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ALASKA SALMON RESEARCH

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Annual Report—1997

to

Bristol Bay Processors

Acknowledgments

The contribution of graduate student research to our program is vital. In 1997, Troy Hamon and Doug Peterson (Wood River system) and Kristina Ramstad (Alaska Peninsula) pursued their graduate research and provided supervision for the summer field work. Other University of Washington students working on the program in 1997 were Megan McPhee, Chris Boatright, Ryan Steen, Jason Griffith, Reina Garcia, Brooks Horan, and Sayre Hodgson. We especially appreciated the assistance of several volunteers: Jamie Gillooly, Bob Donnelly, Andrew Hendry, and Richard Brocksmith.

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Key words

Bristol Bay, escapements, forecasts, genetics, growth, Kvichak, Nushagak, predation, spawning, sockeye salmon, Wood River Lakes

Alaska Salmon Research

D. ROGERS, C. FOOTE, T. QUINN, AND B. ROGERS

INTRODUCTION

Fisheries Research Institute (FRI) was established in 1946 with the financial support of the major Alaskan salmon (*Oncorhynchus* spp.) processors to investigate the causes of the declines in production that had occurred in most stocks since the 1930s, work with the government management agency to increase our knowledge of the biology of salmon and the effects of the fisheries on the stocks, and assist salmon processors by providing a second opinion on matters of salmon fisheries management. With the high levels of production since the 1980s, our primary objectives now are to determine how to maintain the high production (what has caused year-to-year variation) and how to harvest and process salmon most efficiently (e.g., accurate forecasts and fishing evenly distributed throughout the run).

We presently have salmon research projects in Bristol Bay, Alaska Peninsula, and Chignik that are funded in part or entirely by the industry. In addition, we have a federally funded high-seas salmon project that was focused on the oceanic distribution of salmon and the vulnerability of North American stocks to foreign fisheries, but is now focusing on ocean carrying capacity for salmon. In recent years we have also worked in Kodiak, Southeast Alaska, and on the Yukon stocks. All of these projects have been carried out in cooperation with the Alaska Department of Fish and Game (ADFG) or the National Marine Fisheries Service (high seas), and we have also had cooperative research projects with salmon biologists from Japan and Russia.

This report is focused on our 1997 Bristol Bay research with emphasis on salmon forecasting and research relevant to escapement policies for maximizing production. Our Alaska Peninsula annual report was completed in December and our Chignik report will be submitted in March.

FORECASTING

Preseason Forecasts

Forecasts of the 1998 Bristol Bay sockeye salmon (*O. nerka*) runs and catches were provided to participating processors at our October 1997 meeting (Rogers 1997). They are presented in Table 1 with the ADFG forecasts and the past forecasts and runs beginning in 1988. The two river system forecasts (FRI and ADFG) are based on the same data sources, but different analytical methods have often been used. Both 1997 forecasts were for a large run and catch, and the actual run (19 million) and catch (12 million) were much smaller than the forecasts. The outlook for 1998 is for the run and catch to be below the recent years average but larger than 1997. The Kvichak and Egegik combined are expected to produce nearly 56% of the Bristol Bay run in 1998.

The next large run (>20 million) to the Kvichak is likely to come in 1999. Fry from the 1994 escapement of 8 million had relatively poor growth and are likely to spend 2 years in the lake and return as adults mostly in 1999 (5 years after their parents); however, fry from the 1995 escapement of 10 million had relatively good growth and the majority are likely to spend only 1 year in the lake and thus return as adults also in 1999 (4 years after their parents). The preliminary estimate of the 1997 smolt migration from the Kvichak was about 400 million and confirms our earlier prediction (B. Cross, ADFG, pers. comm.).

Port Moller Forecast

The Port Moller inseason test fishery was conducted by ADFG during June and early July from 1968 through 1985, with a change in gear in 1985. There was no test fishery in 1986 and, beginning in 1987, FRI has conducted the test fishery each year. The test fishery now employs a 200-f gillnet that is 60 meshes deep and has 5 1/8-in stretched mesh. The web is multistrand monofilament (center core). Since 1994, we have used the fishing vessel *Cape Cross*. Four stations have been routinely fished along a transect 33 to 63 nmi out from Port Moller (16 to 42 nmi from the nearest coastline). Catch, mean length, and water temperature data were sent daily by radio to Port Moller and then faxed into Bristol Bay. Scales and length data were sent periodically to ADFG (B. Cross, King Salmon), where the scales were aged and the age compositions and average lengths by age were reported.

From 1987 through 1996 the forecasts had been very accurate. The runs differed from the forecasts made on June 25 and 30 by an average of 20%, and we were within an average of 12% on forecasts made about July 3 (Table 2). We have not done as well in forecasting the catch because river system forecasts and thus catches cannot be made until about July 3, when we have the first indication of where the salmon are going. In 1997, the number of fish in the Bristol Bay run was only 50% of the forecasts during June 25 to 30. A large run was forecasted but a relatively small run occurred in the bay. The run began a little earlier than average but never built up as projected from the Port Moller catches (Fig. 1). The distribution of the sockeye salmon as they passed Port Moller was ideal in 1997, as the fish were concentrated in the middle stations (i.e., 4 and 6; Fig. 2). Weather conditions were unusually calm and clear, and record warmwater temperatures were encountered in late June and early July.

The ADFG (B. Cross, Anchorage) provided preliminary length and weight statistics for 1997, and statistics from prior years were available (e.g., Yuen et al. 1981, Stratton and Crawford 1994) from which we could calculate mean lengths in the runs (Table 3). Both the 2-ocean and 3-ocean sockeye salmon in the 1997 run were about average in length. Average weights in the Bristol Bay fishing districts in 1997 ranged from 5.8 lb (Nushagak) to 7.1 lb (Togiak) and were all close to the recent years' averages (Tables 4 and 5).

The Port Moller test fishery in 1997 provided an early indication to ADFG management that a large run was on the way; however, early catches within Bristol Bay indicated that only Egegik and Nushagak districts had relatively strong runs. The only overescapement occurred in the Wood River and was a result of attempts to achieve a larger escapement from a relatively weak run to the Nushagak River (Table 6).

LAKE RESEARCH

During summer 1997, we continued our long-term studies of spawner distribution, growth and abundance of fry, and the physical and biological environment for the sockeye salmon of the Wood River (Nushagak) and Kvichak lake systems. Most of our annual observations in the Wood River Lakes extend over more than 40 years and constitute the longest continuous biological and environmental record on any salmon stock in Alaska. In 1997, we also conducted special studies of bear predation on spawning sockeye salmon. In addition, we provided a crew to ADFG for their Nuyakuk escapement enumeration.

Kvichak System

Our 1997 field season in the Kvichak system (Lakes Iliamna and Clark) consisted of the following: estimating the sockeye salmon escapement into the Newhalen River in late June and July, townetting for juvenile sockeye and threespine sticklebacks (*Gasterosteus aculeatus*) in upper Lake Iliamna and, and conducting spawning ground surveys in late August to early September to collect otoliths for sockeye age determination. In addition, we continued our studies on (1) the ecological relationship between sockeye salmon and two sculpin species, *Cottus cognatus* and *C. aleuticus*; (2) ecological factors promoting the genetic differentiation of sockeye salmon populations; and (3) the spawning behavior of sockeye salmon. Finally, we monitored the spawning runs of sockeye salmon on three island beaches—two shallow and protected and one deeper and unprotected—to determine whether there were demographic effects of the low water and high surface water temperatures that occurred in the summer of 1997.

Newhalen River Escapement

The annual escapements of sockeye salmon to the Kvichak lake system are estimated by ADFG from expanded 10-min counts on each bank of the river near Igiugig at the outlet of Lake Iliamna. Since 1979, we have estimated escapements up the Newhalen River by expanding 20-min counts, for each of 10 daylight hours, on the northwest bank of the river at the town of Newhalen. We assume that fish use both sides of the river equally and that migration rate does not vary over the course of the day. The daily counts at Newhalen are compared with those of ADFG at Igiugig to estimate a travel time. We calculate the daily proportions of the run at Igiugig that went up the Newhalen by lagging the Newhalen counts back the appropriate number of days (3 in 1997).

The cumulative daily escapements for the two rivers, timed to the Kvichak River, are given for 1991–97 (Table 7). In mid-July, milling fish often swim upriver along the banks of the Newhalen and are counted, only to drift back down in the middle of the river and return upstream to be counted again. This behavior inflates the counts for the escapement; therefore, we have used the average proportion of the Newhalen count for day 5 to day 16 (day 1 equals the first day of about 100,000 in the Kvichak) and the season's total Kvichak escapement to estimate the Newhalen/Lake Clark escapement.

In 1997, we estimated that about 270,000 of the Kvichak escapement of 1.5 million (about 18%) migrated to the Newhalen/Lake Clark system (Table 8). The aerial surveys conducted by ADFG (Regnart 1998) provided an estimate of Newhalen spawners (1,000) and this, by subtraction, yielded an estimate of only 269,000 for the Lake Clark escapement. However, during our otolith collection surveys on the Newhalen in late August and early September, we noted that the Newhalen was very turbid compared with previous years, which was likely due to relatively high glacial runoff in the very warm summer of 1997. Thus, aerial surveys of the system would seem likely to produce an underestimate of Newhalen spawners.

Spawning Ground Surveys

Each year since 1956, we have collected scales or otoliths from spawned-out sockeye salmon from several major spawning grounds in the Kvichak River system. In 1997, we continued this work and sampled fish from each of our historically surveyed populations. Collections in the Newhalen River were limited by the high water turbidity associated with greater than usual glacial runoff in the Lake Clark system. Low collection numbers in the Tazimina River reflected the low escapement to the river.

Overall, the age pattern was similar to the composition of the entire lake system (Kvichak escapement). However, age 2.3 fish were scarce in beach populations but quite abundant in the Gibralter and Copper River samples. Age 1.2 fish were more abundant in the Knudson Bay beaches than in the other spawning populations and it was this age group that was most lacking in the Kvichak run in 1997 (Table 9).

We had conducted annual aerial surveys of the Kvichak spawning grounds from 1956 until 1988, after which ADFG took over the surveys. The results of the 1997 survey were reported by Regnart (1998). These are summarized for 29 selected spawning grounds (Table 10). Aerial counts accounted for 28.1% of the relatively small (tower count) escapement into the Kvichak system. This percentage is higher than average for recent years but comparable to percentages counted in the 1960s and 70s. Most of the 1.5 million escapement in 1997 returned to the rivers in Lake Iliamna with very low numbers of spawners in the creeks, on the island beaches, and in Lake Clark.

Sockeye Fry Abundance and Size

We have sampled the sockeye fry (age 0) in the Kvichak system in August of each year since 1962 (1961 brood year) by townetting set stations in Lakes Iliamna and Clark at night. In 1997, we sampled 10 of our 11 sites in the eastern portion of Lake Iliamna. We did not sample Lake Clark in 1997. The geometric mean (23) of the catches per 20 min trawl provides a measure of the relative density. The mean length of fry adjusted to their predicted size on September 1 (based on daily growth estimates) provides a measure of the growing conditions for that year and can be used to estimate the proportion of fry that will migrate to the ocean at age 1 or 2 (Table 11).

Growth of sockeye fry in the lake is affected by environmental conditions (mainly temperature) and biotic conditions (mainly competition with other sockeye fry and yearlings). In general, when the number of sockeye fry in the lake is higher and their growth is slower and water temperatures are warmer during the first growing season, their growth as well as the percentage of fish that will smolt at age 1 will be greater. As seen from the few sockeye caught per 20-minute trawl (23), there was a relatively small number of fry in Iliamna in 1997, which resulted from the small 1996 escapement to the system. In addition, the summer water temperatures were very warm, with the net result being very favorable growth conditions. On the basis of an average size of 67 mm for Iliamna fry on September 1, we estimate that about 82% of fry resulting from the 1996 brood year will smolt and migrate to the ocean in spring 1998.

Predation of Sockeye Eggs by Coastrange and Slimy Sculpins

Since 1992, we have monitored the predation intensity of sculpin species on sockeye salmon eggs during the sockeye spawning season. The first scientific papers resulting from this work are in press in the Canadian Journal of Fisheries and Aquatic Sciences and the Canadian Journal of Zoology. In 1997, as in 1996, we limited our work to simple surveys on the abundance and size of sculpins on a series of island beaches. If, as we have hypothesized, sculpin predation on sockeye eggs is a major factor in the cyclic nature of island beach spawning populations, then in years of low sockeye abundance, such as 1996 and 1997, sculpins should have a greater impact on the sockeye than in years of high abundance. However, this was again not the case in the three beaches we surveyed. While sockeye numbers on the beaches were the lowest we observed in the 6 years of this study, sculpin numbers were relatively even lower. Further, like 1996, the large size-classes of sculpins, which can eat the most eggs and which have dominated most of our previous surveys, remained largely absent. On the basis of our examination of the effects of sculpin predation on sockeye eggs through one cycle of the island beach spawners, we believe that sculpins have significant effects on the dynamics of sockeye spawning (spawning duration and possibly coordination), but we remain unconvinced of their effects on possible sockeye production cycles in Iliamna Lake.

Iliamna Beach Spawning Studies

In Lake Iliamna, sockeye salmon spawn on exposed or wave-swept island beaches. This type of spawning habitat has been poorly studied in this and other lake systems where beach spawning occurs, primarily because it is rare. However, in Lake Iliamna, up to 50% of the spawning run has historically used this habitat during years of peak escapement. In 1997, surface water temperatures on island spawning beaches were consistently warm (>15˚C), sometimes exceeding 17˚C, the highest we have ever noted.

To determine whether these high water temperatures might affect spawning demographics, we surveyed three island beaches for sockeye numbers. The two warmest of these beaches, Woody Island and Between Islands had the fewest spawning fish we have seen in our 7 years of surveys. Indeed, these spawning areas were largely unused. In contrast, Fuel Dump Island beach, which is more exposed to wind-driven currents from the lake and, hence, is cooler, had an absolutely and proportionately much higher number of fish. These results suggest that salmon move among the beaches in search of appropriate spawning conditions. If so, this mixing behavior would restrict the extent of population differentiation among island beaches that is observed among other discrete spawning populations in the lake.

Sockeye Spawning Behavior Studies

In 1997, we extended our studies on the role of color in spawning behavior. As in 1995, we were interested in the role of the carotenoid-based red skin pigment in mate selection. Carotenoids are plant-synthesized compounds that are bio-accumulated throughout the food chain, with sockeye salmon getting their carotenoids largely from krill in the ocean. Carotenoids account for the valuable orange-red color of sockeye salmon flesh. Our results show that males respond mainly to wavelength, and only secondarily to brightness. Hence, males can use color (wavelength) to select mates even during dusk and dawn (when brightness is much reduced). Given the fact that higher wavelengths (red) are relatively more abundant during these periods (thus accounting for red sunsets and sunrises), the color red may provide an enhanced effect throughout most of a 24-hour period. The results of this work, the first of its kind for any salmon species, are presently being prepared for publication.

Stock Separation with Otoliths

Population-specific variation in life history traits (age, size, fecundity, egg size, etc.) and the genetics indicates that sockeye salmon populations must learn the odors or other features of their natal site during incubation in the gravel or as they emerge as free-swimming fry. Thus, the spawning ground is presumed to be the fundamental unit of the population although fisheries may only be manageable at the level of the lake system. Nevertheless, knowing the patterns of population structure as precisely as possible is important. Unfortunately, the great abundance and small size of newly emerged fry make it impractical to mark or tag enough of them to examine patterns of homing and straying of adults. As an alternative to marking fry, we took a different approach.

We hypothesized that natural variation in otolith microstructure might result from differences in thermal regimes experienced by different populations during incubation. To test this, we collected otoliths from adult sockeye salmon that returned to discrete spawning areas in Iliamna Lake: Woody and Fuel Dump islands (variable thermal regimes) and two spring-fed ponds in Pedro Bay (stable thermal regimes). The otoliths were prepared and classified in blind trials by collaborators with the Washington Department of Fish and Wildlife, based on comparisons with juveniles and information on site-specific thermal regimes. Analysis showed that almost all salmon were correctly classified to collection site, and very obvious differences in otolith structure were detected between populations. This demonstrated the utility of otolith analysis for this kind of comparison. The results were consistent with genetic evidence for fine-scale structure of sockeye salmon populations but also enabled us to detect some small level of straying between these distinct incubation habitats.

Wood River System

The Bristol Bay research program of FRI began with spawning ground surveys in the Wood River Lakes in 1946 to determine where, when, and how many sockeye salmon spawned there. During the early 1950s, methods were established to enumerate and sample the commercial catches, escapements (towers), and the smolts produced. By the late 1950s, we had established several important measurements, which we have maintained to the present in order to characterize each year's environment for spawning adults and rearing juveniles.

Environmental Observations

Spring 1997 was again early and ice breakup in Lake Aleknagik (recorded since 1949)—8 days earlier than average (Table 12 and Fig. 3). Early summer water temperatures were above average and record high temperatures were recorded in mid-summer as a result of unusually sunny, dry, and calm weather. Lake levels were well below normal in early June as a result of a small snow pack, and record low lake levels were reached by early July as a result of the dry weather. Rainfall in late August and early September brought water levels up somewhat, but lake levels were still below average during the spawning season. The most unusual environmental conditions in 1997 occurred when adult salmon were entering the lakes during late-June and early-July. At that time, there were record low water levels and record high temperatures especially nearshore (Fig. 4).

The standing crop of phytoplankton (chlorophyll) was average throughout the summer with a record high density recorded for early September, whereas zooplankton volumes were a little above average in June but well below average by August (Fig. 5). Zooplankters are the main source of food for juvenile sockeye salmon after they move offshore in late July. In 1997, there was a general scarcity of the larger forms of zooplankton (calanoid copepods and *Holopedium*) and a preponderance of relatively small cyclopoid copepods (Fig. 6). The abundance of calanoid copepods in 1997 was the lowest recorded in Lake Aleknagik. Insects (mainly pupal and adult midges) are the main source of food in the spring when the fry are inshore. There was an early peak in midge emergence in 1997 (July 1–10) corresponding with the early ice breakup; however, the numbers emerging were exceptionally small (Table 13). In past years, midge emergence has usually peaked in either late July or early August. Water temperatures at the nearshore insect traps in 1997 were the warmest recorded for most of June and July.

Fry Abundance and Growth

In 1997, the sockeye salmon fry in Lake Aleknagik were 5% longer than average in June. They experienced good growth in July, reaching about 46 mm by the end of the month, but their growth during August was well below average, and on September 1 they were 6% shorter than average (Table 14). Fry abundance as measured by beach seine sampling in June and July and townet sampling around September 1 was below the long-term average. The number of parent spawners (606,000) in Lake Aleknagik in 1996 was well above average for the lake. The relatively small size on September 1 indicates that the fry and sticklebacks had cropped down their main food supply, especially larger zooplankton such as calanoid copepods, *Holopedium*, and *Daphnia* (Fig. 6). Threespine sticklebacks were very numerous in 1997 mainly from a very large contribution of young-of-the-year that likely resulted from the early and warm spring. The adult sockeye salmon returns to Lake Aleknagik have generally been large since 1978 even though fry abundances have often been low. This suggests that recent large runs have been caused mainly by improved ocean survival.

The mean lengths of sockeye salmon fry in Lake Nerka indicated that, in 1997, growth was above average; however, townet catches were well below average (Table 15). Juvenile sockeye salmon in the Wood River Lakes system exhibit density-dependent growth, and we are analyzing our long-term data set for Lake Aleknagik to determine the relative effects of physical and biological factors in the lake on the growth of the sockeye salmon fry. In addition, we are examining year-to-year variation in zooplankton population composition along with annual variation in sockeye salmon fry and threespine stickleback abundance to determine the extent to which the fish alter their food resources. We hope the information from these studies will help explain the observed variability in the freshwater phase of the sockeye salmon.

Arctic Char Predation

Each spring when sockeye salmon smolt are migrating seaward from the Wood River lake system, Arctic char concentrate in and around the interconnecting rivers to feed on the smolt. We conducted several studies of this predation during the 1950s to 1970s, and since then, we have sampled the char in Little Togiak River on an opportunistic basis. In 1997, we caught, measured, and examined stomach contents of 28 char during June 13–24 (Table 16). The char were above average in length but contained a low percentage of sockeye salmon smolt in their stomachs (11%).

Spawning Ground Surveys

Sockeye salmon spawning ground surveys have been conducted annually in the Wood River Lakes system since 1946; however, it was not until the early 1950s that all major spawning grounds were included. We collect otoliths from the major spawning grounds for age determination and make ground counts of the number of spawners in the small streams. The ADFG estimates the numbers of spawners on the lake beaches and in the interconnecting rivers by aerial surveys; thus, the total escapement to the lake system can be apportioned to the individual lakes or type of spawning ground (creek, river, and beach). The distribution of spawners among the lakes is used in forecasting the Wood River runs. Even escapement distributions tend to produce larger returns than uneven distributions.

Aerial surveys were conducted by ADFG in 1997. The ground survey counts in 1997 for the major creek spawning grounds are given in Table 17. The creeks draining into Lake Aleknagik again contained relatively high counts of spawners. Hansen Creek contained a large number of spawners for the eighth consecutive year (Fig. 7). Age compositions on the spawning grounds in 1997 differed from past years in that there were higher percentages of 3-ocean fish in beach spawning areas than previously observed (Table 18). Ages in river and creek spawning areas were typical of past years.

Bear Predation

We completed the eighth year of our bear/spawning sockeye salmon interaction study in Hansen Creek, a small tributary of Lake Aleknagik where predation by bears is high relative to larger creeks. During 18 July to 23 August, a large number of spawners were again observed in Hansen Creek (Table 19). Daily count and removal of sockeye salmon killed by bears indicated that 4,831 (55%) of 8,845 spawners were killed by bears in 1997 (Table 20). These estimates excluded dead fish from previous daily surveys that might have been attacked by bears (decisions to exclude fish were based on gill and body coloration, body firmness, and body deterioration). The number of sockeye killed by bears in 1997 was the second highest for the 8-year period.

Consistent with previous years, the salmon killed by bears were larger, on average, than those not killed. However, the predation rate on females was higher than that on males. This was not consistent with data from previous years at Hansen Creek nor with data collected in 1997 on several other creeks in the Wood River system. By classifying the bear-killed salmon by the nature of the tissue eaten and by weighing many carcasses, we were able to estimate that bears ate 500 to 2,000 kg of salmon. This weight consumed was a small fraction of the estimated total fresh weight (about 11,000 kg) of the over 4,000 salmon killed. Thus, predation rates were high but relatively little tissue was eaten from most fish killed.

Our experiences during stream surveys in 1995 suggested that the bear population had increased in the Wood River Lakes system; however, bear sighting were greatly reduced in 1996 and 1997. Analysis of bear predation in Hansen Creek has not resulted in documentation of any correlation between the number of sockeye salmon spawners and the predation rate. The percentage of the salmon killed by bears has varied among years but has been neither higher nor lower when the runs were large or small. However, we have not obtained precise estimates for very low run sizes and we therefore plan to continue the daily surveys in Hansen Creek until we obtain counts for a year when the number of spawners is near the median (2,500) and for a year when there is a small number of spawners (<1,000).

The daily counts on Hansen Creek are also providing us with estimates of the percentages of the total number of spawners that are counted on a single "peak survey" date and, thus, a means of adjusting our annual survey counts to equal the true number of spawners. Hansen Creek has been surveyed most often on August 6 in past years, but in 20% of the years, the survey was done on August 1 or earlier. The Hansen Creek sockeye salmon are about the earliest spawners in the lake system and the fish usually first enter the creek around July 22–25. On the basis of daily counts in 1990–97, if the surveys had been conducted on the single date of August 6, the peak survey counts would have been 67% to 89% of the totals; if the single surveys were done on August 1, the counts would have been 38% to 78% of the actual number of spawners (Table 20).

During our annual 1-day surveys of 16 streams in the Wood River system, we routinely count the numbers of live and dead salmon. Since 1990, we have also tallied the number of dead salmon that were killed by bears. Examination of these data reveal great variation in predation rate from year to year, which is partly caused by variation in the survey date with respect to the timing of spawning. For example, surveys early in the spawning period had a high percentage of bear kills among the dead salmon whereas surveys conducted near the end of the spawning period (when most salmon are dead) had a lower percentage of bear kills. Nevertheless, variation in predation among streams seems to be related to the size of the creek. Not surprisingly, salmon in smaller creeks experience higher rates of predation. We plan to continue these surveys to build a long-term view of the importance of bear predation to salmon populations and to determine how single-day surveys are related to the total number of annual spawners.

In addition to our work on bear predation in Hansen Creek, we have been studying the relationship between female body size, arrival date, aggression, egg burial depth, and longevity (McPhee and Quinn in press; Quinn and McPhee in press). We have determined that early-arriving females live much longer than those arriving late but, despite this advantage, many of the early females' redd sites are used by other females. Such redd superimposition may not destroy the eggs of the early spawners, however, because the early-arriving females tend to be larger than late-arriving females and dig deeper redds than smaller females.

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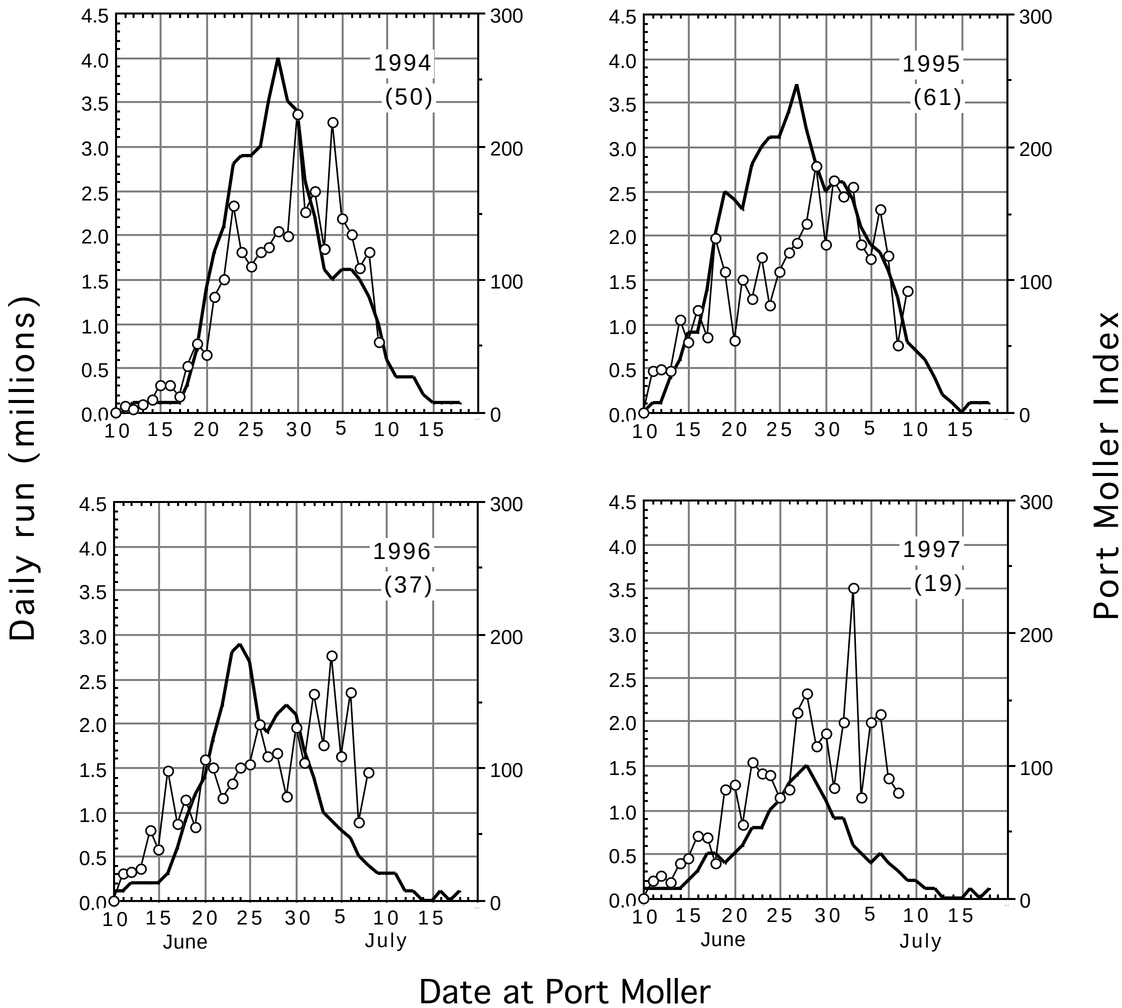

FIGURE 1. Daily Bristol Bay sockeye salmon runs reconstructed at Port Moller.

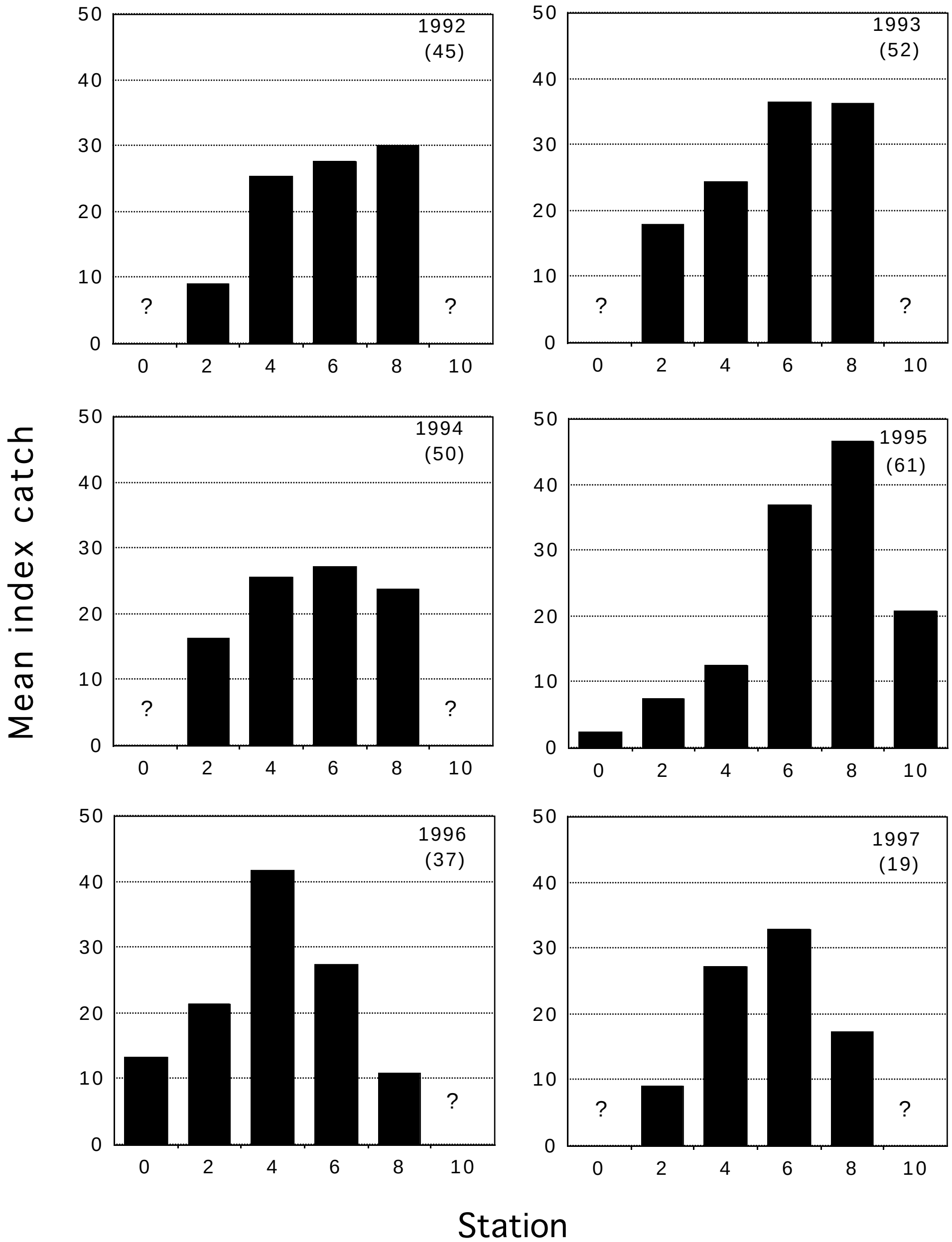

FIGURE 2. Average catches of sockeye salmon at Port Moller stations, June 11–July 5, 1992–97.

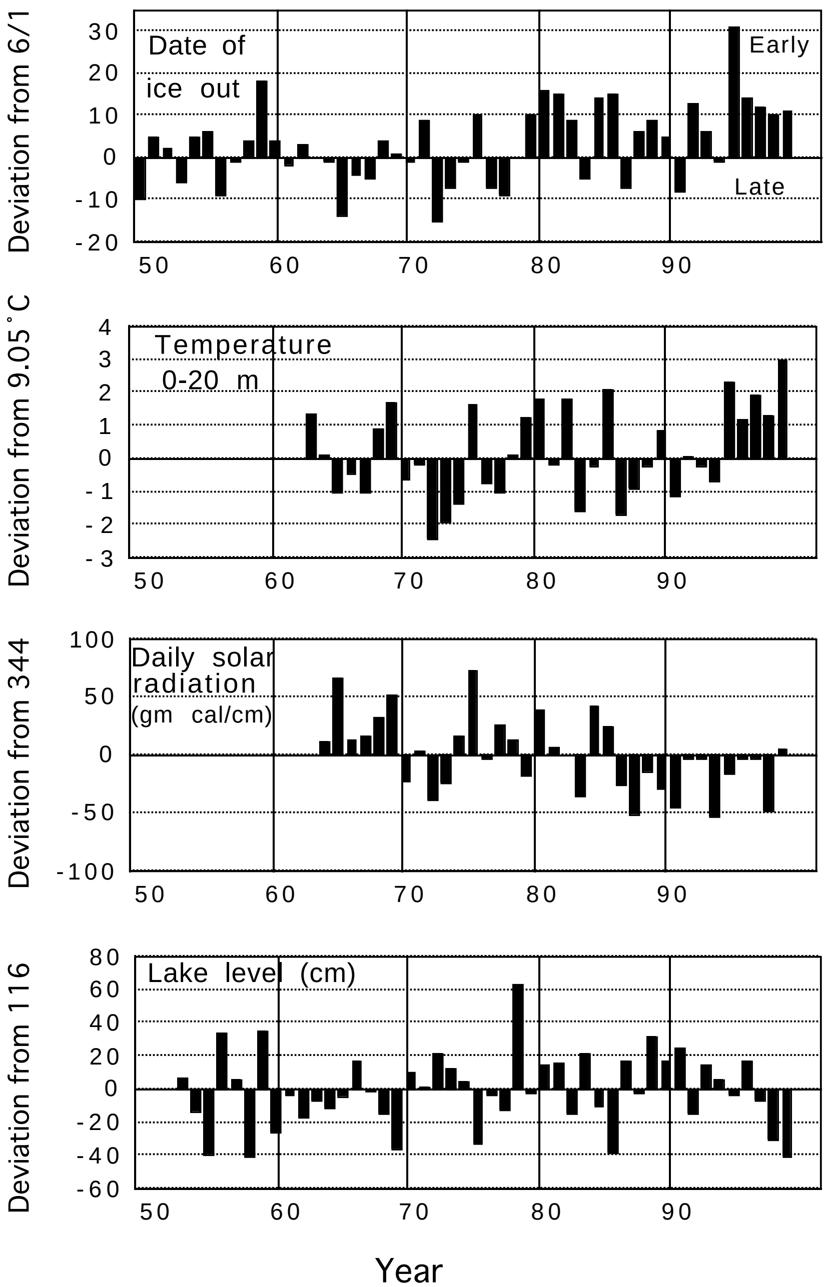

FIGURE 3. Annual deviations from averages of dates of ice out and summer averages of water temperature, solar radiation, and lake level in Lake Aleknagik.

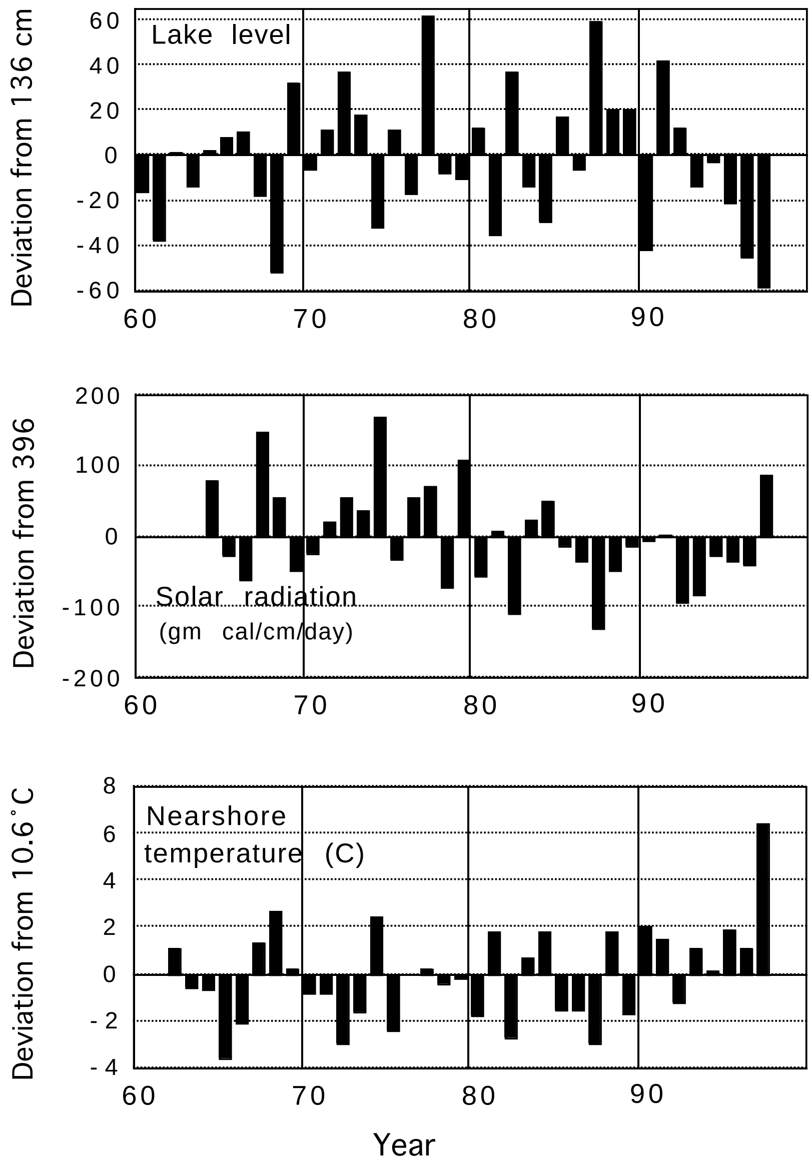

FIGURE 4. Annual deviations from averages of lake level, solar radiation and surface temperatures during June 26–July 15.

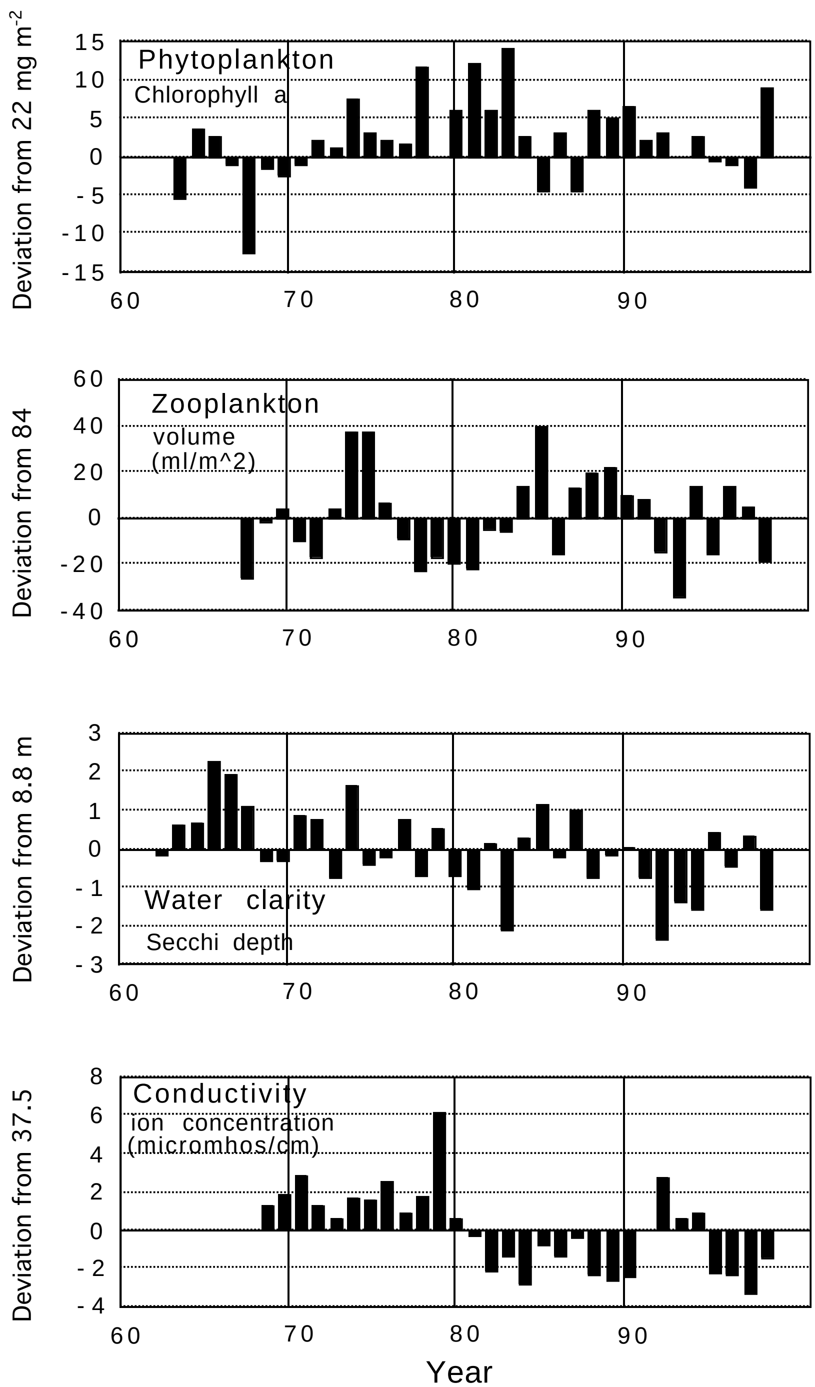

FIGURE 5. Annual deviations from averages of phytoplankton and zooplankton densities, water clarity, and conductivity in Lake Aleknagik.

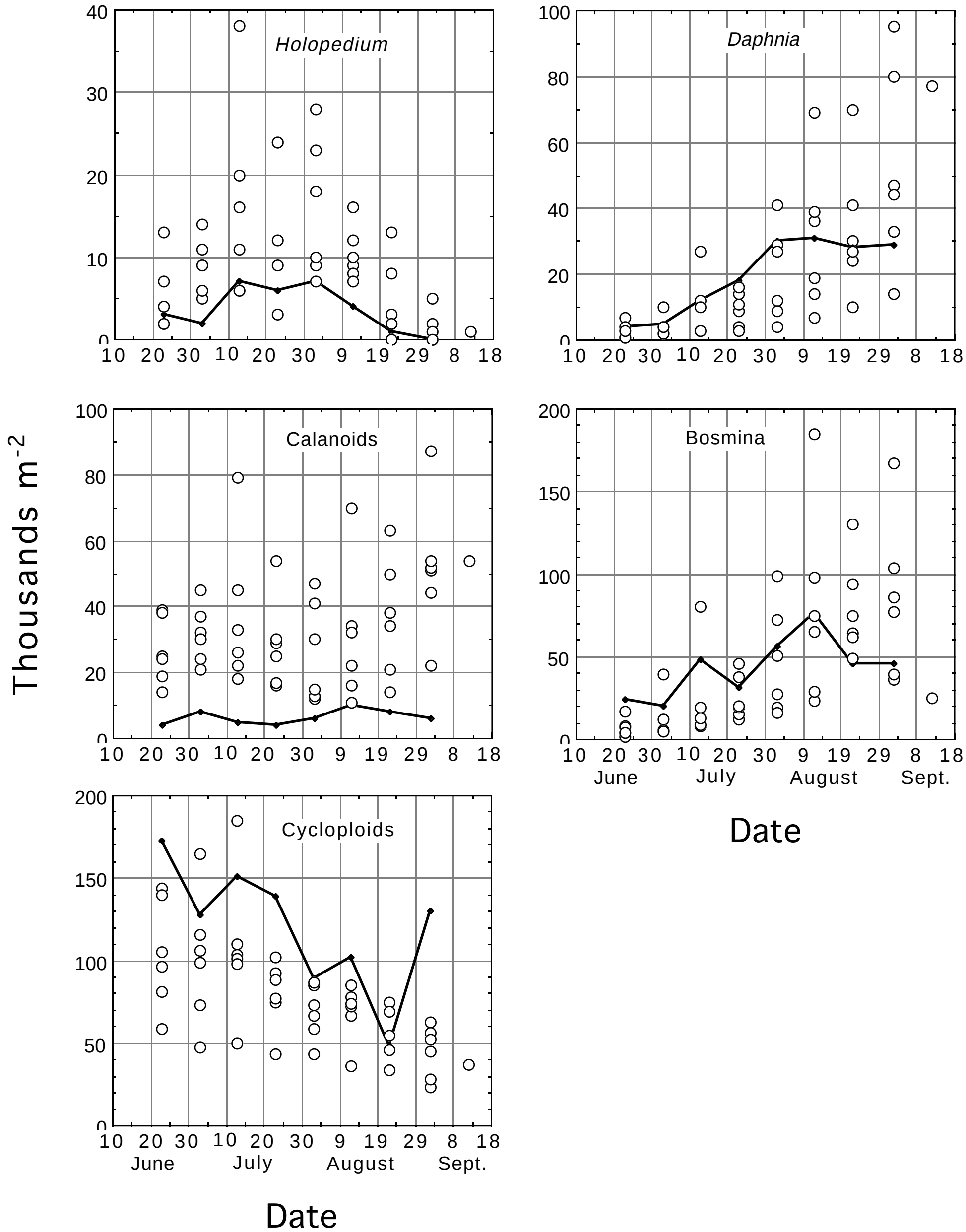

FIGURE 6. Summer densities of zooplankters in 1997 (solid line) compared with densities in 1991–96.

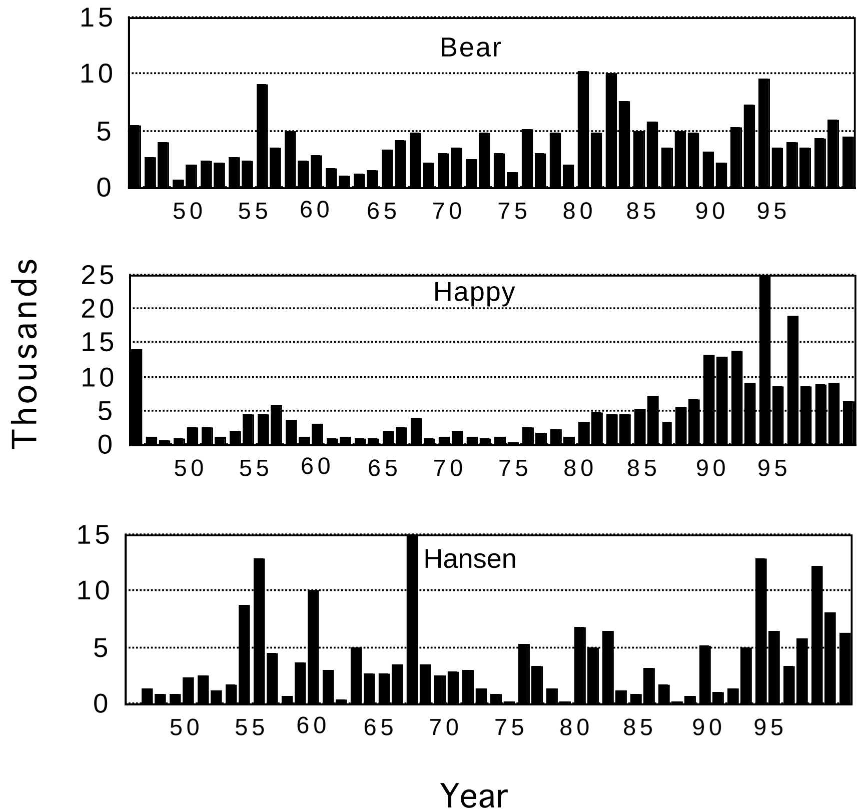

FIGURE 7. Annual peak spawner counts for three creeks on Lake Aleknagik.

TABLE 1. Preseason forecasts of Bristol Bay sockeye salmon inshore runs (millions of fish).

Year	Forecast/run	Kvichak	Naknek	Egegik	Ugashik	Nushagak	Total run	Catch	%Error
1988	FRI	12.3	3.1	6.2	3.1	5.0	30.6	20.8	34
	ADFG	9.3	2.5	5.6	3.2	5.6	26.5	16.8	18
	Actual run	6.7	1.7	8.1	2.2	3.2	23.0	13.8	
1989	FRI	20.4	3.6	6.7	3.0	3.4	38.0	25.4	-13
	ADFG	12.5	3.1	5.6	3.6	3.1	28.9	16.2	-77
	Actual run	19.8	3.2	10.5	4.9	5.0	43.9	28.7	
1990	FRI	10.1	4.8	6.6	3.0	4.6	29.8	19.0	-74
	ADFG	8.9	3.6	5.6	3.1	3.5	25.4	14.7	-125
	Actual run	17.4	8.4	12.3	2.9	5.7	47.6	33.1	
1991	FRI	12.0	4.6	8.9	3.6	6.9	36.7	25.0	-5
	ADFG	7.6	6.0	8.2	3.5	3.8	30.0	21.2	-24
	Actual run	8.1	10.0	9.6	5.5	7.7	42.1	26.2	
1992	FRI	10.2	3.2	10.4	4.0	4.3	33.0	22.0	-45
	ADFG	12.2	4.2	10.7	4.3	4.6	37.1	26.3	-22
	Actual run	10.4	5.0	17.6	5.5	5.2	45.3	32.0	
1993	FRI	9.1	3.6	18.2	5.5	6.0	43.3	31.9	-28
	ADFG	11.7	3.4	15.8	4.9	5.1	41.8	32.0	-27
	Actual run	9.3	4.7	23.3	5.7	7.6	51.9	40.8	
1994	FRI	18.7	3.9	16.2	3.6	5.3	48.8	34.1	-3
	ADF&G	17.8	3.9	18.8	5.6	5.4	52.4	39.6	11
	Actual run	22.0	3.0	12.6	5.4	5.8	50.1	35.2	
1995	FRI	23.6	6.1	12.1	5.0	5.3	53.1	34.4	-29
	ADF&G	25.1	5.3	13.1	5.4	5.3	55.1	40.3	-10
	Actual run	27.5	3.6	15.7	5.8	6.7	60.8	44.4	
1996	FRI	8.0	4.5	15.7	7.8	7.7	45.2	33.4	11
	ADF&G	8.6	4.6	16.9	6.2	5.8	43.4	34.6	14
	Actual run	3.5	6.9	11.9	5.1	8.3	36.9	29.7	
1997	FRI	7.4	3.7	13.9	2.9	5.9	35.1	25.4	52
	ADF&G	6.9	3.3	12.8	3.8	5.7	33.6	24.8	50
	Actual run	1.7	1.4	8.7	2.0	4.6	18.8	12.3	
1998	FRI	10.4	3.5	8.4	4.3	6.2	33.8	23.5	
	ADF&G	8.9	3.4	8.6	3.2	5.3	30.2	20.6	

Total run and catch include Branch River and Togiak District but exclude jacks (1-ocean age).
Percent error = error in forecasted catch (forecast-actual catch/forecast*100).

TABLE 2. Bristol Bay sockeye salmon runs and the predictions from the Port Moller test boat catches.

Bristol Bay			Run pred. on 6/25			Run pred. on 6/30			Final pred. (7/3-9)			Catch pred. (7/3-9)		
Year	Run	Catch	Pred.	R-P	%ofP	Pred.	R-P	%ofP	Pred.	R-P	%ofP	Pred.	C-P	%ofP
1987	27	16	27	0	0	27	0	0	26	1	4	15	1	7
88	23	14	15	8	53	15	8	53	22	1	5	12	2	17
89	44	29	50	-6	-12	37	7	19	42	2	5	28	1	4
90	48	33	42	6	14	56	-8	-14	39	9	23	25	8	32
91	42	26	48	-6	-13	37	5	14	37	5	14	21	5	24
92	45	32	49	-4	-8	45	0	0	41	4	10	29	3	10
93	52	41	61	-9	-15	57	-5	-9	56	-4	-7	44	-3	-7
94	50	35	37	13	35	41	9	22	43	7	16	29	6	21
95	61	44	47	14	30	49	12	24	50	11	22	33	11	33
96	37	30	45	-15	-33	44	-14	-32	41	-4	-10	34	-4	-12
97	19	12	39	-20	-51	41	-22	-50	26	-7	-27	17	-5	-29
Means	41	28	42	-2	0	41	-1	2	38	2	5	26	2	9
absol.				9	24		8	22		5	13		4	18

Numbers in millions of fish.
R= run, P= predicted and C= catch.
absol. = absolute error, ignoring the sign.
%ofP= the percentage that the actual run differed from the prediction.
1993-97 forecasts on 6/25 & 6/30 are from Bristol Bay almanacs (not adjusted for run timing).

TABLE 3. Mean lengths (mid-eye to tail-fork, mm) of sockeye salmon in the Bristol Bay runs.

Year	BB run (millions)	2-ocean Male	2-ocean Female	2-ocean Combined	3-ocean Male	3-ocean Female	3-ocean Combined	Both age groups	Percent 3-ocean
1958	6	527	508	517	586	562	572	544	48
1959	13	522	502	512	585	562	571	522	16
1960	36	496	480	489	580	553	562	498	12
1961	18	525	512	519	583	562	572	554	66
1962	10	527	508	518	582	566	574	535	30
1963	7	529	512	520	594	570	580	546	44
1964	11	517	499	508	584	564	571	522	22
1965	53	506	487	497	574	552	561	502	8
1966	18	514	503	508	581	561	569	554	75
1967	10	534	518	526	592	570	579	544	34
1968	8	516	503	510	594	572	581	535	36
1969	18	524	510	517	591	571	580	525	22
1970	39	511	497	504	572	549	558	509	9
1971	16	530	516	522	584	563	572	552	60
1972	5	521	505	514	583	562	572	543	51
1973	2	522	513	518	601	575	587	575	82
1974	11	525	508	518	581	566	574	528	19
1975	24	518	499	509	587	564	574	523	21
1976	12	531	514	523	592	568	578	543	36
1977	10	533	517	525	597	573	584	556	53
1978	19	520	502	512	595	570	582	539	38
1979	40	537	524	530	586	567	576	538	18
1980	62	519	503	511	583	553	567	525	26
1981	34	536	523	529	588	566	577	555	54
1982	22	522	508	515	587	566	576	561	75
1983	46	530	514	521	574	557	565	529	17
1984	41	515	501	508	580	561	570	526	30
1985	37	527	512	520	583	567	575	543	41
1986	24	535	521	528	583	561	571	553	58
1987	27	521	506	513	590	567	577	538	39
1988	23	525	513	519	592	571	581	554	56
1989	44	525	507	515	586	564	575	538	27
1990	48	507	491	499	578	557	566	528	43
1991	42	508	493	500	573	547	560	536	60
1992	45	511	496	504	568	544	557	531	52
1993	52	530	515	522	582	560	570	547	52
1994	50	512	498	504	575	550	561	524	34
1995	61	520	502	511	578	555	567	526	27
1996	37	522	506	513	585	562	574	558	76
1997	19	519	503	511	585	565	576	540	45
Averages									
58-67	18	520	503	511	584	562	571	532	36
68-77	15	523	508	516	588	566	576	539	39
78-87	35	526	511	519	585	564	574	541	40
88-97	44	517	501	509	579	556	567	536	46

TABLE 4. Average weights of sockeye salmon (lb) in commercial catches on the east side of Bristol Bay, 1988–97.

		Catch	2-ocean			3-ocean			All	All	All	Percent	Percent
District	Year	millions	Male	Female	Comb.	Male	Female	Comb.	males	females	fish	3-ocean	females
Nak/Kvi	88	3.5	5.3	4.5	4.9	7.4	6.5	6.9	6.3	5.6	5.9	52	52
	89	13.8	5.3	4.6	4.9	7.3	6.2	6.8	5.8	4.9	5.3	21	55
	90	17.1	5.0	4.5	4.7	7.3	6.2	6.7	5.9	5.3	5.6	43	54
	91	10.6	4.9	4.3	4.6	7.2	6.0	6.5	6.6	5.5	6.0	71	54
	92	9.3	5.0	4.5	4.7	6.7	5.7	6.2	6.0	5.2	5.6	60	48
	93	8.9	5.3	4.8	5.1	7.1	6.2	6.6	6.3	5.6	5.9	54	53
	94	16.3	5.0	4.5	4.7	7.0	5.5	6.1	5.4	4.7	5.0	18	58
	95	20.4	5.0	4.4	4.8	6.9	5.9	6.5	5.5	4.7	5.2	22	44
	96	8.2	5.5	4.5	4.9	7.4	6.3	7.0	7.1	5.9	6.7	83	39
	97	0.6	5.4	4.8	5.1	7.6	6.3	7.0	6.7	5.6	6.2	55	50
	Means	10.9	5.2	4.5	4.8	7.2	6.1	6.6	6.2	5.3	5.7	48	51
Egegik	88	6.5	5.4	4.9	5.2	7.5	6.7	7.2	6.6	6.0	6.3	57	45
	89	8.9	5.2	4.6	4.9	7.4	5.9	6.7	6.0	5.0	5.5	33	51
	90	10.1	5.3	4.9	5.1	7.3	6.1	6.6	6.3	5.6	5.9	54	52
	91	6.8	5.3	4.4	4.9	7.3	6.0	6.6	6.4	5.3	5.8	55	52
	92	15.7	4.7	4.1	4.5	6.6	5.8	6.2	5.6	5.0	5.4	51	44
	93	21.8	5.5	4.8	5.1	7.1	6.2	6.6	6.3	5.6	5.9	52	54
	94	10.8	4.6	4.1	4.4	7.0	5.6	6.2	5.6	5.0	5.3	51	53
	95	14.5	5.3	4.5	4.9	6.9	5.9	6.4	5.8	5.0	5.4	32	48
	96	10.8	5.5	4.7	5.1	7.6	6.2	6.8	7.0	5.8	6.4	73	54
	97	7.6	5.3	4.4	4.9	7.8	6.6	7.2	6.4	5.4	5.9	44	47
	Means	11.8	5.2	4.6	4.9	7.2	6.1	6.6	6.2	5.4	5.8	51	50
Ugashik	88	1.5	5.4	4.8	5.2	7.5	6.6	7.1	6.4	5.9	6.2	54	43
	89	3.1	5.5	4.7	5.1	7.7	6.5	7.2	5.9	5.0	5.5	19	45
	90	2.1	5.0	4.5	4.7	7.4	6.4	6.9	6.1	5.6	5.9	53	49
	91	3.0	5.3	4.5	4.9	7.0	5.8	6.3	6.2	5.3	5.8	59	52
	92	3.4	5.0	4.5	4.8	6.8	5.6	6.4	6.2	5.2	5.8	64	37
	93	4.3	5.7	4.6	5.2	7.7	6.7	7.2	6.7	5.7	6.2	52	52
	94	4.3	4.9	4.2	4.7	7.1	6.0	6.6	6.0	5.3	5.8	55	40
	95	4.5	5.2	4.3	4.8	6.9	6.1	6.5	5.7	4.9	5.3	30	42
	96	4.4	5.2	4.8	5.0	7.6	6.3	7.0	7.3	6.1	6.7	85	47
	97	1.4	5.5	4.6	5.1	7.7	6.3	7.0	6.5	5.4	6.0	47	47
	Means	3.1	5.3	4.5	5.0	7.4	6.2	6.8	6.3	5.5	5.9	52	45

TABLE 5. Average weights of sockeye salmon (lb) in commercial catches on the west side of Bristol Bay, 1988–97.

District	Year	Catch millions	2-ocean Male	2-ocean Female	2-ocean Comb.	3-ocean Male	3-ocean Female	3-ocean Comb.	All males	All females	All fish	Percent 3-ocean	Percent females
Nushagak	88	1.7	4.9	4.3	4.7	7.8	6.2	7.0	7.1	5.9	6.5	79	49
	89	2.8	5.4	4.3	4.7	7.6	6.2	6.8	6.9	5.6	6.1	68	62
	90	3.6	4.5	4.1	4.4	7.6	5.9	6.7	6.6	5.5	6.0	71	50
	91	5.3	4.3	3.8	4.0	7.1	5.7	6.3	6.4	5.2	5.7	75	56
	92	2.8	4.7	4.0	4.4	6.5	5.4	6.0	5.7	5.0	5.4	61	45
	93	5.3	5.2	4.3	4.8	7.5	6.0	6.6	6.4	5.4	5.9	59	55
	94	3.4	4.3	4.0	4.2	6.9	5.9	6.2	6.3	5.8	6.0	87	60
	95	4.4	4.8	4.3	4.5	6.7	5.6	6.1	5.7	4.9	5.3	49	50
	96	5.8	5.0	4.1	4.5	7.3	5.9	6.5	6.5	5.4	5.8	68	57
	97	2.6	4.9	4.2	4.7	6.9	5.9	6.6	6.1	5.2	5.8	60	35
	Means	3.8	4.8	4.2	4.5	7.2	5.9	6.5	6.4	5.4	5.8	68	52
Togiak	88	0.7	6.3	5.1	5.6	8.8	7.2	7.9	8.7	7.1	7.8	97	54
	89	0.1	5.9	4.7	5.4	8.4	6.3	7.1	7.8	6.1	6.8	82	57
	90	0.2	5.4	4.8	5.0	8.1	6.3	7.1	7.7	6.1	6.8	85	57
	91	0.5	5.9	4.8	5.4	8.1	6.2	7.1	7.4	5.8	6.6	69	50
	92	0.6	5.4	4.8	5.1	8.7	6.3	7.6	8.2	6.1	7.2	85	47
	93	0.5	6.2	5.0	5.6	9.2	6.5	7.9	8.5	6.2	7.3	76	49
	94	0.3	6.4	5.2	5.7	8.1	6.3	7.1	8.0	6.2	7.0	91	53
	95	0.5	6.0	5.1	5.5	7.9	6.6	7.2	7.2	6.1	6.6	66	53
	96	0.4	6.3	5.1	5.8	8.5	6.6	7.5	8.3	6.5	7.4	90	52
	97	0.1	6.2	5.3	5.7	8.2	6.6	7.4	7.8	6.3	7.1	80	49
	Means	0.4	6.0	5.0	5.5	8.4	6.5	7.4	8.0	6.3	7.1	82	52

TABLE 6. Sockeye salmon escapement in excess of management goals for Bristol Bay rivers, 1989–97 (millions of fish).

River system	Escapement goals: Mid-point	Escapement goals: Upper range	Escapement in excess of mid-point: 89	90	91*	92	93	94	95	96	97
Kvichak	variable	variable									
Branch											
Naknek	1.00		.16	1.09	2.57	.61	.54	.00	.11	.08	.03
Egegik	1.00		.61	1.19	1.79	.95	.52	.90	.27	.08	.10
Ugashik	.70		1.01	.05	1.76	1.76	.71	.38	.60	.00	.00
Wood	1.00		.19	.07	.16	.29	.18	.47	.48	.65	.51
Igushik	.20		.26	.17	.56	.10	.21	.25	.27	.20	.00
Nuyakuk/Nush.	.50		.01	.17	.00	.20	.21	.01	.00	.00	.00
Togiak	.15		.00	.04	.13	.07	.04	.02	.06	.01	.00
Total			2.24	2.78	6.97	3.98	2.41	2.03	1.79	1.02	.64
Bristol Bay run			44	48	42	45	52	50	61	37	19
Catch			29	33	26	32	41	35	44	30	12
			Escapement in excess of upper range								
Naknek		1.40	.00	.69	2.18	.21	.14	.00	.00	.00	.00
Egegik**		1.20	.41	.99	1.59	.75	.32	.70	.00	.00	.00
Ugashik**		.90	.81	.00	1.58	1.56	.51	.18	.10	.00	.00
Wood		1.20	.00	.00	.00	.09	.00	.27	.28	.45	.31
Igushik		.25	.21	.12	.51	.05	.16	.20	.22	.15	.00
Nuyakuk/Nush.		.76	.00	.00	.00	.00	.00	.00	.00	.00	.00
Togiak		.25	.00	.00	.03	.00	.00	.00	.00	.00	.00
Total			1.43	1.80	5.89	2.66	1.13	1.35	.60	.60	.31

*Strike in 1991 delayed the start of fishing except at Ugashik.

**Upper range of escapement goals for Egegik and Ugashik were increased to 1.4 and 1.2 million for 1995.

TABLE 7. Cumulative daily escapements of sockeye salmon in the Kvichak and Newhalen rivers, 1992–97. (Numbers in 1,000s of fish, and Newhalen escapements estimated from expanded counts lagged back 2 days for 1992–95, and 3 days for 1996–97.)

	1992		1993		1994		1995		1996		1997	
Date	Kvi	Newh	Kvi	Newh	Kvi	Newh	Kvi	Newh	Kvi	Newh	Kvi	Newh
6/22			13									
23	0		24		0							
24	1		34		0				0	0	0	
25	2		51	6	0		0		4	0	3	
26	10		121	67	1		41	7	25	1	6	
27	17		317	78	8		361	28	37	1	15	0
28	81	5	559	157	24		724	48	40	1	42	1
29	255	18	847	237	25		941	75	41	1	60	2
30	446	67	932	394	25		1113	109	42	2	67	4
7/1	635	88	1014	492	26	0	1610	158	47	2	73	5
2	754	104	1081	650	30	1	2338	255	90	2	76	8
3	798	132	1182	816	254	1	2798	309	224	3	83	13
4	1093	196	1307	937	1550	321	3105	364	318	4	116	18
5	1663	273	1678	1022	2727	558	3346	398	361	6	158	30
6	2244	329	2372	1103	3518	775	3983	430	385	7	206	40
7	2688	406	2733	1121	4273	921	4937	482	420	7	299	50
8	2880	534	2932	1134	5132	1091	5930	581	468	8	439	63
9	2960	661	3101	1163	5821	1286	7020	687	568	15	637	105
10	2985	840	3264	1189	6473	1601	7683	805	669	22	797	132
11	3175	977	3402	1220	7058	1884	8005	1050	769	23	950	182
12	3662	1057	3574	1268	7268	2168	8169	1199	860	25	1053	224
13	4066	1158	3751	1322	7330	2372	8430	1226	1035		1140	230
14	4330	1258	3818	1353	7382	2450	8658	1378	1160		1200	239
15	4438	1434	3864		7495	2535	8878		1238		1291	253
16	4517	1491	3894		7540	2578	9017		1310		1349	
17	4578		3921		7631		9131		1332		1382	
18	4626		3958		7852		9248		1353		1412	
19	4685		3986		8099		9512		1397		1436	
20	4695		3996		8169		9703		1422		1456	
21	4710		4008		8193		9788		1436		1471	
22	4720		4016		8265		9876		1445		1486	
23	4726		4021		8338		9919		1451		1496	
24			4024				9954				1504	
25			4025				9994					

TABLE 8. The Kvichak lake system escapements and the percentages of fish going to the Newhalen River and Lake Clark.

Year	Kvichak system escapement (millions)	Newhalen/ Lake Clark escapement (millions)	Percent of Kvichak	Newhalen River spawners (millions)	Lake Clark escape. (millions)	Percent of Kvichak	Tazimina River aerial count (thousands)
1979	11.22	9.00	80	0.56	8.44	75	504
1980	22.51	7.50	33	2.64	4.86	22	128
1981	1.75	0.26	15	0.03	0.23	13	28
1982	1.14	0.34	30	0.13	0.21	18	31
1983	3.57	1.08	30	0.41	0.67	19	212
1984	10.49	3.20	31	0.67	2.53	24	366
1985	7.21	1.62	22	0.15	1.47	20	186
1986	1.18	0.29	25	0.01	0.28	24	7
1987	6.07	---	--	1.46	--	--	246
1988	4.06	2.41	59	0.29	2.12	52	83
1989	8.32	2.59	31	0.10	2.49	30	30
1990	6.97	1.09	16	*0.07*	--	--	4
1991	4.22	1.93	46	*0.10*	--	--	16
1992	4.73	1.05	22	<0.01	1.04	22	13
1993	4.03	1.55	38	<0.01	1.54	38	38
1994	8.34	2.34	28	0.01	2.33	28	93
1995	10.04	1.12	11	0.12	1.00	10	54
1996	1.45	0.04	2	<0.01	0.03	2	10
1997	1.50	0.27	18	<0.01	0.27	18	11

Newhalen River spawners estimated by two times the aerial survey estimate.
Italics = estimate of missing data.

TABLE 9. Age compositions of sockeye salmon on the Kvichak spawning grounds in 1997.

Spawning ground	Sex	Sample size (n)	Age composition (%) 1.1	1.2	2.2	1.3	2.3	1.4	2.4
Gibralter River	M	97		42.3	11.3	14.4	30.0	2.1	
	F	100		26.0	15.0	27.0	31.0		1.0
Copper River	M	95		46.3	8.4	2.1	42.1	1.1	
	F	98		22.4	18.4	18.4	40.8		
Chinkelyes Creek	M	96		35.4	53.1	7.3	4.2		
	F	98		25.5	54.1	8.2	12.2		
Newhalen River	M	20		15.0	40.0	25.0	20.0		
	F	10		10.0	60.0	30.0	0.0		
Tazimina River	M	57		50.9	19.3	28.1	1.8		
	F	23		73.9	21.7	4.4	0.0		
Woody Island beaches	M	50		34.0	54.0	10.0	2.0		
	F	49		34.7	40.8	20.4	4.1		
Fuel Dump Island beach	M	48		39.6	35.4	12.5	12.5		
	F	50	2.0	42.0	40.0	10.0	6.0		
Knudson Bay beach	M	97		69.1	15.5	11.3	4.1		
	F	88		78.4	14.8	4.5	2.3		
Kvichak escapement	M	573	0.4	45.3	31.5	11.4	11.2		0.1
(ADF&G,Igiugig)	F	597		52.2	29.4	11.7	5.9	0.7	

TABLE 10. Estimates of sockeye salmon spawners on 29 selected spawning grounds in Lake Iliamna and the Newhalen River system.

	Aerial survey counts (1,000s)					Tower count	Aerial count/	
			Beaches			escapement	escapement	Aerial
Year	Rivers	Creeks	Mainland	Island	Total	(1,000s)	(%)	observer
56	775	--	--	--		9443		1
57	170	--	--	--		2843		1
58	44	--	--	--		535		1
59	84	--	--	--		680		1
60	841	--	--	--		14630		1
61	246	40	50	127	463	3706	12.5	2
62	140	52	21	12	225	2581	8.7	2
63	31	13	5	7	56	339	16.5	2
64	36	38	3	21	98	957	10.2	2
65	734	538	261	1352	2885	24326	11.9	2
66	248	153	134	46	581	3776	15.4	2
67	370	63	85	16	534	3216	16.6	3
68	131	64	14	64	273	2557	10.7	3
69	192	168	40	102	502	8394	6.0	3
70	790	574	216	506	2086	13935	15.0	3
71	177	194	27	50	448	2387	18.8	3
72	89	50	15	9	163	1010	16.1	3
73	35	18	6	6	65	227	28.6	3
74	294	269	72	122	757	4433	17.1	3
75	936	440	225	412	2013	13140	15.3	3
76	144	55	19	45	263	1965	13.4	3
77	124	20	88	28	260	1341	19.4	3
78	510	100	42	6	658	4149	15.9	3
79	1424	372	252	81	2129	11218	19.0	3
80	2189	317	77	201	2784	22505	12.4	3
81	187	85	16	20	308	1754	17.6	3
82	255	68	27	9	359	1135	31.6	3
83	743	123	75	9	950	3570	26.6	3
84	1902	359	597	84	2942	10491	28.0	4
85	672	296	260	247	1475	7211	20.5	4
86	57	16	12	5	90	1200	7.5	5
87	1313	111	397	123	1944	6100	31.9	5
88	481	123	116	15	735	4065	18.1	6
89	386	88	31	8	513	8318	6.2	6
90	138	50	19	26	233	6970	3.3	6
91	196	111	18	19	344	4223	8.1	7
92	198	151	35	19	403	4726	8.5	7
93	225	128	42	10	405	4025	10.1	7
94	506	231	41	30	808	8338	9.7	7
95	554	187	50	244	1035	10039	10.3	7
96	177	49	22	10	258	1451	17.8	7
97	255	69	87	11	422	1504	28.1	7
Means								
61-66	239	139	79	261	718	5948	12.5	2
67-83	505	175	76	99	856	5702	17.6	3
84-90	707	149	205	73	1133	6336	16.5	4,5,6
91-97	302	132	42	49	525	4901	13.2	7

TABLE 11. Mean townet catches (geometric means of 20-min tows) and lengths of Sept. 1 of live sockeye salmon fry (mm) in Lake Iliamna and Lake Clark.

Brood year	Kvichak escapement (millions)	Lake Iliamna Mean catch	Lake Iliamna Mean length	Lake Clark Mean catch	Lake Clark Mean length
61	3.7	90	53	13	50
62	2.6	12	45	54	50
63	0.3	5	54	3	50
64	1.0	7	62	2	50
65	24.3	170	53	23	52
66	3.8	67	57	15	47
67	3.2	78	62	47	59
68	2.6	43	62	9	50
69	8.4	386	61	11	55
70	13.9	127	44	20	38
71	2.4	4	50	15	41
72	1.0	3	58	17	48
73	0.2	2	71	12	57
74	4.4	491	54	80	55
75	13.1	252	49	105	49
76	2.0	16	53	--	--
77	1.3	11	61	--	--
78	4.1	339	62	65	56
79	11.2	282	53	60	48
80	22.5	134	61	26	59
81	1.8	37	52	58	46
82	1.1	9	68	18	57
83	3.6	242	64	40	56
84	10.5	147	46	84	51
85	7.2	63	54	16	49
86	1.2	10	60	--	--
87	6.1	79	63	11	56
88	4.1	22	58	21	48
89	8.3	181	55	19	47
90	7.0	336	54	--	--
91	4.2	-	56	20	47
92	4.7	135	57	27	61
93	4.0	64	57	26	55
94	8.3	83	55	21	54
95	10.0	126	62	-	-
96	1.5	23	67	-	-
97	1.5				

Lake Iliamna tows in areas 7 & 8 only.

TABLE 12. Summary of 1997 measurements in Lake Aleknagik.

Measurement and first year measured	Dates	1997	All years Average	All years Range
1. Date of ice breakup 1949-		5/21	5/29	5/01-6/16
2. Water temperature, 0-20m (C) 1958-	6/22	8.6	5.8	3.7, 9.2
	7/13	12.1	8.4	5.7, 12.0
	8/3	14.5	10.8	7.7, 14.0
	9/2	12.9	11.2	9.3, 13.0
3. Water transparency Secchi depth (m) 1962-	6/22	7.0	8.0	5.3, 10.5
	7/13	8.3	8.2	5.0, 10.9
	8/3	7.4	9.3	6.3, 11.9
	9/2	6.0	9.2	5.8, 12.1
4. Water conductivity (micromhos/cm) 1968-	6/22	36.8	38.2	31.1, 52.1
	7/13	36.9	37.1	33.5, 42.6
	8/3	33.5	36.9	32.5, 40.5
	9/2	36.8	38.0	34.8, 47.9
5. Average daily solar radiation (gm/cal/cm) 1963-	June 1-15	389	408	305, 588
	June 16-30	472	409	265, 572
	July 1-15	466	385	284, 543
	July 16-31	297	355	194, 481
	Aug. 1-15	266	301	203, 402
	Aug. 16-31	284	257	170, 421
	Sept. 1-15	173	206	114, 282
6. Lake level (cm) of Lake Nerka 1952-	June 1-15	114	143	84, 222
	June 16-30	97	150	97, 218
	July 1-15	74	131	75, 199
	July 16-31	52	106	54, 172
	Aug. 1-15	46	86	34, 173
	Aug. 16-31	61	82	30, 184
	Sept. 1-15	70	82	29, 161
7. Chlorophyll "a", 0-20m (mg/m2) 1963-	6/22	32	29	10, 45
	7/2	22		
	7/13	21	27	10, 43
	7/22	24		
	8/3	32	22	6, 36
	8/12	36		
	8/24	33		
	9/3	39	24	12, 37
8. Zooplankton volume 0-60m (ml/m2) 1967-	6/22	61	52	20,168
	7/2	76		
	7/13	67	85	45-162
	7/22	85		
	8/3	55	119	43-226
	8/12	58		
	8/24	29		
	9/1	40	62	26-107

TABLE 13. Five-day averages of catches of emergent midges and water temperatures at three stations on Lake Aleknagik, 1997.

5-day period	Catch per day							Water temperature (°C)						
	1997				1969-96			1997				1969-96		
	W	H	B	Mean	Mean	Min	Max	W	H	B	Mean	Mean	Min	Max
6/1-5					2	0	3					3.2	0.0	9.8
6-10					9	0	70					5.6	0.0	10.4
11-15	6	0	0	2	11	1	53	13.2	12.4	13.2	12.9	6.8	1.0	12.1
16-20	2	1	0	1	15	1	168	12.0	12.8	13.4	12.7	8.5	3.9	12.7
21-25	2	2	1	1	6	0	42	15.0	14.9	16.6	15.5	9.0	4.8	12.8
26-30	1	6	1	3	4	0	12	17.2	16.4	17.8	17.1	9.9	6.0	13.9
7/1-5	10	4	4	6	6	1	16	17.8	17.2	18.4	17.8	11.0	7.7	15.5
6-10	6	10	2	6	12	2	69	18.8	18.6	19.2	18.9	11.9	9.6	16.0
11-15	7	3	2	4	14	1	34	16.8	16.9	17.9	17.2	12.4	9.2	17.9
16-20	3	2	1	2	15	2	36	15.7	16.2	17.5	16.5	12.3	8.5	17.0
21-25	1	4	7	4	20	2	74	17.3	17.3	17.2	17.3	12.8	7.9	17.2
26-30	3	2	1	2	27	5	59	18.1	19.4	18.4	18.6	13.5	8.9	16.1
31-4	1	2	0	1	27	4	77	16.0	18.4	18.0	17.5	13.6	10.2	17.5
8/5-9	1	2	4	2	20	3	80	17.1	17.2	18.7	17.7	13.6	10.4	17.1
10-14	2	1	2	2	15	1	54	16.4	14.8	16.0	15.7	13.6	9.5	18.8
15-19	3	5	4	4	13	1	70	17.1	16.5	17.1	16.9	13.6	11.0	16.2
20-24	8	3	1	4	6	0	28	16.1	15.9	16.0	16.0	13.6	9.7	15.4
25-29	23	1	0	8	5	1	11	16.2	15.6	15.2	15.7	13.3	11.3	14.7
30-3	16	0	0	5	6	1	13	13.6	13.8	14.1	13.8			

W = Whitefish Bay; H = Hansen Bay; and B = Bear Bay.

TABLE 14. Average catches, lengths, and growth rates for sockeye salmon fry and age 1 threespine stickleback in Lake Aleknagik.

	Sockeye salmon fry					Sockeye	Threepine stickleback					
Year	Mean beach seine catch	Mean length on 6/23 (mm)	Mean length on 9/1 (mm)	Growth rate (mm/day)	Mean tow net catch	escape-ment in year-1 (1000s)	Mean beach seine catch	Mean length on 6/23 (mm)	Mean length on 9/1 (mm)	Growth rate (mm/day)	Mean tow net catch	Age 0 tow net catch
58	-	-	62.1	-	14	88	-	-	44.6	-	36	<1
59	-	-	62.7	-	13	63	-	-	46.7	-	136	10
60	-	-	55.5	-	111	205	-	-	43.4	-	53	2
61	-	-	58.4	-	103	85	-	-	42.0	-	38	<1
62	334	31.7	54.1	.31	54	153	317	31.0	43.5	.17	139	5
63	-	-	62.1	-	24	48	-	-	46.4	-	46	1
64	227	31.1	60.4	.42	24	31	352	31.2	43.1	.17	272	1
65	549	31.2	53.6	.32	103	155	202	29.1	39.5	.15	182	1
66	395	30.2	47.5	.25	219	220	258	27.1	39.4	.18	150	0
67	339	30.7	43.4	.18	49	287	426	28.2	41.3	.19	61	5
68	46	31.8	57.9	.37	10	92	212	30.8	43.4	.18	268	169
69	96	31.7	61.4	.43	78	177	215	33.4	44.2	.16	81	<1
70	164	31.4	59.0	.40	43	160	156	32.1	44.8	.18	87	<1
71	408	30.6	54.6	.35	17	302	261	29.6	43.4	.20	3	<1
72	126	30.6	54.8	.35	10	182	45	28.0	44.4	.24	12	1
73	30	29.0	66.7	.54	3	98	62	29.3	49.5	.29	8	1
74	47	35.3	62.8	.39	44	162	125	33.1	50.1	.24	119	<1
75	111	29.1	55.3	.39	8	242	69	32.5	42.4	.15	132	<1
76	178	30.1	49.8	.29	394	457	279	27.7	39.6	.17	30	<1
77	223	30.1	48.0	.27	25	314	184	29.3	40.8	.17	36	<1
78	34	32.8	62.7	.43	6	152	64	31.7	47.5	.23	21	1
79	312	31.6	51.5	.28	130	612	82	33.2	42.3	.13	50	18
80	46	31.0	56.4	.35	3	354	32	31.0	44.9	.19	24	<1
81	423	32.4	51.3	.27	6	1230	217	34.7	45.5	.15	12	<1
82	53	30.0	52.2	.33	131	454	63	30.2	43.2	.19	12	0
83	43	32.1	63.9	.45	22	337	12	30.9	48.4	.25	64	12
84	16	36.2	64.2	.41	3	245	54	35.9	48.8	.19	200	155
85	102	31.0	56.3	.36	1	329	109	34.3	40.9	.09	2	0
86	32	32.2	58.4	.37	10	188	24	31.4	45.0	.19	11	0
87	69	29.7	57.5	.40	3	341	27	31.7	44.9	.19	67	<1
88	31	31.2	58.8	.40	2	362	42	32.4	48.5	.23	8	1
89	45	31.4	55.4	.34	18	285	26	32.6	47.0	.21	17	1
90	100	32.7	57.7	.36	20	477	129	31.2	48.1	.24	27	1
91	63	30.1	52.9	.33	14	393	108	31.3	42.2	.16	41	1
92	242	30.0	46.1	.24	52	788	200	27.9	39.4	.17	222	<1
93	34	33.7	56.4	.33	10	357	55	31.7	46.5	.22	3	<1
94	55	32.0	51.7	.29	121	417	31	30.3	46.6	.24	38	2
95	39	32.0	53.9	.31	24	483	33	31.5	46.0	.21	181	31
96	26	32.6	54.8	.32	100	470	43	32.6	47.1	.21	103	7
97	38	33.1	52.1	.27	8	606	164	34.2	41.4	.10	155	141
Means	145	31.5	55.7	.35	50	332	134	31.2	44.4	.19	80	15

1. Beach seine catches at 10 stations for four dates during 6/22-7/14.
2. Tow net catches for 5-min hauls, two at each of six stations during Sept. 1-5.
3. Lengths measured to nearest mm on preserved fish, means adjusted to live measurement.
4. Threespine stickleback catches are for all ages (0-4), but mean lengths for age 1 only.

TABLE 15. Average townet catches and mean lengths of sockeye salmon fry, number of parent spawners, and average catches and mean lengths of threespine stickleback for Lake Nerka.

	Sockeye salmon fry						Sockeye salmon spawners in year-1 (1000s)			Threespine stickleback	
	Mean tow-net catch			Mean length (mm) on 9/1						Mean tow-net catch	Mean length (mm) on 9/1
Year	South	Central	North	South	Central	North	South	Central	North		
58	4	4	10	62	60	61	73	57	52	26	44
59	17	9	4	66	61	61	163	58	188	35	43
60	62	42	42	58	55	51	564	332	395	11	42
61	108	57	64	59	56	54	231	137	214	8	41
62	2	7	26	64	59	59	49	50	143	6	47
63	58	18	55	62	60	62	97	73	126	9	48
64	3	7	44	57	55	64	56	65	110	8	45
65	15	8	93	57	54	54	110	159	161	9	40
66	4	7	70	57	54	54	60	77	184	6	44
67	8	18	58	64	58	59	149	141	246	12	46
68	4	11	8	68	64	65	44	64	114	25	48
69	15	4	27	65	61	60	46	103	150	14	46
70	2	5	21	64	65	63	51	56	266	5	43
71	3	9	197	54	52	58	141	132	229	4	42
72	2	11	8	57	55	55	68	73	178	8	45
73	1	3	11	61	61	61	37	82	109	4	45
74	5	4	34	69	64	64	19	29	83	107	50
75	7	15	9	59	55	53	236	141	242	60	44
76	1	9	40	52	49	45	128	69	297	17	40
77	19	50	143	55	54	51	77	69	176	17	42
78	<1	<1	4	56	61	63	67	65	173	18	46
79	3	17	50	64	54	58	151	181	460	61	47
80	1	14	37	52	49	47	246	142	287	33	41
81	3	16	13	59	55	55	219	224	566	6	46
82	1	6	38	54	56	54	89	169	348	24	45
83	2	4	4	66	63	63	29	43	396	1	48
84	1	11	2	72	61	63	66	84	243	14	50
85	1	2	123	61	56	55	57	89	371	2	45
86	2	16	12	50	54	64	50	106	492	2	42
87	1	7	21	57	56	55	34	64	253	4	43
88	<1	2	7	64	57	57	77	213	293	2	49
89	1	3	16	57	51	59	57	174	176	5	48
90	1	7	3	63	62	58	87	153	377	3	48
91	27	22	32	61	57	56	80	94	219	27	44
92	4	16	10	57	55	55	51	43	99	4	41
93	8	6	16	62	57	55	200	252	201	15	45
94	29	39	66	63	55	52	162	169	203	15	44
95	41	127	49	63	56	50	95	152	372	22	44
96	6	44		66	61		154	153	232	1	49
97	3	2	3	62	59	60	125	202	324	39	43
Means	13	17	38	60	57	57	112	118	244	17	45

TABLE 16. Occurrence and numbers of juvenile sockeye in stomachs of Arctic char collected by hook and line from Little Togiak River during 30 days after ice out.

Year	Date of ice out	Range in sampling dates	Number of char examined	Mean length (mm)	Percent of char with		Mean number per char		Sockeye escape. year-2
					Fry	Smolt	Fry	Smolt	
72	6/17	6/26-7/10	82	446	34	60	2.8	4.5	55
73	6/08	6/19-7/03	121	446	34	44	1.9	2.9	24
74	5/27	6/11-25	64	429	19	39	0.8	1.6	14
75	6/15	6/22-7/13	71	415	9	36	0.2	1.8	14
76	6/17	6/19-7/13	96	418	11	56	0.4	2.2	48
77	6/13	6/11-7/11	325	403	30	17	7.0	0.4	30
78	6/02	6/07-25	316	437	7	42	0.2	1.5	18
79	5/24	6/06-22	178	438	32	25	1.8	1.2	26
80	5/27	6/09-25	278	459	27	81	1.4	9.4	45
81	5/28	6/12-25	124	415	3	31	0.1	1.4	44
82	6/15	6/17-7/05	105	450	18	61	1.8	6.4	81
83	5/27	6/19-7/03	78	424	0	14	0.0	0.3	60
84	5/26	6/20-7/02	56	408	0	18	0.0	0.4	36
85	6/17	6/15-7/06	60	437	22	30	1.6	1.2	29
86	6/04	6/16-7/05	61	437	21	56	0.4	2.7	15
87	6/01	6/14-7/05	51	451	6	78	0.1	4.9	20
88	6/05	6/16-29	43	431	7	26	0.1	0.8	24
89	6/17	6/20-7/15	105	388	37	38	2.2	1.3	15
90	5/28	6/07-24	72	391	35	11	1.8	0.3	16
91	6/07	6/20-7/07	48	415	4	35	0.9	3.2	13
92	6/13	6/15-7/11	79	425	0	46	0.0	1.9	29
93	5/12	6/07-18	51	428	21	22	1.4	0.7	19
94	5/28	6/14-29	39	416	3	21	0.1	0.2	35
95	5/29	6/11-13	3	468	66	66	2.3	2.0	19
96	5/30	6/16-22	40	429	0	42	0.0	1.1	24
97	5/29	6/13-24	28	445	0	11	0.0	0.3	28
Means	6/4		99	429	17	39	1.1	2.1	30

TABLE 17. Ground survey counts of sockeye salmon spawners in the Wood River lakes, 1997.

Location	Date	Estimated off mouth	In creek Live	Dead	Natural	Bear kill	Total
Aleknagik							
Yako	8/01	500	2917	3077	1420	1657	6494
Hansen	8/06	300	2163	3804	1489	2315	6267
Bear	8/05	400	2434	1565	963	602	4399
Happy	8/06	300	1235	4630	1883	2747	6165
Ice*	8/07	300	5128	3544	2499	1045	8972
Eagle	8/11	150	551	246	61	185	947
Mission	8/15	150	659	523	326	197	1332
Whitefish	8/17	300	651	120	16	104	1071
Nerka							
Fenno	8/08	0	1736	2770	1880	890	4506
Pick	8/20	75	2190	3455	2007	1448	5720
Lynx	8/21	400	2504	476	412	64	3380
Hidden Lake	8/22	150	728	1526	940	586	2404
Elva	8/24	200	25	23	8	15	248
Little Togiak River	8/25	500	4055	23	21	2	4578
Stovall*	8/23	1000	1201	365	244	121	2566
Kema*	8/22	0	252	310	172	138	562
Beverley							
Moose*	8/14	400	1863	237	109	128	2500

* Partial count; entire stream not surveyed.

TABLE 18. Age compositions (%) of sockeye spawners in the Wood River Lakes in 1997.

	Males						No. of	Females					No. of
Location	1.1	1.2	2.2	1.3	2.3	1.4	fish	1.2	2.2	1.3	2.3	1.4	fish
Hansen	0.0	76.9	1.5	21.5	0.0	0.0	65	93.0	0.0	7.0	0.0	0.0	100
Happy	0.0	40.2	3.3	55.4	1.1	0.0	92	40.8	4.8	53.4	1.0	0.0	103
Bear	1.0	11.4	0.0	87.6	0.0	0.0	105	24.7	0.0	74.3	1.0	0.0	101
Ice	0.0	9.2	0.0	87.8	2.0	1.0	98	2.9	1.9	94.2	1.0	0.0	103
Agulowak River	0.0	16.7	0.0	79.4	1.0	2.9	102	9.7	0.0	85.4	2.9	1.9	103
Wood River	1.0	47.6	1.0	50.5	0.0	0.0	105	44.4	0.0	55.6	0.0	0.0	108
Fenno	0.0	45.6	0.0	54.4	0.0	0.0	68	52.1	0.0	47.9	0.0	0.0	73
Stovall	0.0	67.3	0.0	32.7	0.0	0.0	101	76.8	0.0	23.2	0.0	0.0	99
Lynx	0.0	35.4	0.0	64.6	0.0	0.0	96	43.7	0.0	56.3	0.0	0.0	103
Pick	0.0	24.5	0.0	75.5	0.0	0.0	102	15.5	0.0	84.5	0.0	0.0	97
LT River	0.0	20.9	0.0	79.1	0.0	0.0	91	22.7	0.0	77.3	0.0	0.0	97
N4-N6 beach	0.0	37.5	2.5	60.0	0.0	0.0	40	27.7	0.0	72.3	0.0	0.0	101
Kema	0.0	34.9	0.0	65.1	0.0	0.0	83	48.5	0.0	51.5	0.0	0.0	103
Hidden Lake	0.0	55.9	0.0	44.1	0.0	0.0	102	57.6	0.0	42.4	0.0	0.0	99
Anvil Bay beach	0.0	14.5	3.2	82.3	0.0	0.0	62	16.2	0.0	83.8	0.0	0.0	99
Agulukpak River	0.0	28.3	1.0	70.7	0.0	0.0	99	8.4	0.0	91.6	0.0	0.0	95
LT beaches	0.0	50.0	0.0	50.0	0.0	0.0	10	17.1	2.9	80.0	0.0	0.0	35
Moose	0.0	81.6	0.0	18.4	0.0	0.0	87	79.1	0.0	20.9	0.0	0.0	86
Grant River	0.0	55.6	0.0	44.4	0.0	0.0	99	54.9	2.0	43.1	0.0	0.0	102
Unweighted mean	0.1	39.7	0.7	59.1	0.2	0.2	1607	38.7	0.6	60.2	0.3	0.1	1807
Wood River ADFG tower	0.4	47.6	2.2	46.9	1.3	1.6	506	58.2	2.6	36.0	1.2	1.1	618

ADF&G F age 1.1= 0.9%

TABLE 19. Daily counts of sockeye spawners in Hansen Creek, 1997.

Date	Estimate off mouth	In creek Live	In creek Natural dead	In creek Bear dead	In ponds Live	In ponds Natural dead	In ponds Bear dead	Total live	Total dead	Cumulative dead	Live+ cum. dead
Jul. 17		0	0	0	0	0	0	0	0	0	0
18		104	14	3	0	0	0	104	17	17	
19		96	12	48	2	0	0	98	60	77	
20		526	53	13	29	0	0	555	66	143	
21		738	50	25	67	0	0	805	75	218	1023
22		556	37	53	120	5	1	676	96	314	990
23		766	43	56	153	0	0	919	99	413	1332
24		649	41	62	45			694	103	516	1210
25		1081	74	97	64			1145	171	687	1832
26		1054	62	127	97			1151	189	876	2027
27		1294	67	121	61			1355	188	1064	2419
28		1175	45	167	62			1237	212	1276	2513
29		1531	62	113	123			1654	175	1451	3105
30		1224	63	146	84			1308	209	1660	2968
31		1019	81	180	97			1116	261	1921	3037
Aug. 1		1478	119	143	119			1597	262	2183	3780
2		2039	157	125	171	2	1	2210	285	2468	4678
3		1758	142	150	138	1	0	1896	293	2761	4657
4		1717	122	223	172			1889	345	3106	4995
5		2315	172	181	163	9	1	2478	363	3469	5947
6	300	1979	130	190	184	8	7	2163	335	3804	5967
7		1733	159	230	102	15	1	1835	405	4209	6044
8		1378	192	225	238	10	3	1616	430	4639	6255
9		1326	214	328	173	18	8	1499	568	5207	6706
10		1055	156	248	169	16	1	1224	421	5628	6852
11		738	198	189	153	29	5	891	421	6049	6940
12	150	1275	192	157	118	10	1	1393	360	6409	7802
13		969	255	180	116	15	0	1085	450	6859	7944
14										6859	6859
15		569	331	282	126	24	3	695	640	7499	8194
16	200	491	99	151	119	7	1	610	258	7757	8367
17	100	358	95	141	220	203	6	578	445	8202	8780
18	100	248	81	129	89	6	11	337	227	8429	8766
19										8429	8429
20										8429	8429
21										8429	8429
22										8429	8429
23		5	48	279	40	25	19	45	371	8800	8845
Totals			3566	4762		403	69				

Dead fish removed on each survey.

Dead counts from the side pond only through 8/16. Both ponds counted on 8/17.

TABLE 20. Summary of Hansen Creek spawning surveys, 1990–97.

Year	Date first fish entered	Survey date	Survey counts				Total from daily surveys	Percent peak count of total	Mortalities		
			Mouth	Live	Dead	Total			Natural dead	Bear-kill dead	Percent bear-kill
1990	7/28	8/1	??	3570	201	3771	6733	56			
		8/6	25	4105	743	4873	6733	72	5139	1594	24
1991	7/21	8/1	??	4460	1664	6124	16296	38			
		8/6	500	8670	3735	12905	16296	79	13671	2625	16
1992	7/18	8/1	??	4594	1085	5679	7292	78			
		8/6	50	3518	2886	6454	7292	89	5991	1301	18
1993	7/20	8/1	??	1359	685	2044	4212	49			
		8/6	200	1482	1573	3055	4212	73	2696	1516	36
1994	7/27	8/1	??	2314	718	3032	7413	41			
		8/6	500	3205	1947	5652	7413	76	3358	4055	55
1995	7/20	8/1	600	6509	2348	9457	17589	54			
		8/6	100	7680	4425	12205	17589	69	9854	7297	43
1996	7/18	8/1	1000	5076	1674	6750	9736	69	6476	2800	30
		8/6	200	3968	3345	7313	9736	75			
1997	7/18	8/1		1597	2183	3780	8845	43	3969	4831	55
		8/6	300	2163	3804	5967	8845	67			