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# ALASKA PENINSULA SALMON

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## Acknowledgments

M. Ferguson and M. McPhee collected scales and took length and weight measurements at King Cove and B. Rogers aged the scales and examined for scale holes. C. Foote, J. Griffith, J. Miller, and M. Adams of FRI, and T. Clark and L. Walters of the Alaska Department of Fish and Game (ADFG) assisted in field sampling at Bear Lake and B. Rogers counted zooplankton samples. Thanks also to A. Shaul, C. Swanton, C. Hicks, and B. Cross of ADFG for providing preliminary 1996 catch and escapement statistics.

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## Key Words

sockeye salmon, chum salmon, False Pass, Bristol Bay, Bear Lake

# ALASKA PENINSULA SALMON

D.E. Rogers and K. Ramstad

## Introduction

The salmon fisheries on the Alaska Peninsula have a long history dating back to the early 1900s. The June fisheries in the Shumagin Islands and south of Unimak Island (Fig. 1), which are collectively called the False Pass fishery or South Peninsula June fishery, target on non-local sockeye salmon (*Oncorhynchus nerka*) primarily bound for Bristol Bay (Eggers et al. 1991, Rogers 1990). Non-local chum salmon (*O. keta*) are also caught by the purse seine and gillnet fleets. In recent years, the June fisheries have been restricted by quotas on both species. After June, most of the gillnet fleet moves to the north side of the Peninsula to target on local stocks of sockeye while the seine fleet targets primarily on pink salmon in August.

The salmon fisheries on the Alaska Peninsula have frequently been subject to proposed restrictions at annual meetings of the Alaska Board of Fisheries by fishers from other areas of Alaska. Claims are often made that catches of non-targeted salmon (chum salmon in the June fishery, sockeye and coho salmon in the post-June fishery, and Bristol Bay sockeye in the northside fishery) have significantly impacted other coastal fisheries.

Since 1992, we have (1) sampled the chum salmon catches in the False Pass fisheries to measure biological attributes (age, length, weight, condition), (2) estimated the annual runs of sockeye and chum salmon in the North Pacific, and (3) estimated the relative impact of the False Pass catches on coastal stocks. Since 1995, we have (1) examined the spacial and temporal distribution of Bristol Bay sockeye off the north coast of the Alaska Peninsula, (2) compared the biological characteristics between local North Peninsula stocks and Bristol Bay stocks, (3) compared the age compositions in the two fisheries, and (4) investigated the salmon productivity of the North Peninsula with studies of Bear Lake, the largest producer of sockeye salmon on the Alaska Peninsula.

This report summarizes the results of investigations in 1996. For the most part, this means adding one more line to existing data sets (Rogers 1996a and 1996b); however, some new observations were made at Bear Lake where we are describing the biological characteristics of the early and late runs as well as rearing conditions in the lake. The data collected in connection with this study are expected to better our understanding of the population dynamics of Bear Lake sockeye and productivity characteristics of the system itself.

## Methods

### False Pass

The accuracy of estimates for annual runs (catch and escapement) of sockeye and chum salmon to major North Pacific regions is 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 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 1996 catch and escapement statistics provided by Alaska Department of Fish & Game (ADFG) area management biologists.

Annual runs of chum salmon to North Pacific regions from 1970 to 1996 were estimated primarily from catch and escapement statistics that were presented in Rogers (1995). Sockeye salmon exploitation rates were used 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 used to estimate escapements in years when only spawning survey counts were available (Rogers 1994). Expanded aerial survey and weir counts from selected spawning areas were used to estimate escapements in the Kotzebue, Norton Sound, and Kuskokwim regions. 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 1996 False Pass catches (June 15–30) 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. Chum without scales in the preferred region were not included in the samples; these chum were usually the smaller fish. The first samples were collected from the June 19 catches and the last samples collected from the June 26 catches. Data from the field forms (date, location, scale card number, fish number, sex, length, and weight) were entered on to 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 was tutored by Brian Bigler (Wards Cove Packing Co., Seattle, Washington) on the identification of focal scale resorbtion (Bigler 1988, 1989). Ages and occurrences of scale holes were then added to the computer database. Data were stratified by location (South Unimak and Shumagin Islands), 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 and then multiplied by 100. 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 Campbell et al. (1997). Mr. A.R. Shaul (ADFG, Kodiak, Alaska) provided preliminary catches by gear, area, and date for 1996. These preliminary catches were used to weight stratified means (length, weight, age compositions) to obtain the annual means for 1996.

## *North Peninsula*

Bristol Bay run timing past Port Moller was estimated annually (1987–96) by combining inshore run statistics collected by ADFG (e.g., Stratton and Crawford 1994) with statistics from the Port Moller test boat catches collected by Fisheries Research Institute (FRI) (Rogers 1995). The test boat catches were also used to examine annual variation in the onshore–offshore distribution of the Bristol Bay run along the North Peninsula, the age composition of sockeye, and the sockeye/chum species composition.

The annual age compositions of sockeye salmon caught in the North Peninsula fisheries were provided by weekly periods for two subdistricts: Bear River (Harbor Point to Cape Seniavin) and Ilnik/Three Hills (Cape Seniavin to Strogonof Point). Age compositions from the subdistricts were averaged through July 11 by weighting the subdistrict compositions by the catch (Murphy et al. 1996). Age compositions for North Peninsula escapements were estimated by weighting the individual river age compositions by the number in the escapement and age compositions in the Bristol Bay catches were calculated from annual run statistics provided by B. Cross (ADFG, Anchorage).

Limnological and fish sampling was conducted in Bear Lake using the same methods employed in our Bristol Bay research. Chlorophyll *a* concentrations were calculated from water samples collected at station 2 (Fig. 2). Water samples were collected from seven depths between 1 and 20 m on our first (7/2) and last (8/24) sampling trips. On the same dates, vertical temperature profiles were taken to 55 m. Six vertical hauls were made (0.5-m net, #6 mesh) on five dates between 6/29 and 8/24 to measure zooplankton density; three sets of six beach seine hauls with a 37-m x 4-m net were made between 6/29 and 7/30 to measure the relative abundance and species composition of fish along the shoreline. In addition, four gillnet sets and two minnow trap sets were made during our first sampling trip (6/29 to 7/1) to identify the resident fishes of Bear Lake.

Adult sockeye salmon were collected randomly from the early (7/1–2) and late (8/22–23) escapement at the Bear Lake ADFG weir. Morphological parameters were recorded including mid-eye to tail fork length, body weight, body depth, and caudal depth from a total of 60 early (36 male, 24 female) and 51 late (30 male, 21 female) sockeye. Twenty-six early female sockeye and 21 late female sockeye were collected for fecundity analyses. Fin clips were taken and preserved in ethyl alcohol from 100 sockeye (50 males, 50 females) each of the early and late sampling periods for genetic analysis. In addition, 57 sockeye (30 males, 27 females) were collected on 7/1 and caged.

The two cages, one containing females, the other containing males, were subsequently sunk offshore in Bear Lake (Fig. 2). These fish were monitored to determine their seasonal time of maturation. Two indices of maturation were used in this study. All fish sampled were assigned a maturity code based on skin color ranging from 1 to 4: 1 for an entirely silver or gray fish and 4 representing a fish with full red and green spawning coloration. In addition, the flesh of sockeye changes from orange/red to a light beige as they mature (Crozier 1970); therefore, all dead fish were also scored against the Hoffman-LaRoche color card for salmonids, which classifies flesh redness on a scale of 11 to 18 (11 = beige and 18 = dark red). Maturity scores were used to control states of maturity between early and late fish in comparisons of morphology, fecundity, egg size, and time of maturation in early and late-run sockeye.

## RESULTS

### *False Pass*

Abundance.—The False Pass sockeye salmon catch is regulated by a quota set at 8.3% of the forecasted Bristol Bay catch. In the last 10 years, the quota has been caught only 50% of the time and the catch has never reached 8.3% of the actual Bristol Bay catch (Table 1). Three factors contribute to the inability of the fishery to achieve an allotment of 8.3% of the Bristol Bay catch: (1) the tendency of preseason forecasts to be too low, (2) a high abundance of chum salmon with a low chum salmon cap (quota), and (3) the availability of migratory Bristol Bay sockeye. Over the past 3 years, the low availability of Bristol Bay sockeye has been the main factor. Although the runs were fished nearly every day (Table 2), the 1994–96 catches were about 2 million fish short of the quotas. The False Pass fishery depends only on those Bristol Bay sockeye that are returning from ocean rearing in the Gulf of Alaska (Rogers 1987). Most Bristol Bay sockeye begin their homeward migration west of the fishery (south of the Aleutian Islands). A shift in the oceanic distribution from east to west or a shift from a nearshore to an offshore migratory route would result in a lower availability to the Shumagin and South Unimak fisheries.

The 1990 and 1994–96 observations were omitted as outliers, resulting in the CPUE of sockeye salmon at South Unimak explaining 61% of the annual variation in the Western Alaska runs (Fig. 2). This correlation was very good and provided a method of forecasting the Bristol Bay run about 2 weeks in advance of its arrival in the bay (Eggers and Shaul 1987). Although the sockeye CPUE no longer appears reliable as a forecast tool, the age composition of the sockeye catch at False Pass has been useful in forecasting the Bristol Bay runs (Table 3). In contrast, the chum salmon catches at False Pass have shown no correlation with the chum runs to western Alaska even though these stocks were the most abundant stocks in the 1987 tagging. Chum 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 (except 1995), and increased for Asian (primarily Japanese hatchery) stocks.

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 4 and Fig. 3). The chum percentage in the False Pass catch of 1996 was a little below average whereas the chum percentage in Western Alaska was a little above average. Both runs were exceptionally large in 1995. In 1996, however, chum salmon were as scarce in the False Pass fisheries as sockeye, and while sockeye salmon abundance in 1996 was down from recent years, it was still well above the historical average (Tables 5 and 6). Bering Sea runs of chum salmon were only a little above average in 1996; however, the Japanese hatchery returns were the highest on record and total chum abundance in the North Pacific was nearly as large as the record run in 1995 (Tables 7 and 8). The impact of Japanese chum salmon on the False Pass fishery is evident in the correlation of 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 40% of the annual variation in the differences in False Pass and western Alaska chum salmon percentages (Fig. 4). With increases in the number of Japanese hatchery chum salmon, the False Pass catches have contained a higher percentage of chum salmon than expected based on the percentages of chum salmon in the Western Alaska runs.

Age, weight, and length.—About 97% of the chum salmon caught in the 1996 South Unimak and Shumagin fisheries were ages 0.3 and 0.4; however, there were higher percentages of older (age 0.5 and 0.6) female chum salmon in 1996 than in past years (Table 9). Chum salmon in 1996 were larger than in past years and condition factors in the Shumagin samples were the highest recorded. In 1996, the False Pass chum were again much larger at each age than the average chum salmon in the Nushagak (Bristol Bay) catch (Table 10).

In the Nushagak catch, annual mean lengths of 3-ocean chum salmon and 3-ocean sockeye salmon have been significantly correlated (1967–1996, $r = 0.80$). Nushagak and other Bristol Bay sockeye have been smaller than average since the consecutive large runs that began in 1989 (Fig. 5). The annual sizes of Bristol Bay 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). In the Nushagak catch, 3-ocean chum salmon tend to be shorter and lighter than 3-ocean sockeye salmon; however, this was not the case in 1996 as Nushagak chum were the largest since 1988. Annual mean lengths of Nushagak chum have been more closely correlated with the numbers of sockeye in the western Alaska runs ($r = .77$) than were the mean lengths of Nushagak sockeye ($r = .75$). There was no significant correlation between chum salmon mean lengths and Nushagak chum or sockeye runs (Table 10). Chum and sockeye salmon returning to Bristol Bay over the past 8 years would likely have been even smaller if the spring weather since 1989 had not been warmer than normal (Fig. 6). Early Bristol Bay runs have been associated with warm spring weather and late runs with cold spring weather; however, the late run in 1994 was associated with average spring temperatures.

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 1996 are given in Table 11. For the combined samples, 1.15%, 1.53%, 2.25%, and 1.78% of the chum salmon had scale "holes" for 1992, 1993, 1994, and 1995, respectively (Rogers 1996b). Thus, the 1996 samples with a combined percentage of 1.52% was typical of the past years.

Assuming that the incidence of focal scale resorbtion is zero in Alaskan stocks and ~11.8% in Asian stocks (Murphy 1993), the Asian stock contribution has been close to the 20% figure estimated 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 of scale holes in Asian stocks. 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, but this was not the case in 1996 (South Unimak 1.78% and Shumagins 1.30%). The low availability of chum salmon in 1996 probably affected these percentages because the Japanese chum salmon abundance was at a record level.

## North Peninsula

Abundance and Distribution.—Last year, we described the sockeye salmon fisheries along the north side of the Alaska Peninsula and the offshore migration of Bristol Bay salmon into the bay and the inshore migration out of the bay for Ugashik and North Peninsula stocks (Rogers 1996a). The 1996 runs, while down somewhat from recent years (Fig. 7), were still large, and harvest rates were again higher for the Egegik (87%) and Ugashik (78%) runs than for the combined North Peninsula runs (70%). Harvest rates on the North Peninsula stocks were especially low during June, and catches were below average in August as a result of a rather weak Bear River late run (Fig. 8).

The vulnerability of Bristol Bay sockeye salmon to the North Peninsula fisheries from Port Moller to Ilnik is dependent on the offshore distribution and timing of the Bristol Bay run. The Port Moller test fishery offers a measure of offshore distribution. During June 1996, it appeared that Bristol Bay sockeye would be quite vulnerable to the nearshore North Peninsula fisheries; however, by July the Bristol Bay sockeye had shifted to a more typical offshore distribution (Fig. 9). In 1995, when the distribution was well offshore (station 0 is 3 mi and station 10 is 53 mi from the coastline), plankton (food) abundance and salinity were greater at the outermost stations. No plankton sampling was conducted in 1996; however, surface salinities were consistently higher at all stations in 1996 (Table 12). The nearshore salinities in 1996 were greater than the farthest offshore salinities measured in 1995. The higher inshore salinity in 1996 may have caused the greater inshore distribution of Bristol Bay sockeye during June, if sockeye prefer higher saline water. The 1996 Bristol Bay run was earlier than average and that would also lead to a low vulnerability of Bristol Bay sockeye to the North Peninsula fisheries (Table 13). The reconstructed Bristol Bay run off Port Moller indicates that 90% of the run had passed Port Moller by July 4 in 1996 (Table 14).

Age composition.—A comparison of the age compositions of sockeye salmon in the North Peninsula fisheries to the compositions in the offshore Port Moller test boat catches, the Bristol Bay inshore catches, and the North Peninsula escapements provides another measure of the possible contribution of Bristol Bay sockeye to the local fishery. The age compositions in the local escapements differ significantly among rivers. Bear River and Nelson Lagoon stocks have a preponderance of age-2.2 and -2.3 sockeye, while Sandy River sockeye are mostly ages 1.2 and 1.3 and Ilnik sockeye contribute a high percentage of age-0.3 fish (Table 15). These differences in age compositions were reflected in the 1996 catches in the Harbor Point to Strogonof Point districts as the freshwater age shifted from younger to older during the course of the season (Table 16). This shift in age generally corresponds to the timing of the contributing stocks. The August catch contained mostly ages 2.2 and 2.3 as did the late Bear River escapement (Table 17). The age composition of the sockeye caught in the offshore test fishery at Port Moller in 1996 was again closely comparable to the age composition of the inshore Bristol Bay catch; however, both catches differed from the age composition in the North Peninsula catch (Table 18). It was difficult to construct a weighted escapement age composition for the North Peninsula to match the catch because the fishery extends over a long coastline where stocks with differing ages contribute at different rates depending on the run timing. The estimated escapement age composition in 1996 was quite different than the composition in the June to early-July catch.

Sockeye productivity.—During the 1990s, the sockeye salmon runs to the Northern District averaged 3.7 million (2.8 million catch and .9 million escapement). These recent runs and escapements appear very high considering that the total surface area of lakes in the district is only 96 km$^2$ (Honnold et al. 1996). Adjusted for lake surface area, the runs averaged 39,000 fish/km$^2$ and escapements averaged 10,000 fish/km$^2$. For comparison, the Ugashik sockeye runs averaged 13,000 fish/km$^2$ and the escapements averaged 4,000 fish/km$^2$. The Ugashik Lakes, with 385 km$^2$ of surface area, are four times larger than the combined Northern District lakes (Burgner 1991); however, small lakes tend to be more productive per unit of surface area than large lakes. Bear Lake, with a surface area of 25.6 km$^2$, has produced nearly half of the Northern District runs in the 1990s, or about 79,000 fish/km$^2$, and the Bear Lake escapements averaged 20,000 fish/km$^2$. Satsup Lake (Nelson Lagoon), with a surface area of 11 km$^2$, had average runs of 59,000 fish/km$^2$ and escapements of 25,000 fish/km$^2$ during the 1990s. For comparison, nearby Chignik Lake (22 km$^2$) averaged runs of 66,000 fish/km$^2$ and escapements of 15,000 fish/km$^2$ while Ayakulik lake on Kodiak Island (8 km$^2$ surface area) had average runs of 122,000 fish/km$^2$ and escapements of 43,000 fish/km$^2$ during the 1990s. Therefore, the recent sockeye productivity of the lakes in the Northern District appear to be in line with other lakes of comparable size in southwestern Alaska.

Age, length, and weight statistics from Bear Lake sockeye salmon smolts were summarized from data presented in Honnold et al. (1996) and compared with smolt statistics from Bristol Bay lake systems presented in Crawford and Cross (1994) and Crawford et al. (1992). Bear Lake smolt were second only to Egegik smolt in average body size as most Bear Lake smolt migrate to sea at age 2 (Table 19). Marine survival tends to increase with larger and older smolts and, although no direct measure of smolt-to-adult survival is available for Bear Lake, one would expect marine survival to be at least comparable with that experienced by Egegik smolt (21% average).

Bear Lake limnology and fish survey.—A paucity of fish and zooplankton species was again observed this season in Bear Lake. Only two major species of zooplankton, *Cyclops* sp. and *Bosmina* sp., were caught (Table 20). Four species of fish were represented in the gillnet and minnow trap catches this year including sockeye salmon, coastrange sculpin (*Cottus aleuticus*), coho salmon (*O. kisutch*) and Arctic char (*Salvelinus alpinus*) (Table 21). The previous year's survey revealed the presence of ninespine sticklebacks (*Pungitius pungitius*) and Alaska blackfish (*Dallia pectoralis*) in Bear Lake as well. The Arctic char collected appeared to be of two different phenotypic forms. Few juvenile sockeye were captured in beach seining in 1996, which was probably caused by the early spring and early movement out of the littoral zone prior to the initiation of our sampling program. Forty-one sockeye smolt were captured; the range of lengths (95–177 mm) suggests that the potential exists for very high growth rates of sockeye juveniles while rearing in the lake.

Total zooplankton abundance changed little throughout the season. *Cyclops* abundance peaked early in the season and decreased through August. *Bosmina* were present throughout the season as well with their numbers peaking in late August. Bear Lake had a uniform temperature of 6°C from the surface to 55 m early in the season (July 7). Later in the season (August 23), surface waters warmed to 10°C with a subsequent decrease to 6°C with depth (Table 22). Water clarity exhibited a drop near the end of the season, with Secchi depths ranging from 6 to 9 m between June 29 and August 8 and measuring at 5 and 5.5 m on August 23.

Zooplankton and phytoplankton standing crop (chlorophyll *a*) were higher in Bear Lake than in Lake Aleknagik (Rogers et al. 1997) but somewhat lower in comparison to Chignik Lake. Water clarity (Secchi depth) was consistently lower in Bear Lake than in Lake Aleknagik but not as low as in Chignik Lake.

Early and late Bear Lake escapements.—Preliminary results support the hypothesis of multiple runs of sockeye salmon in Bear Lake. Age structures of the early and late escapements differ significantly. The primary age classes of the early and late escapements are typically 2.3 and 2.2; however, ages 1.2 and 1.3 are more abundant in the early run and age 2.1 (jacks) is more abundant in the late run (Table 17). Analysis of covariance (Table 23) revealed that among males, caudal depth relative to length differed significantly ($p < 0.001$) between early and late sockeye. Similarly, among females, early and late season sockeye differed significantly in body depth relative to length ($p = 0.028$) and body weight relative to length ($p < 0.001$). Early-run females were relatively deeper bodied and heavier than late-run females.

The majority of the 57 sockeye that were caged on July 1 died between July 13 and July 30, at which time about 8–10 sockeye were alive and all were either beginning to mature or fully mature. The cages were again raised on August 9, three fish remained alive and all were fully mature as displayed by skin color (maturity code 4), flesh color (Hoffman-LaRoche color code <11 to 13) and free emission of eggs and milt when handled. In contrast, sockeye salmon collected from the late escapement on August 22–23 were not yet sexually mature: their skin color indicated the majority of fish at a maturity code of 1 and their flesh color at a Hoffman-LaRoche code of 15.5 to 17.

## Discussion

### False Pass

The catch of chum salmon in the 1996 False Pass fisheries (360,000) was well below the chum salmon cap of 700,000 in spite of an above-average run of chum to western Alaska and a record Japanese chum run. Although there was another large sockeye salmon run to Bristol Bay of 37 million, the False Pass fishery was only able to catch about 1 million (one-third of the preseason quota). In a normal year, ~25% of maturing Bristol Bay sockeye return from the central and eastern Gulf of Alaska, and many of these pass through the Shumagin and South Unimak fishing districts (Rogers 1987). In 1990, 1994, 1995 and again in 1996, a smaller than normal proportion of the Bristol Bay run returned from the Gulf of Alaska or the sockeye returning from the Gulf of Alaska migrated farther offshore than normal. The percentage of chum salmon in the catch (26%) was about average in 1996 but still 50% above the percentage of chum in western Alaska (17%). There was a record abundance of Japanese chum salmon and large runs of chum to other areas; however, as was the case with sockeye, chum were not very available to the False Pass fisheries in 1996.

### North Peninsula

A combination of early run timing and an offshore distribution in early July made it very unlikely that Bristol Bay contributed a significant number of sockeye salmon to the North Peninsula fisheries in 1996. The age composition in the North Peninsula catch differed from the compositions in the offshore test boat catches and the Bristol Bay catches (which were very similar), also indicating a lack of a significant contribution of Bristol Bay sockeye to the local fishery.

The small Alaska Peninsula lakes have been producing more sockeye salmon per unit of lake surface area than the much larger Bristol Bay lakes. A striking feature of Bear Lake is the very low number of fish and zooplankton species present in this system. Six species of fish have been documented through collection efforts, and two others—pink salmon and chum salmon—have been observed in Bear River. This is in contrast to other sockeye-supporting lakes in southwestern Alaska, which typically have several additional species of freshwater fishes including whitefishes, smelts, and lampreys (Burgner et al. 1969). The threespine stickleback (*Gasterosteus aculeatus*) is notably absent in Bear Lake although it is ubiquitous in Bristol Bay lakes and found in Chignik as well. The absence of the threespine stickleback may contribute to the quality of the lake as a rearing area for juvenile sockeye as they are known to be a major competitor for food (Burgner 1987). Similarly, the lack of many predatory fishes typically found in sockeye lakes, such as rainbow trout, lake trout, and northern pike, may also enhance the survival of young sockeye within the lake rearing environment. Arctic char appear to be present in large numbers and are likely the primary predator of sockeye fry and smolt in Bear Lake.

The species assemblage of zooplankton is equally impoverished. The presence of only two primary species is markedly different from other lakes of southwestern Alaska, which typically have five or more species of zooplankton. Total volumes of zooplankton, however, are within the range of those found in Bristol Bay lakes suggesting that what the zooplankton community in Bear Lake may lack in diversity is compensated for in abundance primarily by *Cyclops* in spring and *Bosmina* in late summer. Phytoplankton standing crop as measured by chlorophyll *a* also places Bear Lake within the range of productivity found in the Bristol Bay lakes and Chignik Lakes.

Bear Lake temperature appears to be mixed throughout the summer season; there is little evidence of a thermocline between the surface and 55 m. Intense wind in this region likely prevents a strong thermocline from developing. There is some evidence to suggest that ice cover is not a strictly annual event at Bear Lake, which may also be due to high winds. Intermittent freezing over and warmer winter temperatures than those that prevail in Bristol Bay may allow for a longer growing season at Bear Lake than is observed Bristol Bay lakes. In addition, decreased predation and competition and high food availability may contribute to high-quality rearing conditions for sockeye salmon in the lake; however, the most important factor for enhanced survival would seem to be the predominance of large age-2 smolts in the annual migrations.

Preliminary results presented here suggest differences in seasonal time of maturity, age structure, and morphology between sockeye salmon of the early and late escapements at Bear lake. Although a high mortality was experienced with the caged fish, results suggest that the sockeye of the early escapement likely mature in late July and early August while the late sockeye mature at least 2 weeks after August 23. Age structure of the early and late escapements, as well as morphology, continue to be analyzed. Preliminary findings, however, support the hypothesis that there are two seasonally separated and distinct runs of sockeye within Bear Lake.

Fecundity, scale pattern, and genetic analyses are currently underway. Scale data will allow for comparisons of growth at each year of life and time spent in the freshwater phase between early and late sockeye salmon. The genetic portion of the study may provide concrete evidence of genetic differentiation and reproductive isolation between the early and late runs and, therefore, enable us to approach important questions on the population level, such as minimum effective population size for each of the runs.

Further study of resource partitioning within the lake on a spatial and temporal basis is recommended. More data regarding growth of fry and size of smolts could also prove useful. Climatalogical data is generally lacking for this area. Remote sensing temperature meters were installed by FRI in the lake this past season. Consistent monitoring of ambient temperature and date of ice out (or lack of ice) would also be of use in testing the observations presented here.

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# Figures

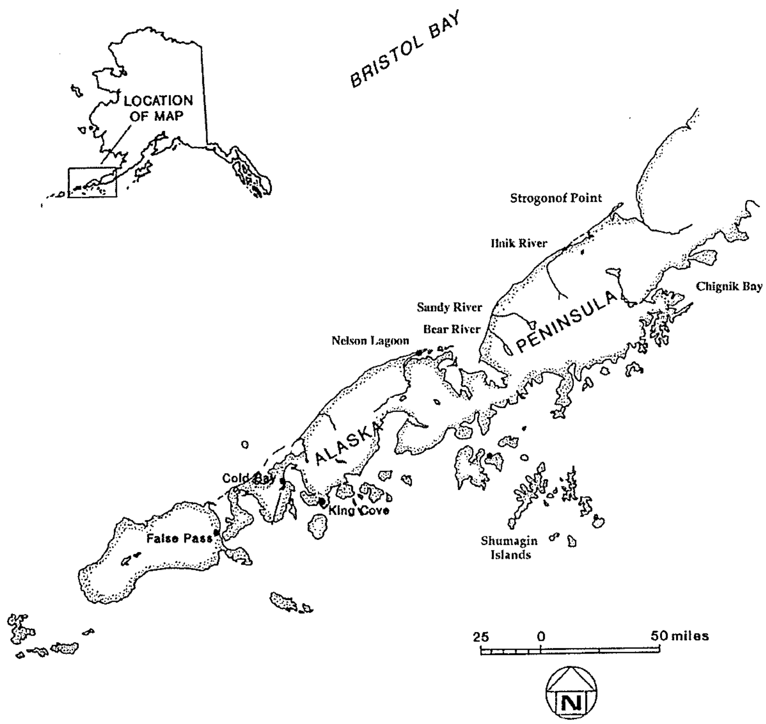


Figure 1. Bristol Bay and the Alaska Peninsula.

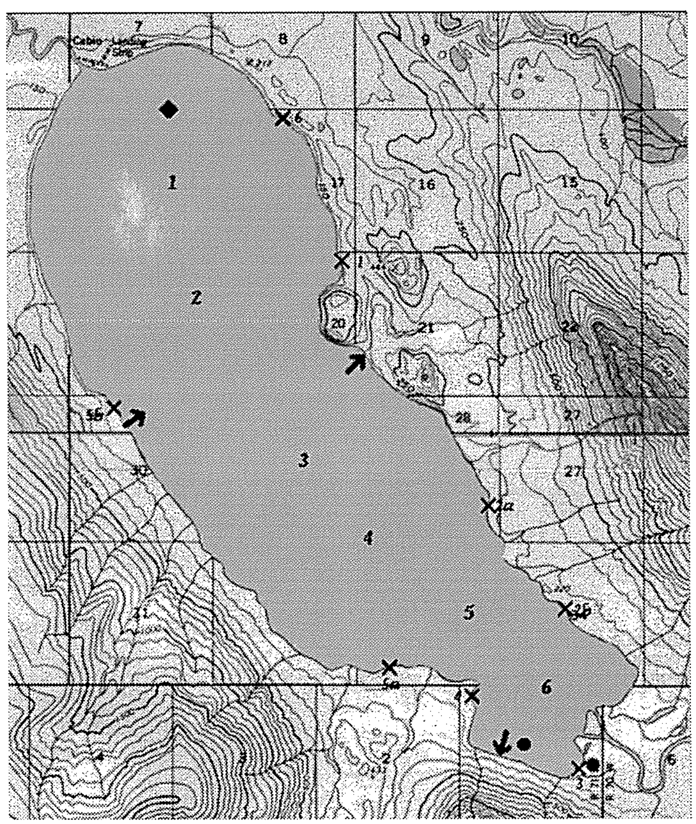

Figure 2. Sampling sites on Bear Lake: ✕ = beach seining sites, ➔ = gillnet sites, ● = minnow trap sets, and ◆ = cage deployment ); limnology sites are numbered.

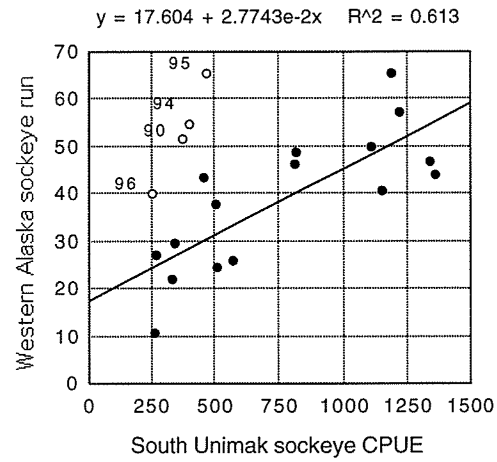


Figure 3. Western Alaska sockeye runs regressed on South Unimak catch per unit effort.

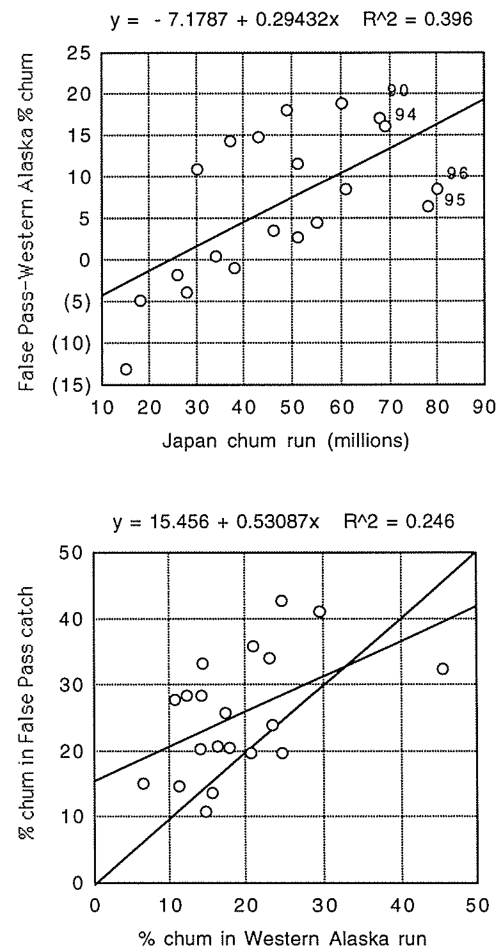


Figure 4. Top: Differences in the percentage of chum salmon in the False Pass catch and in the Western Alaska run regressed on the Japanese hatchery run. Bottom: The percentage of chum salmon in the False Pass catch plotted on the percentage of chum in the Western Alaska run.

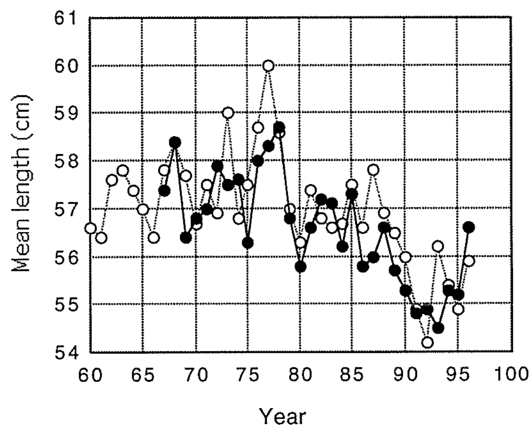


Figure 5. The annual mean lengths of 3-ocean sockeye and chum salmon in the Nushagak catches. O = sockeye (age 1.3); ● = chum (age 0.3).

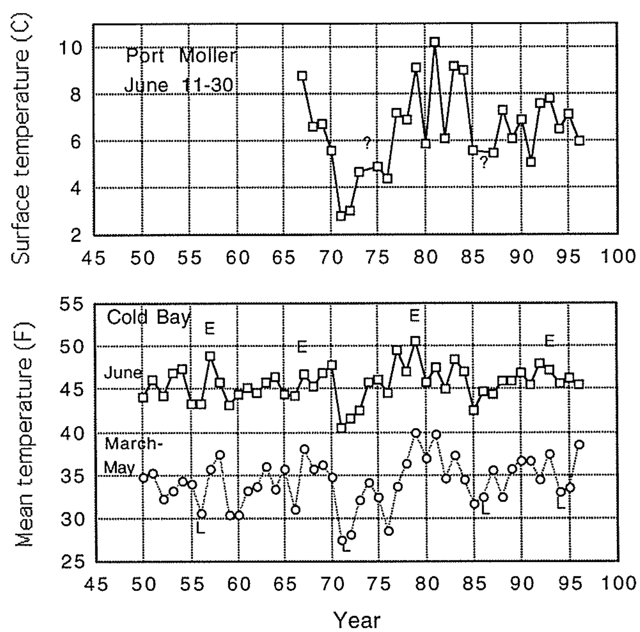


Figure 6. Annual air temperatures at Cold Bay and water temperatures at Port Moller.

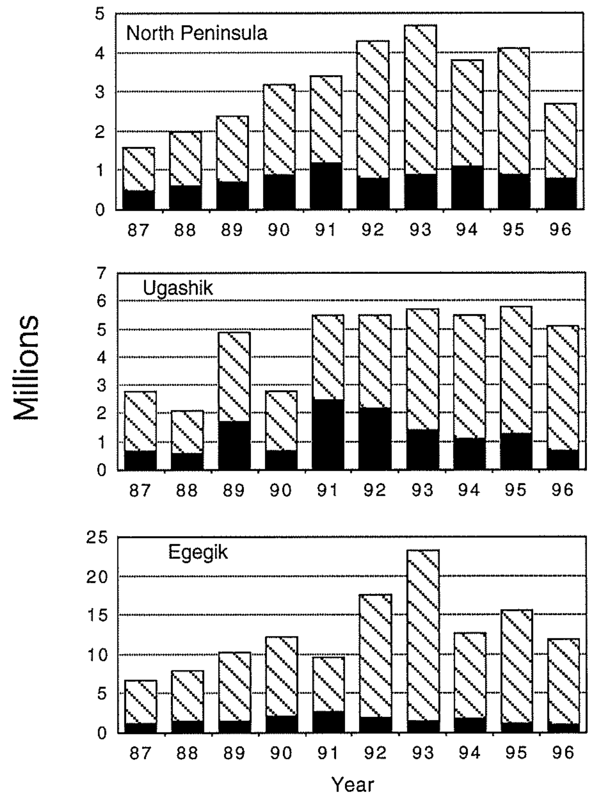


Figure 7. Annual sockeye salmon runs to Egegik, Ugashik, and the North Peninsula. Solid bars = escapement; pattern-fill bars = catch.

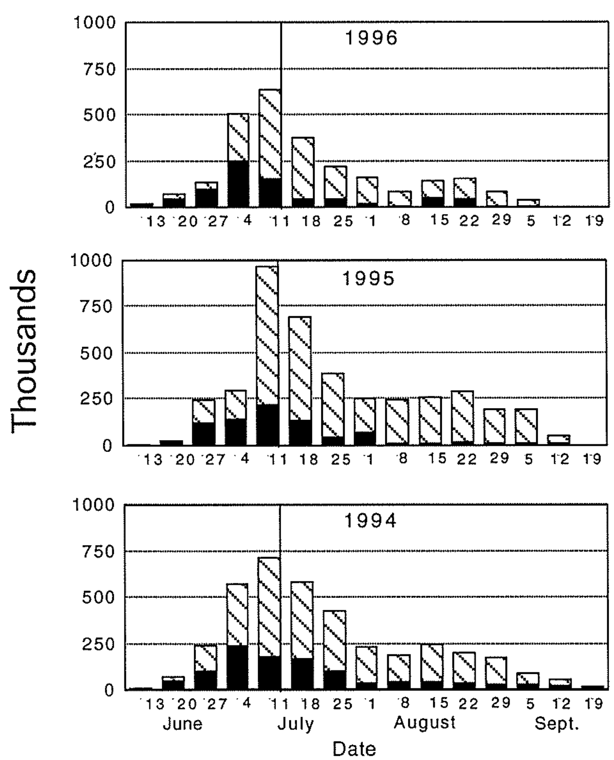


Figure 8. Northern District sockeye salmon catches and escapements, 1994–96. Solid bars = escapement; pattern-fill bars = catch.

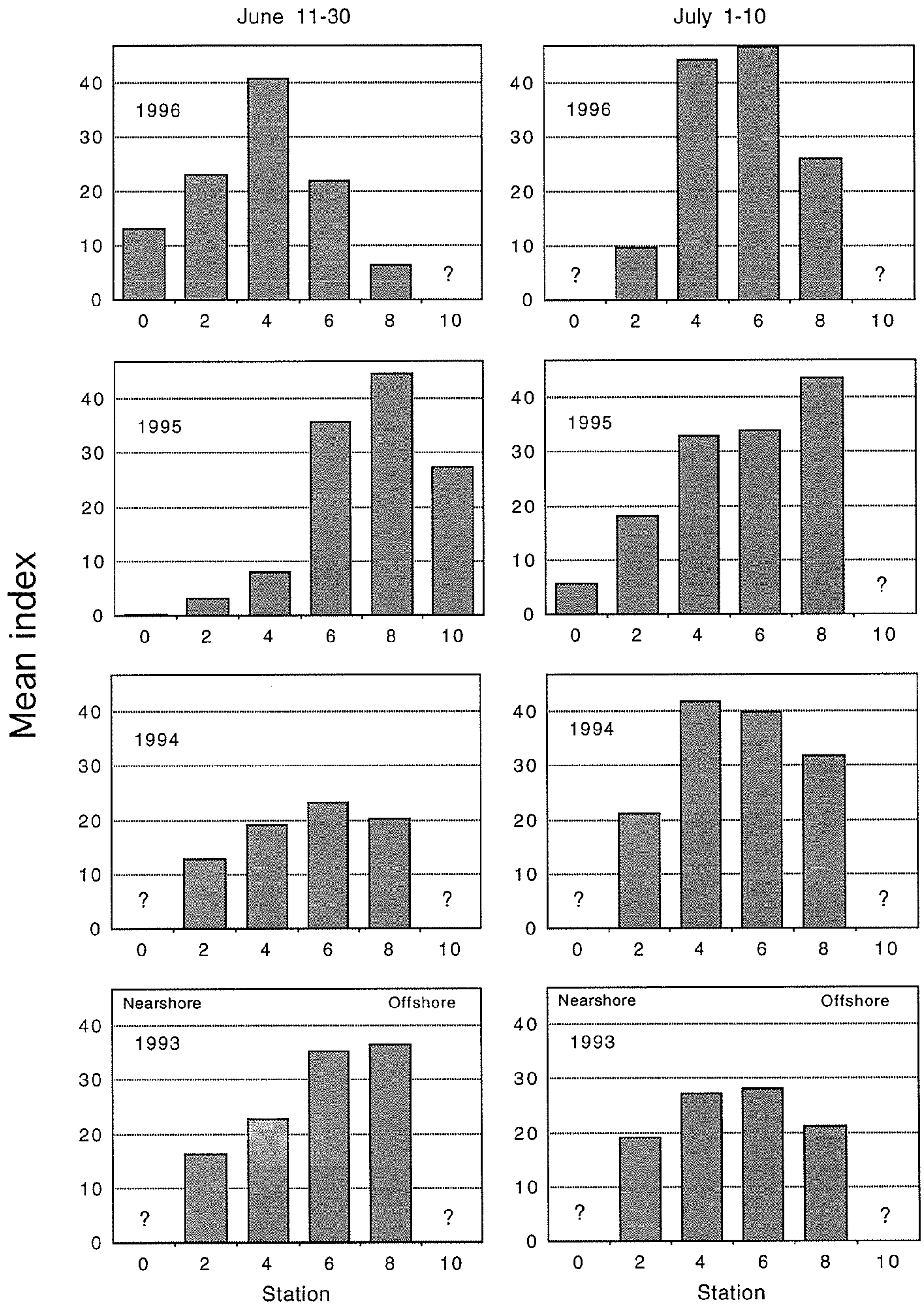


Figure 9. Average sockeye salmon index catches off Port Moller by station and month.

# Tables

Table 1. False Pass fishery catches, the preseason quotas, and the actual Bristol Bay catches.

| | Sockeye salmon (millions) | | | | | | | Chum salmon (1,000s) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Bristol Bay | | False Pass | | | | | | | |
| Year | Run | Catch | Catch | Quota | 8.3% | C-Q | C-8.3% | Catch | Cap | Catch-cap |
| 77 | 9.72 | 4.88 | .24 | .24 | .42 | .00 | -.19 | 116 | | |
| 78 | 19.92 | 9.93 | .49 | .52 | .86 | -.04 | -.38 | 122 | | |
| 79 | 39.90 | 21.43 | .85 | 1.10 | 1.85 | -.25 | -1.00 | 104 | | |
| 80 | 62.49 | 23.76 | 3.21 | 3.07 | 2.24 | .14 | .97 | 509 | | |
| 81 | 34.47 | 25.60 | 1.82 | 1.76 | 2.28 | .06 | -.46 | 564 | | |
| 82 | 22.21 | 15.10 | 2.12 | 2.26 | 1.43 | -.14 | .69 | 1095 | | |
| 83 | 45.91 | 37.37 | 1.96 | 1.79 | 3.26 | .17 | -1.30 | 786 | | |
| 84 | 41.11 | 24.71 | 1.39 | 1.36 | 2.17 | .03 | -.78 | 337 | | |
| 85 | 36.86 | 23.70 | 1.79 | 1.69 | 2.12 | .11 | -.33 | 434 | | |
| 86 | 23.74 | 15.78 | .47 | 1.11 | 1.35 | -.64 | -.88 | 352 | 300 | 52 |
| 87 | 27.52 | 16.07 | .79 | .78 | 1.40 | .02 | -.61 | 443 | 0 | |
| 88 | 23.42 | 13.99 | .76 | 1.54 | 1.22 | -.79 | -.47 | 527 | 500 | 27 |
| 89 | 44.05 | 28.74 | 1.74 | 1.46 | 2.53 | .28 | -.79 | 455 | 500 | -45 |
| 90 | 48.12 | 33.52 | 1.35 | 1.33 | 2.89 | .02 | -1.55 | 519 | 600 | -81 |
| 91 | 41.91 | 25.82 | 1.55 | 1.92 | 2.27 | -.37 | -.72 | 773 | 600 | 173 |
| 92 | 45.22 | 31.88 | 2.46 | 2.39 | 2.85 | .07 | -.39 | 426 | 700 | -274 |
| 93 | 52.22 | 40.46 | 2.97 | 2.90 | 3.60 | .07 | -.63 | 532 | 700 | -168 |
| 94 | 50.58 | 35.22 | 1.46 | 3.59 | 3.04 | -2.13 | -1.58 | 582 | 700 | -118 |
| 95 | 60.89 | 44.43 | 2.11 | 3.65 | 3.86 | -1.54 | -1.76 | 537 | 700 | -163 |
| 96 | 37.00 | 29.65 | 1.03 | 3.13 | 2.55 | -2.10 | -1.52 | 360 | 700 | -340 |
| 97 | | | | 2.20 | | | | | | |
| 87-96 average | 43.09 | 29.98 | 1.62 | 2.27 | 2.62 | -0.65 | -1.00 | 523 | 633 | -110 |

Table 2. Sockeye and chum salmon catches in the South Unimak June fishery, 1989–96.

| | Year | Date | Hours open | Catch (1,000s) Sockeye | Catch (1,000s) Chum | % chum | Sockeye CPUE |
|---|---|---|---|---|---|---|---|
| | 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 | 14 | 12 | 5 | 29 | 180 |
| | (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 | | 267 | 1071 | 453 | 30 | 375 |
| | 91 | 15 | 16 | 121 | 45 | 27 | 574 |
| | (42) | 17 | 18 | 51 | 27 | 35 | 319 |
| Q=1.6 | | 18 | 24 | 104 | 49 | 32 | 600 |
| C=1.2 | | 19 | 24 | 108 | 56 | 34 | 1494 |
| cap=.6 | | 20 | 22 | 222 | 115 | 34 | 1040 |
| | | 23 | 18 | 184 | 49 | 21 | 1783 |
| | | 24 | 24 | 256 | 187 | 42 | 828 |
| | | 25 | 12 | 144 | 137 | 49 | 642 |
| | Sum | | 158 | 1190 | 665 | 36 | 811 |
| | 92 | 15 | 18 | 214 | 26 | 11 | 1214 |
| | (45) | 16 | 24 | 132 | 22 | 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 | 1073 |
| | | 21 | 18 | 340 | 45 | 12 | 1307 |
| | | 22 | 14 | 345 | 75 | 18 | 1352 |
| | | 26 | 5 | 87 | 15 | 15 | 1410 |
| | Sum | | 139 | 1958 | 320 | 14 | 1105 |
| | 93 | 13 | 16 | 284 | 38 | 12 | 1271 |
| | (52) | 15 | 18 | 255 | 45 | 15 | 1357 |
| Q=2.9 | | 16 | 24 | 305 | 43 | 12 | 1009 |
| C=2.9 | | 17 | 18 | 304 | 39 | 11 | 1071 |
| cap=.7 | | 19 | 18 | 350 | 51 | 13 | 1567 |
| | | 20 | 22 | 492 | 68 | 12 | 1481 |
| | | 22 | 12 | 203 | 73 | 26 | 1130 |
| | | 26 | 18 | 50 | 3 | 6 | 1590 |
| | | 27 | 22 | 112 | 13 | 10 | 830 |
| | | 29 | 8 | 12 | 9 | 43 | 272 |
| | Sum | | 204 | 2367 | 382 | 14 | 1218 |
| | 94 | 17 | 9 | 118 | 45 | 28 | 689 |
| | (50) | 18 | 9 | 64 | 24 | 27 | 855 |
| Q=2.9 | | 19 | 17 | 165 | 47 | 22 | 592 |
| C=1.0 | | 20 | 12 | 51 | 18 | 26 | 525 |
| cap=.7 | | 21 | 17 | 39 | 10 | 20 | 215 |
| | | 22 | 24 | 93 | 26 | 22 | 397 |
| | | 23 | 24 | 128 | 34 | 21 | 471 |
| | | 24 | 24 | 63 | 20 | 24 | 276 |
| | | 25 | 24 | 44 | 19 | 30 | 276 |
| | | 26 | 24 | 39 | 19 | 33 | 278 |
| | | 27 | 24 | 55 | 42 | 43 | 489 |
| | | 28 | 24 | 65 | 54 | 45 | 560 |
| | | 29 | 15 | 15 | 9 | 38 | 234 |
| | | 30 | 15 | 5 | 2 | 29 | 159 |
| | Sum | | 262 | 944 | 369 | 28 | 437 |
| | 95 | 13 | 16 | 126 | 41 | 25 | 686 |
| | (61) | 14 | 8 | 23 | 5 | 18 | 1133 |
| Q=2.9 | | 15 | 16 | 185 | 32 | 15 | 933 |
| C=1.4 | | 16 | 16 | 72 | 14 | 16 | 417 |
| cap=.7 | | 17 | 16 | 47 | 10 | 18 | 265 |
| | | 18 | 8 | 8 | 3 | 27 | 152 |
| | | 19 | 18 | 14 | 2 | 13 | 163 |
| | | 20 | 24 | 98 | 15 | 13 | 444 |
| | | 21 | 24 | 139 | 28 | 17 | 494 |
| | | 22 | 24 | 155 | 44 | 22 | 552 |
| | | 23 | 24 | 153 | 36 | 19 | 534 |
| | | 24 | 24 | 122 | 33 | 21 | 390 |
| | | 25 | 24 | 83 | 18 | 18 | 333 |
| | | 26 | 24 | 71 | 20 | 22 | 344 |
| | | 27 | 24 | 40 | 14 | 26 | 500 |
| | | 28 | 24 | 27 | 8 | 23 | 325 |
| | | 29 | 24 | 22 | 6 | 21 | 294 |
| | | 30 | 24 | 19 | 5 | 21 | 557 |
| | Sum | | 362 | 1404 | 334 | 19 | 468 |
| | 96 | 15 | 18 | 59 | 13 | 18 | 289 |
| | (37) | 16 | 24 | 6 | 1 | 14 | 173 |
| Q=2.6 | | 17 | 24 | 68 | 9 | 12 | 272 |
| C=.6 | | 18 | 24 | 53 | 10 | 16 | 220 |
| cap=.7 | | 19 | 24 | 56 | 14 | 20 | 237 |
| | | 20 | 24 | 62 | 14 | 18 | 226 |
| | | 21 | 24 | 63 | 15 | 19 | 278 |
| | | 22 | 24 | 62 | 17 | 22 | 303 |
| | | 24 | 24 | 22 | 3 | 12 | 310 |
| | | 25 | 24 | 10 | 2 | 17 | 247 |
| | | 26 | 24 | 17 | 6 | 26 | 124 |
| | | 27 | 24 | 25 | 7 | 22 | 215 |
| | | 28 | 18 | 17 | 5 | 23 | 305 |
| | | 29 | 24 | 15 | 4 | 21 | 311 |
| | | 30 | 24 | 14 | 8 | 36 | 326 |
| | Sum | | 348 | 549 | 128 | 19 | 251 |

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 3. Comparison of the age compositions of sockeye salmon in Bristol Bay runs with age compositions from the False Pass fishery, inseason Port Moller test fishery, and the ADFG preseason forecast, 1987–96.

| 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 |
| 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 |
| 1994 | ADF&G pre-f'cast | 14 | 43 | 19 | 22 | 57 | 43 | 52.5 |
| | Moller in-f'cast | 7 | 42 | 20 | 28 | 50 | 50 | 46.0 |
| | False Pass catch | 8 | 34 | 33 | 22 | 42 | 57 | |
| | Bristol Bay run | 8 | 56 | 14 | 18 | 65 | 34 | 50.1 |
| 1995 | ADF&G pre-f'cast | 16 | 53 | 17 | 13 | 69 | 31 | 55.1 |
| | Moller in-f'cast | 14 | 51 | 15 | 19 | 65 | 34 | 49.2 |
| | False Pass catch | 19 | 57 | 12 | 11 | 76 | 24 | |
| | Bristol Bay run | 16 | 56 | 12 | 15 | 72 | 27 | 60.7 |
| 1996 | ADF&G pre-f'cast | 18 | 36 | 26 | 19 | 54 | 48 | 43.4 |
| | Moller in-season | 8 | 13 | 51 | 24 | 21 | 79 | 41.0 |
| | False Pass catch | 15 | 24 | 38 | 20 | 39 | 61 | |
| | Bristol Bay run | 10 | 13 | 51 | 24 | 23 | 76 | 36.9 |
| Means | ADF&G pre-f'cast | 22 | 38 | 26 | 15 | 59 | 41 | 35.7 |
| | Moller in-season | 15 | 30 | 30 | 22 | 45 | 53 | 40.1 |
| | False Pass catch | 17 | 38 | 25 | 18 | 55 | 44 | |
| | Bristol Bay run | 17 | 35 | 27 | 18 | 53 | 46 | 42.9 |

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 4. Percent chums in chum and sockeye salmon catches and runs, 1977–96.

| | 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 | 9.0 | 45.5 | 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 | 7.4 | 14.5 | 0.85 | 0.10 | 10.5 | 9.6 | 0.2 | 2.0 |
| 80 | 62.4 | 3.3 | 5.1 | 65.4 | 12.0 | 15.5 | 3.21 | 0.51 | 13.7 | 4.6 | 1.6 | 25.8 |
| 81 | 34.3 | 2.1 | 5.8 | 37.9 | 11.6 | 23.4 | 1.82 | 0.56 | 23.5 | 7.6 | 2.0 | 20.8 |
| 82 | 22.1 | 1.3 | 5.7 | 24.6 | 7.4 | 23.1 | 2.12 | 1.09 | 34.0 | 5.1 | 1.1 | 17.7 |
| 83 | 45.7 | 2.2 | 4.5 | 48.8 | 8.0 | 14.1 | 1.96 | 0.78 | 28.5 | 4.4 | 0.4 | 8.3 |
| 84 | 40.7 | 3.5 | 7.8 | 43.9 | 11.4 | 20.6 | 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 | 1.79 | 0.43 | 19.4 | 15.9 | 0.9 | 5.4 |
| 86 | 23.6 | 2.2 | 8.6 | 27.1 | 8.9 | 24.7 | 0.47 | 0.35 | 42.7 | | | |
| 87 | 27.3 | 2.9 | 9.5 | 29.7 | 7.9 | 21.0 | 0.79 | 0.44 | 35.8 | 11.1 | 0.8 | 6.7 |
| 88 | 23.2 | 2.5 | 9.8 | 26.0 | 10.9 | 29.5 | 0.76 | 0.53 | 41.1 | 7.0 | 1.1 | 13.6 |
| 89 | 43.9 | 2.2 | 4.9 | 46.8 | 9.1 | 16.3 | 1.75 | 0.46 | 20.8 | 18.9 | 1.0 | 5.0 |
| 90 | 47.8 | 1.8 | 3.6 | 51.6 | 6.2 | 10.7 | 1.35 | 0.52 | 27.8 | 23.4 | 1.3 | 5.3 |
| 91 | 42.2 | 2.1 | 4.7 | 46.3 | 7.8 | 14.4 | 1.55 | 0.77 | 33.2 | 17.5 | 1.6 | 8.4 |
| 92 | 45.0 | 1.4 | 3.0 | 49.9 | 6.3 | 11.2 | 2.46 | 0.43 | 14.7 | 24.4 | 1.7 | 6.5 |
| 93 | 52.1 | 1.1 | 2.1 | 57.2 | 4.0 | 6.5 | 2.97 | 0.53 | 15.1 | 30.3 | 1.4 | 4.4 |
| 94 | 50.3 | 1.5 | 2.9 | 54.7 | 7.6 | 12.2 | 1.46 | 0.58 | 28.4 | 22.7 | 1.5 | 6.2 |
| 95 | 60.7 | 1.4 | 2.3 | 65.5 | 10.7 | 14.0 | 2.11 | 0.54 | 20.4 | 30.0 | 0.8 | 2.6 |
| 96 | 37.0 | 1.2 | 3.1 | 40.1 | 8.4 | 17.3 | 1.03 | 0.36 | 25.9 | 22.6 | 1.6 | 6.6 |
| Means 83-96 | 41.2 | 2.0 | 5.2 | 45.2 | 8.3 | 16.4 | 1.60 | 0.52 | 26.7 | 19.6 | 1.5 | 7.3 |

Table 5. Annual sockeye salmon runs (milliions) to the eastern Bering Sea (western Alaska), 1970–96.

| | 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 | .64 | 40.1 | 1.65 | 3.4 |
| 71 | .006 | .02 | .42 | 2.61 | 9.37 | 1.94 | 1.48 | 15.82 | .79 | 16.6 | .46 | 2.3 |
| 72 | .004 | .01 | .16 | .91 | 2.85 | 1.39 | .10 | 5.41 | .37 | 5.8 | .50 | 6.8 |
| 73 | .005 | .01 | .21 | .85 | .79 | .55 | .04 | 2.44 | .35 | 2.8 | .25 | 7.0 |
| 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 | .85 | 1.6 |
| 80 | .043 | .11 | 1.21 | 12.81 | 40.57 | 3.68 | 4.22 | 62.49 | 2.78 | 65.4 | 3.21 | 4.0 |
| 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 | 1.79 | 3.6 |
| 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 | 1.77 | 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 | 4.87 | 57.3 | 2.97 | 4.2 |
| 94 | .191 | .38 | .50 | 5.86 | 25.83 | 12.70 | 5.45 | 50.34 | 3.96 | 54.7 | 1.46 | 2.2 |
| 95 | .198 | .40 | .73 | 6.69 | 31.78 | 15.73 | 5.81 | 60.74 | 4.35 | 65.5 | 2.11 | 2.7 |
| 96 | .120 | .24 | .67 | 8.30 | 11.02 | 11.92 | 5.10 | 37.01 | 2.88 | 40.1 | 1.03 | 2.1 |
| Means | | | | | | | | | | | | |
| 70-79 | | .04 | .42 | 3.08 | 11.88 | 1.95 | .60 | 17.94 | 1.13 | 19.1 | .50 | 2.8 |
| 80-89 | | .27 | .75 | 6.32 | 18.37 | 6.57 | 4.17 | 36.18 | 2.63 | 39.1 | 1.61 | 3.3 |
| 90-96 | | .36 | .67 | 6.72 | 20.61 | 14.74 | 5.14 | 47.89 | 3.95 | 52.2 | 1.85 | 2.9 |

Kuskokwim run estimated by catch/0.4 (1970–89) and catch/0.5 (1990–96).
South Peninsula percent = (SP catch*.85)/(SP catch*.85+ WA total)*100.

Table 6. North Pacific runs (catch + escapement, millions) of sockeye salmon, 1970–96.

| Year | Bristol Bay run | Alaska runs Western | Alaska runs Central | Japan high seas catch | Russian run | North Pacific total run | SE Alaska and British Columbia | Total Pacific run | Percent Western Alaska |
|---|---|---|---|---|---|---|---|---|---|
| 70 | 39 | 42 | 7 | 10 | 3 | 62 | 9 | 71 | 59 |
| 71 | 16 | 17 | 6 | 7 | 2 | 32 | 12 | 44 | 39 |
| 72 | 5 | 6 | 5 | 7 | 1 | 19 | 8 | 27 | 22 |
| 73 | 2 | 3 | 4 | 6 | 1 | 14 | 15 | 29 | 10 |
| 74 | 11 | 12 | 4 | 5 | 1 | 22 | 14 | 36 | 33 |
| 75 | 24 | 25 | 3 | 5 | 2 | 35 | 7 | 42 | 60 |
| 76 | 12 | 13 | 7 | 6 | 1 | 27 | 10 | 37 | 35 |
| 77 | 10 | 11 | 10 | 3 | 3 | 27 | 13 | 40 | 28 |
| 78 | 20 | 22 | 9 | 3 | 4 | 38 | 14 | 52 | 42 |
| 79 | 40 | 44 | 7 | 3 | 3 | 57 | 12 | 69 | 64 |
| 80 | 62 | 68 | 8 | 3 | 4 | 83 | 7 | 90 | 76 |
| 81 | 34 | 40 | 10 | 3 | 4 | 57 | 15 | 72 | 56 |
| 82 | 22 | 26 | 14 | 3 | 3 | 46 | 20 | 66 | 39 |
| 83 | 46 | 51 | 15 | 2 | 5 | 73 | 10 | 83 | 61 |
| 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 | 22 | 1 | 8 | 61 | 11 | 72 | 42 |
| 88 | 23 | 27 | 17 | <1 | 5 | 49 | 10 | 59 | 46 |
| 89 | 44 | 48 | 17 | <1 | 6 | 71 | 24 | 95 | 51 |
| 90 | 48 | 53 | 18 | <1 | 12 | 83 | 24 | 107 | 50 |
| 91 | 42 | 48 | 19 | <1 | 8 | 75 | 20 | 95 | 51 |
| 92 | 45 | 52 | 23 | 0 | 10 | 85 | 18 | 103 | 50 |
| 93 | 52 | 60 | 19 | 0 | 8 | 87 | 29 | 116 | 52 |
| 94 | 50 | 56 | 16 | 0 | 9 | 81 | 20 | 101 | 55 |
| 95 | 61 | 67 | 17 | 0 | 9 | 93 | 12 | 105 | 64 |
| 96 | 37 | 41 | 19 | 0 | 10 | 70 | 15 | 85 | 48 |
| Means | | | | | | | | | |
| 70-79 | 18 | 20 | 6 | 6 | 2 | 33 | 11 | 45 | 39 |
| 80-89 | 36 | 40 | 15 | 2 | 6 | 63 | 15 | 77 | 51 |
| 90-96 | 48 | 54 | 19 | 0 | 9 | 82 | 20 | 102 | 53 |

Western Alaska includes Bristol Bay, North Peninsula and 85% of South Peninsula catch.
Japan high seas catches since1992 are included in Russian run.

Table 7. Estimated runs (catch + escapement, millions) of chum salmon to the eastern Bering Sea, 1970–96.

| Year | Kotze-bue | Norton Sound | Yukon River Summer | Yukon River Fall | Arctic/Yukon Region | Kusko-kwim | Togiak | Nush-agak | Naknek/Kvichak | Ege-gik | Uga-shik | Bristol Bay Total | North Alaska Pen. | S.P. June catch | Total Run |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70 | .60 | .75 | .92 | .82 | 3.09 | .60 | .22 | 1.14 | .22 | .07 | .09 | 1.74 | .22 | .44 | 6.0 |
| 71 | .37 | .44 | .82 | .80 | 2.43 | .42 | .24 | .75 | .24 | .04 | .02 | 1.29 | .17 | .51 | 4.7 |
| 72 | .50 | .30 | .74 | .59 | 2.13 | .43 | .38 | .74 | .30 | .07 | .06 | 1.55 | .21 | .52 | 4.7 |
| 73 | .55 | .35 | 1.36 | .90 | 3.16 | .69 | .44 | 1.06 | .59 | .06 | .07 | 2.22 | .28 | .20 | 6.5 |
| 74 | 1.27 | .37 | 1.45 | .99 | 4.08 | .92 | .14 | .89 | .51 | .03 | .07 | 1.64 | .14 | .00 | 6.8 |
| 75 | .97 | .44 | 2.87 | 1.78 | 6.06 | .78 | .18 | .68 | .47 | .01 | .07 | 1.41 | .12 | .10 | 8.4 |
| 76 | .34 | .19 | 1.82 | .74 | 3.09 | .90 | .25 | 1.74 | .74 | .07 | .03 | 2.83 | .37 | .41 | 7.5 |
| 77 | .30 | .44 | 1.49 | .97 | 3.20 | .97 | .52 | 2.65 | .74 | .12 | .01 | 4.04 | .81 | .12 | 9.1 |
| 78 | .27 | .47 | 2.04 | .87 | 3.65 | .79 | .47 | 1.38 | .37 | .08 | .01 | 2.31 | .47 | .12 | 7.3 |
| 79 | .23 | .27 | 1.71 | 1.63 | 3.84 | 1.57 | .33 | .85 | .36 | .06 | .06 | 1.66 | .37 | .10 | 7.5 |
| | | | | | | | | | | | | | | | 0.0 |
| 80 | .92 | .44 | 2.44 | .98 | 4.78 | 2.45 | .57 | 1.94 | .55 | .11 | .17 | 3.34 | 1.47 | .51 | 12.4 |
| 81 | 1.10 | .48 | 3.79 | 1.28 | 6.65 | 1.62 | .36 | 1.11 | .47 | .10 | .06 | 2.10 | 1.24 | .56 | 12.0 |
| 82 | .61 | .40 | 2.13 | .76 | 3.90 | 1.38 | .23 | .57 | .30 | .12 | .11 | 1.33 | .79 | 1.10 | 8.2 |
| 83 | .53 | .62 | 2.14 | 1.05 | 4.34 | .79 | .45 | 1.01 | .42 | .14 | .14 | 2.16 | .74 | .79 | 8.6 |
| 84 | .57 | .54 | 2.88 | .86 | 4.85 | 1.31 | .55 | 1.63 | .81 | .22 | .31 | 3.52 | 1.67 | .34 | 11.6 |
| 85 | .70 | .35 | 2.85 | 1.15 | 5.05 | .74 | .38 | .91 | .45 | .15 | .15 | 2.04 | 1.01 | .43 | 9.2 |
| 86 | .68 | .34 | 3.41 | .90 | 5.33 | .89 | .51 | .88 | .57 | .12 | .13 | 2.21 | .51 | .35 | 9.2 |
| 87 | .18 | .25 | 1.72 | 1.00 | 3.15 | 1.02 | .81 | .67 | 1.09 | .18 | .13 | 2.88 | .88 | .44 | 8.3 |
| 88 | .57 | .20 | 3.70 | .75 | 5.22 | 2.24 | .66 | .70 | .74 | .30 | .14 | 2.54 | .89 | .53 | 11.3 |
| 89 | .46 | .21 | 3.31 | 1.14 | 5.12 | 1.34 | .49 | .93 | .53 | .16 | .13 | 2.24 | .37 | .46 | 9.4 |
| | | | | | | | | | | | | | | | 0.0 |
| 90 | .31 | .20 | 1.64 | .90 | 3.05 | 1.00 | .22 | .71 | .65 | .16 | .04 | 1.78 | .35 | .52 | 6.6 |
| 91 | .56 | .28 | 2.16 | 1.02 | 4.02 | 1.17 | .38 | .75 | .77 | .10 | .10 | 2.10 | .49 | .77 | 8.4 |
| 92 | .43 | .19 | 2.05 | .63 | 3.30 | .79 | .23 | .62 | .38 | .13 | .09 | 1.45 | .69 | .43 | 6.6 |
| 93 | .26 | .26 | 1.23 | .38 | 2.13 | .26 | .22 | .63 | .07 | .05 | .09 | 1.06 | .54 | .53 | 4.4 |
| 94 | .33 | .28 | 2.79 | 1.01 | 4.41 | 1.23 | .35 | .67 | .32 | .07 | .06 | 1.47 | .56 | .58 | 8.1 |
| 95 | .93 | .38 | 3.67 | 1.50 | 6.48 | 1.82 | .31 | .58 | .37 | .07 | .08 | 1.41 | .86 | .54 | 11.0 |
| 96 | .75 | .31 | 2.81 | 1.20 | 5.07 | .96 | .30 | .55 | .17 | .09 | .12 | 1.23 | .89 | .36 | 8.4 |
| Means | | | | | | | | | | | | | | | |
| 70-79 | .54 | .40 | 1.52 | 1.01 | 3.47 | .81 | .32 | 1.19 | .45 | .06 | .05 | 2.07 | .32 | .25 | 6.9 |
| 80-89 | .63 | .38 | 2.84 | .99 | 4.84 | 1.38 | .50 | 1.04 | .59 | .16 | .15 | 2.44 | .96 | .55 | 10.0 |
| 90-96 | .51 | .27 | 2.34 | .95 | 4.07 | 1.03 | .29 | .64 | .39 | .10 | .08 | 1.50 | .63 | .53 | 7.6 |

Total run includes 75% of South Peninsula June catch.

Table 8. North Pacific runs (catch + escapement, millions) of chum salmon, 1970–96.

| | | Alaska runs | | Japan catch | | Russian | North | SE Alaska | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Bristol | | | High | | run | Pacific | B.C. and | Pacific | % |
| Year | Bay run | Western | Central | seas | Coastal | (Catch/.5) | total run | Wash. | run | Asia |
| 70 | 1.7 | 6.0 | 5.2 | 17 | 7 | 7 | 43 | 11 | 54 | 59 |
| 71 | 1.3 | 4.7 | 6.6 | 17 | 10 | 7 | 45 | 7 | 52 | 65 |
| 72 | 1.6 | 4.7 | 4.5 | 22 | 9 | 4 | 45 | 17 | 62 | 57 |
| 73 | 2.2 | 6.5 | 3.5 | 16 | 12 | 3 | 41 | 15 | 56 | 56 |
| 74 | 1.6 | 6.8 | 1.9 | 22 | 13 | 5 | 48 | 10 | 58 | 68 |
| 75 | 1.4 | 8.4 | 2.1 | 19 | 20 | 4 | 54 | 5 | 59 | 74 |
| 76 | 2.8 | 7.5 | 3.4 | 22 | 12 | 8 | 53 | 9 | 62 | 68 |
| 77 | 4.0 | 9.1 | 5.9 | 12 | 15 | 9 | 51 | 5 | 56 | 64 |
| 78 | 2.3 | 7.3 | 4.3 | 7 | 18 | 11 | 47 | 9 | 56 | 63 |
| 79 | 1.7 | 7.5 | 4.0 | 6 | 28 | 12 | 58 | 4 | 62 | 75 |
| 80 | 3.3 | 12.4 | 5.1 | 6 | 26 | 7 | 57 | 11 | 68 | 58 |
| 81 | 2.1 | 12.0 | 8.3 | 6 | 34 | 9 | 70 | 6 | 76 | 65 |
| 82 | 1.3 | 8.2 | 8.9 | 7 | 30 | 7 | 61 | 9 | 70 | 63 |
| 83 | 2.2 | 8.6 | 7.0 | 6 | 37 | 12 | 71 | 6 | 77 | 72 |
| 84 | 3.5 | 11.6 | 6.5 | 6 | 38 | 7 | 70 | 13 | 83 | 62 |
| 85 | 2.0 | 9.2 | 5.5 | 4 | 51 | 12 | 82 | 17 | 99 | 68 |
| 86 | 2.2 | 9.2 | 8.1 | 3 | 49 | 14 | 83 | 17 | 100 | 66 |
| 87 | 2.9 | 8.3 | 6.2 | 3 | 43 | 13 | 73 | 12 | 85 | 69 |
| 88 | 2.5 | 11.3 | 8.7 | 2 | 51 | 13 | 86 | 20 | 106 | 62 |
| 89 | 2.2 | 9.4 | 4.9 | 1 | 55 | 13 | 83 | 9 | 92 | 74 |
| 90 | 1.8 | 6.6 | 4.6 | 1 | 68 | 13 | 94 | 13 | 107 | 77 |
| 91 | 2.1 | 8.4 | 5.2 | 1 | 60 | 10 | 84 | 11 | 95 | 74 |
| 92 | 1.5 | 6.6 | 4.4 | 0 | 46 | 17 | 74 | 16 | 90 | 70 |
| 93 | 1.1 | 4.4 | 3.8 | 0 | 61 | 21 | 90 | 21 | 111 | 74 |
| 94 | 1.5 | 8.1 | 6.0 | 0 | 69 | 20 | 103 | 21 | 124 | 72 |
| 95 | 1.4 | 11.0 | 6.5 | 0 | 78 | 17 | 113 | 20 | 133 | 72 |
| 96 | 1.2 | 8.4 | 5.7 | 0 | 80 | 10 | 104 | 30 | 134 | 67 |
| Means | | | | | | | | | | |
| 70-79 | 2.1 | 6.9 | 4.1 | 16 | 14 | 7 | 48 | 9 | 58 | 65 |
| 80-89 | 2.4 | 10.0 | 6.9 | 4 | 41 | 11 | 74 | 12 | 86 | 66 |
| 90-96 | 1.5 | 7.6 | 5.2 | 0 | 66 | 15 | 94 | 19 | 113 | 72 |

Western Alaska includes Bristol Bay, North Peninsula, Yukon-Kuskokwim regions and 75% of June catch south of the Alaska Peninsula.
Japan high seas catches since 1992 included in Russian runs.
Japan coastal catch includes inriver catch (hatchery returns).

Table 9. Summary of length, weight, and condition factors for chum salmon in the False Pass catches.

| | | | Sex/age percent | | | | | Mean length (mm) | | | | | Mean weight (kg) | | | | | Mean condition factor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Sex | Age | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 | 92 | 93 | 94 | 95 | 96 |
| Unimak | Male | 0.2 | 0.4 | 1.0 | 0.4 | 1.6 | 0.1 | 491 | 488 | 498 | 538 | 548 | 1.75 | 1.41 | 1.88 | 2.61 | 2.68 | | | | | |
| | | 0.3 | 26.9 | 31.4 | 23.6 | 21.2 | 26.4 | 550 | 557 | 568 | 580 | 588 | 3.00 | 2.55 | 3.14 | 3.32 | 3.62 | 1.79 | 1.45 | 1.69 | 1.68 | 1.76 |
| | | 0.4 | 21.8 | 17.0 | 26.7 | 18.5 | 15.0 | 579 | 591 | 589 | 602 | 619 | 3.62 | 3.14 | 3.50 | 3.76 | 4.19 | 1.85 | 1.51 | 1.69 | 1.72 | 1.75 |
| | | 0.5 | 0.1 | 0.6 | 2.0 | 2.0 | 0.5 | 628 | 599 | 611 | 619 | 634 | 4.42 | 3.16 | 3.85 | 4.07 | 4.52 | | | | | |
| | | 0.6 | | | 0.1 | | 0.1 | | | 652 | | 651 | | | 4.90 | | 5.49 | | | | | |
| | Female | 0.2 | 0.1 | 1.2 | 0.3 | 1.2 | 0.1 | 514 | 514 | 507 | 517 | 525 | 2.30 | 1.82 | 2.02 | 2.18 | 2.54 | | | | | |
| | | 0.3 | 29.7 | 35.4 | 26.8 | 30.6 | 40.0 | 543 | 545 | 546 | 556 | 567 | 2.83 | 2.35 | 2.59 | 2.77 | 3.02 | 1.76 | 1.43 | 1.57 | 1.60 | 1.65 |
| | | 0.4 | 20.8 | 13.3 | 19.2 | 23.9 | 16.0 | 568 | 574 | 563 | 581 | 594 | 3.23 | 2.84 | 2.84 | 3.19 | 3.52 | 1.78 | 1.47 | 1.58 | 1.62 | 1.67 |
| | | 0.5 | 0.2 | 0.1 | 0.9 | 1.0 | 1.7 | 573 | 582 | 587 | 615 | 610 | 3.58 | 2.90 | 3.13 | 3.93 | 3.93 | | | | | |
| | | 0.6 | | | | | 0.1 | | | | | 629 | | | | | 4.17 | | | | | |
| | Comb. | 0.2 | 0.5 | 2.2 | 0.7 | 2.8 | 0.2 | 496 | 502 | 502 | 529 | 536 | 1.86 | 1.63 | 1.94 | 2.43 | 2.61 | | | | | |
| | | 0.3 | 56.6 | 66.8 | 50.4 | 51.8 | 66.4 | 546 | 551 | 556 | 566 | 575 | 2.91 | 2.44 | 2.85 | 3.00 | 3.26 | 1.77 | 1.44 | 1.63 | 1.63 | 1.69 |
| | | 0.4 | 42.6 | 30.3 | 45.9 | 42.4 | 31.0 | 574 | 584 | 578 | 590 | 606 | 3.43 | 3.01 | 3.22 | 3.44 | 3.84 | 1.82 | 1.49 | 1.64 | 1.66 | 1.71 |
| | | 0.5 | 0.3 | 0.7 | 2.9 | 3.0 | 2.2 | 591 | 597 | 604 | 618 | 615 | 3.86 | 3.12 | 3.63 | 4.02 | 4.05 | | | | | |
| | | 0.6 | | | 0.1 | | 0.2 | | | 652 | | 644 | | | 4.90 | | 5.05 | | | | | |
| Shuma-gin | Male | 0.2 | 0.0 | 0.7 | 0.3 | 1.0 | 0.0 | | 519 | 567 | 561 | | | 1.99 | 3.09 | 3.13 | | | | | | |
| | | 0.3 | 23.7 | 27.6 | 27.1 | 22.6 | 24.7 | 547 | 554 | 575 | 588 | 600 | 2.74 | 2.49 | 3.29 | 3.54 | 3.90 | 1.64 | 1.42 | 1.71 | 1.72 | 1.79 |
| | | 0.4 | 21.6 | 20.7 | 28.8 | 23.4 | 20.2 | 589 | 586 | 589 | 604 | 637 | 3.47 | 2.88 | 3.52 | 3.84 | 4.63 | 1.67 | 1.39 | 1.69 | 1.73 | 1.78 |
| | | 0.5 | 0.2 | 1.0 | 1.2 | 2.0 | 1.6 | 651 | 632 | 618 | 610 | 635 | 5.44 | 3.47 | 4.12 | 4.07 | 4.56 | | | | | |
| | | 0.6 | | | | | 0.1 | | | | | 658 | | | | | 4.22 | | | | | |
| | Female | 0.2 | 0.0 | 0.1 | 0.1 | 0.6 | 0.0 | | 534 | 532 | 527 | | | 2.31 | 2.59 | 2.36 | | | | | | |
| | | 0.3 | 32.0 | 33.2 | 21.2 | 28.4 | 31.9 | 543 | 547 | 550 | 563 | 577 | 2.62 | 2.31 | 2.71 | 2.92 | 3.20 | 1.62 | 1.39 | 1.62 | 1.63 | 1.66 |
| | | 0.4 | 21.7 | 15.4 | 20.5 | 20.1 | 18.3 | 574 | 577 | 572 | 587 | 616 | 3.11 | 2.79 | 3.04 | 3.38 | 4.00 | 1.63 | 1.41 | 1.61 | 1.65 | 1.70 |
| | | 0.5 | 0.8 | 1.3 | 0.8 | 1.7 | 3.0 | 609 | 662 | 595 | 604 | 630 | 3.39 | 4.25 | 3.33 | 3.68 | 4.35 | | | | | |
| | | 0.6 | | | | 0.2 | 0.2 | | | | 595 | 664 | | | | 4.08 | 5.53 | | | | | |
| | Comb. | 0.2 | 0.0 | 0.8 | 0.4 | 1.6 | 0.0 | | 521 | 558 | 548 | | | 2.03 | 2.97 | 2.84 | | | | | | |
| | | 0.3 | 55.7 | 60.8 | 48.3 | 50.0 | 56.6 | 545 | 550 | 564 | 586 | 587 | 2.67 | 2.39 | 3.04 | 3.26 | 3.51 | 1.63 | 1.40 | 1.67 | 1.70 | 1.72 |
| | | 0.4 | 43.3 | 36.1 | 49.3 | 43.5 | 38.5 | 581 | 582 | 582 | 596 | 627 | 3.29 | 2.84 | 3.32 | 3.63 | 4.33 | 1.65 | 1.40 | 1.66 | 1.69 | 1.74 |
| | | 0.5 | 1.0 | 2.3 | 2.0 | 3.7 | 4.6 | 617 | 649 | 609 | 607 | 632 | 3.80 | 3.91 | 3.80 | 3.89 | 4.42 | | | | | |
| | | 0.6 | | | | 0.2 | 0.3 | | | | 595 | 662 | | | | 4.08 | 5.09 | | | | | |

Table 10. Age composition, mean length, and weight 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 | | | .18 | .43 |
| 69 | 21.3 | 529 | 2.31 | 73.9 | 564 | 2.82 | | 4.8 | 594 | | | .21 | .54 |
| 70 | 1.1 | 531 | 3.33 | 96.5 | 568 | 2.95 | | 2.4 | 610 | | | .44 | 1.14 |
| 71 | 5.5 | 542 | 2.28 | 68.5 | 570 | 2.91 | | 26.0 | 585 | | | .36 | .84 |
| 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 | .38 | .71 | 5.71 |
| 91 | 2.3 | 526 | 2.47 | 67.4 | 548 | 2.71 | 30.3 | 573 | 3.18 | 0.0 | .46 | .75 | 7.69 |
| 92 | 0.2 | 479 | | 55.2 | 549 | 2.80 | 44.1 | 565 | 2.97 | 0.4 | .31 | .62 | 5.19 |
| 93 | 0.2 | 502 | | 42.6 | 545 | 2.61 | 53.6 | 570 | 2.94 | 3.6 | .41 | .63 | 7.62 |
| 94* | 0.4 | 512 | | 51.2 | 553 | 2.81 | 47.0 | 562 | 2.83 | 1.5 | .29 | .67 | 5.86 |
| 95 | 7.1 | 533 | 2.44 | 52.7 | 552 | 2.75 | 36.6 | 568 | 3.06 | 3.6 | .36 | .58 | 6.70 |
| 96 | 0.2 | 545 | | 77.2 | 566 | 3.17 | 21.8 | 592 | 3.63 | 0.8 | .32 | .55 | 8.30 |
| Means 70-95 | 5.2 | 532 | 2.55 | 65.3 | 565 | 2.97 | 29.9 | 540 | 50.83 | 0.9 | .49 | .96 | 4.96 |

Sources: Yuen and Nelson (1984), annual ADFG reports on Bristol Bay salmon (e.g., Stratton and Crawford 1994) and B. Cross (ADFG) for 1993–96.
*About 55% of catch made with king salmon gear. AWL statistics are for sockeye gear (7/1-21).

Table 11. Frequencies of focal scale resorption on chum salmon scales from the 1996 False Pass fisheries.

| Location | Date | Number of normal scales (2) | Number with holes | | Percent with holes (1 or 2) | Number with questionable holes (1 or 2) | Percent with holes including questionable | Number of normal scales (1) | Number with holes | Percent with holes | Number with question. | Percent including question. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | One scale | Both scales | | | | | | | | |
| Unimak | 6/19 | 161 | 3 | 0 | 1.83 | 1 | 2.42 | 26 | 0 | 0.00 | 0 | 0.00 |
| | 6/20 | 226 | 4 | 2 | 2.59 | 1 | 3.00 | 43 | 0 | 0.00 | 0 | 0.00 |
| | 6/21 | 79 | 0 | 1 | 1.25 | 1 | 2.47 | 6 | 0 | 0.00 | 0 | 0.00 |
| | 6/22 | 29 | 0 | 0 | 0.00 | 0 | 0.00 | 4 | 0 | 0.00 | 0 | 0.00 |
| | 6/23 | 98 | 1 | 0 | 1.01 | 1 | 2.02 | 20 | 0 | 0.00 | 0 | 0.00 |
| | 6/25 | 28 | 0 | 0 | 0.00 | 1 | 3.45 | 3 | 0 | 0.00 | 0 | 0.00 |
| | 6/26 | 42 | 1 | 0 | 2.33 | 0 | 2.33 | 3 | 0 | 0.00 | 0 | 0.00 |
| | Totals | 663 | 9 | 3 | 1.78 | 5 | 2.43 | 105 | 0 | 0.00 | 0 | 0.00 |
| Shumagin Is. | 6/21 | 298 | 3 | 1 | 1.32 | 2 | 1.97 | 35 | 0 | 0.00 | 0 | 0.00 |
| | 6/22 | 201 | 0 | 0 | 0.00 | 1 | 0.50 | 21 | 0 | 0.00 | 0 | 0.00 |
| | 6/23 | 262 | 2 | 4 | 2.24 | 1 | 2.60 | 46 | 0 | 0.00 | 0 | 0.00 |
| | Totals | 761 | 5 | 5 | 1.30 | 4 | 1.81 | 102 | 0 | 0.00 | 0 | 0.00 |
| False Pass | Combined | 1424 | 14 | 8 | 1.52 | 9 | 2.13 | 264 | 4 | 1.49 | 5 | 3.30 |

Table 12. Surface (1.5 m) salinities and temperatures at Port Moller test fishing stations, 1996.

| | | Salinity (‰) | | | | | Temperature (°C) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Station | | | | | Station | | | | |
| | Date | 0 | 2 | 4 | 6 | 8 | 0 | 2 | 4 | 6 | 8 |
| June | 12 | | 33.60 | 33.70 | 33.74 | 33.81 | | 5.27 | 4.89 | 4.91 | 4.59 |
| | 13 | | 33.58 | 33.70 | 33.74 | | | 5.59 | 4.89 | 4.51 | 5.0 |
| | 14 | | 33.60 | 33.72 | 33.77 | 33.82 | | 5.97 | 5.56 | 5.30 | 4.90 |
| | 15 | 32.80 | 33.50 | 33.71 | 33.74 | | 8.7 | 6.86 | 5.69 | 5.32 | 4.5 |
| | 16 | | 33.55 | 33.71 | | | | 6.60 | 6.02 | 6.0 | 5.0 |
| | 17 | | | | | | 6.5 | 6.5 | 7.0 | 5.0 | 5.0 |
| | 18 | | 33.60 | 33.70 | 33.71 | 33.72 | | 6.14 | 6.17 | 5.55 | 5.45 |
| | 19 | | 33.57 | 33.67 | 33.68 | | | 6.76 | 6.21 | 5.32 | 5.0 |
| | 20 | | 33.62 | 33.68 | 33.68 | 33.71 | | 6.08 | 6.26 | 5.71 | 5.57 |
| | 21 | | 33.63 | 33.70 | 33.70 | | | 6.27 | 5.88 | 5.44 | 5.5 |
| | 22 | | 33.64 | 33.69 | 33.65 | 33.70 | | 6.60 | 6.76 | 6.88 | 6.79 |
| | 23 | | | 33.69 | 33.70 | | | 7.0 | 6.43 | 6.95 | 7.0 |
| | 24 | | | | | | | | | | |
| | 25 | | | | | | | 7.0 | 6.0 | 6.0 | 6.0 |
| | 26 | | | | | | | 6.5 | 6.0 | 6.0 | 6.0 |
| | 27 | | | | | | | 6.5 | 6.5 | 6.5 | 6.0 |
| | 28 | | | | | | | 6.0 | 6.0 | 6.0 | 6.0 |
| | 29 | | | | | | | 6.0 | 6.0 | 6.5 | 7.0 |
| | 30 | | 33.50 | 33.69 | | | 6.5 | 6.58 | 6.13 | 6.0 | |
| July | 1 | | 33.49 | 33.70 | 33.70 | 33.74 | | 6.66 | 6.05 | 6.00 | 6.14 |
| | 2 | | 33.48 | | 33.71 | | | 6.74 | | 6.00 | |
| | 3 | | 33.47 | | | | | 7.43 | | | |
| | 4 | | | | | | | 7.0 | 7.0 | 6.0 | 6.0 |
| | 5 | | | | | | | 7.0 | 6.0 | 6.0 | 7.0 |
| | 6 | | | | | | | 6.0 | 6.0 | 6.0 | 6.0 |
| | 7 | | | | | | | 7.0 | 9.0 | 8.0 | 8.0 |
| | 8 | | | | | | | 8.0 | 7.0 | 7.0 | 8.0 |
| | 9 | | | | | | | | | | |
| | Means | 32.80 | 33.56 | 33.70 | 33.71 | 33.75 | 7.24 | 6.54 | 6.23 | 5.96 | 5.93 |

Temperatures recorded by hand-held thermometer are reported to the nearest tenth of a degree while those measured by NOAA instrumentation by the nearest hundredth of a degree.

Table 13. Timing of Bristol Bay sockeye runs and between Bristol Bay and Port Moller.

| | Mean date of run (July) | | | | Mean date at P.M.* | Days P.M. to B.B. | P.M. mean temp. (C) 6/11 to 7/5 |
|---|---|---|---|---|---|---|---|
| Year | Egegik | Nak/Kvi | Nush. | Wt'd mean | | | |
| 85 | 2.1 | 3.0 | 4.3 | 2.9 | 27.1 | 5.8 | 5.8 |
| 86 | 6.6 | 6.4 | 8.3 | 7.0 | | | |
| 87 | 3.4 | 5.5 | 4.3 | 4.7 | 25.5 | 9.2 | 5.7 |
| 88 | 1.5 | 2.0 | 5.1 | 2.3 | 26.8 | 5.5 | 7.5 |
| 89 | 3.4 | 1.4 | 3.0 | 2.1 | 27.0 | 5.1 | 6.3 |
| 90 | 6.0 | 5.0 | 6.4 | 5.5 | 28.0 | 7.5 | 7.3 |
| 91 | 4.1 | 3.6 | 5.4 | 4.1 | 25.8 | 8.3 | 5.3 |
| 92 | 5.4 | 5.0 | 6.0 | 5.3 | 26.7 | 8.6 | 7.6 |
| 93 | 0.3 | 0.6 | 1.4 | 0.6 | 25.3 | 5.3 | 7.7 |
| 94 | 6.4 | 7.0 | 8.0 | 7.0 | 28.0 | 9.0 | 6.6 |
| 95 | 4.4 | 5.0 | 4.0 | 4.7 | 26.3 | 8.4 | 7.3 |
| 96 | 1.4 | 3.6 | 3.6 | 2.8 | 25.9 | 6.9 | 6.1 |
| Means 1987-96 | 3.6 | 3.9 | 4.7 | 3.9 | 26.5 | 7.4 | 6.7 |

* Date in June of 50% of index through July 5.

Table 14. Estimates of the daily passage of sockeye salmon off Port Moller, 1987–96.

| Date | | Daily passage 0-70 mi off coast (millions) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 |
| June | 11 | .08 | .07 | .26 | .07 | .05 | .26 | .22 | .04 | .10 | .15 |
| | 12 | .07 | .12 | .33 | .03 | .04 | .12 | .19 | .07 | .12 | .20 |
| | 13 | .08 | .19 | .48 | .05 | .07 | .21 | .29 | .09 | .36 | .20 |
| | 14 | .11 | .30 | .59 | .10 | .12 | .34 | .58 | .10 | .61 | .21 |
| | 15 | .11 | .45 | .83 | .10 | .18 | .64 | 1.09 | .07 | .91 | .18 |
| | 16 | .19 | .56 | .97 | .12 | .30 | .68 | 1.50 | .10 | .87 | .34 |
| | 17 | .39 | .69 | .97 | .17 | .50 | .92 | 1.31 | .09 | 1.40 | .65 |
| | 18 | .72 | .74 | 1.29 | .36 | .74 | .69 | 1.33 | .26 | 1.99 | .90 |
| | 19 | .89 | .73 | 1.53 | .72 | 1.01 | .97 | 1.53 | .74 | 2.49 | 1.18 |
| | 20 | 1.16 | .82 | 1.98 | 1.00 | 1.28 | .98 | 2.12 | 1.42 | 2.44 | 1.37 |
| | 21 | 1.08 | .94 | 2.72 | 1.44 | 1.72 | 1.50 | 2.46 | 1.76 | 2.29 | 1.82 |
| | 22 | .99 | .93 | 2.87 | 1.99 | 2.08 | 1.72 | 2.69 | 2.15 | 2.75 | 2.22 |
| | 23 | 1.28 | 1.07 | 2.92 | 1.87 | 2.36 | 2.00 | 2.84 | 2.77 | 2.96 | 2.79 |
| | 24 | 1.51 | 1.30 | 2.62 | 1.95 | 2.54 | 1.94 | 3.02 | 2.88 | 3.09 | 2.92 |
| | 25 | 1.97 | 1.72 | 2.79 | 2.61 | 2.64 | 2.25 | 3.57 | 2.89 | 3.14 | 2.69 |
| | 26 | 1.62 | 1.45 | 2.71 | 3.55 | 2.97 | 2.93 | 4.03 | 2.95 | 3.42 | 2.02 |
| | 27 | 1.63 | 1.19 | 2.19 | 4.06 | 2.82 | 3.34 | 4.08 | 3.48 | 3.68 | 1.92 |
| | 28 | 1.35 | 1.00 | 1.93 | 3.32 | 2.66 | 3.17 | 3.51 | 3.97 | 3.16 | 2.05 |
| | 29 | 1.19 | .97 | 1.94 | 3.28 | 2.19 | 2.51 | 2.86 | 3.48 | 2.80 | 2.18 |
| | 30 | 1.06 | .98 | 1.54 | 2.78 | 2.15 | 2.47 | 2.47 | 3.38 | 2.54 | 2.10 |
| July | 1 | .91 | .81 | 1.24 | 2.87 | 2.13 | 2.42 | 2.22 | 2.62 | 2.59 | 1.67 |
| | 2 | 1.00 | .76 | 1.02 | 2.07 | 2.14 | 2.54 | 1.97 | 2.17 | 2.56 | 1.39 |
| | 3 | 1.15 | .71 | 1.18 | 2.36 | 1.99 | 2.16 | 1.60 | 1.59 | 2.39 | 1.02 |
| | 4 | 1.29 | .66 | 1.37 | 1.75 | 1.73 | 1.76 | 1.20 | 1.51 | 2.13 | .89 |
| | 5 | 1.31 | .70 | 1.37 | 1.84 | 1.39 | 1.35 | .83 | 1.60 | 1.94 | .81 |
| | 6 | 1.11 | .59 | 1.14 | 1.28 | .99 | 1.13 | .59 | 1.57 | 1.84 | .66 |
| | 7 | .86 | .68 | .84 | 1.38 | .73 | 1.08 | .44 | 1.51 | 1.65 | .54 |
| | 8 | .65 | .58 | .52 | 1.16 | .58 | .94 | .34 | 1.31 | 1.27 | .42 |
| | 9 | .42 | .55 | .48 | .99 | .56 | .73 | .25 | 1.03 | .85 | .35 |
| | 10 | .38 | .35 | .38 | .67 | .48 | .49 | .18 | .64 | .75 | .32 |
| | 11 | .22 | .27 | .34 | .58 | .35 | .24 | .14 | .45 | .61 | .25 |
| | 12 | .17 | .17 | .25 | .41 | .21 | .16 | .11 | .40 | .45 | .15 |
| | 13 | .13 | .11 | .14 | .28 | .13 | .10 | .09 | .35 | .24 | .07 |
| | 14 | .12 | .08 | .07 | .17 | .10 | .07 | .08 | .24 | .07 | .04 |
| | 15 + | .29 | .18 | .21 | .34 | .38 | .16 | .18 | .39 | .23 | .21 |
| Totals | | 27 | 23 | 44 | 48 | 42 | 45 | 52 | 50 | 61 | 37 |

Table 15. Age compositions of sockeye salmon from North peninsula rivers in July, 1994–96.

| | | 1-ocean | | | 2-ocean | | | | 3-ocean | | | 4-ocean | | | Escape. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | River | 1.1 | 2.1 | 3.1 | 0.2 | 1.2 | 2.2 | 3.2 | 0.3 | 1.3 | 2.3 | 0.4 | 1.4 | 2.4 | 1,000s |
| 94 | Ilnik | | | | | .083 | | | .350 | .317 | .033 | .017 | .117 | .083 | 75 |
| | Sandy | .017 | .002 | | .001 | .899 | .019 | | .001 | .060 | .001 | | .001 | | 115 |
| | Bear (early) | .006 | .060 | | | .012 | .477 | | | .057 | .366 | | .002 | .020 | 262 |
| | Nelson | | .047 | | | .020 | .843 | .005 | | .010 | .069 | | .004 | .001 | 325 |
| | Combined | .005 | .040 | | .000 | .153 | .516 | .002 | .034 | .063 | .156 | .002 | .014 | .015 | 777 |
| 95 | Ilnik | | | | .022 | .129 | .010 | | .125 | .650 | .037 | .015 | .012 | | 38 |
| | Sandy | .033 | | | .006 | .320 | .030 | | | .603 | .007 | | | | 124 |
| | Bear (early) | .000 | .112 | | | .027 | .424 | | | .006 | .416 | | .006 | .009 | 221 |
| | Nelson | .001 | .086 | | .001 | .013 | .826 | .002 | | .014 | .056 | | | .002 | 338 |
| | Combined | .006 | .075 | | .003 | .076 | .523 | .001 | .007 | .146 | .157 | .001 | .002 | .004 | 721 |
| 96 | Ilnik | | | | .006 | .033 | .006 | | .676 | .259 | | .013 | .007 | | 61 |
| | Sandy | .008 | .001 | | .012 | .521 | | | .077 | .372 | .005 | | .003 | | 62 |
| | Bear (early) | .002 | .142 | | | .046 | .576 | | | .032 | .197 | | | .005 | 247 |
| | Nelson | .002 | .065 | | .001 | .139 | .651 | .005 | .001 | .054 | .082 | | | | 242 |
| | Combined | .002 | .083 | | .002 | .130 | .490 | .002 | .076 | .098 | .112 | .001 | .001 | .002 | 612 |

Source: P. Nelson and C. Hicks, ADFG Kodiak

Table 16. Age compositions in the Northern District by week, 1996.

| Section | Week ending | 2-ocean 0.2 | 2-ocean 1.2 | 2-ocean 2.2 | 2-ocean 3.2 | 3-ocean 0.3 | 3-ocean 1.3 | 3-ocean 2.3 | 3-ocean 3.3 | 4-ocean 0.4 | 4-ocean 1.4 | 4-ocean 2.4 | Catch 1,000s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nelson Lagoon | | | | | | | | | | | | | |
| June | 13 | | .188 | .177 | .004 | .032 | .537 | .052 | .000 | .002 | .004 | .004 | 6 |
| | 20 | .002 | .133 | .239 | .000 | .053 | .430 | .137 | .000 | .000 | .003 | .000 | 17 |
| | 27 | | .095 | .393 | .002 | .025 | .283 | .196 | .000 | .000 | .002 | .001 | 35 |
| July | 4 | | .093 | .624 | .002 | .011 | .157 | .110 | .000 | .000 | .001 | .000 | 174 |
| | 11 | | .094 | .680 | .003 | .013 | .112 | .096 | .000 | .000 | .001 | .000 | 111 |
| | 18 | .001 | .186 | .529 | .011 | .009 | .157 | .101 | .000 | .000 | .003 | .000 | 54 |
| | 25 | .007 | .375 | .304 | .003 | .023 | .240 | .044 | .000 | .000 | .002 | .000 | 27 |
| Aug. | 1 | .005 | .653 | .101 | .000 | .010 | .214 | .013 | .000 | .000 | .003 | .002 | 10 |
| | 8 | .008 | .624 | .041 | .002 | .010 | .301 | .012 | .000 | .000 | .001 | .000 | 7 |
| | 15 | .009 | .614 | .032 | .002 | .011 | .319 | .012 | .000 | .000 | .000 | .000 | 5 |
| | 22 | | | | | | | | | | | | 1 |
| Sept. | 12 | | | | | | | | | | | | 0 |
| Total number | | 0 | 67 | 241 | 1 | 7 | 81 | 46 | 0 | 0 | 1 | 0 | 445 |
| Proportion | | .001 | .150 | .537 | .003 | .015 | .180 | .103 | .000 | .000 | .002 | .000 | |
| Harbor Point to Stoganof Point | | | | | | | | | | | | | |
| June | 27 | .001 | .032 | .194 | .002 | .045 | .403 | .321 | .001 | .000 | .002 | .001 | 19 |
| July | 4 | .001 | .032 | .194 | .002 | .045 | .403 | .321 | .001 | .000 | .002 | .001 | 78 |
| | 11 | .002 | .035 | .206 | .002 | .040 | .386 | .315 | .001 | .001 | .004 | .004 | 365 |
| | 18 | .004 | .045 | .222 | .002 | .024 | .371 | .324 | .000 | .000 | .002 | .005 | 275 |
| | 25 | .006 | .038 | .231 | .005 | .014 | .267 | .434 | .000 | .000 | .001 | .003 | 149 |
| Aug. | 1 | .002 | .029 | .249 | .010 | .008 | .189 | .509 | .001 | .000 | .002 | .001 | 130 |
| | 8 | .002 | .035 | .330 | .014 | .006 | .164 | .448 | .000 | .000 | .001 | .000 | 69 |
| | 15 | .000 | .019 | .346 | .014 | .002 | .122 | .494 | .000 | .000 | .000 | .002 | 81 |
| | 22 | .000 | .010 | .309 | .017 | .000 | .051 | .612 | .000 | .000 | .000 | .001 | 116 |
| | 29 | .000 | .008 | .338 | .026 | .000 | .022 | .603 | .001 | .000 | .000 | .002 | 81 |
| Sept. | 19 | .000 | .001 | .342 | .039 | .000 | .005 | .610 | .000 | .000 | .000 | .000 | 33 |
| Total number | | 3 | 43 | 347 | 11 | 29 | 375 | 577 | 1 | 0 | 3 | 4 | 1394 |
| Proportion | | .001 | .018 | .146 | .005 | .012 | .158 | .242 | .000 | .000 | .001 | .002 | |

Source: C. Hicks, ADFG Kodiak

Table 17. Age compositions in early- and late-run escapements to Bear Lake.

| Year | Early run (through July 11) 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | other | Escapement (1000s) | Late run (August 2 to end) 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | other | Escapement (1000s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85 | .062 | .136 | .094 | .541 | .152 | .015 | 202 | .012 | .006 | .045 | .826 | .103 | .008 | 156 |
| 86 | .056 | .071 | .002 | .439 | .428 | .004 | 121 | .005 | .013 | .015 | .734 | .233 | .000 | 98 |
| 87 | .030 | .201 | .001 | .537 | .225 | .006 | 117 | .020 | .037 | .002 | .554 | .387 | .000 | 81 |
| 88 | .000 | .077 | .011 | .230 | .682 | .000 | 117 | .007 | .011 | .134 | .550 | .297 | .001 | 140 |
| 89 | .020 | .001 | .071 | .269 | .573 | .066 | 135 | .017 | .001 | .077 | .787 | .111 | .007 | 178 |
| 90 | .154 | .020 | .013 | .368 | .390 | .055 | 147 | .039 | .008 | .002 | .854 | .073 | .024 | 232 |
| 91 | .032 | .336 | .046 | .512 | .069 | .005 | 293 | .110 | .020 | .101 | .681 | .067 | .021 | 65 |
| 92 | .038 | .037 | .055 | .577 | .271 | .022 | 168 | .003 | .003 | .150 | .712 | .104 | .028 | 194 |
| 93 | .015 | .038 | .009 | .323 | .593 | .022 | 194 | .013 | .008 | .193 | .439 | .316 | .031 | 194 |
| 94 | .012 | .072 | .055 | .271 | .548 | .042 | 163 | .000 | .018 | .005 | .831 | .094 | .052 | 173 |
| 95 | .036 | .003 | .075 | .386 | .485 | .015 | 130 | .007 | .006 | .148 | .659 | .176 | .004 | 84 |
| 96 | .045 | .034 | .122 | .581 | .212 | .006 | 188 | .010 | .006 | .163 | .467 | .211 | .143 | 97 |
| Means | .042 | .086 | .046 | .420 | .386 | .022 | 165 | .020 | .011 | .086 | .675 | .181 | .027 | 141 |

Table 18. Comparison of age compositions, 1994–96.

| Year | Location | Age composition 1.2 | 2.2 | 1.3 | 2.3 | Other |
|---|---|---|---|---|---|---|
| 94 | BB catch | .054 | .534 | .155 | .225 | .032 |
| | PM catch | .059 | .433 | .206 | .272 | .030 |
| | NP catch | .040 | .154 | .208 | .546 | .052 |
| | NP escape. | .322 | .141 | .124 | .280 | .133 |
| 95 | BB catch | .153 | .548 | .123 | .163 | .013 |
| | PM catch | .142 | .496 | .151 | .202 | .009 |
| | NP catch | .109 | .250 | .241 | .375 | .025 |
| | NP escape. | .172 | .203 | .347 | .245 | .033 |
| 96 | BB catch | .088 | .127 | .514 | .248 | .023 |
| | PM catch | .075 | .117 | .522 | .255 | .031 |
| | NP catch | .034 | .204 | .391 | .317 | .054 |
| | NP escape. | .142 | .403 | .149 | .148 | .158 |

BB= Bristol Bay, PM=Port Moller, NP= North Peninsula.
NP catch for Bear River and Ilnik/Three Hills sections through July 11.
NP escapement for Ilnik, Sandy, and early Bear River (through July 11).
Escapement age composition excludes jacks (1-ocean fish).

Table 19. Average body sizes of sockeye salmon smolts.

| Lake system | Years | Mean length (mm) Age 1 | Age 2 | Comb. | Mean weight (gm) Age 1 | Age 2 | Comb. | Percent age 1 Mean | Range | Smolt/adult survival (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Tikchik | 1983-89 | 80 | 92 | 81 | 4.6 | 6.7 | 4.7 | 96 | 91, 99 | 6.2 |
| Wood River | 1975-90 | 84 | 97 | 86 | 5.8 | 8.4 | 6.1 | 89 | 83, 98 | 6.1 |
| Ugashik | 1983-93 | 90 | 108 | 98 | 7.1 | 11.5 | 8.9 | 63 | 22,85 | 6.0 |
| Naknek | 1982-93 | 95 | 108 | 102 | 8.5 | 12.6 | 10.2 | 63 | 32, 90 | 6.1 |
| Kvichak | 1976-93 | 86 | 104 | 93 | 5.6 | 9.7 | 7.2 | 48 | 2,95 | 9.9 |
| Egegik | 1982-93 | 103 | 118 | 111 | 9.8 | 14.5 | 12.4 | 42 | 5, 77 | 21.0 |
| Bear | 1986-95 | 97 | 107 | 105 | 9.3 | 12.2 | 11.5 | 15 | 1, 52 | ? |

Table 20. Limnological measurements in Bear Lake,1996.

| Mo | Date | Sta. | Secchi | Surface temp. | Chlorophyll a 0-20 m (mg/m^2) | Zooplankton depth (m) | Zooplankton number (1,000/m^2) Cyclops | Bosmina | Total |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 29 | 1 | 6.5 | 6.0 | | 40 | 309 | 50 | 359 |
| | | 2 | 7.0 | 7.0 | 21.2 | 40 | 196 | 90 | 286 |
| | | 3 | 9.0 | 7.0 | | 40 | 391 | 80 | 471 |
| | | 4 | 7.5 | 6.5 | | 40 | 306 | 112 | 418 |
| | | 5 | 7.0 | 7.0 | | 40 | 308 | 71 | 379 |
| | | 6 | 7.0 | 7.0 | | 20 | 143 | 105 | 248 |
| | | Means | 7.3 | 6.8 | | 37 | 276 | 85 | 360 |
| 7 | 13 | 1 | 9.0 | | | 40 | 271 | 90 | 361 |
| | | 2 | 8.5 | | | 40 | 267 | 110 | 377 |
| | | 3 | 8.5 | | | 40 | 286 | 106 | 392 |
| | | 4 | 8.3 | | | 40 | 234 | 87 | 321 |
| | | 5 | 8.5 | | | 40 | 305 | 59 | 364 |
| | | 6 | 7.0 | | | 20 | 66 | 23 | 89 |
| | | Means | 8.3 | | | 37 | 238 | 79 | 317 |
| 7 | 30 | 1 | 9.0 | | | 40 | 232 | 242 | 474 |
| | | 2 | 8.5 | | | 40 | 215 | 182 | 397 |
| | | 3 | 8.5 | | | 40 | 201 | 157 | 358 |
| | | 4 | 8.3 | | | 40 | 253 | 159 | 412 |
| | | 5 | 8.5 | | | 40 | 100 | 141 | 241 |
| | | 6 | 7.0 | | | 20 | 88 | 238 | 326 |
| | | Means | 8.3 | | | 37 | 182 | 187 | 368 |
| 8 | 8 | 1 | 6.5 | | | 40 | 238 | 304 | 542 |
| | | 2 | 6.8 | | | 40 | 278 | 282 | 560 |
| | | 3 | 6.3 | | | 40 | 269 | 214 | 483 |
| | | 4 | 7.0 | | | 40 | 134 | 102 | 236 |
| | | 5 | 6.2 | | | 40 | 138 | 69 | 207 |
| | | 6 | 6.0 | | | 20 | 47 | 118 | 165 |
| | | Means | 6.5 | | | 37 | 184 | 182 | 366 |
| 8 | 23 | 1 | 5.5 | 10.0 | | 40 | 150 | 437 | 587 |
| | | 2 | 5.0 | 9.5 | 30.9 | 40 | 160 | 271 | 431 |
| | | 3 | 5.5 | 10.0 | | 40 | 143 | 240 | 383 |
| | | 4 | 5.0 | 10.0 | | 40 | 59 | 370 | 429 |
| | | 5 | 5.0 | 10.0 | | 40 | 58 | 416 | 474 |
| | | 6 | 5.0 | 10.5 | | 20 | 13 | 262 | 275 |
| | | Means | 5.2 | 10.0 | | 37 | 97 | 333 | 430 |

1 near outlet; 2 off Gibralter Rock, and 6 near upper end

Table 21. Catches from fish sampling in Bear Lake, 1995-96.

| Gear | Date | Number of hauls/sets | Catch: Species | Ages | Lengths (mm) | Mean catch |
|---|---|---|---|---|---|---|
| Beach seine | 6/20-22/95 | 5 | Sockeye salmon | 0 | 23-35 | 479 |
| | | | | 1 | 83 | <1 |
| | | | Coho salmon | 0 | 36-45 | 1 |
| | | | | 1 | 58-86 | 2 |
| | | | Coastrange sculpin | 1 | 24-26 | 3 |
| | | | Ninespine stickleback | 1+ | 31-62 | 2 |
| | | | Arctic char | 1 | 65-79 | <1 |
| | | | Alaska blackfish | ? | 54 | <1 |
| | 6/29/96 | 7 | Sockeye salmon | 0 | 25-40 | 1 |
| | | | | 1 | 49-62 | <1 |
| | | | | 2 | 95 | <1 |
| | | | Coastrange sculpin | 0+ | 14-65 | 9 |
| | 7/13/96 | 6 | Coastrange sculpin | 0+ | 16-70 | 2 |
| | 7/30/96 | 6 | Coastrange sculpin | 0+ | 20-68 | 1 |
| Gill net | 6/20-22/95 | 7 | Sockeye salmon | 1+ | | 10 |
| | | | Coho salmon | 1+ | | 2 |
| | | | Arctic char | 2+ | | 3 |
| | 6/30-7/1/96 | 4 | Sockeye salmon | 1+ | 106-177 | 10 |
| | | | Arctic char | 2+ | 192-426 | 1 |
| Minnow trap | 6/30-7/1/96 | 2 | Coho salmon | 1+ | 50-93 | 42 |
| | | | Coastrange sculpin | 1+ | 52-90 | 2 |
| | | | Arctic char | 1+ | 69-137 | 14 |

Each minnow trap set for 24 h. Gillnets fished both from shore and offshore below the surface for 14 to 24 h.

Table 22. Temperature profiles in Bear Lake, 1996.

| Depth (m) | Site: Date: | Station 2 2-Jul | Station 2 23-Aug | Cage site 23-Aug |
|---|---|---|---|---|
| 0 | | 6.0 | 10.0 | 9.0 |
| 1 | | 6.0 | 10.0 | 9.0 |
| 3 | | 6.0 | 10.0 | 9.0 |
| 5 | | 6.0 | 10.0 | 9.0 |
| 7 | | 6.0 | 10.0 | 9.0 |
| 10 | | 6.0 | 10.0 | 8.5 |
| 15 | | 6.0 | 10.0 | 8.0 |
| 20 | | 6.0 | 9.0 | 7.5 |
| 25 | | 6.0 | 8.5 | 7.0 |
| 30 | | 6.0 | 8.0 | 7.0 |
| 35 | | 6.0 | 7.5 | 6.5 |
| 40 | | 6.0 | 7.0 | 6.5 |
| 45 | | 6.0 | 7.0 | 6.5 |
| 50 | | 6.0 | 7.0 | 6.0 |
| 55 | | 6.0 | 6.5 | 6.0 |

Table 23. Analysis of covariance for 3 body measurements on early and late-run sockeye.

| Sex | Measurement | Run | Adjusted Mean | C.I. ± | F | P |
|---|---|---|---|---|---|---|
| Male | Caudal depth (mm) | Early | 39.1 | 0.7 | 11.1 | .000 |
| | | Late | 41.2 | 0.7 | | |
| | Body depth (mm) | Early | 123.4 | 2.2 | 0.4 | .521 |
| | | Late | 124.7 | 2.4 | | |
| | Body weight (gm) | Early | 1852 | 1.0 | 0.6 | .441 |
| | | Late | 1889 | 1.0 | | |
| Female | Caudal depth (mm) | Early | 40.3 | 0.7 | 2.6 | .113 |
| | | Late | 41.3 | 0.7 | | |
| | Body depth (mm) | Early | 123.0 | 1.8 | 5.2 | .028 |
| | | Late | 119.4 | 1.9 | | |
| | Body weight (gm) | Early | 2150 | 1.0 | 25.0 | .000 |
| | | Late | 1959 | 1.0 | | |

Measurements regressed on body length.