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FALSE PASS CHUM SALMON

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Approved

Submitted_____ _____

Director

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KEY WORDS

Alaska, Bristol Bay, sockeye salmon, chum salmon, False Pass,

INTRODUCTION

The salmon fisheries on the south side of the Alaska Peninsula have been the subject of controversy since nearly the time of their inception in the early 1900s. The June fisheries in the Shumagin Islands and south of Unimak Island, which are commonly called the False Pass fishery or South Peninsula June fishery, target on non-local sockeye (*Oncorhynchus nerka*) salmon. Several studies, culminating in a 1987 tagging experiment by the Alaska Department of Fish and Game (ADF&G), have clearly demonstrated that most of the sockeye salmon caught in the False Pass fishery (about 80%) are bound for rivers in Bristol Bay (Eggers et al 1991 and Rogers 1990). The non-Bristol Bay contributions to the sockeye salmon catches in 1987 were mainly North Peninsula stocks (7%) in the South Unimak catch and stocks from Chignik (20%), North Peninsula (10%) and Kodiak (9%) in the Shumagin catch. For management purposes, ADF&G has assumed that the entire False Pass sockeye salmon catch consists of Bristol Bay fish. Since 1975 the annual False Pass sockeye salmon catch has been based on a quota (guideline harvest) of 8.3% (Unimak, 6.8% and Shumagin, 1.5%) of the forecasted Bristol Bay and False Pass catch (ADF&G 1992B). The average annual percent of the total Bristol Bay catch taken in the False Pass fishery over the past 10 years was 5.3% (range: 2.9% to 7.3%). The fishery has thus been managed in a very conservative manner, especially considering the historical high abundance of sockeye salmon over the past 10 years; however, the fishery is not without controversy because with the increase in sockeye salmon catch there was an increase in the catch of non-local chum (*O. keta*) salmon.

The 1987 tagging of chum salmon demonstrated that while Bristol Bay stocks still contributed the highest percentage to the False Pass catch (Unimak, 40%; Shumagin, 18%; and combined 38%), Asian stocks were the next major contributor in 1987 (Unimak 18%; Shumagin 39%; and combined 20%). Arctic and Yukon River stocks, for which there had recently been conservation concerns, were minor contributors to the 1987 False Pass chum salmon catch. However, it was argued to the Alaska Board of Fisheries that these northern stocks were in low abundance in 1987 and that their typical contribution to the False Pass catch was underestimated by the 1987 tagging. The fishery has operated with a chum salmon cap (second quota) since 1986 (with an exception in 1987) and the sockeye-targetted fishery has been closed early three times because the chum cap was attained; 1986, 1988 and 1991 (Shaul et al 1992). The resultant loss in sockeye salmon catch to the False Pass fishery for those three years was 1.8 million fish, while the gain to the coastal runs of chum salmon to the Arctic and Yukon rivers was largely unmeasurable.

The potential impact of the False Pass fishery on a single stock or group of stocks will depend on the availability of the stock (the proportion migrating through the fishery) and the relative abundances of that stock and other contributing stocks, both are likely to vary from year to year. Our main purpose is to examine the year to year changes in chum salmon abundance with particular reference to 1) the abundances in 1987 and 2) a possible increase in the contribution of Asian chum salmon. In recent years, False Pass fishermen have noted a significant occurrence of chum salmon with a snake-like appearance. These chum salmon of poor condition (low weight for their length) are believed to originate from Japanese hatcheries, because Japan has increased production to the point of density-dependent growth. The occurrence of Asian chum salmon in the False Pass

fishery can also be assessed from the presence of scale holes (focal scale resorbtion) that are nearly unique to Asian stocks, both hatchery and wild (Bigler 1988 and 1989). The specific objectives this year were to: 1) estimate chum salmon runs (catch + escapement) to North Pacific coastal regions for 1970-1992, 2) measure the incidence of scale holes in the 1992 False Pass catch, and 3) examine frequency distributions of chum salmon condition factors from the 1992 catch for bimodality.

METHODS

The accuracy of estimates of the annual runs (catch and escapement) of sockeye and chum salmon to major North Pacific regions are quite variable. Annual catch statistics for sockeye and chum salmon, since the 1950s, are fairly accurate (probably within 10%) for most North American regions and Japan, but less so for Russia (Fredin 1980). There are accurate annual escapement estimates for sockeye salmon for most runs since the mid-1950s, but estimates for chum salmon escapements are either lacking, inaccurate or only available for recent years. For most regions of Alaska, except the Arctic-Yukon-Kuskokwim (A-Y-K), chum salmon runs coincide with more valuable sockeye or more numerous pink (*O. gorbuscha*) salmon runs and therefore receive less monitoring for escapement. However, chum salmon runs can be estimated in these situations from the chum salmon catch and the rate of exploitation on the targetted species (Rogers 1987).

Annual runs of chum salmon to North Pacific regions from 1970 to 1992 were estimated primarily from catch statistics presented in Appendix Tables 1-10. Sockeye salmon exploitation rates were utilized in Bristol Bay even though some aerial and sonar estimates of chum salmon escapement were available (Nushagak and Togiak). Sonar estimates of chum salmon escapement were used for a few recent years in the Yukon River, and aerial survey estimates were used for most estimates of chum salmon escapements to Central Alaska, otherwise assumed exploitation rates and chum salmon catches were used to estimate chum salmon runs.

Chum salmon from the 1992 False Pass catch were sampled at the Peter Pan processing plant in King Cove. Fish were selected randomly from the processing line and a crew of four measured length (mid-eye to tail fork) and weight, determined the sex from external appearance, and collected two scales from the preferred region. The first samples, collected from the June 15 catch, suffered from inexperience of the crew and nearly one-third of the scales were useless (mostly poor mounting); in addition, the electronic scale used for June 15 broke and a different scale (obtained from the plant) was used to weigh fish after June 15. Data from the field forms (date, location, scale card number, fish number, sex, length, and weight) were entered on a computor file. Weights measured in pounds and ounces (after June 15) were later transformed to kilograms.

Scales were aged and examined for focal scale resorbtion (holes) by an experienced scale reader who had been tutored by Mr. Brian Bigler (Wards Cove Packing Co., Seattle, WA) on the identification of focal scale resorbtion. Ages and occurrences of scale holes were then added to the computor data base. Data were stratified by location (South Unimak and Shumagin Is.), date, sex, and age. Weight-length scattergrams were examined for outliers and they were then removed prior

to statistical analyses, e.g., means and standard deviations of lengths and weights, age compositions, and length-weight regressions. A condition factor was calculated from weight in grams divided by the cube of length in centimeters. Frequency distributions of condition factors were then graphed and examined for possible bimodality.

Catch statistics for the False Pass fisheries of past years were obtained from Shaul et al (1992) and Mr. R.L. Murphy (ADF&G, Kodiak, AK) provided preliminary catches by gear, area, and date for 1992. These preliminary catches were used to weight stratified means (length, weight, age compositions) to obtain the annual means for 1992.

RESULTS

ABUNDANCE

Most sockeye salmon caught in the False Pass area during June are bound for Bristol Bay and this fact was used by Eggers and Schaul (1987) to develop an in-season forecast about 10 days prior to the arrival of the fish in Bristol Bay. I updated the data base used by Eggers and Schaul (Table 1), added it to their data base, and calculated a new regression to predict the Bristol Bay run (Fig 1). Sockeye salmon were difficult to catch in 1990, probably because there were persistent offshore winds, so there was a low CPUE relative to the run. Omitting the 1990 observation as an outlier, the CPUE of sockeye salmon at South Unimak explained 61% of the annual variation in the Bristol Bay runs (64% if the CPUE at 50% of the quota was used). The age composition of the sockeye salmon catch at False Pass has also been useful in forecasting the Bristol Bay runs (Table 2). In contrast, the chum salmon catches at False Pass have shown no correlation with the chum salmon runs to Bristol Bay even though the Bristol Bay stocks were the most abundant stocks in the 1987 tagging (Fig. 1).

The species compositions (sockeye and chum salmon only) in the False Pass catches and the Western Alaska runs have shown some correlation that has changed over the years along with an increase in the production from Japanese hatcheries (Table 3, Figs. 2 and 3). The chum salmon percentage in the False Pass catch of 1992 was unusually low compared to the trend of recent years (lowest since 1980); however, sockeye salmon abundance in 1992 was the third highest in history while domestic runs of chum salmon were low and the Japanese hatchery returns were at least lower than the recent-year average (Tables 4-7). The impact of Japanese chum salmon on the False Pass fishery is evident in the correlation between the differences in chum salmon percentages between False Pass and Western Alaska as a function of the Japanese catch (hatchery return). The Japanese chum salmon catch explained 55% of the annual variation in the differences in False Pass and Western Alaska chum salmon percentages (Fig. 4). With increases in Japanese hatchery chum salmon. False Pass catches contained a higher percentage of chum salmon than expected from the percentages of chum salmon in the Western Alaska runs.

AGE, WEIGHT, AND LENGTH

About 99% of the chum salmon caught in the 1992 South Unimak and Shumagin fisheries were ages 0.3 and 0.4 with age 0.3 slightly more numerous (Table 8). AWL summaries are given for the South Unimak and Shumagin catches by age, sex, and date in Appendix Tables 11 and 12. Males averaged about 1-2% longer than females but were 5-12% heavier and therefore had higher condition factors.

The weight -length relation for fish is usually represented by a curvilinear relation (power curve) and the observations are plotted on a log-log scale. However, simple linear relations tend to fit well when fish are stratified by sex and age. The chum salmon measured at King Cove in 1992 tended to be relatively heavy in the South Unimak sample of June 15, relatively light in the South Unimak, June 16 and Shumagin, June 17 samples and then the fish had very similar weight-length relationships in the remainder of the samples (Figs. 5-7). The regressions given in Figure 7 for the June 21 samples are probably the most representative of the chum salmon caught in 1992.

CONDITION FACTORS

The main purpose in calculating condition factors was to determine whether a group of fish with poor condition (thin body or low weight for the length) was present in the False Pass catch. Chum salmon with a condition factor less than 0.011 or more than 0.024 were removed as outliers (erroneous measurement) and the remaining observations were graphed by age, sex and date.

The condition factors of chum salmon caught on June 15 were significantly higher, and those caught on June 16-17 were significantly lower, than the condition factors for fish caught during the remainder of the 1992 season (Table 9). Males tended to have higher condition factors than females and age 0.4 fish tended to have higher factors than age 0.3 fish; however in no instance was there any indication of a bimodal distribution in the frequencies of the condition factors (Figs. 8-10). The lightest fish were in the Shumagin catch of June 17. Many of these chum salmon would probably qualify as "snakes" or very thin fish, typical of Japanese hatchery fish; however, more measurements (years) are needed to verify this.

FOCAL SCALE RESORBTION

Murphy (1993) presents a summary of the incidence of focal scale resorbtion for chum salmon in the False Pass fisheries, including our preliminary results for 1992. Scales had only been examined from South Unimak in 1990 (600) and from the Shumagins in 1989 (302) and 1990 (298). The final results for 1992 are given in Table 10. About 3% of the original observations were removed as AWL outliers (e.g. too long or short for the age, or too heavy or light for the length); however, the results were nearly the same as in the original samples: 1% to 3% of the chum salmon had focal scale resorbtion, depending on the inclusion of questionable "holes".

Assuming that the incidence of focal scale resorbtion is zero in Alaskan stocks and about 11.8% in Asian stocks (Murphy 1993), the Asian stocks contributed about 10% to 25% to the 1992 False

Pass chum salmon catch which is similar to the 20% estimate from the 1987 tagging. To obtain more precise estimates of Asian stock contribution we need a measure of the year to year variation in the incidence in Asian stocks and larger sample sizes for the Shumagins (about 1000). From the tagging results in 1987, we would expect the incidence of "holes" to be much greater in the Shumagin samples than in the South Unimak samples; however, that was not the case in 1992.

DISCUSSION

The catch of chum salmon in the 1992 False Pass fisheries (430,000) was the lowest since 1986 and the percentage of chum salmon in the catch (15%) was the lowest since 1980. In contrast, the sockeye salmon catch in 1992 (2.5 million) was the largest since 1980 and correctly indicated a large Bristol Bay run (45 million). The low percentage and number of chum salmon in the 1992 False Pass catch was probably caused by a continuation of poor chum salmon runs to Western Alaska and a downturn in the production of chum salmon by Japanese hatcheries.

We were unable to detect the presence of poor-conditioned chum salmon (snakes) as reported by fishermen in past years. This may have been because they were simply not present in high numbers in 1992 or that our measurement technique was poor. In the future we need to note on our data form, those fish with unusual body shapes, so they are not removed from the data set as outliers (incorrect measurement). Many scales were lost from our samples to examine for focal scale resorbtion because too many scales were mounted on a card. We need two well-mounted scales from each fish and this can be done by mounting scales from half as many fish as there are numbered spaces on a card.

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FIGURES

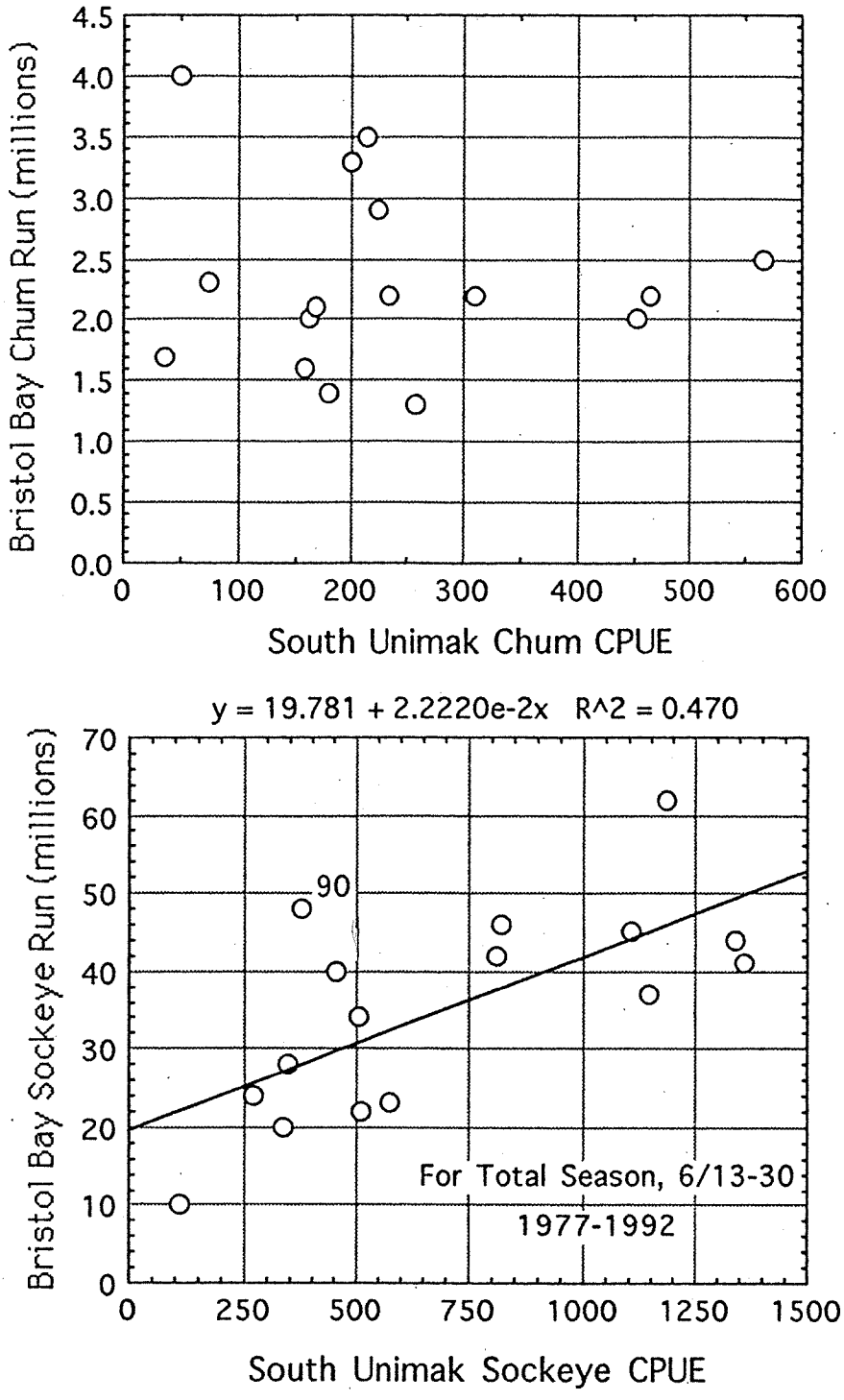

Figure 1. Bristol Bay sockeye and chum salmon runs plotted on South Unimak catch-per-unit-effort.

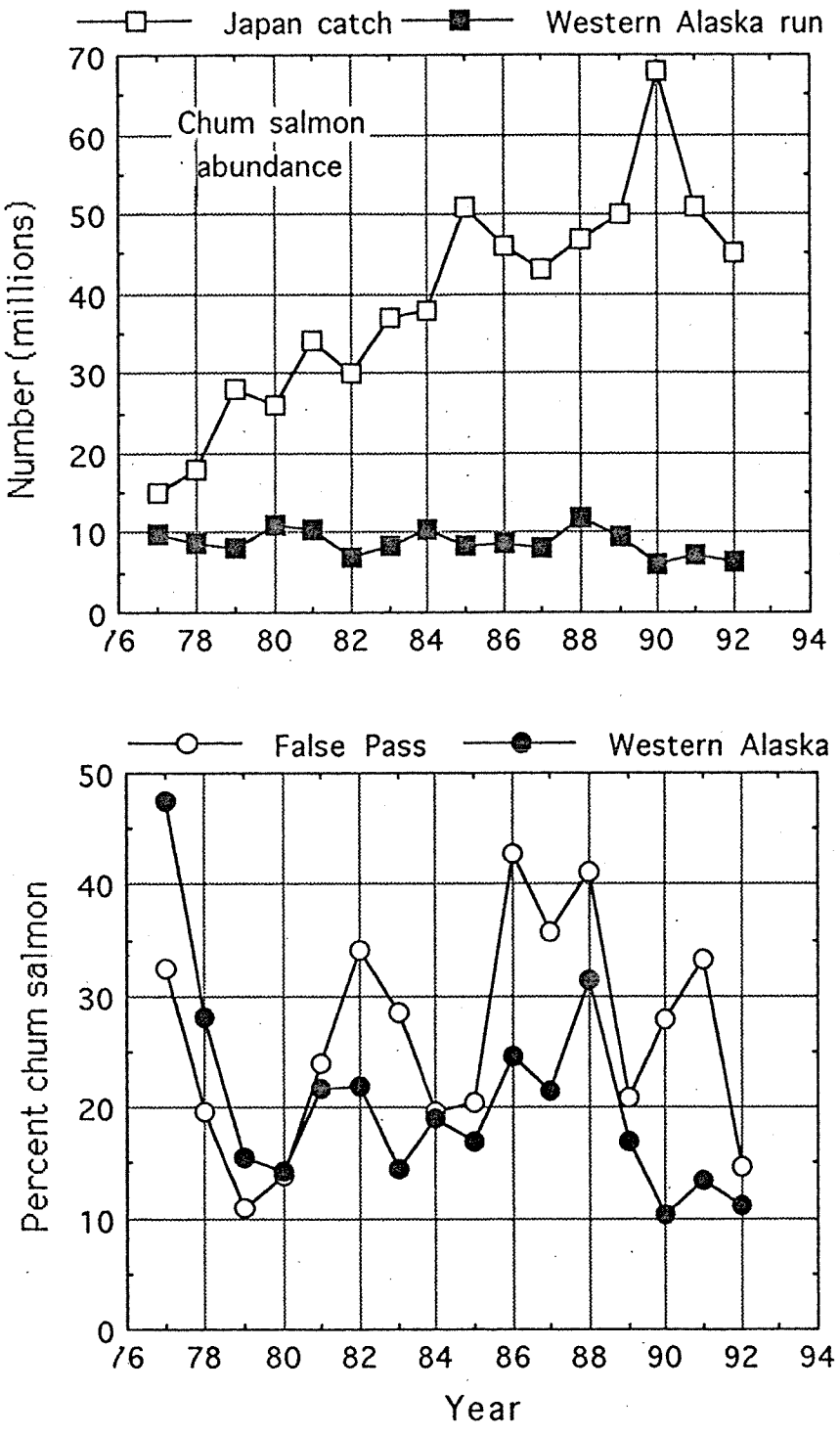

Figure 2. Annual species composition in the False Pass catch and the Western Alaska runs (bottom), and the runs of chum salmon to Western Alaska and Japanese hatcheries (top).

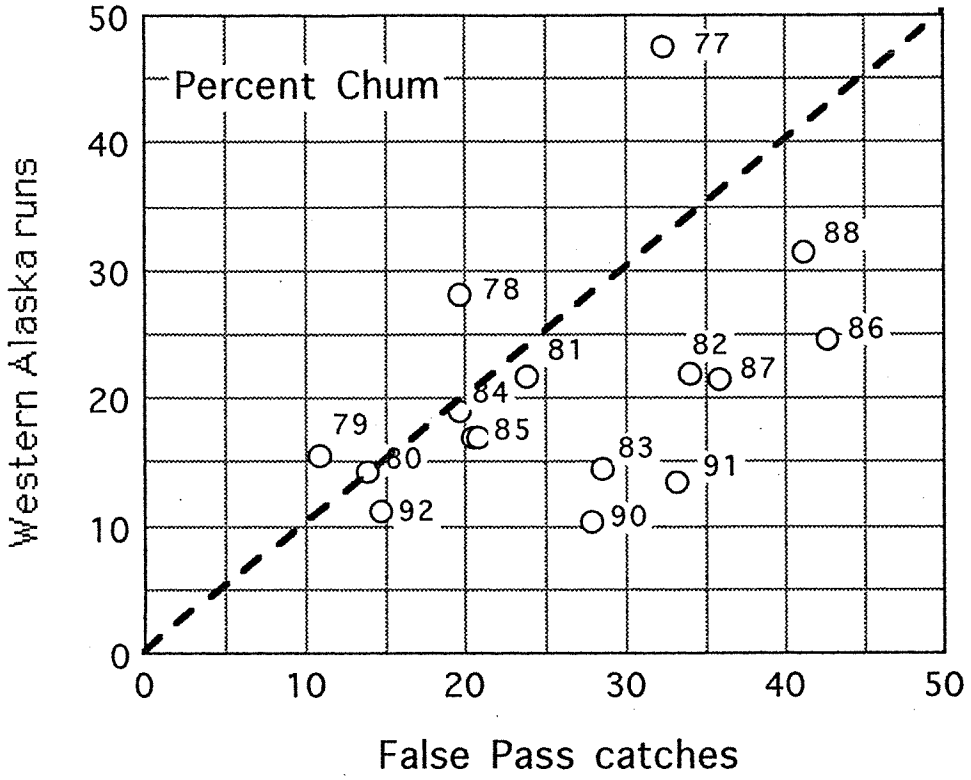

Figure 3. The percentage of chum salmon in the Western Alaska run plotted on he percent chums in the False Pass catch.

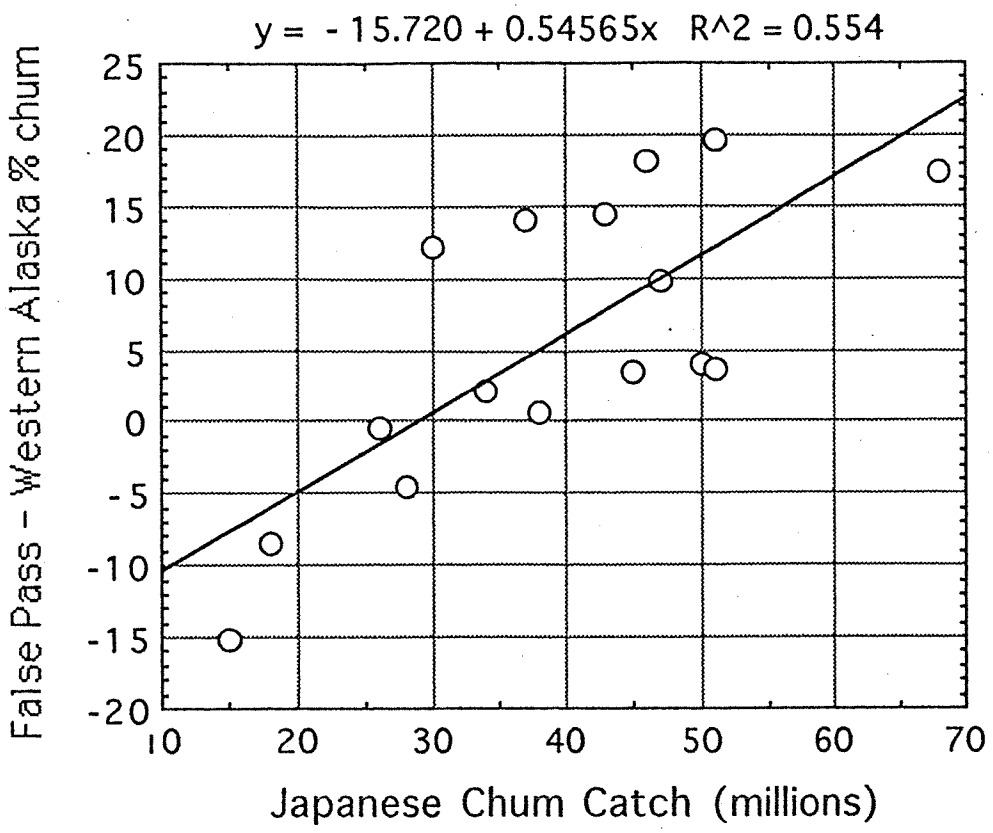

Figure 4. Differences in the percent chum salmon in the Western Alaska run and the False Pass catch regressed on the Japanese chum salmon catch.

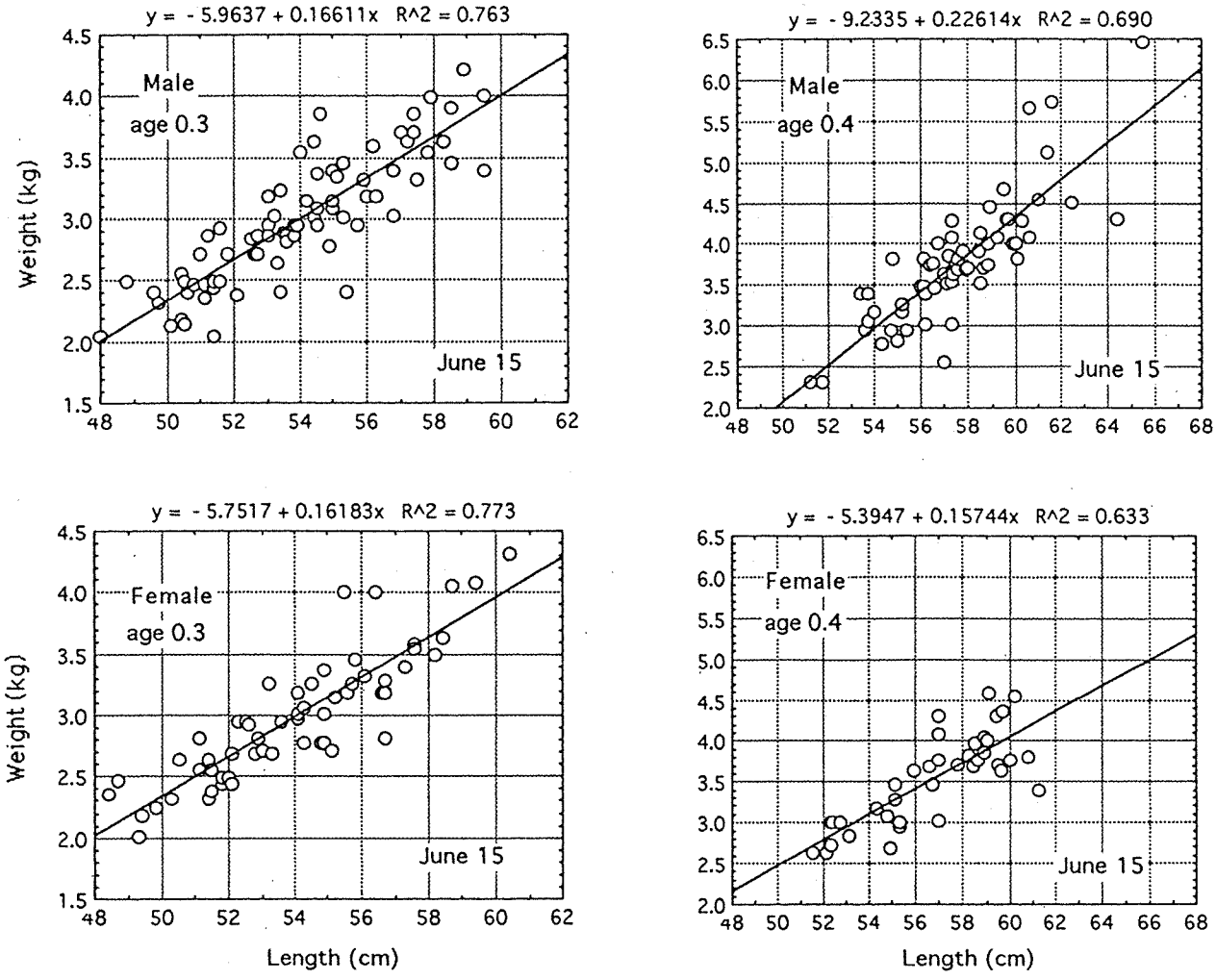

Figure 5. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 15, 1992.

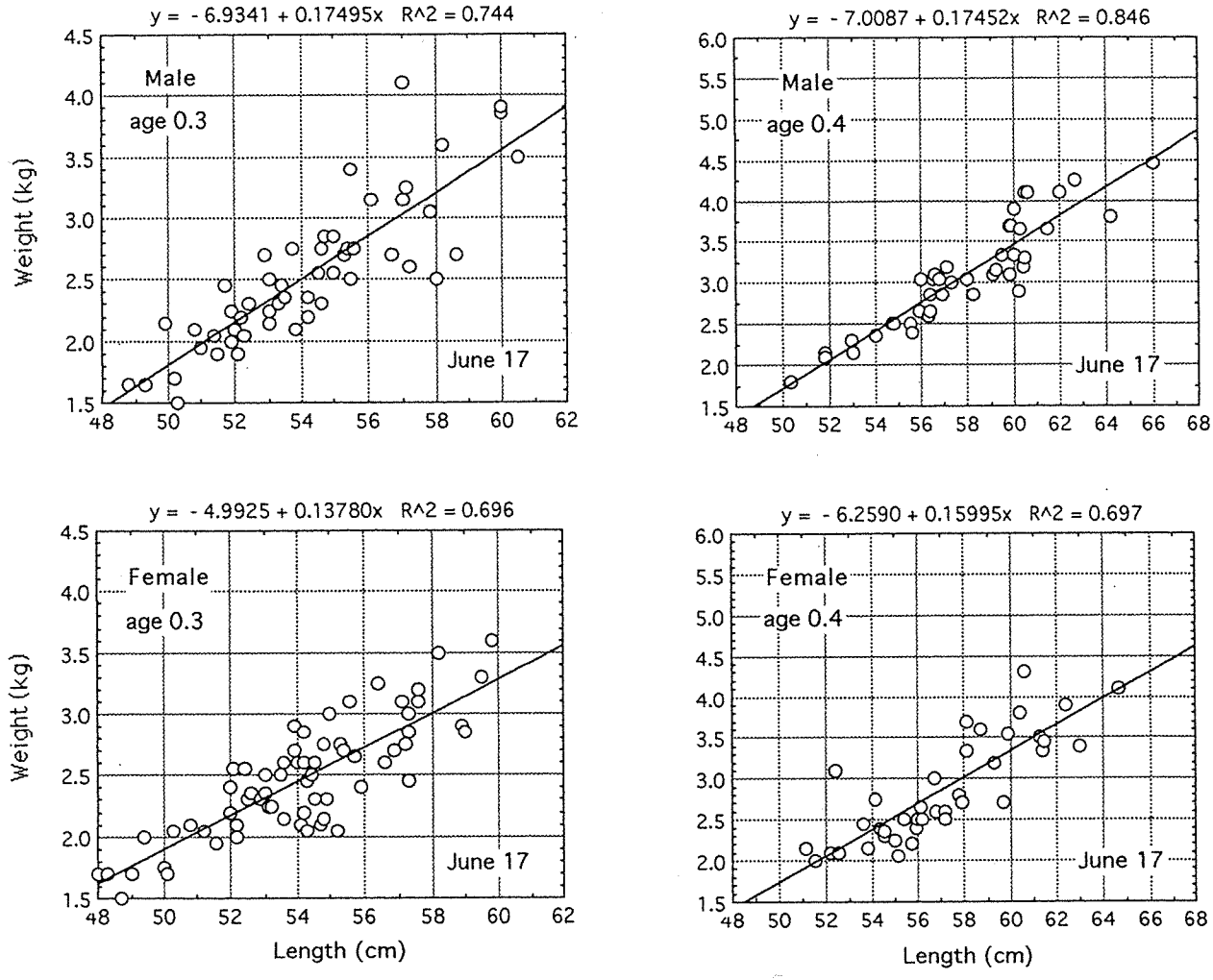

Figure 6. Regressions of weight on length by sex and age from Shumagin Island chum salmon catch samples on June 17, 1992.

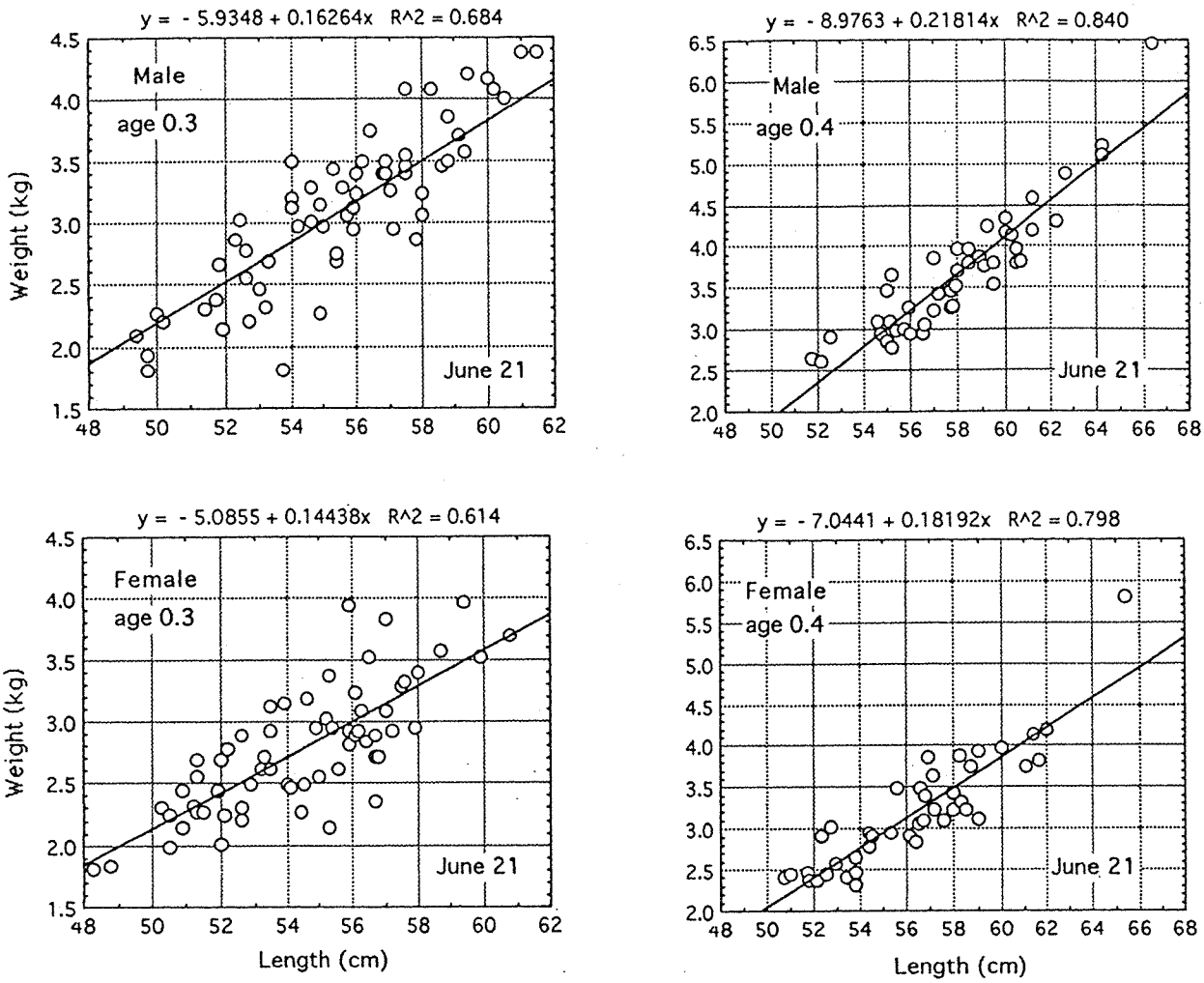

Figure 7. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 21, 1992.

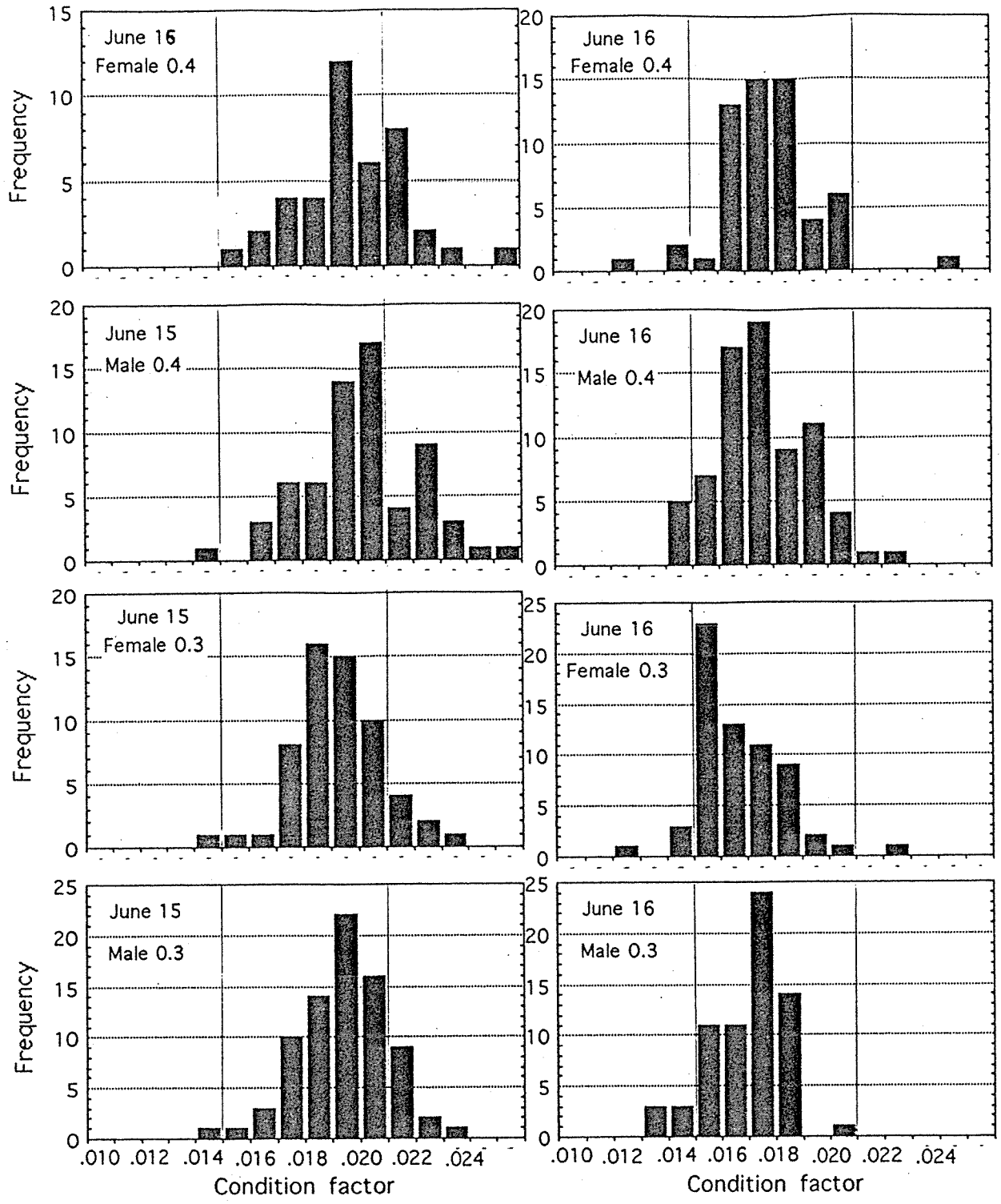

Figure 8. Frequency distributions of condition factors by age and sex for samples of chum salmon from South Unimak catches on June 15 and 16.

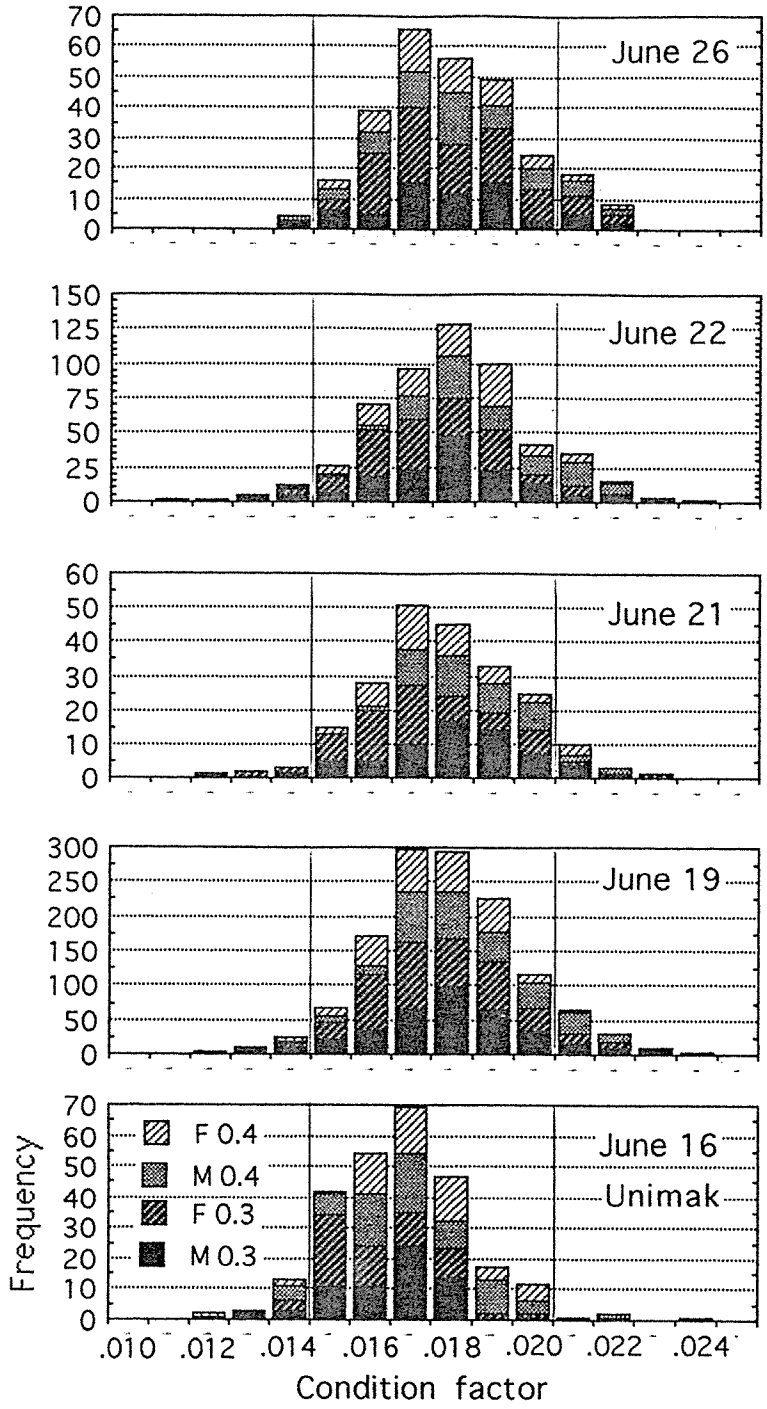

Figure 9. Frequency distributions of condition factors for chum salmon from the South Unimak catches, June 16-26, 1992

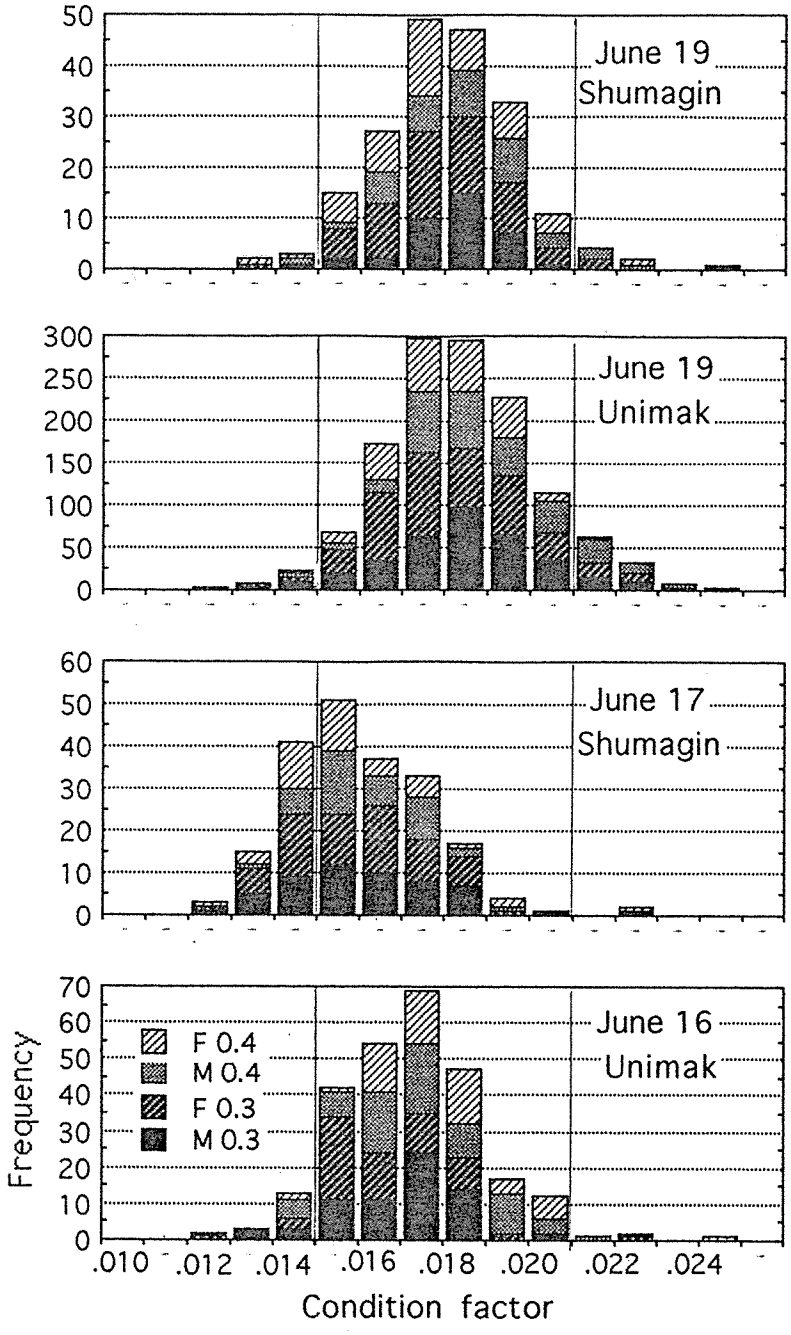

Figure 10. Frequency distributions of condition factors for chum salmon from South Unimak and Shumagin catches during June 16-19,1992.

TABLES

Table 1. Sockeye and chum salmon catches in the South Unimak June fishery, 1986-1992.

Year	Date	Hours open	Catch (1,000s) Sockeye	Catch (1,000s) Chum	% chum	Sockeye CPUE
86	11	24	7	14	67	102
(24)	14	16	29	55	65	138
Q=.9	16	6	31	35	53	383
C=.3	18	12	92	102	53	562
	21	18	65	32	33	253
cap=.3	23	24	20	7	26	116
	24	24	17	5	23	253
	25	24	24	8	24	276
Sum	13-	124	278	244	47	268
87	10	18	14	16	53	80
(27)	11	20	18	22	55	155
Q=.6	14	18	44	24	35	263
C=.6	15	22	47	30	39	240
no cap	17	18	83	63	43	414
	18	16	66	54	45	322
	20	18	54	23	30	295
	21	24	96	48	33	463
	22	20	74	42	36	330
	25	12	44	24	35	706
	26	22	49	56	53	277
Sum	13-	170	557	364	40	343
88	11	14	11	18	62	222
(23)	15	14	42	35	45	829
Q=1.3	16	14	75	70	48	1190
C= .5	18	6	56	49	47	788
cap=.4	21	15	80	63	44	462
	22	9	35	26	43	719
	23	22	114	112	50	486
	27	16	46	87	65	328
Sum	13-	96	448	442	50	573
89	10	16	144	82	36	885
(44)	16	16	350	145	29	1584
Q=1.2	19	18	126	38	23	900
C=1.3	20	22	434	119	22	1455
cap=.4	23	12	259	20	7	1213
Sum	13-	68	1169	322	22	1339
90	13	18	12	5	29	140
(48)	14	22	33	12	27	135
Q=1.1	16	18	67	18	21	377
C=1.1	17	24	145	42	22	519
cap=.5	18	24	90	26	22	331
	19	24	33	9	21	181
	20	24	81	29	26	329
	21	24	118	57	33	417
	22	24	118	35	23	448
	23	24	104	47	31	354
	24	22	87	76	47	363
	26	18	166	91	35	600
	28	5	17	6	26	597
Sum	13-	271	1071	453	30	373
91	15	14	121	45	27	574
(42)	17	14	51	27	35	319
Q=1.6	18	14	104	49	32	600
C=1.2	19	6	108	56	34	1494
cap=.5	20	15	221	115	34	1040
	23	9	183	49	21	1783
	24	22	256	187	42	828
	25	16	143	137	49	642
Sum	13-	110	1187	665	36	811
92	15	18	214	26	11	1208
(45)	16	24	132	21	14	610
Q=2.0	17	24	245	37	13	888
C=2.0	18	14	236	42	15	1229
cap=.6	19	22	359	58	14	1075
	21	18	340	45	12	1307
	22	14	345	75	18	1348
	26	5	87	15	15	1445
Sum	13-	139	1958	319	14	1105

Sockeye CPUE = catch/boat/24h; 1 purse seine = 3.28 drift gill nets (set nets excluded).
( ) = Bristol Bay run, Q= Unimak sockeye quota, C= Unimak sockeye catch, and cap= chum cap (in millions).

Table 2. Comparison of the age compositions of sockeye salmon in Bristol Bay runs with age compositions from the False Pass fishery, in-season Port Moller test fishery, and the ADF&G pre-season forecast, 1987-1992.

Year		Age composition (%) 1.2	2.2	1.3	2.3	all .2	all .3	Bristol Bay run (millions)
1987	ADF&G pre-f'cast	26	24	33	17	50	50	16.1
	Moller in-f'cast	49	19	19	12	68	31	26.0
	False Pass catch	35	13	33	14	49	51	
	Bristol Bay run	49	12	24	13	61	39	27.3
1988	ADF&G pre-f'cast	30	27	34	9	57	43	26.5
	Moller in-f'cast	17	20	48	12	37	60	22.0
	False Pass catch	23	42	23	9	66	33	
	Bristol Bay run	20	22	41	13	43	55	23.0
1989	ADF&G pre-f'cast	22	45	24	9	67	33	28.9
	Moller in-f'cast	13	45	22	17	58	39	37.0
	False Pass catch	8	62	13	15	70	28	
	Bristol Bay run	11	62	16	9	73	26	43.8
1990	ADF&G pre-f'cast	19	42	26	13	61	39	25.4
	Moller in-f'cast	10	37	24	26	48	52	56.0
	False Pass catch	16	37	20	25	53	45	
	Bristol Bay run	14	41	21	20	56	43	47.8
1991	ADF&G pre-f'cast	28	25	31	16	53	47	30.0
	Moller in-f'cast	12	14	55	13	28	71	37.0
	False Pass catch	21	33	36	6	54	46	
	Bristol Bay run	19	20	46	11	39	60	42.1
1992	ADF&G pre-f'cast	19	39	27	13	58	42	37.1
	Moller in-f'cast	8	35	31	22	43	53	45.0
	False Pass catch	6	35	25	30	42	58	
	Bristol Bay run	13	34	27	22	47	50	44.9
Means	ADF&G pre-f'cast	24	34	29	13	58	42	27.3
	Moller in-season	18	28	33	17	47	51	37.2
	False Pass catch	18	37	25	17	56	44	
	Bristol Bay run	21	32	29	15	53	46	38.2

Age composition for Port Moller is for June 11-30 only, whereas the forecast is the one ussed about July 2-3. Forecasts and runs do not include jacks (1-ocean fish).

Table 3. Percent chums in sockeye and chum salmon catches and runs (in millions), 1977-1992.

	Bristol Bay						Western Alaska						South Peninsula			Port Moller		
	Catch			Run			Catch			Run			June Catch			Test boat CPUE		
Year	Sock.	Chum	% C	Sock.	Chum	% C	Sock.	Chum	% C	Sock.	Chum	% C	Sock.	Chum	% C	Sock.	Chum	% C
77	4.86	1.59	24.7	9.6	4.00	29.4	5.1	3.7	42.0	10.8	9.8	47.6	0.24	0.12	32.4	6.9	2.3	25.0
78	9.90	1.15	10.4	19.8	2.31	10.4	10.8	3.7	25.5	22.1	8.7	28.2	0.49	0.12	19.7	3.2	0.8	20.0
79	21.36	0.91	4.1	39.8	1.66	4.0	23.4	3.4	12.7	43.6	8	15.5	0.86	0.11	10.9	9.6	0.2	2.0
80	23.72	1.31	5.2	62.4	3.34	5.1	25.1	5.1	16.9	65.4	10.9	14.3	3.30	0.53	13.8	4.6	1.6	25.8
81	25.58	1.52	5.6	34.3	2.10	5.8	27.6	5.8	17.4	37.9	10.5	21.7	1.83	0.58	23.9	7.6	2.0	20.8
82	15.09	0.92	5.7	22.1	1.33	5.7	16.8	3.6	17.6	24.6	6.9	21.9	2.12	1.09	34.0	5.1	1.1	17.7
83	37.31	1.63	4.2	45.7	2.16	4.5	39.6	4.7	10.6	48.8	8.3	14.5	1.96	0.78	28.5	4.4	0.4	8.3
84	24.60	2.03	7.6	40.7	3.52	8.0	26.6	5.4	16.9	43.9	10.3	19.0	1.39	0.34	19.7	27.1	5.0	15.6
85	23.63	1.07	4.3	36.6	2.04	5.3	26.4	4.4	14.3	40.7	8.3	16.9	1.86	0.48	20.5	18.0	0.8	4.3
86	15.66	1.23	7.3	23.6	2.21	8.6	18.4	4.1	18.2	27.1	8.8	24.5	0.47	0.35	42.7			
87	16.00	1.54	8.8	27.3	2.88	9.5	17.4	4.0	18.7	29.7	8.1	21.4	0.79	0.44	35.8	12.4	0.8	6.1
88	13.84	1.47	9.6	23.2	2.54	9.9	16.4	5.4	24.8	26.0	11.9	31.4	0.76	0.53	41.1	7.8	1.2	13.3
89	28.71	1.25	4.2	43.9	2.24	4.9	30.5	4.7	13.4	46.8	9.5	16.9	1.75	0.46	20.8	18.6	0.9	4.6
90	33.11	1.01	3.0	47.8	1.61	3.3	35.8	3.0	7.7	51.7	6.0	10.4	1.35	0.52	27.8	26.8	1.3	4.6
91	26.19	1.28	4.7	42.2	2.03	4.6	28.6	3.7	11.5	46.1	7.2	13.5	1.55	0.77	33.2	19.2	1.6	7.7
92	32.00	0.88	2.7	45.0	1.39	3.0	35.7	3.1	8.0	50.1	6.3	11.2	2.46	0.43	14.7	23.0	1.5	6.1
Means 83-92	25.11	1.34	5.6	37.6	2.26	6.1	27.5	4.3	14.4	41.1	8.5	18.0	1.43	0.51	28.5	17.5	1.5	7.8

Table 4. Annual sockeye salmon runs (millions) to the eastern Bering Sea (Western Alaska), 1970-1992.

	Kuskokwim		Bristol Bay runs					Bristol Bay	North Penin.	Total
Year	Catch	Run	Togiak	Nushagak	Nak/Kvi	Egegik	Ugashik	Total	Run	Run
70	.013	.03	.37	3.15	32.65	2.32	.91	39.40	.66	40.1
71	.006	.02	.42	2.61	9.37	1.94	1.48	15.82	.79	16.6
72	.004	.01	.16	.91	2.85	1.39	.10	5.41	.37	5.8
73	.005	.01	.21	.85	.79	.55	.04	2.44	.35	2.8
74	.028	.07	.25	2.78	6.43	1.45	.06	10.97	.58	11.6
75	.018	.05	.38	2.92	18.35	2.14	.44	24.23	.75	25.0
76	.014	.04	.50	2.75	5.92	1.84	.53	11.54	1.17	12.7
77	.019	.05	.42	1.84	4.69	2.47	.29	9.71	1.01	10.8
78	.014	.04	.79	6.62	10.32	2.10	.09	19.92	2.11	22.1
79	.039	.10	.69	6.40	27.43	3.29	2.10	39.91	3.55	43.6
80	.043	.11	1.21	12.81	40.57	3.68	4.22	62.49	2.78	65.4
81	.106	.27	1.01	10.34	14.63	5.06	3.44	34.48	3.19	37.9
82	.096	.24	.94	7.93	7.54	3.48	2.32	22.21	2.15	24.6
83	.089	.22	.83	7.07	26.11	7.55	4.35	45.91	2.67	48.8
84	.081	.20	.52	3.81	26.50	6.36	3.93	41.12	2.56	43.9
85	.121	.30	.40	2.99	17.36	8.63	7.48	36.86	3.50	40.7
86	.142	.36	.58	4.85	6.28	6.01	6.02	23.74	3.04	27.1
87	.171	.43	.66	5.15	12.27	6.63	2.82	27.53	1.76	29.7
88	.150	.38	1.16	3.23	8.85	8.01	2.19	23.44	2.14	26.0
89	.080	.20	.21	5.05	23.56	10.31	4.90	44.03	2.53	46.8
90	.204	.51	.52	5.71	26.36	12.28	2.89	47.76	3.45	51.7
91	.202	.51	.80	7.69	18.64	9.59	5.50	42.22	3.40	46.1
92	.194	.49	.80	5.19	15.89	17.62	5.53	45.03	4.60	50.1
Means										
70-79		.04	.42	3.08	11.88	1.95	.60	17.94	1.13	19.1
80-89		.27	.75	6.32	18.37	6.57	4.17	36.18	2.63	39.1
90-92		.50	.71	6.20	20.30	13.16	4.64	45.00	3.82	49.3

Kuskokwim run estimated by catch/ 0.4

Table 5. North Pacific runs of sockeye salmon, 1970-1992, catch + escapement in millions. Western Alaska includes Bristol Bay, North Peninsula and June South Peninsula catch.

Year	Bristol Bay run	Alaska runs		Japan high seas catch	Russian run	North Pacific total run	SE Alaska and British Columbia	Total Pacific run	Percent Bristol Bay
		Western	Central						
70	39	42	6	10	3	61	9	70	56
71	16	17	6	7	2	32	12	44	36
72	5	6	6	7	1	20	8	28	18
73	2	3	5	6	1	15	15	30	7
74	11	12	5	5	1	23	14	37	30
75	24	25	4	5	2	36	7	43	56
76	12	13	8	6	1	28	10	38	32
77	10	11	10	3	3	27	13	40	25
78	20	22	10	3	4	39	14	53	38
79	40	44	7	3	3	57	12	69	58
80	62	69	8	3	4	84	7	91	68
81	34	40	10	3	4	57	15	72	47
82	22	27	14	3	3	47	20	67	33
83	46	51	14	2	5	72	10	82	56
84	41	45	14	2	7	68	11	79	52
85	37	42	15	1	8	66	23	89	42
86	24	27	17	1	6	51	18	69	35
87	27	30	21	1	8	60	11	71	38
88	23	26	17	<1	5	48	10	58	40
89	44	48	16	<1	6	70	24	94	47
90	48	53	18	<1	12	83	24	107	45
91	42	47	17	<1	8	72	20	92	46
92	45	52	20	<1	6	78	11	89	51
Means									
70-79	18	20	7	6	2	34	11	45	35
80-89	36	41	15	2	6	62	15	77	46
90-92	45	51	18	<1	9	78	18	96	47

Table 6. Estimated runs of chum salmon (catch + escapement, millions) to Bering Sea coastal areas, 1970-1992.

Year	Kotzebue	Norton Sound	Yukon River	Arctic/ Yukon Region	Kusko-kwim	Togiak	Nush-agak	Naknek/ Kvichak	Egegik	Ugashik	Bristol Bay total	North Alaska Penins.	Total Run
70	.45	.30	1.43	2.18	.65	.22	1.14	.22	.07	.09	1.74	.22	4.8
71	.45	.35	1.33	2.13	.75	.24	.75	.24	.04	.02	1.29	.17	4.3
72	.48	.28	1.10	1.86	.75	.38	.74	.30	.07	.06	1.55	.21	4.4
73	1.00	.35	1.85	3.20	1.10	.44	1.06	.59	.06	.07	2.22	.28	6.8
74	1.65	.43	3.00	5.08	1.20	.14	.89	.51	.03	.07	1.64	.14	8.1
75	1.48	.55	3.25	5.28	1.00	.18	.68	.47	.01	.07	1.41	.12	7.8
76	.45	.25	2.55	3.25	1.15	.25	1.74	.74	.07	.03	2.83	.37	7.6
77	.53	.58	2.60	3.71	1.25	.52	2.65	.74	.12	.01	4.04	.81	9.8
78	.40	.40	4.00	4.80	1.03	.47	1.38	.37	.08	.01	2.31	.47	8.6
79	.40	.30	4.05	4.75	1.15	.33	.85	.36	.06	.06	1.66	.37	7.9
80	.76	.40	3.44	4.60	1.52	.57	1.94	.55	.11	.17	3.34	1.47	10.9
81	1.40	.36	4.12	5.88	1.28	.36	1.11	.47	.10	.06	2.10	1.24	10.5
82	.90	.42	2.40	3.72	1.04	.23	.57	.30	.12	.11	1.33	.79	6.9
83	.38	.66	3.28	4.32	1.00	.45	1.01	.42	.14	.14	2.16	.74	8.2
84	.68	.30	2.84	3.82	1.28	.55	1.63	.81	.22	.31	3.52	1.67	10.3
85	1.06	.28	3.14	4.48	.76	.38	.91	.45	.15	.15	2.04	1.02	8.3
86	.60	.32	4.20	5.12	1.00	.51	.88	.57	.12	.13	2.21	.51	8.8
87	**.27**	**.20**	**2.58**	**3.05**	**1.25**	**.81**	**.67**	**1.09**	**.18**	**.13**	**2.88**	**.88**	8.1
88	.74	.22	4.32	5.28	3.18	.66	.70	.74	.30	.14	2.54	.89	11.9
89	.54	.10	4.34	4.98	1.88	.49	.93	.53	.16	.13	2.24	.37	9.5
90	.36	.14	2.14	2.64	1.34	.26	.50	.65	.16	.04	1.61	.35	5.9
91	.52	.20	2.69	3.41	1.28	.38	.68	.77	.10	.10	2.03	.45	7.2
92	.46	.42	2.16	3.04	1.14	.23	.56	.38	.13	.09	1.39	.66	6.2
Means													
70-79	.73	.38	2.52	3.62	1.00	.32	1.19	.45	.06	.05	2.07	.32	7.0
80-89	.73	.33	3.47	4.53	1.42	.50	1.04	.59	.16	.15	2.44	.96	9.3
90-92	.45	.25	2.33	3.03	1.25	.29	.58	.60	.13	.08	1.68	.49	6.4

A-Y-K estimates assume exploitation rates of .4 for 1970s and .5 since 1980 (87 estimates from Eggers et al 1991) sonar escapement estimates were used to estimate Yukon River runs for 1986-1991.

Table 7. North Pacific runs of chum salmon, 1970-1992, catch + escapement in millions. Western Alaska includes Bristol Bay, North Peninsula and the A-Y-K region.

Year	Bristol Bay Run	Alaska runs		Japan catches		Russian run (Catch/.6)	North Pacific total run	SE Alaska B.C. and Wash.	Total Pacific run	Percent Asia
		Western	Central	High Seas	Coastal					
70	1.7	4.8	5.2	17	7	8	42	11	53	61
71	1.3	4.3	6.5	17	9	8	45	7	52	66
72	1.6	4.4	4.5	22	8	5	44	17	61	57
73	2.2	6.8	3.5	16	11	5	42	15	57	56
74	1.6	8.1	1.9	22	12	5	49	10	59	66
75	1.4	7.8	2.1	19	18	5	52	5	57	74
76	2.8	7.6	3.4	22	11	7	51	9	60	66
77	4.0	9.8	5.9	12	14	10	52	5	57	63
78	2.3	8.6	4.3	7	17	12	49	9	58	62
79	1.7	7.9	4.0	6	26	8	52	4	56	72
80	3.3	10.9	5.1	6	23	7	52	11	63	57
81	2.1	10.5	8.5	6	31	5	61	6	67	63
82	1.3	6.9	8.8	7	27	5	55	9	64	61
83	2.2	8.2	7.0	6	35	8	65	6	71	70
84	3.5	10.3	6.6	6	35	7	65	13	78	61
85	2.0	8.3	5.5	4	48	11	77	17	94	67
86	2.2	8.8	8.1	3	42	13	75	17	92	63
87	2.9	8.1	6.2	3	43	12	72	12	84	69
88	2.5	11.9	8.6	2	44	12	79	20	99	59
89	2.2	9.5	4.0	1	50	11	76	9	85	73
90	1.6	5.9	4.6	1	67	12	91	13	104	77
91	2.0	7.2	5.3	1	51	8	73	11	84	72
92	1.4	6.2	4.5	0	45	12	68	N/A	N/A	N/A
Means										
70-79	2.1	7.0	4.1	16	13	7	48	9	57	64
80-89	2.4	9.3	6.8	4	38	9	67	12	79	64
90-92	1.7	6.4	4.8	1	54	11	77			

Table 8. Age and sex composition of the False Pass chum salmon catches in 1992.

	Age group				
	0.2	0.3	0.4	0.5	Total
South Unimak					
Males	1300	86900	70700	300	159200
Percent	0.4	26.8	21.8	0.1	49.2
Females	400	96300	67300	700	164700
Percent	0.1	29.7	20.8	0.2	50.8
Both sexes	1700	183200	138000	1000	323900
Percent	0.5	56.6	42.6	0.3	100.0
Shumagin Islands					
Males	0	24200	22100	200	46500
Percent	0.0	23.7	21.6	0.2	45.5
Females	0	32700	22300	800	55800
Percent	0.0	32.0	21.8	0.8	54.5
Both sexes	0	56900	44400	1000	102300
Percent	0.0	55.6	43.4	1.0	100.0
Combined areas					
Males	1300	111100	92800	500	205700
Percent	0.3	26.1	21.8	0.1	48.3
Females	400	129000	89600	1500	220500
Percent	0.1	30.3	21.0	0.4	51.7
Both sexes	1700	240100	182400	2000	426200
Percent	0.4	56.3	42.8	0.5	100.0

Table 9. Means and standard errors of chum salmon condition factors, 1992.

Location/date		Age 0.3				Age 0.4			
		Male		Female		Male		Female	
		Mean	Std error	Mean	Std error	Mean	Std error	Mean	Std error
Unimak	6/15	.0189	.0002	.0188	.0002	.0197	.0003	.0194	.0003
	6/16	.0164	.0002	.0163	.0002	.0171	.0002	.0163	.0002
	6/19	.0183	.0002	.0180	.0002	.0185	.0003	.0174	.0002
	6/21	.0180	.0002	.0171	.0002	.0186	.0002	.0177	.0002
	6/22	.0178	.0002	.0174	.0001	.0189	.0002	.0180	.0002
	6/26	.0178	.0002	.0179	.0002	.0181	.0002	.0178	.0002
	Mean	.0179	.0002	.0176	.0002	.0185	.0002	.0178	.0002
Shumagin	6/17	.0157	.0003	.0154	.0002	.0157	.0002	.0153	.0003
	6/19	.0178	.0003	.0174	.0002	.0179	.0003	.0173	.0003
	6/26	.0174	.0004	.0173	.0006	.0185	.0021	.0168	.0005

Table 10. Frequency of focal plane resorption ("holes") on chum salmon scales from the 1992 False Pass fisheries.

Location	Date	Number with both normal	Number with holes		Percent with holes (1 or 2)	Number with questionable holes (1 or 2)	Percent with holes including questionable
			One scale	Both scales			
Unimak	6/15	189	5	2	3.57	4	5.50
	6/16	244	1	1	0.81	3	2.01
	6/19	256	1	0	0.39	3	1.54
	6/21	207	2	0	0.96	3	2.36
	6/22	532	5	3	1.48	12	3.62
	6/26	254	2	0	0.78	2	1.55
	Totals	1682	16	6	1.29	27	2.83
Shumagin Is.	6/17	201	1	1	0.99	4	2.90
	6/19	155	0	0	0.00	3	1.90
	6/26	28	0	0	0.00	1	3.45
	Totals	384	1	1	0.52	8	2.54
False Pass	Combine	2066	17	7	1.15	35	2.78

APPENDIX

Appendix Table 1. Nushagak District chum and sockeye salmon statistics (numbers in 1,000s), 1966-92.

	Chum salmon							Sockeye salmon			
		Escapement				Rate of	Mean weight	Rate of exploitation		Mean weight in catch (kg)	
Year	Catch	Air/tower	Sonar	Adj. sonar	Run	exploitation	in catch (kg)	age .3 Male	all fish	age .3 males	all fish
66	129	80			209	.62	3.88	.48	.42		
67	338	200			538	.63	2.97	.38	.43		
68	179	100			279	.64	3.19	.50	.42		
69	214	130			344	.62	2.76	.37	.39		
70	435	273			708	.61	2.97	.42	.38	3.20	2.60
71	360	226			586	.61	2.95	.51	.43	3.40	2.90
72	310	195			505	.61	3.06	.55	.42	3.23	2.50
73	336	200			536	.63	3.16	.35	.31	3.90	3.50
74	158	100			258	.61	3.06	.16	.18	3.40	2.50
75	153	80			233	.66	2.79	.22	.22	3.50	2.90
76	801	500			1301	.62	2.98	.49	.46	4.00	3.00
77	900	609			1509	.60	3.25	.29	.34	4.30	3.50
78	652	293			945	.69	3.63	.51	.47	3.84	2.85
79	440	100	166	--	606	.73	3.01	.53	.52	3.75	2.87
80	682	1053	332	969	1651	.41	2.94	.35	.35	3.67	2.97
81	795	--	143	177	972	.82	3.19	.73	.72	3.55	3.08
82	435	--	230	256	691	.63	3.00	.76	.75	3.55	3.09
83	725	--	106	164	889	.82	3.34	.81	.73	3.49	2.71
84	850	--	362	--	1212	.70	3.16	.56	.54	3.38	2.91
85	397	--	214	288	685	.58	3.07	.51	.44	3.21	2.56
86	488	--	168	200	657	.74	2.95	.58	.56	3.46	3.17
87	416	--	147	--	564	.74	3.14	.78	.63	3.77	2.91
88	371	--	186	--	557	.67	3.09	.49	.53	3.53	3.00
89	523	--	378	--	901	.58	2.91	.51	.56	3.46	2.78
90	306	--	330		636	.48	2.95	.63	.62	3.46	2.76
91	466	--	252		698	.67	2.77	.61	.69	3.20	2.58
92	313	--	303		616	.51		.64	.56	2.96	2.42
Means											
70-79	455	258			719	.64	3.09	.40	.37	3.65	2.91
80-89	568		227		878	.67	3.08	.61	.58	3.51	2.92
90-92	362		295		650	.55	2.86	.63	.62	3.21	2.59

Data sources: Yeun and Nelson (1984), ADF&G (1992), and personal comunication with ADF&G, Anchorage.

Appendix Table 2. Bristol Bay chum catches (in millions), sockeye exploitation and estimated chum runs (catch/exploitation rate).

	Nushagak				Togiak				Nak/Kvi			Egegik			Ugashik			Bristol
Year	Chum catch	Sock. expl.	Catch/ expl.	ADFG Run	Chum catch	Sock. expl.	Catch/ expl.	ADFG Run	Chum catch	Sock. expl.	Catch/ expl.	Chum catch	Sock. expl.	Catch/ expl.	Chum catch	Sock. expl.	Catch/ expl.	Bay run
70	.44	.38	1.14	.71	.10	.46	.22	.34	.120	.55	.22	.044	.60	.07	.018	.19	.09	1.75
71	.36	.48	.75	.59	.12	.50	.24	.35	.151	.63	.24	.027	.67	.04	.014	.64	.02	1.29
72	.31	.42	.74	.51	.18	.48	.38	.35	.116	.39	.30	.042	.61	.07	.010	.18	.06	1.53
73	.34	.32	1.06	.54	.20	.45	.44	.36	.124	.21	.59	.023	.40	.06	.006	.09	.07	2.22
74	.16	.18	.89	.26	.08	.56	.14	.24	.041	.08	.51	.004	.12	.03	.002	.03	.07	1.64
75	.15	.22	.68	.23	.09	.50	.18	.20	.080	.17	.47	.004	.45	.01	.002	.03	.07	1.41
76	.80	.46	1.74	1.30	.15	.60	.25	.55	.318	.43	.74	.047	.72	.07	.010	.33	.03	2.82
77	.90	.34	2.65	1.51	.27	.52	.52	.77	.340	.46	.74	.083	.72	.12	.004	.32	.01	4.03
78	.65	.47	1.38	.94	.27	.57	.47	.67	.185	.50	.37	.044	.57	.08	.001	.09	.01	2.31
79	.44	.52	.85	.61	.22	.67	.33	.51	.196	.55	.36	.038	.69	.06	.012	.19	.06	1.65
80	.68	.35	1.94	1.65	.30	.53	.57	.71	.205	.37	.55	.079	.71	.11	.036	.21	.17	3.35
81	.80	.72	1.11	.97	.23	.64	.36	.56	.356	.75	.47	.088	.86	.10	.036	.61	.06	2.11
82	.43	.75	.57	.69	.15	.64	.23	.24	.198	.66	.30	.084	.70	.12	.053	.49	.11	1.34
83	.73	.72	1.01	.89	.32	.71	.45	.49	.352	.83	.42	.127	.89	.14	.105	.77	.14	2.17
84	.85	.52	1.63	1.21	.34	.62	.55	.54	.447	.55	.81	.178	.82	.22	.211	.68	.31	3.52
85	.40	.44	.91	.68	.20	.52	.38	.42	.210	.47	.45	.127	.87	.15	.132	.87	.15	2.04
86	.49	.56	.88	.66	.27	.53	.51	.60	.263	.46	.57	.095	.81	.12	.111	.83	.13	2.21
87	.42	.63	.67	.56	.42	.52	.81	.78	.447	.41	1.09	.145	.81	.18	.101	.76	.13	2.88
88	.37	.53	.70	.56	.47	.71	.66	.88	.296	.40	.74	.238	.80	.30	.095	.70	.14	2.53
89	.52	.56	.93	.90	.20	.41	.49	.35	.311	.59	.53	.136	.84	.16	.085	.65	.13	2.24
90	.31	.62	.50	.64	.12	.46	.26	.18	.425	.65	.65	.128	.82	.16	.032	.74	.04	1.61
91	.47	.69	.68	.72	.25	.65	.38	.40	.430	.56	.77	.071	.71	.10	.057	.55	.10	2.04
92	.31	.55	.56	.62	.17	.75	.23		.227	.59	.38	.114	.89	.13	.057	.62	.09	1.40
Means																		
70-79	.45	.38	1.19	.72	.17	.53	.32	.43	.17	.40	.45	.04	.56	.06	.01	.21	.05	2.07
80-89	.57	.58	1.04	.88	.29	.58	.50	.56	.31	.55	.59	.13	.81	.16	.10	.66	.15	2.44
90-92	.36	.62	.58	.66	.18	.62	.29	.19	.36	.60	.60	.10	.81	.13	.05	.64	.08	1.68

Data source: ADF&G (1992)

Appendix Table 3. Estimates of annual chum salmon runs to areas of Central Alaska, 1970-1992.

	South Peninsula			Chignik			Kodiak			Cook Inlet			Prince William Sound			Total
Year	Catch	Escape.	Run	Catch	Escape.	Run	Catch	Escape.	Run	Catch	Escape.	Run	Catch	Escape.	Run	run
70	0.57	0.28	0.85	0.46	0.23	0.69	0.92		1.88	1.00		1.43	0.23	0.10	0.33	5.18
71	0.75	0.34	1.09	0.35	0.47	0.82	1.54		3.14	0.48		0.69	0.57	0.17	0.74	6.48
72	0.21	0.25	0.46	0.08	0.19	0.27	1.16		2.37	0.71		1.01	0.05	0.30	0.35	4.46
73	0.08	0.21	0.29	0.01	0.12	0.13	0.32		0.65	0.78		1.11	0.73	0.55	1.28	3.47
74	0.07	0.26	0.33	0.03	0.15	0.18	0.25		0.51	0.42		0.60	0.09	0.20	0.29	1.91
75	0.03	0.19	0.22	0.02	0.13	0.15	0.08		0.16	0.97		1.39	0.10	0.05	0.15	2.07
76	0.13	0.33	0.46	0.08	0.21	0.29	0.74		1.51	0.52		0.74	0.37	0.08	0.45	3.45
77	0.13	0.77	0.90	0.11	0.15	0.26	1.07	0.98	2.05	1.38		1.97	0.57	0.15	0.72	5.90
78	0.48	0.60	1.08	0.12	0.10	0.22	0.81	0.64	1.45	0.65		0.93	0.49	0.16	0.65	4.33
79	0.38	0.41	0.79	0.18	0.18	0.36	0.36	0.80	1.16	0.87		1.24	0.33	0.10	0.43	3.98
80	0.82	0.36	1.18	0.31	0.23	0.54	1.08	1.10	2.18	0.46		0.66	0.48	0.09	0.57	5.13
81	1.20	0.38	1.58	0.58	0.24	0.82	1.35	0.98	2.33	1.17		1.67	1.88	0.20	2.08	8.48
82	1.18	0.39	1.57	0.39	0.26	0.65	1.26	1.36	2.62	1.63		2.33	1.33	0.31	1.64	8.81
83	0.92	0.45	1.37	0.16	0.10	0.26	1.09	1.09	2.18	1.27		1.81	1.04	0.36	1.40	7.02
84	1.32	0.70	2.02	0.06	0.37	0.43	0.65	0.90	1.55	0.76		1.09	1.24	0.23	1.47	6.56
85	0.91	0.50	1.41	0.03	0.06	0.09	0.43	0.96	1.39	0.78		1.11	1.28	0.18	1.46	5.46
86	1.40	0.54	1.94	0.18	0.05	0.23	1.13	1.17	2.30	1.19		1.70	1.68	0.27	1.95	8.12
87	0.93	0.62	1.55	0.13	0.08	0.21	0.68	0.85	1.53	0.48		0.69	1.92	0.30	2.22	6.20
88	1.38	0.50	1.88	0.27	0.36	0.63	1.43	0.95	2.38	0.94		1.34	1.84	0.48	2.32	8.55
89	0.54	0.31	0.85	0.00	0.14	0.14	0.02	1.53	1.55	0.14		0.20	1.00	0.24	1.24	3.98
90	0.72	0.35	1.07	0.27	0.25	0.52	0.58		1.18	0.36		0.51	0.97	0.30	1.27	4.56
91	0.82	0.59	1.41	0.26	0.47	0.73	1.03		2.10	0.33		0.47	0.37	0.25	0.62	5.33
92	0.93	0.47	1.40	0.24	0.36	0.60	0.66		1.35	0.38		0.54	0.30	0.28	0.58	4.47
Means																
70-79	0.28	0.36	0.65	0.14	0.19	0.34	0.73	0.81	1.49	0.78		1.11	0.35	0.19	0.54	4.12
80-89	1.06	0.48	1.54	0.21	0.19	0.40	0.91	1.09	2.00	0.88		1.26	1.37	0.27	1.64	6.83
90-92	0.82	0.47	1.29	0.26	0.36	0.62	0.76		1.54	0.36		0.51	0.55	0.28	0.82	4.79

Sources: Barrett et al (1990), Quimby and Owen (1992), Shaul et al (1992), ADF&G (1988), and Sharr (1988).
Cook Inlet run estimated from catch and mean sockeye salmon harvest rate,0.7 (King and Tarbox 1989).
Kodiak runs for 1970-76 and 1990-92 estimated from catch and mean harvest rate of .49 (1977-88).
1992 escapements estimated by 1990-91 means.

Appendix Table 4. Catches of chum salmon in the Yukon River (1,000s of fish), 1970-1992.

			Fall chum				Total	Total		Escapement		
	Summer chum		Commercial		Subsistence		comm-	subsis-				
Year	Commercial	Subsistence	U.S.	Canada	U.S.	Canada	ercial	tence	Total	Summer	Fall	Total
70	137	167	210	2	56	2	347	225	572			
71	100	171	190	2	57	15	290	243	533			
72	136	108	152	3	36	5	288	149	437			
73	286	161	232	3	54	7	518	222	740			
74	590	228	290	3	94	9	880	331	1211			
75	710	212	275	2	87	19	985	318	1303			
76	601	187	156	1	72	4	757	263	1020			
77	535	160	258	4	83	8	793	251	1044			
78	1078	188	247	3	84	7	1325	279	1604			
79	820	191	378	9	215	13	1198	419	1617			
80	1068	168	298	9	168	13	1366	349	1715			
81	1280	118	478	15	177	7	1758	302	2060			
82	717	117	225	11	132	5	942	254	1196			
83	995	149	308	26	188	3	1303	340	1643			
84	866	167	211	23	172	6	1077	345	1422			
85	934	158	270	36	204	5	1204	367	1571			
86	1189	182	140	11	163	3	1329	348	1677	1933	583	2516
87	623	175	0	41	362	4	623	541	1164	826	596	1422
88	1620	203	137	30	157	4	1757	364	2121	1773	424	2197
89	1457	169	285	18	209	5	1742	383	2125	1604	606	2210
90	516	119	136	28	178	6	652	303	955	932	250	1182
91	655	169	254	31	138	4	909	311	1220	1233	241	1474
92	537	*144*	19	19	*158*	5	556	307	863			*1300*

Source: ADF&G (1993)

Appendix Table 5. Catches of chum salmon (1,000s of fish) on the Bering Sea coast of Alaska.

	A-Y-K Region					Bristol Bay					North	Subsistence catch				Western
Year	Kotze-bue	Norton Sound	Yukon River	Kusko-kwim	Total	Togiak	Nush-agak	Naknek/ Kvichak	Egegik	Ugashik	Alaska Peninsula	Kotze-bue	Norton Sound	Yukon River	Kusko-kwim	Alaska Total
70	159	107	347	61	674	101	435	120	44	18	50			222		
71	155	131	290	99	675	124	360	151	27	15	64			229		
72	169	101	288	97	655	179	310	116	42	10	85			144		
73	379	124	518	185	1206	195	336	124	23	6	156			220		
74	628	164	883	194	1869	81	158	41	4	2	34			331		
75	564	213	987	224	1988	87	153	80	4	2	9			317		
76	160	96	758	233	1247	154	801	318	47	10	74	24	8	265	231	3179
77	193	200	797	298	1488	271	900	340	83	4	129	16	27	250	203	3711
78	119	189	1292	282	1882	275	652	185	44	1	164	13	12	279	125	3632
79	142	138	1148	296	1724	220	440	196	38	12	66	16	12	419	163	3306
80	366	181	1375	559	2481	300	682	205	79	36	700	12	20	348	203	5066
81	677	170	1773	483	3103	230	795	356	88	36	709	23	13	302	160	5815
82	416	183	953	323	1875	151	435	198	84	53	331	34	23	255	196	3635
83	176	319	1329	295	2119	323	725	352	127	105	349	10	15	340	202	4667
84	320	146	1100	489	2055	337	850	447	178	211	805	16	8	345	152	5404
85	521	135	1240	225	2121	203	397	210	127	132	667	13	*9*	367	*150*	4396
86	261	147	1340	349	2097	270	488	263	95	111	271	36	*9*	349	*150*	4139
87	109	102	664	602	1477	419	416	447	145	101	369	14	8	540	103	4039
88	353	107	1787	1447	3694	470	69	98	90	44	393	14	6	363	144	5385
89	256	43	1760	802	2861	203	446	309	129	84	157	*19*	*9*	383	133	4733
90	163	65	680	532	1440	116	306	425	128	32	126	*19*	*9*	302	*133*	3036
91	240	87	940	502	1769	249	466	430	71	57	191	*19*	*9*	312	*133*	3706
92	208	198	575	436	1417	174	313	227	114	57	332	*19*	*9*	*307*	*133*	3102
Means																
70-79	267	146	731	197	1341	169	455	167	36	8	83	17	15	268	181	3457
80-89	346	153	1332	557	2388	291	530	289	114	91	475	19	12	359	159	4728
90-92	204	117	732	490	1542	180	362	361	104	49	216	19	9	307	133	3281

Yukon River includes Canadian catches; ADF&G (1993).
Other catches through 1989 are from INPFC Statistical Yearbooks (e.g. INPFC,1992) and 1990-1992 catches are preliminary from ADF&G.
Italics for estimates of missing data.

Appendix Table 6. Annual catches of chum salmon (commercial + subsistence, millions) in Bering Sea fisheries.

Year	Kotz-ebue	Norton Sound	Yukon River	Arctic/ Yukon Region	Kusko-kwim	Togiak	Nush-agak	Naknek/ Kvichak	Egegik	Ugashik	Bristol Bay Total	North Alaska Penins.
70	.18	.12	.57	.87	.26	.10	.44	.12	.04	.02	.72	.05
71	.18	.14	.53	.85	.30	.12	.36	.15	.03	.02	.68	.06
72	.19	.11	.44	.74	.30	.18	.31	.12	.04	.01	.66	.08
73	.40	.14	.74	1.28	.44	.20	.34	.12	.02	.01	.69	.16
74	.66	.17	1.20	2.03	.48	.08	.16	.04	.00	.00	.28	.03
75	.59	.22	1.30	2.11	.40	.09	.15	.08	.00	.00	.32	.01
76	.18	.10	1.02	1.30	.46	.15	.80	.32	.05	.01	1.33	.07
77	.21	.23	1.04	1.48	.50	.27	.90	.34	.08	.00	1.59	.13
78	.16	.16	1.60	1.92	.41	.28	.65	.18	.04	.00	1.15	.16
79	.16	.15	1.62	1.93	.46	.22	.44	.20	.04	.01	.91	.07
80	.38	.20	1.72	2.30	.76	.30	.68	.21	.08	.04	1.31	.70
81	.70	.18	2.06	2.94	.64	.23	.80	.36	.09	.04	1.52	.71
82	.45	.21	1.20	1.86	.52	.15	.44	.20	.08	.05	.92	.33
83	.19	.33	1.64	2.16	.50	.32	.72	.35	.13	.11	1.63	.35
84	.34	.15	1.42	1.91	.64	.34	.85	.45	.18	.21	2.03	.80
85	.53	.14	1.57	2.24	.38	.20	.40	.21	.13	.13	1.07	.67
86	.30	.16	1.68	2.14	.50	.27	.49	.26	.10	.11	1.23	.27
87	**.16**	**.12**	**1.17**	**1.45**	**.71**	**.42**	**.42**	**.45**	**.15**	**.10**	**1.54**	**.37**
88	.37	.11	2.12	2.60	1.59	.47	.37	.30	.24	.09	1.47	.39
89	.27	.05	2.13	2.45	.94	.20	.52	.31	.14	.08	1.25	.16
90	.18	.07	.96	1.21	.67	.12	.31	.42	.13	.03	1.01	.13
91	.26	.10	1.22	1.58	.64	.25	.47	.43	.07	.06	1.28	.19
92	.23	.21	.86	1.30	.57	.17	.31	.23	.11	.06	.88	.33
Means												
70-79	.29	.15	1.01	1.45	.40	.17	.46	.17	.03	.01	.83	.08
80-89	.37	.17	1.67	2.21	.72	.29	.57	.31	.13	.10	1.40	.48
90-92	.22	.13	1.01	1.36	.63	.18	.36	.36	.10	.05	1.06	.22

Appendix Table 7. Western and Central Alaska chum salmon runs, 1970-1992, in millions.

	Western Alaska				South	Central Alaska					West./	Percent
Year	Bristol Bay	North Penin.	AYK Region	Total	Penin. June C	PWS	Cook Inlet	Kodiak	Chignik/ So. Penin.	Total	Central total	South Penin.
70	1.7	.2	2.8	4.7	.5	.3	1.4	1.9	1.5	5.1	10.3	4.9
71	1.3	.2	2.9	4.4	.7	.7	.7	3.1	1.9	6.4	11.5	6.1
72	1.5	.2	2.6	4.3	.6	.4	1.0	2.4	.7	4.5	9.4	6.4
73	2.2	.3	4.3	6.8	.2	1.3	1.1	.7	.4	3.5	10.5	1.9
74	1.6	.2	6.3	8.1	.0	.3	.6	.5	.5	1.9	10.0	0.0
75	1.4	.1	6.3	7.8	.1	.1	1.4	.2	.4	2.1	10.0	1.0
76	2.8	.4	4.4	7.6	.4	.5	.7	1.5	.7	3.4	11.4	3.5
77	4.0	.8	5.0	9.8	.1	.7	2.0	2.0	1.2	5.9	15.8	0.6
78	2.3	.5	5.9	8.7	.1	.7	.9	1.4	1.3	4.3	13.1	0.8
79	1.7	.4	5.9	8.0	.1	.4	1.2	1.2	1.2	4.0	12.1	0.8
80	3.3	1.5	6.1	10.9	.5	.6	.7	2.2	1.7	5.2	16.6	3.0
81	2.1	1.2	7.2	10.5	.6	2.1	1.7	2.3	2.4	8.5	19.6	3.1
82	1.3	.8	4.8	6.9	1.1	1.7	2.3	2.6	2.2	8.8	16.8	6.5
83	2.2	.7	5.4	8.3	.8	1.4	1.8	2.2	1.6	7.0	16.1	5.0
84	3.5	1.7	5.1	10.3	.3	1.5	1.1	1.6	2.4	6.6	17.2	1.7
85	2.0	1.0	5.3	8.3	.5	1.5	1.1	1.4	1.5	5.5	14.3	3.5
86	2.2	.5	6.1	8.8	.4	1.9	1.7	2.3	2.2	8.1	17.3	2.3
87	2.9	.9	4.3	8.1	.4	2.2	.7	1.5	1.8	6.2	14.7	2.7
88	2.5	.9	8.5	11.9	.5	2.3	1.3	2.4	2.5	8.5	20.9	2.4
89	2.2	.4	6.9	9.5	.5	1.2	.2	1.6	1.0	4.0	14.0	3.6
90	1.6	.4	4.0	6.0	.5	1.3	.5	1.2	1.6	4.6	11.1	4.5
91	2.0	.5	4.7	7.2	.6	.6	.5	2.1	2.1	5.3	13.1	4.6
92	1.4	.7	4.2	6.3	.4	.6	.5	1.4	2.0	4.5	11.2	3.6
Means												
70-79	2.1	.3	4.6	7.0	.3	.5	1.1	1.5	1.0	4.1	11.4	2.6
80-89	2.4	1.0	6.0	9.4	.6	1.6	1.3	2.0	1.9	6.8	16.8	3.4
90-92	1.7	.5	4.3	6.5	.5	.8	.5	1.6	1.9	4.8	11.8	4.2

Appendix Table 8. Annual catches of chum salmon by Asian fisheries.

	Russia						Japan			
	Catch (1,000s m.t.)			Catch (millions of fish)			Catch (millions of fish)			
	Okhotsk	Bering		Okhotsk	Bering		USSR/Japan	High-seas		Asia
Year(s)	Sea	Sea	Total	Sea	Sea	Total	coastal	Mothership	Landbased	total
1925-29	52.53	10.65	63.18	15.01	2.88	17.89	14.50	0	0	32
1930-39	62.72	14.39	77.11	17.92	3.89	21.81	19.67	2.19	4.56	48
1940-49	46.82	14.45	61.27	13.38	3.91	17.28	6.42	1.01	2.63	27
1950-59	46.07	7.83	53.90	13.16	2.12	15.28	3.52	9.87	3.66	32
1960-69	24.87	4.91	29.78	7.11	1.33	8.43	4.85	7.48	9.66	30
70	14.70	4.50	19.20	4.20	1.22	5.42	7.20	9.64	7.53	30
71	13.48	3.33	16.81	3.85	.90	4.75	10.19	9.97	6.78	32
72	8.65	3.12	11.77	2.47	.84	3.31	8.64	13.37	8.84	34
73	7.45	2.52	9.97	2.13	.68	2.81	11.57	7.86	7.75	30
74	9.83	2.81	12.64	2.81	.76	3.57	12.98	9.28	12.35	38
75	8.38	3.39	11.77	2.39	.92	3.31	19.90	7.37	11.76	42
76	13.13	2.45	15.58	3.75	.66	4.41	12.39	10.44	11.43	39
77	14.28	6.17	20.45	4.08	1.67	5.75	15.19	6.00	6.23	33
78	19.17	8.04	27.21	5.48	2.17	7.65	18.18	3.80	3.49	33
79	9.87	9.93	19.80	2.82	2.68	5.50	27.96	3.28	2.86	40
80	8.58	5.98	14.56	2.45	1.62	4.07	25.70	3.10	3.17	36
81	8.37	6.51	14.88	2.39	1.76	4.15	33.54	2.54	3.09	43
82	8.07	6.21	14.28	2.31	1.68	3.98	29.95	3.22	3.52	41
83	6.85	15.25	22.10	1.96	4.12	6.08	37.07	3.08	2.61	49
84	4.39	9.35	13.74	1.25	2.53	3.78	37.79	3.28	2.52	47
85	13.93	11.34	25.27	3.98	3.06	7.04	50.93	2.84	1.57	62
86	12.76	14.77	27.53	3.65	3.99	7.64	46.02	1.93	1.04	57
87	13.50	13.76	27.26	3.86	3.72	7.58	42.66	1.82	1.09	53
88	16.30	10.50	26.80	4.66	2.84	7.49	47.21	.89	.91	57
89	16.00	8.50	24.50	4.57	2.30	6.87	50.40	.61	.75	59
90	13.89	13.18	27.07	3.97	3.56	7.53	67.50	.50	.54	76
91	14.05	3.66	17.71	4.01	.99	5.00	51.00	.00	.00	56
92			20.11			7.24	45.27	.00	.00	53

Sources: Russian catches through 1988 from VINRO (Moscow, USSR) and 1989-1992 from TINRO (Vladivostok, Russia). Mean weights of 3.5 kg (Okhotsk) and 3.7 kg (Bering) used to convert from weight to numbers (INPFC 1979).
Japanese catches through 1989 from INPFC Statistical Yearbooks and 1990-1992 from Y. Ishida, National Research Institute of Far Seas Fisheries (Shimizu, Japan).

Appendix Table 9. Kamchatkan sockeye salmon runs (in thousands), 1957-1992.

	Ozernaya River (Kuril)					Kamchatka River			Total
Year	Escape-ment	Domestic catch	Inshore run	Combined run	Japan catch	Escape-ment	Domestic catch	Inshore run	Russian Run
57	1400	1100	2500	9600	7100	800	212	1012	3797
58	500	300	800	7000	6200	600	153	753	1679
59	2100	900	3000	6080	3080	2000	537	2537	5986
60	1550	900	2450	6050	3600	1500	683	2183	5009
61	2500	2000	4500	8500	4000	1500	347	1847	6862
62	800	1200	2000	6426	4426	1000	181	1181	3439
63	500	780	1280	4804	3524	450	339	789	2237
64	300	500	800	2170	1370	550	722	1272	2240
65	1000	1000	2000	4030	2030	725	711	1436	3715
66	1000	700	1700	4654	2954	475	817	1292	3235
67	700	500	1200	5266	4066	350	734	1084	2469
68	650	100	750	4136	3386	800	782	1582	2521
69	370	30	400	3212	2812	575	591	1166	1693
70	380	180	560	2301	1741	1225	1443	2668	3490
71	550	330	880	2352	1472	425	750	1175	2222
72	450	150	600	1951	1351	440	233	673	1376
73	260	150	410	1534	1124	350	506	856	1369
74	460	340	800	1687	887	130	94	224	1107
75	530	175	705	2344	1639	355	377	732	1554
76	400	140	540	1753	1213	435	299	734	1377
77	750	660	1410	1440	30	1060	636	1696	3358
78	1450	245	1695	2420	725	720	988	1708	3679
79	1350	220	1570	2415	845	515	906	1421	3234
80	1500	500	2000	2773	773	560	1010	1570	3859
81	1250	550	1800	2540	740	640	836	1476	3542
82	750	457	1207	1794	587	790	711	1501	2928
83	1650	518	2168	2752	584	1265	1052	2317	4849
84	2750	930	3680	4161	481	1361	1260	2621	6812
85	3420	2130	5550	5881	331	741	1015	1756	7898
86	2350	1752	4102	4320	218	305	764	1069	5590
87	3000	2680	5680	5680	0	465	1092	1557	7824
88	2050	1650	3700	3700	0	293	732	1025	5108
89	2500	2472	4972	4972	0	361	531	892	6339
90	6000	4583	10583	10583	0	511	83	594	12083
91	2500	4179	6679	6679	0	398	228	626	7897
92	1500	2500	4000	4000	0	800	800	1600	6054

Source: V. Bugaev (TINRO), 8/18/92
Total Russian run estimated from sum of Ozernaya and Kamchatka runs divided by .925

Appendix Table 10. Russian catches of chum salmon (1000s of fish).

	District catch (from JFA via TINRO)								Total no.	Total (1,000s m.t.)		
		East	West	North	Coastal				Fredin	VINRO	TINRO	FAO
Year	Anadyr	Kamch.	Kamch.	Okhot.	Okhot.	Sahkal.	Amur	Total	1980	1988	1992	annual
51									22135			
52		2394	2394			2000	2524	9312	11650			
53		879	2030			1152	2467	6528	8969			
54		1606	4242			758	1167	7773	13902			
55		3212	5061			1606	2929	12808	17355			
56		3575	3485			1000	3476	11536	20285			
57		1114	654			1654	1357	4779	8472			
58		1030	343			696	2378	4447	7274			
59		2216	2538			240	2727	7721	10062			
60		1107	972			265	3837	6181	11283			
61		1222	801			216	3664	5903	9513			
62		1395	600	712	1617	409	4509	9242	9242			
63		958	350	476	2226	386	4053	8449	9449			
64		966	303	500	698	448	3557	6472	6472			
65		616	340	308	2270	461	4526	8521	8521			
66		593	205	447	2403	220	4005	7873	7873			
67		674	66	343	808	171	3051	5113	5113			
68		255	63	192	39	589	3308	4446	4446			
69	562	309	78	10	67	175	818	2019	1457			
70	573	320	190	157	711	208	1506	3665	3092			
71	542	185	66	150	424	532	1507	3406	3460			
72	309	171	42	99	70	510	1000	2201	1382	11.8		
73	274	312	33	9	25	187	835	1675	1402	10.0		
74	345	231	80	93	137	438	1001	2325	1888	12.6		
75	570	267	17	101	147	305	571	1978	1800	12.8		
76	354	382	24	100	89	790	2236	3975	2730	15.6		
77	335	1308	46	51	99	984	1464	4287	4500	20.4		
78	450	1205	130	172	224	1857	1358	5396		27.2		
79	552	2048	97	154	220	1845	1226	6142		19.8		
80	437	1060	57	125	258		1572	3509		14.0		14.8
81	653	1688	113	96	177	705	1270	4702		12.4		12.9
82	751	1001	94	138	402		987	3373		11.4		10.8
83	887	3468	37	227	431		1172	6222		18.7		19.0
84	813	1710	133	196	405		464	3721		13.7		13.7
85	566	2801	1451	116	669		611	6214		20.6	25.3	23.5
86	675	3482	795	173	759		1144	7028			27.5	23.4
87	925	2550	641	90	614	730	885	6435			27.3	23.7
88	1043	1423	574	155	356	753	2415	6719			26.8	30.5
89	561	1766	284	98	724	1123	1886	6442			24.5	21.7
90	220	3182	441	136	743	925	1038	6685			27.1	
91	540	753	273	343	3324	978	1724	7935			17.7	
92											20.1	

Appendix Table 11. Age, weight, and length statistics for chum salmon in the South Unimak catch, 1992.

	Age 0.2		Age 0.3		Age 0.4		Age 0.5		
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Unimak 6/15									
Number	102	102	8267	6328	6940	4593	0	0	26333
Sample size	1	1	81	62	68	45	0	0	258
Mean length	51.3	53.3	54.1	54.1	57.4	56.8			
Std Dev			2.9	2.8	2.8	2.7			
Mean weight	2.18	2.61	3.01	2.99	3.74	3.57			3.29
Std Dev			.54	.52	.74	.59			
Sample size	1	1	79	59	65	41			
Unimak 6/16-17									
Number	217	217	14957	14523	16474	13656	0	217	60260
Sample size	1	1	69	67	76	63	0	1	278
Mean length	50.5	50.6	54.6	53.4	57.3	55.5		57.3	
Std Dev			2.8	2.5	3.3	2.3			
Mean weight	2.00	2.20	2.70	2.50	3.26	2.81		3.30	
Std Dev			.50	.43	.69	.44			
Sample size			67	64	74	61		1	
Unimak 6/18-19									
Number	360	0	26314	34244	18744	21628	0	0	101291
Sample size	1	0	73	95	52	60	0	0	281
Mean length	50.3		55.2	54.8	58.3	57.7			
Std Dev			2.8	2.5	3.1	3			
Mean weight	2.27		3.09	3.00	3.70	3.36			
Std Dev			0.51	0.57	0.71	0.55			
Sample size	1		71	92	50	58			
Unimak 6/21									
Number	0	0	13074	13659	9562	8976	0	195	45466
Sample size	0	0	67	70	49	46	0	1	233
Mean length			55.6	54.4	58.1	56.3		60.2	
Std Dev			3.1	2.7	3.2	3.4			
Mean weight			3.13	2.77	3.69	3.19		3.63	
Std Dev			.66	.50	.76	.68			
Sample size			65	66	45	42		1	
Unimak 6/22									
Number	532	133	20760	22091	15703	15836	266	266	75588
Sample size	4	1	156	166	118	119	2	2	568
Mean length	47.4	51.4	55.0	54.0	58.2	56.9	62.8	55.1	
Std dev			3.4	2.6	3.4	3.1			
Mean weight	1.22	2.24	3.01	2.75	3.78	3.33	4.42	3.78	
Std dev			.70	.50	.81	.67			
Sample size	4	1	153	158	113	115	2	2	
Unimak 6/26									
Number	52	0	3543	5419	3282	2657	0	0	14953
Sample size	1	0	68	104	63	51	0	0	287
Mean length	47.0		55.0	54.5	58.7	56.5			
Std dev			3.1	2.6	3.1	2.8			
Mean weight	1.70		3.01	2.93	3.70	3.23			
Std Dev			.65	.55	.71	.58			
sample size	1	0	66	102	62	50			
Unimak total									
Number	1264	452	86915	96264	70706	67346	266	678	323891
Mean length	49.1	51.4	55.0	54.3	57.9	56.8	62.8	57.3	55.8
Mean weight	1.75	2.30	3.00	2.83	3.62	3.23	4.42	3.58	3.13

Appendix Table 12. Age, weight, and length statistics for chum salmon in the Shumagin catch, 1992.

	Age 0.2		Age 0.3		Age 0.4		Age 0.5		
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Shumagin 6/15-17									
Number	0	0	16004	18938	12803	10936	0	533	59214
Sample size	0	0	60	71	48	41	0	2	222
Mean length			54.1	54.1	57.8	57.1		61.5	
Std dev			2.9	2.8	3.4	3.4			
Mean weight			2.53	2.46	3.08	2.87		3.35	
Std dev			.59	.45	.64	.64			
Sample size	0	0	54	68	42	40	0	2	
Shumagin 6/19-21									
Number	0	0	6903	11734	8743	10124	230	230	37964
Sample size	0	0	30	51	38	44	1	1	165
Mean length			56.3	54.8	60.3	57.8	65.1	59.6	
Std dev			2.4	2.6	3.9	2.9			
Mean weight			3.21	2.88	3.99	3.37	5.44	3.49	
Std dev			.60	.50	.85	.62			
Sample size	0	0	30	51	35	43	1	1	
Shumagin 6/26									
Number	0	0	1351	2027	540	1216	0	0	5134
Sample size	0	0	10	15	4	9	0	0	38
Mean length			54.3	52.5	60.7	57.2			
Std dev			3.2	3.5	2.6	4.3			
Mean weight			2.82	2.56	4.16	3.19			
Std dev			.65	.62	.84	.82			
Sample size	0	0	9	14	4	8	0	0	
Shumagin total									
Number	0	0	24257	32699	22087	22276	230	764	102312
Mean length			54.7	54.3	58.9	57.4	65.1	60.9	56.1
Mean weight			2.74	2.62	3.47	3.11	5.44	3.39	2.95