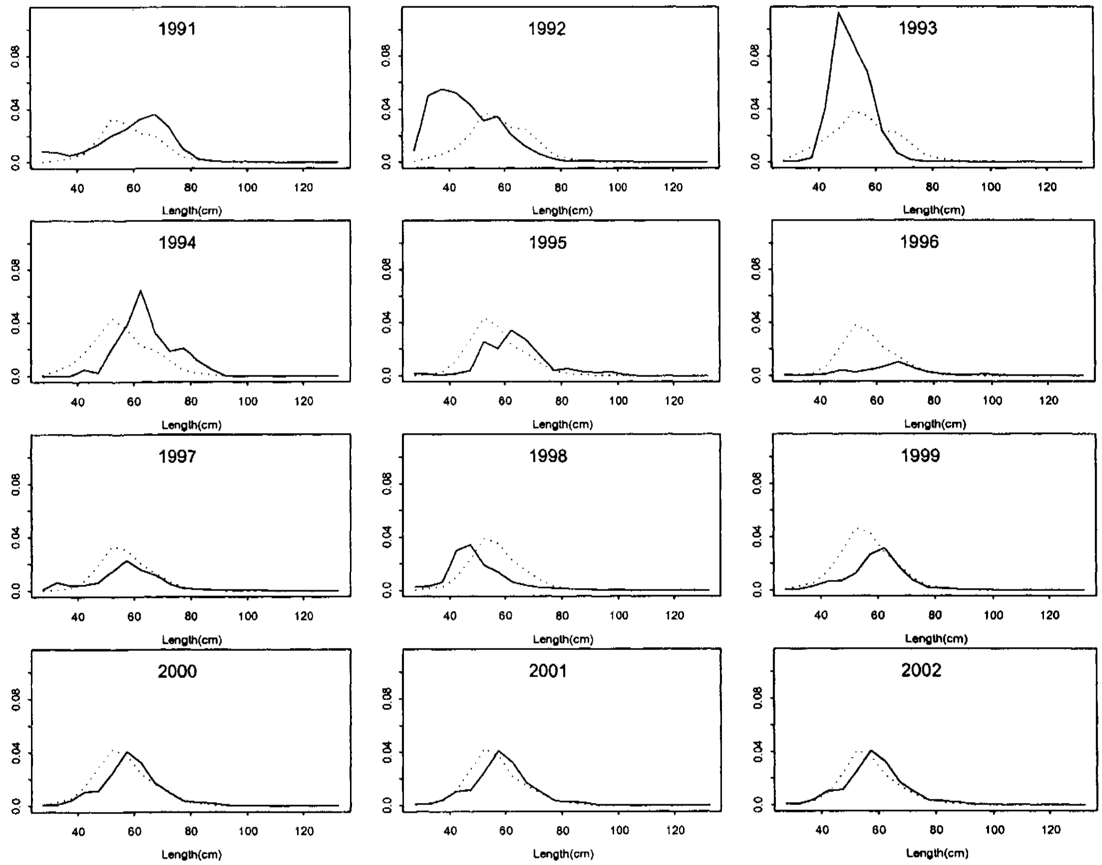

Figure 37. Model fit to the groundfish trawl discard female size frequency data. Dotted line is the model fit.

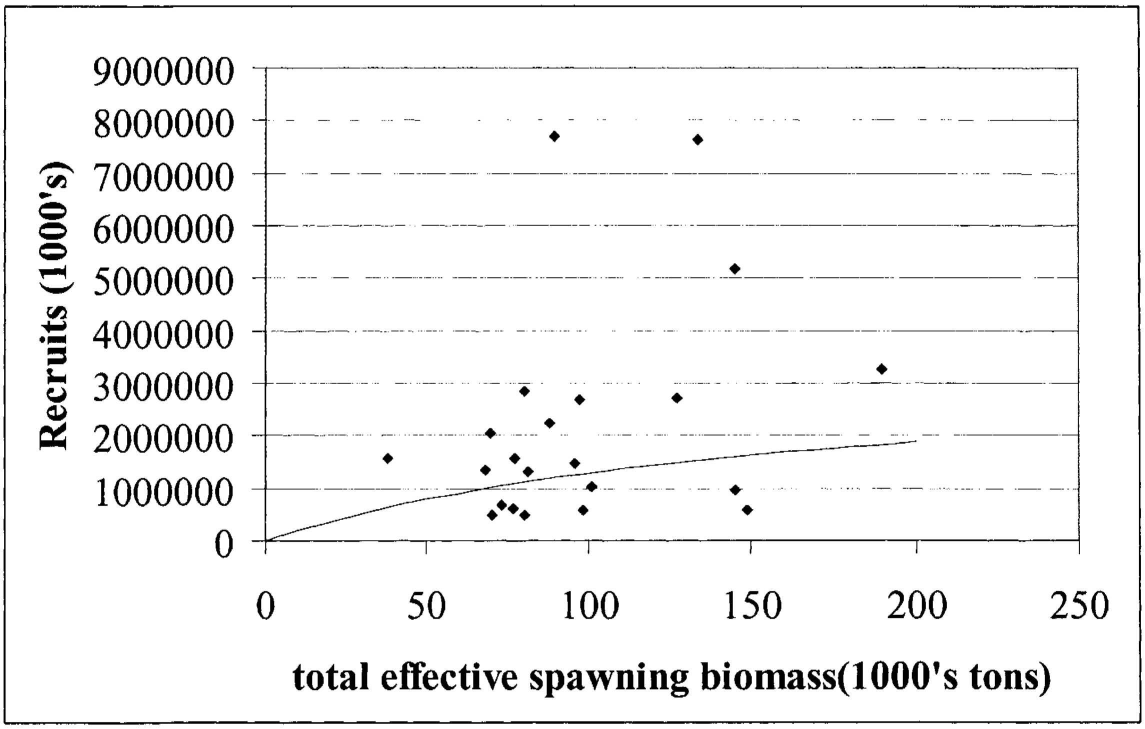

Figure 38. Spawner recruit curve using total effective spawning biomass. Curve has a steepness parameter of 0.51 and R0 of 2.32 billion recruits.

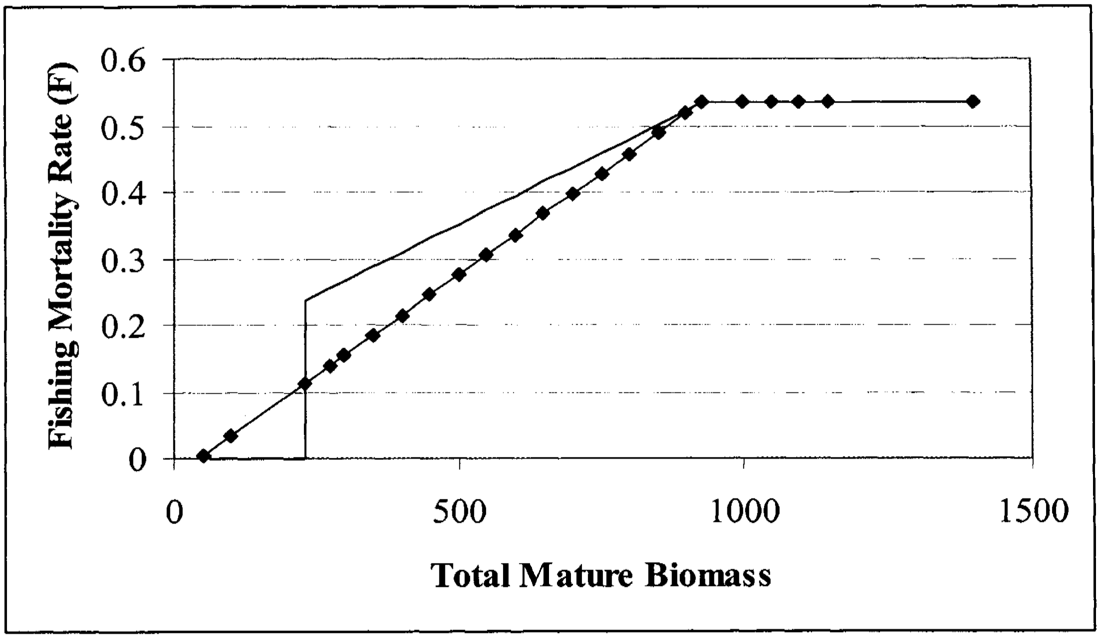

Figure 39. Harvest control rules. Solid line is snow crab harvest control rule using Fmsy = 0.71, Bmsy = 926 million lbs and alpha = -0.25. Solid line with squares is the harvest control rule with alpha = 0.05 (used for North Pacific Groundfish), Fmsy=0.71 and Bmsy= 926 mill lbs.

Appendix A.

Table A.1. Model equations describing the population dynamics.

$N_{s,t,1} = R_{s,t} = R_{0,s} e^{\tau_{s,t}}$	$\tau_{s,t} \sim N(0,\sigma$	Recruitment
TOTAL POT CATCH $C_{t,totalpotfishery,s,sh,l} = \sum_{mature,immature} \frac{F_{s,totalpotfishery,mat,sh,t,l}}{F_{s,mat,sh,t,l}} (1 - e^{-F_{s,mat,sh,t,l}}) e^{-M_{s,mat,sh} Cmid_t} N_{s,mat,sh,t,l}$ RETAINED POT CATCH $C_{t,retainedfishery,s,sh,l} = \sum_{mature,immature} \frac{F_{s,retainedfishery,mat,sh,l}}{F_{s,mat,sh,t,l}} (1 - e^{-F_{s,mat,sh,t,l}}) e^{-M_{s,mat,sh} Cmid_t} N_{s,mat,sh,t,l}$ TRAWL BYCATCH $C_{t,trawlfishery,s,sh,l} = \sum_{mature,immature} \frac{F_{s,ftrawlishery,mat,sh,t,l}}{F_{s,mat,sh,t,l}} (1 - e^{-F_{s,mat,sh,t,l}}) e^{-M_{s,mat,sh} Cmid_t} N_{s,mat,sh,t,l}$	$1 \le t \le$ $1 \le l \le$	Catch taken as a pulse fishery at midpoint of catch(survey is considered start of the year).
$Nimmature_{new,t+1,s,l+1} =$ $(Nimmature_{new,t,s,l} e^{-Zimmat_{new,t,s,l}}) Gr_{s,l} (1 - \phi_{s,l})$ $Nmature_{new,t+1,s,l+1} =$ $(Nimmature_{new,t,s,l} e^{-Zimmat_{new,t,s,l}}) Gr_{s,l} (\phi_{s,l})$ $Nmature_{old,t+1,s,l+1} =$ $(Nmature_{new,t,s,l} e^{-Zmat_{new,t,s,l}}) + (Nmature_{old,t,s,l} e^{-Zmat_{old,t,s,l}})$	$1 \le t <$ $1 \le l \le$	Numbers at size
$SB_{t,s} = \sum_{l=1}^{L} w_{s,l} (Nmature_{new,t,s,l} + Nmature_{old,t,s,l})$		spawning biomass by sex

Table A.1. continued.

$Z_{t,s,sh,l} = \sum_{fishery} F_{t,fishery,s,sh,l} + M$			Total Mortality
$C_{t,fishery} = \sum_{s}\sum_{sh}\sum_{l} C_{t,fishery,s,sh,l}$			Total Catch in numbers
$p_{t,sh,l} = C_{t,sh,l} / C_t$			proportion at size in the catch
$Y_t = \sum_{l=1}^{L} w_{t,l} C_{t,l}$			Catch biomass
$F_{t,fishery,s,sh,l} = s_{t,s,sh,l} F_{t,fishery}$			Fishing mortality
$F_{t,s,sh,l} = \sum_{fishery} F_{t,fishery,s,sh.l}$			Total F over all fisheries (total pot and trawl fisheries)
$S_{t,s,sh,l} = \frac{1}{1+e^{-a_{s,sh}(l-b_{t,s,sh})}}$			Fishery selectivity for total catch sex or shell condition s and size bin l. The 50% parameter changes over time.
$S_{male,t,sh,l} = \frac{1}{1+e^{-a_{male,sh}(l-b_{t,male,sh})}} \frac{1}{1+e^{-c_{sh}(l-d_{sh})}}$			Fishery selectivity for male retained catch by shell condition sh and size bin l is the selectivity for total catch multiplied by the retention curve

Table A.1. continued. $S_{surv,l} = q\dfrac{1}{1+e^{-a_{surv}(l-b_{surv})}}$ $S_{trawl,s,l} = \dfrac{1}{1+e^{-a_{s,trawl}(l-b_{s,trawl})}}$ $MP_l = 1 - \dfrac{1}{1+e^{-a(l-b)}}$			Survey selectivity by size – same for males and females Trawl bycatch selectivity by size and sex Declining logistic for Molting probability by size
$SB_{s,t} = \sum_{s} \sum_{l=1}^{L} w_{s,l} s_{surv,l} N_{s,t,l}$ $Gr_{s,l \to l'} = \int_{l'-2.5}^{l'+2.5} Gamma(\alpha_{s,l}, \beta_s)$ $width_{t+1} = a_s + b_s width_t$			Total Survey biomass Growth transition matrix using a Gamma distribution Mean post-molt width given pre-molt width

Table A.2. Negative log likelihood components.

$\lambda\sum_{t=1}^{T}\left[\log(C_{t,fishery,obs})-\log(C_{t,fishery.pred})\right]^{2}$	Catch using a lognormal distribution.
$-\sum_{t=1}^{T}\sum_{l=1}^{L} nsamp_t * p_{obs,t,l}\log(p_{pred,t,l})$ - offset	size compositions using a multinomial distribution. Nsamp is the observed sample size. Offset is a constant term based on the multinomial distribution.
offset = $\sum_{t=1}^{T}\sum_{a=1}^{A} nsamp_t * p_{obs,t,a}\log(p_{obs,t,a})$	the offset constant is calculated from the observed proportions and the sample sizes.
$\sum_{t=1}^{ts}\left[\frac{\log\left[\frac{SB_{obs,t}}{SB_{pred,t}}\right]}{sqrt(2)*s.d.(\log(SB_{obs,t}))}\right]^{2}$	Survey biomass using a lognormal distribution, ts is the number of years of surveys.
$s.d.(\log(SB_{obs,t})) = sqrt(\log((cv(SB_{obs,t}))^2+1))$	
$\lambda\sum_{s=1}^{2}\sum_{t=1}^{T}(e^{\tau_{s,t}})^2$	Recruitment, where $\tau_{s,t}\sim N(0,\sigma_R^2)$
$\lambda\sum_{t}\left[\log(\frac{R_{male,t}}{R_{female,t}})\right]^{2}$	Sex ratio penalty
$\lambda\sum_{t=1}^{t=T-1}\left[\log(s_{50\%,sh,t+1})-\log(s_{50\%,sh,t})\right]^{2}$	Constraint on size at 50% for fishery selectivity

Table A.3. List of variables and their definitions used in the model.

Variable	Definition
T	number of years in the model(t=1 is 1978 and t=T is 2003
L	number of size classes (L =22)
W_l	mean body weight(kg) of crabs in size group l.
ϕ_l	proportion mature at size l.
R_t	Recruitment in year t
R_0	Geometric mean value of recruitment
τ_t	Recruitment deviation in year t
$N_{l,a}$	number of fish in size group l in year t
$C_{t,l}$	catch number of size group l in year t
$p_{t,l}$	proportion of the total catch in year t that is in size group l
C_t	Total catch in year t
Y_t	total yield in year t
$F_{t,s,sh,l}$	Instantaneous fishing mortality rate for size group l, sex s, shell condition sh, in year t
M	Instantananeous natural mortality rate
E_t	average fishing mortality in year t
ε_t	Deviations in fishing mortality rate in year t
$Z_{t,l}$	Instantantaneous total mortality for size group l in year t
GR	Growth transition matrix
$S_{s,l}$	selectivity for size group l, sex or shell condition s.

Table A.4. Estimated parameters for the model. There were 213 total parameters estimated in the model.

Parameter	Description
$\log(R_0)$	log of the geometric mean value of recruitment, one parameter
τ_t $1978 \le t \le 2002$, 25 parameters for each sex.	Recruitment deviation in year t
Initial numbers by length for each sex and shell condition, 88 parameters.	Initial numbers by length
$\log(f_0)$	log of the geometric mean value of fishing mortality
ε_t $1978 \le t \le 2002$, 25 parameters, one set for retained catch, one set for female discard, and one set for trawl bycatch equals 75 total.	deviations in fishing mortality rate in year t
Slope and 50% selected parameters of the logistic curve	selectivity parameters for the total catch (retained plus discard) of new and old shell males.
Slope and 50% selected parameters of the logistic curve(2 parameters new shell, 2 parameters old shell)	Retention curve parameters for the retained males.
Slope and 50% selected parameters of the logistic curve (6 parameters)	Selectivity parameters for survey male and female crabs for three survey periods (1978-81, 82-88,89 to present).
Slope and 50% selected parameters of the logistic curve(2 parameters male, 2 parameters female)	Selectivity parameters for trawl bycatch male and female
Slope and 50% selected parameters of the logistic curve(2 parameters)	Selectivity parameters for crab fishery female bycatch
Size at 50% selected for fishery new and old shell 1978 to 2002, 2*25 paramaters plus 2 means	Changing fishery selectivity over time

Table A.5. Fixed parameters in the Admodel builder model.

Parameter	Description
M	Natural mortality
Q = 1.0 for 1982 to present surveys	Survey catchability
Parameters for the linear growth function, intercept a and slope b (2 parameters male, 2 parameters female). Standard deviation of size at the first size bin and standard deviation of size for the last size bin.	Growth parameters estimated from Bering sea snow crab data (14 observations).
Slope and 50% parameters of the declining logistic curve	molting probabilities for immature male crabs

SUMMARY OF ACTIONS
ALASKA BOARD OF FISHERIES
Teleconference re: Bristol Bay Red King Crab
June 24, 2003

DESIGNATED REPORTER: Art Hughes

This summary of actions is for information purposes only and is not intended to detail, reflect or fully interpret the reasons for the board's actions.

PETITIONS NO. 1 & 2 **ACTION:** Delegate to Commissioner
DESCRIPTION: Change Bristol Bay red king crab harvest exploitation rate.
AMENDMENTS: Adjust the setting of GHL for legal male crab utilizing a: 10% harvest rate if the effective spawning biomass (ESB) is 14.5 million pounds to 34.75 million pounds, 12.5% harvest rate if the ESB is 34.75 million pounds to 55 million pounds, and 15% harvest rate if the ESB is greater than 55 million pounds.
DISCUSSION: The board was briefed by the department on the mechanics of the existing harvest strategy which allows for a harvest rate of either 10% or 15% of the mature male crabs depending upon effective spawning biomass (ESB). The board then discussed the status of red king crab stocks in Bristol Bay and determined that stocks were healthy and increasing and at a level where different harvest strategy could be discussed.

The board determined that the two petitions on the subject were essentially asking for the same relief. The board discussed whether the petitions meet criteria found in the petition policy and determined that an unforeseen, unexpected resource situation exists where a biologically allowable resource harvest would be precluded by delayed regulatory action because the board received new information on the resource from the department which wasn't available when these harvest strategies were set. The board found that according to the best available science more crab could be taken without harming the resource and that the options available were all conservation-minded and pose little risk to the resource.

After determining that action needed to be taken the board discussed how the public process would best be served since the fishery does not occur until October 15. One option that was considered was a full regulatory meeting. The board decided that in light of budget reductions the public process would best be served by expressing the board's regulatory intent and then delegating authority to the commissioner to promulgate the regulation. This will still allow for public comment prior to the start of the fishery. The board then defined a narrow delegation described in the amendment above.

MEETING SCHEDULE **ACTION:** Carries as amended
DISCUSSION: The board discussed the current meeting schedule and in light of the current budget situation determined that significant cost savings could be achieved by reducing meeting days and changing meeting locations. The board received a report from the executive director listing the various program changes that will occur in Boards Support Section in FY04, including the following:

- BOF will cut 10 meeting days off of the current meeting schedule
- BOG will cut four meeting days off of the current meeting schedule
- Board meetings will occur in Anchorage, Fairbanks, and Juneau only
- The number of proposal books published each year will be significantly reduced and people will be directed to the website for copies
- The Western regional coordinator position will be eliminated, and the four advisory committees formerly supported by this position will be assigned to other staff

Two options were considered that eliminated ten days from the current schedule. The board decided on the following meeting schedule:

Dates/Duration	Topic	Location
October 1 – 3, 2003 [3 days]	Work Session ACRs, cycle organization, Stocks of Concern	Anchorage
October 4, 2003 [1 day]	Pribilof Island Blue King Crab Rebuilding Plan	Anchorage
November 12 – 17, 2003 [6 days]	Statewide Finfish	Anchorage
November 18 – 19, 2003 [2 days]	Chignik Salmon Co-op	Anchorage
December 9 – 17, 2003 [9 days]	Bristol Bay Finfish	Anchorage
January 12 – 19, 2004 [8 days]	Arctic/Yukon/Kuskokwim Finfish	Fairbanks
February 15 – 26, 2004 [12 days]	AK Peninsula/Aleutian Islands Finfish and Supplemental Issues	Anchorage

Subject: **BBay red king reg**
Date: Fri, 22 Aug 2003 16:27:56 -0800
From: Kerri Tonkin <kerri_tonkin@fishgame.state.ak.us>
To: Douglas Pengilly <doug_pengilly@fishgame.state.ak.us>, Wayne K Donaldson <wayne_donaldson@fishgame.state.ak.us>, Denby S Lloyd <denby_lloyd@fishgame.state.ak.us>

Was signed to day with an effective date of Sept 21, 2003. Have a great weekend. Cheers K

Kerri Tonkin, Regulation Specialist CF & SF <kerri_tonkin@fishgame.state.ak.us>

Evaluation of Alternative Harvest Strategies for Bristol Bay Red King Crabs

By

Jie Zheng

Regional Information Report[1] No. 5J03-04
Alaska Department of Fish & Game
Division of Commercial Fisheries
P.O. Box 25526
Juneau, Alaska 99802-5526

March 19, 2003

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[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The North Pacific Fishery Management Council's Crab Plan Team received requests from Industry in September 2002 to consider an intermediate step between 10% and 15% in the Bristol Bay red king crab (*Paralithodes camtschaticus*) mature male harvest rate. That request was supported by many members of the Pacific Northwest Crab Industry Advisory Committee. The Crab Plan Team unanimously requested the Alaska Department of Fish and Game to analyze the Bristol Bay red king crab harvest strategy relative to two alternatives: (1) an intermediate exploitation rate of 12.5% when the stock is between 34.75 and 55 million pounds of effective spawning biomass (ESB; Zheng et al. 1995); and (2) a continuous linear function for the mature male harvest rate, increasing from 10% at threshold to 15% when ESB is at or above 55 million pounds. Two more alternatives are also evaluated in this report: (3) a continuous linear function for the mature male harvest rate, increasing from 7% at threshold to 15% when ESB is at or above 55 million pounds; and (4) a continuous linear function for the mature male harvest rate, increasing from 9% to 13% when ESB is between threshold and 55 million pounds, and a mature male harvest rate of 15% when ESB is at or above 55 million pounds.

The status quo and these four alternative harvest strategies were compared through computer simulations in terms of mean annual yield, fishing opportunity, mature crab abundance and biomass, and probabilities below minimum stock size threshold and biomass at maximum sustained yield. Under the likely stock–recruitment relationship and handling mortality rate, the status quo and Alternatives 1 and 4 are preferred over Alternatives 2 and 3. Performance of both Alternative 1 and the status quo is very close. Alternative 1 has slightly higher mean yield than the status quo, but its ESB, mature biomass, and mature abundance are slightly lower than the status quo, and it also has a slightly higher probability of fishery closure. Overall, Alternative 1 may increase the yield marginally in the near future whereas the status quo may offer a slightly better protection of the stock. Alternative 4 offers a compromise between Alternative 1 and the status quo and has smoother harvest rates than these two strategies.

ISSUES AND PURPOSE

The North Pacific Fishery Management Council's Crab Plan Team received requests from Industry during their September 19–20, 2002 meeting to consider an intermediate step between 10% and 15% in the Bristol Bay red king crab mature male harvest rate. That request was supported by nine of the Pacific Northwest Crab Industry Advisory Committee members available for comment. The Crab Plan Team unanimously endorsed evaluation of this alternative and requested the Alaska Department of Fish and Game to analyze the Bristol Bay red king crab harvest strategy relative to two alternatives: (1) an exploitation rate of 12.5% when the stock is between 34.75 and 55 million pounds of effective spawning biomass (ESB; Zheng et al. 1995); and (2) a continuous linear function for the mature male harvest rate, increasing from 10% at threshold to 15% when ESB is at or above 55 million pounds (Minutes of the Bering Sea/Aleutian Islands Crab Plan Team Meeting, September 19–20, 2002, NPFMC, Anchorage, AK).

The purpose of this report is to evaluate these and other alternative harvest strategies for the Bristol Bay red king crab fishery. A brief history of the harvest strategies is presented. Then, the computer-simulated results for alternative harvest strategies are summarized and compared. Finally, merits for each alternative harvest strategy are discussed.

HISTORY OF HARVEST STRATEGIES

Harvest strategies for the Bristol Bay red king crab fishery have changed over time. The fishery is managed by the State of Alaska with federal oversight (NPFMC 1998). Two major management objectives for the fishery are to maintain a healthy stock that ensures reproductive viability and to provide for sustained levels of harvest over the long term (ADF&G 2000). In attempting to meet these objectives, guideline harvest levels (GHLs) are coupled with size-sex-season restrictions. Only males =6.5-in carapace width (equivalent to 135-mm carapace length, CL) may be harvested and no fishing is allowed during molting and mating periods (ADF&G 2000). Specification of GHLs is based on a harvest rate strategy. Before 1990, harvest rates on legal males were based on population size, abundance of prerecruits to the fishery, and postrecruit abundance, and varied from less than 20% to 60% (Schmidt and Pengilly 1990). In 1990, the harvest strategy was modified, and a 20% mature male harvest rate was applied to the abundance of mature-sized (=120-mm CL) males with a maximum 60% harvest rate cap of legal (=135-mm CL) males (Pengilly and Schmidt 1995). In addition, a threshold of 8.4 million mature-sized females (=90-mm CL) was added to existing management measures to avoid recruitment overfishing (Pengilly and Schmidt 1995). Based on a new assessment model and research findings, the Alaska Board of Fisheries adopted the current harvest strategy in 1996. The current strategy has two mature male harvest rates: 10% when ESB is between 14.5 and 55 million pounds and 15% when ESB is at or above 55 million pounds (Zheng el al. 1996). The maximum harvest rate cap of legal males was changed from 60% to 50%. An additional threshold of 14.5 million pounds of ESB was also added. In 1997, a minimum threshold of 4 million pounds was established as the minimum GHL for opening the fishery and maintaining fishery manageability when the stock abundance is low.

ALTERNATIVE HARVEST STRATEGIES

Five alternative strategies are evaluated in this report:

1. **Status quo**: a mature male harvest rate of 10% when ESB is between 14.5 and 55 million pounds and 15% when ESB is at or above 55 million pounds.

2. **Alternative 1**: a mature male harvest rate of 10% when ESB is between 14.5 and 34.75 million pounds, 12.5% when ESB is between 34.75 and 55 million pounds, and 15% when ESB is at or above 55 million pounds.

3. **Alternative 2**: a continuous linear function for the mature male harvest rate, increasing from 10% at threshold to 15% when ESB is at or above 55 million pounds.

4. **Alternative 3**: a continuous linear function for the mature male harvest rate, increasing from 7% at threshold to 15% when ESB is at or above 55 million pounds.

5. **Alternative 4**: a continuous linear function for the mature male harvest rate, increasing from 9% to 13% when ESB is between threshold and 55 million pounds, and a mature male harvest rate of 15% when ESB is at or above 55 million pounds.

The alternative strategies are illustrated in Figure 1. Except for the mature male harvest rates, all other elements of the current harvest strategy are the same for all five alternative strategies:

(1) Three thresholds: 8.4 million mature females, 14.5-million pound ESB, and 4-million pound minimum GHL; and
(2) Maximum harvest rate on legal males: 50%.

EVALUATION OF ALTERNATIVE HARVEST STRATEGIES

Approach

The length-based model (Zheng et al. 1995) was used in computer simulations to evaluate alternative harvest strategies for Bristol Bay red king crabs. Both male (=95-mm CL) and female (=90-mm CL) components of the stock were simulated in the model. Model parameters for simulations are those estimated during the 2002 stock assessment (Vining and Zheng 2003). Molting probabilities for males and natural mortality for both males and females are variable over time in the assessment model. Average of molting probabilities by size for males from 1980 to 2000 and the modes of estimates of natural mortality for both males and females were used for the simulations.

A stock-recruitment (S–R) relationship predicts likely recruitment of progeny from a given spawning stock size and has important implications for harvest strategies. The S–R relationship for Bristol Bay red king crabs was updated using the recruitment and ESB time series estimated in 2002 (Figure 2). Note that the strong recruitment primarily came from hatching years before 1976. It may not be realistic to expect such strong recruitment to occur in the near future because of the regime shift in climate and physical oceanography that occurred in 1976–77 (Hare and Mantua 2000). Note also that the Crab Plan Team does not consider levels of mature biomass prior to 1983 to be representative of that attainable under the current environmental conditions (NPFMC 1998). Therefore, the alternative harvest strategies were evaluated under the environmental conditions since 1976. A Ricker S–R curve (solid line) was fit to the S–R data (open circles) from hatching years after 1975 (Figure 2). Alternatively, a general S–R curve (dotted line) was optimally estimated using all S–R data from hatching years 1969–1995, and environmental noises modifying recruitments estimated from the S–R curve were derived from the S–R data from hatching years 1976–1995 (Figure 2). Both curves were used in the computer simulations.

The primary features of the simulation scenarios and options are as follows:

- The model was initialized with data on the population status for 2002.

- Natural mortality (*M*) is 0.2 for males and 0.35 for females based on the modes of estimates of natural mortality for both males and females from the length-based model.

- Selectivities for the directed pot fishery bycatch and retained males (Figure 3) were estimated by comparing survey abundance and estimated bycatch from 1991 to 2001.

- The current biomass at maximum sustained yield (B_{msy}, 89.6 million pounds, NPFMC 1998) is defined for both male and female red king crabs based on maturity schedule by CL. Because the model estimates abundance only for males ≥95-mm CL and females ≥90-mm CL and the current harvest strategy defines males ≥120-mm CL and females ≥90-mm CL to be mature, B_{msy} has to be approximated in the simulations. Based on the model estimates of crab abundances from 1983 to 1997, an equivalent B_{msy} was approximated as 77.0 million pounds of male crabs ≥120-mm CL and female crabs ≥90-mm CL.

- For each alternative strategy, the population and fishery were simulated for 35 years with 2000 replicates. The average population status, probability below the overfished level (the percentage of replicates below the overfished level), loss of fishing opportunity (the percentage of replicates with fishery closure), and mean yield from the simulations were summarized to compare the alternative harvest strategies.

- Recruitment was modeled with two approaches: (1) the Ricker S–R curve estimated from the S–R data during hatching years of 1976–1995 with log-normal noises (solid line, Figure 2), and (2) the general S–R curve estimated from the S–R data during hatching years of 1969–1995 with environmental noises being random sampling from noise estimates from hatching years of 1976–1995 (dotted line, Figure 2). Assumption (1) was used as the base model and assumption (2) for sensitivity studies.

- Handling mortality rate of captured, but discarded sublegal males was assumed to be 20% for the directed crab fishery. The sensitivities of the results to handling mortality rates of 0 and 50% were also investigated.

- The annual groundfish trawl bycatch was assumed to be the upper bound on red king crab bycatch set for the Bering Sea groundfish fisheries in the simulations, i.e., 97,000 red king crabs annually when ESB is below 55 million pounds and 197,000 red king crabs annually when ESB is at or above 55 million pounds. Handling mortality rate of trawl bycatch was assumed to be 80%.

- Standard deviation for log-normally distributed measurement (assessment) error was assumed to be 0.2.

Results and Discussion

Simulated results are summarized in Table 1. With the base model (the Ricker S–R curve and 0.2 handling mortality rate), mean yields do not differ greatly among five alternative strategies; mean yields range from 8.17 million pounds for the status quo to 8.76 million pounds for Alternative 2. The mean yield for Alternative 1 is slightly higher than that for the status quo, but its annual yield is also more variable. ESB, mature biomass, mature female and male abundances are highest for the status quo and lowest for Alternative 2. Percentages of years with fishery closure are highest for Alternative 3 (7.5%) due to low harvest rates when the population abundance is low resulting in GHLs below the 4-million pound minimum. Percentages of years with total mature biomass below B_{msy} are highest (31.7%) for Alternative 2 due to relatively high harvest rates. Because of low recruitment levels used to estimate the S–R relationship, annual ESB is rarely above 55 million pounds for any of the alternative strategies. Under the given S–R relationship, percentages of years with the stock below minimum stock size threshold (MSST) are extremely low for any of the five alternative strategies.

The general S–R curve is more density-dependent and has higher overall recruitment levels than the Ricker S–R curve. Therefore, mean yield, ESB, mature biomass, and population abundance are much higher under the general curve than the Ricker curve. The general S–R curve makes the stock rebuild quickly and favors a harvest strategy with a low harvest rate when the population abundance is low. Under the general S–R curve, the status quo strategy performs best among five alternative strategies: highest mean yield, ESB, mature biomass and mature abundance, and lowest percentages of years with fishery closure. Overall, the results from five alternative strategies are not much different under the general S–R curve.

Handling mortality rate for crab bycatch from the directed fishery is not very well known. Bycatch catchability for large females =90-mm CL and sublegal males 95–134 mm CL was estimated as 50% (relative to 100% for legal males) using the observer data in 1990 and 1991 in previous harvest strategy studies for Bristol Bay red king crabs (Zheng et al. 1997a, b). Observer data since 1991 indicate that bycatch catchability for large females is much lower than 50%. The updated bycatch catchability (or selectivities, Figure 3) was used in this study. Because of low bycatch catchability for females, handling mortality had less pronounced effects in this study than the earlier studies. Overall, higher handling mortality rates decrease mean yield, ESB, mature biomass and mature abundance, and increase percentages of years with fishery closure and with mature biomass below B_{msy} (Table 1). Higher handling mortality rates also favor a more conservative harvest strategy, especially under the general S–R curve.

Based on the results in this study, which alternative strategy should be adopted? The answer to this question depends on the S–R curve and handling mortality rate. If we think that the general S–R curve is likely to prevail during the next two to three decades, then we believe that the current low harvest rate will allow the stock to rebuild quickly. The status quo strategy performed the best under this condition. If we expect the environmental conditions during the last two and half decades to continue into the future, then we believe that the Ricker S–R curve will prevail in the future. Under this condition, if the handling mortality rate is very high, say 50%, the overall performance of the status quo strategy is still the best. If the handling mortality rate is about 20%, as is commonly assumed in king crab studies, the mean yield is higher for Alternative 1, 2, or 4 than that for the status quo and the population abundance decreases only slightly under the Ricker S–R curve. Under this condition, Alternative 1 or 4 is preferred over Alternative 2 because the percentages of years with mature biomass below B_{msy} for Alternative 2 (31.7%) is much higher than that for Alternative 1 (24.4%) or 4 (23.7%). The overall fishing mortality for Alternative 3 is similar to the status quo. However, due to the minimum GHL, the low harvest rates when the population is low for Alternative 3 result in higher percentages of years with fishery closure. Performance of Alternative 4 is between those of the status quo and Alternative 1, yet Alternative 4 has smoother harvest rates than the status quo and Alternative 1.

Using the results of length-based assessments and observer data from 1996 to 2002 and assuming handling mortality rate to be 20% and selectivity, catchability, implementation errors, and abundance assessment errors to be the same for Alternative 1 as for the status quo, we can compare the performance of the status quo and Alternative 1 from 1996 to 2002 after the status quo strategy was adopted. Given that ESB estimated annually during 1996–1998 was either <34.75 million pounds or >55 million pounds, application of the status quo harvest strategy and Alternative 1 would have resulted in the same GHLs. However, for each year during 1999–2002 GHLs were determined under the status quo harvest strategy using a 10% harvest rate on mature males, whereas under Alternative 1 the GHLs would have been set using a 12.5% mature male harvest rate. As a result, during the period since the status quo harvest strategy was adopted in 1996, application of Alternative 1 would have increased mean annual yield by about 11% and decreased total male and female mature biomass by about 2%. Estimates of ESBs are below 34.75 million pounds from 1982 to 1996 (Vining and Zheng 2003), so there would have been no difference between the status quo and Alternative 1 during these years.

Spatial distributions of red king crabs in the eastern Bering Sea went through profound changes during the last three decades (Figure 4). Crab abundance in southern Bristol Bay was high during the 1970s and declined substantially over time after 1979. Female red king crabs were found primarily in central Bristol Bay during 1980–1987 and 1992–2001. Strong recruitment occurred from brood years in the late 1960s and early 1970s, a period when mature female abundance was high in southern Bristol Bay. It is not clear whether the strong recruitment and high mature female abundance in southern Bristol Bay are directly related. One possible cause of the northward movement of red king crabs is the regime shift in climate and physical oceanography that occurred in 1976–77 (Hare and Mantua 2000). Given the regime shift in 1976–77 and change in spatial distributions, the Ricker S–R curve estimated with data after 1975 is more suitable in the near future than the general S–R curve estimated with data from 1969 to 1995. Under the low productivity Ricker S–R curve, the status quo and Alternatives 1 and 4 are preferred over Alternatives 2 and 3 as reasoned in the above paragraph. Performance of the status quo and Alternative 1 is very close. Alternative 1 has slightly higher mean yield than the status quo, but its ESB, mature biomass, and mature abundance are slightly lower than the status quo. Thus, Alternative 1 may marginally increase yield in the near future whereas the status quo may offer slightly better protection of the stock. Alternative 4 offers a compromise between Alternative 1 and the status quo and has smoother harvest rates than both strategies.

Compared to historical high abundances in the 1970s, the current Bristol Bay red king crab population status is quite depressed (Vining and Zheng 2003) and the stock is very unlikely to rebuild to such high abundance quickly under the current low productivity environment. Thus, a conservative harvest strategy is appropriate to assure protection of the stock. The simulations presented here indicate that the chance for the stock to fall below MSST will be extremely low under any of the five alternative strategies if the future stock productivity is the same as the past. However, if the future stock productivity is much lower than we expect based on the past productivity, no harvest strategy will be able to completely prevent stock collapse. Still, a precautionary approach will reduce the chance of prolonged stock collapse.

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Table 1. Comparisons of mean yield (Yield), standard deviation of yield (SD), effective spawning biomass (ESB), total mature biomass (TMB), mature female abundance (Female), mature male abundance (Male), and mean percentages of years with fishery closure (Closure), below minimum stock size threshold (<MSST), below B_{msy} (<B_{msy}) and below 55 million pounds of ESB (<15%HR) during 35 years after year 2002 under five management alternatives with different levels of handling mortality rates (HM). Biomass is in million pounds and abundance in millions of crabs. The results from the base model are in bold font.

Alternative	HM	Yield	SD	ESB	TMB	Female	Male	Closure	<MSST	<B_{msy}	<15%HR
					Ricker S–R Relationship						
Closure	0	0	0	34.39	152.08	18.05	20.78	100	<0.01	0.6	95.5
Status q.	0	9.12	4.653	3.76	105.84	17.91	14.20	3.3	<0.01	13.0	96.6
Status q.	**0.2**	**8.17**	**4.123**	**1.29**	**97.74**	**16.74**	**13.03**	**4.9**	**<0.01**	**21.1**	**98.1**
Status q.	0.5	6.93	3.582	7.95	86.98	15.15	11.48	8.5	<0.01	37.2	99.3
Alter. 1	0	9.62	4.903	3.58	102.64	17.87	13.73	3.3	<0.01	14.6	96.9
Alter. 1	**0.2**	**8.46**	**4.373**	**0.80**	**94.06**	**16.55**	**12.49**	**5.1**	**<0.01**	**24.4**	**98.5**
Alter. 1	0.5	6.98	3.832	7.17	83.15	14.83	10.93	9.4	<0.01	43.2	99.5
Alter. 2	0	10.12	4.863	3.33	99.40	17.81	13.25	3.4	<0.01	18.8	97.1
Alter. 2	**0.2**	**8.76**	**4.363**	**0.16**	**89.98**	**16.33**	**11.90**	**5.6**	**<0.01**	**31.7**	**98.7**
Alter. 2	0.5	7.04	3.902	6.09	78.31	14.40	10.23	11.1	<0.01	53.9	99.7
Alter. 3	0	9.50	5.273	3.62	103.27	17.88	13.82	4.9	<0.01	12.3	96.9
Alter. 3	**0.2**	**8.28**	**4.763**	**0.94**	**95.31**	**16.60**	**12.67**	**7.5**	**<0.01**	**20.6**	**98.5**
Alter. 3	0.5	6.78	4.242	7.58	85.61	15.00	11.29	13.2	<0.01	36.8	99.5
Alter. 4	0	9.54	4.843	3.62	103.17	17.88	13.80	3.5	<0.01	14.2	96.9
Alter. 4	**0.2**	**8.41**	**4.323**	**0.90**	**94.72**	**16.59**	**12.59**	**5.4**	**<0.01**	**23.7**	**98.4**
Alter. 4	0.5	6.96	3.812	7.34	83.97	14.90	11.05	9.9	<0.01	41.9	99.5
					General S–R Relationship						
Closure	0	0	0	74.49	314.39	39.92	43.18	100	<0.01	0.2	31.2
Status q.	0	22.73	12.53	70.50	204.57	39.28	27.34	0.2	<0.01	1.0	34.9
Status q.	0.2	19.43	10.81	62.35	181.55	35.71	23.99	0.3	<0.01	1.5	42.8
Status q.	0.5	14.77	8.33	50.46	149.43	30.08	19.41	0.8	<0.01	3.4	60.7
Alter. 1	0	22.93	11.97	69.81	201.30	39.07	26.86	0.2	<0.01	1.2	36.1
Alter. 1	0.2	19.37	10.13	60.76	175.77	35.06	23.17	0.4	<0.01	1.9	45.8
Alter. 1	0.5	14.29	7.43	47.30	139.30	28.57	18.00	0.9	<0.01	4.8	68.4
Alter. 2	0	23.01	11.58	69.13	198.50	38.83	26.46	0.2	<0.01	1.5	37.1
Alter. 2	0.2	19.23	9.66	59.23	170.65	34.41	22.44	0.4	<0.01	2.6	48.7
Alter. 2	0.5	13.74	6.81	44.23	129.99	27.06	16.72	1.3	<0.01	8.0	74.9
Alter. 3	0	23.01	11.89	69.73	200.76	39.06	26.78	0.4	<0.01	1.0	36.2
Alter. 3	0.2	19.41	10.05	60.51	174.82	34.99	23.03	0.7	<0.01	1.6	46.3
Alter. 3	0.5	14.24	7.38	46.84	137.97	28.40	17.81	1.6	<0.01	4.0	69.8
Alter. 4	0	22.91	12.03	69.92	201.75	39.11	26.93	0.2	<0.01	1.1	35.9
Alter. 4	0.2	19.40	10.21	61.01	176.61	35.17	23.28	0.4	<0.01	1.8	45.3
Alter. 4	0.5	14.38	7.54	47.81	140.89	28.82	18.22	1.0	<0.01	4.4	67.1

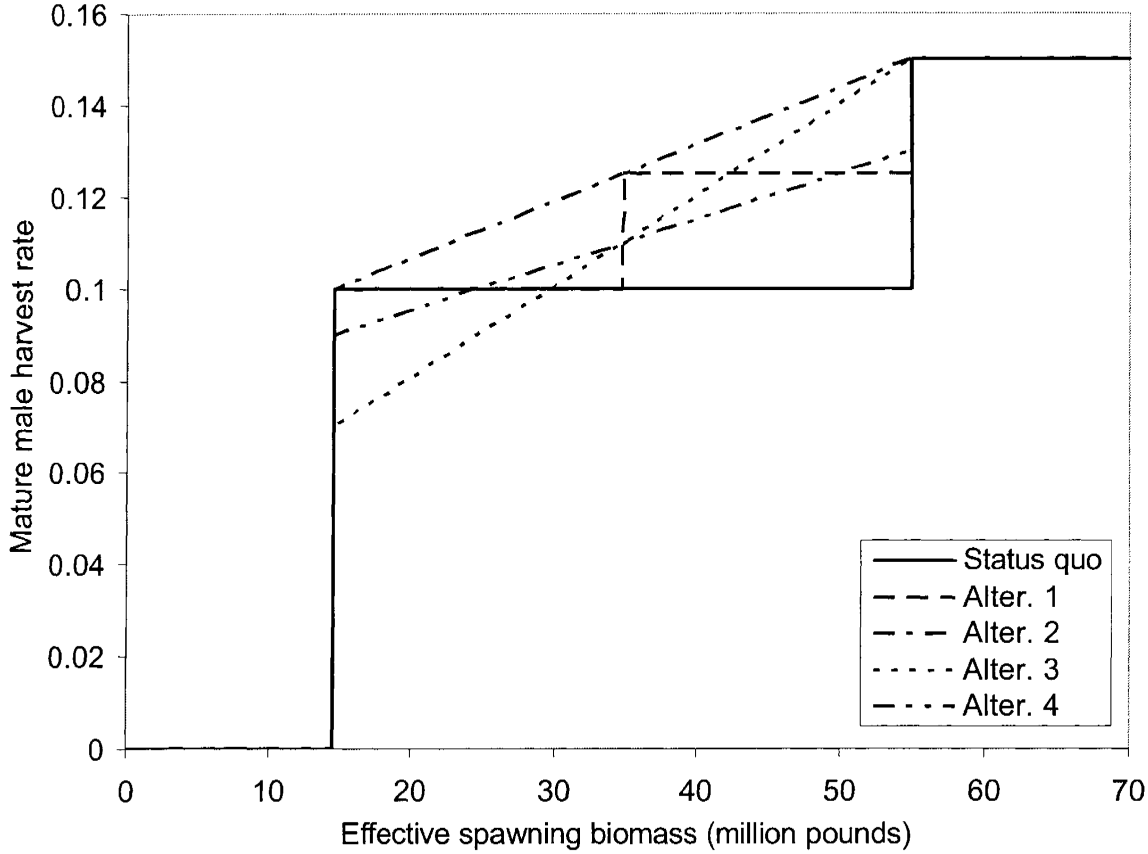

Figure 1. Five alternative harvest strategies for Bristol Bay red king crabs.

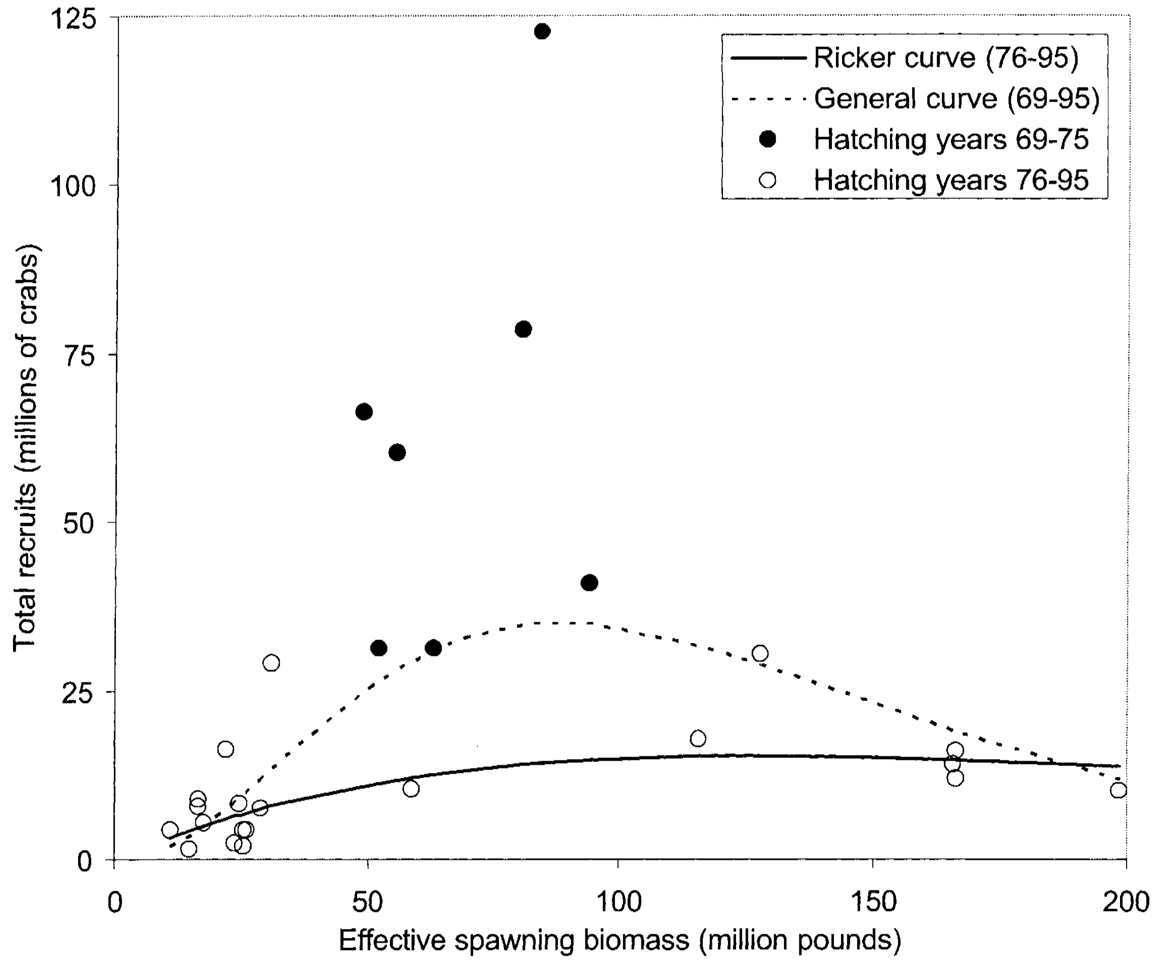

Figure 2. Relationships between total recruits at age 7.2 years (i.e., 8-year time lag) and effective spawning biomass for Bristol Bay red king crabs.

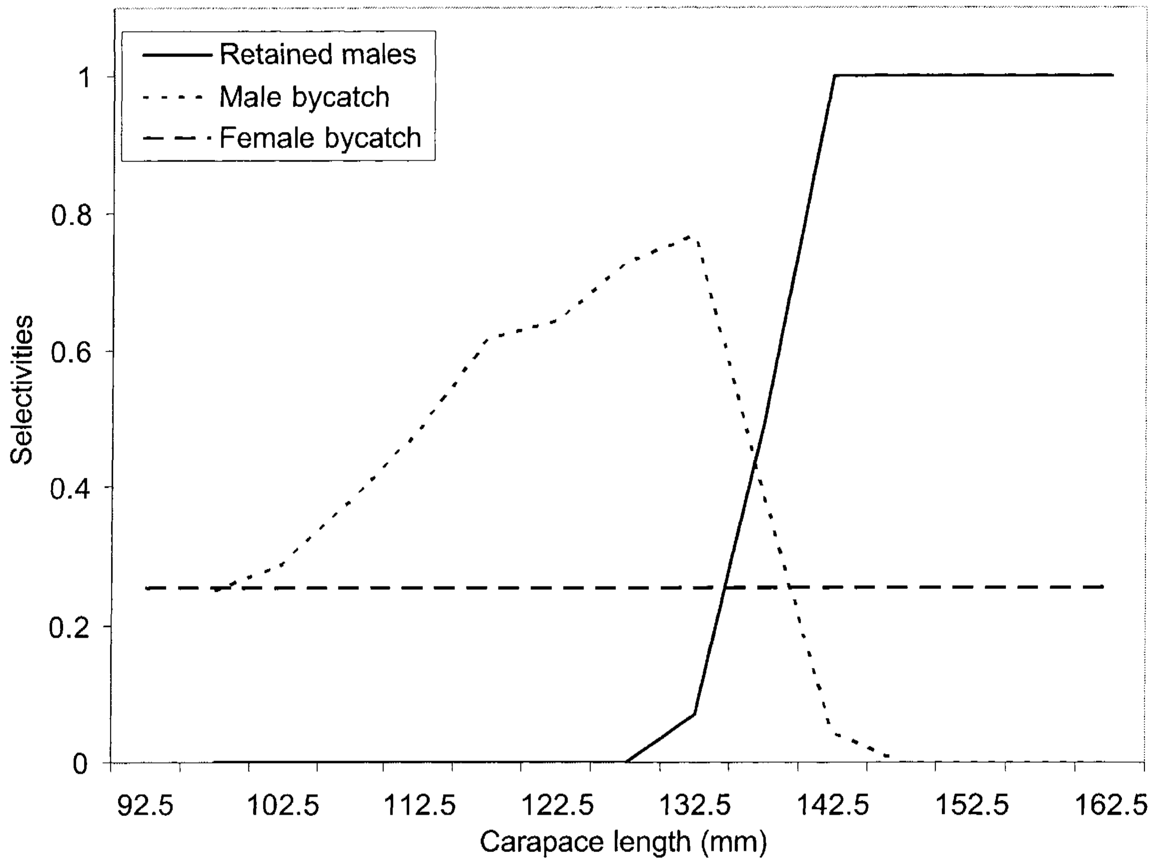

Figure 3. Estimated selectivities for male bycatch, female bycatch, and retained males for Bristol Bay red king crabs.

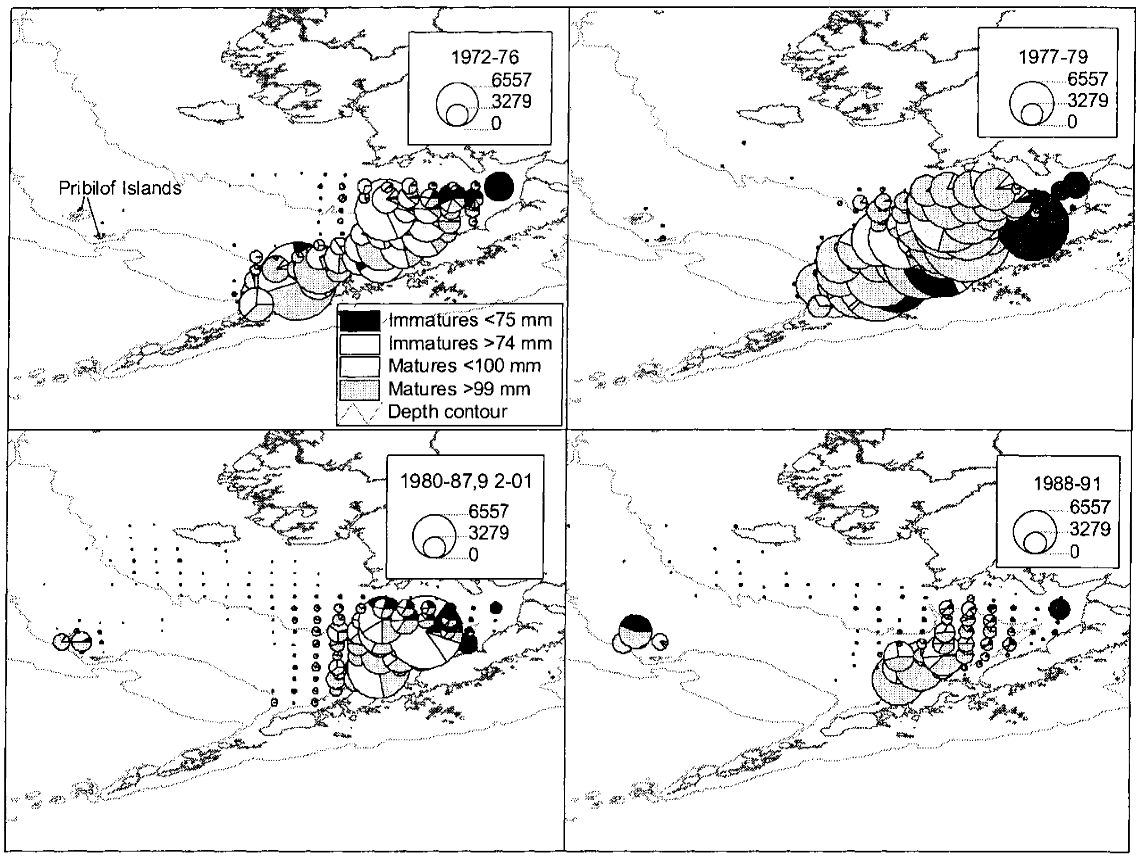

Figure 4. Distributions of female red king crabs from 1972 to 2001 in the eastern Bering Sea derived from NMFS summer trawl survey data. Crab density is expressed as the number of crab per square nautical mile. The three depth contour lines are 50, 100, and 200 m.