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# ALASKA SALMON RESEARCH

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T. QUINN, ASSOCIATE PROFESSOR;
C. FOOTE, ASSISTANT PROFESSOR; AND
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ANNUAL REPORT—1992
to
PACIFIC SEAFOOD PROCESSORS ASSOCIATION

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**FISHERIES RESEARCH INSTITUTE**
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Approved

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Director

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## KEY WORDS

Bristol Bay, Egegik, Kvichak, Nushagak, limnology, predation, sockeye salmon, spawning grounds, Ugashik, Wood River Lakes

# INTRODUCTION

Fisheries Research Institute (FRI) was established in 1946 with the financial support of the major Alaskan salmon processors to (1) investigate the causes of the declines in production that had occurred in most stocks since the 1930s, (2) 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 (3) assist salmon processors by providing a second opinion on matters of salmon fisheries management. These objectives are still valid today, but 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/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, Southeast Alaska and Chignik that are funded in part or entirely by the industry. In addition, we have a federally funded high seas salmon project that is concerned with the oceanic distribution of salmon and the vulnerability of North American stocks to foreign fisheries. In recent years, we have also worked at Kodiak and on the Yukon stocks. All of these projects have been carried out in cooperation with the Alaska Department of Fish and Game (ADF&G) or the National Marine Fisheries Service (high seas), and we have also had cooperative research projects with salmon biologists from Japan and Russia. This past summer we hosted four Russian salmon biologists for 3 weeks at our field stations in Bristol Bay and then visited their research stations in Kamchatka.

This report focuses on our 1992 Bristol Bay research with emphasis on salmon forecasting and research relevant to escapement policies to maximize production. The Southeast pink salmon (*Oncorhynchus gorbuscha*) research will be reported in a separate report from the University of Alaska, our Chignik salmon research is reported to the National Marine Fisheries Service, and a report on our Alaska Peninsula (False Pass) work will be completed soon.

# FORECASTING

## PRE-SEASON FORECASTS

Forecasts of the 1993 Bristol Bay sockeye salmon (*O. nerka*) runs and catches were provided to participating processors at an October 1992 meeting. They are presented in Table 1 with the ADF&G forecasts and the past forecasts and runs beginning in 1985. The two river system forecasts (FRI and ADF&G) are based on the same data sources, but different analytical methods often have been used. Both 1992 forecasts were for an average (recent years) run and catch, whereas the actual run was above average and the catch (32 million) was the third largest on record. Since 1985, the actual catch has been between the two forecasted catches only once. In the other 7 years, the catch was either higher (6) or lower (1) than both forecasts. The 1992 catch was 45% greater than our forecast, which made it our second worst forecast since 1985.

Our forecasts of the runs to the fishing districts have been closest for the Nushagak, with an average error (percent that the run was above or below the forecast) of 22%, and furthest off for the Naknek/Kvichak, where the average error has been 43%. Average errors in forecasts of the Egegik and Ugashik runs have been 39% and 35%, respectively.

## PORT MOLLER FORECAST

The Port Moller in-season test fishery was conducted by ADF&G 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, we have conducted the test fishery each year. The accuracy of the forecasts since 1987 has been very good. The runs have differed from the forecasts made on June 25 and 30 by an average of 17%, and we have been within an average of 10% on forecasts made about July 3 (Table 2). We have not done as well in forecasting the catch as we have for the runs 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 1992, the test-fish catches projected that the run would be larger than the pre-season forecasts and the actual run turned out to be exactly as forecast on June 30 (45 million).

The test fishery at Port Moller employs a 200-fathom gillnet that is 60 meshes deep and has 5-in stretched mesh. The web is multistrand monofilament (center core). We have used a 70-ft vessel (*Nettie H*) and fished each day from June 11 through about July 5 (weather permitting). Four stations are fished along a transect about 30 to 60 mi out from Port Moller. Catch, mean length and water temperature data are sent daily by radio to Port Moller and then faxed to Bristol Bay. The vessel comes into port every other day to deliver fish and salmon scales collected by the two to three biologists on board. In 1992, scales and length data were sent periodically to ADF&G in King Salmon, where the scales were aged and the age compositions and average lengths by age were reported.

The statistics from Port Moller in 1992 were again a challenge to interpret, although they ultimately predicted the total run and age composition accurately. The sockeye were exceptionally small for their age, and yet there was a high percentage of 3-ocean sockeye, so the average length of all fish did not accurately reflect the ocean age composition (the same as in 1991). Usually, high percentages of 3-ocean are associated with small runs, but small fish (for a given age) are usually associated with large runs. ADF&G provided preliminary daily catches and escapements for 1992, and from these data as well as published statistics (e.g., Stratton 1991) we reconstructed the run timing in the Bristol Bay fishing districts to compare with past years and with the Port Moller index catches (Figs. 1 and 2). The timing and magnitude of the 1992 run was fairly well predicted by the Port Moller catches assuming an 8-day travel time and that Ugashik fish passed Port Moller at the same time as the other stocks (Rogers 1990).

ADF&G provided preliminary length and weight statistics for 1992, and statistics from prior years were available (e.g., Yuen et al. 1981 and Stratton 1991) for calculating mean lengths in the runs (Tables 3). Sockeye in the 1992 run were among the smallest recorded and similar to the small fish in the 1990 and 1991 runs. We are presently unable to predict the effect of variation in fish size on the selectivity of the Port Moller gill net in-season; however, the small size of the sockeye in 1992 was not so unusual given the large run. Large runs typically contain smaller fish because of density-dependent growth in their final spring at sea (Rogers 1980).

The Port Moller test fishery in 1992 also provided an early indication to ADF&G management that a large run was on the way; however, the early distribution of the run, heavy to the Egegik District, created some doubt as to the size of the run (40+ million). Although there were still large over-escapements in the Naknek, Egegik, and Ugashik rivers, the escapements in 1992 were closer to the goals than in the past 3 years (Table 4).

# LAKE RESEARCH

During the summer of 1992, 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 30 years and constitute the longest continuous biological and environmental record on any salmon stock in Alaska. In 1992, we also conducted special studies of bear predation on spawning sockeye salmon and stock specific traits of sockeye spawning populations.

## KVICHAK SYSTEM

Our 1992 field season in the Kvichak system (Iliamna and Clark lakes) consisted of estimating the sockeye escapement into the Newhalen River in late-June and July, townetting for juvenile sockeye and threespine stickleback (*Gasterosteus aculeatus*) in upper Lake Iliamna and Lake Clark in August, and conducting spawning ground surveys in late August-early September to collect otoliths for age determination. We also completed a special study of rainbow (*O. mykiss*)-sockeye interactions (predator-prey) and continued a study of variation in the body shapes of spawning sockeye on different spawning grounds

### Newhalen River Escapement

The annual escapements of sockeye salmon to the Kvichak lake system are estimated by ADF&G from expanded 10-min counts on each bank of the river at the outlet of Lake Iliamna (Igiugig). In addition, since 1979 we have estimated the escapements up the Newhalen River by expanding 20-min counts on one bank, for each of 10 daylight hours, to a daily count for both banks. We count when and where the visibility is best and assume that the fish utilize both banks equally and that their migratory rate does not change at night. The daily counts at Newhalen are compared to the counts at Igiugig to estimate a travel time; then, by lagging the Newhalen counts back to Igiugig the appropriate number of days, we can calculate the daily proportions of the Kvichak run that went up the Newhalen River.

The cumulative daily escapements for the two rivers, timed to the Kvichak, are given in Table 5 for 1988–1992. In mid-July, milling fish often swim upriver along the banks of the Newhalen and are counted, and then drift downriver in the middle where they cannot be seen, only to swim up river again. This inflates the counts for the escapement; therefore, we have used the average proportion of Newhalen count to Kvichak count for day 5 to day 16 (day one equals the first day of 100,000 in the Kvichak) and the season's total Kvichak escapement to estimate the Newhalen/Lake Clark escapement.

In 1992, we estimated that 1.1 million of the Kvichak escapement of 4.7 million (about 22%) ended up in the Newhalen/Lake Clark system (Table 6). This was a little lower than the average percentage for the past 5 years (30%). The aerial surveys conducted by ADF&G in 1992 provided an estimate of the Newhalen River spawners and, thus by subtraction, an estimate of the Lake Clark escapement of 1.0 million.

Spawning Ground Surveys

We have collected scales or otoliths from spawned-out sockeye salmon from several major spawning grounds in the Kvichak system each year since 1956. In 1992, eight spawning grounds were sampled, and the age compositions from the samples provided a different pattern than the age composition in the lake system escapement (Table 7). The age compositions of the beach spawners looked similar to the lake system age compositions, but the rivers and creeks had quite different age compositions. Chinkelyes Creek and the Tazimina River had high percentages of age 2.2, the Newhalen River a high percentage of age 1.3, and Copper River a high percentage of age 2.3 sockeye salmon.

We had conducted annual aerial surveys of the Kvichak spawning grounds from 1956 until 1988, when ADF&G took over the surveys. The results of the 1992 surveys were provided by ADF&G and are summarized for 29 selected spawning grounds in Table 8. In recent years the surveys have accounted for smaller percentages of the total (tower count) escapement than was typical for past years. This may have been caused by differences in observers, weather conditions (visibility), or distribution of sockeye salmon on the spawning grounds.

In 1990 and 1991, we conducted studies to determine the life duration of male and female sockeye on Woody, Fuel Dump, and Porcupine Islands. These data, along with accurate transect counts of the number of sockeye present, will allow us to determine more accurately the number of sockeye present on the beaches than can be presently done through aerial surveys alone. In 1992, we refined our estimates by tagging, *in situ*, sockeye arriving on the spawning grounds. This was done by divers using a modified spear gun to deploy individually color-coded Floy Dart tags. With these data, we will now be able to estimate the breeding life span depending on time of arrival.

We expanded our transect counts of sockeye on Fuel Dump Island to examine the possibility of local population differentiation in run timing in association with exposure to different wind-driven currents. The results indicated run timing differences between segments of the local population located within 20 m of one another.

For the second year, we deployed a continuous water temperature monitor at Woody Island at a depth of approximately 3 m (10 ft). This provides us with year-round records of lake temperature. We expect that these continuous, high-resolution records will assist us in understanding the year-to-year variation in growth and survival of sockeye fry in the lake and the patterns of spawning time, incubation rate and survival to emergence of the beach spawning stocks. We also retrieved a monitor near Fuel Dump island that measured water temperature and lake level. This is the first continuous measure of lake level, and it revealed a drop of near 2 m (5 ft) during the winter. Fluctuations in lake level are likely of major importance to the developing alevins of sockeye spawning on shallow beaches.

One of the basic tools of fisheries management is genetic stock identification. Here, natural variation in protein and associated DNA structure among stocks is used to estimate stock composition in mixed stock fisheries. In 1991, we sampled 50 fish from each of six potentially discrete stocks in Lake Iliamna (Gibralter Cr., Copper R., Knutson Bay, Chinkelyes Cr., and Woody and Fuel Dump islands). In 1992, we repeated the sampling at Woody and Fuel Dump islands, Knutson Bay and Copper River to both refine our original estimates and to get an estimate of inter-year variation within populations. In addition, we collected 50 new samples from sockeye migrating up the Newhalen River in the spring and from spawning sockeye in the Tazimina River in September to determine the degree of differentiation between fish spawning in the Newhalen system and those spawning in Lake Iliamna. Finally, we collected 30 blood samples each from fish spawning at Woody Island Beach, Tazimina River, and Hansen Creek in Lake Aleknagik in order to analyze these populations for potential stock (and lake) specific variation in total genomic DNA.

We continued and expanded our investigations of factors involved in the variation of life history traits observed among populations within the watershed. We are particularly interested in variation in egg size with respect to size of the spawning substrate and associated water current and in variation in total egg number of salmon spawning in different areas. We plan to integrate these data into our information on size and age structure to understand productivity and mortality patterns among populations.

<u>Sockeye Fry Abundance and Size</u>

We have sampled the sockeye fry (age 0) in the Kvichak system each year since 1962 (1961 brood year) by townetting at night. However, we had a long run of bad weather in late-August of 1992 that made it impossible to townet in the upper end of Iliamna Lake, where most of the fry are concentrated. We did townet in Lake Clark, but as usual we did not sample the fry in Six-mile Lake (upper end of the Newhalen River), where fry from the Tazimina River are likely to concentrate. The geometric means of the catches provide a measure of the relative density (number per 20-min tow), and the mean lengths of the fry are adjusted each year, based on their daily growth rate, to September 1 (Table 9).

The sockeye fry are usually smaller in Lake Clark than in Lake Iliamna because temperatures are usually colder and Lake Clark has a shorter ice-free period. In both lakes, the annual growth of the fry is correlated with water temperatures, which are mostly influenced by spring weather. Cold temperatures typically result in small fry (40–50 mm), which then spend 2 years in the lake before seaward migration and tend to return as adults 5 years after their parents. Warm temperatures usually result in large fry (over 60 mm), which tend to migrate to sea after 1 year and mostly return 4 years after their parents. The townet sampling has been useful in predicting, 3 years in advance, the main age at return from the larger Kvichak escapements by utilizing the relationship between age at return and mean length of fry in Lake Iliamna.

## Sculpin Predation on Salmon Eggs

Predation by fish on salmon eggs has been observed on numerous occasions in the wild. However, the magnitude and effects of such predation have never been documented. In 1992, we conducted a study to determine the extent of sculpin predation on salmon eggs on the Woody Island spawning beaches in Lake Iliamna. Freshwater sculpins are a relatively small species (<13 cm total length) of the Family Cottidae. Two sculpin species occur in Lake Iliamna: the coastrange sculpin (*Cottus aleuticus*) and the slimy sculpin (*C. cognatus*).

The study consisted of two parts: (1) We monitored sculpin density and size range on twenty-four 1-$m^2$ plots placed on and just off the known salmon spawning grounds, and (2) we conducted experiments to determine the number of salmon eggs hungry sculpins would consume.

Sculpin density increased on the spawning grounds in accordance with the increasing number of spawning sockeye present and decreased dramatically after all the sockeye had completed spawning. In contrast, sculpin densities changed very little in areas off the spawning grounds. Taken together, these data indicate that the sculpin species were responding (and migrating) to an egg resource that was clumped in space and time. Overall, sculpin densities reached a peak of nearly 13 $m^{-2}$ on the spawning grounds, but only 2.5 $m^{-2}$ off the grounds. While the number on the spawning grounds appears relatively high and indicative of extensive egg predation, it pales in comparison to the number of sculpins actually observed in sockeye redds immediately after spawning. On average, 21 sculpins were observed in sockeye nests either nearing completion or just after spawning. In the extreme case, over 113 sculpins were counted in a single sockeye nest just after spawning had occurred.

The maximum number of eggs hungry slimy and coastrange sculpins would consume was determined by placing individual sculpins in 0.67 m screen pens, allowing them to acclimate to the conditions, and then by introducing batches of either 40 water-hardened eggs or non-water-hardened eggs (fresh). Salmon eggs expand and develop a strong outer shell when they come in contact with water, in a process called "water-hardening." We considered that this expansion and hardening would both limit the size range of sculpins to which eggs were available (because of their small mouth size) and limit the total number of eggs that could be ingested (because of their size and the inability of sculpins to crush them). The number of eggs consumed by sculpins depended on the species, the size of the individual fish and the condition of the eggs. In general, slimy sculpins with relatively larger mouths were able to consume more eggs per a given-sized fish than coastrange sculpins. In both species, the number of eggs consumed increased with increasing size. Further, both species were able to ingest a significantly larger number of eggs when the eggs were not water-hardened. The maximum number of non-water-hardened eggs consumed in a single 15-min feeding by a slimy sculpin was 48.

Future work will address the egg digestion rates of sculpins in order to estimate the total number of eggs taken during spawning. Further, we will compare the extent of sculpin predation by spawning habitat (gravel size, beach versus river, etc.) to determine the relative cost of this predation to various populations. Ultimately, we intend to relate salmon population characteristics (egg size, length of spawning period) to the extent of sculpin egg predation, to determine if such predation is responsible for observed stock structure.

### Rainbow Trout Predation

Arctic char (*Salvelinus alpinus*) predation on sockeye salmon smolts has been shown to be very significant at predation "bottlenecks" (river inlets and outlets) in the Wood River Lakes. In 1992, we completed a study to investigate whether predation by rainbow trout, Arctic char and lake trout (*Salvelinus namaycush*) accounts for a significant portion of juvenile sockeye mortality in Iliamna Lake (Berejikian 1992). This study was also an attempt to determine whether there was any relationship between rainbow trout growth and the abundance of sockeye salmon eggs, fry, or smolts.

Rainbow trout and Arctic char were the primary predators on sockeye salmon smolt near the outlet of Iliamna Lake. Both species preyed on smolt at similar rates; however rainbow trout supplemented their primary diet of smolt with mostly insects, whereas char preferred other fishes during the smolt outmigration. Throughout the summer, rainbow trout consumed a relatively constant amount of insects but utilized pulses of additional food, like smolts during the smolt outmigration and eggs during salmon spawning.

Growth of rainbow trout to age 3 appeared to be important in determining the subsequent growth to ages 4 and 5. For fish in their 5th growing season, the abundance of smolt and salmon eggs (as measured by escapement) provided additional nutrition that led to increased growth. Apparently, rainbow trout in Iliamna Lake were dependent on sockeye and other salmon for their nutritional requirements, but they were not a major factor in regulating sockeye salmon smolt production near the outlet of the lake.

## 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 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

The spring of 1992 was typical for Bristol Bay, and ice breakup was just 2 days later than average in Lake Aleknagik (Table 10). Although ice breakup was average, water temperatures were cooler than average except in early August. This was because solar radiation (sunlight) was below average during most of the summer. Lake levels were about normal until late August, when heavy rainfall caused a moderate increase. Standing crop of phytoplankton (chlorophyll) was about average during the summer, whereas zooplankton abundance was well below average both in number of individuals and volume (Table 11 and Fig. 3). Zooplankton are the main source of food for juvenile sockeye salmon after they move offshore in late July. Insects (mainly pupal and adult midges) are the main source of food in the spring, when the fry are inshore. Midge abundance in the spring of 1992 also appeared lower than average; however, the abundance in late July was greater than normal (Table 12).

## Fry Abundance and Growth

The sockeye fry in Lake Aleknagik in 1992 were a little shorter than average in June, but their growth during July and August was very poor and on September 1 they averaged only 46 mm, the second shortest that we have recorded (Table 13). Their abundance as measured by beach seine and townet sampling was above average, and although we do not have an estimate of the total number of parent spawners (an aerial survey was not done in 1991), there was a record high count of spawners in the Aleknagik creeks in 1991 (Fig. 4). The small size on September 1 indicates that the very abundant fry cropped down their main food supply, especially the larger forms of the zooplankton such as calanoid copepods and *Daphnia*. The poor growth in 1992 will likely result in a substantial holdover of yearlings in Lake Aleknagik in 1993.

The mean lengths of sockeye fry in Lake Nerka indicated that growth was also below average in 1992, but not as severe as in Lake Aleknagik (Table 14). Zooplankton volumes in Lake Nerka during late August were about 60% of average, where as in lake Aleknagik it was 44% of average. The fry in Lake Nerka will likely migrate to sea in 1993 as relatively small age 1 smolt. No townet sampling was conducted in the upper lakes (Beverley and Kulik) in 1992; however, zooplankton volumes in 1992 were 78% of average (1968-1991) and growth of sockeye fry was likely to be only a little below average.

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 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.

## Char Predation

We have sampled the Arctic char in Little Togiak River each spring since 1972 to follow the rate of predation on juvenile sockeye, especially smolts. This short river flows from Little Togiak Lake into Lake Nerka, and the smolts are very vulnerable to the char for the few minutes it takes them to move from one lake to the next. Large char usually eat more juvenile sockeye than small char. The char caught in 1992 were about average in length and they consumed an average of 2 smolts per day (Table 15). We were surprised to find no sockeye fry in the char stomachs in 1992, since our sampling began soon after the ice was out. Perhaps fry emergence in the river was earlier than normal or the numbers of fry were low in 1992. There are about 5,000 char in and around the river mouth, so that at just two sockeye smolt per char per night for a migration of 20 to 30 days, a significant number of smolts are lost from the production of this small lake in the system.

Spawning Ground Surveys

Sockeye salmon spawning ground surveys have been conducted annually in the Wood River lake system since 1946; however, it was not until the early 1950s that all of the 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. ADF&G 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 large returns and uneven distributions tend to produce small returns.

Aerial surveys were not conducted by ADF&G in 1990 and1991 because of inadequate funding. We provided funding for 1992, and the surveys were conducted; however, we have not yet compiled the aerial survey counts to estimate the escapements to the lakes. The ground survey counts and the age compositions for the major spawning grounds in 1992 are given in Tables 16 and 17. Spawning ground counts were again high in Lake Aleknagik but were below average in most creeks on Lake Nerka. Sockeye of age 1.2 (1 yr freshwater and 2 yrs at sea) were the most abundant age group in the escapement to the lake system and also to most of the spawning grounds except for the small creeks on Lake Aleknagik, where age 1.3 sockeye were most numerous. It was unusual in 1992 that fish of age 1.2 were most numerous in the two large rivers (Agulowak and Agulukpak), because these rivers typically produce 3-ocean sockeye salmon. Perhaps this signals a large return of 3-ocean sockeye in 1993.

Bear Predation

We completed the third year of our bear/spawning sockeye interaction study in Hansen Creek, a small tributary of Lake Aleknagik where predation by bears is high relative to larger creeks. During 21 July to 21 August, a large number of sockeye were again observed in Hansen Creek (the third year in a row). Daily count and removal of sockeye killed by bears indicated that 1,301 (18%) of 7,292 spawners were killed by bears in 1992 (Table 18). 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). Number of sockeye killed by bears in 1992 was less than in 1990 or 1991; however, the percentage of sockeye killed by bears in 1992 was intermediate to the percentages in 1990 and 1991 (24% and 16%), when approximately 6,700 and 16,300 sockeye salmon were observed in the creek (Table 19). We plan to continue the daily surveys in Hansen Creek until we obtain counts for a year when number of spawners is near the median number (2,500) and 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 are about the earliest spawners in the lake system, and the fish usually first enter the creek about July 22-25. From the daily counts in 1990-1992, we determined that had the surveys been conducted on the single date of August 6, the "peak survey" counts would have been 72% to 89% of the totals, and if the single surveys were done on August 1, the counts would have been 38% to 78% of the actual number of spawners (Table 19). The percentage counted in 1992 on August 1 (78%) was relatively high because spawning was early, with the fish first entering the creek on July 18.

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# FIGURES

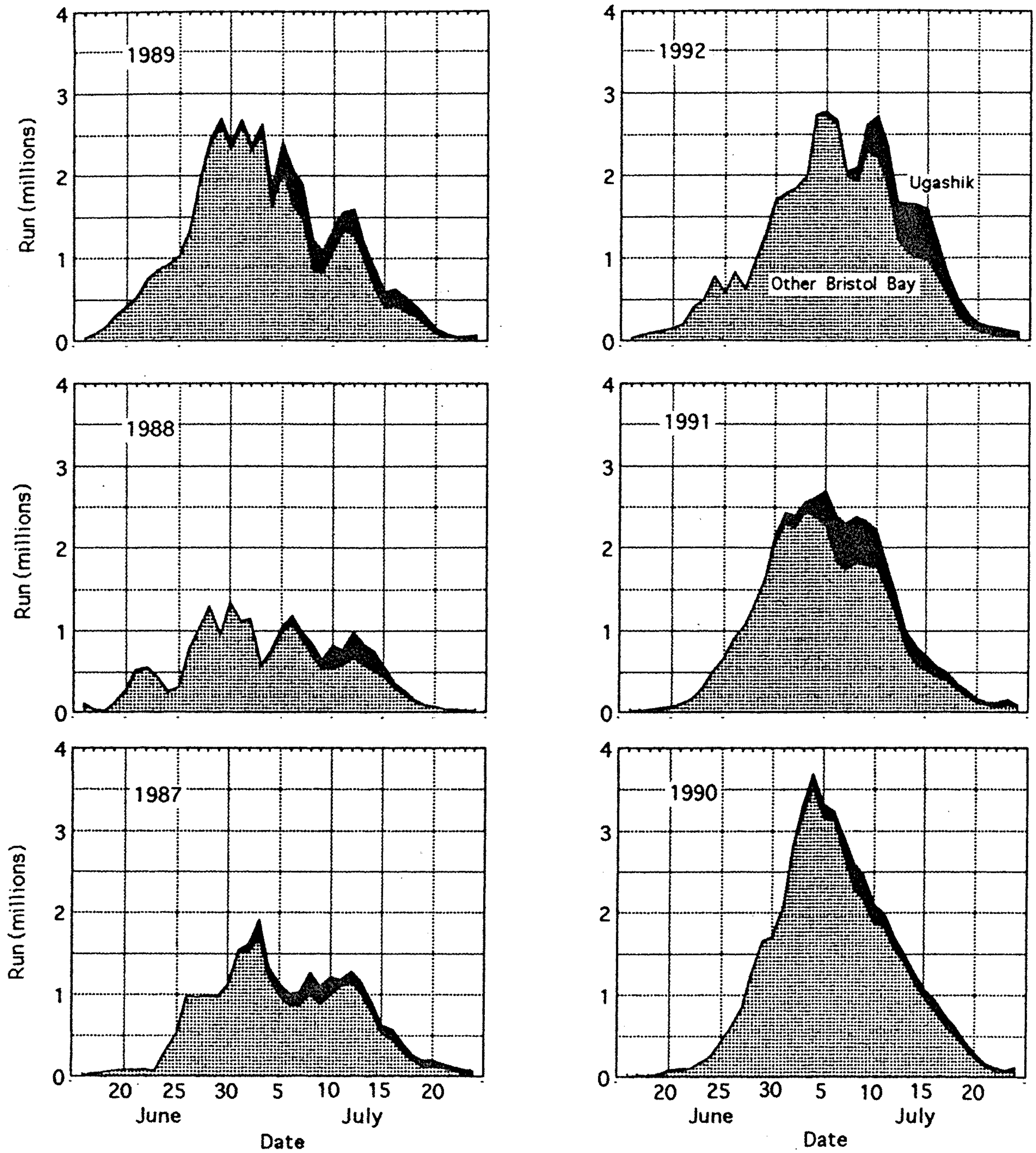


Figure 1. Reconstructed daily Bristol Bay sockeye salmon runs; Naknek/Kvichak, Egegik and Nushagak combined plus the Ugashik District, 1987-1992.

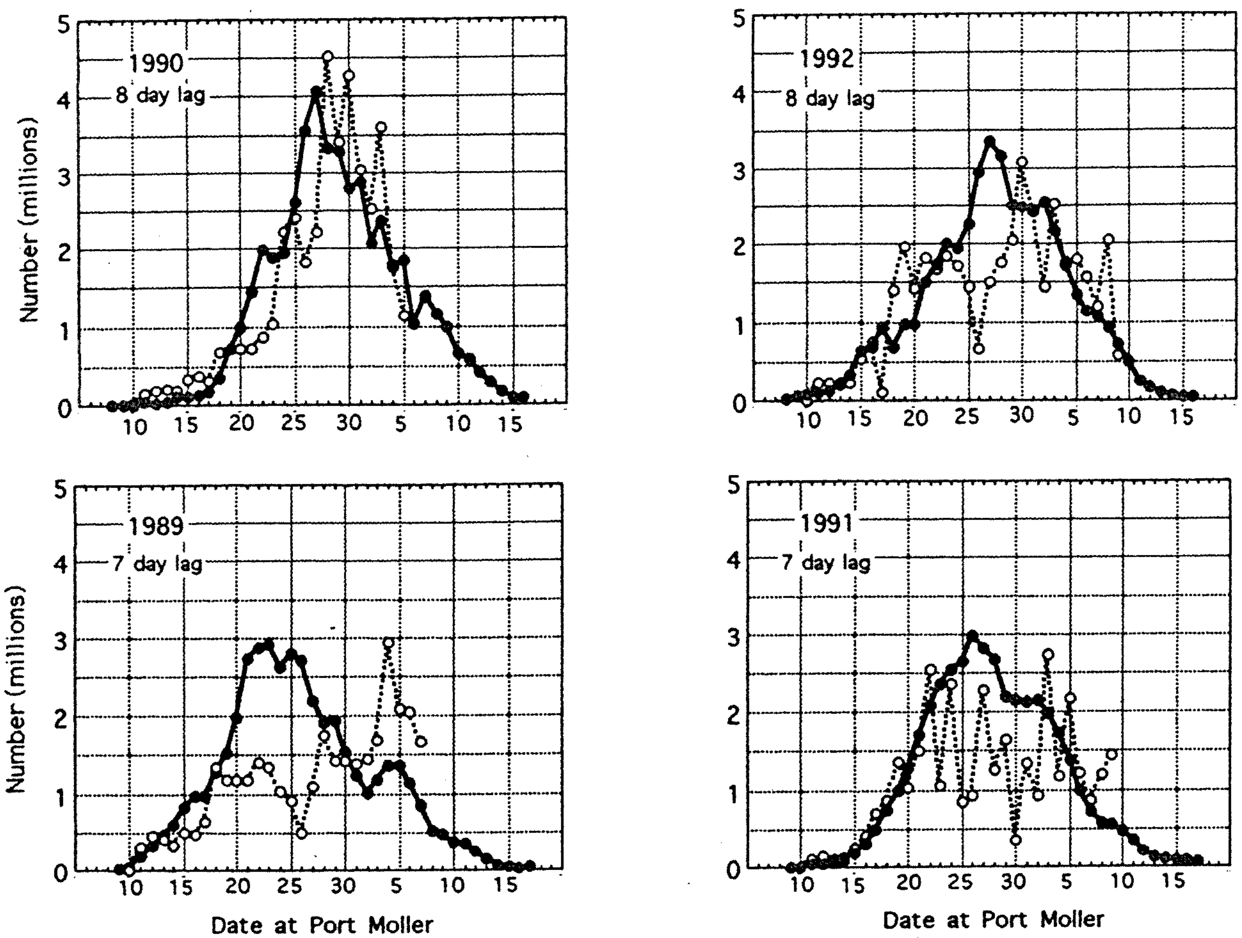


Figure 2. Reconstructed daily Bristol Bay sockeye salmon runs at Port Moller and the daily sockeye salmon index catches, 1989-1992.

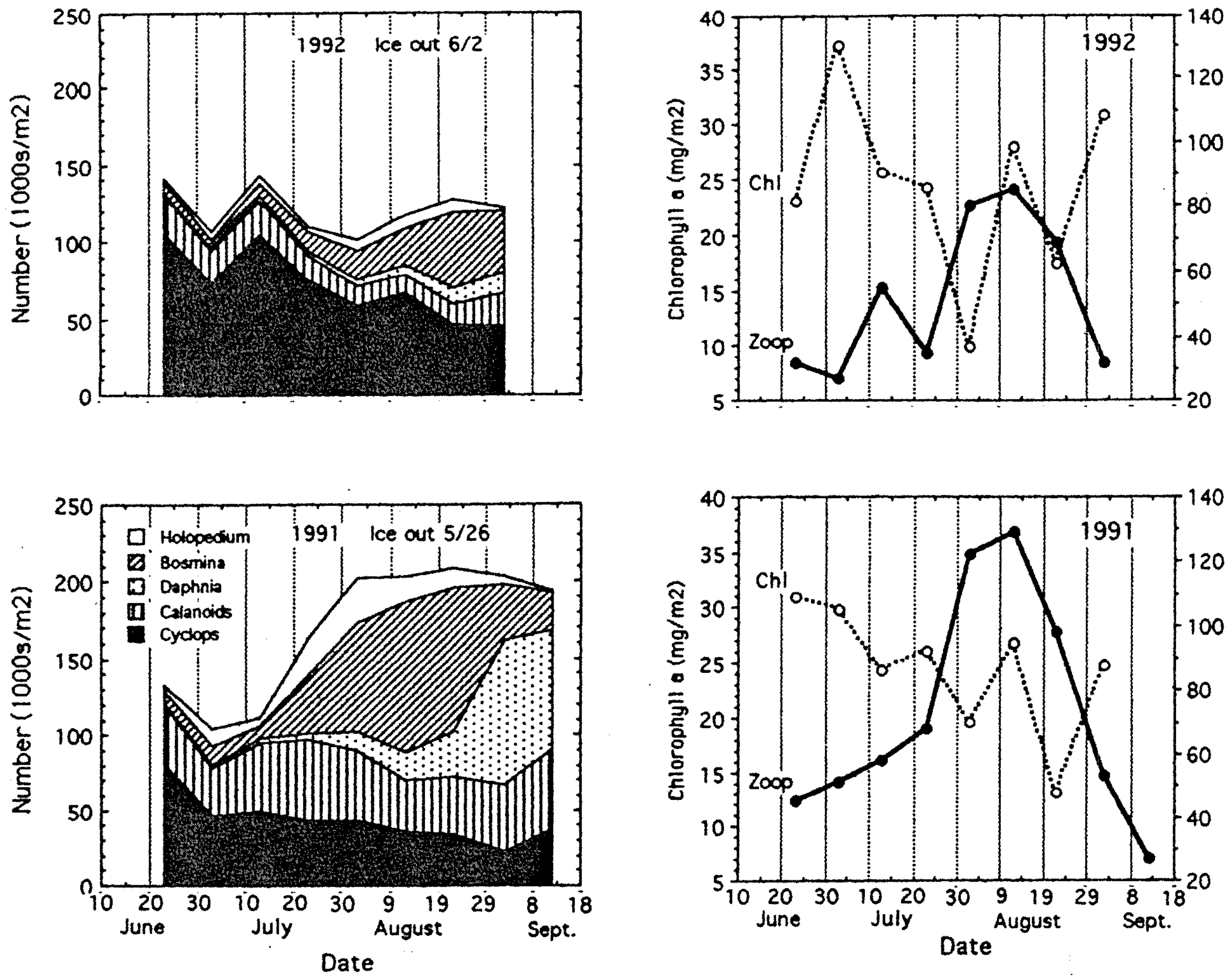


Figure 3. Summer abundances of zooplankton in Lake Aleknagik during 1991 and 1992.

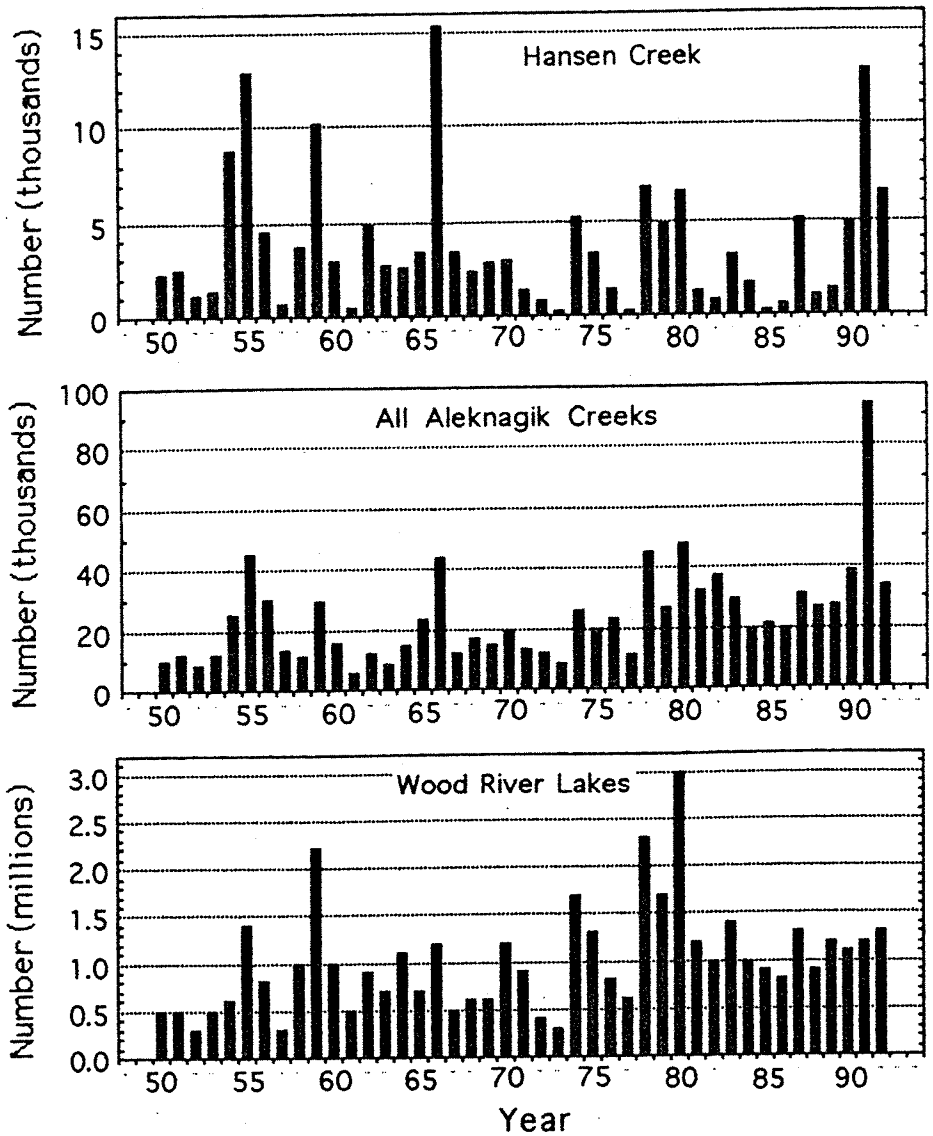


Figure 4. Annual escapements of sockeye salmon to the Wood River Lakes and annual stream survey counts for all Lake Aleknagik creeks and Hansen Creek, 1950-1992.

# TABLES

Table 1. Pre-season forecasts of Bristol Bay sockeye salmon inshore runs.

| Year | Forecast/run | Kvichak | Naknek | Egegik | Ugashik | Nushagak | Total run | Catch | %Error |
|---|---|---|---|---|---|---|---|---|---|
| 1985 | FRI | 12.2 | 5.3 | 5.8 | 4.4 | 4.3 | 33.0 | 18.2 | 29 |
| | ADFG | 12.2 | 4.9 | 6.6 | 5.6 | 4.3 | 35.0 | 20.3 | |
| | Actual run | 13.4 | 3.7 | 8.6 | 7.4 | 3.0 | 36.6 | 23.5 | |
| 1986 | FRI | 9.2 | 4.5 | 5.9 | 6.7 | 4.8 | 32.1 | 19.4 | 19 |
| | ADFG | 4.5 | 3.2 | 5.4 | 4.9 | 3.8 | 22.5 | 13.3 | |
| | Actual run | 2.0 | 3.9 | 6.2 | 5.9 | 4.9 | 23.7 | 15.8 | |
| 1987 | FRI | 2.8 | 2.0 | 5.8 | 3.1 | 5.1 | 19.5 | 12.4 | 29 |
| | ADFG | 2.7 | 2.1 | 4.9 | 3.1 | 3.3 | 16.8 | 9.3 | |
| | Actual run | 9.6 | 2.4 | 6.7 | 2.8 | 5.1 | 27.3 | 16.0 | |
| 1988 | FRI | 12.3 | 3.1 | 6.2 | 3.1 | 5.0 | 30.6 | 20.8 | 33 |
| | ADFG | 9.3 | 2.5 | 5.6 | 3.2 | 5.6 | 26.5 | 16.8 | |
| | Actual run | 6.8 | 1.8 | 8.0 | 2.2 | 3.2 | 23.4 | 14.0 | |
| 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 | |
| | Actual run | 19.8 | 3.2 | 10.3 | 4.9 | 5.0 | 44.0 | 28.7 | |
| 1990 | FRI | 10.1 | 4.8 | 6.6 | 3.0 | 4.6 | 29.8 | 19.0 | 75 |
| | ADFG | 8.9 | 3.6 | 5.6 | 3.1 | 3.5 | 25.4 | 14.7 | |
| | Actual run | 17.4 | 8.4 | 12.3 | 2.9 | 5.7 | 47.7 | 33.2 | |
| 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 | |
| | Actual run | 8.1 | 10.0 | 9.6 | 5.5 | 7.7 | 42.2 | 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 | |
| | Actual run | 10.4 | 5.0 | 17.6 | 5.5 | 5.2 | 45.1 | 32.0 | |
| 1993 | FRI | 9.1 | 3.6 | 18.2 | 5.5 | 6.0 | 43.3 | 31.9 | |
| | ADFG | 11.7 | 3.4 | 15.8 | 4.9 | 5.1 | 41.8 | 32.0 | |
| | Actual run | | | | | | | | |

Total run and catch include Branch River and Togiak District.

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 | | | Run pred. on 7/3 | | | Catch pred. on 7/3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 1988 | 23 | 14 | 15 | 8 | 53 | 15 | 8 | 53 | 22 | 1 | 5 | 12 | 2 | 17 |
| 1989 | 44 | 29 | 50 | -6 | -12 | 37 | 7 | 19 | 42 | 2 | 5 | 28 | 1 | 4 |
| 1990 | 48 | 33 | 42 | 6 | 14 | 56 | -8 | -14 | 39 | 9 | 23 | 25 | 8 | 32 |
| 1991 | 42 | 26 | 48 | -6 | -13 | 37 | 5 | 14 | 37 | 5 | 14 | 21 | 5 | 24 |
| 1992 | 45 | 32 | 49 | -4 | -8 | 45 | 0 | 0 | 41 | 4 | 10 | 29 | 3 | 10 |
| Means | 38 | 25 | 39 | 0 | 6 | 36 | 2 | 12 | 35 | 4 | 10 | 22 | 3 | 16 |
| absol. | | | | 5 | 17 | | 5 | 17 | | 4 | 10 | | 3 | 16 |

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.

Table 3. Mean lengths 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 |
| Averages | | | | | | | | | |
| 58-67 | 18 | 520 | 503 | 511 | 584 | 562 | 571 | 532 | 36 |
| 68-77 | 15 | 523 | 508 | 516 | 588 | 566 | 576 | 539 | 39 |
| 78-88 | 35 | 526 | 511 | 519 | 585 | 564 | 574 | 541 | 40 |
| 88-92 | 45 | 513 | 497 | 505 | 576 | 553 | 565 | 533 | 46 |

Table 4. The 1992 sockeye salmon runs to Bristol Bay river systems and the escapements compared to the management goals.

| River system | Run | Escapement | Escapement goals Mid | Escapement goals Upper | Excess escapement Mid | Excess escapement Upper |
|---|---|---|---|---|---|---|
| Kvichak | 10.40 | 4.73 | 6.00 | 8.00 | 0.00 | 0.00 |
| Naknek | 5.00 | 1.61 | 1.00 | 1.40 | 0.61 | 0.21 |
| Branch | 0.49 | 0.22 | | | | |
| Egegik | 17.61 | 1.95 | 1.00 | 1.20 | 0.95 | 0.75 |
| Ugashik | 5.52 | 2.17 | 0.70 | 0.90 | 1.76 | 1.56 |
| Wood | 2.52 | 1.29 | 1.00 | 1.20 | 0.29 | 0.09 |
| Igushik | 0.81 | 0.30 | 0.20 | 0.25 | 0.10 | 0.05 |
| Nuyakuk/Nush. | 1.85 | 0.70 | 0.50 | 0.76 | 0.20 | 0.00 |
| Togiak | 0.81 | 0.22 | 0.15 | 0.25 | 0.07 | 0.00 |
| Totals | 45.01 | 13.19 | | | 3.98 | 2.66 |

Table 5. Cumulative daily escapements of sockeye salmon in the Kvichak and Newhalen Rivers, 1988-1992.

| | 1988 | | 1989 | | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Kvichak | Newhalen | Kvichak | Newhalen | Kvichak | Newhalen | Kvichak | Newhalen | Kvichak | Newhalen |
| 6/25 | 1 | 0 | 58 | 17 | 1 | | 0 | | 2 | |
| 26 | 4 | 5 | 298 | 97 | 2 | | 1 | | 9 | |
| 27 | 75 | 85 | 525 | 162 | 3 | | 3 | | 16 | |
| 28 | 264 | 128 | 653 | 200 | 5 | 0 | 50 | 7 | 81 | 5 |
| 29 | 313 | 140 | 892 | 454 | 8 | 1 | 125 | 46 | 255 | 18 |
| 30 | 328 | 187 | 1509 | 641 | 39 | 2 | 277 | 95 | 446 | 67 |
| 7/1 | 364 | 244 | 2052 | 712 | 46 | 37 | 588 | 146 | 635 | 88 |
| 2 | 778 | 456 | 2566 | 785 | 219 | 66 | 901 | 188 | 754 | 104 |
| 3 | 1193 | 632 | 3287 | 892 | 825 | 90 | 1256 | 330 | 798 | 132 |
| 4 | 1598 | 676 | 4378 | 1185 | 1412 | 110 | 1581 | 517 | 1093 | 196 |
| 5 | 1901 | 784 | 5418 | 1287 | 1874 | 139 | 1925 | 620 | 1663 | 273 |
| 6 | 2079 | 1076 | 5947 | 1358 | 2399 | 204 | 2141 | 805 | 2244 | 329 |
| 7 | 2189 | 1313 | 6611 | 1567 | 2901 | 304 | 2208 | 1132 | 2688 | 406 |
| 8 | 2232 | 1505 | 7182 | 1962 | 3509 | 375 | 2277 | 1531 | 2880 | 534 |
| 9 | 2272 | 1629 | 7518 | 2317 | 4061 | 459 | 2355 | 1721 | 2960 | 661 |
| 10 | 2389 | 1721 | 7670 | 2478 | 4692 | 648 | 2633 | 2048 | 2985 | 840 |
| 11 | 2775 | 1868 | 7708 | 2614 | 5081 | 790 | 3080 | 2202 | 3175 | 977 |
| 12 | 3473 | 2106 | 7755 | 2728 | 5388 | 961 | 3460 | | 3662 | 1057 |
| 13 | 3753 | 2372 | 7806 | 2829 | 5803 | 1079 | 3724 | | 4066 | 1158 |
| 14 | 3840 | 2657 | 7860 | 2944 | 6208 | 1193 | 3822 | | 4330 | 1258 |
| 15 | 3948 | 2848 | 7914 | | 6418 | 1297 | 3909 | | 4438 | 1434 |
| 16 | 3990 | 2976 | 8060 | | 6510 | | 3999 | | 4517 | 1491 |
| 17 | 4020 | 3094 | 8130 | | 6603 | | 4063 | | 4578 | |
| 18 | 4046 | 3203 | 8164 | | 6674 | | 4098 | | 4626 | |
| 19 | 4057 | 3313 | 8205 | | 6733 | | 4132 | | 4685 | |
| 20 | 4062 | 3435 | 8245 | | 6781 | | 4166 | | 4695 | |
| 21 | 4065 | | 8273 | | 6827 | | 4193 | | 4710 | |
| 22 | 4065 | | 8287 | | 6876 | | 4213 | | 4720 | |
| 23 | | | 8295 | | 6915 | | 4220 | | 4726 | |
| 24 | | | 8302 | | 6941 | | | | | |
| 25 | | | 8312 | | 6970 | | | | | |

Table 6. The Kvichak lake system escapements and the percentages going to Newhalen River and Lake Clark.

| Year | Kvichak system escapement (millions) | Newhalen/ Lake Clark escapement (millions) | Percent of Kvichak (%) | Newhalen River spawners (millions) | Lake Clark escapement (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* | – | – | *49* |
| 1992 | 4.73 | 1.05 | 22 | 0.01 | 1.04 | 22 | 13 |

Table 7. Age compositions of sockeye salmon on the Kvichak spawning grounds in 1992.

| Spawning ground | Sex | Sample size (n) | Age composition (%) 2.1 | 1.2 | 2.2 | 1.3 | 2.3 |
|---|---|---|---|---|---|---|---|
| Copper River | M | 18 | | 38.9 | 22.2 | 5.6 | 33.3 |
| | F | 29 | | 20.7 | 20.7 | 20.7 | 37.9 |
| Chinkelyes Creek | M | 98 | | 9.2 | 83.7 | 4.1 | 3.0 |
| | F | 98 | | 8.2 | 81.6 | 8.2 | 2.0 |
| Newhalen River | M | 97 | 1.0 | 12.4 | 46.4 | 39.2 | 1.0 |
| | F | 97 | 1.0 | 8.2 | 53.6 | 37.1 | 0.0 |
| Tazimina River | M | 62 | | 17.7 | 77.4 | 4.8 | 0.0 |
| | F | 98 | | 15.3 | 74.5 | 9.2 | 1.0 |
| Woody Is. beaches | M | 49 | | 63.3 | 20.4 | 12.2 | 4.1 |
| | F | 48 | | 64.6 | 8.3 | 14.6 | 12.5 |
| Fuel Dump Is. beach | M | 46 | 2.2 | 28.3 | 43.5 | 17.4 | 8.7 |
| | F | 49 | | 59.2 | 26.5 | 8.2 | 6.1 |
| Knudson Bay beach | M | 90 | 2.2 | 26.7 | 45.6 | 14.4 | 11.1 |
| | F | 79 | | 30.4 | 39.2 | 21.5 | 8.9 |
| Knudson Creek | M | 17 | | 11.8 | 58.9 | 17.5 | 11.8 |
| | F | 24 | | 16.7 | 58.3 | 12.5 | 12.5 |
| Kvichak escapement | M | 1216 | 0.7 | 31.5 | 40.5 | 16.8 | 9.0 |
| (ADF&G,Igiugig) | F | 1815 | | 31.8 | 46.8 | 15.0 | 5.4 |

Table 8. Spawning ground estimates of sockeye salmon on 29 selected spawning grounds in Lake Iliamna and the Newhalen River system, 1956-1992.

| | 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 | 94 | 116 | 15 | 706 | 4065 | 17.4 | 6 |
| 89 | 396 | 111 | 31 | 8 | 546 | 8318 | 6.6 | 6 |
| 90 | 141 | 47 | 19 | 26 | 233 | 6970 | 3.3 | 6 |
| 91 | 229 | 43 | 18 | 19 | 309 | 4223 | 7.3 | 7 |
| 92 | 214 | 63 | 36 | 19 | 332 | 4726 | 7.0 | 7 |
| 61-92 Means | 482 | 155 | 102 | 119 | 857 | 5810 | 15.8 | |

Table 9. Mean townet catches and lengths on Sept. 1 of sockeye salmon fry in Lakes Iliamna and 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 | | | | |

Lake Iliamna tows in areas 7 and 8 only.

Table 10. Summary of 1992 measurements in Lake Aleknagik.

| Measurement and first year measured | Dates | 1992 | Past years Average | Range |
|---|---|---|---|---|
| 1. Date of ice breakup 1949- | | 6/2 | 5/31 | 5/14-6/16 |
| 2. Water temperature, | 6/23 | 4.7 | 5.8 | 3.7, 9.2 |
| 0-20m (C) | 7/13 | 7.1 | 8.3 | 5.7, 12.0 |
| 1958- | 8/3 | 10.9 | 10.7 | 7.7, 14.0 |
| | 9/2 | 10.8 | 11.2 | 9.3, 13.0 |
| 3. Water transparency | 6/23 | 7.5 | 8.2 | 5.3, 10.5 |
| Secchi depth (m) | 7/13 | 7.3 | 8.2 | 5.0, 10.9 |
| 1962- | 8/3 | 7.4 | 9.3 | 6.3, 11.9 |
| | 9/2 | 7.3 | 8.7 | 5.8, 12.1 |
| 4. Water conductivity | 6/23 | 37.4 | 38.7 | 34.7, 52.1 |
| (micromhos/cm) | 7/13 | 38.0 | 37.4 | 33.5, 42.6 |
| 1968- | 8/3 | 38.2 | 37.1 | 32.5, 40.5 |
| | 9/2 | 38.8 | 38.3 | 34.8, 42.5 |
| 5. Average daily | June 1-15 | 394 | 409 | 305, 588 |
| solar radiation | June 16-30 | 396 | 410 | 265, 572 |
| (gm/cal/cm) | July 1-15 | 326 | 393 | 284, 543 |
| 1963- | July 16-31 | 309 | 354 | 194, 481 |
| | Aug. 1-15 | 266 | 301 | 203, 402 |
| | Aug. 16-31 | 164 | 255 | 170, 421 |
| | Sept. 1-15 | 213 | 210 | 114, 282 |
| 6. Lake level (cm) | June 1-15 | 127 | 141 | 84, 222 |
| of Lake Nerka | June 16-30 | 149 | 152 | 97, 218 |
| 1952- | July 1-15 | 147 | 133 | 75, 199 |
| | July 16-31 | 105 | 107 | 54, 172 |
| | Aug. 1-15 | 90 | 86 | 34, 173 |
| | Aug. 16-31 | 113 | 83 | 30, 184 |
| | Sept. 1-15 | 133 | 83 | 29, 161 |
| 7. Chlorophyll "a", | 6/23 | 23 | 30 | 10, 45 |
| 0-20m (mg/m2) | 7/3 | 37 | | |
| 1963- | 7/13 | 26 | 28 | 10, 43 |
| | 7/21 | 24 | | |
| | 8/3 | 10 | 23 | 6, 36 |
| | 8/12 | 28 | | |
| | 8/21 | 12 | | |
| | 9/2 | 31 | 24 | 12, 37 |

Table 11. Average counts of zooplankton from 6 stations on Lake Aleknagik in 1992 and the means and ranges in means from past years.

| | | 1992 | Past years, 1967-1991 | | |
|---|---|---|---|---|---|
| Category | Date | Mean | Mean | Lowest | Highest |
| Cyclopoid copepods | 6/23 | 105 | 106 | 51 | 188 |
| (1000s/m2) | 7/13 | 104 | 111 | 50 | 188 |
| | 8/02 | 59 | 111 | 43 | 170 |
| | 9/02 | 45 | 81 | 23 | 194 |
| Calanoid copepods | 6/23 | 25 | 24 | 3 | 61 |
| (1000s/m2) | 7/13 | 22 | 29 | 10 | 55 |
| | 8/02 | 12 | 36 | 7 | 96 |
| | 9/02 | 22 | 44 | 13 | 88 |
| Daphnia | 6/23 | 1 | 3 | 0 | 19 |
| (1000s/m2) | 7/13 | 3 | 7 | 0 | 31 |
| | 8/02 | 4 | 20 | 3 | 75 |
| | 9/02 | 14 | 40 | 5 | 95 |
| Bosmina | 6/23 | 7 | 9 | 3 | 35 |
| (1000s/m2) | 7/13 | 8 | 22 | 4 | 93 |
| | 8/02 | 19 | 62 | 19 | 148 |
| | 9/02 | 39 | 101 | 36 | 150 |
| Holopedium | 6/23 | 2 | 4 | 0 | 31 |
| (1000s/m2) | 7/13 | 6 | 9 | 1 | 30 |
| | 8/02 | 7 | 17 | 2 | 48 |
| | 9/02 | 2 | 5 | 0 | 17 |
| Total number | 6/23 | 140 | 144 | 74 | 285 |
| (1000s/m2) | 7/13 | 144 | 178 | 101 | 323 |
| | 8/02 | 100 | 246 | 157 | 405 |
| | 9/02 | 125 | 269 | 154 | 435 |
| Settled volume | 6/23 | 32 | 55 | 22 | 181 |
| (ml/m2) | 7/13 | 55 | 85 | 47 | 200 |
| | 8/02 | 80 | 130 | 69 | 238 |
| | 9/02 | 32 | 71 | 36 | 110 |

Table 12. 5-day averages of catches of emergent midges and water temperatures at 3 stations on Lake Aleknagik, 1992.

| 5-day period | Catch per day: 1992 W | H | B | Mean | 1969-91 Mean | Min | Max | Water temperature (C): 1992 W | H | B | Mean | 1969-91 Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/1-5 | 0 | 0 | 0 | 0 | | | | 2.6 | 2.6 | 4.1 | 3.1 | 2.3 | 0.0 | 9.8 |
| 6-10 | 2 | 0 | 3 | 1 | 13 | 0 | 70 | 4.9 | 5.1 | 7.4 | 5.8 | 5.0 | 0.0 | 10.4 |
| 11-15 | 2 | 18 | 1 | 7 | 13 | 1 | 53 | 5.3 | 6.5 | 9.2 | 7.0 | 6.4 | 1.0 | 9.2 |
| 16-20 | 3 | 16 | 1 | 7 | 18 | 1 | 168 | 7.0 | 6.4 | 9.3 | 7.6 | 8.0 | 3.9 | 12.7 |
| 21-25 | 0 | 1 | 1 | 1 | 7 | 0 | 42 | 7.3 | 9.7 | 10.1 | 9.0 | 8.5 | 4.8 | 12.8 |
| 26-30 | 0 | 2 | 1 | 1 | 5 | 0 | 12 | 6.5 | 9.0 | 10.1 | 8.6 | 9.9 | 6.0 | 13.9 |
| 7/1-5 | 0 | 2 | 1 | 1 | 5 | 1 | 15 | 7.9 | 10.7 | 12.1 | 10.2 | 11.1 | 7.7 | 15.5 |
| 6-10 | 1 | 2 | 2 | 2 | 9 | 2 | 24 | 8.8 | 8.8 | 11.2 | 9.6 | 11.9 | 9.7 | 15.8 |
| 11-15 | 4 | 2 | 15 | 7 | 14 | 1 | 34 | 10.3 | 12.4 | 12.8 | 11.8 | 12.2 | 9.2 | 15.9 |
| 16-20 | 4 | 3 | 60 | 22 | 14 | 2 | 36 | 10.5 | 14.0 | 14.4 | 13.0 | 12.0 | 8.5 | 17.0 |
| 21-25 | 12 | 9 | 200 | 73 | 19 | 2 | 50 | 12.0 | 12.2 | 14.2 | 12.8 | 12.6 | 7.9 | 17.2 |
| 26-30 | 32 | 8 | 94 | 45 | 30 | 8 | 58 | 14.0 | 13.9 | 12.3 | 13.4 | 13.2 | 8.9 | 15.7 |
| 31-4 | 39 | 8 | 10 | 19 | 30 | 4 | 77 | 11.9 | 13.2 | 13.9 | 13.0 | 13.5 | 10.2 | 17.5 |
| 8/5-9 | 35 | 2 | 6 | 14 | 22 | 3 | 80 | 13.0 | 14.6 | 14.3 | 14.0 | 13.5 | 10.5 | 17.1 |
| 10-14 | 21 | 2 | 3 | 9 | 16 | 2 | 54 | 11.3 | 13.4 | 14.1 | 12.9 | 13.3 | 9.5 | 18.8 |
| 15-19 | 13 | 1 | 5 | 6 | 15 | 2 | 70 | 10.1 | 12.5 | 12.6 | 11.7 | 13.2 | 11.0 | 15.7 |
| 20-24 | 6 | 0 | 4 | 3 | 7 | 1 | 28 | 7.8 | 10.5 | 10.8 | 9.7 | 13.7 | 12.0 | 15.4 |
| 25-29 | | | | | 5 | 1 | 11 | | | | | 13.1 | 11.3 | 14.7 |

Table 13. Average catches, lengths and growth rates for sockeye 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 | 247 | 54 | 35.9 | 48.8 | .19 | 200 | 155 |
| 85 | 102 | 31.0 | 56.3 | .36 | 1 | 311 | 109 | 34.3 | 40.9 | .09 | 2 | 0 |
| 86 | 32 | 32.2 | 58.4 | .37 | 10 | 184 | 24 | 31.4 | 45.0 | .19 | 11 | 0 |
| 87 | 69 | 29.7 | 57.5 | .40 | 3 | 330 | 27 | 31.7 | 44.9 | .19 | 67 | <1 |
| 88 | 31 | 31.2 | 58.8 | .40 | 2 | 335 | 42 | 32.4 | 48.5 | .23 | 8 | 1 |
| 89 | 45 | 31.4 | 55.4 | .34 | 18 | 276 | 26 | 32.6 | 47.0 | .21 | 17 | 1 |
| 90 | 100 | 32.7 | 57.7 | .36 | 20 | 478 | 129 | 31.2 | 48.1 | .24 | 27 | 1 |
| 91 | 63 | 30.1 | 52.9 | .33 | 14 | - | 108 | 31.3 | 42.2 | .16 | 41 | 1 |
| 92 | 242 | 30.0 | 46.1 | .24 | 52 | - | 200 | 27.9 | 39.4 | .17 | 222 | <1 |
| Means | 163 | 31.3 | 56.0 | .35 | 49 | 289 | 145 | 31.1 | 44.3 | .19 | 78 | 11 |

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 14. Average townet catches and mean lengths of sockeye fry, numbers 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 | 67 | 79 | 247 | 14 | 50 |
| 85 | 1 | 2 | 123 | 61 | 56 | 55 | 62 | 84 | 377 | 2 | 45 |
| 86 | 2 | 16 | 12 | 50 | 54 | 64 | 56 | 110 | 494 | 2 | 42 |
| 87 | 1 | 7 | 21 | 57 | 56 | 55 | 39 | 63 | 258 | 4 | 43 |
| 88 | <1 | 2 | 7 | 64 | 57 | 57 | 87 | 218 | 307 | 2 | 49 |
| 89 | 1 | 3 | 16 | 57 | 51 | 59 | 66 | 162 | 196 | 5 | 48 |
| 90 | 1 | 7 | 3 | 63 | 62 | 58 | 83 | 167 | 375 | 3 | 48 |
| 91 | 27 | 22 | 32 | 61 | 57 | 56 | - | - | - | 27 | 44 |
| 92 | 4 | 16 | 10 | 57 | 55 | 55 | - | - | - | 4 | 41 |
| Means | 12 | 13 | 38 | 60 | 57 | 58 | 111 | 111 | 247 | 17 | 45 |

Table 15. Occurrence and numbers of juvenile sockeye salmon 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: Fry | Smolt | Mean number per char Fry | Smolt | Sockeye escape. year-2 |
|---|---|---|---|---|---|---|---|---|---|
| 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 | 31 |
| 86 | 6/04 | 6/16-7/05 | 61 | 437 | 21 | 56 | 0.4 | 2.7 | 17 |
| 87 | 6/01 | 6/14-7/05 | 51 | 451 | 6 | 78 | 0.1 | 4.9 | 21 |
| 88 | 6/05 | 6/16-29 | 43 | 431 | 7 | 26 | 0.1 | 0.8 | 21 |
| 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 | 19 |
| 91 | 6/07 | 6/20-7/07 | 48 | 415 | 4 | 35 | 0.9 | 3.2 | 15 |
| 92 | 6/13 | 6/15-7/11 | 79 | 425 | 0 | 46 | 0.0 | 1.9 | |
| 72-91 means | 6/05 | | 117 | 427 | 18 | 40 | 1.3 | 2.4 | 32 |

Table 16. Ground survey counts of sockeye salmon spawners in the Wood River Lakes, 1992.

| Location | Date | Estimated off mouth | In creek Live | Dead | Natural | Bear kill | Total | 1950-1991 Mean | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|---|
| Aleknagik | | | | | | | | | | |
| Yako | 8/02 | 1500 | 2849 | 137 | 129 | 8 | 4486 | 1600 | 100 | 6900 |
| Hansen | 8/06 | 50 | 3518 | 2886 | 1948 | 938 | 6454 | 3700 | 200 | 15300 |
| Bear | 8/06 | 300 | 2490 | 726 | 482 | 244 | 3516 | 3800 | 1000 | 10200 |
| Happy | 8/07 | 500 | 3531 | 4354 | 4124 | 230 | 8385 | 4200 | 200 | 25700 |
| Ice* | 8/09 | 200 | 6557 | 3512 | 3124 | 388 | 10269 | 8000 | 1100 | 35500 |
| Eagle | 8/10 | 25 | 70 | 29 | 15 | 14 | 124 | 1400 | 100 | 7400 |
| Mission | 8/16 | 0 | 509 | 626 | 584 | 42 | 1135 | 600 | <100 | 2400 |
| Whitefish | 8/13 | 3 | 337 | 103 | 43 | 60 | 443 | 1000 | 100 | 4200 |
| Nerka | | | | | | | | | | |
| Fenno | 8/11 | 50 | 3379 | 3012 | 2794 | 218 | 6441 | 2900 | 400 | 15600 |
| Lynx | 8/27 | 150 | 1109 | 753 | 650 | 103 | 2012 | 2800 | 100 | 17000 |
| Stovall* | 8/25 | 0 | 56 | 10 | 10 | 0 | 66 | 5500 | 200 | 75000 |
| Pick | 8/13 | 5 | 5646 | 962 | 250 | 712 | 6613 | 11700 | 2500 | 85000 |
| Kema* | 8/26 | 0 | 69 | 280 | 140 | 140 | 349 | 4700 | 500 | 20000 |
| Hidden Lake | 8/26 | 0 | 116 | 221 | 44 | 177 | 337 | 2400 | 100 | 16000 |
| Beverley | | | | | | | | | | |
| Moose* | 8/12 | 500 | 1679 | 198 | 97 | 101 | 2377 | 3900 | 400 | 25600 |
| Kulik | | | | | | | | | | |
| Grant River* | 8/22 | 20 | 3595 | 503 | 350 | 153 | 4118 | 9600 | 500 | 40000 |

*Partial count; entire stream not surveyed

Table 16. Ground survey counts of sockeye salmon spawners in the Wood River Lakes, 1992.

| Location | Date | Estimated off mouth | In creek Live | Dead | Natural | Bear kill | Total | 1950-1991 Mean | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|---|
| Aleknagik | | | | | | | | | | |
| Yako | 8/02 | 1500 | 2849 | 137 | 129 | 8 | 4486 | 1600 | 100 | 6900 |
| Hansen | 8/06 | 50 | 3518 | 2886 | 1948 | 938 | 6454 | 3700 | 200 | 15300 |
| Bear | 8/06 | 300 | 2490 | 726 | 482 | 244 | 3516 | 3800 | 1000 | 10200 |
| Happy | 8/07 | 500 | 3531 | 4354 | 4124 | 230 | 8385 | 4200 | 200 | 25700 |
| Ice* | 8/09 | 200 | 6557 | 3512 | 3124 | 388 | 10269 | 8000 | 1100 | 35500 |
| Eagle | 8/10 | 25 | 70 | 29 | 15 | 14 | 124 | 1400 | 100 | 7400 |
| Mission | 8/16 | 0 | 509 | 626 | 584 | 42 | 1135 | 600 | <100 | 2400 |
| Whitefish | 8/13 | 3 | 337 | 103 | 43 | 60 | 443 | 1000 | 100 | 4200 |
| Nerka | | | | | | | | | | |
| Fenno | 8/11 | 50 | 3379 | 3012 | 2794 | 218 | 6441 | 2900 | 400 | 15600 |
| Lynx | 8/27 | 150 | 1109 | 753 | 650 | 103 | 2012 | 2800 | 100 | 17000 |
| Stovall* | 8/25 | 0 | 56 | 10 | 10 | 0 | 66 | 5500 | 200 | 75000 |
| Pick | 8/13 | 5 | 5646 | 962 | 250 | 712 | 6613 | 11700 | 2500 | 85000 |
| Kema* | 8/26 | 0 | 69 | 280 | 140 | 140 | 349 | 4700 | 500 | 20000 |
| Hidden Lake | 8/26 | 0 | 116 | 221 | 44 | 177 | 337 | 2400 | 100 | 16000 |
| Beverley | | | | | | | | | | |
| Moose* | 8/12 | 500 | 1679 | 198 | 97 | 101 | 2377 | 3900 | 400 | 25600 |
| Kulik | | | | | | | | | | |
| Grant River* | 8/22 | 20 | 3595 | 503 | 350 | 153 | 4118 | 9600 | 500 | 40000 |

*Partial count; entire stream not surveyed

Table 17. Age compositions of sockeye spawners in the Wood River Lakes in 1992.

| Location | Males 1.1 | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | No. of fish | Females 1.1 | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | No. of fish |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hansen | 0.0 | 16.1 | 1.6 | 82.3 | 0.0 | 0.0 | 255 | 0.0 | 10.4 | 0.5 | 89.1 | 0.0 | 0.0 | 201 |
| Happy | 0.0 | 22.8 | 3.0 | 76.2 | 0.0 | 0.0 | 101 | 0.0 | 35.1 | 0.0 | 64.9 | 0.0 | 0.0 | 97 |
| Bear | 0.0 | 37.3 | 0.0 | 59.8 | 2.9 | 0.0 | 102 | 0.0 | 41.2 | 0.0 | 58.8 | 0.0 | 0.0 | 102 |
| Ice | 0.0 | 44.7 | 1.1 | 54.2 | 0.0 | 0.0 | 94 | 0.0 | 42.7 | 1.0 | 55.3 | 0.0 | 1.0 | 103 |
| Agulowak | 0.0 | 71.7 | 0.0 | 25.3 | 2.0 | 1.0 | 99 | 0.0 | 51.7 | 0.0 | 46.6 | 1.7 | 0.0 | 60 |
| Wood | 2.2 | 63.3 | 0.0 | 34.5 | 0.0 | 0.0 | 90 | 0.0 | 78.5 | 0.0 | 21.5 | 0.0 | 0.0 | 107 |
| Fenno | 1.0 | 71.8 | 0.0 | 27.2 | 0.0 | 0.0 | 103 | 2.1 | 75.3 | 0.0 | 22.6 | 0.0 | 0.0 | 97 |
| Stovall | | | | | | | 2 | | | | | | | 5 |
| Lynx | 1.0 | 88.6 | 0.0 | 10.4 | 0.0 | 0.0 | 105 | 0.0 | 83.8 | 1.0 | 15.2 | 0.0 | 0.0 | 99 |
| Pick | 1.0 | 46.1 | 0.0 | 52.9 | 0.0 | 0.0 | 102 | 0.0 | 67.0 | 0.9 | 32.1 | 0.0 | 0.0 | 109 |
| LT River | 0.0 | 86.0 | 0.0 | 14.0 | 0.0 | 0.0 | 57 | 0.0 | 73.0 | 0.9 | 26.1 | 0.0 | 0.0 | 111 |
| N4-N6 beach | 0.0 | 66.7 | 3.3 | 30.0 | 0.0 | 0.0 | 30 | 0.0 | 58.5 | 1.9 | 39.6 | 0.0 | 0.0 | 53 |
| Kema | 0.0 | 73.1 | 0.0 | 26.9 | 0.0 | 0.0 | 93 | 0.0 | 74.0 | 1.9 | 24.1 | 0.0 | 0.0 | 104 |
| Hidden Lake | 0.0 | 73.3 | 0.0 | 26.7 | 0.0 | 0.0 | 15 | 0.0 | 79.0 | 0.0 | 21.0 | 0.0 | 0.0 | 62 |
| Anvil Bay beach | 0.0 | 51.6 | 1.1 | 42.3 | 0.0 | 0.0 | 95 | 1.1 | 42.5 | 3.2 | 53.2 | 0.0 | 0.0 | 94 |
| Agulukpak | 0.0 | 78.3 | 0.0 | 19.8 | 0.0 | 1.9 | 106 | 0.0 | 86.0 | 0.0 | 14.0 | 0.0 | 0.0 | 57 |
| LT beaches | 0.0 | 54.8 | 4.8 | 40.4 | 0.0 | 0.0 | 42 | 0.0 | 60.0 | 3.7 | 33.8 | 2.5 | 0.0 | 80 |
| Moose | 2.4 | 69.0 | 0.0 | 28.6 | 0.0 | 0.0 | 84 | 0.0 | 77.4 | 0.0 | 22.6 | 0.0 | 0.0 | 93 |
| Grant River | 0.0 | 77.8 | 0.0 | 21.1 | 0.0 | 1.1 | 90 | 0.0 | 86.4 | 0.0 | 13.6 | 0.0 | 0.0 | 103 |
| Unweighted mean | 0.4 | 60.7 | 0.8 | 37.4 | 0.3 | 0.2 | 1665 | 0.2 | 62.4 | 0.8 | 36.3 | 0.2 | 0.1 | 1737 |
| Wood River ADF&G tower | 0.4 | 65.7 | 1.8 | 29.9 | 1.5 | 0.3 | 1216 | 0.2 | 74.4 | 1.8 | 21.1 | 1.4 | 0.5 | 1788 |

Other = males: age 0.2 (0.1%), age 0.3 (0.1%) and age 0.4 (0.2%); females: age 0.3(0.2%), age 0.4 (0.4%)

Table 18. Daily counts of sockeye salmon spawners in Hansen Creek in 1992.

| Date | Estimate off mouth | In creek | | | In ponds | | | Cumu-lative dead | Live + cum. dead |
|---|---|---|---|---|---|---|---|---|---|
| | | Live | Natural dead | Bear dead | Live | Natural dead | Bear dead | | |
| 7/18 | | 60 | 4 | 44 | 0 | | | 48 | 108 |
| 19 | | | | | | | | | |
| 20 | | 55 | 5 | 153 | 80 | 0 | 0 | 206 | 341 |
| 21 | | 31 | 0 | 22 | 85 | 0 | 0 | 228 | 344 |
| 22 | | 512 | 15 | 83 | 115 | 0 | 0 | 326 | 953 |
| 23 | | 1064 | 19 | 80 | 155 | 0 | 0 | 425 | 1644 |
| 24 | | 1592 | 6 | 23 | 195 | 0 | 0 | 454 | 2241 |
| 25 | | 1737 | 17 | 24 | 285 | 0 | 0 | 495 | 2517 |
| 26 | | 2846 | 15 | 56 | 400 | 0 | 0 | 566 | 3812 |
| 27 | | 2924 | 25 | 26 | 560 | 0 | 0 | 617 | 4101 |
| 28 | | 2848 | 25 | 67 | 675 | 0 | 0 | 709 | 4232 |
| 29 | | 2829 | 35 | 30 | 750 | 0 | 0 | 774 | 4353 |
| 30 | | 2510 | 31 | 28 | 750 | 0 | 0 | 833 | 4093 |
| 31 | | 3717 | 96 | 60 | 850 | 0 | 0 | 989 | 5556 |
| 8/1 | | 3994 | 65 | 31 | 600 | 0 | 0 | 1085 | 5679 |
| 2 | | 3461 | 192 | 40 | 975 | 7 | 0 | 1324 | 5760 |
| 3 | 500 | 3695 | 221 | 30 | nc | 3 | 0 | 1578 | (5944) |
| 4 | 200 | 3789 | 334 | 34 | nc | 9 | 2 | 1957 | (6417) |
| 5 | 100 | 3428 | 380 | 54 | nc | 7 | 0 | 2398 | (6497) |
| 6 | 50 | 3150 | 429 | 49 | 368 | 10 | 0 | 2886 | 6404 |
| 7 | 20 | 2974 | 446 | 32 | 340 | 6 | 2 | 3372 | 6686 |
| 8 | 15 | 2499 | 406 | 87 | nc | 23 | 1 | 3889 | (6873) |
| 9 | 40 | 2264 | 387 | 13 | 275 | 13 | 0 | 4302 | 6841 |
| 10 | | 2044 | 439 | 15 | 150 | 18 | 0 | 4774 | 6968 |
| 11 | | 1546 | 326 | 13 | 149 | 0 | 1 | 5114 | 6809 |
| 12 | | | | | | | | | |
| 13 | | 1020 | 600 | 59 | 97 | 35 | 0 | 5808 | 6925 |
| 14 | | 734 | 388 | 15 | 80 | 20 | 0 | 6231 | 7045 |
| 15 | | 305 | 349 | 37 | 35 | 8 | 0 | 6625 | 6965 |
| 16 | | 225 | 183 | 32 | 56 | 20 | 3 | 6863 | 7144 |
| 17 | | 112 | 106 | 21 | 35 | 23 | 0 | 7013 | 7160 |
| 18 | | | | | | | | | |
| 19 | | 32 | 107 | 11 | 10 | 8 | 0 | 7139 | 7181 |
| 20 | | | | | | | | | |
| 21 | | 1 | 121 | 23 | 1 | 7 | 0 | 7290 | 7292 |
| Totals | | | 5772 | 1292 | | 217 | 9 | | |

Table 19. Summary of Hansen Creek spawning surveys, 1990-1992.

| 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 |