FRI-UW-9404
March 1994

FISHERIES RESEARCH INSTITUTE
SCHOOL OF FISHERIES
UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

FALSE PASS CHUM SALMON, 1993

D.E. ROGERS

Approved

Submitted _____ May 18, 1994
Director

CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX TABLES

ACKNOWLEDGMENTS

Tanya Hibbing collected scales and took length and weight measurements at King Cove with the assistance of Alaska Department of Fish and Game personnel and Brenda Rogers aged the scales and examined for scale holes. Thanks also to the Alaska Department of Fish and Game for providing preliminary 1993 catch and escapement statistics.

This project was funded jointly by Peter Pan Seafoods, Trident Seafoods, Icicle Seafoods, and Crusader (through Pacific Seafood Processors Association), the Aleutian East Borough, and Concerned Area M Fishermen.

KEY WORDS

sockeye salmon, chum salmon, False Pass, Bristol Bay, Arctic-Yukon-Kuskokwim

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 (~80%) are bound for rivers in Bristol Bay (Eggers et al. 1991, 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 1992). The average annual percent of the total Bristol Bay catch taken in the False Pass fishery over the past 10 years was 5.4% (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-targeted fishery has been closed early three times because the chum cap was attained: 1986, 1988 and 1991 (Shaul et al. 1993). 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 1993 were to (1) update estimates of chum salmon runs (catch and escapement) to North Pacific coastal regions, (2) measure the incidence of scale holes in the 1993 False Pass catch, and (3) examine frequency distributions of chum salmon condition factors from the 1993 catch.

METHODS

The accuracy of estimates of the annual runs (catch and escapement) of sockeye and chum salmon to major North Pacific regions is quite variable. Since the 1950s annual catch statistics for sockeye and chum salmon 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 targeted species (Rogers 1987). The most important statistics for management are usually the most recent statistics, and these are only available in preliminary form or in-house reports. This report relies heavily on salmon statistics presented by the ADF&G to the Alaska Board of Fisheries on December 1, 1993 (Anchorage, Alaska) and preliminary 1993 catch statistics (ADF&G 1994).

Annual runs of chum salmon to North Pacific regions from 1970 to 1993 were estimated primarily from catch and escapement statistics presented in Appendix Tables 1-11. 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 available for a few recent years in the Yukon River, and regressions of sonar count on spawning survey count were utilized to estimate escapements in years when only spawning survey counts were available. 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 1993 False Pass catches (June 13–29) were sampled at the Peter Pan processing plant in King Cove. Fish were selected randomly from the processing line and measured for length (mid-eye to tail fork) and weight, sex was determined from external appearance, and two scales were collected from the preferred region. The first samples, collected from the June 16–17 catches, did not have the sex recorded; otherwise sampling was conducted as planned with the last samples collected from the June 26–27 catches. Data from the field forms (date, location, scale card number, fish number, sex, length, and weight) were entered on a computer file. Weights measured in pounds and ounces were transformed to kilograms.

Scales were aged and examined for focal scale resorbtion (holes) by an experienced scale reader who had been tutored on the identification of focal scale resorbtion by Mr. Brian Bigler (Wards Cove Packing Co., Seattle, Washington). Ages and occurrences of scale holes were then added to the computer database. Data were stratified by location (South Unimak and Shumagin Is.), date, sex, and age. Weight-length scattergrams were examined for outliers, which 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. (1993), and Mr. A.R. Shaul (ADF&G, Kodiak, Alaska) provided preliminary catches by gear, area, and date for 1993. These preliminary catches were used to weight stratified means (length, weight, age compositions) to obtain the annual means for 1993.

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 Shaul (1987) to develop an in-season forecast about 10 days prior to the arrival of the fish in Bristol Bay. I updated the database used by Eggers and Shaul (Table 1), and calculated a new regression to predict the Western Alaska (Bristol Bay, North Peninsula and Kuskokwim) run (Fig. 1). Sockeye salmon were difficult to catch in 1990, probably because there were persistent offshore winds, so there was a low catch-per-unit-effort (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 Western Alaska 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 Western Alaska even though these stocks were the most abundant stocks in the 1987 tagging (Fig. 1). Chum salmon abundance in the 1990s has changed relative to 1987 as follows: decreased for Bristol Bay/North Peninsula, about the same for the A-Y-K region, and increased for Asian (primarily Japanese hatchery) stocks (Fig. 2).

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 and Fig. 3). The chum salmon percentage in the False Pass catch of 1993 was low compared with the trend of recent years (second lowest since 1980); however, chum salmon percentage in Western Alaska was the lowest recorded (4.5%). Sockeye salmon abundance in 1993 was the second highest in history and, while domestic runs of chum salmon were low, the Japanese hatchery returns were the second highest on record (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 46.5% of the annual variation in the differences in False Pass and Western Alaska chum salmon percentages (Fig. 3). With increases in Japanese hatchery chum salmon, the False Pass catches contained a higher percentage of chum salmon than expected from the percentages of chum salmon in the Western Alaska runs.

One would expect the annual catch of chum salmon in the False Pass fishery to be somewhat correlated with the catch of the more abundant and targeted sockeye salmon, and this was so until the imposition of chum salmon caps on the fishery (Fig. 4). For the years with a chum salmon cap, there is no apparent correlation between sockeye and chum salmon catches. A regression of False Pass chum salmon catch on the False Pass sockeye catch as a proportion of the Bristol Bay run has been used to predict the chum salmon catch given the sockeye salmon quota and Bristol Bay run (Eggers 1993a). Although there is a significant correlation for all years since 1977, there is no correlation when only years with a chum salmon cap are considered (Fig. 5). Assuming a chum salmon cap for 1994, there is at present no statistically significant relationship to predict the chum salmon catch given the sockeye quota and forecast for 1994.

ADF&G projections for 1994 chum salmon runs to the A-Y-K region are for below-average runs (Hilsinger 1993); however, some unusually high incidental catches of chum salmon in 1993 trawl fisheries would seem to point to a strong run of chum salmon in 1994 (Eggers 1993b). In addition, the outlook for chum salmon catch in the False Pass fishery in 1994 will most likely be determined by the abundance of Asian or Japanese hatchery chum salmon rather than by the Western Alaska runs.

Age, Weight, and Length

About 98% of the chum salmon caught in the 1993 South Unimak and Shumagin fisheries were ages 0.3 and 0.4, with age 0.3 being the more numerous (Table 8). Age-weight-length (AWL) summaries are given for the South Unimak and Shumagin catches by age, sex, and date in Appendix Tables 12 and 13. Chum salmon in 1993 were slightly longer but considerably lighter by age and sex than they were in the 1992 catches. For the combined sexes in the 1993 Unimak catch, the age 0.3 and 0.4 chum salmon were 1–2% longer but weighed 12-16% less than the chum salmon in the 1992 catch.

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 1993 weighed significantly less at various lengths than the chum salmon in 1992 (Figs. 6–12). The False Pass chums in 1993 weighed less than the typical average chum salmon in the Nushagak (Bristol Bay) catch (no results were available for 1992–1993) (e.g., at an average length of 55 cm, age 0.3 chums in the Unimak catch averaged 2.44 kg compared with an average weight of 2.8 kg in the Nushagak catch; Fig. 13). Chum salmon at False Pass, however, would be expected to put on some growth prior to their arrival on the coast.

In the Nushagak catch, 3-ocean chum salmon tend to be somewhat shorter and much lighter than 3-ocean sockeye at a given length; however, annual mean lengths of the two species have been significantly correlated (1967–1991, r = 0.77). Nushagak and other Bristol Bay sockeye have been smaller than average since the consecutive large runs that began in 1989 (Table 9). The annual sizes of sockeye are density dependent (large numbers-small size) and temperature dependent (cold spring- small size), and for recent years the small size has also caused some delay in maturation as fish have been spending a longer time at sea (Rogers and Ruggerone 1993). A similar condition (delayed maturation) may also be occurring in Western Alaska chum salmon; however, this is not a result of their own abundance but rather from the recent high abundances of Japanese chum salmon and perhaps Bristol Bay sockeye salmon.

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 0.010 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 in 1993 were significantly lower than those in 1992 on all sample dates (Table 10). In contrast to 1992, males did not have consistently higher condition factors than females, and there was no significant difference in condition between the two ages. As in 1992, there were no instances of a bimodal distribution in the frequencies of the condition factors (Figs. 14 and 15). The lightest fish were in the Shumagin catch of June 20. 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) presented 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 1993 are given in Table 11. About 14% of the chum salmon sampled were removed as either AWL outliers (e.g., too long or short for the age, or too heavy or light for the length) or because two good scales were not available. In 1992, 1.29% of the South Unimak chum salmon (two scales examined with certain identification) and 0.52% of the Shumagin chum salmon had scale "holes" (Rogers 1993). In the 1993 samples, the results were similar for South Unimak (1.07%) but much higher for the Shumagin chum salmon (2.51%). For the combined samples, 1.53% of the 1993 chum salmon had scale "holes" compared with 1.15% in 1992.

Assuming that the incidence of focal scale resorbtion is zero in Alaskan stocks and ~11.8% in Asian stocks (Murphy 1993), the Asian stocks contributed about 13% (19% including questionable) to the 1993 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 1,000). 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, as was the case in 1993.

DISCUSSION

The catch of chum salmon in the 1993 False Pass fisheries (530,000) was well below the chum salmon cap of 700,000, even though there was a near record sockeye salmon catch of nearly 3 million. The percentage of chum salmon in the catch (15%) was similar to 1992 and was the third lowest since 1980. The sockeye salmon run to Western Alaska in 1993 (57 million) was the largest since 1980 and, along with the smallest recorded chum salmon run to Western Alaska (4.5 million), contributed to a low percentage and number of chum salmon in the 1993 False Pass catch. This happened in spite of a high abundance of Japanese chum salmon, which in past years has significantly affected the percentage of chum salmon in the False Pass catch. It appears that Asian chum salmon were less available to the False Pass fisheries in 1993 (and perhaps 1992) than they were in other recent years; however, actions by ADF&G management and the False Pass fishermen to avoid areas and times of high chum salmon abundance have certainly contributed to the relatively low percentages of chum salmon the past 2 years.

We were unable again 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 1993, or that poor condition has been common to all chum salmon stocks in recent years as a result of the very high abundances of both chum and sockeye in the North Pacific since 1989. During the 1990s relatively little year to year change has occurred in the abundances of the various stock complexes that contribute to the False Pass fisheries. Compared with 1987, the year of the large tagging program, Bristol Bay chum salmon have been less abundant, A-Y-K chum salmon abundance has been about the same, and Asian (Japanese hatchery) chum salmon have increased in abundance.

REFERENCES

Alaska Department of Fish and Game. 1988. Prince William Sound area finfish management report 1987. Cordova, AK. 142 p.

Alaska Department of Fish and Game. 1992. Annual management report-1991—Bristol Bay area. ADF&G Reg. Inform. Rep. No. 2A92-08. 165 p.

Alaska Department of Fish and Game. 1993. Salmon fisheries in the Yukon area, Alaska 1992. ADF&G Reg. Inform. Rep. No. 3A93-02. 49 p.

Alaska Department of Fish and Game. 1994. Preliminary forecasts and projections for 1994 Alaska salmon fisheries and review of the 1993 season. *In* H.J. Geiger, H. Savikko and E. Simpson (eds). ADF&G Reg. Inform. Rep. Abstract only.

Barrett, B.M., C.O. Swanton, and P.A. Roche. 1990. An estimate of the 1989 Kodiak management area salmon catch, escapement, and run number had there been a normal fishery without the Exxon Valdez oil spill ADF&G Reg. Inform. Rep. 4K90-35. 150 p.

Bergstrom, D. 1993. Yukon area summer chum salmon stocks and fisheries. A handout of figures and tables by ADF&G, Anchorage, AK.

Bigler, B. 1988. Focal scale damage among chum salmon (*Onchorynchus keta*) of Hokkaido, Japan. Can. J. Fish. Aquat. Sci. 45:698-704.

Bigler, B. 1989. Mechanism and occurrence of focal scale resorption among chum salmon (*Onchorynchus keta*) of the North Pacific Ocean. Can. J. Fish Aquat. Sci. 46:1147-1153.

Eggers, D. 1993a. Outlook for chum salmon catch in the 1994 South Alaska Peninsula June fishery. A handout of figures by ADF&G, Juneau, AK.

Eggers, D. 1993b. Chum salmon bycatch in trawl fisheries and history of high seas salmon interception fisheries. A handout of graphs by ADF&G, Juneau, AK.

Eggers, D.M. and A.R. Shaul. 1987. Assessment of Bristol Bay sockeye salmon run strength based on in-season performance of the South Peninsula June interception fishery. ADF&G Inform. Leaf. No. 264. 53 p.

Eggers, D.M., K. Rowell, and B. Barrett. 1991. Stock composition of sockeye and chum salmon catches in the southern Alaska Peninsula fisheries in June. ADF&G Fish. Res. Bull. No. 91-01. 49 p.

Francisco, R.K., C Anderson, C. Burkey, and D. Molyneaux. 1993. Report to the Alaska Board of Fisheries Kuskokwim area chum salmon, 1993. ADF&G, Bethel, AK. 41 p.

Fredin, R.A. 1980. Trends in North Pacific salmon fisheries. Pages 59-119 *in* W.J. McNeil and D.C. Himsworth (eds.), Salmonid Ecosystems of the North Pacific. Oregon State Univ. Press.

Hilsinger, J. 1993. Summary of chum salmon outlook and management plans for the Arctic-Yukon-Kuskokwim region in 1994. A handout of tables. ADF&G, Anchorage, AK

INPFC Secretariat. 1979. Historical catch statistics for salmon of the North Pacific. INPFC Bull. 39. 166 p.

INPFC. 1993. Statistical yearbook 1990. Vancouver, Canada. 116 p.

King, B.E. and K.E. Tarbox. 1989. Upper Cook Inlet salmon escapement studies 1988. ADF&G Tech. Fish. Rep. 89-19. 116 p.

McCullough, J.N. 1993. South Alaska Peninsula chum salmon stocks and fisheries exclusive of the South Unimak and Shumagin Islands June Fisheries. A handout of tables and figures. ADF&G Kodiak, AK.

Murphy, R.L. 1993. Occurrence of focal scale resorption in chum salmon from the June South Peninsula fisheries. ADF&G Reg. Inform. Rep. No. 4K93-2. 19 p.

Murphy, R.L. 1993. Report to the Alaska Board of Fisheries on North Peninsula chum salmon stocks and fisheries. A handout of tables and figures. ADF&G Kodiak, AK.

Owen D. 1993. Chignik management area chum salmon oral report to the Board of Fisheries. A handout of tables and figures by ADF&G, Kodiak.

Rogers, D.E. 1987. Pacific salmon. Pages 461-475 *in* D.W. Hood and S.T. Zimmerman (eds.), The Gulf of Alaska. U.S. Dept. Commerce, NOAA.

Rogers, D.E. 1990. Stock composition and timing of sockeye salmon in the False Pass fishery. Univ. Washington, Fish. Res. Inst. FRI-UW-9006. Seattle, WA. 40 p.

Rogers, D.E. 1993. False Pass chum salmon. Univ. Washington, Fish. Res. Inst. FRI-UW-9309. Seattle, WA. 45 p.

Rogers, D.E. and G.T. Ruggerone. 1993. Factors affecting marine growth of Bristol Bay sockeye salmon. Fish. Res. 18(1993):89-103.

Schultz, K. 1993. Yukon area fall chum salmon fisheries and stock status. A handout of figures and tables by ADF&G, Anchorage, AK.

Sharr, S. 1988. 1989 Prince William Sound salmon forecast. ADF&G Reg. Inform. Rep. 2C88-14. 7 p. plus appendices.

Shaul, A.R., J. McCullough, R.L. Murphy, P.B. Holmes, R.S. Berceli and R.D. Campbell. 1993. Alaska Peninsula and Aleutian Islands management areas annual salmon management report, 1992. ADF&G Reg. Inform. Rep. No. 4K93-30. 379 p.

Stratton, B.L. 1993. Report to the Alaska Board of Fisheries on Bristol Bay chum salmon stocks and fisheries. A handout of tables and figures. ADF&G Anchorage, AK.

Stratton, B.L. and D.L. Crawford. 1992. Abundance, age, sex, and size statistics for Pacific salmon in Bristol Bay, 1991. ADF&G Tech. Fish. Rep. 92-17. 168 p.

Yuen, H.J. and M.L. Nelson. 1984. Bristol Bay chum salmon (*Oncorhynchus keta)* sex, age, weight, and length statistics, 1960 to 1977. ADF&G Tech. Data Rep. 127. 82 p.

FIGURES

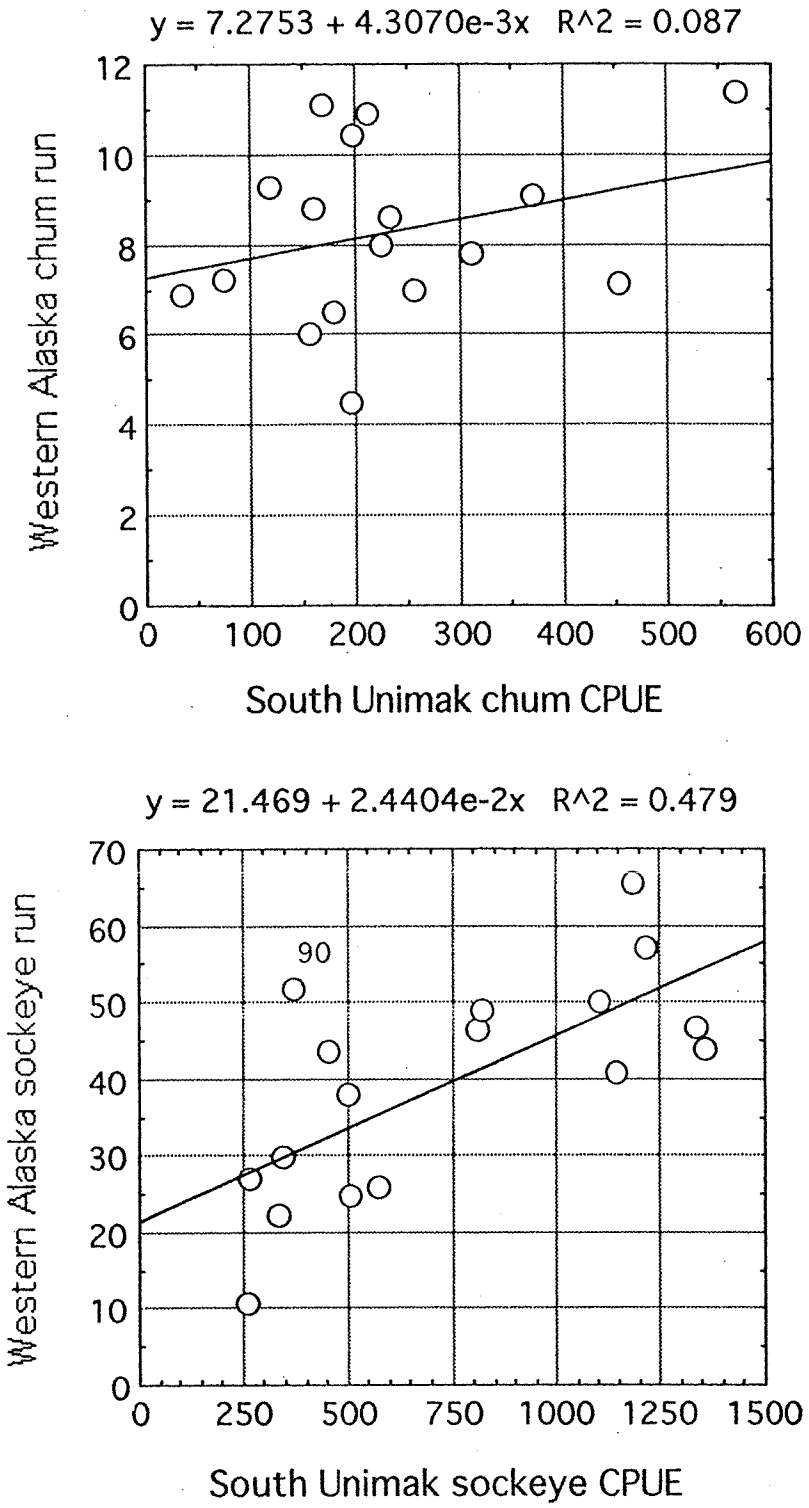

Figure 1. Western Alaska sockeye and chum salmon runs regressed on South Unimak CPUE.

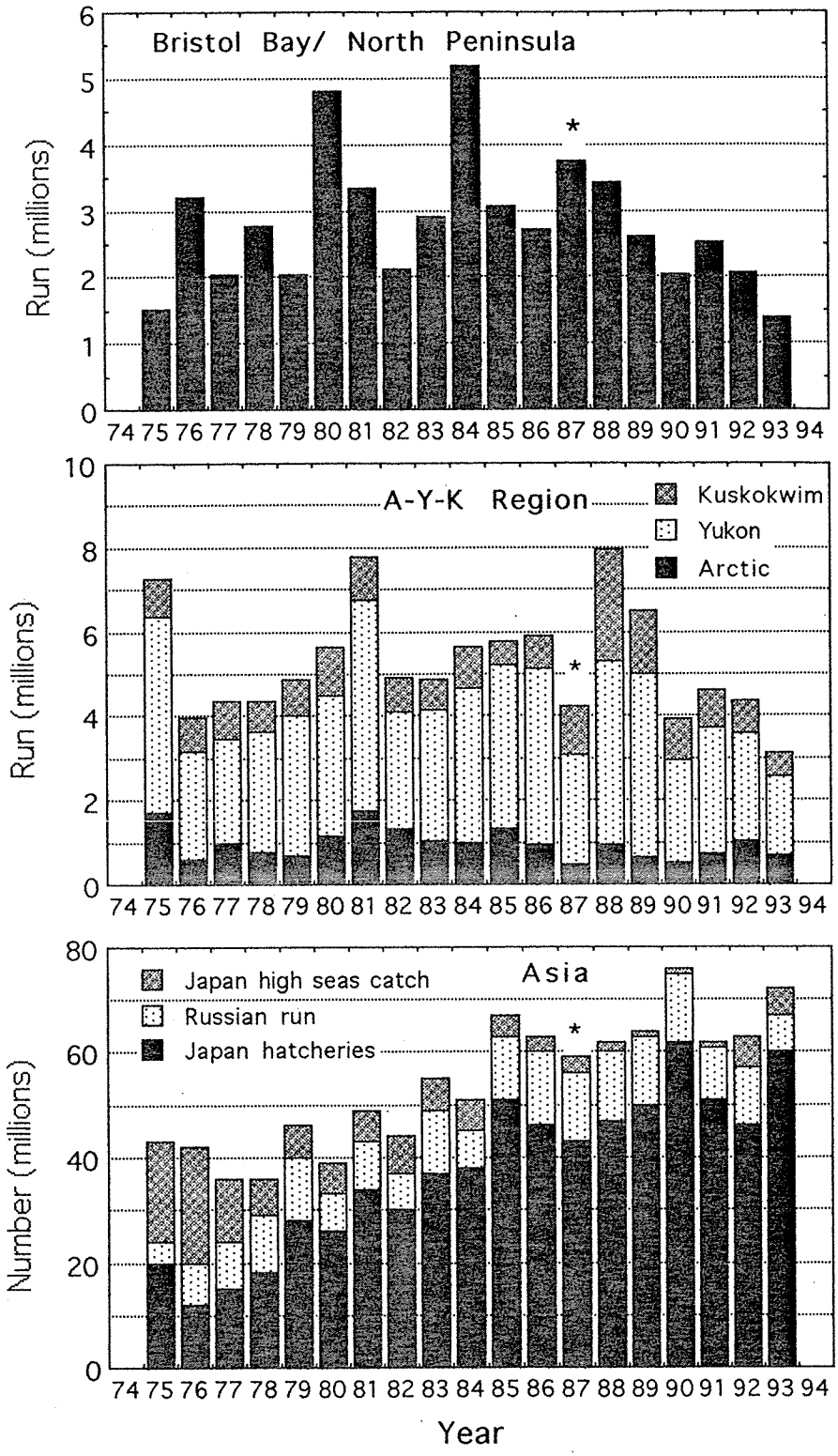

Figure 2. Chum salmon runs to Bristol Bay, A-Y-K and Asia, 1975-1993.

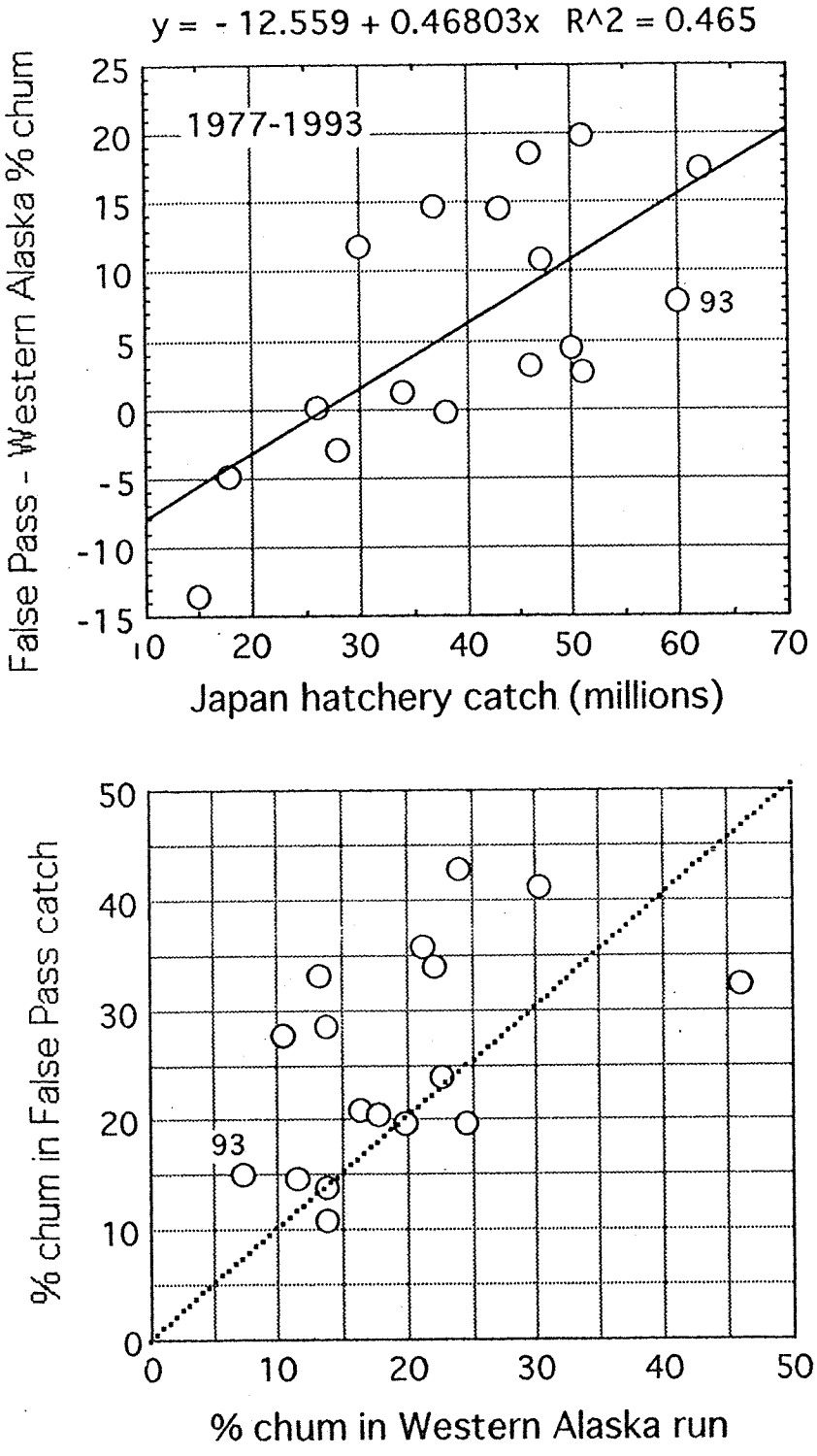

Figure 3. The percentage of chum salmon in the False Pass catch plotted on the percent chums in the Western Alaska run (bottom), and differences in the percent chum salmon in the False Pass catch and in the Western Alaska run regressed on Japanese hatchery catch (top).

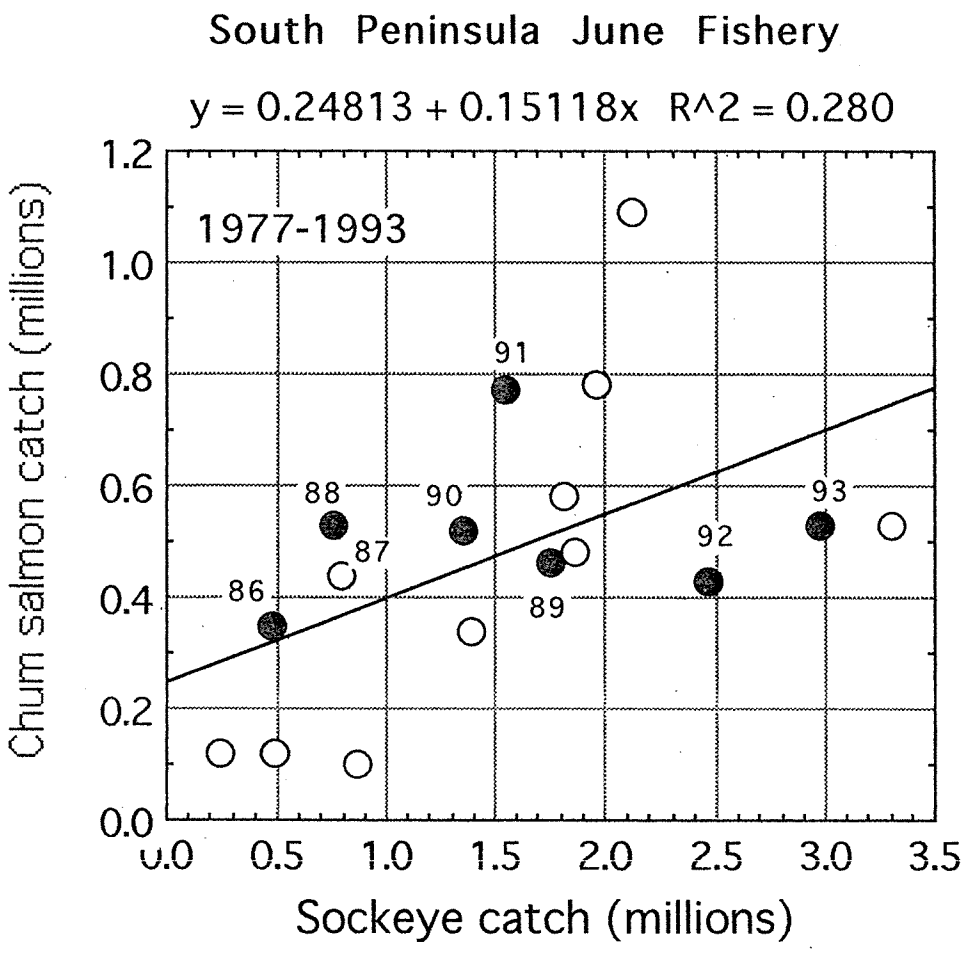

Figure 4. Annual chum salmon catch regressed on sockeye salmon catch in the False Pass fisheries (solid points for years with a chum salmon cap).

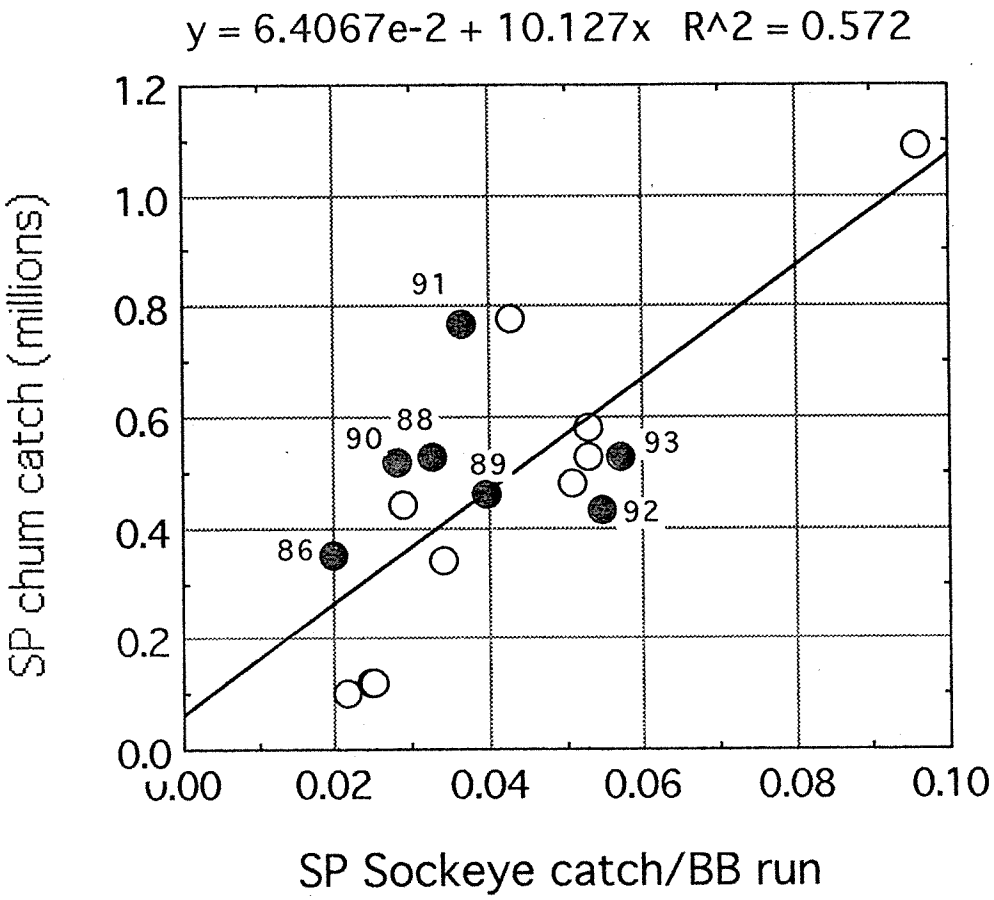

Figure 5. Regression of False Pass (SP) chum salmon catch on the proportion that the sockeye catch was of the Bristol Bay run (solid points for years with a chum cap).

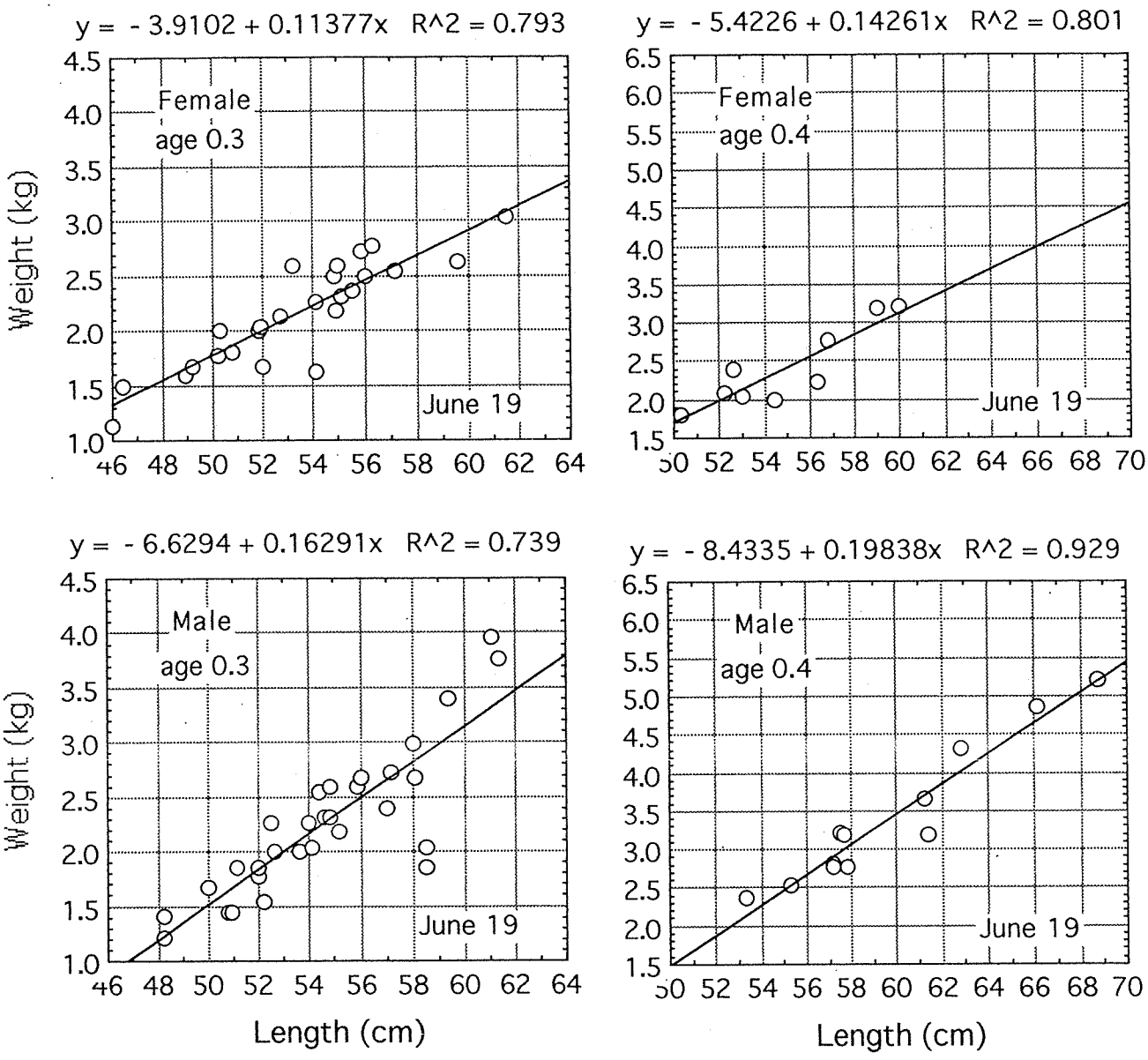

Figure 6. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 19, 1993.

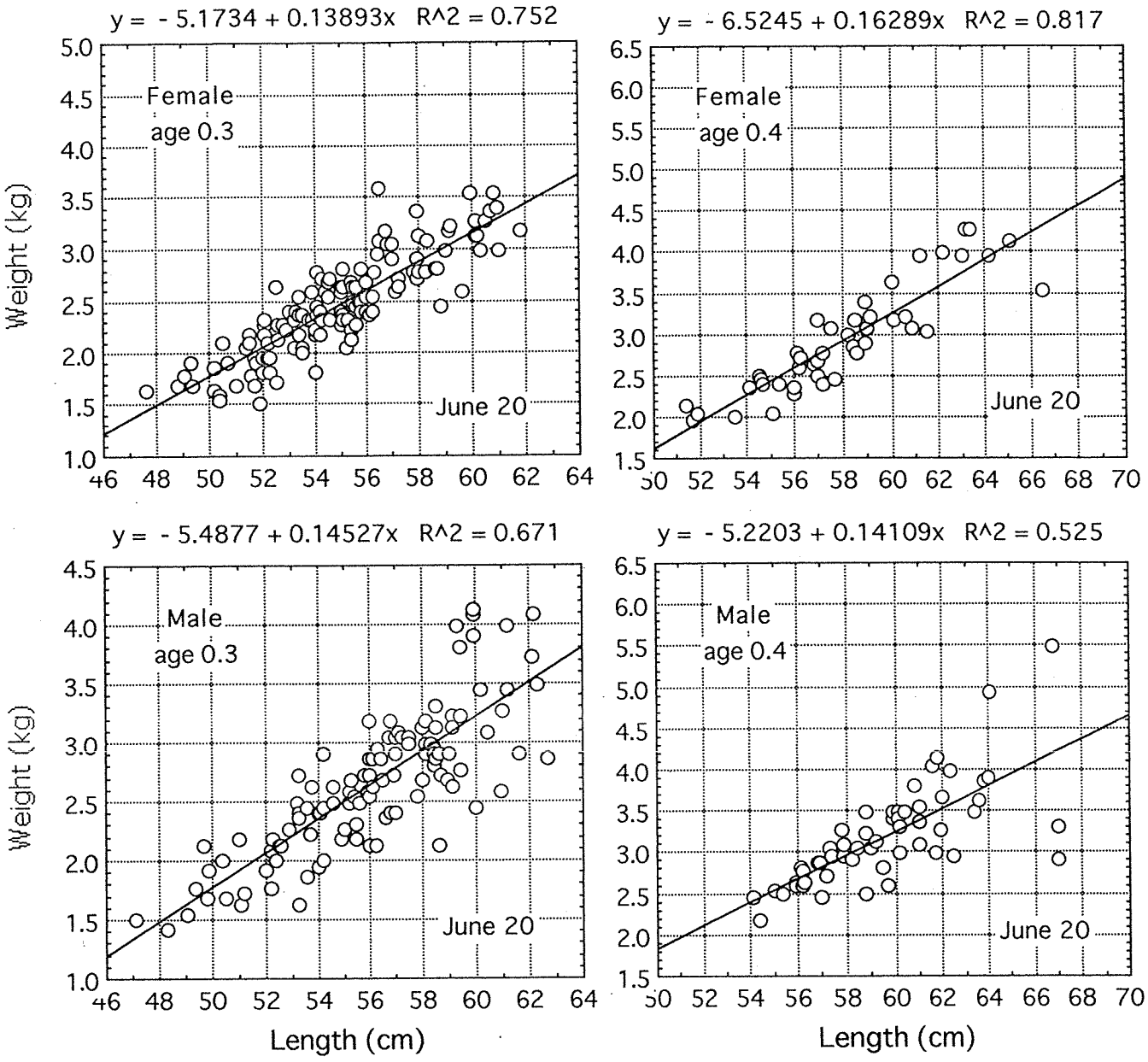

Figure 7. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 20, 1993.

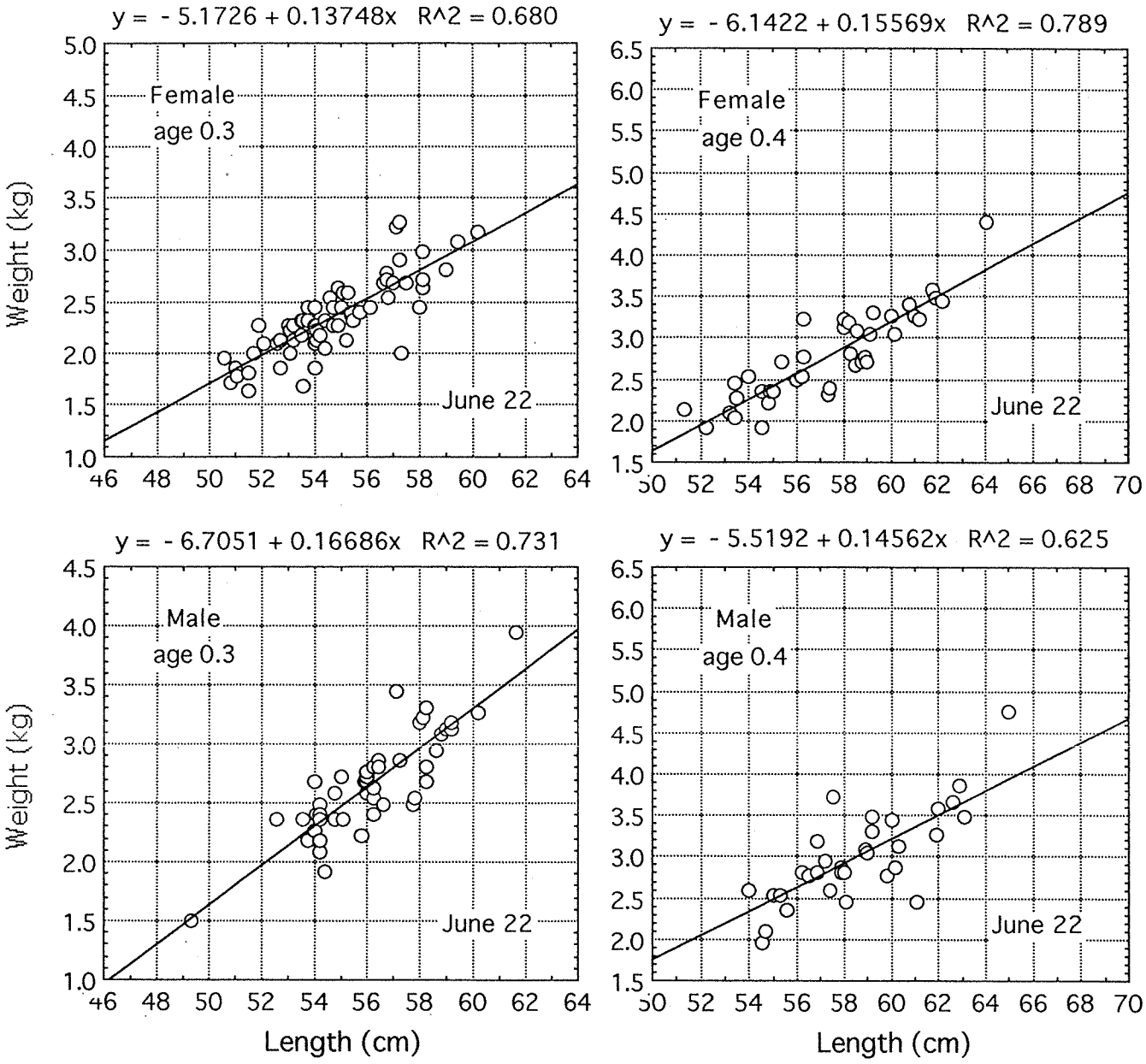

Figure 8. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 22, 1993.

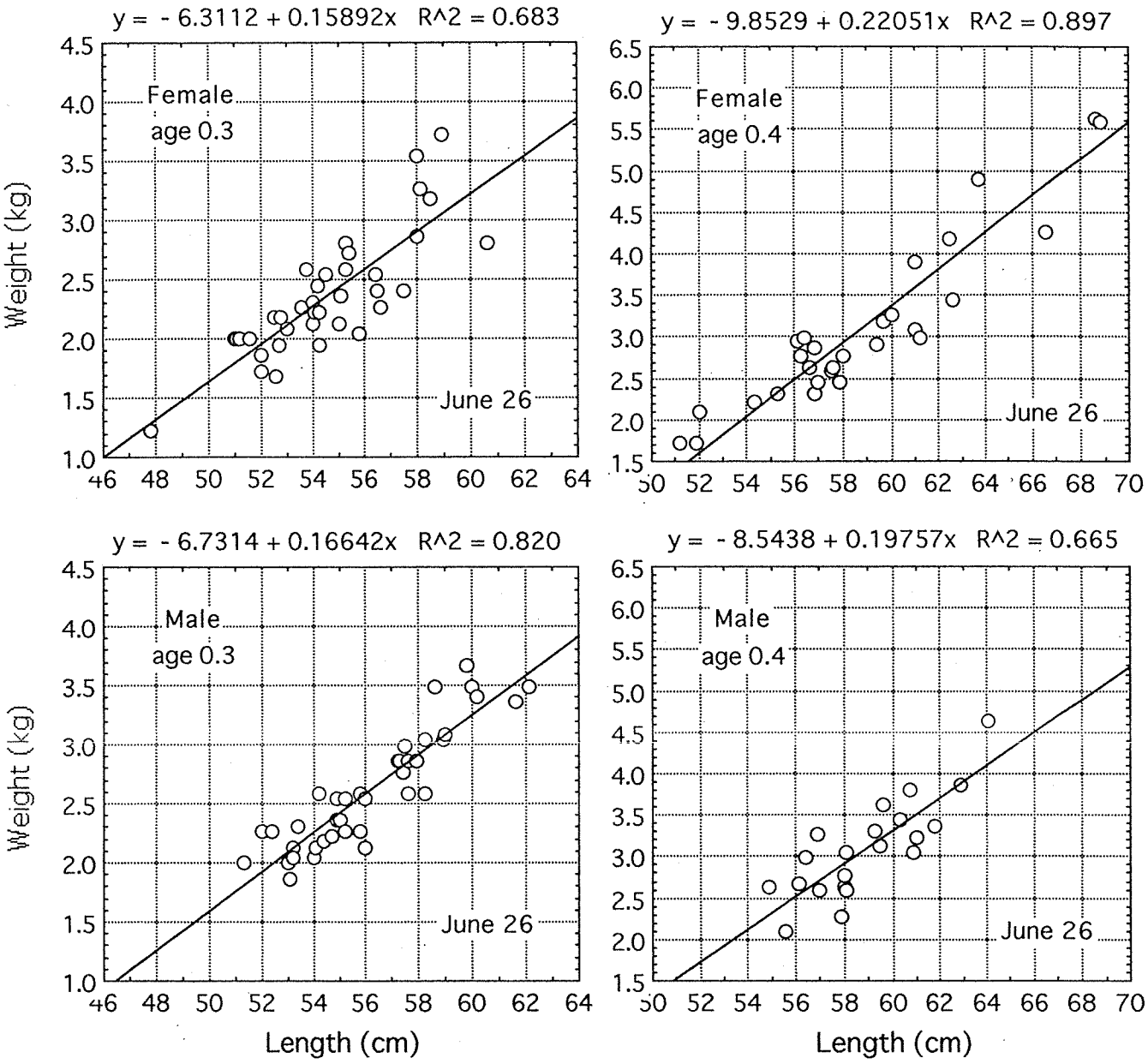

Figure 9. Regressions of weight on length by sex and age from South Unimak chum salmon catch samples on June 26, 1993.

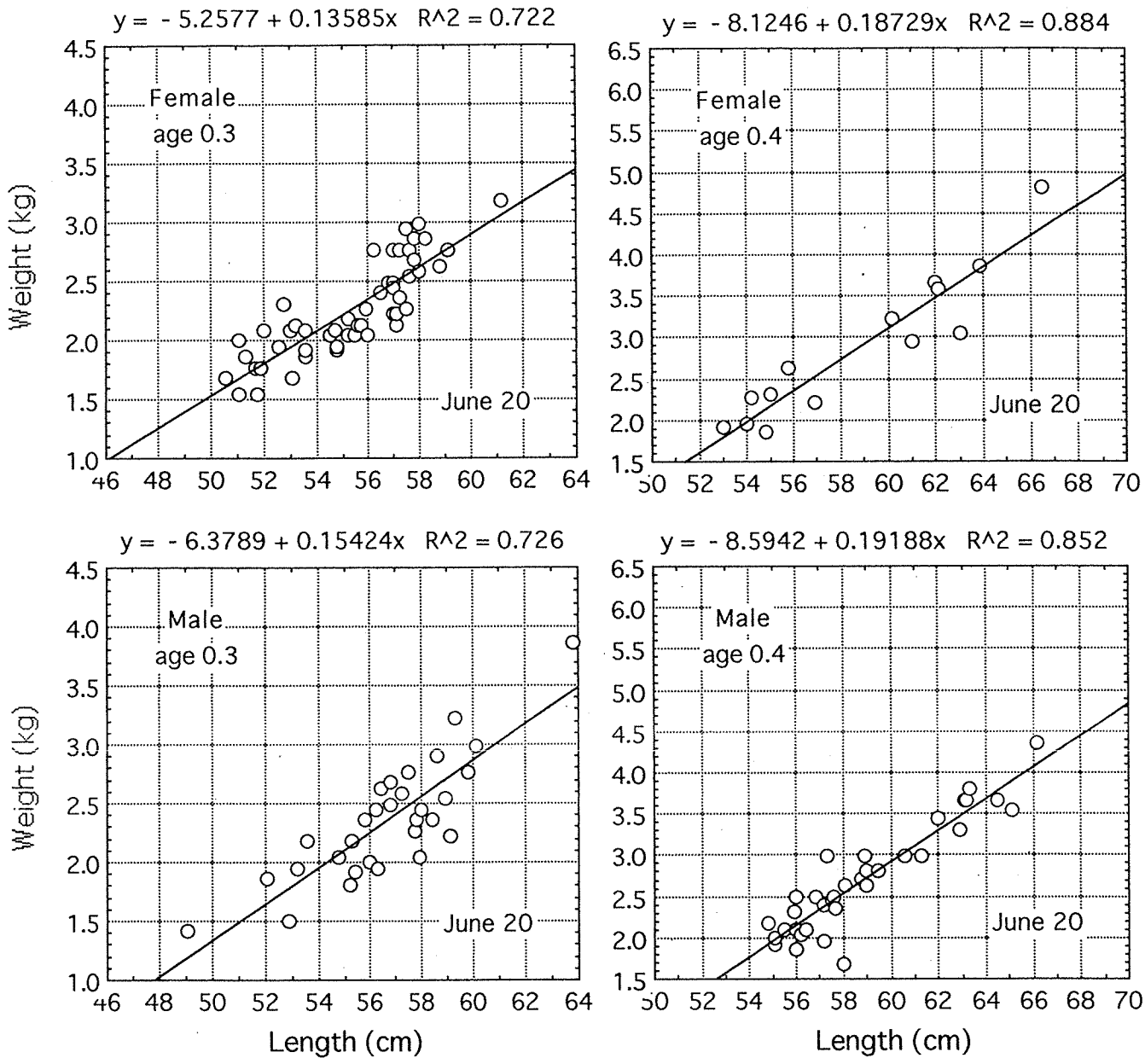

Figure 10. Regressions of weight on length by sex and age from Shumagin chum salmon catch samples on June 20, 1993.

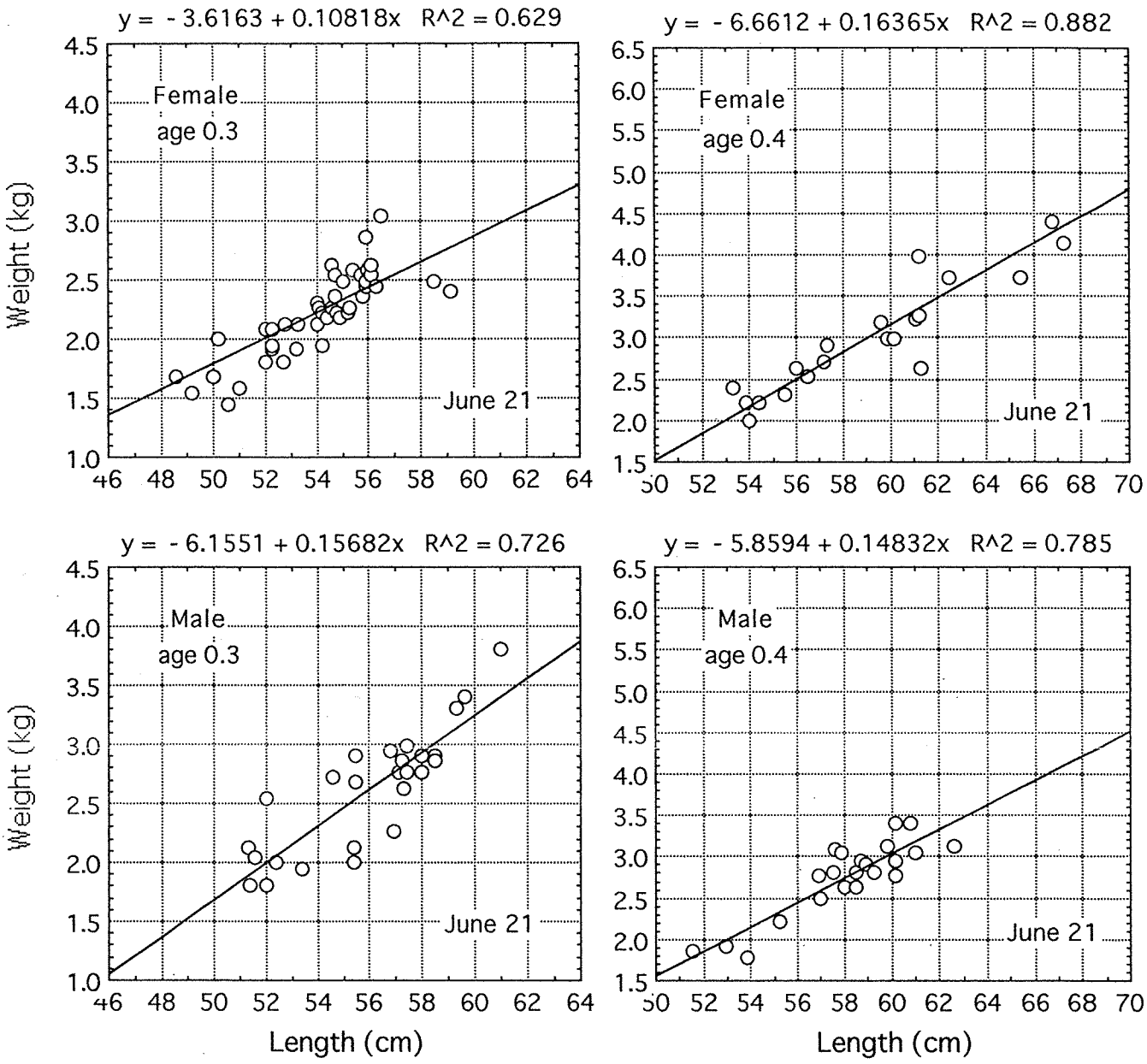

Figure 11. Regressions of weight on length by sex and age from Shumagin chum salmon catch samples on June 21, 1993.

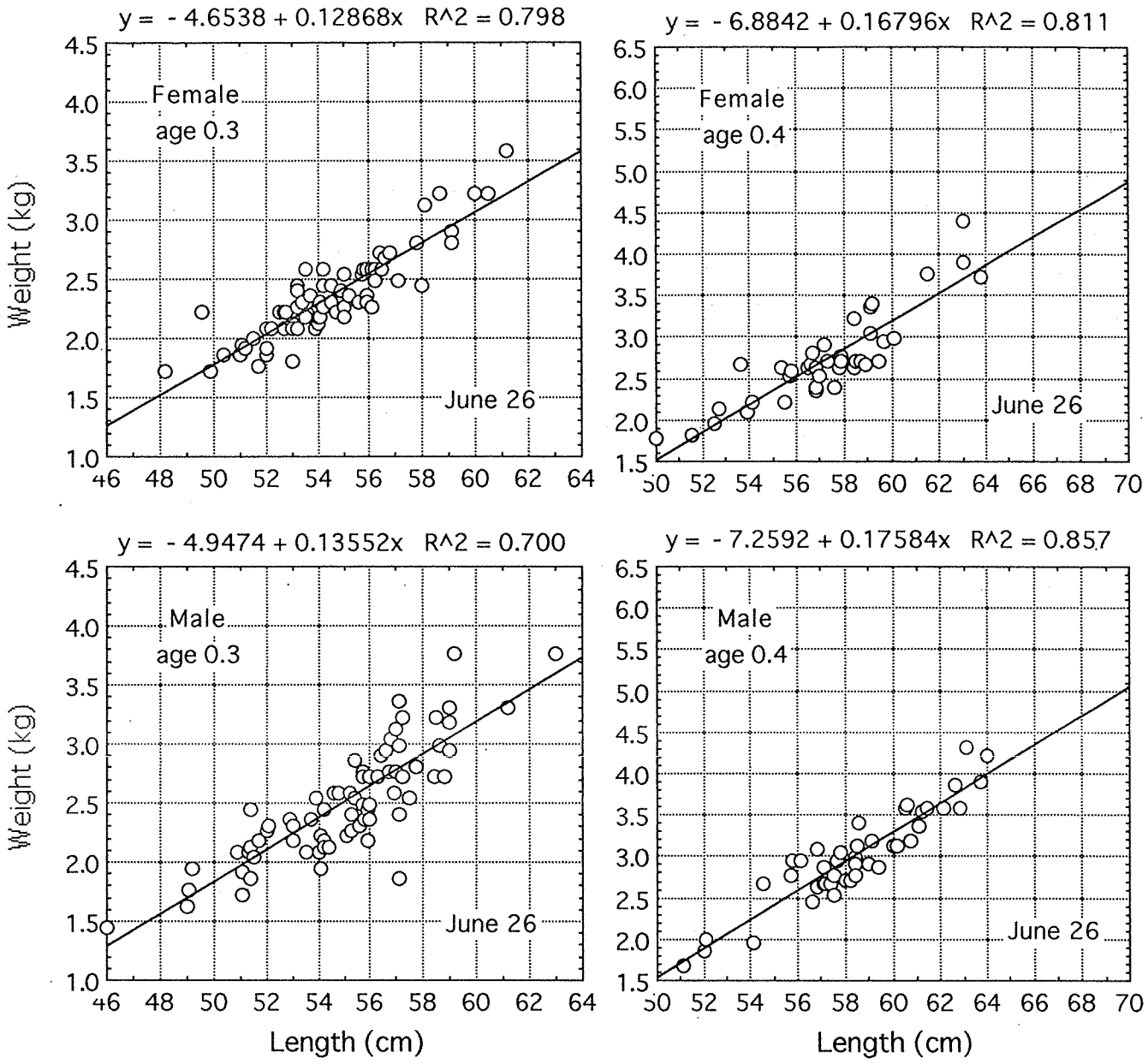

Figure 12. Regressions of weight on length by sex and age from Shumagin chum salmon catch samples on June 26, 1993.

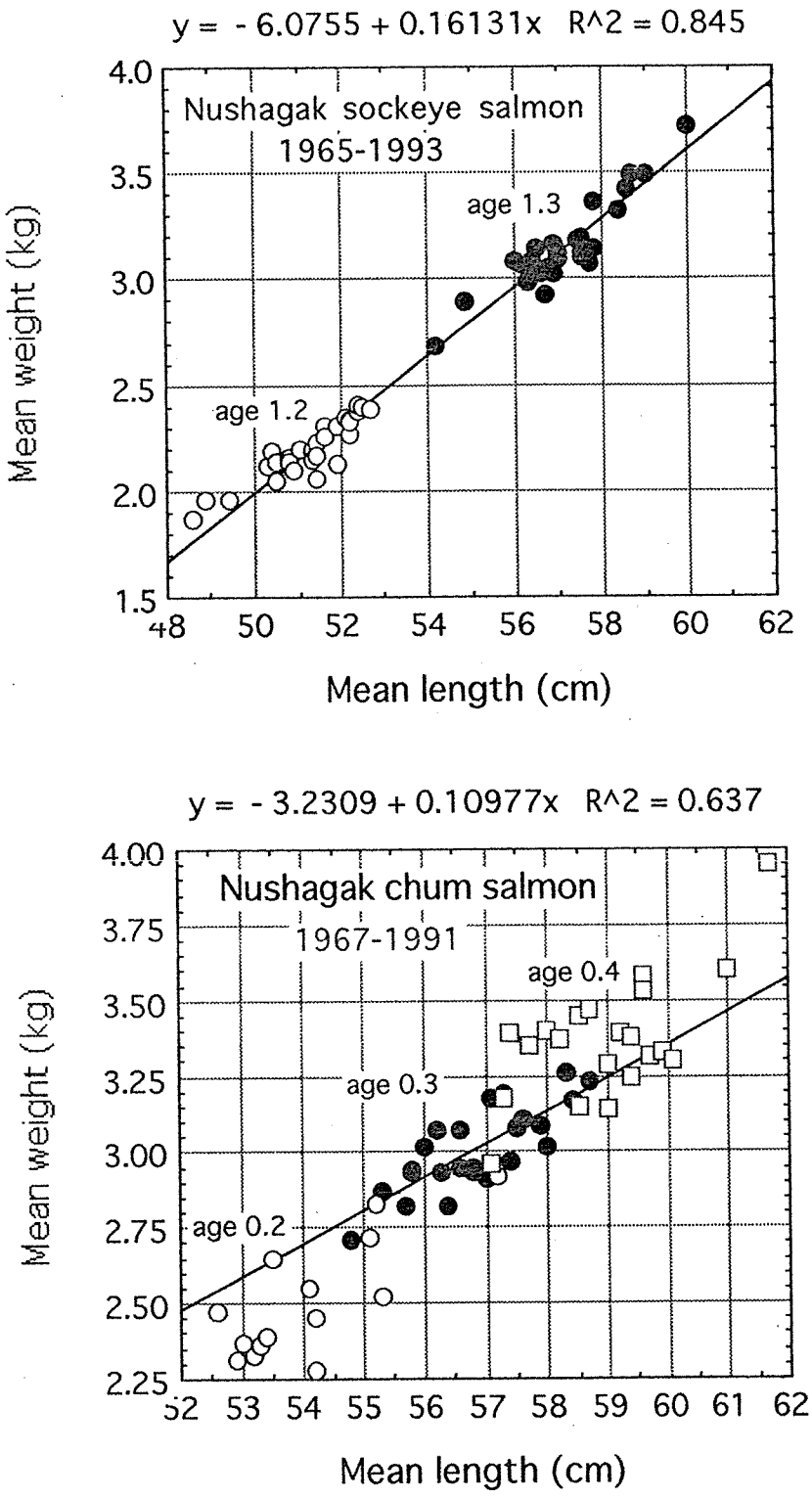

Figure 13. Regressions of mean weights on mean lengths from Nushagak commercial catch samples of chum salmon (bottom) and sockeye salmon (top). Regression lines fitted to ages 0.3 and 1.3 only.

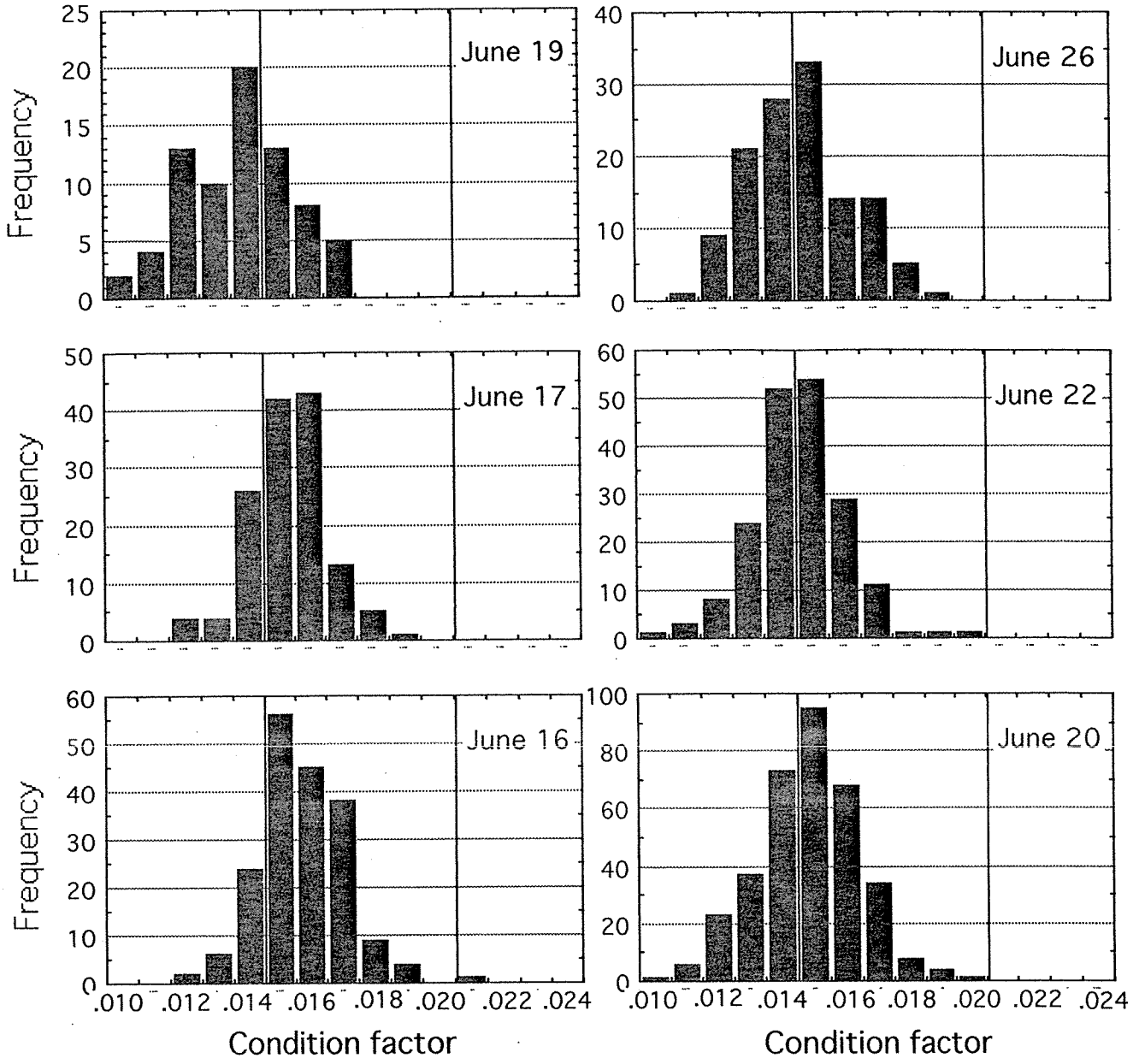

Figure 14. Frequency distributions of condition factors for samples of chum salmon from South Unimak catches on June 16-26.

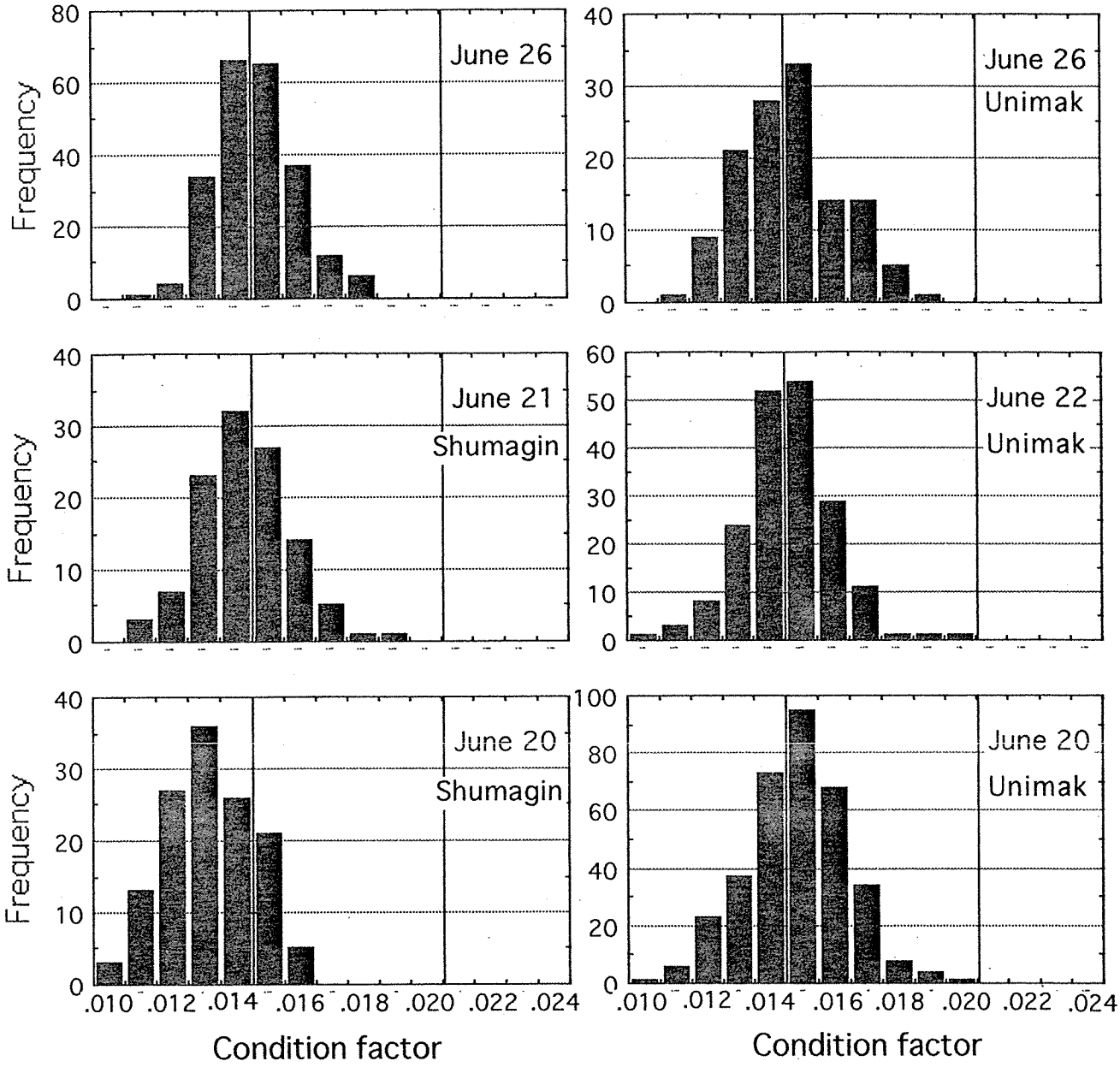

Figure 15. Frequency distributions of condition factors for chum salmon from the South Unimak catches (right) and Shumagin catches (left), 1993.

TABLES

Table 1. Sockeye and chum salmon catches in the South Unimak June fishery, 1986-93.

Year	Date	Hours open	Catch (1,000s) Sockeye	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=.4	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=.5	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=.5	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=.6	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=.6	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=.7	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
93	13	16	284	38	12	1263
(52)	15	18	255	45	15	1351
Q=2.9	16	24	305	43	12	1009
C=2.9	17	18	304	39	11	1075
cap=.7	19	18	350	51	13	1552
	20	22	492	68	12	1475
	22	12	203	73	26	1130
	26	18	50	3	6	1660
	27	22	112	13	10	848
	29	8	12	9	43	277
Sum	13-	204	2367	382	14	1218

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 = total chum cap (Unimak & Shumagin) 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, 1987-1993.

Year		Age composition (%)						Bristol Bay run (millions)
		1.2	2.2	1.3	2.3	all .2	all .3	
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
1993	ADF&G pre-f'cast	23	41	21	14	64	35	41.8
	Moller in-f'cast	7	27	19	44	34	65	42.0
	False Pass catch	14	46	14	23	61	38	
	Bristol Bay run	13	33	18	33	46	53	51.9
Means	ADF&G pre-f'cast	24	35	28	13	59	41	29.4
	Moller in-season	17	28	31	21	45	53	37.9
	False Pass catch	18	38	23	17	56	43	
	Bristol Bay run	20	32	28	17	52	47	40.1

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

Table 3. Percent chums in chum and sockeye salmon catches and runs (in millions), 1977-93.

	Bristol Bay Run			Western Alaska Run			South Peninsula June Catch			Port Moller Test Boat CPUE		
Year	Sockeye	Chum	% C	Sockeye	Chum	% C	Sockeye	Chum	% C	Sockeye	Chum	% C
77	9.6	4.0	29.4	10.8	9.2	46.0	0.24	0.12	32.4	6.9	2.3	25.0
78	19.8	2.3	10.4	22.1	7.2	24.6	0.49	0.12	19.7	3.2	0.8	20.0
79	39.8	1.7	4.0	43.6	7.0	13.8	0.86	0.11	10.9	9.6	0.2	2.0
80	62.4	3.3	5.1	65.4	10.4	13.7	3.30	0.53	13.8	4.6	1.6	25.8
81	34.3	2.1	5.8	37.9	11.1	22.7	1.83	0.58	23.9	7.6	2.0	20.8
82	22.1	1.3	5.7	24.6	7.0	22.2	2.12	1.09	34.0	5.1	1.1	17.7
83	45.7	2.2	4.5	48.8	7.8	13.8	1.96	0.78	28.5	4.4	0.4	8.3
84	40.7	3.5	7.8	43.9	10.9	19.9	1.39	0.34	19.7	27.1	5.0	15.6
85	36.6	2.0	5.3	40.7	8.8	17.8	1.86	0.48	20.5	18.0	0.8	4.3
86	23.6	2.2	8.6	27.1	8.6	24.1	0.47	0.35	42.7			
87	27.3	2.9	9.5	29.7	8.0	21.2	0.79	0.44	35.8	12.4	0.8	6.1
88	23.2	2.5	9.8	26.0	11.3	30.3	0.76	0.53	41.1	7.8	1.2	13.3
89	43.9	2.2	4.9	46.8	9.1	16.3	1.75	0.46	20.8	18.6	0.9	4.6
90	47.8	1.7	3.4	51.6	6.0	10.4	1.35	0.52	27.8	26.8	1.3	4.6
91	42.2	2.0	4.6	46.3	7.1	13.3	1.55	0.77	33.2	19.2	1.6	7.7
92	45.0	1.4	3.0	49.9	6.5	11.5	2.46	0.43	14.7	23.0	1.5	6.1
93	52.1	1.0	1.9	57.3	4.5	7.3	2.97	0.53	15.1	28.8	1.3	4.3
Means 83-92	37.6	2.3	6.1	41.1	8.4	17.9	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), 1970-93.

	Kuskokwim		Bristol Bay runs					Bristol Bay	North Penin.	Total	South Peninsula June catch	
Year	Catch	Run	Togiak	Nushagak	Nak/Kvi	Egegik	Ugashik	Total	Run	Run	Number	%
70	.013	.03	.37	3.15	32.65	2.32	.91	39.40	.66	40.1	1.68	3.4
71	.006	.02	.42	2.61	9.37	1.94	1.48	15.82	.79	16.6	.61	3.0
72	.004	.01	.16	.91	2.85	1.39	.10	5.41	.37	5.8	.52	7.1
73	.005	.01	.21	.85	.79	.55	.04	2.44	.35	2.8	.26	7.3
74	.028	.07	.25	2.78	6.43	1.45	.06	10.97	.58	11.6	.00	0.0
75	.018	.05	.38	2.92	18.35	2.14	.44	24.23	.75	25.0	.24	0.8
76	.014	.04	.50	2.75	5.92	1.84	.53	11.54	1.17	12.7	.31	2.0
77	.019	.05	.42	1.84	4.69	2.47	.29	9.71	1.01	10.8	.24	1.9
78	.014	.04	.79	6.62	10.32	2.10	.09	19.92	2.11	22.1	.49	1.9
79	.039	.10	.69	6.40	27.43	3.29	2.10	39.91	3.55	43.6	.86	1.7
80	.043	.11	1.21	12.81	40.57	3.68	4.22	62.49	2.78	65.4	3.30	4.1
81	.106	.27	1.01	10.34	14.63	5.06	3.44	34.48	3.19	37.9	1.82	3.9
82	.096	.24	.94	7.93	7.54	3.48	2.32	22.21	2.15	24.6	2.12	6.8
83	.089	.22	.83	7.07	26.11	7.55	4.35	45.91	2.67	48.8	1.96	3.3
84	.081	.20	.52	3.81	26.50	6.36	3.93	41.12	2.56	43.9	1.39	2.6
85	.121	.30	.40	2.99	17.36	8.63	7.48	36.86	3.50	40.7	1.86	3.7
86	.142	.36	.58	4.85	6.28	6.01	6.02	23.74	3.04	27.1	.47	1.5
87	.171	.43	.66	5.15	12.27	6.63	2.82	27.53	1.76	29.7	.79	2.2
88	.150	.38	1.16	3.23	8.85	8.01	2.19	23.44	2.14	26.0	.76	2.4
89	.080	.20	.21	5.05	23.56	10.31	4.90	44.03	2.53	46.8	1.74	3.1
90	.204	.41	.52	5.71	26.36	12.28	2.89	47.76	3.45	51.6	1.35	2.2
91	.202	.40	.80	7.69	18.64	9.59	5.50	42.22	3.71	46.3	1.55	2.8
92	.194	.39	.80	5.19	15.89	17.62	5.53	45.03	4.44	49.9	2.46	4.0
93	.167	.33	.70	7.62	14.78	23.34	5.67	52.11	4.80	57.2	2.97	4.2
Means												
70-79		.04	.42	3.08	11.88	1.95	.60	17.94	1.13	19.1	.52	2.9
80-89		.27	.75	6.32	18.37	6.57	4.17	36.18	2.63	39.1	1.62	3.4
90-93		.38	.71	6.55	18.92	15.71	4.90	46.78	4.10	51.3	2.08	3.3

Kuskokwim run estimated by catch/ 0.4 (1970-89) and catch/0.5 (1990-93).
South Peninsula percent= (SP catch*.85)/ (SP catch*.85+BB total)*100.

Table 5. North Pacific runs of sockeye salmon, 1970-93, catch + escapement in millions.

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 Western Alaska
		Western	Central						
70	39	42	6	10	3	61	9	70	60
71	16	17	6	7	2	32	12	44	39
72	5	6	6	7	1	20	8	28	21
73	2	3	5	6	1	15	15	30	10
74	11	12	5	5	1	23	14	37	32
75	24	25	4	5	2	36	7	43	58
76	12	13	8	6	1	28	10	38	34
77	10	11	10	3	3	27	13	40	28
78	20	22	10	3	4	39	14	53	42
79	40	44	7	3	3	57	12	69	64
80	62	68	9	3	4	84	7	91	75
81	34	40	10	3	4	57	15	72	56
82	22	26	14	3	3	46	20	66	39
83	46	51	14	2	5	72	10	82	62
84	41	45	14	2	7	68	11	79	57
85	37	42	15	1	8	66	23	89	47
86	24	27	17	1	6	51	18	69	39
87	27	30	21	1	8	60	11	71	42
88	23	27	17	<1	5	49	10	59	46
89	44	48	16	<1	6	70	24	94	51
90	48	53	18	<1	12	83	24	107	50
91	42	48	17	<1	8	73	20	93	52
92	45	52	20	0	9	81	11	92	57
93	52	60	*19*	0	*7*	86	*25*	111	54
Means									
70-79	18	20	7	6	2	34	11	45	39
80-89	36	40	15	2	6	62	15	77	51
90-93	47	53	19	0	9	81	20	101	53

Western Alaska includes Bristol Bay, North Peninsula and 85% of South Peninsula catch. Japan high seas catch in 1992 included in Russian run.

Table 6. Estimated runs of chum salmon (catch + escapement, millions) to Bering Sea coastal areas, 1970-93.

Year	Kotz-ebue	Norton Sound	Yukon River Summer	Yukon River Fall	Arctic/ Yukon Region	Kusko-kwim	Togiak	Nush-agak	Naknek/ Kvichak	Egegik	Ugashik	Bristol Bay Total	North Alaska Penins.	Total Run
70	.43	.36	.92	.82	2.53	.76	.22	1.14	.22	.07	.09	1.74	.22	5.3
71	.43	.42	.82	.80	2.47	.58	.24	.75	.24	.04	.02	1.29	.17	4.5
72	.48	.33	.74	.59	2.14	.61	.38	.74	.30	.07	.06	1.55	.21	4.5
73	1.00	.42	1.36	.90	3.68	.83	.44	1.06	.59	.06	.07	2.22	.28	7.0
74	1.30	.43	1.45	.99	4.17	1.12	.14	.89	.51	.03	.07	1.64	.14	7.1
75	1.16	.55	2.87	1.78	6.36	.90	.18	.68	.47	.01	.07	1.41	.12	8.8
76	.36	.25	1.82	.74	3.17	.80	.25	1.74	.74	.07	.03	2.83	.37	7.2
77	.42	.58	1.49	.97	3.46	.90	.52	2.65	.74	.12	.01	4.04	.81	9.2
78	.26	.50	2.03	.84	3.63	.74	.47	1.38	.37	.08	.01	2.31	.47	7.2
79	.32	.38	1.71	1.61	4.02	.84	.33	.85	.36	.06	.06	1.66	.37	6.9
80	.76	.40	2.34	.98	4.48	1.14	.57	1.94	.55	.11	.17	3.34	1.47	10.4
81	1.40	.36	3.70	1.28	6.74	1.02	.36	1.11	.47	.10	.06	2.10	1.24	11.1
82	.90	.42	1.99	.76	4.07	.83	.23	.57	.30	.12	.11	1.33	.79	7.0
83	.38	.66	2.05	1.05	4.14	.72	.45	1.01	.42	.14	.14	2.16	.74	7.8
84	.68	.30	2.82	.86	4.66	1.00	.55	1.63	.81	.22	.31	3.52	1.67	10.9
85	1.06	.28	2.74	1.15	5.23	.53	.38	.91	.45	.15	.15	2.04	1.02	8.8
86	.60	.32	3.30	.90	5.12	.79	.51	.88	.57	.12	.13	2.21	.51	8.6
87	**.27**	**.20**	**1.62**	**1.00**	**3.09**	**1.12**	**.81**	**.67**	**1.09**	**.18**	**.13**	**2.88**	**.88**	8.0
88	.74	.22	3.60	.74	5.30	2.63	.66	.70	.74	.30	.14	2.54	.89	11.4
89	.54	.10	3.24	1.10	4.98	1.53	.49	.93	.53	.16	.13	2.24	.37	9.1
90	.36	.14	1.56	.88	2.94	.98	.22	.61	.65	.16	.04	1.68	.35	6.0
91	.52	.20	2.00	1.00	3.72	.90	.38	.68	.77	.10	.10	2.03	.49	7.1
92	.62	.42	1.94	.63	3.61	.77	.23	.55	.38	.13	.09	1.38	.69	6.5
93	.45	.24	1.18	.69	2.56	.55	.22	.59	.07	.05	.09	1.02	.36	4.5
Means														
70-79	.62	.42	1.52	1.00	3.56	.81	.32	1.19	.45	.06	.05	2.07	.32	6.8
80-89	.73	.33	2.74	.98	4.78	1.13	.50	1.04	.59	.16	.15	2.44	.96	9.3
90-93	.49	.25	1.67	.80	3.21	.80	.26	.61	.47	.11	.08	1.53	.47	6.0

A-Y-K estimates assume exploitation rates of .4 for 1970s and .5 since 1980 (87 estimates from Eggers et al 1991).
Yukon River runs from Appendix Tables 4 and 5. Bristol Bay runs from Appendix Table 2 and North Peninsula from Shaul et al. (1993) and Murphy (1993).

Table 7. North Pacific runs of chum salmon, 1970-93, catch + escapement in millions.

Year	Bristol Bay run	Alaska Runs Western	Central	S.P.	Japan catch High seas	Coastal	Russian Run (Catch/.5)	North Pacific total run	SE Alaska B.C. and Wash.	Total Pacific run	Percent Asia
70	1.7	5.2	5.0	0.5	17	7	7	42	11	53	59
71	1.3	4.6	6.7	0.7	17	10	7	46	7	53	64
72	1.6	4.5	4.6	0.6	22	9	4	45	17	62	57
73	2.2	7.0	3.8	0.2	16	12	3	42	15	57	55
74	1.6	7.0	2.0	0.0	22	13	5	49	10	59	68
75	1.4	8.8	2.1	0.1	19	20	4	54	5	59	73
76	2.8	7.2	3.4	0.4	22	12	8	53	9	62	68
77	4.0	9.2	6.1	0.1	12	15	9	51	5	56	64
78	2.3	7.2	4.2	0.1	7	18	11	47	9	56	64
79	1.7	7.0	4.3	0.1	6	28	12	58	4	62	75
80	3.3	10.4	5.2	0.5	6	26	7	55	11	66	59
81	2.1	11.1	8.9	0.6	6	34	9	70	6	76	65
82	1.3	7.0	8.7	1.1	7	30	7	61	9	70	63
83	2.2	7.8	6.8	0.8	6	37	12	71	6	77	72
84	3.5	10.9	6.6	0.3	6	38	7	69	13	82	63
85	2.0	8.8	5.4	0.5	4	51	12	82	17	99	68
86	2.2	8.6	7.9	0.4	3	46	14	80	17	97	65
87	2.9	8.0	6.1	0.4	3	43	13	73	12	85	69
88	2.5	11.3	8.3	0.5	2	47	13	83	20	103	61
89	2.2	9.1	4.8	0.5	1	50	13	78	9	87	73
90	1.7	6.0	4.5	0.5	1	62	13	87	13	100	76
91	2.0	7.1	5.4	0.8	1	51	10	75	11	86	72
92	1.4	6.5	4.2	0.4	6	46	11	74	16	90	70
93	1.0	4.5	4.6	0.5	0	60	7	76	*12*	88	76
Means											
70-79	2.1	6.8	4.2	0.3	16	14	7	49	9	58	65
80-89	2.4	9.3	6.9	0.6	4	40	11	72	12	84	66
90-93	1.5	6.0	4.7	0.6	2	55	10	78	13	91	73

Western Alaska includes Bristol Bay, North Peninsula and the Yukon-Kuskokwim region. Japan coastal run does not include hatchery returns (brood stock) to Hokkaido and Honshu.

Table 8. Age and sex composition of the False Pass chum salmon catches in 1993.

		Age group				
		0.2	0.3	0.4	0.5	Total
South Unimak						
	Males	2300	111700	76700	1600	192300
	Percent	0.6	29.3	20.1	0.4	50.4
	Females	2800	126400	60100	300	189600
	Percent	0.7	33.1	15.7	0.1	49.6
	Both sexes	5100	238100	136800	1900	381900
	Percent	1.3	62.4	35.8	0.5	100.0
Shumagin Islands						
	Males	1100	41400	31100	1500	75100
	Percent	0.7	27.5	20.7	1.0	50.0
						0
	Females	100	49900	23200	2000	75200
	Percent	0.1	33.2	15.4	1.3	50.0
	Both sexes	1200	91300	54300	3500	150300
	Percent	0.8	60.7	36.1	2.3	100.0
Combined areas						
	Males	3400	153100	107800	3100	267400
	Percent	0.6	28.8	20.3	0.6	50.2
	Females	2900	176300	83300	2300	264800
	Percent	0.5	33.1	15.7	0.4	49.8
	Both sexes	6300	329400	191100	5400	532200
	Percent	1.2	61.9	35.9	1.0	100.0

Table 9. Age composition, mean length (mm), and mean weight (kg) of chum salmon from Nushagak catches.

	Age 0.2			Age 0.3			Age 0.4			0.5	Number (millions)		
											Chum salmon		Sockeye
Year	%	Length	Weight	%	Length	Weight	%	Length	Weight	%	catch	run	run
66	10.5		1.81	75.5		3.88	14.0		4.07	0.0	.13	.31	2.80
67	3.6	534	2.39	89.2	574	2.97	7.2	590	3.29	0.0	.34	.79	1.53
68	6.9	552	2.83	65.9	584	3.17	27.1	597	3.32	0.1	.18	.43	1.68
69	21.3	529	2.31	73.9	564	2.82	4.8	594	3.38	0.0	.21	.54	1.99
70	1.1	531	3.33	96.5	568	2.95	2.4	610	3.60	0.0	.44	1.14	3.15
71	5.5	542	2.28	68.5	570	2.91	26.0	585	3.15	0.0	.36	.84	2.61
72	8.2	551	2.72	67.9	579	3.09	23.5	590	3.14	0.4	.31	.74	0.91
73	0.2			71.6	575	3.08	26.7	592	3.39	1.5	.34	1.10	0.85
74	16.3	533	2.36	42.4	576	3.11	39.6	594	3.25	1.7	.16	.89	2.78
75	24.3	530	2.37	73.9	563	2.93	1.7	585	2.88	0.1	.15	.68	2.92
76	9.3	542	2.45	84.1	580	3.02	6.6	601	3.30	0.0	.80	1.74	2.75
77	3.1	553	2.52	93.3	583	3.26	3.6	596	3.53	0.0	.90	2.65	1.84
78	2.3	541	2.55	40.6	587	3.23	57.1	617	3.95	0.0	.65	1.38	6.62
79	6.7	532	2.33	62.8	568	2.93	29.9	599	3.33	0.6	.44	.85	6.40
80	0.9	523	2.29	98.3	558	2.94	0.8	588	3.01	0.0	.68	1.94	12.81
81	0.3			61.0	566	2.95	38.7	596	3.58	0.0	.80	1.11	10.34
82	1.3			44.2	572		53.5	576		1.0	.44	.57	7.93
83	2.0	535		34.5	571	3.18	61.5	585	3.45	2.0	.72	1.00	7.07
84	1.6	528		87.2	562	3.07	10.0	584	4.06	1.2	.85	1.57	3.81
85	32.7	572	2.92	54.4	573	3.19	12.4	571	2.96	0.5	.40	.91	2.99
86	0.3			85.2	558	2.93	14.5	574	3.39	0.0	.49	.88	4.85
87	0.0			40.2	560	3.02	57.3	582	3.37	2.5	.42	.67	5.15
88	6.9	535	2.65	62.3	566	3.07	30.0	580	3.40	0.8	.37	.70	3.23
89	0.4			82.0	557	2.82	17.3	577	3.35	0.3	.52	.93	5.05
90	0.5			78.8	553	2.87	20.2	587	3.47	0.5	.31	.61	5.71
91	2.3	526	2.47	67.4	548	2.71	30.3	573	3.18	0.0	.47	.68	7.69
92											.31	.55	5.19
93											.42	.59	7.62
Means													
70-91	5.7	538	2.56	68.1	568	3.01	25.6	588	3.37	0.6	.50	1.07	4.88

Sources: Yuen and Nelson (1984) and annual ADF&G reports on Bristol Bay salmon; e.g. Stratton and Crawford (1992).

Table 10. Means and standard errors of chum salmon condition factors, 1993.

		Age 0.3					Age 0.4				
		Male		Female		M+F	Male		Female		M+F
Location/date		Mean	Std. error	Mean	Std. error	Mean	Mean	Std. error	Mean	Std. error	Mean
Unimak	6/16					.0158					.0155
	6/17					.0152					.0155
	6/19	.0136	.0004	.0140	.0003	.0138	.0157	.0003	.0144	.0005	.0151
	6/20	.0149	.0002	.0147	.0002	.0148	.0149	.0002	.0148	.0002	.0149
	6/22	.0149	.0002	.0142	.0002	.0145	.0149	.0003	.0146	.0003	.0148
	6/26-27	.0146	.0002	.0144	.0003	.0145	.0150	.0004	.0149	.0003	.0149
	Mean	.0145		.0143		.0148	.0151		.0147		.0151
Shumagin	6/20	.0128	.0002	.0132	.0002	.0131	.0130	.0003	.0138	.0004	.0133
	6/21	.0148	.0003	.0141	.0002	.0144	.0139	.0003	.0143	.0003	.0141
	6/26	.0150	.0002	.0144	.0001	.0147	.0149	.0002	.0143	.0002	.0146
		.0142		.0139		.0141	.0139		.0141		.0140
1992 means											
	Unimak	.0179		.0176		.0177	.0185		.0178		.0182
	Shumagin	.0164		.0162		.0163	.0167		.0163		.0165

Table 11. Frequencies of focal scale resorption (holes) on chum salmon scales from the 1993 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	6/16	165	2	1	1.79	3	3.51
	6/17	117	1	0	0.85	0	0.85
	6/19	68	1	0	1.45	1	2.86
	6/20	314	0	0	0.00	2	0.64
	6/22	141	0	1	0.70	2	2.08
	6/26	116	4	0	3.33	1	4.13
	Totals	921	8	2	1.07	9	2.02
Shumagin Is.	6/20	115	1	1	1.71	0	1.71
	6/21	107	0	0	0.00	0	0.00
	6/26	206	8	1	4.19	1	4.63
	Totals	428	9	2	2.51	1	2.73
False Pass	Combined	1349	17	4	1.53	10	2.25

APPENDIX TABLES

Appendix Table 1. Nushagak District chum and sockeye salmon statistics (numbers in 1,000s), 1966-93.

	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	all fish	age .3	all fish
66	129	80			209	.62	3.88	.49	.42	3.06	2.84
67	338	200			538	.63	2.97	.51	.43	3.02	2.62
68	179	100			279	.64	3.19	.48	.42	3.30	3.03
69	214	130			344	.62	2.76	.38	.39	3.05	2.56
70	435	273			708	.61	2.97	.46	.38	2.86	2.60
71	360	226			586	.61	2.95	.53	.43	3.11	2.90
72	310	195			505	.61	3.06	.58	.42	2.98	2.50
73	336	200			536	.63	3.16	.34	.31	3.46	3.50
74	158	100			258	.61	3.06	.14	.18	3.06	2.50
75	153	80			233	.66	2.79	.22	.22	3.17	2.90
76	801	500			1301	.62	2.98	.50	.46	3.39	3.00
77	900	609			1509	.60	3.25	.36	.34	3.60	3.50
78	652	293			945	.69	3.63	.54	.47	3.39	2.85
79	440	100	166	--	606	.73	3.01	.50	.52	3.09	2.87
80	682	1053	332	969	1651	.41	2.94	.37	.35	2.96	2.97
81	795	--	143	177	972	.82	3.19	.74	.72	3.17	3.08
82	435	--	230	256	691	.63	3.00	.76	.75	3.09	3.09
83	725	--	106	164	889	.82	3.34	.81	.73	3.00	2.71
84	850	--	362	--	1212	.70	3.16	.55	.54	3.00	2.91
85	397	--	214	288	685	.58	3.07	.51	.44	3.11	2.56
86	488	--	168	200	657	.74	2.95	.57	.56	3.01	3.17
87	416	--	147	--	564	.74	3.14	.77	.63	2.97	2.91
88	371	--	186	--	557	.67	3.09	.49	.53	3.17	3.00
89	523	--	378	--	901	.58	2.91	.58	.56	3.08	2.78
90	306	--	330		636	.48	2.95	.64	.62	3.05	2.76
91	466	--	252		698	.67	2.77	.65	.69	2.86	2.58
92	313	--	303		616	.51		.63	.56	2.71	2.42
93	415	--	217		632	.66		.68	.70	3.01	2.67
Means											
70-79	455	258			719	.64	3.09	.42	.37	3.21	2.91
80-89	568		227		878	.67	3.08	.62	.58	3.06	2.92
90-93	375		276		646	.58	2.86	.65	.64	2.91	2.61

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

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

	Nushagak			Togiak			Nak/Kvi			Egegik			Ugashik			Bristol Bay run	
Year	Chum. catch.	Catch/ expl.	ADFG Run	Chum. catch.	Catch/ expl.	ADFG Run	Chum. catch.	Catch/ expl.	ADFG Run	Chum. catch.	Catch/ expl.	ADFG run	Chum. catch.	Catch/ expl.	ADFG run	Catch/ expl.	ADFG
70	.44	1.14	.71	.10	.22	.34	.120	.22		.044	.07		.018	.09		1.75	
71	.36	.75	.59	.12	.24	.35	.151	.24		.027	.04		.014	.02		1.29	
72	.31	.74	.51	.18	.38	.35	.116	.30		.042	.07		.010	.06		1.53	
73	.34	1.06	.54	.20	.44	.36	.124	.59		.023	.06		.006	.07		2.22	
74	.16	.89	.26	.08	.14	.24	.041	.51		.004	.03		.002	.07		1.64	
75	.15	.68	.23	.09	.18	.20	.080	.47		.004	.01		.002	.07		1.41	
76	.80	1.74	1.30	.15	.25	.55	.318	.74		.047	.07		.010	.03		2.82	
77	.90	2.65	1.51	.27	.52	.77	.340	.74		.083	.12		.004	.01		4.03	
78	.65	1.38	.94	.27	.47	.67	.185	.37		.044	.08		.001	.01		2.31	
79	.44	.85	.61	.22	.33	.51	.196	.36		.038	.06		.012	.06		1.65	
80	.68	1.94	1.65	.30	.57	.71	.205	.55	.21	.079	.11		.036	.17	.05	3.35	
81	.80	1.11	.97	.23	.36	.56	.356	.47	.43	.088	.10		.036	.06	.04	2.11	
82	.43	.57	.69	.15	.23	.24	.198	.30	.21	.084	.12	.10	.053	.11	.11	1.34	1.35
83	.73	1.01	.89	.32	.45	.49	.352	.42	.36	.127	.14	.14	.105	.14	.14	2.17	2.02
84	.85	1.63	1.21	.34	.55	.54	.447	.81	.50	.178	.22	.20	.211	.31	.38	3.52	2.83
85	.40	.91	.68	.20	.38	.42	.210	.45	.23	.127	.15	.13	.132	.15	.16	2.04	1.62
86	.49	.88	.66	.27	.51	.60	.263	.57	.30	.095	.12	.10	.111	.13	.12	2.21	1.78
87	.42	.67	.56	.42	.81	.78	.447	1.09	.46	.145	.18	.17	.101	.13	.13	2.88	2.10
88	.37	.70	.56	.47	.66	.88	.296	.74	.36	.238	.30	.25	.095	.14	.15	2.53	2.20
89	.52	.93	.90	.20	.49	.35	.311	.53	.32	.136	.16	.14	.085	.13	.10	2.24	1.81
90	.38	.61	.71	.12	.22	.17	.425	.65	.47	.128	.16	.14	.032	.04	.04	1.68	1.53
91	.46	.68	.75	.25	.38	.40	.430	.77	.49	.071	.10	.07	.057	.10	.07	2.03	1.78
92	.31	.55	.62	.17	.23	.29	.227	.38	.34	.114	.13	.12	.057	.09	.10	1.39	1.47
93	.41	.59	.63	.15	.22	.25	.039	.07	.04	.049	.05	.05	.068	.09	.08	1.02	1.05
Means																	
70-81	.50	1.24	.82	.18	.34	.47	.19	.46		.04	.07		.01	.06		2.18	
82-89	.53	.91	.77	.30	.51	.54	.32	.61	.34	.14	.17	.15	.11	.15	.16	2.36	1.96
90-93	.39	.61	.68	.17	.26	.28	.28	.47	.34	.09	.11	.10	.05	.08	.07	1.53	1.46

Source: ADF&G (1992) and Stratton (1993).

Appendix Table 3. Estimates of annual chum salmon runs to areas of Central Alaska, 1970-1993.

	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		1.25	0.23	0.10	0.33	5.00
71	0.75	0.34	1.09	0.35	0.47	0.82	1.54		3.14	0.48		0.89	0.57	0.17	0.74	6.68
72	0.21	0.25	0.46	0.08	0.19	0.27	1.16		2.37	0.71		1.18	0.05	0.30	0.35	4.63
73	0.08	0.21	0.29	0.01	0.12	0.13	0.32		0.65	0.78		1.41	0.73	0.55	1.28	3.76
74	0.07	0.26	0.33	0.03	0.15	0.18	0.25		0.51	0.42		0.68	0.09	0.20	0.29	1.99
75	0.03	0.19	0.22	0.02	0.13	0.15	0.08		0.16	0.97		1.43	0.10	0.05	0.15	2.11
76	0.13	0.33	0.46	0.08	0.21	0.29	0.74		1.51	0.52		0.72	0.37	0.08	0.45	3.43
77	0.13	0.77	0.90	0.11	0.15	0.26	1.07	0.98	2.05	1.38		2.16	0.57	0.15	0.72	6.09
78	0.48	0.60	1.08	0.12	0.10	0.22	0.81	0.64	1.45	0.65		0.81	0.49	0.16	0.65	4.21
79	0.38	0.41	0.79	0.18	0.18	0.36	0.36	0.80	1.16	0.87		1.58	0.33	0.10	0.43	4.32
80	0.82	0.36	1.18	0.31	0.23	0.54	1.08	1.10	2.18	0.46		0.75	0.48	0.09	0.57	5.22
81	1.20	0.38	1.58	0.58	0.24	0.82	1.35	0.98	2.33	1.17		2.06	1.88	0.20	2.08	8.87
82	1.18	0.39	1.57	0.39	0.26	0.65	1.26	1.36	2.62	1.63		2.18	1.33	0.31	1.64	8.66
83	0.92	0.45	1.37	0.16	0.10	0.26	1.09	1.09	2.18	1.27		1.56	1.04	0.36	1.40	6.77
84	1.32	0.70	2.02	0.06	0.37	0.43	0.65	0.90	1.55	0.76		1.15	1.24	0.23	1.47	6.62
85	0.91	0.50	1.41	0.03	0.06	0.09	0.43	0.96	1.39	0.78		1.05	1.28	0.18	1.46	5.40
86	1.40	0.54	1.94	0.18	0.05	0.23	1.13	1.17	2.30	1.19		1.46	1.68	0.27	1.95	7.88
87	0.93	0.62	1.55	0.13	0.08	0.21	0.68	0.85	1.53	0.48		0.59	1.92	0.30	2.22	6.10
88	1.38	0.50	1.88	0.27	0.36	0.63	1.43	0.95	2.38	0.94		1.13	1.84	0.48	2.32	8.34
89	0.54	0.31	0.85	0.00	0.14	0.14	0.02	1.53	1.55	0.14		1.00	1.00	0.24	1.24	4.78
90	0.72	0.35	1.07	0.27	0.25	0.52	0.58		1.18	0.36		0.46	0.97	0.30	1.27	4.50
91	0.82	0.59	1.41	0.26	0.47	0.73	1.03		2.10	0.33		0.50	0.37	0.25	0.62	5.36
92	0.89	0.34	1.23	0.22	0.57	0.79	0.66	0.53	1.19	0.38		0.44	0.30	0.28	0.58	4.23
93	0.98	0.40	1.38	0.12	0.22	0.34	0.64		1.31	0.12		0.16	1.15	0.30	1.45	4.64
Means																
70-79	0.28	0.36	0.65	0.14	0.19	0.34	0.73	0.81	1.49	0.78		1.21	0.35	0.19	0.54	4.22
80-89	1.06	0.48	1.54	0.21	0.19	0.40	0.91	1.09	2.00	0.88		1.29	1.37	0.27	1.64	6.86
90-93	0.85	0.42	1.27	0.22	0.38	0.60	0.73		1.45	0.30		0.39	0.70	0.28	0.98	4.68

Sources: Barrett et al (1990), Owen (1993), Shaul et al (1993), ADF&G (1988), McCullough (1993), 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 1990-91 estimated from catch and mean harvest rate of .49 (1977-88).

Appendix Table 4. Catches of chum salmon in the Yukon River in thousands of fish, 1970-1993.

	Summer chum		Fall chum				Total	Total		Escapement		
			Commercial		Subsistance		comm-	subsis-		Sum-		
Year	Commercial	Subsistance	U.S.	Canada	U.S.	Canada	ercial	tance	Total	mer	Fall	Total
70	137	167	210	2	56	2	349	225	574			
71	100	171	190	2	57	15	292	243	535			
72	136	108	152	3	36	5	291	149	440			
73	286	161	232	3	54	7	521	222	743			
74	590	228	290	3	94	9	883	331	1214	*632*	*592*	1224
75	710	212	275	2	87	19	987	318	1305	*1952*	*1394*	3346
76	601	187	156	1	72	4	758	263	1021	*1033*	*504*	1537
77	535	160	258	4	83	8	797	251	1048	*791*	*619*	1410
78	1078	188	247	3	84	7	1328	279	1607	*766*	*500*	1266
79	820	191	378	9	215	13	1207	419	1626	*696*	*997*	1693
80	1068	168	298	9	168	13	1375	349	1724	*1104*	*490*	1594
81	1280	118	478	15	189	7	1773	314	2087	*2300*	*592*	2892
82	717	118	225	11	133	5	953	256	1209	*1156*	*387*	1543
83	995	150	308	26	193	3	1329	346	1675	*902*	*523*	1425
84	866	167	211	23	175	6	1100	348	1448	*1785*	*450*	2235
85	934	159	270	36	206	5	1240	370	1610	*1648*	*636*	2284
86	1189	183	140	11	164	3	1340	350	1690	1933	583	2516
87	623	176	0	41	362	4	664	542	1206	826	596	1422
88	1620	204	137	30	141	3	1787	348	2135	1773	424	2197
89	1463	171	285	18	188	5	1766	364	2130	1604	606	2210
90	514	118	134	28	168	6	676	292	968	932	*547*	1479
91	651	120	254	31	146	4	936	270	1206	1233	*561*	1794
92	546	144	19	19	108	2	584	254	838	*1249*	*478*	1727
93	142	*150*	0	8	*150*	*5*	150	305	455	*884*	*524*	1408

Sources: ADF&G (1993), Bergstom (1993), and Schultz (1993). Escapement estimates from Appendix 5.

Appendix Table 5. Chum salmon escapement counts (in thousands) from the Yukon River.

	Summer chum salmon										
	Andreafsky River		Anvik	Rodo	Nulato River		Gisasa	Hogatza	Salcha		Total/
Year	East	West	River	River	South	North	River	River	River	Total	Anvik
74	63	34	201	16	29	29	22	*16*	4	414	2.06
75	223	236	845	25	51	87	57	22	8	1554	1.84
76	105	118	406	38	*14*	31	21	21	6	760	1.87
77	113	63	263	16	11	58	*10*	11	*6*	551	2.10
78	127	57	251	18	13	42	*12*	5	5	530	2.11
79	66	43	281	*13*	2	36	11	14	3	469	1.67
80	*131*	115	493	*16*	*11*	*22*	10	20	4	822	1.67
81	147	*120*	1486	*23*	14	*31*	*13*	*12*	9	1855	1.25
82	181	*150*	445	*16*	*13*	*29*	*15*	*14*	4	867	1.95
83	111	*88*	363	*14*	*9*	20	*10*	28	*4*	647	1.78
84	70	239	891	*37*	*30*	*72*	*38*	*23*	10	1410	1.58
85	66	53	1080	25	10	19	13	23	3	1292	1.20
86	168	99	1190	*23*	17	47	12	*17*	8	1581	1.33
87	45	36	456	*13*	4	7	2	*10*	4	577	1.27
88	69	45	1125	14	15	30	9	7	*4*	1318	1.17
89			637							*777*	*1.22*
90			404							*493*	*1.22*
91	32	47	848	4	13	12	7	10	*3*	976	1.15
92			776	4	5	12	9	3	3	*947*	*1.22*
93			518	8	5	8	2	*10*	<1	*632*	*1.22*

	Fall chum salmon							
	Toklat	Delta	Chan-dalar	Sheen-jek	Fishing Branch	Canada main-stem		Total/
	River	River	River	River	River		Total	T,D,S,F
74	43	6		90	33		*322*	*1.87*
75	91	4		173	353		*1161*	*1.87*
76	54	6		26	37		*230*	*1.87*
77	36	17		46	88		*350*	*1.87*
78	37	11		32	41		*226*	*1.87*
79	180	8		91	120		*746*	*1.87*
80	26	5		29	55		*215*	*1.87*
81	16	24		75	57		*322*	*1.87*
82	4	4	*21*	31	16	32	108	1.96
83	21	8	*54*	49	27	91	250	2.38
84	17	12	*46*	27	15	57	174	2.45
85	23	17	*57*	153	56	62	368	1.48
86	19	7	59	83	32	88	288	2.04
87	22	21	52	140	49	81	365	1.57
88	13	18	34	41	24	37	167	1.74
89	30	21	69	102	44	36	302	1.53
90	34	9	79	66	35	52	275	1.91
91	13	33	*38*	90	38	78	290	1.67
92	11	9	*34*	79	23	47	203	1.66
93	29	20	*69*	45	30	*58*	251	2.02

Italics= regression estimates from correlations in counts among locations
Although Andreafsky East and West counts were correlated, counts from other locations were uncorrelated with Andreafsky counts.
Sources: Bergstrom (1993) and Schultz (1993)

Appendix Table 6. 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	*15*	*15*	225	247	1944
71	155	131	290	99	675	124	360	151	27	15	64	*15*	*15*	243	116	1805
72	169	101	288	97	655	179	310	116	42	10	85	*15*	*15*	149	120	1696
73	379	124	518	185	1206	195	336	124	23	6	156	*15*	*15*	222	179	2477
74	628	164	883	194	1869	81	158	41	4	2	34	*15*	*15*	331	277	2827
75	564	213	987	224	1988	87	153	80	4	2	9	*15*	*15*	318	176	2847
76	160	96	758	233	1247	154	801	318	47	10	74	24	8	263	224	3170
77	193	200	797	298	1488	271	900	340	83	4	129	16	27	251	198	3707
78	119	189	1292	282	1882	275	652	185	44	1	164	13	12	279	119	3626
79	142	138	1148	296	1724	220	440	196	38	12	66	16	12	419	161	3304
80	366	181	1375	559	2481	300	682	205	79	36	700	12	20	349	165	5029
81	677	170	1773	483	3103	230	795	356	88	36	709	23	13	314	157	5824
82	416	183	953	323	1875	151	435	198	84	53	331	34	23	256	190	3630
83	176	319	1329	295	2119	323	725	352	127	105	349	10	15	346	147	4618
84	320	146	1100	489	2055	337	850	447	178	211	805	16	8	348	143	5398
85	521	135	1240	225	2121	203	397	210	127	132	667	13	*9*	370	*96*	4345
86	261	147	1340	349	2097	270	488	263	95	111	271	36	*9*	350	*142*	4132
87	109	102	664	603	1478	419	416	447	145	101	369	14	8	542	69	4008
88	353	107	1787	1444	3691	470	69	98	90	44	393	14	6	348	117	5340
89	256	43	1762	802	2863	203	446	309	129	84	157	*19*	*9*	364	122	4705
90	163	65	676	523	1427	116	306	425	128	32	126	*19*	*9*	292	96	2976
91	240	87	936	502	1765	249	466	430	71	57	191	*19*	*9*	270	82	3609
92	289	198	584	437	1508	174	313	227	114	57	332	*19*	*9*	254	85	3092
93	71	54	150	95	370	153	415	39	49	68	130	*19*	*9*	*305*	*66*	1623
Means																
70-79	267	146	731	197	1341	169	455	167	36	8	83	16	15	270	182	2740
80-89	346	153	1332	557	2388	291	530	289	114	91	475	19	12	359	135	4703
90-93	191	101	587	389	1268	173	375	280	91	54	195	19	9	280	82	2825

Yukon River includes Canadian catches; ADF&G (1993). Italics for estimates of missing data.
Other catches through 1990 are from INPFC Statistical Yearbooks (e.g. INPFC,1993) and 1991-1993 catches are preliminary from ADF&G.
Francisco et al (1993), Bergstrom (1993), Shultz (1993), Murphy (1993), and Stratton (1993).

Appendix Table 7. 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	.25	.10	.44	.12	.04	.02	.72	.05
71	.18	.14	.53	.85	.19	.12	.36	.15	.03	.02	.68	.06
72	.19	.11	.44	.74	.20	.18	.31	.12	.04	.01	.66	.08
73	.40	.14	.74	1.28	.33	.20	.34	.12	.02	.01	.69	.16
74	.66	.17	1.20	2.03	.45	.08	.16	.04	.00	.00	.28	.03
75	.59	.22	1.30	2.11	.36	.09	.15	.08	.00	.00	.32	.01
76	.18	.10	1.02	1.30	.40	.15	.80	.32	.05	.01	1.33	.07
77	.21	.23	1.04	1.48	.45	.27	.90	.34	.08	.00	1.59	.13
78	.16	.16	1.60	1.92	.37	.28	.65	.18	.04	.00	1.15	.16
79	.16	.15	1.62	1.93	.42	.22	.44	.20	.04	.01	.91	.07
80	.38	.20	1.72	2.30	.65	.30	.68	.21	.08	.04	1.31	.70
81	.70	.18	2.06	2.94	.58	.23	.80	.36	.09	.04	1.52	.71
82	.45	.21	1.20	1.86	.47	.15	.44	.20	.08	.05	.92	.33
83	.19	.33	1.64	2.16	.41	.32	.72	.35	.13	.11	1.63	.35
84	.34	.15	1.42	1.91	.57	.34	.85	.45	.18	.21	2.03	.80
85	.53	.14	1.57	2.24	.30	.20	.40	.21	.13	.13	1.07	.67
86	.30	.16	1.68	2.14	.45	.27	.49	.26	.10	.11	1.23	.27
87	**.16**	**.12**	**1.17**	**1.45**	**.64**	**.42**	**.42**	**.45**	**.15**	**.10**	**1.54**	**.37**
88	.37	.11	2.12	2.60	1.50	.47	.37	.30	.24	.09	1.47	.39
89	.27	.05	2.13	2.45	.87	.20	.52	.31	.14	.08	1.25	.16
90	.18	.07	.97	1.22	.56	.12	.31	.42	.13	.03	1.01	.13
91	.26	.10	1.21	1.57	.51	.25	.47	.43	.07	.06	1.28	.19
92	.31	.21	.84	1.36	.44	.17	.31	.23	.11	.06	.88	.33
93	.09	.06	.46	.61	.11	.15	.42	.04	.05	.07	.73	.13
Means												
70-79	.29	.15	1.01	1.45	.34	.17	.46	.17	.03	.01	.83	.08
80-89	.37	.17	1.67	2.21	.64	.29	.57	.31	.13	.10	1.40	.48
90-93	.21	.11	.87	1.19	.41	.17	.38	.28	.09	.06	.98	.20

Appendix Table 8. Western and Central Alaska chum salmon runs, 1970-1993, 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	3.3	5.2	.5	.3	1.3	1.9	1.5	5.0	10.7	4.7
71	1.3	.2	3.1	4.6	.7	.7	.9	3.1	1.9	6.6	11.9	5.9
72	1.5	.2	2.8	4.5	.6	.4	1.2	2.4	.7	4.7	9.8	6.1
73	2.2	.3	4.5	7.0	.2	1.3	1.4	.7	.4	3.8	11.0	1.8
74	1.6	.1	5.3	7.0	.0	.3	.7	.5	.5	2.0	9.0	0.0
75	1.4	.1	7.3	8.8	.1	.1	1.4	.2	.4	2.1	11.0	0.9
76	2.8	.4	4.0	7.2	.4	.5	.7	1.5	.7	3.4	11.0	3.6
77	4.0	.8	4.4	9.2	.1	.7	2.2	2.0	1.2	6.1	15.4	0.6
78	2.3	.5	4.4	7.2	.1	.7	.8	1.4	1.3	4.2	11.5	0.9
79	1.7	.4	4.9	7.0	.1	.4	1.6	1.2	1.2	4.4	11.5	0.9
80	3.3	1.5	5.6	10.4	.5	.6	.7	2.2	1.7	5.2	16.1	3.1
81	2.1	1.2	7.8	11.1	.6	2.1	2.1	2.3	2.4	8.9	20.6	2.9
82	1.3	.8	4.9	7.0	1.1	1.7	2.2	2.6	2.2	8.7	16.8	6.5
83	2.2	.7	4.9	7.8	.8	1.4	1.6	2.2	1.6	6.8	15.4	5.2
84	3.5	1.7	5.7	10.9	.3	1.5	1.2	1.6	2.4	6.7	17.9	1.7
85	2.0	1.0	5.8	8.8	.5	1.5	1.1	1.4	1.5	5.5	14.8	3.4
86	2.2	.5	5.9	8.6	.4	1.9	1.5	2.3	2.2	7.9	16.9	2.4
87	2.9	.9	4.2	8.0	.4	2.2	.6	1.5	1.8	6.1	14.5	2.8
88	2.5	.9	7.9	11.3	.5	2.3	1.1	2.4	2.5	8.3	20.1	2.5
89	2.2	.4	6.5	9.1	.5	1.2	1.0	1.6	1.0	4.8	14.4	3.5
90	1.7	.4	3.9	6.0	.5	1.3	.5	1.2	1.6	4.6	11.1	4.5
91	2.0	.5	4.6	7.1	.8	.6	.5	2.1	2.1	5.3	13.2	6.1
92	1.4	.7	4.4	6.5	.4	.6	.4	1.2	2.0	4.2	11.1	3.6
93	1.0	.4	3.1	4.5	.5	1.5	.2	1.3	1.7	4.7	9.7	5.2
Means												
70-79	2.1	.3	4.4	6.8	.3	.5	1.2	1.5	1.0	4.2	11.3	2.5
80-89	2.4	1.0	5.9	9.3	.6	1.6	1.3	2.0	1.9	6.9	16.8	3.4
90-93	1.5	.5	4.0	6.0	.6	1.0	.4	1.5	1.9	4.7	11.3	4.8

Appendix Table 9. 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	2.78	.89	3.67	7.20	9.64	7.53	28
71	13.48	3.33	16.81	2.68	.73	3.41	10.19	9.97	6.78	30
72	8.65	3.12	11.77	1.72	.48	2.20	8.64	13.37	8.84	33
73	7.45	2.52	9.97	1.09	.59	1.68	11.57	7.86	7.75	29
74	9.83	2.81	12.64	1.75	.58	2.33	12.98	9.28	12.35	37
75	8.38	3.39	11.77	1.14	.84	1.98	19.90	7.37	11.76	41
76	13.13	2.45	15.58	3.23	.74	3.97	12.39	10.44	11.43	38
77	14.28	6.17	20.45	2.65	1.64	4.29	15.19	6.00	6.23	32
78	19.17	8.04	27.21	3.74	1.66	5.40	18.18	3.80	3.49	31
79	9.87	9.93	19.80	3.54	2.60	6.14	27.96	3.28	2.86	40
80	8.58	5.98	14.56	2.01	1.50	3.51	25.70	3.10	3.17	35
81	8.37	6.51	14.88	2.36	2.34	4.70	33.54	2.54	3.09	44
82	8.07	6.21	14.28	1.62	1.75	3.37	29.95	3.22	3.52	40
83	6.85	15.25	22.10	1.87	4.35	6.22	37.07	3.08	2.61	49
84	4.39	9.35	13.74	1.20	2.52	3.72	37.79	3.28	2.52	47
85	13.93	11.34	25.27	2.84	3.37	6.21	50.93	2.84	1.57	62
86	12.76	14.77	27.53	2.87	4.16	7.03	46.02	1.93	1.04	56
87	13.50	13.76	27.26	2.96	3.48	6.44	42.66	1.82	1.09	52
88	16.30	10.50	26.80	4.25	2.47	6.72	47.21	.89	.91	56
89	16.00	8.50	24.50	4.11	2.33	6.44	50.40	.61	.75	58
90	13.89	13.18	27.07	3.28	3.40	6.68	62.27	.50	.65	70
91	14.05	3.66	17.71	3.65	1.29	4.94	51.00	.00	.00	56
92	11.20	6.40	17.60	2.89	1.88	4.77	45.90	.00	5.51	56
93			11.30			3.30	60.10			

Bering Sea is East Kamchatka plus the Anadyr River; all other runs Included in Okhotsk Sea.
Sources: Russian catches (m.t.) through 1988 from VINRO (Moscow, USSR) and 1989-1992 from TINRO (Vladivostok, Russia). Catches in number of fish from JFA via TINRO to numbers (INPFC Secretariat 1979).
Japanese catches through 1990 from INPFC Statistical Yearbooks, 1991-1993 from Y. Ishida (JFA).
1992 Japan landbased catch is within Russian 200 mi zone.

Appendix Table 10. Kamchatkan sockeye salmon runs (in thousands), 1957-1993.

	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	1400	4400	5800	8151	2351	600	1500	2100	8541
93									7000

Source: 1957-1991, V. Bugaev (TINRO), 8/18/92; 1992 from NPAFC Doc. 41.
Total Russian run estimated from sum of Ozernaya and Kamchatka runs divided by .925
1993 run preliminary expanded from catch only.

Appendix Table 11. Russian catches of chum salmon (1,000s 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	332	978	1724	4943			17.7	
92	563	1314	371	0	971	405	1148	4772			17.6	
93								3330			11.3	

1992 from TINRO (NPAFC Doc. 41); 1993 from TINRO via O.A. Mathisen (Oct. 1993).

Appendix Table 12. Age, weight and length statistics for chum salmon in the South Unimak catch, 1993.

	Age 0.2		Age 0.3		Age 0.4		Age 0.5		Total
Unimak 6/13-17									
Number		500		93000		71200		500	165200
Sample size		1		183		140		1	325
Mean length		50.0		56.1		59.3		59.5	57.2
Std Dev				2.9		3.3			
Mean weight		1.77		2.77		3.25		3.72	2.97
Std Dev				.54		.63			
Sample size		1		183		140		1	325
	Male	Female	Male	Female	Male	Female	Male	Female	
Unimak 6/19									
Number	1300	1300	18900	15700	7600	5700	600		51100
Sample size	2	2	30	25	12	9	1		81
Mean length	49.1	50.5	54.6	53.3	59.7	55.0	57.5		54.8
Std Dev			3.5	3.7	34.5	3.3			
Mean weight	1.43	1.72	2.26	2.16	3.41	2.41	3.04		2.39
Std Dev			.66	.47	.93	.52			
Sample size	2	2	30	25	12	9	1		81
Unimak 6/20									
Number	400	600	21500	25500	10600	8500	400	200	67700
Sample size	2	3	114	135	56	45	2	1	358
Mean length	49.2	51.7	56.1	54.9	59.7	58.0	65.5	58.2	56.4
Std Dev			3.3	3	3.2	3.6			
Mean weight	1.61	1.93	2.66	2.46	3.20	2.92	3.77	2.90	2.70
Std Dev			.59	.47	.60	.65			
Sample size	2	3	114	135	56	45	2	1	358
Unimak 6/22									
Number		400	20300	28700	14600	8900			72900
Sample size		1	46	65	33	20			165
Mean length		55.0	56.2	54.7	58.3	57.3			56.2
Std dev			2.2	2.2	3.2	3.1			
Mean weight		2.31	2.67	2.35	2.97	2.79			2.62
Std dev			.44	.37	.59	.54			
Sample size		1	46	65	33	20			165
Unimak 6/26-29									
Number	400	200	7400	7100	4000	5700	200		25000
Sample size	2	1	39	37	21	30	1		131
Mean length	47.4	49.3	56.2	54.5	58.9	59.2	55.8		56.6
Std dev			2.7	2.7	2.4	5.0			
Mean weight	1.14	1.13	2.62	2.36	3.09	3.21	2.31		2.72
Std Dev			.50	.51	.59	1.15			
sample size	2	1	39	37	21	29	1		130
Unimak total									
Number	2100	2500 0	68100	77000	36800	28800	1200	200	381900
Mean length	48.8	51.4	55.7	54.5	59.1	57.4	59.9	58.2	56.5
Mean weight	1.41	1.82	2.55	2.35	3.14	2.84	3.16	2.90	2.76

Appendix Table 13. Age, weight and length statistics for chum salmon in the Shumagin Is. catch, 1993.

	Age 0.2		Age 0.3		Age 0.4		Age 0.5		
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Shumagin 6/13-20									
Number	300		9700	16300	10700	4400	300	300	42000
Sample size	1		31	52	34	14	1	1	134
Mean length	57.0		56.8	55.4	58.9	58.7	57.8	65.3	57.1
Std dev			2.8	2.5	3.2	4.4			
Mean weight	2.54		2.38	2.27	2.70	2.88	2.59	4.13	2.49
Std dev			.51	.40	.67	.88			
Sample size	1		31	52	34	14	1	1	134
Shumagin 6/21									
Number		100	3400	5700	2900	2800		100	15000
Sample size		1	26	44	22	21		1	115
Mean length		53.4	55.9	53.9	58.0	59.8		67.5	56.3
Std dev			2.8	2.6	2.7	4.8			
Mean weight		2.31	2.61	2.21	2.75	3.12		5.31	2.60
Std dev			.52	.35	.46	.84			
Sample size		1	26	44	22	21		1	115
Shumagin 6/26-28									
Number	800		28300	27900	17500	16000	1200	1600	93300
Sample size	2		71	70	44	40	3	4	234
Mean length	50.0		54.9	54.5	58.5	57.1	64.6	66.3	56.1
Std dev			2.9	2.6	3.1	3.1			
Mean weight	1.79		2.51	2.36	3.02	2.71	3.69	4.20	2.62
Std dev			.46	.38	.57	.58			
Sample size	2		71	70	44	40	3	4	234
Shumagin total									
Number	1100	100	41400	49900	31100	23200	1500	2000	150300
Mean length	51.9	53.4	55.4	54.7	58.6	57.7	63.2	66.2	56.4
Mean weight	1.99	2.31	2.49	2.31	2.88	2.79	3.47	4.25	2.59