FRI-UW-9201
February 1922

FISHERIES RESEARCH INSTITUTE
SCHOOL OF FISHERIES WH–10
UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

ALASKA SALMON RESEARCH

D. ROGERS, PRINCIPAL INVESTIGATOR
T. QUINN, ASSOCIATE PROFESSOR;
B. ROGERS AND G. RUGGERONE, FISHERY BIOLOGISTS; AND
B. BEREJIKIAN, L. PATTERSON AND K. WORK, GRADUATE STUDENTS

ANNUAL REPORT—1991

to

PACIFIC SEAFOOD PROCESSORS ASSOCIATION

Approved

Submitted 5 Feb. 1992 RC Francis

Director

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KEY WORDS

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

ALASKA SALMON RESEARCH

INTRODUCTION

Fisheries Research Institute 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, 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. Also a project is under way, in conjunction with the School of Oceanography and School of Marine Affairs, to investigate how changes in the dynamics of large-scale North Pacific atmospheric and physical oceanographic features relate to time and space dynamics of the biological production of salmon. In recent years, we have also worked at Kodiak, the Alaska Peninsula 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 the U.S.S.R.

This report will focus on our 1991 Bristol Bay research with emphasis on salmon forecasting and research relevant to escapement policies to maximize production. The Southeast pink salmon research will be reported in a separate report from the University of Alaska and our Chignik salmon research is reported to the National Marine Fisheries Service.

FORECASTING

PRE-SEASON FORECASTS

Forecasts of the 1992 Bristol Bay sockeye runs and catches were provided to participating processors at our October 1991 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 have often been used. Both 1991 forecasts were an average run and catch; whereas the actual run was above average, the catch was very close to the pre-season forecast. Since 1985, the actual catch has been between the two forecasted catches only once. In the other 6 years, the catch was either higher (5) or lower (1) than both forecasts.

Prior to the 1990 run, the FRI forecasted catches had been within 13 to 33% (average = 25%) of the actual catches; however, the forecasted catch for 1990 was off by 74% (ADF&G by 125%).

The closeness of the 1991 forecasted catch (5%) was welcomed because an error of over 50% is probably unacceptable for processor planning.

PORT MOLLER FORECAST

The Port Moller in-season test fishery was conducted by ADF&G 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 during 1987–1989 was outstanding—within 4% of the actual runs. We were not so close in 1990 (24%); however, the 1990 forecast was probably more valuable to the industry because it was for a large run and catch when a small to average run was expected. In 1991, the test-fish catches projected a run equal to or a little larger than the pre-season forecast. The actual run turned out to be 14% larger than forecast.

The test fishery at Port Moller employs a 200-fathom gillnet that is 60 meshes deep and has 5-inch 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 (Fig. 1) and one station is usually repeated each day for a total of five drifts. Catch, mean length and water temperature data are sent by radio daily to Port Moller and then faxed into Bristol Bay. The vessel comes into port every other day to deliver fish and salmon scales collected by the two biologists on board. In 1991, we had a third biologist stationed at Port Moller to age the sockeye salmon scales and report the age composition of the catches about every other day.

The statistics from Port Moller in 1991 were somewhat of a challenge to interpret. 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. Usually high percentages of 3-ocean are associated with small runs, but small fish (for a given age) are usually associated with large runs. A fishermen's strike over price, which resulted in reduced fishing during June, made it difficult to forecast the District runs until early July. ADF&G provided preliminary daily catches and escapements for 1991, 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. 2 and 3). The timing and magnitude of the 1991 run was fairly well predicted by the Port Moller catches; however most Bristol bay catches were taken later than average as a result of the strike (Figs. 4–6).

ADF&G provided preliminary length and weight statistics for 1991, and statistics from prior years were available (e.g., Yuen et al. 1981 and Stratton 1991) so that we could calculate mean lengths in the runs (Tables 2) . Sockeye in the 1991 run were among the smallest recorded and similar to the small fish in the 1990 run. We are presently unable to predict the effect of variation in fish size on the selectivity of the Port Moller gill net; however, the small size of the sockeye in 1991 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 1991 also provided an early indication to ADF&G management that a large run was on the way; however, this information was not as useful to management in 1991 as it might have been because of the strike. Unfortunately there were large over-escapements in the Naknek, Egegik, Ugashik and Igushik rivers that were caused partly by the strike and partly by management (Table 3). With the exception of Egegik, these large escapements will probably result in reduced future production because this has usually happened when escapement densities (number per square kilometer of lake area) exceed 3,000 per km^2 (Table 4). In all, the excess escapements (over the point goals) in 1990 totaled more than the False Pass catches of Bristol Bay sockeye during the 1989–1991 seasons combined (Shaul et al. 1991).

LAKE RESEARCH

During the summer of 1991, 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 1991, we also conducted special studies of bear predation on spawning sockeye salmon, stock specific traits of sockeye spawning populations, predation by rainbow trout on juvenile sockeye and predation by juvenile sockeye on the freshwater zooplankton community.

KVICHAK SYSTEM

Our 1991 field season in the Kvichak system (Lakes Iliamna and Clark) consisted of estimating the sockeye escapement into the Newhalen River in late-June and July, townetting for juvenile sockeye and threespine stickleback 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 conducted a special study of possible rainbow-sockeye interaction (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 1985–1991 (no Newhalen counts for 1987). 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 1991, we estimated that 1.9 million of the Kvichak escapement of 4.2 million (about 46%) ended up in the Newhalen/Lake Clark system (Table 6). This was a similar percentage to that which occurred in 1988 with a similar Kvichak escapement. The aerial surveys conducted by

ADF&G in 1991 did not include an estimate for the Newhalen River, which is needed to estimate the Lake Clark escapement. In addition, no aerial estimate of the spawners in the Tazimina River (major spawning ground in Lake Clark) was made in 1991.

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 1991, six spawning grounds were sampled and the age compositions from the samples provided an unusual pattern when compared to the age composition in the lake system escapement. In 1990, the sockeye spawning in the creeks and rivers had an age structure different from those spawning on the beaches and in the lake system escapement; however, in 1991 there was considerable variation in age composition among spawning grounds irrespective of the type of spawning ground (Table 7). None of the spawning grounds in 1991 had an age composition close to the composite age composition for the lake system, which is an unusual situation for the Kvichak.

In 1990 we conducted studies to determine the life duration of male and female sockeye on island beach spawning areas, and in 1991 we made additional observations to estimate the turnover of salmon (difference between peak count and total population) in an effort to obtain accurate population estimates from single-day aerial estimates. We established transects on Woody, Fuel Dump and Porcupine islands. These transects, at four depths, allowed us to estimate the total number of salmon present each day. By recording the reproductive state of the fish, we can determine the turnover rate, and by combining these data with information from the 1990 tagging study, we should be able to calculate a correction factor for use in expanding daily counts to a seasonal total. This is especially important for island spawning populations, whose numbers are difficult to count from the air.

In August 1990 we deployed a continuous water temperature monitor at Woody Island at a depth of ~3 m (10 ft). We recovered this monitor, retrieved the data and redeployed it in August 1991. This provided us with the first year-round record 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 important beach spawning stocks. We also deployed a monitor near Fuel Dump Island in 1991 to measure water temperature and lake level. This will provide a comparison with the Woody Island temperatures and the first year-round record of changes in lake level. We believe that temperature and lake level are critical factors in the recruitment of fry from beach spawning areas and we will use these data to design controlled experiments.

One of the basic tools of fisheries management is genetic stock identification—the use of natural variations in protein patterns among stocks to distinguish one from another in mixed-stock situations. Such information has not been published for Iliamna Lake; therefore we collected samples from 50 sockeye from Gibralter Creek, Copper River, Knutson Bay, Chinkelyes Creek, and Woody and Fuel Dump islands. Analyses of these initial samples will indicate the magnitude of genetic variation within the lake and help to plan further sampling. If successful, this technique could enable us to determine the origin of adults and juveniles as they migrate in the Kvichak River. We plan to include Newhalen River–Lake Clark populations in 1992.

Sockeye Fry Abundance and Size

We have sampled the sockeye fry (age 0) in the Kvichak system each year since 1962 (1961 brood year) by townetting at night. However, only the upper end of Iliamna Lake, where most of the fry are concentrated, has been sampled consistently. We have usually not sampled 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 8).

The sockeye fry are usually smaller in Lake Clark than in Lake Iliamna (as was the case in 1990) 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. We did not tow in Lake Clark in 1991 because most of the spawning in 1990 was in Lake Iliamna (over 6 million of the 7 million total Kvichak escapement).

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. Fry from the 1984 brood year averaged only 46 mm in 1985, and we predicted that 85% (19 million) of the total return would return in 1989. The actual return in 1989 was 18 million. The majority of the production from the 1985 brood year (mean length of 54 mm) should have returned in 1990 and that was also the case as 13 million returned in 1990 out of a total brood year return of 17 million (Table 9). The small escapement in 1986 did not produce much, and the 1987 brood with fry averaging 63 mm should have produced most of the return in 1991 (4 years later, only 4 million). The 1992 and 1993 runs are likely to be smaller, with the next large runs to the Kvichak coming in 1994 (from the 1989 brood year) and 1995 (from the 1990 brood year).

Rainbow Trout Predation

Arctic char 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 the spring of 1991, we began a study to investigate whether predation by rainbow trout, Arctic char and lake trout accounts for a significant portion of juvenile sockeye mortality in Iliamna Lake. 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 smolt.

We collected potential predators during the smolt migration from Iliamna Lake within a 1-mile radius of the outlet to the Kvichak River. Preliminary analysis suggests that less than 1% of all smolts migrating out of Iliamna Lake was consumed by Arctic char and rainbow trout at this location. Although less than 25% of rainbows examined contained sockeye smolt, migrating smolt, when present, were the primary component in the rainbow diet (73% by weight). During late summer, Igiugig rainbow trout ate mainly chum salmon eggs in both the outlet area of Lake Iliamna and in the Kvichak River. In even-numbered years, when pink salmon spawn in abundance in the Kvichak River, the total number of eggs available to rainbows would likely be greater.

The presence of pink salmon and annual sockeye smolt abundance were both significantly correlated with the annual growth of rainbow trout.

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 1991 was warmer than average in Bristol Bay and ice breakup was 5 days earlier than average in Lake Aleknagik (Table 10). Although ice breakup was early, water temperatures were cooler than average until September. This was because solar radiation (sunlight) was below average during most of the summer. Lake levels were well above normal in June and July but below normal during August and September when spawning took place. There was more suspended material in the lake than usual, as indicated by high conductivity measurements and low water transparency in 1991. Standing crop of phytoplankton (chlorophyll) was about average during the summer, whereas zooplankton abundance was a little below average.

Fry Abundance and Growth

The sockeye fry in Lake Aleknagik in 1991 were a little shorter than average in June and their growth during July and August was also a little below average (Table 11). Their abundance as measured by beach seine and townet sampling was also below average, but we do not have an estimate of the number of parent spawners because an aerial survey was not done in 1990. The small size on September 1 suggests that abundance was high because neither water temperatures nor abundance of zooplankton were especially low in 1991. The mean lengths of sockeye fry in Lake Nerka suggest that growth was about average in 1991 (Table 12). Of particular note was that sockeye fry were relatively abundant in the south arm of Lake Nerka for the first time in many years, suggesting that sockeye spawning in 1990 was evenly distributed around the lake.

Juvenile sockeye salmon in the Wood River Lakes system exhibit density-dependent growth, and selective utilization of the food resources by sockeye fry may intensify density-dependent competition. Selective predation on zooplankton has been noted in other species and can take the form of species selection or size selection. The selective consumption of species and/or sizes of zooplankton may in turn shape the size and species composition in the zooplankton community. Therefore, an examination of the diet (stomach contents) of sockeye fry and threespine stickleback (their major competitor) was conducted in 1991. The stomach contents of fish collected during the annual August/September townet sampling in Lake Aleknagik were analyzed and compared to samples of potential food items from the lake (plankton hauls). The species composition of zooplankton in the fish stomachs was significantly different than the composition in the lake. The fish contained higher percentages of the smaller-sized zooplankters (*Cyclops* and *Bosmina*) than was present in the lake (Fig. 7)

An analysis of the long-term data set for Lake Aleknagik is under way to determine the relative effects of physical and biological factors in the lake on the growth of sockeye fry. In addition, we are examining year-to-year variation in zooplankton population composition with annual variation in sockeye fry and 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 smolt. 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, and the char caught in 1991 were generally small, as has been the case since 1988 (Table 13). There are about 5,000 char in and around the river mouth, so that at just one 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.

Bear Predation

We completed the second year of our bear/spawning sockeye interaction study in Hansen Creek, a small tributary of Aleknagik Lake where predation by bears is high relative to larger creeks. During 21 July to 1 September, an exceptionally large number of sockeye were observed in Hansen Creek. Daily count and removal of sockeye killed by bears indicated that 2,569 (16.4%) of 15,631 spawners (excluding fish in ponds) were killed by bears in 1991 (Table 14). Up to 213 sockeye were killed per night. 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). Numbers of sockeye killed by bears in 1991 was considerably greater than that in 1990 (1,334 sockeye), indicating that the bear population responded to substantially greater sockeye abundance in 1991 by killing more fish. However, the percentage of sockeye killed by bears in 1991 (16.4%) was slightly less than that in 1990 (20%), when approximately 6,600 sockeye were observed in the creek.

Percentage of prespawned female sockeye killed by bears was greater than the percentage of prespawned females in the creek during 12 of 20 days of observation. Bears selectively killed larger male and female sockeye than available among 1,278 fish tagged and recovered in the creek (two factor ANOVA, $df = 1274$, $F = 16.4$, $p = 0.001$). Bears selectively killed males over females, as indicated by the greater percentage of tagged males killed (66%) relative to those available (59%).

Longevity of Dead Sockeye

Stream surveys have been conducted on about 16 streams in the Wood River Lakes over the past 45 years. The objectives of these surveys are to count live and dead spawners and collect otoliths to determine age composition. The data are used to estimate distribution of spawners in the lake system for the purpose of improving both escapement goals and our pre-season forecast of adult run size. However, these surveys are conducted only once per year. We do not know the numbers of sockeye that might have died early and decomposed before our annual survey, which typically occurs near peak spawning.

To address this question, we tagged 60 recently dead sockeye (within 24 hrs of death) in Hansen Creek and placed the fish in one of three habitat types: (1) deep water (~20 cm), (2) shallow water that exposed 50% of the fish to air, and (3) on the bank. We then examined the tagged fish during days that we conducted our survey of sockeye killed by bears. When a tagged fish became indistinguishable from other sockeye of similar decomposition, then the days to reach this stage was recorded. One day was added to the decomposition period to account for the time between death and tagging.

Of the 60 tagged fish, 37 were observed throughout decomposition. Location of the fish significantly influenced time to reach the identifiable stage (ANOVA, df = 34, F = 16.2, p = 0.001). Fish found on the bank (11.1 days) decomposed faster than those completely (21.4 days) or partially (20.4 days) covered by water (Newman-Keuls multiple range test, $P < 0.05$). Rapid decomposition on the bank was attributed to maggots, which avoid fish parts submerged in water.

Twenty-three dead fish were attacked by gulls and bears before the fish reached complete decomposition. When these data were included in the analysis (i.e., based on the date they were no longer distinguishable from other sockeye), then time to become unidentifiable was reduced. Fish recovered on the bank decomposed after 10.3 days compared to 14.9 days and 15.6 days for fish covered partially and completely by water, respectively. These estimates of time to decomposition may be biased high because some fish might have been in good condition but moved to another area without a tag. Fish recovered on the bank decomposed faster than those in water (Newman-Keuls multiple range test, $P < 0.05$).

This study indicates that sockeye dragged to the creek bank can be positively identified for 10 days, on average, after death, whereas those remaining in water can be identified for at least 15 days after death. Stream surveys by FRI personnel typically occur 7–10 days after fish begin entering creeks. Thus, most fish entering the creek prior to the survey should be available for counting.

Spawning Ground Surveys

Sockeye salmon spawning surveys are conducted annually in the Wood River lake system. 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).

We have not yet compiled the aerial survey estimates from ADF&G for 1991; however, the age compositions on the spawning grounds are given in Table 15. Although the escapement to the lake system contained about equal numbers of ages 1.2 and 1.3, on the individual spawning grounds one age or the other was usually predominant—age 1.2 in the creeks and age 1.3 in the larger rivers. This is typical of the age compositions in past years (Rogers 1987). Beach spawners in the past have contained a majority of age 1.2, but in 1991 there were about equal proportions of the two ages on the three beach areas that were sampled. During the past decade there appears to be a shift to more 3-ocean fish in the beach spawners.

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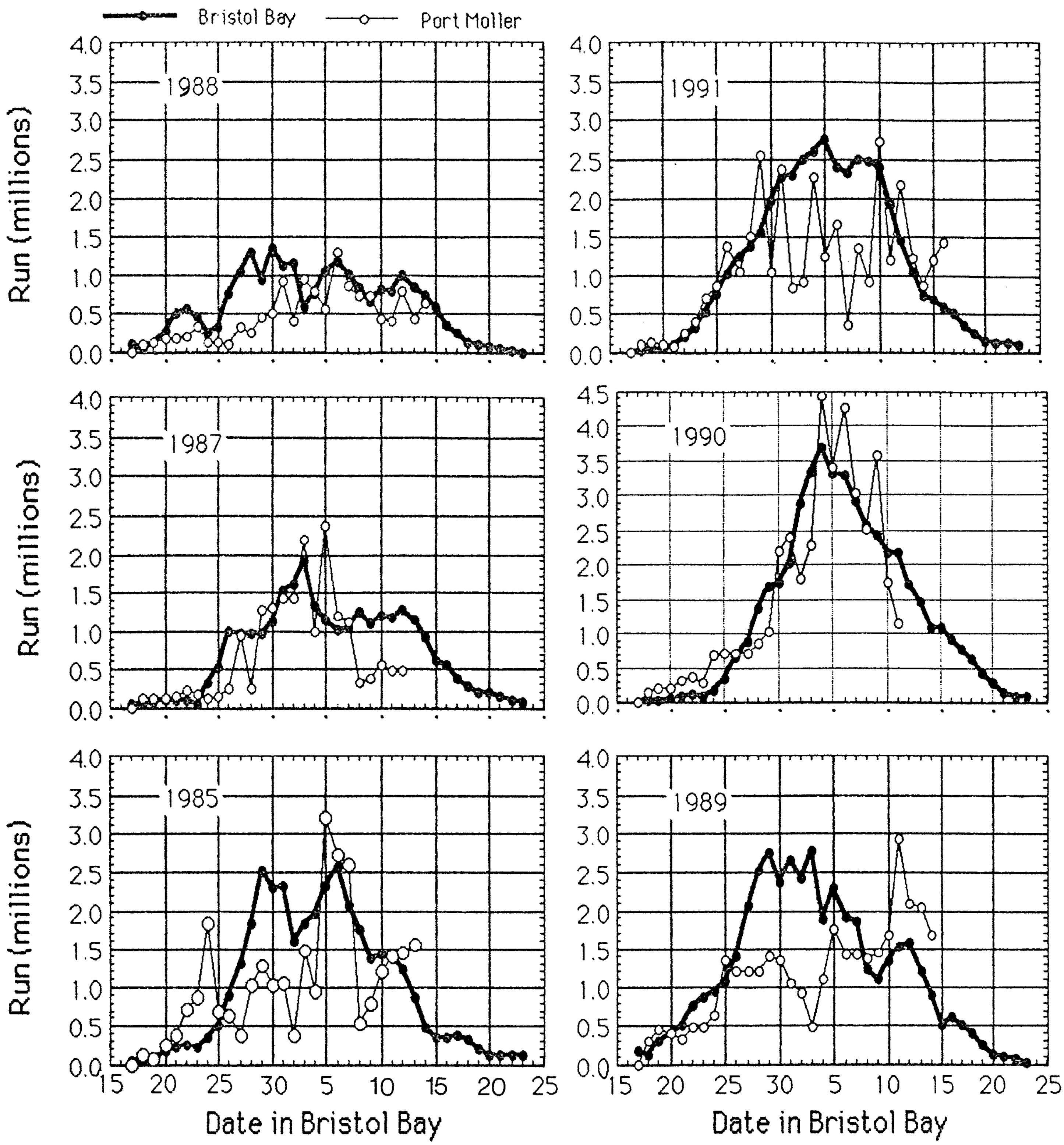

Figure 1. Daily Bristol Bay sockeye runs and the daily Port Moller index catches lagged 7 days and scaled to 1 index = 15,000 in the run.

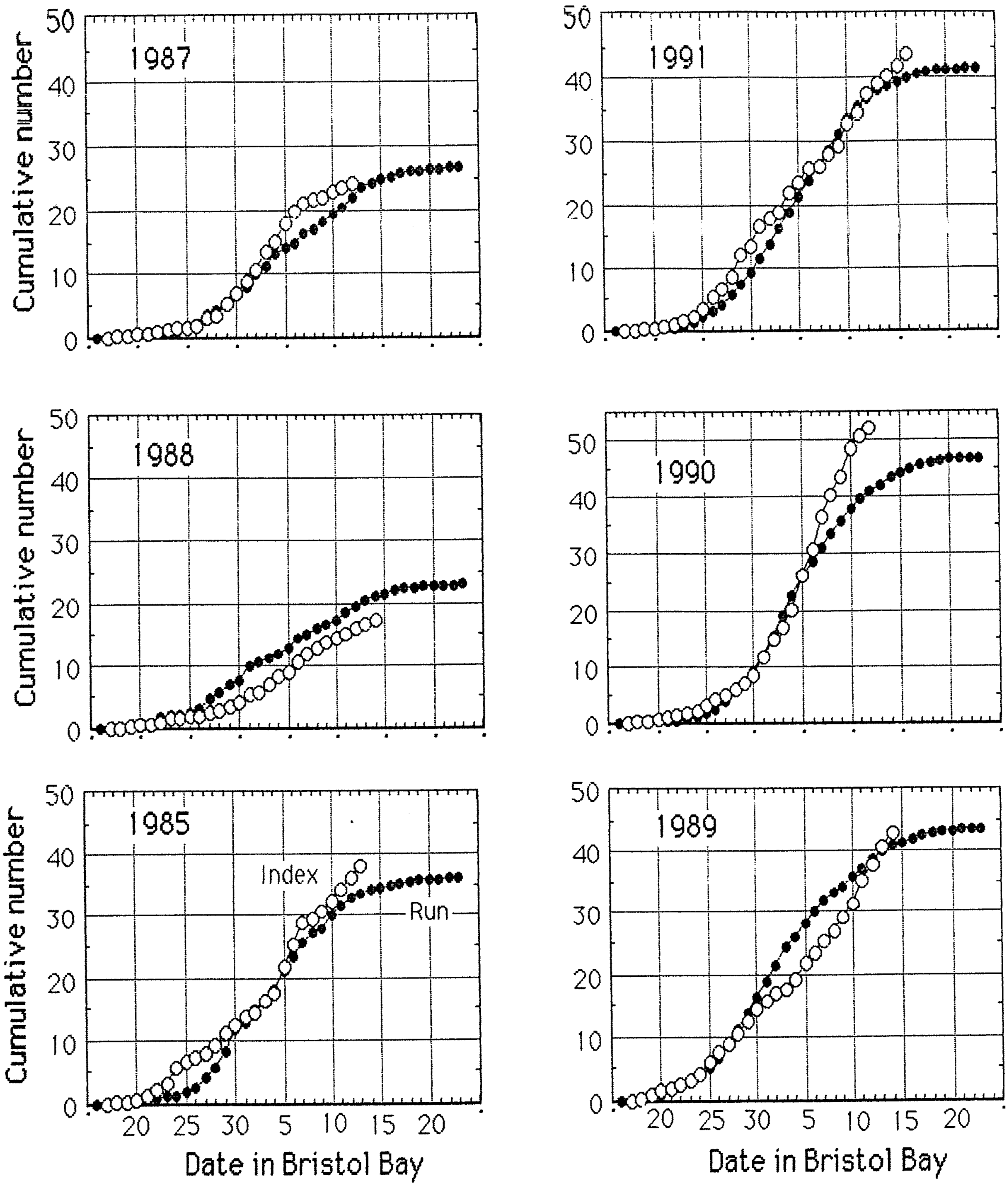

Figure 2. Cumulative daily Bristol Bay sockeye runs and the Port Moller index catches lagged 7 days and scaled to 1 index = 20,000 in the run.

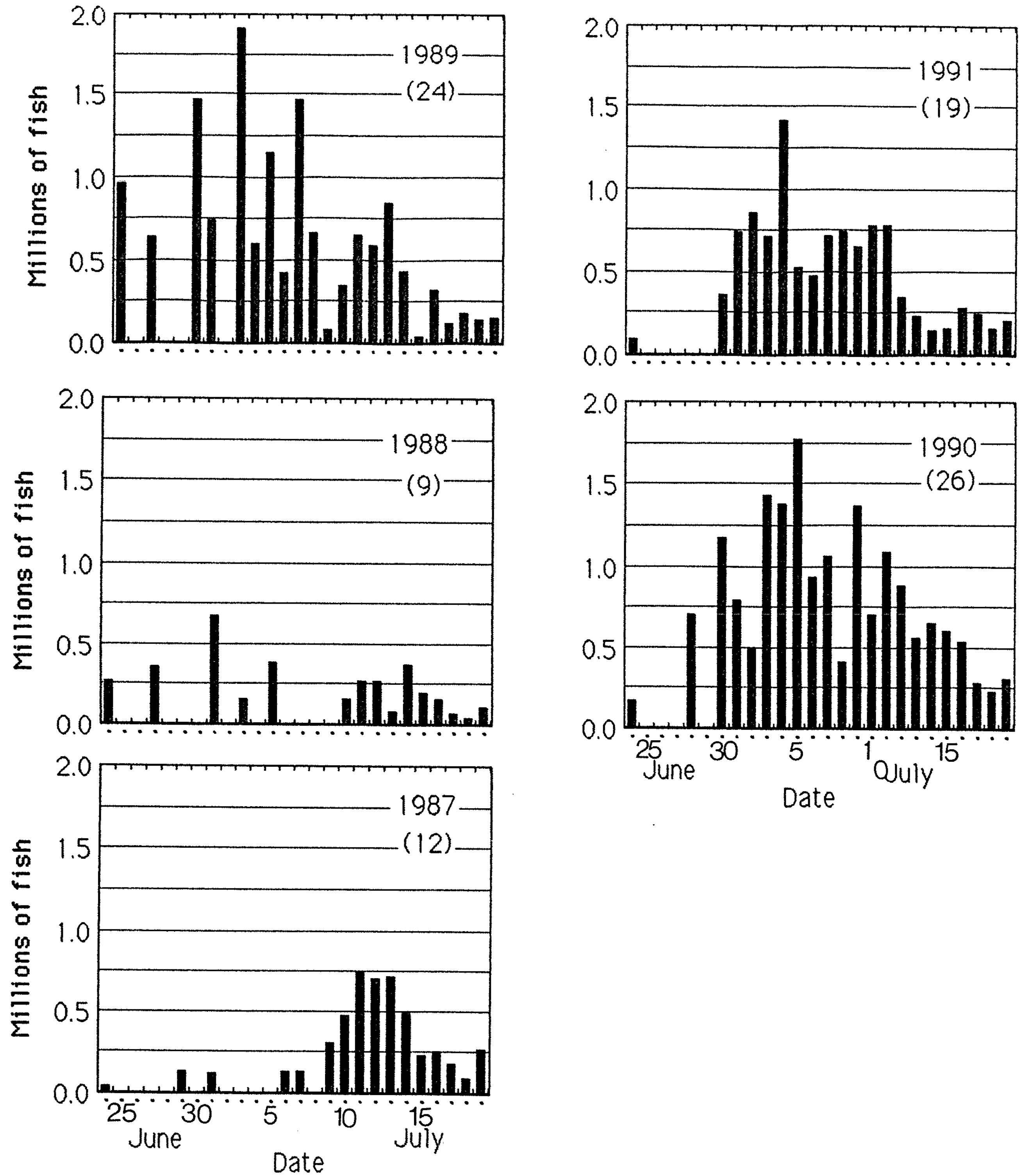

Figure 3. Daily catches of sockeye salmon in the Naknek/Kvichak District, 1987-91.

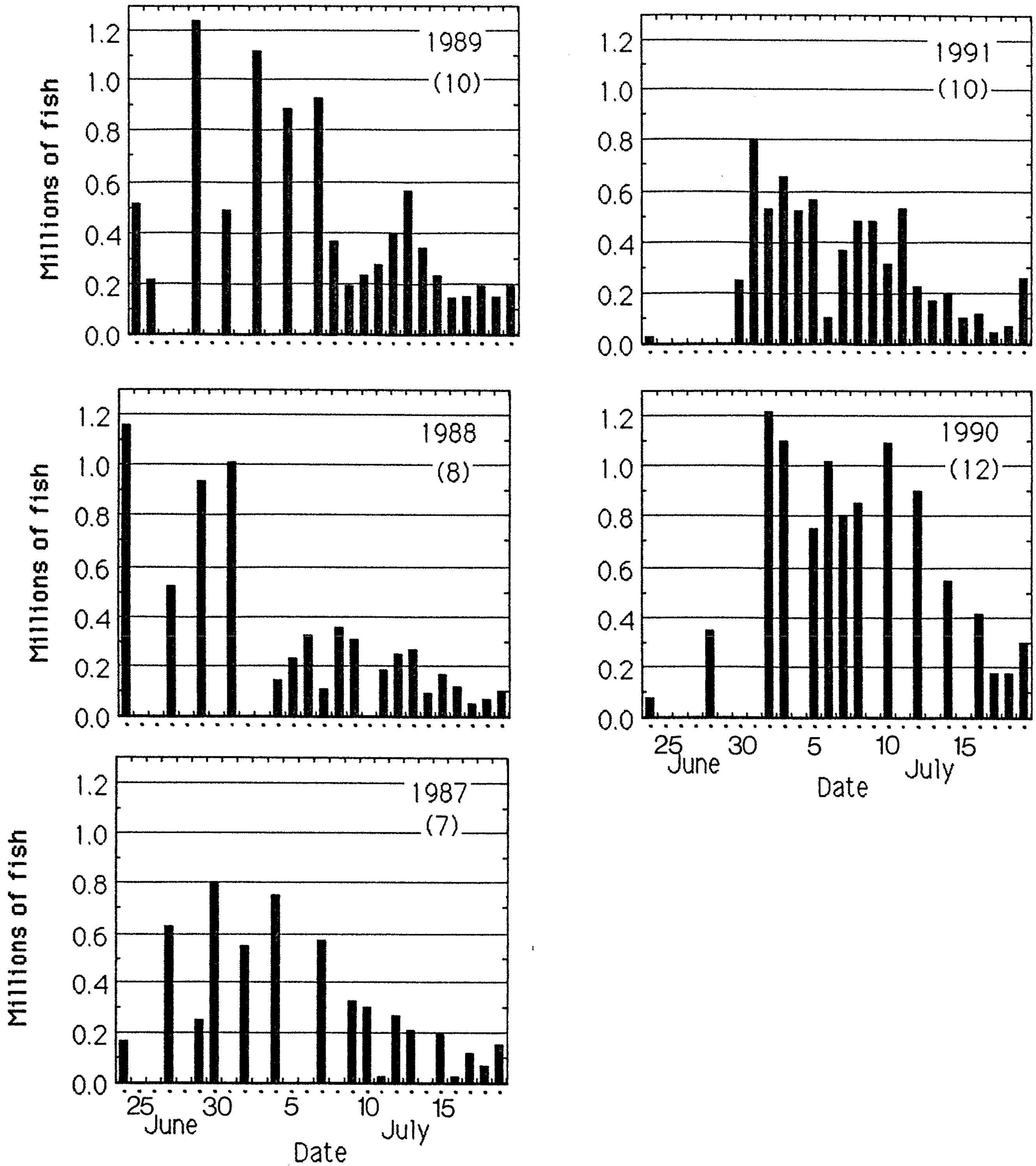

Figure 4. Daily catches of sockeye salmon in the Egegik District, 1987-91.

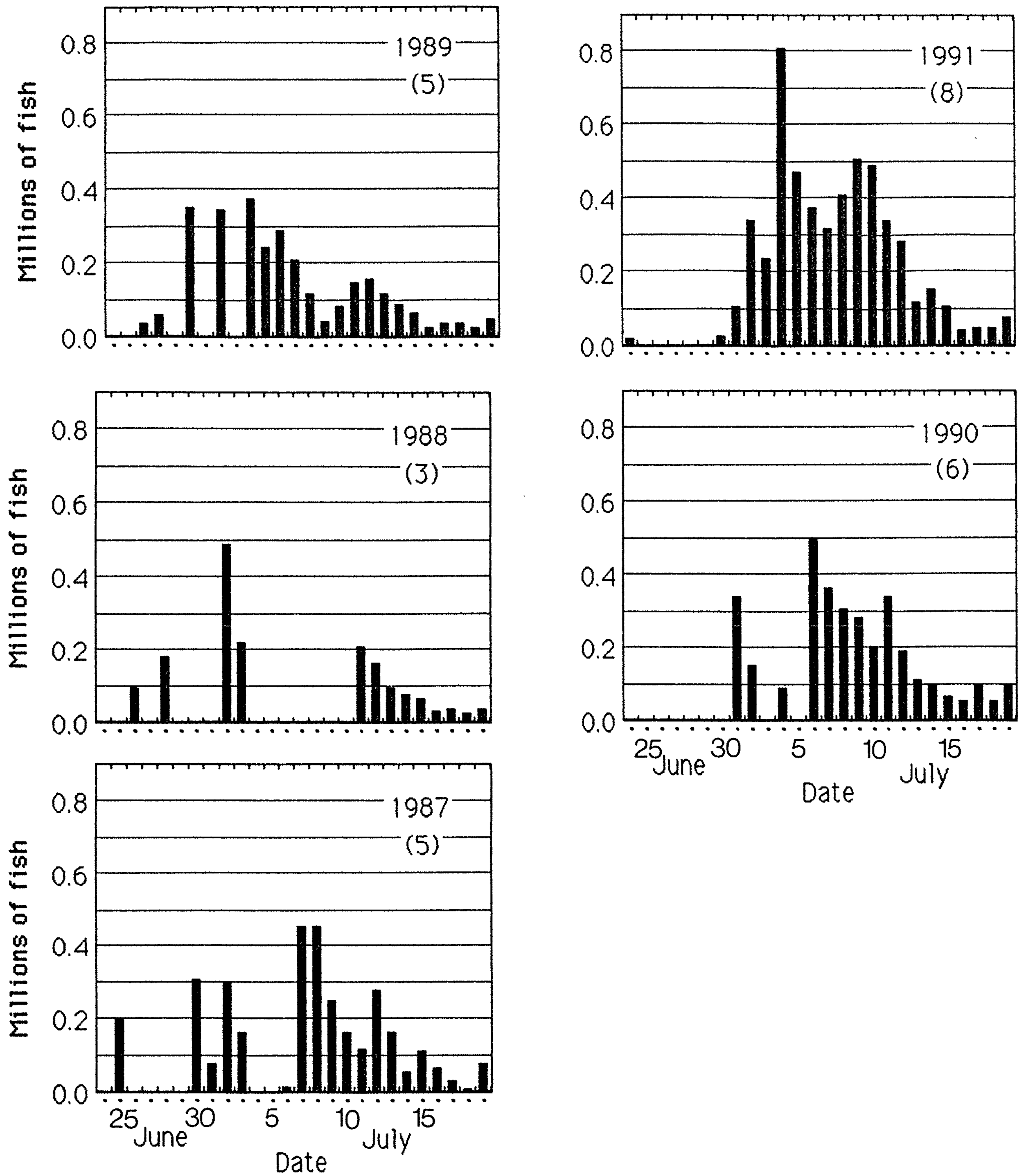

Figure 5. Daily catches of sockeye salmon in the Nushagak District, 1987-91.

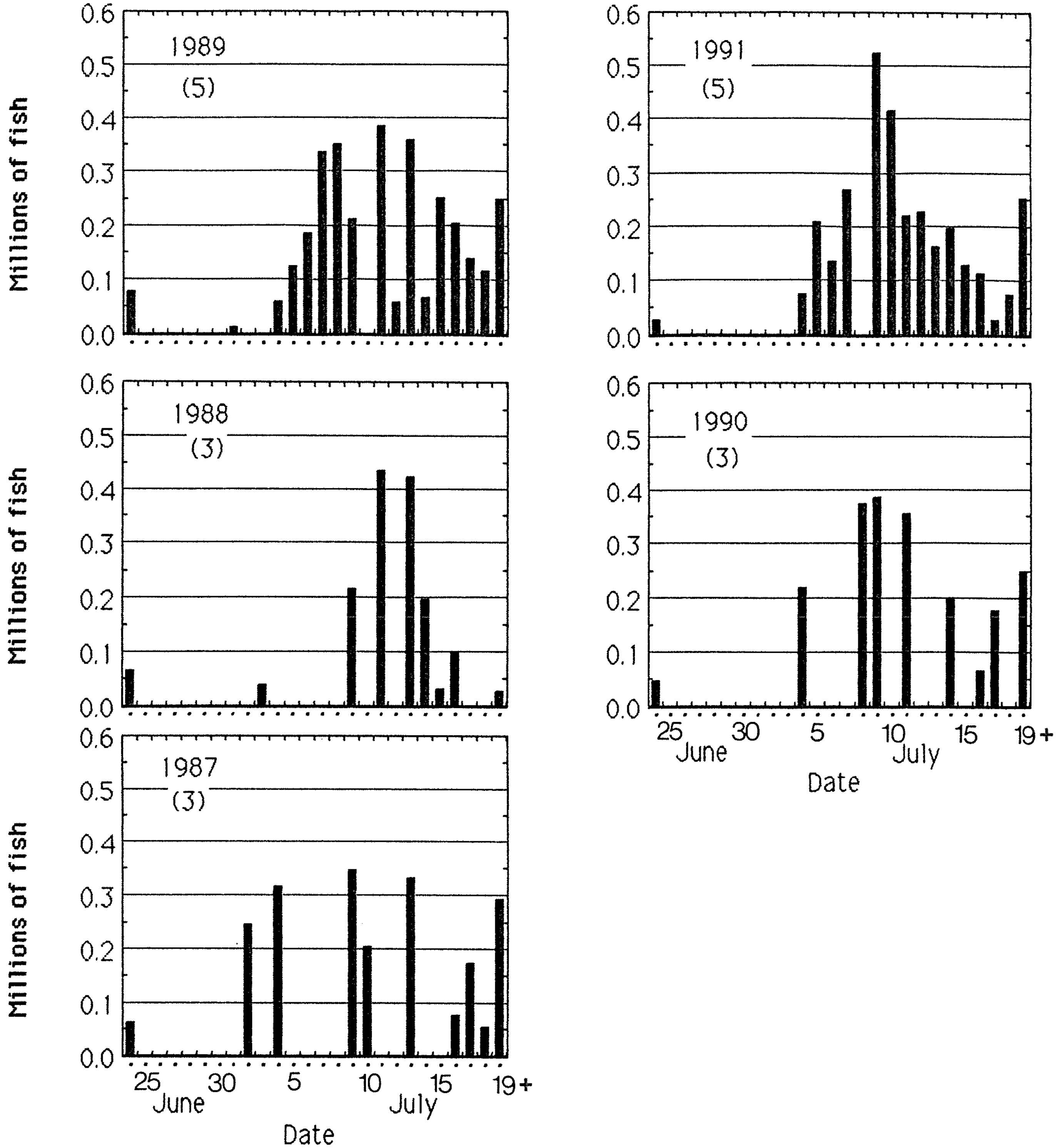

Figure 6. Daily catches of sockeye salmon in the Ugashik District, 1987-91.

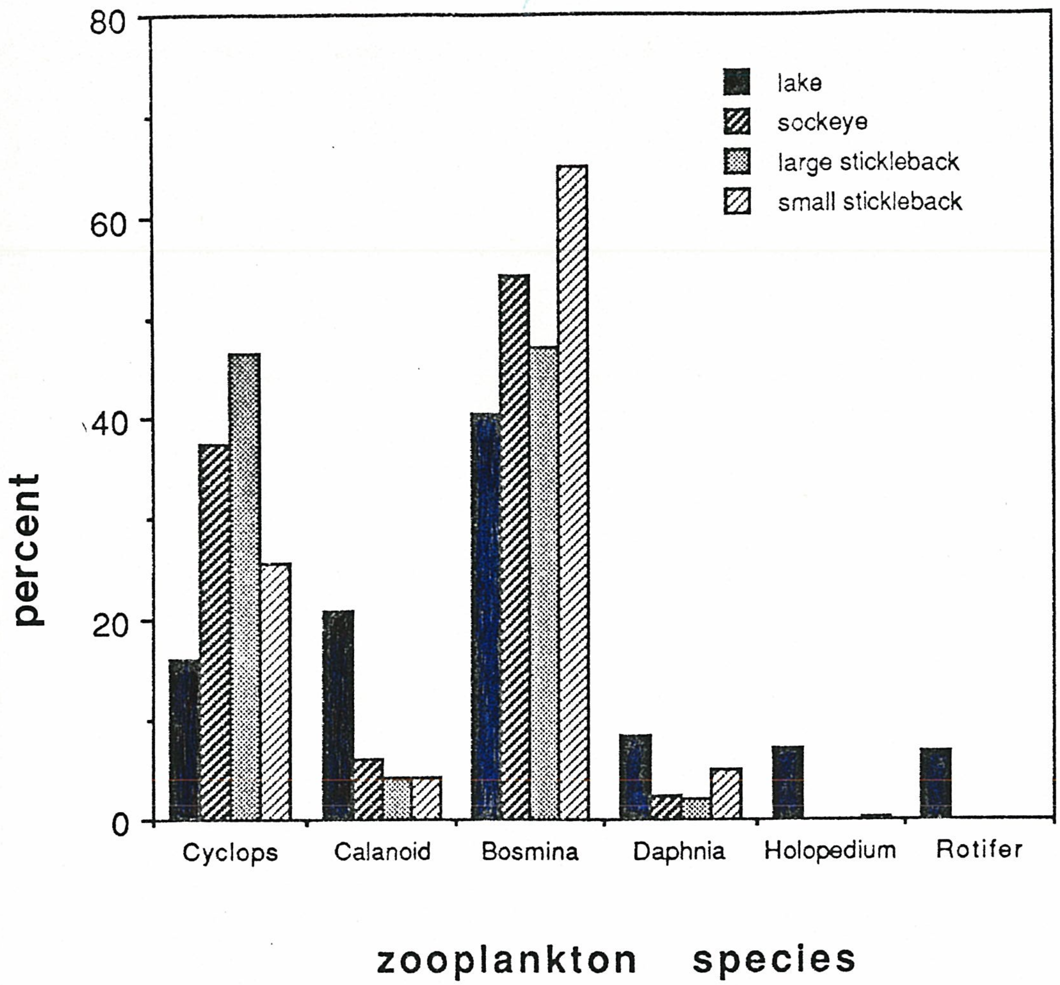

Figure 7. Species composition of zooplankton from net hauls in Lake Aleknagik and from the stomachs of sockeye fry and threespine stickleback.

Table 1. Pre-season Bristol Bay sockeye forecasts and the actual inshore runs (millions).

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	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	
	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	
	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	
	ADFG	12.2	4.2	10.7	4.3	4.6	37.1	26.3	
	Actual run								

Total run and catch include Branch River and Togiak District

Table 2. Mean lengths (mid-eye to tail-fork, mm) of sockeye salmon in the Bristol Bay area.

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
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
Averages									
60-76	18	520	505	513	586	564	573	535	37
77-89	33	527	512	519	586	565	575	543	41

Table 3. The 1991 sockeye salmon runs to Bristol Bay river systems and the escapements compared to the management goals (in millions).

River system	Run	Escapement	Escapement goals Mid	Escapement goals Upper	Excess escapement Mid	Excess escapement Upper
Kvichak	8.06	4.22	6.00	8.00	0.00	0.00
Naknek	9.97	3.57	1.00	1.40	2.57	2.17
Branch	0.61	0.28				
Egegik	9.59	2.79	1.00	1.20	1.79	1.59
Ugashik	5.50	2.46	0.70	0.90	1.76	1.56
Wood	3.42	1.16	1.00	1.20	0.16	0.00
Igushik	2.48	0.76	0.20	0.25	0.56	0.51
Nuyakuk/Nush.	1.78	0.50	0.50	0.76	0.00	0.00
Togiak	0.80	0.28	0.15	0.25	0.13	0.03
Totals	42.21	16.02			6.97	5.86

Table 4. Escapement densities (number/km^2 of lake surface area) for Bristol Bay sockeye systems.

River system	No. of lakes	Surface area (km^2)	Mean depth (m)	Escapement densities (1,000s/km^2) Mid goal	1972-1986 Median	1972-1986 Low	1972-1986 High	1991	1990	1989	1988	1987
Major runs												
Kvichak	2	2889	49	2.1	1.2	0.1	7.8	1.5	2.4	2.9	1.4	2.1
Egegik	1	1132	-	0.9	0.9	0.3	1.1	2.5	1.9	1.4	1.4	1.1
Naknek	4	791	41	1.3	1.6	0.5	3.3	4.5	2.6	1.5	1.3	1.3
Wood	5	425	47	2.4	2.4	0.8	7.0	2.7	2.5	2.8	2.0	3.1
Ugashik	2	385	-	1.8	2.6	0.1	8.6	6.4	1.9	4.4	1.7	1.7
Nuyakuk	3	279	94	1.8	1.5	0.1	10.8	0.4	1.5	1.1	1.1	0.6
Igushik	2	74	26	2.7	3.3	0.8	26.9	10.2	4.9	6.2	2.3	2.3
Togiak	2	49	-	3.1	3.6	1.5	9.4	5.7	2.9	1.7	5.7	5.7
Minor runs												
Alagnak	2	297	-	-	0.5	0.1	1.0	0.9	0.6	0.7	0.7	0.5
Snake	1	89	57	-	0.2	<0.1	0.4	0.1	0.3	0.3	<0.1	<0.1

Table 5. Cumulative daily escapements of sockeye salmon in the Kivchak and Newhalen rivers, 1985-1991. (Numbers in 1,000s and Newhalen escapements estimated from expanded counts lagged back 3 days for 1986 and 2 days for other years.)

	19 85		19 86		19 88		19 89		19 90		19 91	
Date	Kvichak	Newhalen	Kvichak	Newhalen	Kvichak	Newhalen.	Kvichak	Newhalen	Kvichak	Newhalen	Kvichak	Newhalen
6/25					1	0	58	17	1		0	
26					4	5	298	97	2		1	
27	1	0			75	85	525	162	3		3	
28	113	14			264	128	653	200	5	0	50	7
29	362	38			313	140	892	454	8	1	125	46
30	631	67			328	187	1509	641	39	2	277	95
7/1	979	110			364	244	2052	712	46	37	588	146
2	1216	192	1	0	778	456	2566	785	219	66	901	188
3	1337	278	8	3	1193	632	3287	892	825	90	1256	330
4	1601	350	75	7	1598	676	4378	1185	1412	110	1581	517
5	1907	451	212	8	1901	784	5418	1287	1874	139	1925	620
6	2330	480	268	16	2079	1076	5947	1358	2399	204	2141	805
7	2738	538	278	24	2189	1313	6611	1567	2901	304	2208	1132
8	3137	754	280	30	2232	1505	7182	1962	3509	375	2277	1531
9	3833	874	310	51	2272	1629	7518	2317	4061	459	2355	1721
10	4625	1138	442	72	2389	1721	7670	2478	4692	648	2633	2048
11	5327	1311	539	98	2775	1868	7708	2614	5081	790	3080	2202
12	5800	1373	680	189	3473	2106	7755	2728	5388	961	3460	
13	6067	1445	854	250	3753	2372	7806	2829	5803	1079	3724	
14	6366		987	320	3840	2657	7860	2944	6208	1193	3822	
15	6586		1080	359	3948	2848	7914		6418	1297	3909	
16	6674		1012	382	3990	2976	8060		6510		3999	
17	6706		1110	391	4020	3094	8130		6603		4063	
18	6856		1115	397	4046	3203	8164		6674		4098	
19	6976		1119	406	4057	3313	8205		6733		4132	
20	7051		1122	410	4062	3435	8245		6781		4166	
21	7116		1130	420	4065		8273		6827		4193	
22	7171		1154	428	4065		8287		6876		4213	
23	7201		1169	441			8295		6915		4220	
24	7211		1174	450			8302		6941			
25			1177	454			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	0.06	2.53	30	30
1990	6.97	1.09	16	–	–	–	4
1991	4.22	1.93	46				

Newhalen River spawners estimated by two times the aerial survey estimate.

Table 7. Kvichak spawning ground age compositions in 1990 and 1991.

Year	Spawning ground	Sex	Sample size (n)	Age composition (%)						
				2.1	1.2	2.2	3.2	1.3	2.3	2.4
1990	Gibralter Creek	M	95		0.0	50.5		1.1	48.4	
		F	96		3.1	50.0		1.0	45.9	
	Copper River	M	97		0.0	46.4	0.0		53.6	
		F	92		2.2	50.0	6.5		41.3	
	Chinkelyes Creek	M	78		2.6	60.2	0.0	7.7	29.5	
		F	92		6.5	57.6	1.1	5.4	29.4	
	Tazimina River	M	62		1.6	53.2		4.9	40.3	
		F	12		8.3	41.7		0.0	50.0	
	Woody Is. beaches	M	91		3.3	95.6		1.1		
		F	88		0.0	100.0		0.0		
	Knudson Bay beach	M	89		5.6	80.9		0.0	13.5	
		F	85		4.7	90.6		1.2	3.5	
	Kvichak escapement	M	1178		3.1	85.6		3.7	7.1	
	(ADF&G,Igiugig)	F	1732		3.2	89.6		2.6	4.4	
1991	Gibralter Creek	M	98	1.0	25.5	31.6		25.5	16.3	
		F	32		13.8	51.7		13.8	20.7	
	Copper River	M	39		5.1	48.7		10.3	35.9	
		F	53		1.9	50.9		9.4	35.9	1.9
	Chinkelyes Creek	M	100	5.0	55.0	25.0		6.0	9.0	
		F	98		33.7	35.7		13.3	17.3	
	Tazimina River	M	62		96.8			1.6	1.6	
		F	38		84.2			2.6	13.2	
	Woody Is beaches	M	96		27.1	5.2		8.3	59.4	
		F	98		9.2	7.1		8.2	75.5	
	Knutson Bay beaches	M	93		80.6	15.1		3.2	1.1	
		F	77		68.8	24.7		2.6	3.9	
	Kvichak escapement	M	1811	1.2	59.9	16.3		8.4	12.4	
		F	1667	0.7	62.5	16.6		7.4	11.3	

Table 8. Mean townet catches and lengths on Sept. 1 (in mm) of sockeye fry in Lakes Iliamna and Clark (geometric mean of 20-min tows).

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				

Lake Iliamna tows in areas 7 & 8 only

Table 9. Kvichak sockeye salmon freshwater production statistics, 1973-1991 brood years.

Brood	Run (millions)		Fry (age 0)		Smolts (millions)			Adult returns (millions)		
			Index	Mean				From	From	
year	Total	Escape.	catch	length	Age 1	Age 2	Total	age 1	age 2	Total
73	0.3	0.2	2	65	–	3		1.4	0.8	2.3
74	4.6	4.4	491	54	108	114	223	8.1	17.4	25.5
75	14.9	13.1	252	49	78	213	292	6.7	29.0	35.8
76	3.0	2.0	16	50	32	26	58	5.8	4.1	9.9
77	1.8	1.3	11	58	29	10	39	2.7	0.3	3.0
78	8.0	4.1	339	62	182	32	215	2.7	2.0	4.7
79	24.6	11.2	282	52	220	89	309	19.8	20.4	40.2
80	35.2	22.5	134	61	150	76	226	4.3	8.2	12.5
81	7.0	1.8	37	51	7	38	45	1.0	1.1	2.1
82	3.0	1.1	9	66	52	2	54	1.0	0.6	1.6
83	20.1	3.6	242	64	24	53	77	11.4	1.7	13.1
84	22.8	10.5	147	46	83	330	413	4.3	18.8	23.1
85	12.2	7.2	63	54	11	87	98	2.2	14.6	16.8
86	2.0	1.2	10	60	13	7	20	1.7	1.3+	3+
87	9.4	6.1	79	63	147	41	188	4.0+		
88	6.8	4.1	22	58	47					
89	19.8	8.3	181	55						
90	17.4	7.0	336	54						
91	8.1	4.2								

Table 10. Summary of 1991 measurements in Lake Aleknagik (Wood River Lakes).

Measurement and first first year measured	Dates	1991	Past years Average	Past years Range
1. Date of ice breakup 1949-		26-May	31-May	14 May, 16 Jun
2. Water temperature, 0-20m (C) 1958-	23-Jun	5.5	5.8	3.7, 9.2
	13-Jul	7.8	8.3	5.7, 12.0
	2-Aug	10.3	10.7	7.7, 14.0
	2-Sep	11.7	11.2	9.3, 13.0
3. Water transparency Secchi depth (m) 1962-	23-Jun	5.3	8.2	5.5, 10.5
	13-Jul	5.4	8.2	5.0, 10.9
	2-Aug	8.2	9.3	6.3, 11.9
	2-Sep	6.7	8.8	5.8, 12.1
4. Water conductivity (micromhos/cm) 1968-	23-Jun	43.2	38.7	34.7, 52.1
	13-Jul	39.1	37.4	33.5, 42.6
	2-Aug	39.0	37.1	32.5, 40.5
	2-Sep	39.8	38.3	34.8, 42.5
5. Average daily solar radiation (gm/cal/cm) 1963-	June 1-15	400	403	305, 588
	June 16-30	301	412	265, 572
	July 1-15	408	389	284, 543
	July 16-31	347	356	192, 485
	Aug. 1-15	298	303	203, 402
	Aug. 16-31	275	264	170, 421
	Sept. 1-15	194	206	114, 282
6. Lake level (cm) of Lake Nerka 1952-	June 1-15	170	142	84, 222
	June 16-30	182	152	97, 218
	July 1-15	174	133	75, 199
	July 16-31	115	107	54, 172
	Aug. 1-15	76	86	34, 173
	Aug. 16-31	66	82	30, 184
	Sept. 1-15	57	81	29, 161
7. Chlorophyll "a", 0-20m (mg/m2) 1963-	23-Jun	31	30	10, 45
	13-Jul	24	28	10, 43
	2-Aug	20	23	6, 36
	2-Sep	25	24	12, 37
8. Zooplankton volume (ml/m2) 1967-	23-Jun	45	56	20, 168
	13-Jul	58	81	45, 161
	2-Aug	122	127	67, 226
	2-Sep	53	65	26, 107

Table 11. Average catches, lengths and growth rates for sockeye fry and age 1 threespine stickleback in Lake Aleknagik.

	Sockeye salmon fry					Sockeye	Threespine 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	escapement 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	.37	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
Means	160	31.3	56.4	.36	49	289	143	31.2	44.4	.19	73	12

(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 12. Average townet catches and mean lengths of sockeye fry (by lake area), numbers of parent spawners, and average catches and mean lengths (age 1) of threespine stickleback for Lake Nerka.

	Sockeye salmon fry						Sockeye salmon spawners in year-1 (1000s)			Threespine stickleback	
	Mean townet 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
Mean	12	13	39	60	57	58	111	111	247	17	45

Table 13. 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

Table 14. Daily counts of sockeye salmon spawners in Hansen Creek (Lake Aleknagik) in 1991. Dead fish were marked and removed on each survey.

		In creek				Live plus
	Estimated		Natural	Bear-kill	Cumulative	cumulative
Date	off mouth	Live	dead	dead	dead	dead
7/19	Too many	0				
21	"	1307	22	4	26	1333
22	"	3000	32	84	142	3142
23	"	2308	8	44	194	2502
24	"	1812	9	148	351	2163
25	"	2476	22	32	405	2881
26	"	2469	28	92	525	2994
27	"	3743	46	188	759	4502
28	"	4516	33	94	886	5402
29	"	4024	45	108	1039	5063
30	"	4874	67	138	1244	6118
31	"	4020	82	137	1463	5483
8/1	"	4232	121	77	1661	5893
2	"	4512	145	60	1866	6378
3	"	5246	220	26	2112	7358
4	"	5263	337	24	2473	7736
5	1000	7359	613	26	3112	10471
6	500	7979	503	98	3713	11692
7	500	7516	650	49	4412	11928
8	600	7041	624	104	5140	12181
9	600	6260	560	47	5747	12007
10	300	6682	624	87	6458	13140
11	100	6889	730	14	7202	14091
12	no survey					
13	0	6309	1585	213	9000	15309
14	3	5835	822	26	9848	15683
15	100	4023	922	174	10944	14967
16	30	3509	856	20	11820	15329
17	25	2767	793	38	12651	15418
18	no estimate	2276	722	113	13486	15762
19	no survey					
20	6	1030	949	71	14506	15536
21	no survey					
22	"					
23	"					
24	"					
25	no estimate	29	848	203	1557	15536
26	no survey					
27	"					
28	"					
29	"					
30	"					
31	"					
9/1	0	0	44	30	15631	15631

Table 15. Age compositions (%) of sockeye spawners in the Wood River Lakes in 1991.

Location	Males						No. of	Females						No. of
	1.1	1.2	2.2	1.3	2.3	1.4	fish	1.1	1.2	2.2	1.3	2.3	1.4	fish
Hansen		77.4		22.6			230		70.6		29.4			235
Happy		19.8	1.0	79.2			96		19.0		80.0	1.0		105
Bear		15.2		84.8			105		11.1		88.9			108
Ice		2.9		97.1			104		6.9		93.1			102
Agulowak		1.8		98.2			113		2.8		97.2			107
Wood	1.1	65.5	1.1	32.3			87	0.9	56.0		43.1			109
Fenno		37.0		63.0			92		41.3		58.7			104
Stovall	0.9	28.6		70.5			112		30.0		70.0			110
Lynx		70.9		27.8	1.3		79		66.4		33.6			110
Pick		33.3		65.8	0.9		108		49.5	1.0	48.5	1.0		103
LT River		42.9		57.1			98		29.1	0.9	70.0			110
N4-N6 beach		58.4		41.6			89		45.6		53.4		1.0	103
Kema		40.4		59.6			109	1.0	48.6		49.4			105
Hidden Lake		78.9		21.1			95		75.4		24.6			122
Anvil Bay beach		52.0	1.0	47.0			102		56.6		41.5	1.9		106
Agulukpak		3.6		92.8	3.6		112		0.9		98.2	0.9		112
LT beaches		69.7		32.1			28		35.3		64.7			51
Moose		37.7		62.3			106		40.8		59.2			98
Grant River		67.0		33.0			103		68.0		32.0			97
Wood River ADF&G tower	0.2	38.2	0.7	58.6	0.3	0.3	1048		45.2	0.7	53.3	0.3		1187

Other = age 0.3 male (1.5%) and female (0.3%)