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BRISTOL BAY SOCKEYE SALMON SMOLT STUDIES FOR 2001



by

Drew L. Crawford

Regional Information Report¹ No. 2A01-27

Alaska Department of Fish and Game
Division of Commercial Fisheries
Regional Office
333 Raspberry Road
Anchorage, Alaska 99518-1599

December 2001

¹Contribution 01-27 from the Anchorage regional office. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate needs for up-to-date information, reports in this series may contain preliminary data.

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AUTHOR

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- ^a Egegik River smolt sonar project
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- ^d Ugashik River smolt sonar project
- ^e Kvichak smolt sonar evaluation project

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ABSTRACT

Numbers of sockeye salmon *Oncorhynchus nerka* smolt emigrating to sea from three rivers in Bristol Bay, Alaska, were estimated from sonar counts and age-weight-length samples from mid-May to mid-June in 2001. Hydroacoustic equipment was used to estimate total smolt biomass, and age-weight-length samples were used to convert biomass estimates into numbers of smolt by age group. Estimated numbers of smolt emigrating were 325,914,951 from Kvichak River, 30,245,410 from Egegik River, and 35,123,888 from Ugashik River. Age-1. smolt, the progeny of 1999 spawners, predominated at Kvichak River (71%), Egegik River (62%) and Ugashik River (82%). The 2001 field season was the second year of a three-year Western Alaska Disaster Grant (WADG) study (\$450 K) to evaluate the smolt sonar project on the Kvichak River.

KEYWORDS: smolt, sockeye salmon, *Oncorhynchus nerka*, Bristol Bay, Kvichak River, Egegik River, Ugashik River, sonar, smolt emigration estimate, outmigration timing, age-length-weight relationship

INTRODUCTION

The Bristol Bay Management Area includes all waters east of a line from Cape Newenham to Cape Menshikof (Figure 1) and supports the largest sockeye salmon *Oncorhynchus nerka* fishery in the world. From 1981 to 2000 the commercial catch in Bristol Bay averaged 25.5 million sockeye salmon (ADF&G 2001). To effectively manage this fishery, managers need accurate abundance forecasts of returning sockeye salmon and precise estimates of maximally sustainable spawning escapement goals. Estimates of outmigrating smolt numbers are currently used as an index of production for adult salmon; this information is used to prepare preseason forecasts of adult returns and aids in setting biological escapement goals.

This report summarizes upward-looking smolt sonar studies conducted on the Kvichak, Egegik, and Ugashik Rivers in 2001. The objectives of these studies were to: (1) estimate numbers of outmigrating sockeye salmon smolt; (2) describe smolt migration patterns; (3) collect smolt age, weight, and length data; and (4) record climatological and hydrological parameters which might affect migratory behavior.

Background

Fyke nets were used to estimate smolt numbers on Kvichak River from 1956 to 1970; on Naknek River from 1956 to 1978; on Egegik River during 1957, 1969, and 1978; on Ugashik River from 1955 to 1965, 1967 to 1970, and 1972 to 1975; and on Wood River from 1955 to 1966 (Burgner and Koo 1954; Rietze and Spangler 1958; Kerns 1961; Burgner 1962; Jaenicke 1963, 1968; Church 1963; Church and Nelson 1963; Nelson 1964, 1965a, 1965b, 1966a, 1966b, 1969; Marriott 1965; Nelson and Jaenicke 1965; Pennoyer and Seibel 1965; Pennoyer 1966; Pennoyer and Stewart 1967, 1969; Robertson 1967; Siedelman 1967, 1969; Paulus and McCurdy 1969, 1972; Van Valin 1969a, 1969b; Shroeder 1972a, 1972b, 1974a; McCurdy and Paulus 1972a, 1972b; Paulus 1972; McCurdy 1974a, 1974b; Bill 1975, 1976, 1977; Pella and Jaenicke 1978; Yuen 1978). Although fyke net sampling provided information on age, size, and relative abundance of smolt, it did not provide an accurate estimate of the total number of smolts. To improve estimates of smolt numbers, the department began experimenting with and using hydroacoustic (sonar) equipment in the 1970's.

Hydroacoustic equipment was used to estimate sockeye salmon smolt numbers on Kvichak River from 1971 through 2001; Wood River from 1975 to 1990; Naknek River from 1982 to 1986 and 1993 to 1994; Egegik River from 1982 through 2001; Ugashik River from 1983 to 1991 and 1993 to 2001; Nuyakuk River from 1983 to 1989; and Togiak River in 1988 (Russell 1972; Parker 1974a, 1974b; Krasnowski 1975; Randall 1976, 1977, 1978; Newcome 1978; Yuen 1980a, 1980b; Clark and Robertson 1980; Bucher 1980, 1981, 1982, 1983, 1984, 1986a, 1986b, 1987; Bergstrom and Yuen 1981; Yuen and Wise 1982; Eggers 1984; Eggers and Yuen 1984; Bue 1986a, 1986b; Bue and Fried 1987; Bue et al. 1988; Cross et al. 1990; Woolington et al. 1990, 1991; Crawford et

al. 1992; Crawford and Cross 1992, 1994a, 1994b, 1995a, 1995b, 1996, 1997, 1998, 1999; Crawford 2000; Crawford and West 2001).

Hydroacoustic equipment developed by Bendix Corporation² was tested on Kvichak River in 1969 (McCurdy and Paulus 1972b; Paulus and Parker 1974). Further testing and modification of this prototype resulted in the construction of smolt counters for use on Wood (Krasnowski 1976, 1977) and Kvichak Rivers (Randall 1977) in 1975 and 1976. Hydroacoustic equipment for counting smolt was tested on Ugashik River from 1973 to 1975 (Schroeder 1974b, 1975; Sanders 1976). Smolt studies on Naknek, Egegik, Ugashik, and Nuyakuk Rivers were limited to occasional fyke net sampling to obtain age and size data from 1975 to 1982 (Huttunen 1980; Eggers 1984; Minard 1984). An experimental two-array sonar system similar to the one used on Kvichak River was tested on Egegik River in 1981 (Bue 1982). Smolt enumeration projects using modified Bendix counters began on Naknek and Egegik Rivers in 1982 (Huttunen 1984; Bue 1984) and on Ugashik and Nuyakuk Rivers in 1983 (Fried et al. 1987; Minard and Frederickson 1987).

In 1985 and 1986, a Lowrance², Model X-16 sonar with a 192 kHz frequency transmitter and a horizontally-mounted 8° transducer were used to determine the lateral distribution of smolt passing each of the respective sonar sites. Bue et al. (1988) reported that most smolt passing the Kvichak River sonar site stayed within a 68-m corridor that began 6.4 m from the left bank³ (total river width = 100 m). Smolt passing the Egegik River sonar primarily used a 73-m corridor beginning 12.2 m from the left bank (total river width = 104 m). Ugashik River smolt used a 21-m corridor, which began 7.0 m from the left bank (total river width = 43 m). This Lowrance sonar unit was not an effective tool for collecting lateral smolt distribution data on Wood River (Cross et al. 1990; Woolington et al. 1990, 1991).

The monitoring of smolt migrations was discontinued on Naknek River in 1986 (Bue et al. 1988), on Togiak River in 1988 (Woolington et al. 1990), on Nuyakuk River in 1989 (Woolington et al. 1991), and on Wood River in 1990 (Crawford et al. 1992).

In 1990 a single narrow-beam, side-looking BioSonics² sonar unit was used from May 29 to 31 to determine the lateral limits of smolt distribution at the Kvichak River sonar site (Huttunen and Skvorc 1991); most smolt migrated between 40 and 100 m offshore from the right bank. The total river width at the site was 136 m.

The results of the 1990 study were encouraging, so in 1991 it was expanded to evaluate the feasibility of using side-looking sonar to enumerate outmigrating Kvichak River sockeye salmon smolt. Huttunen and Skvorc (1992) estimated, based on 81 h of horizontal-aspect echo-integration data collected June 2-14, that 44,972,864 smolt passed through the sonar site during the counting period. This compared well to an upward-looking Bendix² sonar estimate of 43,525,980 smolt for

² Use of a company's name does not constitute endorsement.

³ In this report the location of projects and the placement of equipment are referenced to the right and left bank of the respective river as determined by facing downstream at the study site.

the same hours of operation. The maximum single-beam listening range for the side-looking sonar varied from 118 to 120 m, ensonifying 88%-90% of the total 134-m river cross section. In comparison, the three array upward-looking sonar ensonifies about 7.5% of the river. The spatial distributions of smolt on a nightly basis were highly dynamic; side-looking estimates peaked at ranges from 64 m on June 12 to 118 m on June 7. Whereas the distribution of upward-looking estimates also varied between nights, the largest estimates were typically from the inshore array at 56 m from the right bank. No side-looking sonar smolt studies were conducted from 1992 to 1999.

The last year the Alaska Department of Fish and Game (ADF&G) funded the entire Ugashik smolt project was 1991; in 1992 the smolt migration on Ugashik River was not monitored (Crawford and Cross 1992). The Ugashik River smolt study was resumed to measure the freshwater production, the size and age structure of smolt from recent sockeye salmon spawning escapements, and to continue use of smolt data for preparing preseason forecasts of adult salmon returns. Cooperative agreements between ADF&G and other local private and public agencies have funded the Ugashik smolt project from 1993-2001 (e.g., City of Pilot Point (CPP) and ADF&G in 1993; Lake and Peninsula Borough (L&PB) and ADF&G in 1994; CPP, L&PB, and ADF&G in 1995; L&PB and ADF&G in 1996; CPP, L&PB, and ADF&G in 1997 and 1998; L&PB and ADF&G in 1999; and Bristol Bay Science and Research Institute, L&PB, and ADF&G in 2000 and 2001).

In 1993, approval of a cooperative agreement between the National Park Service and ADF&G allowed for continued enumeration of sockeye salmon smolt with hydroacoustic equipment on Naknek River in 1993 and 1994. The primary reason for resuming the Naknek River smolt study was to measure freshwater production from the record sockeye salmon escapement (3.6 million fish) that entered the Naknek River drainage to spawn during the 1991 commercial fishermen strike. This study was concluded in 1994 and was summarized in Crawford and Cross (1995b).

In 1997 and 1998, returns of adult sockeye salmon to Bristol Bay were well below forecast. For the Kvichak River, the low returns of adult salmon followed three consecutive years of record high smolt abundance estimates (greater than 300 million smolt per year). Consequently a new study was initiated in the fall of 1999 with Western Alaska Disaster Grant (WADG) monies to evaluate the existing acoustic equipment and sampling design used to estimate smolt abundance on the Kvichak River and to investigate new equipment and techniques to see if it is possible to improve annual smolt outmigration estimates.

In order to provide a quick inseason comparison of Bendix smolt counter data with sonar counts from other hydroacoustic systems, ADF&G contracted the Applied Physics Laboratory at the University of Washington during the winter of 1999/2000 to design and insert a computer interface into each of three smolt counters and write software to accept and store smolt count data on a computer. This new data collection system was tested and used at Kvichak River and Ugashik River smolt sonar sites in 2000 and at Kvichak River in 2001.

The 2001 field season was the second year of a three-year WADG study (\$450 K) to evaluate the smolt sonar project on the Kvichak River. The objectives of this study are: (1) Clearly document the current acoustic methodology (Bendix counter) for estimating abundance of outmigrating sockeye salmon smolt in the Kvichak River. Identify the potential sources of bias and

imprecision in the current estimation method, and mechanisms by which the Bendix system may have failed in any or all of the previous 30 years. (2) Study and describe smolt behavior (e.g., fish speed, school density, and school structure) in the vicinity of the current site and evaluate the assumptions about smolt behavior that must be made to derive acoustic estimates of smolt abundance. (3) Based on (1) and (2) above, determine if the historical smolt abundance estimates are valid and, if not, whether they can be corrected. If the historical estimates can be corrected, develop the means to do so. (4) Compare sockeye salmon smolt abundance estimates among a Bendix array, a Hydroacoustic Technologies, Inc.² (HTI) upward-looking multiple transducer array, and a HTI side-looking split beam transducer and recommend the best system to estimate smolt abundance on the Kvichak River. (5) Design an acoustic system that improves upon weaknesses identified in the Bendix smolt counter and deploy this complete system in May 2001. Run the new and old systems side-by-side for two complete seasons and thoroughly compare the results derived from each. Results and findings from this study will be published for ADF&G in a separate report by hydroacoustic consultant, Don Degan of Aquacoustics, Inc.

METHODS

For step-by-step procedures on the installation, operation, maintenance, troubleshooting, and retrieval of smolt sonar and sampling equipment; plus detailed instructions on data collection, recording, and reporting techniques see Crawford and Tilly (1995).

Hydroacoustic Equipment

Bendix Corporation constructed all hydroacoustic systems used to estimate smolt numbers in Bristol Bay river systems in 2001; all projects used 1982 or 1983 model smolt counters. Transducers used to transmit and receive sound pulses at each sonar site were housed in 3.0-m long arrays set on the river bottom and connected by coaxial cable to a control unit located on shore. Three arrays were used at each sonar site except Ugashik River, where two arrays were used because of a narrow channel width. Each array had 10 upward-facing single-element International Transducer Corporation², Model 5095 transducers that operate at a frequency of 235 kHz and a half-power beam angle of 9°. Belcher (2000a) reported that the smolt counter performs an analog version of echo integration which integrates the mean-square echo voltage over a range of interest which is proportional to fish biomass. Detected echoes from each transducer were accumulated in the smolt counter and a printer produced a hard copy of totaled counts by array at prescribed intervals, which were summed and recorded hourly on a field data collection form. A single 12-volt battery recharged by a pair of 43 watt, 2.9 amp solar panels, powered each smolt counting system.

In addition to collecting smolt counts at prescribed intervals on printer tape, the smolt project at Kvichak River also had a computer interface on the Bendix smolt counter and software to accept

and store smolt counts on a computer. The computer interface recorded counts (e.g., [actual Bendix sonar count] * [5 smolt/count]) at one-second intervals. Sonar counts from each array are kept separate. Belcher (2000b) outlines the details of the computer interface software. This additional data collection system was used at Kvichak River in order to compare the Bendix system with other WADG hydroacoustic and video data.

Hydroacoustic equipment to monitor smolt outmigrations was operated on Kvichak, Egegik, and Ugashik Rivers from mid-May to mid-June. The smolt outmigrations in Kvichak, Egegik, and Ugashik Rivers generally peak during late May or early June and drop off by mid-June. All arrays at each project site were removed from the water at the end of the field season.

All smolt hydroacoustic systems used in 2001 were calibrated with a smolt simulator by hydroacoustic consultant, Al Menin, to record one count whenever 41.5 g of biomass passed through each transducer beam during a given period. Because most smolt migrate within the upper portion of the water column, individual arrays were calibrated independently, which allowed the operator to set the counting range as near the surface as possible. The pulse width of the smolt counter is 0.136 mS, which theoretically allows the counting range to be set within 10 cm of the surface (1/2 pulse width). The counting range was set 1-2 cm below this theoretical limit to avoid common surface disturbances caused by debris, light wind, and rain. The counting range was reduced further or the system was disabled if disturbances penetrated deeper.

Sources of false counts (e.g., boats, wind, rain, snow, debris) were noted and the hydroacoustic equipment was disabled whenever false-count conditions were detected. Known false counts were subtracted from hourly totals, and linear interpolations were used to estimate counts missed while equipment was disabled. The control unit automatically recorded and stored the length of time the system was disabled. Manual control was available for adjusting printing intervals for accumulated counts, transducer pulse rate, and the portion of the water column monitored. Transducer signal characteristics were visually monitored with an oscilloscope.

Site location and equipment changes that have been made over the years to improve our ability to enumerate annual sockeye salmon smolt outmigrations using sonar are summarized in Crawford and Cross (1996, 1997, 1998).

Project Locations

The Kvichak River counting site was located 6 km below the outlet of Lake Iliamna (Figure 1); the smolt sonar was moved to this location in 1989, approximately 1 km downstream from the site used during the previous 15 years (Woolington et al. 1991). The Kvichak River was approximately 137 m wide at this site. Three transducer arrays referred to as *inshore*, *center*, and *offshore*, were anchored 55 m, 78 m, and 85 m from the right bank (Figure 2). The Global Positioning System (GPS) coordinates for the Kvichak River smolt sonar tent were – 59°18.049' N latitude, 155°57.859' W longitude.

The Egegik River counting site was located 4 km below the outlet of Becharof Lake (Figure 1); it has been operated at this location since 1982 (Eggers and Yuen 1984). Egegik River was 110 m wide at this site. The inshore, center and offshore arrays were anchored 40 m, 55 m, and 67 m from the left bank (Figure 3). The GPS coordinates for the Egegik River smolt sonar tent were – 58°03.53' N latitude, 156°53.23' W longitude.

The Ugashik River counting site was located 50 m below the outlet of Lower Ugashik Lake (Figure 1). Because this river-section is only 40 m wide, only two arrays have been used. The inshore and offshore arrays were anchored 24 m and 30 m from the right bank (Figure 4). The GPS coordinates for the Ugashik River smolt sonar tent were – 57°33.89' N latitude, 156°59.90' W longitude.

Appendices A.1 to A.3 summarize river widths and locations of arrays at each river from 1989-2001.

Estimation of Smolt Numbers

The process of generating smolt numbers was divided into three steps: (1) estimating total fish biomass emigrating past the study site; (2) sampling the emigrating fish population to estimate species, age, weight, and length composition; and (3) converting fish biomass into numbers of smolt by age and species.

Biomass Estimation

Fish biomass was estimated using hydroacoustic equipment operated 24 h/d. The signal pulse rate or ping rate of the smolt counter was set to correspond with the river velocity.

Belcher (2000a) reported the ping rate (pr) for the Bendix smolt sonar system was calculated as–

$$pr = \frac{(v + 0.34)}{(0.47 * h / 3)} \text{ pings/s}$$

where

v = river velocity, and

h = height of the cross beam measurement (m).

The river velocity was measured at a location referred to as the *velocity index*. The velocity index at Kvichak River was measured at the center array. At Ugashik River, the velocity index was measured at the inshore array. At Egegik River, a buoyed flow meter anchored downriver of the center array was used as the velocity index.

Estimation of River Velocities and Adjustments to Sonar Counts . River velocities at the Kvichak and Ugashik River sites were nearly constant; thus velocities were measured once a week with a Gurley², Model 622, flow meter and the counter was adjusted accordingly.

River velocities at the Egegik River site were influenced by tides, therefore river velocities were measured continuously by a Gurley, Model 625, flow meter anchored directly downstream of the velocity index array, and smolt counts were adjusted every 15-30 min to account for changes in river velocity. To account for differences in river velocities between the velocity index and the arrays (i), readings were taken over each array at specified intervals (e.g., hourly at Egegik and every 7-10 days at Kvichak and Ugashik) and velocity correction factors (vcf_i) were then calculated as:

$$vcf_i = \frac{v_i}{v_{index}},$$

where

$$\begin{aligned} v_i &= \text{velocity over array } i, \text{ and} \\ v_{index} &= \text{velocity over the velocity index array.} \end{aligned}$$

Adjustments to daily counts ($ac_{i,z}$) were then made for differences in river velocity:

$$ac_{i,z} = c_{i,z}(vcf_i),$$

where $c_{i,z}$ = counts for array i on day z .

Ideally, all sonar arrays monitored fish biomass 24 h/d, so daily counts for each array represented actual sonar counts. If an array was not monitored during an hour, counts were linearly interpolated using estimated counts from several hours before and after the missing count.

Expansion of Biomass Estimates. The width of river section ($l_{i,z}$) monitored by array i on day z depended on array length (3.03 m), water depth over the array, and transducer signal beam width, calculated as:

$$l_{i,z} = 3.03 + 2 \left(d_{i,z} \tan \frac{bw}{2} \right),$$

where

- $d_{i,z}$ = average water depth over array i on day z , and
 bw = transducer beam width in degrees (9° for all transducers).

Arrays were placed perpendicular to the river current; distances from each array to a reference point on one riverbank were measured to the nearest meter (Appendix A.1, A.2, and A.3). The inshore and offshore limits of smolt passage were estimated based on past studies with side-looking hydroacoustic equipment (Bue et al. 1988; Huttunen and Skvorc 1991, 1992). However, because of changing water levels and river velocities at Kvichak River in 1997, the crew noticed schools of smolt farther from the inshore bank. Since then, the inshore limit dead zone (e.g., the shallow or slack water area of the river that extends outward from the right river bank where little or no smolt passage was recorded or observed) was varied from 9 to 18 m (Appendix A.1). Distances were calculated between inshore limit of smolt passage to first array (D_1); first to second array (D_2); second to third array (D_3) at sites where three arrays were used; and offshore array to offshore limit of smolt passage (D_4).

The estimated biomass of fish (\hat{B}_z) passing the counting site on day z was calculated as follows:

$$\hat{B}_z = \frac{1}{2} D_1 \left(\frac{ac_{1,z}}{l_{1,z}} \right) + \sum_{i=2}^{na} \left[\frac{1}{2} D_i \left(\frac{ac_{i-1,z}}{l_{i-1,z}} + \frac{ac_{i,z}}{l_{i,z}} \right) \right] + \frac{1}{2} D_{na+1} \left(\frac{ac_{na,z}}{l_{na,z}} \right),$$

where

- D_i = the distance for interval i , and
 na = number of transducer arrays used.

Age, Weight, and Length Estimation

Data on age, weight, and length of sockeye salmon smolt were obtained from samples captured in a fyke net. Smolt weight in grams and length, from tip-of-snout to fork-of-tail, in millimeters were measured; age was determined from visual observations of scales mounted on glass slides. European ages -- 1., 2., or 3. depending on the number of freshwater annuli -- were used. Parent year escapements that produced 2001 smolt occurred in 1999 for age-1. smolt, 1998 for age-2. smolt, and 1997 for age-3. smolt.

Sample size goals for Kvichak, Egegik, and Ugashik Rivers were set at a minimum of 400 smolt/d. Based on binomial proportions for the two major age groups, a sample size of 400 smolt would simultaneously estimate the percentage of each age class within 5% of the true percentage 95% of the time (Goodman 1965; Cochran 1977). When the daily goal of 400 smolt was not obtained, samples from subsequent days were combined until a total of at least 400 were reached.

Mean length of smolt differs among fyke net samples from a single day (Minard and Brandt 1986). Thus, to ensure that daily age composition estimates were representative of the population, attempts were made daily to obtain 100 smolt from each of six different fyke net catches. Because weight and age of smolt are strongly correlated to length, the time and cost of data collection was reduced by measuring up to a maximum of 600 smolt each day for length and up to 100 of those smolt for age and weight (Bue and Eggers 1989).

Age was estimated for smolt measured only for length using an age-length key (Bue and Eggers 1989). The key used length to categorize age-1. or -2. sockeye salmon smolt by determining a discriminant length that minimized classification error. This discriminant length was chosen such that the number of age-1. smolt classified as age-2. smolt was equal to the number of age-2. smolt classified as age-1. smolt. Age-3. smolt were not included in this analysis because too few samples were collected.

Weight was estimated for smolt measured only for length using a least squares linear regression. Based on paired weight-length data obtained from smolt sampled for age, weight, and length, we estimated weights (W_j) of age j smolt measured only for length as explained by (Ricker 1975):

$$W_j = \alpha L_j^\beta ,$$

where

L_j = fork length of an age j smolt, and
 α and β = parameters which determine the y-axis intercept and the slope of the line.

Due to the variability of age and size composition estimates among subsamples (e.g., fyke net catches) taken the same day, daily mean weight (\hat{W}) and age proportions (\hat{P}_j) were estimated as the mean of subsampled values:

$$\hat{W} = \frac{\sum_{k=1}^m \left(\frac{\sum w_k}{n_k} \right)}{m} ,$$

where

m = number of subsamples collected during a sampling period,
 w_k = observed weights from subsample k , and
 n_k = number of observations in subsample k ; and

$$\hat{P}_j = \frac{\sum_{k=1}^m \left(\frac{n_{j,k}}{n_k} \right)}{m} ,$$

where $n_{j,k}$ = number of observations of age j in subsample k .

Estimation of Smolt Numbers

Numbers of smolt by age were estimated by combining biomass estimates with estimates of age and weight composition. Mean weight of smolt was used to convert estimates of biomass per count to estimates of smolt per count ($S\hat{P}C$):

$$S\hat{P}C = \frac{BPC}{\hat{W}} ,$$

where BPC = biomass (g) per count.

The estimated number of smolt passing the counting site (\hat{N}_z) each day (z) was computed:

$$\hat{N}_z = \hat{B}_z (S\hat{P}C) .$$

The estimated contribution of age j smolt on day z ($\hat{N}_{j,z}$) was estimated by:

$$\hat{N}_{j,z} = \hat{N}_z (\hat{P}_j).$$

Finally, daily estimates of smolt numbers were summed. The seasonal total of all smolt passing the sonar site (\hat{N}_{tot}) was

$$\hat{N}_{tot} = \sum \hat{N}_z ,$$

and the estimated number of age j smolt that passed the site during the season ($\hat{N}_{j,tot}$) was

$$\hat{N}_{j,tot} = \sum \hat{N}_{j,z} .$$

Vertical Distribution of Smolt Passage

Monitoring of vertical distribution of passing smolt schools was conducted with an oscilloscope during the 2 weeks of peak smolt passage. Vertical distribution of smolt was monitored for approximately 1 h during each 8-h shift. Observers recorded the top and bottom depth (in centimeters) of passing smolt schools and spread their hour of monitoring throughout their shift and among all arrays. Arrays that received the highest counts were monitored most often.

Climatological Data Collection

Climatological data were recorded at each smolt sonar site. Observations of sky conditions and measurements of wind direction, wind velocity (km/h), daily precipitation (mm), air and water temperatures (°C) were recorded at 0800 and 2000 hours daily. Wind direction, wind velocity, and air temperature data were measured with a West Marine², Model 332356, weather monitor. Precipitation data was collected with a direct-read rain gauge graduated from 0.1 mm to 15.0 mm. Water temperatures were collected with a mercury pocket thermometer graduated in 1° increments from -10°C to +110°C.

RESULTS

Kvichak River

Due to unseasonably warm temperatures and strong prevailing winds, open water was observed on most of Lake Iliamna throughout the winter of 2000/2001. Some ice formed on protected bays and shores of the lake from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits, however, the entire lake never froze completely.

Since 1970, Lake Iliamna has averaged 118 ice-covered days per year (Appendix B.1). Historically, the average freeze-up date for the lake is January 15 and the average lake ice break-up date is May 13.

ADF&G's Kvichak smolt personnel arrived at Igiugig on the morning of May 15; there was no ice in Lake Iliamna or Kvichak River.

We were able to set and fish our fyke net daily. The first fyke net set at 1850 hours on May 18 caught 300 sockeye salmon smolt in 4 min (Appendix C.1). Eighty-six percent of these smolt were age-2. See Appendices C.2 to C.4 for a complete summary of the 2001 Kvichak River fyke net catch by date, species, hour, and time fished. In addition to sockeye salmon smolt, other species

captured in the fyke net were: threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, chinook salmon smolt *Oncorhynchus tshawytscha*, coho salmon smolt *Oncorhynchus kisutch*, lamprey (*sp.*), and sculpin *Cottus sp.*

The Kvichak smolt counter (S/N 8230001) was activated at 1200 hours on May 18. The smolt passage rate during the first 4 days of sonar operation was high. Hourly passage rates ranged from 0.0 to 1.9 million smolt per hour and averaged 248 thousand smolt per hour.

River velocity measurements over the center index array, which were used to adjust the sonar counter firing rate, ranged from 1.3 to 1.4 m/s (4.3 to 4.7 ft/sec). The average river velocity in 2001 was 1.3 m/s (4.4 ft/sec), slightly more than the recent 13-year average at the Kvichak River sonar site (Appendices D.1 and D.2). Velocity correction factors (m/s) used for the three arrays were as follows:

Smolt Days	Inshore	Center	Offshore
May 18 – May 29	0.96	1.00	0.96
May 30 - June 05	0.95	1.00	1.02
June 06 - June 10	0.97	1.00	0.99
June 11	0.94	1.00	0.98

A total of 6,578,104 sonar counts were recorded at the Kvichak River counting site from May 18 to June 10, 2001 (Table 1). This year the sonar counts were highest over the offshore sonar array (51%) followed by the center (27%) and inshore sonar arrays (22%). Daily sonar counts were highest from May 18-21 and June 3. The peak daily sonar count of 2,062,323 occurred on May 20. Over the course of the entire sampling season, 58% of the total sonar counts were obtained between 1400 hours and 2200 hours (Table 2); the peak hourly passage rate of 290,564 sonar counts per hour occurred at 1700 hours on May 20.

We also collected six 3.5" double sided high density diskettes which contained 458 *.dat files with 6.8 Mbytes of University of Washington, Applied Physics Lab (UW/APL) smolt counter application data (Appendix E.1). These data files were collected to provide details of Bendix smolt sonar counts in one-second increments that can be compared with hydroacoustic and video data from the WADG Kvichak River smolt sonar evaluation project. These data were not used to generate a smolt outmigration estimate in 2001.

Based on expanded sonar counts an estimated 325,914,951 sockeye salmon smolt migrated from Kvichak River in 2001 (Table 3). Age-1. smolt (1999 brood year) comprised 71% of the total smolt estimate and they were the predominant age class from May 18 to June 10. Age-2. smolt (1998 brood year) were most numerous from May 18-19, comprising 50% of the total daily smolt estimates. The highest daily smolt count occurred on May 20. The smolt per count estimates based on mean smolt weights ranged from 6.3 to 9.2 with an average of 8.1 smolt per count (Table 4).

Age, weight, and length data were collected from 2,283 sockeye salmon smolt in 2001 (Table 5). All smolt sampled were age 1. or 2. Mean length was 78 mm for age-1. smolt and 102 mm for age-2. smolt. Mean weight was 4.2 g for age-1. smolt and 8.5 g for age-2. smolt. An additional 11,864 smolt were measured for length only (Table 6). The discriminating length calculated to differentiate age-1. from age-2. smolt was 88 mm.

Sixty-four range-of-passage measurements were recorded for smolt schools passing over Kvichak River sonar arrays between May 17 and June 7 (Table 7). Schools passed at an average range of 192 cm to 248 cm above the transducers. Average counting range above the transducers was 264 cm to 270 cm during the peak smolt passage. The difference in the range of smolt passage by hour over each sonar array is shown in Figure 5.

River and weather conditions were recorded at the counting site from May 18 to June 11 (Table 8). The river and weather conditions were excellent for counting smolt in 2001. There was no disabled time from lake ice in the river and few storms. The smolt counter was disabled for 3.7 h (<1%) of the 576 h it operated in 2001 because of weather (Figure 6). Strong SW winds, wave action, and rainsqualls were the primary causes. The only smolt days with 1-or-more hours of disabled time because of weather were 5/25 (1.3 h) and 5/26 (1.4 h). Mean water temperature during the project was 7.8°C (range 5.0°C to 10.5°C). Mean daily water temperatures during the peak of the smolt migration ranged from 6.5°C to 7.5°C.

In 2001, boat traffic caused the Kvichak River smolt sonar to be disabled for an additional 7.9 h (Figure 7). Average disabled time from boat traffic prior to the opening of the rainbow trout sport fishing season at 0001 hours on June 8th was 0.2 h/d, but after the sport fish opening, it increased to 1.1 h/d. Most boat traffic occurred from 1000 to 2100 hours with peak passages from 1300 to 1500 hours. An additional 6.6 h of disabled time was attributed to WADG Kvichak Smolt Sonar Evaluation Study activities.

Egegik River

Open water was observed on Becharof Lake throughout the winter of 2000/2001. Unseasonably warm temperatures and strong prevailing winds kept the lake open. Some ice may have formed briefly on protected bays and shores of the lake from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits, however, the entire lake never froze completely.

Since 1976, Becharof Lake has averaged 87 ice-covered days per year (Appendix B.2). Historically, the average freeze-up date for the lake is January 30 and the average lake ice break-up date is April 22.

The first Egegik River smolt crewmembers flew to the study site on the morning of May 15. No observations of smolt or birds feeding on smolt were reported prior to the activation of the smolt counter. The crew activated the Egegik smolt counter (S/N 8240002) at 1500 hours on May 17.

Sonar counts during the first 5 days of sonar operations were negligible; the first daily sonar count greater than 100,000 occurred on smolt day 5/22 (Table 9).

A fyke net installed and fished several hours nightly from May 17-21 caught only 4 sockeye salmon smolt (Appendix C.5). The first fyke net catch greater than or equal to 100 smolt occurred on May 22. Fyke net catches were greater than or equal to 500 smolt from May 29 through June 1. For a complete summary of the 2001 Egegik River fyke net catch by date, species, hour, and time fished see Appendices C.5 to C.8. In addition to sockeye salmon smolt, the following other species were also captured in the fyke net: threespine stickleback, pink salmon fry *Oncorhynchus gorbuscha*, sculpin *Cottus sp.*, and lamprey (*sp.*).

River velocities at the counting site ranged from 0.5 to 0.7 m/s (1.6 to 2.3 ft/sec). The river velocities at the center array were equal to the 1984-2000 average of 2.1 ft/sec (Appendices D.3 and D.4). In 2001, the smolt counter ping rate was set according to the water velocities at an index buoy set downstream from the center array. Velocity correction factors (m/s) used for three arrays were:

Smolt Days	Index Buoy	Inshore	Center	Offshore
May 17 - May 24	1.00	0.75	1.02	1.08
May 25 - Jun 01	1.00	0.85	1.04	1.07
Jun 02 - Jun 08	1.00	0.90	1.09	1.10

A total of 2,089,222 sonar counts were recorded at the Egegik River counting site from May 17 to June 8, 2001 (Table 9). Sonar counts were most numerous over the center array (46%) and offshore array (46%) followed by the inshore (8%) array. Daily sonar counts were highest from May 29 through June 1. Fifty percent of the total sonar count was recorded during this four-day period. The peak daily sonar count of 508,828 occurred on May 29. Over the course of the season, the largest hourly sonar counts were recorded from 0100 hours to 0400 hours (Table 10); 45% of all smolt counts were obtained during these times.

An estimated 30,245,410 sockeye salmon smolt migrated from Egegik River in 2001 based on expanded sonar counts (Table 11). Age-1. smolt (1999 brood year) comprised 62% of the total smolt estimate from May 17 to June 8. Age-2. smolt (1998 brood year) and age-3. smolt (1997 brood year) composed 36% and 2% of the total smolt estimate, respectively. A mean weight of 11.7 g per smolt (Table 12) resulted in an average 3.6 smolt per count adjustment factor to expand sonar counts.

Age, weight, and length data were collected from 1,232 sockeye salmon smolt in 2001 (Table 13). Age-1., -2., and -3. smolt were sampled. Mean length was 101 mm for age-1. smolt, 116 mm for age-2. smolt, and 142 mm for age-3. smolt. Mean weight was 10.0 g for age-1. smolt, 14.5 g for age-2. smolt, and 26.4 g for age-3. smolt. An additional 2,468 smolt were measured for length only

(Table 14). Age-1. smolt were separated from age-2. smolt using a discriminating length of 109 mm.

Twenty-eight range-of-passage measurements were recorded for smolt schools passing over Egegik River sonar arrays during peak smolt passages from May 22 to June 8 (Table 15). Schools passed at an average range of 174 cm to 256 cm above the transducers. The average counting range above the transducers was 353 cm to 369 cm during the peak smolt passage. The difference in the range of smolt passage by hour for each array is shown in Figure 8.

River and weather conditions were recorded at the counting site from May 17 to June 9 (Table 16). The weather was excellent for counting smolt in 2001. The smolt counter was disabled because of weather for only 21.9 hours (4%) of the 549 hours it operated (Figure 9). Wave action from strong SW winds and rain and snow squalls were the primary causes. Smolt days with 6 or more hours of disabled time because of weather were 5/26 (9 h) and 5/27 (8 h). Mean water temperature during the season was 7.3°C (range 4.0°C to 12.5°C). Mean daily water temperature during the peak of the smolt count on June 9 was 8.0°C.

In 2001, the Egegik River smolt sonar disabled time from boat traffic (1.2 h) and equipment problems (0.6 h) were negligible.

Ugashik River

Open water was observed on Upper and Lower Ugashik Lakes throughout the winter of 2000/2001. Unseasonably warm temperatures and strong prevailing winds kept the lake open. Some ice may have formed briefly on protected bays and shores of the lake from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits, however, the entire lake never froze completely.

Since 1977, Upper and Lower Ugashik Lakes have averaged 94 ice-covered days per year (Appendix B.3). Historically, the average freeze-up date for the lake is January 21 and the average lake ice break-up date is April 22.

In 2001, the first two Ugashik crewmembers arrived at the study site mid-afternoon on May 18 and the remaining crewmembers arrived that evening. The crew reported no signs of smolt prior to the deployment of their sonar gear.

The Ugashik smolt counter (S/N 8320004) was activated at 1400 hours on May 20. Initial sonar counts indicated little or no smolt passage at the smolt sonar site prior to May 29. The first daily sonar counts greater than 100,000 occurred on May 29.

A fyke net fished from 2322 hours to 0042 hours on May 20 caught 66 smolt (Appendix C.9). Complete summaries of the 2001 Ugashik River fyke net catch by date, species, hour, and time

fished are presented in Appendices C.10 to C.12. Other species that were captured in the fyke net were: coho salmon smolt, pink salmon fry, and chum salmon fry *Oncorhynchus keta*.

River velocity measurements over the inshore index array ranged from 1.6 to 1.8 m/s (5.4 to 5.8 ft/sec). The average velocity at the inshore array in 2001 was less than the 1983-2000 average of 1.9 m/sec (6.3 ft/sec) (Appendix D.5 and D.6). Velocity correction factors (m/s) used to adjust the sonar counter transmit rate for the two arrays were as follows:

Smolt Days	Inshore	Offshore
May 20 - May 26	1.00	0.93
May 27 - Jun 03	1.00	0.83
Jun 04 - Jun 12	1.00	0.81

A total of 3,340,432 sonar counts were recorded at the Ugashik River sonar counting site from May 20 to June 12, 2001 (Table 17). Counts were fairly evenly distributed between the inshore array (51%) and the offshore array (49%). Daily sonar counts were highest from May 29 to June 7. Eighty-four percent of the total counts were recorded during these days. The peak daily sonar count of 578,226 occurred on June 6. Over the entire sampling season, 90% of all smolt counts were recorded between 2300 hours and 0500 hours with peak passages occurring at 0100 hours (Table 18).

Based on expanded sonar counts an estimated 35,123,888 sockeye salmon smolt migrated from Ugashik River in 2001 (Table 19). Age-1. smolt (1999 brood year) comprised 82% of the total smolt estimate and they were the predominant age class throughout most of the samples. Age-2. smolt (1998 brood year) composed 18% of the total migration and they were most numerous from May 26-28. Mean weights of smolt ranged from 6.7 to 11.3 g per smolt (Table 20), resulting in an average 4.9 smolt per count adjustment factor for the expansion of sonar counts.

Age, weight, and length data were collected from 1,744 sockeye salmon smolt in 2001 (Table 21). Mean length was 92 mm for age-1. smolt and 108 mm for age-2. smolt. Mean weight was 7.3 g for age-1. smolt and 11.5 g for age-2. smolt. An additional 7,006 sockeye salmon smolt were sampled for length only (Table 22). A discriminating length of 101 mm was calculated to differentiate age-1. smolt from age-2. smolt at Ugashik River.

Twenty-seven range-of-passage measurements were recorded for smolt schools passing over Ugashik River sonar arrays between May 24 and June 9, 2001 (Table 23). Schools passed at an average range of 229 cm to 279 cm above the transducers. The average counting range above the transducers during peak passage was 291 cm to 294 cm. The difference in the range of smolt passage by hour for each array is shown in Figure 10.

River and weather conditions were recorded at the counting site from May 20 to June 13 (Table 24). Weather conditions were good for enumerating sockeye salmon smolt emigrating from Upper

and Lower Ugashik Lakes in 2001. The smolt counter was disabled for 14.9 h (<3%) of the 574 h it operated in 2001 because of weather (Figure 11). Snow, rainsqualls, wave action, and entrained air in the water column from strong W, WNW, and N winds were the primary causes. The only smolt day with six or more hours of disabled time because of weather was 5/26 (6 h). Average water temperature was 4.6°C (range 3.5°C to 7.0°C). The mean water temperature during the peak of the smolt outmigration, on June 6, was 5.0°C.

During 2001, Ugashik River smolt sonar counters were also disabled for 0.4 h from boat-or-floatplane traffic and there was no disabled time from equipment problems or adjustments.

DISCUSSION

Kvichak River

The 2001 smolt outmigration estimate of 325,914,951 smolt is the fourth largest smolt outmigration estimate recorded at the Kvichak River sonar site (Appendices F.1 and F.2). It is almost twice as big as the 1983-2000 average of 169,810,025 smolt. All smolt outmigration estimates since 1994 have been composed primarily of age-1. smolt.

Comparing the percent of the total adjusted sonar count by smolt day for 2001 with the 1991-2000 mean it appears that the timing of the peak count was 1 d earlier (Figure 12). A comparison of the 2001 cumulative percent of the total adjusted sonar count by smolt day with the 1991-2000 mean shows that the timing for the front end (25%) of the smolt outmigration was 2 d earlier, the mid-point (50%) was 6 d earlier than the recent 10-year average, and the later portion (75%) was 3 d earlier (Figure 13).

Historically, the proportion of age-2. smolt has been highest early in the season. This was also true in 2001, with age-2. smolt 41-50% of the fyke net catch from May 18-20. Thereafter, age-2. smolt comprised 12-44% of the fyke net catch.

The percent of the total adjusted sonar count by hour for 2001 showed much higher counts in the mid-to-late afternoon and early evening than the 1991-2000 mean (Figure 14). In 2001, the 1400 to 2100 hour counts were above average and the counts from 2300 to 0700 were below average.

The mean length and weight of age-1. smolt in 2001 were less than or equal to the smallest on record for Kvichak River. They were 9 mm shorter and 1.7 g lighter than the 1955-2000 mean (Table 25). Other years that we have documented short mean lengths for age-1. smolt were: 1959 (80 mm), 1972 (80 mm), and 1983 (80 mm). Low mean weights for age-1. smolt were also recorded in 1962 (4.3 g), 1972 (4.2 g), and 1985 (4.5 g).

The age-2. smolt in 2001 were also small; they were 5 mm shorter and 1.9 g lighter than the 1955-2000 mean (Table 25). However, the age 2. smolt that outmigrated in 1986 are the smallest on record with a mean length of 96 mm and a mean weight of 7.0 g.

The mean water temperature in 2001 was 1.9°C warmer (NSC) than the 1963-2000 mean of 5.9°C (Table 26). The mean daily water temperature when the Kvichak River sonar project began this year was 2.3°C warmer than the average of 4.5°C (Appendix G.1). On May 20, the peak of the 2001 smolt passage, the mean daily water temperature was 0.9°C warmer than the 1984-2000 mean. For a summary of other climatological factors that may have affected the freshwater survival of smolt that outmigrated in 2001 see Appendix H.

The most recent brood year of sockeye salmon that spawned in the Kvichak River drainage and had all of its offspring outmigrate from freshwater spawning and rearing areas to the marine environment is brood year 1997. A comparison of total smolt outmigration estimates by age with the 1997 brood year escapement of 1,530,732 sockeye salmon showed a freshwater survival rate of approximately 103 smolt per spawner (Table 27). Since we expect no catch of age-3. smolt at Kvichak River in 2002, the freshwater survival rate for the 1998 brood year escapement of 2,296,074 sockeye salmon should remain at 87 smolt per spawner. Smolt-per-spawner estimates for 1997 and 1998 were both greater than the recent ten-year average for Kvichak River; mean production from brood years 1987-1996 was 42 smolt per spawner. The smolt-per-spawner estimate for 1998 is the third highest on record for any eastside Bristol Bay river and it is twice as high as the recent 10-year average.

Nineteen ninety-four (1994) was the most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Kvichak River drainage to spawn. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1985-1994 (Table 28) shows an average marine survival (i.e. adult salmon returns per smolt) of 0.09 for age-1. smolt and 0.15 for age-2. smolt. For brood year 1995, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Kvichak River in 2002 as 7-year-old fish. Since 7-year-old fish historically compose < 1% of the total sockeye salmon return to the Kvichak River, the average marine survival for brood year 1995 age-1. (0.04) and age-2. smolt (0.01) will remain below the 1985-1994 averages.

A comparison of the age composition of sockeye salmon smolt from the Kvichak River with the freshwater age composition of the total adult returns shows close comparison for brood years 1985, 1988, 1990, and 1993 (Figure 15). For example in brood year 1985, 11% of the smolt were estimated to be age-1. and 89% of the smolt were estimated to be age-2. Analysis of the freshwater age of the total adult return for the 1985 brood year showed 13% age-1. and 87% age-2. However, the freshwater age relationship between smolt and adults does not always hold true. In brood years 1986, 1987, 1989, 1992, and 1994 estimates of smolt age composition were significantly higher for age-1. smolt and lower for age-2. smolt than adult returns (Table 29). Similarly, in brood year 1991, smolt age composition showed lower percentages of age-1. and greater percentages of age-2. smolt than the age composition of the adult return.

If the fyke net catches a representative sample of outmigrating smolt and smolt survival rates by age are equal, then you would expect the freshwater age composition of the smolt to match the freshwater age composition of the total adult return from corresponding brood years. However, there is strong evidence that survival rates are higher for the larger age-2. smolt than for the smaller age-1. smolt (Table 29). Differences in freshwater age composition between smolt and their corresponding adult return can be attributed to a number of factors including: (1) differential survival rates of smolt by age; (2) errors in estimates of smolt age composition; (3) errors in estimates of adult total return age composition; and (4) inaccurate estimates of numbers of smolt by age because of not counting the early or late portions of the outmigration.

Egegik River

The 2001 Egegik River smolt outmigration estimate was 42% smaller than the 1983-2000 average of 52,163,728 smolt (Appendices F.3 and F.4). All smolt outmigration estimates since 1996 have been below the 1983-2000 average, except 1998. In three of the last five years, age-2. smolt have been the predominant age class outmigrating from the Egegik River.

Comparing the percent of the total adjusted sonar count by smolt day for 2001 with the 1991-2000 mean, the timing of the peak count appeared to be 3 d later than average (Figure 16). A comparison of the cumulative percent of the total adjusted sonar count by smolt day for 2001 with the 1991-2000 mean shows that the timing for the front end (25%) of the smolt outmigration was 2 d late, the mid-point (50%) was 1 d late, and the later portion (75%) was 0.5 d earlier than average (Figure 17).

The percent of the total adjusted sonar count by hour for 2001 was similar to the 1991-2000 mean (Figure 18).

Age-1. smolt in 2001 were 2 mm shorter and 0.3 g heavier than the 1956-2000 mean (Table 30). Age-2. smolt were 2 mm shorter than the historical mean and weighed 0.3 g more; age-3. smolt were 10 mm longer and weighed 6.6 g more.

The mean water temperature in 2001 was 1.1°C warmer than the 1981-2000 average of 6.2°C (Table 31). The mean daily water temperature when the Egegik River sonar was activated was 3.1°C warmer than the 1984-2000 average (Appendix G.2). During the peak smolt passage on May 29, the mean daily water temperature was 2.6°C warmer than the 1984-2000 average. Other climatological factors that may have affected the freshwater survival of 2001 smolt are summarized in Appendix H.

In the Egegik River drainage, the most recent brood year of sockeye salmon that has spawned and outmigrated as smolt from freshwater to the marine environment is brood year 1997. A comparison of total smolt outmigration estimates by age with the 1997 brood year escapement of 1,103,964 sockeye salmon showed a freshwater survival rate of approximately 29.5 smolt per spawner (Table 32). Since we expect age-3. smolt to comprise < 3% of the total smolt outmigration at Egegik

River in 2002, the freshwater survival rate for the 1998 brood year escapement of 1,110,882 sockeye salmon should remain at 10.8 smolt per spawner. The smolt-per-spawner estimate for 1997 and 1998 were below the recent ten-year average for Egegik River; mean production from brood years 1987-1996 was 38.1 smolt per spawner.

The most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Egegik River drainage to spawn was 1994. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1985-1994 (Table 33) shows an average marine survival (i.e., adult salmon returns per smolt) of 0.21 for age-1. smolt and 0.33 for age-2. smolt. For brood year 1995, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Egegik River in 2002 as 7-year-old fish. Seven-year-old fish historically composed < 1% of the total sockeye salmon return to the Egegik River, therefore the average marine survival for brood year 1995 age-1. smolt (0.52) will be above the 1985-1994 average and age-2. smolt (0.11) will be below the 1985-1994 average.

A comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of the total adult returns shows similarities ($\pm 15\%$) for brood years 1985, 1988-1991, and 1993 (Figure 19, Table 34). However, as we saw at Kvichak River, the smolt to adult freshwater age relationship does vary. In brood year 1986, 1987, and 1992, and 1994 smolt age composition showed a higher percentage of age-1. smolt and a lower percentage of age-2. smolt than the adult returns.

Ugashik River

The 2001 smolt outmigration of 35,123,888 smolt is the second largest estimate recorded at the Ugashik River smolt sonar site since 1993 (Appendices F.5 and F.6). All smolt outmigrations from Ugashik River from 1994-2000 were smaller than the 1990-2000 average of 30,264,229 smolt. Four of the last five years have had smolt outmigrations composed primarily of age-1. smolt.

Comparing the percent of the total adjusted sonar count by smolt day for 2001 with the 1991-2000 mean, it appears that the timing of the peak counts was 2 d late (Figure 20). A comparison of the cumulative percent of the total adjusted sonar count by smolt day with the 1991-2000 mean shows that the timing for the front end (25%) of the smolt outmigration was 5.5 d later, the mid-point (50%) was 3 d later than the average, and the later portion (75%) was 2 d later than average (Figure 21). Judging from the low sonar counts prior to May 25, we probably counted most of the smolt early in the outmigration. The percent of the total adjusted sonar count by hour for 2001 was similar to the 1991-2000 mean (Figure 22).

The dominant age groups of adult sockeye salmon from the 2001 smolt outmigration will return in 2003 (ages 1.2 and 2.2 fish) and 2004 (ages 1.3 and 2.3 fish).

Age-1. smolt in 2001 were 1 mm longer than the 1958-2000 mean and weighed 0.3 g more (Table 35). Age-2. smolt were 4 mm shorter and 0.7 g lighter than the 1958-2000 mean.

The mean water temperature in 2001 was 1.3°C less than the 1983-2000 mean of 5.9 °C (Table 36). The average daily water temperature when the sonar was activated this year was 0.2 °C warmer than the 1984-2000 average (Appendix G.3). At the peak of the 2001 smolt passage on June 6 the mean daily water temperature was 1.5°C less than the 1984-2000 average. See Appendix H for other climatological factors that may have affected the freshwater survival of smolt that outmigrated in 2001.

In the Ugashik River drainage, 1997 is the most recent brood year of sockeye salmon that has spawned and outmigrated as smolt from freshwater to the marine environment. A comparison of total smolt outmigration estimates by age with the 1997 brood year escapement of 618,396 sockeye salmon showed a freshwater survival rate of approximately 31.4 smolt per spawner (Table 37). Since we expect no catch of age-3. smolt at Ugashik River in 2002, the freshwater survival rate for the 1998 brood year escapement of 890,508 sockeye salmon should remain at 9.3 smolt per spawner. Smolt-per-spawner estimates for 1997 and 1998 were both below the recent ten-year average for Ugashik River; mean production from brood years 1987-1996 was 47.1 smolt per spawner.

The most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Ugashik River drainage to spawn was 1994. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1985-1994 (Table 38) shows an average marine survival (i.e. adult salmon returns per smolt) of 0.13 for age-1. smolt and 0.23 for age-2. smolt. For brood year 1995, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Ugashik River in 2002 as 7-year-old fish. Seven-year-old fish historically make up < 1% of the total sockeye salmon return to the Ugashik River. Therefore, the average marine survival for age-1. smolt from brood year 1995 (0.31) will be above the 1985-1994 average for Ugashik River and the average marine survival of age-2. smolt (0.12) is well below the 1985-1994 average.

A comparison of the age composition of outmigrating smolt at Ugashik River with the freshwater age composition of the total adult salmon return showed similarities ($\pm 5\%$) for brood years 1988, 1991, and 1994 (Figure 23, Table 39). In brood year 1985, age composition estimates from outmigrating smolt showed a lower percentage of age-1. smolt and a higher percentage of age-2. smolt compared to returning adults. In brood years 1986, 1987, 1992, and 1993 smolt age composition data showed higher percentages of age-1. smolt and lower percentages of age-2. smolt compared to adult returns.

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Table 1. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Kvichak River, 2001.

Smolt Day ^a	Transducer Array			Total
	Inshore	Center	Offshore	
5/18 ^{b c}	64,760	74,007	123,012	261,779
5/19	125,243	109,210	382,901	617,354
5/20 ^d	397,044	655,947	1,009,332	2,062,323
5/21 ^e	164,949	255,624	412,519	833,092
5/22	16,981	18,635	23,651	59,267
5/23	33,651	49,383	92,843	175,877
5/24 ^e	50,190	41,448	93,321	184,959
5/25	13,533	8,283	11,592	33,408
5/26 ^e	23,128	32,611	80,481	136,220
5/27	28,339	44,106	167,370	239,815
5/28	46,563	44,543	52,398	143,504
5/29 ^e	20,751	31,388	27,878	80,017
5/30	7,895	14,961	32,635	55,491
5/31	13,205	9,929	21,496	44,630
6/01	34,875	19,312	24,816	79,003
6/02	59,847	38,103	81,728	179,678
6/03	97,616	166,991	425,661	690,268
6/04	41,331	41,338	97,451	180,120
6/05	26,590	18,767	35,186	80,543
6/06 ^e	32,269	29,977	61,323	123,569
6/07 ^f	44,300	23,115	60,787	128,202
6/08	34,960	19,357	33,936	88,253
6/09 ^e	24,502	17,296	19,113	60,911
6/10	19,349	8,319	12,153	39,821
Total	1,421,871	1,772,650	3,383,583	6,578,104
Percent	21.6	27.0	51.4	

^a Smolt day began at 1200 hours and ended at 1159 hours the next calendar day.

^b Sonar counter was activated at 1200 hours on May 18, 2001.

^c First fyke net set at 1852-1854 hours, catch = 300 smolt.

^d Peak daily passage estimate for 2001.

^e Sonar counts interpolated for one or more arrays for the following periods:
 2200 hours (1 h) on smolt day 5/21 due to sonar evaluation crew working over the arrays
 1500 hours (1 h) on smolt day 5/24 due to sonar evaluation crew working over the arrays
 0800 hours (1 h) on smolt day 5/26 due to high wind (SW 15-20) and waves
 1200-1459 hours (3 h) on smolt day 5/29, sonar disabled to measure river velocities
 1200 hours (1 h) on smolt day 6/06, sonar disabled to measure river velocities
 0700 hours (1 h) on smolt day 6/09, inshore array count interpolated due to false counts

^f Rainbow trout *Oncorhynchus mykiss* sport fishing season opened at 0001 hours on June 8. Increased boat traffic after this opening produced 4.6 hours of sonar disabled time.

Table 2. Sonar counts by hour and array at the sockeye salmon smolt counting site on Kvichak River, 2001.

Sonar Operating Period	Hour	Sonar Count				Hourly Percent
		Transducer Array			Total	
		Inshore	Center	Offshore		
	1200	36,789	45,890	167,890	250,569	3.81
	1300	62,711	53,361	93,948	210,019	3.19
	1400	89,959	98,883	127,820	316,662	4.81
	1500	142,211	138,314	152,459	432,983	6.58
	1600	97,599	154,644	202,060	454,303	6.91
	1700	90,585	173,899	280,188	544,672	8.28
	1800	69,252	110,062	250,455	429,769	6.53
	1900	59,310	104,815	256,864	420,989	6.40
	2000	63,749	114,459	263,238	441,446	6.71
Smolt Days	2100	98,101	159,343	228,737	486,181	7.39
	2200	72,112	60,502	179,117	311,731	4.74
5/18 to	2300 ^b	26,009	29,201	107,093	162,303	2.47
	2400 ^c	24,544	21,909	43,819	90,272	1.37
6/10	0100 ^c	62,634	58,475	153,099	274,208	4.17
	0200 ^c	95,126	142,401	180,604	418,131	6.36
	0300 ^c	77,890	76,995	85,636	240,521	3.66
	0400 ^c	30,131	17,140	23,640	70,911	1.08
	0500 ^c	30,748	18,646	47,346	96,740	1.47
	0600 ^b	17,453	20,029	32,578	70,060	1.07
	0700	20,325	30,434	37,258	88,017	1.34
	0800	28,792	41,414	73,839	144,045	2.19
	0900	51,596	38,219	132,372	222,187	3.38
	1000	47,020	35,459	114,816	197,295	3.00
	1100	27,226	28,157	148,707	204,090	3.10
Total		1,421,871	1,772,650	3,383,582	6,578,104	100.00

^a Daylight hours unless indicated otherwise.

^b Twilight hours

^c Hours of darkness

Table 3. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Kvichak River, 2001.

Smolt Day ^a	Age 1.			Age 2.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/18	5,441,852	49.9	5,441,852	5,461,478	50.1	5,461,478	10,903,330	10,903,330
5/19	13,113,801	49.9	18,555,653	13,161,096	50.1	18,622,574	26,274,897	37,178,227
5/20	51,255,109	58.6	69,810,762	36,225,875	41.4	54,848,449	87,480,984	124,659,211
5/21	36,572,759	81.9	106,383,521	8,109,903	18.2	62,958,352	44,682,662	169,341,873
5/22	3,032,338	85.6	109,415,859	512,183	14.5	63,470,535	3,544,521	172,886,394
5/23	7,917,624	83.0	117,333,483	1,618,235	17.0	65,088,770	9,535,859	182,422,253
5/24	9,584,162	85.8	126,917,645	1,582,285	14.2	66,671,055	11,166,447	193,588,700
5/25	873,458	56.4	127,791,103	676,051	43.6	67,347,106	1,549,509	195,138,209
5/26	5,262,203	74.0	133,053,306	1,849,843	26.0	69,196,949	7,112,046	202,250,255
5/27	12,580,761	86.7	145,634,067	1,931,594	13.3	71,128,543	14,512,355	216,762,610
5/28	7,610,999	87.6	153,245,066	1,079,340	12.4	72,207,883	8,690,339	225,452,949
5/29	2,875,960	74.4	156,121,026	988,538	25.6	73,196,421	3,864,498	229,317,447
5/30	2,885,668	88.0	159,006,694	394,245	12.0	73,590,666	3,279,913	232,597,360
5/31	2,134,040	81.9	161,140,734	470,989	18.1	74,061,655	2,605,029	235,202,389
6/01	2,864,560	69.2	164,005,294	1,276,773	30.8	75,338,428	4,141,333	239,343,722
6/02	8,677,838	82.9	172,683,132	1,791,263	17.1	77,129,691	10,469,101	249,812,823
6/03	23,919,102	70.5	196,602,234	10,008,702	29.5	87,138,393	33,927,804	283,740,627
6/04	9,106,802	85.3	205,709,036	1,570,653	14.7	88,709,046	10,677,455	294,418,082
6/05	4,222,727	84.7	209,931,763	764,549	15.3	89,473,595	4,987,276	299,405,358
6/06	4,960,050	74.7	214,891,813	1,679,909	25.3	91,153,504	6,639,959	306,045,317
6/07	6,935,563	84.8	221,827,376	1,247,992	15.3	92,401,496	8,183,555	314,228,872
6/08	4,904,478	86.1	226,731,854	790,457	13.9	93,191,953	5,694,935	319,923,807
6/09	2,763,212	77.9	229,495,066	782,094	22.1	93,974,047	3,545,306	323,469,113
6/10	1,906,286	77.9	231,401,352	539,552	22.1	94,513,599	2,445,838	325,914,951
	231,401,352	71.0		94,513,599	29.0		325,914,951	

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 4. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Kvichak River, 2001.

Smolt Day ^a	Mean Weight of Smolt (g)	Smolt per Count
5/18	6.6	6.3
5/19	6.6	6.3
5/20	6.3	6.6
5/21	5.0	8.3
5/22	4.6	9.0
5/23	5.0	8.3
5/24	4.7	8.8
5/25	6.4	6.5
5/26	5.2	7.9
5/27	4.5	9.2
5/28	4.6	9.0
5/29	5.5	7.6
5/30	4.6	8.9
5/31	5.0	8.3
6/01	5.7	7.2
6/02	5.1	8.2
6/03	5.6	7.4
6/04	4.8	8.6
6/05	4.7	8.8
6/06	5.3	7.9
6/07	4.7	8.9
6/08	4.6	9.0
6/09	5.0	8.3
6/10	5.0	8.3

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 5. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Kvichak River, 2001.

Smolt Day ^a	Age 1.					Age 2.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size
5/18	83	12.1	5.3	2.20	16	103	14.7	9.1	3.54	83
5/19	80	9.3	4.6	2.00	57	102	14.4	8.6	3.13	42
5/20	81	11.4	5.0	3.29	34	101	16.9	9.2	4.10	66
5/21	78	9.0	4.7	2.16	78	99	17.1	8.2	3.74	12
5/22	76	7.8	4.2	2.09	92	96	12.5	7.9	2.96	8
5/23	78	10.2	4.2	1.92	96	104	4.9	8.7	0.62	3
5/24	77	11.3	4.1	2.22	98	101	0.0	7.8	0.36	2
5/25	78	10.9	4.4	1.77	60	104	14.6	9.7	3.93	39
5/26	77	10.2	4.0	1.70	51	105	15.9	9.4	3.70	49
5/27	77	8.6	3.8	1.30	98	92		6.2		1
5/28	77	8.1	4.2	1.54	97	103	16.3	10.0	4.77	3
5/29	78	14.2	4.3	2.08	71	108	16.5	10.1	3.67	29
5/30	78	12.5	4.4	2.49	98	106	7.1	9.3	1.25	2
5/31	79	10.9	4.3	1.60	87	107	11.3	9.3	2.49	13
6/01	77	7.9	3.9	1.63	84	104	16.9	9.1	4.25	16
6/02	79	12.8	4.8	2.80	90	104	8.3	9.3	1.85	10
6/03	77	8.3	4.0	1.28	98	106		8.4		1
6/04	78	8.6	4.3	1.54	99	93		6.5		1
6/05	77	9.2	3.8	1.59	97	93	4.8	6.1	1.08	3
6/06	78	10.2	3.8	1.70	84	103	13.5	8.4	3.19	15
6/07	77	9.3	3.9	1.55	99	107		9.1		1
6/08	77	9.4	3.8	1.65	97	99	14.4	8.1	2.36	3
6/09	76	9.0	3.8	1.60	98	99	1.8	6.9	0.77	2
Total Mean	78		4.2		1,879	102		8.5		404

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 6. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Kvichak River, 2001.

Smolt Day ^b	Age 1. ^a				Age 2. ^a			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/18	81	8.0	4.5	61	103	18.7	9.0	228
5/19	80	13.7	4.4	438	101	20.8	8.5	248
5/20	79	14.0	4.3	335	103	16.7	9.0	141
5/21	77	15.5	4.1	568	100	17.9	8.5	45
5/22	75	13.6	3.9	504	99	10.2	8.2	16
5/23	78	14.4	4.2	536	101	19.5	8.7	45
5/24	76	13.0	4.0	524	102	14.6	8.9	21
5/25	79	14.6	4.3	360	104	21.6	9.1	220
5/26	75	13.4	3.8	484	103	19.1	9.1	59
5/27	75	11.4	3.8	527	99	16.0	8.3	15
5/28	76	12.8	4.0	504	95	6.6	7.3	7
5/29	78	14.0	4.1	315	105	17.1	9.5	29
5/30	76	12.8	4.0	450	101	10.2	8.6	5
5/31	78	14.3	4.2	522	99	17.4	8.3	39
6/01	79	13.7	4.3	428	104	20.2	9.3	139
6/02	78	13.1	4.2	539	102	16.2	8.8	37
6/03	77	13.8	4.1	404	106	23.3	9.7	138
6/04	77	13.3	4.1	527	100	13.2	8.4	27
6/05	77	12.6	4.0	498	101	17.0	8.6	27
6/06	77	15.0	4.1	444	102	18.0	8.8	89
6/07	76	13.5	4.0	519	98	16.6	8.0	30
6/08	76	14.0	4.0	539	101	14.2	8.6	18
6/09	76	11.2	4.0	206	102	10.8	8.8	9
Total Mean	77		4.1	10,232	101		8.7	1,632

^a Length-weight parameters by age group and discriminating length used to separate ages from May 18 to June 09 were:

Age 1. $a = -9.0023$ $b = 2.3904$ $r^2 = 0.4387$ $n = 1,879$

Age 2. $a = -9.3253$ $b = 2.4829$ $r^2 = 0.7855$ $n = 404$

Discriminating Length = 88.26 mm

^b Sampling day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 7. Range of sockeye salmon smolt passage from the transducers at Kvichak River sonar site, May 17 to June 7, 2001.

	Range of Passage from the Transducers (cm)							
	Inshore Array ^a Smolt Schools		Center Array ^b Smolt Schools		Offshore Array ^c Smolt Schools		All Combined Smolt Schools	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
Maximum	264	252	270	258	270	249	270	258
Mean	245	185	250	198	248	192	248	192
Minimum	214	126	215	160	224	132	214	126
n	18	18	19	19	27	27	64	64

a Average depth of inshore array on smolt day 5/20 was 264 cm.

b Average depth of center array on smolt day 5/20 was 270 cm.

c Average depth of offshore array on smolt day 5/20 was 270 cm.

Table 8. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Kvichak River, 2001.

Date	Cloud Cover ^a		Precipitation ^b (mm)	Wind Direction & Velocity (km/h)		Air Temperature (°C)		Water Temperature (°C)		Water Clarity ^c
	0800	2000		0800	2000	0800	2000	0800	2000	
5/18	n	1	trace	n	E 16	n	8.0	n	7.5	n
5/19	3	1	0.0	0	W 08	4.0	11.0	6.0	7.0	clear
5/20	1	3	0.0	W 27	0	8.0	11.0	6.0	7.5	clear
5/21	1	3	0.0	0	NW 19	16.0	11.0	6.5	8.0	clear
5/22	3	3	0.0	W 13	E 14-18	11.0	9.0	6.0	7.0	clear
5/23	4	3	0.0	E 27	E 13	6.0	10.0	6.5	7.0	clear
5/24	4	3	0.0	E 13	NW 18	5.0	8.0	6.0	7.0	clear
5/25	2	4	0.2	0	SE 11	7.0	6.0	6.0	6.0	clear
5/26	4	3	0.4	E 13	S 21	5.0	6.0	5.0	5.0	clear
5/27	3	3	0.0	SW 27	SW 16-26	6.0	15.0	5.5	8.0	clear
5/28	1	3	0.0	NE 08	S 10	16.0	19.0	6.5	8.0	clear
5/29	1	2	0.0	0	N 08	n	18.0	7.0	9.0	clear
5/30	3	3	0.0	SE 13	E 21	12.0	14.0	8.0	9.0	clear
5/31	2	3	0.0	E 16	ENE 29	14.0	n	7.5	8.0	clear
6/01	3	1	0.0	E 19	W 08	8.0	19.0	6.5	7.5	clear
6/02	1	1	0.0	0	NNW 19	22.0	20.0	7.0	8.0	clear
6/03	3	2	0.0	0	W 14	12.0	15.0	7.0	10.0	clear
6/04	4	3	0.0	E 08	W 13	10.0	15.0	8.5	10.0	clear
6/05	4	4	0.0	E 11	SE 11	8.0	14.0	8.0	9.5	clear
6/06	4	4	0.0	W 08	W 16	8.0	11.0	8.5	9.0	clear
6/07	3	3	0.0	0	E 08	11.0	15.0	8.5	10.0	clear
6/08	3	3	0.0	0	S 06	13.0	15.0	9.0	10.0	clear
6/09	1	3	0.0	E 13	NE 10	21.0	18.0	9.0	10.5	clear
6/10	1	1	0.0	E 13	SE 19	21.0	16.0	9.5	10.5	clear
6/11	4	4	0.0	0	n	n	n	9.0	n	clear

^a 1 = Cloud cover not more than 1/10
 2 = Cloud cover not more than 1/2
 3 = Cloud cover more than 1/2
 4 = Completely overcast
 5 = Fog

^b n = no observation

^c Water clarity at 0800 hours

son counts by smolt day and array at the sockeye salmon smolt counting site on Egegik River, 2001.

Day	Transducer Array			Total
	Inshore	Center	Offshore	
5/17 ^{a, b, c, d}	290	899	149	1,338
5/18 ^d	794	712	588	2,094
5/19 ^d	688	470	117	1,275
5/20 ^d	299	1,077	671	2,047
5/21 ^d	142	846	564	1,552
5/22	5,039	47,561	107,010	159,610
5/23	9,039	55,026	30,974	95,039
5/24	2,172	52,253	60,234	114,659
5/25 ^d	3,011	17,372	35,341	55,724
5/26 ^d	6,132	29,357	31,979	67,468
5/27 ^d	13,069	29,461	9,063	51,593
5/28	15,821	63,796	24,203	103,820
5/29 ^e	20,327	264,332	224,169	508,828
5/30 ^d	20,010	90,814	65,253	176,077
5/31	3,089	11,067	132,860	147,016
6/01	25,828	152,717	28,744	207,289
6/02 ^d	22,199	46,054	34,940	103,193
6/03	823	11,645	58,600	71,068
6/04	538	7,660	27,042	35,240
6/05	956	25,303	31,281	57,540
6/06	3,675	11,527	21,229	36,431
6/07	3,069	18,796	23,616	45,481
6/08	13,621	23,067	8,152	44,840
Total	170,631	961,812	956,779	2,089,222
Percent	8.2	46.0	45.8	

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

^b Sonar counter was activated at 1500 hours on May 17, 2001.

^c Fyke net fished for 1-2 h per night from this smolt day forward whenever conditions permitted.

^d Sonar counts interpolated for one or more arrays for the following periods:

0300-0359 hours on smolt day 5/17 from boat traffic

2300-0159 and 0300-0359 hours on smolt day 5/18 from boat traffic

2400-0159 hours on smolt day 5/19 from boat traffic

1500-1559 and 0300-0359 hours on smolt day 5/20 from boat traffic

1800-1959 hours on smolt day 5/21 from strong SW winds and white capped waves

1600-1659 hours on smolt day 5/25 from NE winds and scattered showers

1300-0559 and 1100-1159 hours on smolt day 5/26 from strong SW winds, waves, heavy snow and rain

1200-1559 and 1700-2159 hours on smolt day 5/27 from strong SW winds, waves and driving rain

2000-2159 hours on smolt day 5/30 from equipment problems

1900-1959 hours on smolt day 6/02 from boat traffic

^e Peak daily smolt passage for 2001.

Table 10. Sonar counts by hour and array at the sockeye salmon smolt counting site on Egegik River, 2001.

Sonar Operating Period	Hour	Sonar Count				Hourly Percent	
		Transducer Array			Total		
	^a	Inshore	Center	Offshore			
	1200		6,077	30,701	4,490	41,269	1.98
	1300		13,536	35,069	6,569	55,173	2.64
	1400		10,383	102,560	4,001	116,946	5.60
	1500		5,524	34,135	3,074	42,733	2.05
	1600		1,863	24,912	3,347	30,122	1.44
	1700		2,549	59,470	9,730	71,749	3.43
	1800		14,092	36,467	11,683	62,242	2.98
	1900		10,805	21,443	8,667	40,915	1.96
	2000		10,365	53,054	41,656	105,076	5.03
Smolt Days	2100		11,124	50,517	28,617	90,259	4.32
	2200		2,144	23,417	12,578	38,138	1.83
5/17	2300	^b	1,223	14,080	46,845	62,147	2.97
to	2400	^c	1,076	12,935	83,870	97,880	4.69
6/08	0100	^c	3,876	37,481	89,833	131,190	6.28
	0200	^c	17,834	81,060	187,358	286,253	13.70
	0300	^c	16,384	86,218	202,772	305,373	14.62
	0400	^c	28,221	77,663	107,996	213,880	10.24
	0500	^c	987	48,997	46,305	96,289	4.61
	0600	^b	3,528	55,919	36,407	95,854	4.59
	0700		3,754	24,579	5,568	33,901	1.62
	0800		1,054	21,260	1,039	23,353	1.12
	0900		176	4,190	4,906	9,272	0.44
	1000		746	15,539	4,450	20,735	0.99
	1100		3,312	10,146	5,016	18,474	0.88
Total			170,631	961,812	956,778	2,089,222	100.00

^a Daylight hours unless indicated otherwise.

^b Twilight hours

^c Hours of darkness

Table 11. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Egegik River, 2000

Smolt Day ^a	Age 1.			Age 2.			Age 3.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/17	8,798	52.5	8,798	7,285	43.5	7,285	668	4.0	668	16,751	16,751
5/18	14,485	52.5	23,283	11,994	43.5	19,279	1,100	4.0	1,768	27,579	44,330
5/19	8,596	52.5	31,879	7,118	43.5	26,397	653	4.0	2,421	16,367	60,697
5/20	14,137	52.5	46,016	11,707	43.5	38,104	1,074	4.0	3,495	26,918	87,615
5/21	10,779	52.5	56,795	8,925	43.5	47,029	818	4.0	4,313	20,522	108,137
5/22	1,174,138	52.5	1,230,933	972,263	43.5	1,019,292	89,200	4.0	93,513	2,235,601	2,343,738
5/23	648,835	52.5	1,879,768	537,277	43.5	1,556,569	49,292	4.0	142,805	1,235,404	3,579,142
5/24	814,640	52.5	2,694,408	674,575	43.5	2,231,144	61,889	4.0	204,694	1,551,104	5,130,246
5/25	408,052	52.5	3,102,460	337,893	43.5	2,569,037	31,000	4.0	235,694	776,945	5,907,191
5/26	489,324	52.5	3,591,784	405,192	43.5	2,974,229	37,174	4.0	272,868	931,690	6,838,881
5/27	360,471	52.5	3,952,255	298,494	43.5	3,272,723	27,385	4.0	300,253	686,350	7,525,231
5/28	715,584	52.5	4,667,839	592,551	43.5	3,865,274	54,363	4.0	354,616	1,362,498	8,887,729
5/29	2,859,761	45.0	7,527,600	3,339,880	52.6	7,205,154	151,783	2.4	506,399	6,351,424	15,239,153
5/30	1,875,085	69.3	9,402,685	819,267	30.3	8,024,421	12,179	0.5	518,578	2,706,531	17,945,684
5/31	1,689,204	69.4	11,091,889	740,609	30.4	8,765,030	5,601	0.2	524,179	2,435,414	20,381,098
6/01	1,888,526	63.9	12,980,415	1,065,989	36.1	9,831,019	0	0.0	524,179	2,954,515	23,335,613
6/02	1,571,332	86.3	14,551,747	229,369	12.6	10,060,388	21,133	1.2	545,312	1,821,834	25,157,447
6/03	1,121,344	86.3	15,673,091	163,683	12.6	10,224,071	15,081	1.2	560,393	1,300,108	26,457,555
6/04	512,521	82.4	16,185,612	104,593	16.8	10,328,664	4,725	0.8	565,118	621,839	27,079,394
6/05	806,946	82.4	16,992,558	164,679	16.8	10,493,343	7,440	0.8	572,558	979,065	28,058,459
6/06	524,884	82.4	17,517,442	107,116	16.8	10,600,459	4,839	0.8	577,397	636,839	28,695,298
6/07	646,283	82.4	18,163,725	131,891	16.8	10,732,350	5,959	0.8	583,356	784,133	29,479,431
6/08	631,321	82.4	18,795,046	128,837	16.8	10,861,187	5,821	0.8	589,177	765,979	30,245,410
	18,795,046	62.1		10,861,187	35.9		589,177	2.0		30,245,410	

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 12. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Egegik River, 2001.

Smolt Day ^a	Mean Weight of Smolt (g)	Smolt per Count
5/17	12.6	3.3
5/18	12.6	3.3
5/19	12.6	3.3
5/20	12.6	3.3
5/21	12.6	3.3
5/22	12.6	3.3
5/23	12.6	3.3
5/24	12.6	3.3
5/25	12.6	3.3
5/26	12.6	3.3
5/27	12.6	3.3
5/28	12.6	3.3
5/29	13.4	3.1
5/30	10.9	3.8
5/31	10.9	3.8
6/01	11.3	3.7
6/02	10.0	4.1
6/03	10.0	4.1
6/04	10.3	4.0
6/05	10.3	4.0
6/06	10.3	4.0
6/07	10.3	4.0
6/08	10.3	4.0

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 13. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Egegik River, 2001.

Smolt Day ^a	Age 1.					Age 2.					Age 3.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size
5/19	93		7.3		1					0					0
5/20					0	112	7.1	12.2	2.20	2					0
5/21					0					0					0
5/22	103	12.1	10.9	3.82	53	117	15.7	14.9	5.77	37	133	6.5	21.2	2.56	10
5/23	102	12.5	10.2	2.40	19	121	21.1	16.8	5.80	11	137	6.8	22.7	2.88	3
5/24	102	13.2	10.3	2.99	43	120	21.4	15.9	8.60	39	137	15.3	21.7	6.69	17
5/25	103	8.4	10.9	3.27	26	118	20.2	15.1	7.33	27	139	4.2	23.5	1.72	2
5/26					0					0					0
5/27	103		10.0		1					0					0
5/28	103	7.3	10.7	2.16	7	119	14.4	15.3	4.44	10					0
5/29	103	12.6	11.1	4.50	32	121	21.2	16.6	7.69	48	138	11.3	23.2	4.68	18
5/30	102	16.0	9.7	4.88	73	115	21.0	13.4	7.39	22	124	19.4	17.0	6.65	4
5/31	102	12.8	10.0	4.14	56	117	20.1	14.3	5.73	41	137	1.2	21.0	2.38	2
6/01	100	19.9	9.8	5.86	68	112	25.9	12.6	8.83	32					0
6/02	98	11.8	10.1	3.93	26	122	4.9	17.0	2.64	3	169		44.3		1
6/03	99	11.8	9.1	3.29	73	112	17.7	12.7	5.94	22	139	8.1	22.2	1.14	3
6/04	97	15.5	8.7	3.82	83	113	16.6	13.0	5.04	17					0
6/05	102	16.3	10.1	5.41	68	114	14.4	13.8	5.62	30	139	7.7	23.9	2.08	2
6/06	101	10.9	10.7	3.53	39	116	14.7	14.8	5.05	10	138		20.9		1
6/07	100	19.2	10.0	5.71	132	114	17.9	14.2	6.29	17	170		55.0		1
Total Mean	101		10.0		800	116		14.5		368	142		26.4		64

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 14. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Egegik River, 2001.

Smolt Day ^b	Age 1. ^a				Age 2. ^a			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/22	99	7.2	9.4	25	125	18.3	17.3	27
5/23				0				0
5/24	100	6.1	9.8	18	123	24.2	16.8	34
5/25				0				0
5/26				0				0
5/27				0				0
5/28				0				0
5/29	102	11.7	10.2	125	124	44.7	17.2	324
5/30	101	16.7	9.9	279	117	24.3	14.5	157
5/31	101	16.0	9.9	369	118	31.1	14.9	220
6/01	101	17.5	9.9	310	119	32.7	15.4	253
6/02				0				0
6/03	99	15.1	9.6	235	116	19.1	14.3	44
6/04				0				0
6/05	99	7.2	9.4	11	126	23.3	18.4	3
6/06				0				0
6/07	97	11.8	9.1	28	125	27.5	18.1	6
Total Mean	100		9.7	1,400	121		16.3	1,068

^a Length-weight parameters by age group and discriminating length used to separate ages were:

Age 1. $a = -9.5302$ $b = 2.5598$ $r^2 = 0.6885$ $n = 800$

Age 2. $a = -10.3147$ $b = 2.7251$ $r^2 = 0.8631$ $n = 368$

Discriminating Length = 108.86 mm

^b Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 15. Range of sockeye salmon smolt passage from the transducers at Egegik River sonar site, May 22 to June 8, 2001.

	Range of Passage from the Transducers (cm)							
	Inshore Array ^a Smolt Schools		Center Array ^b Smolt Schools		Offshore Array ^c Smolt Schools		All Combined Smolt Schools	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
Maximum			331	211	309	249	309	211
Mean			256	174	265	197	256	174
Minimum			191	91	229	169	191	91
n	0	0	11	11	17	17	28	28

^a Average depth of inshore array on smolt day 5/22 was 292 cm.

^b Average depth of center array on smolt day 5/22 was 353 cm.

^c Average depth of offshore array on smolt day 5/22 was 369 cm.

Table 16. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Egegik River, 2001.

Date	Cloud Cover ^a		Precipitation (mm)	Wind Direction & Velocity (km/h)		Air Temperature ^b (°C)		Water Temperature (°C)		Water Clarity ^c
	0800	2000		0800	2000	0800	2000	0800	2000	
5/17	1	2	0.0	na	0	na	14	7.0	9.5	clear
5/18	3	2	0.5	SW 18	NE 21	7	9	6.0	8.0	clear
5/19	3	1	0.0	0	N 23	5	20	5.0	10.0	clear
5/20	3	2	0.0	N 11	N 32	5.0	13.0	5.0	9.0	clear
5/21	2	4	0.0	W 11	W 32	5.0	10.0	6.0	8.5	clear
5/22	4	4	0.5	E 23	NE 18	3.0	6.0	5.0	8.0	clear
5/23	4	3	0.0	S 13	S 13	3.0	11.0	5.0	9.0	clear
5/24	4	4	5.3	E 13	na	4.0	na	5.0	na	clear
5/25	3	4	0.0	NE 11	E 16	6.0	3.0	5.0	7.0	clear
5/26	4	4	8.4	SE 19	W 32	2.0	5.0	5.0	7.0	clear
5/27	3	3	0.3	SW 32-40	W 24	3.0	11.0	4.0	7.0	clear
5/28	1	2	0.0	SW 10	W 40	10.0	16.0	5.0	8.0	clear
5/29	1	3	0.0	0	NE 24	6.0	10.0	5.0	9.5	clear
5/30	5	4	0.0	S 08	NE 08	5.0	4.0	6.5	8.5	clear
5/31	5	4	0.0	0	S 31	3.0	5.0	na	7.5	clear
6/01	5	1	0.0	0	0	na	na	na	9.5	clear
6/02	1	2	0.0	N 19	E 13	12.0	16.0	5.0	10.0	clear
6/03	3	3	trace	NE 10	S 18	7.0	12.0	6.0	10.0	clear
6/04	5	3	trace	0	W 15	7.0	10.0	6.5	9.0	clear
6/05	4	4	0.0	E 08	SE 21	6.0	9.0	5.5	9.5	clear
6/06	4	3	0.0	W 06	E 19	5.0	13.0	6.0	10.5	clear
6/07	4	3	0.8	0	W 13	5.0	12.0	6.0	10.5	clear
6/08	2	3	0.0	0	0	10.0	13.0	7.0	12.5	clear
6/09	5	na	na	0	na	6.0	na	7.0	na	clear

^a 1 = Cloud cover not more than 1/10
 2 = Cloud cover not more than 1/2
 3 = Cloud cover more than 1/2
 4 = Completely overcast
 5 = Fog

^b na = not available

^c Water clarity at 0800 hours

Table 17. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Ugashik River, 2001.

Smolt Day ^a	Sonar Count		
	Transducer Array		Total
	Inshore	Offshore	
5/20 ^b	15,164	12,269	27,433
5/21	22,584	15,760	38,344
5/22	2,509	903	3,412
5/23	6,405	4,044	10,449
5/24	11,485	13,285	24,770
5/25 ^c	17,012	24,393	41,405
5/26 ^c	3,963	6,105	10,068
5/27	1,322	1,234	2,556
5/28	37,178	11,088	48,266
5/29	218,938	161,596	380,534
5/30	140,136	32,205	172,341
5/31	8,607	4,475	13,082
6/01	44,641	37,265	81,906
6/02	338,306	161,769	500,075
6/03	84,171	257,394	341,565
6/04	27,061	48,326	75,387
6/05	94,048	131,938	225,986
6/06 ^{c,d}	336,639	241,587	578,226
6/07 ^d	121,351	324,083	445,434
6/08 ^c	75,795	87,939	163,734
6/09	54,672	49,109	103,781
6/10 ^e	23,463	21,392	44,855
6/11	2,561	1,810	4,371
6/12	1,547	905	2,452
Total	1,689,558	1,650,874	3,340,432
Percent	50.6	49.4	

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

^b The sonar counter was activated at 1400 hours on smolt day 5/20.

^c Sonar counts interpolated for one or more arrays for the following periods:

0200-0659 hours on smolt day 5/25 from heavy rain and W wind

1200-1759 and 2000-2359 hours on smolt day 5/26 from high WNW wind & waves

1000-1059 hours on smolt day 5/26 from high W wind gusts

0300-0359 hours on smolt day 6/06 from rain and waves

2000-2159 hours on smolt day 6/08 from rain squalls

^d Distinct smolt schools (6'-7' diameter) passing at/near the surface (8" water depth) at 1-2 min intervals, inside the dead range of the inshore array from 1030-1230 hrs on smolt days 6/06-6/07.

^e Distinct smolt schools (~4'x6' each) passing at/near the surface (8" water depth) at 2-3 min intervals, inside the dead range of the inshore array; band of smolt 5' to 15' offshore from as far as the eye could see along the N shore of Lower Ugashik Lake to the outlet from 2100-0200 hours on smolt day 6/10.

Table 18. Sonar counts by hour and array at the sockeye salmon smolt counting site on Ugashik River, 2001.

Sonar Operating Period	Hour	a	Sonar Count			Hourly Percent
			Transducer Array		Total	
			Inshore	Offshore		
	1200		1,787	6,809	8,596	0.26
	1300		2,498	1,241	3,739	0.11
	1400		3,037	3,725	6,762	0.20
	1500		3,003	4,341	7,344	0.22
	1600		2,863	4,385	7,248	0.22
	1700		3,156	4,869	8,025	0.24
	1800		2,426	17,409	19,835	0.59
	1900		9,672	15,131	24,803	0.74
	2000		12,820	13,789	26,608	0.80
Smolt	2100		22,463	28,443	50,906	1.52
Days	2200		28,664	51,371	80,035	2.40
5/20	2300	b	132,107	127,099	259,205	7.76
to	2400	c	279,975	191,018	470,993	14.10
6/12	0100	c	320,102	365,832	685,934	20.53
	0200	c	323,813	265,338	589,150	17.64
	0300	c	211,613	204,963	416,576	12.47
	0400	c	243,450	207,448	450,898	13.50
	0500	c	51,591	95,633	147,224	4.41
	0600	b	11,097	19,197	30,294	0.91
	0700		4,868	3,740	8,608	0.26
	0800		8,038	7,238	15,276	0.46
	0900		7,364	6,573	13,937	0.42
	1000		1,214	3,606	4,821	0.14
	1100		1,937	1,679	3,616	0.11
Total			1,689,558	1,650,874	3,340,432	100.00

^a Daylight hours unless indicated otherwise.

^b Twilight hours.

^c Hours of darkness.

Table 19. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Ugashik River, 2001.

Smolt Day ^a	Age 1.			Age 2.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/20	118,407	48.1	118,407	127,864	51.9	127,864	246,271	246,271
5/21	167,297	48.1	285,704	180,658	51.9	308,522	347,955	594,226
5/22	20,440	60.2	306,144	13,530	39.8	322,052	33,970	628,196
5/23	60,544	60.2	366,688	40,077	39.8	362,129	100,621	728,817
5/24	156,744	64.6	523,432	85,894	35.4	448,023	242,638	971,455
5/25	259,917	64.6	783,349	142,431	35.4	590,454	402,348	1,373,803
5/26	22,810	30.6	806,159	51,807	69.4	642,261	74,617	1,448,420
5/27	5,697	30.6	811,856	12,940	69.4	655,201	18,637	1,467,057
5/28	118,389	30.6	930,245	268,884	69.4	924,085	387,273	1,854,330
5/29	2,335,424	65.2	3,265,669	1,245,965	34.8	2,170,050	3,581,389	5,435,719
5/30	1,538,682	80.3	4,804,351	376,769	19.7	2,546,819	1,915,451	7,351,170
5/31	111,593	80.6	4,915,944	26,791	19.4	2,573,610	138,384	7,489,554
6/01	844,225	90.1	5,760,169	92,969	9.9	2,666,579	937,194	8,426,748
6/02	5,421,375	90.1	11,181,544	597,025	9.9	3,263,604	6,018,400	14,445,148
6/03	2,621,616	83.2	13,803,160	530,122	16.8	3,793,726	3,151,738	17,596,886
6/04	314,168	53.8	14,117,328	269,787	46.2	4,063,513	583,955	18,180,841
6/05	1,560,935	74.6	15,678,263	530,910	25.4	4,594,423	2,091,845	20,272,686
6/06	5,408,596	85.6	21,086,859	912,072	14.4	5,506,495	6,320,668	26,593,354
6/07	4,550,495	93.2	25,637,354	333,058	6.8	5,839,553	4,883,553	31,476,907
6/08	1,728,502	89.8	27,365,856	196,547	10.2	6,036,100	1,925,049	33,401,956
6/09	1,006,788	87.6	28,372,644	141,988	12.4	6,178,088	1,148,776	34,550,732
6/10	434,048	87.6	28,806,692	61,214	12.4	6,239,302	495,262	35,045,994
6/11	43,445	87.6	28,850,137	6,127	12.4	6,245,429	49,572	35,095,566
6/12	24,822	87.6	28,874,959	3,500	12.4	6,248,929	28,322	35,123,888
	28,874,959	82.2		6,248,929	17.8		35,123,888	

^a Sample day began at 1200 hours and ended at 1159 the next calendar day.

Table 20. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Ugashik River 2001.

Smolt Day ^a	Mean Weight of Smolt (g)	Smolt per Count
5/20	9.7	4.3
5/21	9.7	4.3
5/22	9.2	4.5
5/23	9.2	4.5
5/24	8.7	4.8
5/25	8.7	4.8
5/26	11.3	3.7
5/27	11.3	3.7
5/28	11.3	3.7
5/29	9.0	4.6
5/30	8.3	5.0
5/31	8.2	5.0
6/01	7.3	5.7
6/02	7.3	5.7
6/03	8.0	5.2
6/04	9.8	4.2
6/05	8.4	4.9
6/06	7.7	5.4
6/07	6.7	6.2
6/08	6.8	6.1
6/09	7.4	5.6
6/10	7.4	5.6
6/11	7.4	5.6
6/12	7.4	5.6

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 21. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Ugashik River, 2001.

Smolt Day ^a	Age 1.					Age 2.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size
5/20	91	14.5	6.9	3.39	40	108	15.4	11.3	4.50	26
5/21	92	12.2	7.2	3.02	31	112	15.6	12.9	4.79	68
5/22	92	10.4	7.3	2.92	30	107	8.8	11.1	3.12	8
5/23	93	10.5	7.6	2.75	51	111	14.3	12.7	5.47	48
5/24	94	9.0	6.8	1.79	23	112	3.1	12.5	1.13	4
5/25	92	11.9	7.1	2.77	64	110	16.4	12.0	5.29	36
5/26	96	8.5	7.5	1.83	4	114	7.4	12.3	1.92	10
5/27	93	9.2	7.7	2.46	13	104	1.8	10.1	0.56	4
5/28	93	19.1	8.7	4.80	13	114	15.3	14.2	5.98	64
5/29	95	12.3	8.1	3.32	55	105	15.1	10.9	4.16	44
5/30	92	13.6	7.7	3.50	74	104	10.9	10.7	3.75	26
5/31	91	13.0	7.4	2.78	69	114	20.0	13.9	6.14	31
6/02	89	17.2	6.4	3.72	93	108	7.7	11.0	1.60	7
6/03	92	11.3	7.3	3.41	90	105	9.9	11.0	3.27	9
6/04	93	13.5	8.4	3.76	65	111	11.2	11.6	2.16	34
6/05	91	13.4	7.2	3.83	83	111	9.8	12.0	3.11	17
6/06	92	18.4	8.1	5.31	89	106	17.9	11.9	5.62	11
6/07	87	13.7	6.1	3.38	95	100	16.5	8.9	4.15	5
6/08	87	16.2	6.6	3.55	146	103	4.5	10.2	1.08	4
6/09	87	14.6	6.4	3.35	58	96	7.1	8.0	1.78	2
6/10	89	14.0	7.3	3.38	92	109	8.0	12.6	2.64	8
Total Mean	92		7.3		1,278	108		11.5		466

^a Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 22. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Ugashik River, 2001.

Smolt Day ^b	Age 1. ^a				Age 2. ^a			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/21	89	22.3	6.8	281	111	20.2	12.4	282
5/22				0				0
5/23	93	13.7	7.7	188	108	14.2	11.6	133
5/24				0				0
5/25	90	20.4	6.9	226	108	18.1	11.7	142
5/26				0				0
5/27				0				0
5/28	91	18.5	7.3	113	114	21.1	13.3	438
5/29	94	18.6	7.8	371	107	16.8	11.4	180
5/30	93	19.7	7.7	473	107	13.7	11.2	81
5/31	92	18.8	7.3	274	111	17.9	12.7	38
6/01				0				0
6/02	90	24.9	6.9	476	107	8.6	11.3	24
6/03	91	18.4	7.3	425	109	14.1	11.8	62
6/04	93	13.8	7.7	181	112	19.0	12.8	188
6/05	91	19.0	7.1	292	112	20.8	12.9	99
6/06	89	26.1	6.8	460	109	12.7	11.9	47
6/07	87	23.6	6.3	616	111	12.2	12.6	5
6/08	85	26.3	6.0	623	111	11.6	12.4	55
6/09				0				0
6/10	89	16.8	6.8	220	108	6.6	11.6	13
Total Mean	90		7.1	5,219	110		12.1	1,787

^a Length-weight parameters by age group and discriminating length used to separate ages were:

Age 1. $a = -10.5616$ $b = 2.7749$ $r^2 = 0.7362$ $n = 1,278$

Age 2. $a = -10.0572$ $b = 2.6679$ $r^2 = 0.8098$ $n = 466$

Discriminating Length = 101.1 mm

^b Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 23. Range of sockeye salmon smolt passage from the transducers at Ugashik River sonar site, May 24 to June 9, 2001.

	Range of Passage from the Transducers (cm)					
	Inshore Array ^a Smolt Schools		Offshore Array ^b Smolt Schools		All Combined Smolt Schools	
	Top	Bottom	Top	Bottom	Top	Bottom
Minimum	241	131	291	251	0	191
Mean	266	187	291	271	279	229
Maximum	281	231	291	281	286	256
n	14	14	13	13	27	27

^a Average depth of inshore array on smolt day 6/06 was 291cm.

^b Average depth of offshore array on smolt day 6/06 was 294 cm.

Table 24. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Ugashik River, 2001.

Date	Cloud Cover ^a		Precipitation (mm)	Wind Direction & Velocity (km/h)		Air Temperature ^b (°C)		Water Temperature (°C)		Water Clarity ^c
	0800	2000		0800	2000	0800	2000	0800	2000	
5/20	2	3	0.0	E 19	NW 08	5.0	13.0	6.0	5.0	clear
5/21	2	4	3.6	SW 11	W 29	8.0	4.0	4.0	4.0	clear
5/22	4	3	2.0	NW 19	NW 16	2.0	10.0	4.0	3.0	clear
5/23	4	3	0.0	0	NW 08	4.0	10.0	3.0	4.0	clear
5/24	4	3	0.0	S 0-08	0	4.0	15.0	3.0	5.0	clear
5/25	1	4	trace	0	WSW 13	4.0	6.0	3.0	4.0	clear
5/26	4	4	3.6	W 24-32	W 40	1.0	4.0	3.0	4.0	clear
5/27	4	4	0.0	W 24-32	NW 21	3.0	5.0	3.0	4.0	clear
5/28	1	2	0.0	NW 15	W 24	4.0	13.0	3.0	5.0	clear
5/29	3	2	0.0	SW 16	N 13	7.0	12.0	4.0	4.5	clear
5/30	4	3	1.0	0	W 23	5.0	6.0	4.0	4.5	clear
5/31	4	4	0.0	W 18	W 16	3.0	4.0	4.0	4.0	clear
6/01	4	1	trace	NW 19	0	3.0	11.0	3.0	4.0	clear
6/02	1	2	0.0	E 13	E 16	7.0	11.0	4.0	7.0	clear
6/03	4	4	0.0	E ??	W 16	na	9.0	4.0	5.0	clear
6/04	4	4	trace	0	SW 08	7.0	8.0	4.5	5.0	clear
6/05	4	4	trace	W 10	W 16	5.0	8.0	4.0	5.0	clear
6/06	4	2	trace	S 13	SE 21	7.0	11.0	4.0	5.0	clear
6/07	4	2	trace	0	E 19	8.0	14.0	5.0	6.0	clear
6/08	2	3	0.0	0	W 16	7.0	12.0	6.0	8.0	clear
6/09	5	1	7.0	W 08	WNW 19	5.0	15.0	6.5	6.0	clear
6/10	5	1	0.0	0	NW 16	6.0	13.0	6.0	6.0	clear
6/11	5	4	0.0	0	NW 11	5.0	8.0	5.5	5.5	clear
6/12	4	4	0.0	W 11	W 16	4.0	6.0	5.0	5.0	clear
6/13	4			W 16		5.0		5.0		clear

^a 1 = Cloud cover not more than 1/10
 2 = Cloud cover not more than 1/2
 3 = Cloud cover more than 1/2
 4 = Completely overcast
 5 = Fog

^b na = not available

^c Water clarity at 0800 hours

Table 25. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Kvichak River, 1955-2001.

Year of Migration	Age 1.				Age 2.				Age 3.				Total Estimate ^a
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	
1955	1953	7	89	--	1952	93	--	--	1951	0	--	--	260,068
1956	1954	39	92	--	1953	61	116	--	1952	0	--	--	77,660
1957	1955	72	96	7.3	1954	28	120	14.4	1953	0	--	--	30,907
1958	1956	98	84	4.6	1955	2	114	--	1954	0	--	--	3,333,953
1959	1957	3	80	--	1956	97	99	7.6	1955	0	--	--	2,863,876
1960	1958	10	91	6.3	1957	90	108	10.3	1956	0	--	--	614,003
1961	1959	72	92	6.8	1958	28	117	13.1	1957	0	--	--	36,164
1962	1960	94	82	4.3	1959	6	110	9.9	1958	0	--	--	1,203,000
1963	1961	3	83	4.8	1960	97	98	7.5	1959	0	--	--	4,229,431
1964	1962	22	87	5.2	1961	78	108	9.8	1960	0	--	--	2,061,586
1965	1963	4	90	6.8	1962	96	109	11.3	1961	0	--	--	1,812,555
1966	1964	92	94	7.4	1963	8	114	12.6	1962	0	--	--	275,761
1967	1965	93	86	5.9	1964	7	118	14.2	1963	0	--	--	3,088,742
1968	1966	11	88	5.5	1965	89	104	9.2	1964	0	--	--	6,123,683
1969	1967	52	92	5.7	1966	48	109	10.6	1965	0	--	--	1,135,344
1970	1968	38	91	6.0	1967	62	110	11.0	1966	0	--	--	483,638
1971	1969	93	90	5.8	1968	7	111	11.1	1967	0	--	--	91,682,813
1972	1970	1	80	4.2	1969	99	106	10.0	1968	0	--	--	54,623,559
1973	1971	3	86	5.1	1970	97	97	8.3	1969	0	--	--	196,966,331
1974	1972	9	96	8.3	1971	79	111	13.1	1970	12	124	17.5	27,082,626
1975	1973	63	98	8.4	1972	37	122	16.4	1971	0	--	--	15,632,531
1976	1974	97	88	5.8	1973	3	121	14.2	1972	0	--	--	111,388,180
1977	1975	38	86	5.5	1974	62	106	10.1	1973	0	--	--	192,578,099
1978	1976	12	88	6.0	1975	88	97	7.8	1974	0	--	--	245,591,014
1979	1977	51	90	6.0	1976	49	109	10.3	1975	0	--	--	55,181,540
1980	1978	94	88	5.9	1977	6	110	10.7	1976	0	--	--	192,853,007
1981	1979	89	85	5.4	1978	11	108	10.2	1977	0	--	--	252,222,769
1982	1980	58	84	5.1	1979	39	103	9.1	1978	0	--	--	239,721,729
1983	1981	8	80	4.9	1980	92	98	8.5	1979	0	--	--	82,793,899
1984	1982	58	90	6.8	1981	42	104	10.0	1980	0	--	--	89,489,975
1985	1983	92	85	5.3	1982	8	102	9.2	1981	0	--	--	25,527,851
1986	1984	61	84	5.5	1983	39	107	10.4	1982	<1	102	9.1	136,733,218
1987	1985	3	82	4.5	1984	97	96	7.0	1983	<1	97	8.5	342,686,918
1988	1986	13	86	5.6	1985	87	99	8.3	1984	<1	107	9.8	100,173,692
1989	1987	95	85	5.5	1986	5	108	10.8	1985	<1	105	9.5	153,464,216
1990	1988	53	87	6.1	1987	47	105	10.5	1986	0	--	--	88,004,103
1991	1989	72	85	5.5	1988	28	105	9.9	1987	0	--	--	121,454,182
1992	1990	23	84	5.6	1989	77	100	9.3	1988	0	--	--	79,490,008
1993	1991	10	86	6.0	1990	90	97	8.2	1989	0	--	--	226,407,888
1994	1992	64	84	5.7	1991	36	102	9.5	1990	0	--	--	83,845,472
1995	1993	95	87	6.2	1992	5	103	9.8	1991	0	--	--	220,892,127
1996	1994	74	89	6.5	1993	26	110	11.3	1992	0	--	--	373,166,532
1997	1995	74	88	6.8	1994	26	105	10.6	1993	0	--	--	363,397,663
1998	1996	65	90	6.7	1995	35	112	11.9	1994	0	--	--	295,470,850
1999	1997	92	86	5.8	1996	8	108	10.3	1995	0	--	--	143,543,215
2000	1998	82	86	5.8	1997	18	103	9.5	1996	0	--	--	130,038,649
Mean			87	5.9			107	10.4			107	10.9	
2001	1999	71	78	4.2	1998	29	102	8.5	1997	0	--	--	325,914,951
Difference from Mean			-9	-1.7			-5	-1.9					

^a Estimates of smolt numbers from 1955 to 1970 based on fyke net catches; estimates of smolt numbers from 1971 to present based on hydroacoustic techniques.

Table 26. Water temperatures at sockeye salmon smolt counting site, Kvichak River, 1963-2001.

Year	Sample Period	Water Temperature (°C)		
		Minimum	Mean	Maximum
1963	May 16 - June 14	2.2	5.5	8.9
1964	May 18 - June 14	0.0	2.6	5.6
1965	May 17 - June 11	0.0	4.4	8.9
1966	May 16 - June 26	0.0	4.7	11.1
1967	May 17 - June 20	1.1	6.9	9.4
1968	May 12 - June 12	3.3	5.4	8.3
1969	May 16 - June 18	0.3	3.9	7.8
1970	May 13 - June 07	2.8	6.8	11.1
1971	May 17 - June 20	1.1	2.4	3.3
1972	May 18 - June 18	0.6	2.9	5.0
1973	May 15 - June 14	2.9	4.9	8.9
1974	May 13 - June 09	3.0	6.2	8.0
1975	May 17 - June 15	2.0	3.8	8.0
1976	May 18 - June 19	2.0	3.9	9.5
1977	May 17 - June 14	3.0	6.4	9.5
1978	May 19 - June 09	5.0	7.6	11.0
1979	June 01 - June 10	8.0	8.6	10.0
1980	May 16 - June 18	1.5	5.5	9.0
1981	May 15 - June 09	7.0	8.2	10.0
1982	May 14 - June 15	2.5	4.9	8.5
1983	May 19 - June 14	5.2	7.9	10.5
1984	May 19 - June 11	5.5	7.9	10.0
1985	May 23 - June 20	2.0	4.6	7.0
1986	May 18 - June 12	1.0	4.6	7.0
1987	May 21 - June 13	4.5	6.7	9.0
1988	May 17 - June 17	3.0	7.1	11.0
1989	May 19 - June 16	3.0	5.8	8.8
1990	May 22 - June 15	3.5	7.3	9.5
1991	May 23 - June 17	1.0	4.8	8.5
1992	May 22 - June 14	5.0	7.8	10.0
1993	May 19 - June 12	4.0	6.6	11.0
1994	May 22 - June 16	1.5	6.1	11.0
1995	May 21 - June 14	4.0	8.1	12.5
1996	May 17 - June 13	5.0	8.1	13.0
1997	May 17 - June 13	5.0	8.8	13.0
1998	May 18 - June 13	2.0	6.2	9.5
1999	May 23 - June 17	0.0	2.9	8.0
2000	May 20 - June 14	2.5	7.4	9.5
Mean		2.8	5.9	9.2
2001	May 18 - June 11	5.0	7.8	10.5
Difference from Mean		2.2	1.9	1.3

Table 27. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by each age class, and number of smolt produced per spawner for 1968-1999 brood years, Kvichak River.

Brood Year	Total Spawning Escapement ^a	Number of Smolt Produced						Total	Per Spawner
		Age 1.	(%) ^b	Age 2.	(%) ^b	Age 3.	(%) ^b		
1968				5,959,383		0			
1969	8,394,204	85,723,430	61	54,159,340	39	0	139,882,770	16.7	
1970	13,935,306	464,219	<1	191,842,930	98	2,918,768	195,225,917	14.0	
1971	2,387,392	5,123,400	19	21,423,246	81	0	26,546,646	11.1	
1972	1,009,962	2,740,610							
1973	226,554			3,031,287		0			
1974	4,433,844	108,356,892	49	114,269,848	51	0	222,626,740	50.2	
1975	13,140,450	78,308,251	27	213,364,470	73	0	291,672,721	22.2	
1976	1,965,282	32,226,544	55	26,423,348	45	0	58,649,892	29.8	
1977	1,341,144	28,758,191	73	10,410,467	27	0	39,168,658	29.2	
1978	4,149,288	182,442,540	85	32,294,536	15	0	214,737,076	51.8	
1979	11,218,434	219,928,232	71	89,300,703	29	0	309,228,935	27.6	
1980	22,505,268	150,421,026	66	76,244,773	34	0	226,665,799	10.1	
1981	1,754,358	6,549,125	15	37,595,987	85	0	44,145,112	25.2	
1982	1,134,840	51,893,988	96	1,937,408	4	2,065	53,833,461	47.4	
1983	3,569,982	23,590,443	31	53,260,693	69	123,975	76,975,111	21.6	
1984	10,490,670	83,470,460	20	331,384,545	80	43,135	414,898,140	39.5	
1985	7,211,046	11,178,398	11	87,004,194	89	30,345	98,212,937	13.6	
1986	1,179,322	13,126,363	66	6,830,717	34	0	19,957,080	16.9	
1987	6,065,880	146,603,154	78	41,434,534	22	0	188,037,688	31.0	
1988	4,065,216	46,569,569	58	34,266,421	42	0	80,835,990	19.9	
1989	8,317,500	87,187,761	59	61,317,308	41	0	148,505,069	17.9	
1990	6,970,020	18,172,700	8	204,626,879	92	0	222,799,579	32.0	
1991	4,222,788	21,781,009	42	30,207,268	58	0	51,988,277	12.3	
1992	4,725,864	53,638,204	83	11,034,144	17	0	64,672,348	13.7	
1993	4,025,166	209,857,983	69	96,434,554	31	0	306,292,537	76.1	
1994	8,337,840	276,731,978	75	94,049,964	25	0	370,781,942	44.5	
1995	10,038,720	269,347,699	72	103,481,449	28	0	372,829,148	37.1	
1996	1,450,578	191,989,401	94	12,200,727	6	0	204,190,128	140.8	
1997	1,503,732	131,342,488	85	23,859,650	15	0	155,202,138	103.2	
1998	2,296,074	106,178,999	53	94,513,599	47	^c	200,692,598 ^c	87.4 ^c	
1999	6,196,914	231,401,352				^c			
1987-1996 Max	10,038,720	276,731,978	94	204,626,879	92	0	372,829,148	140.8	
1987-1996 Avg	5,821,957	132,187,946	64	68,905,325	36	0	201,093,271	42.5	
1987-1996 Min	1,450,578	18,172,700	8	11,034,144	6	0	51,988,277	12.3	

^a Kvichak River tower count only. Does not include aerial survey index counts from Branch River.

^b Percent of total smolt production.

^c Incomplete returns from brood year escapements.

Table 28. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1968-1999 brood years, Kvichak River.

Brood Year	Total Spawning Escapement ^a	Age 1.			Age 2.		
		Number of Smolt	Adult ^b Returns	Adult Returns per Smolt	Number of Smolt	Adult ^b Returns	Adult Returns per Smolt
1968	2,557,440				5,959,383	209,138	0.04
1969	8,394,204	85,723,430	449,791	0.01	54,159,340	4,824,026	0.09
1970	13,935,306	464,219	56,778	0.12	191,842,930	15,351,498	0.08
1971	2,387,392	5,123,400	337,314	0.07	21,423,246	2,489,981	0.12
1972	1,009,962	2,740,610	436,837	0.16		1,504,435	^c
1973	226,554		1,606,766	^c	3,031,287	818,529	0.27
1974	4,433,844	108,326,892	8,353,542	0.08	114,269,848	17,796,617	0.16
1975	13,140,450	78,308,251	6,920,452	0.09	213,364,470	31,164,576	0.15
1976	1,965,282	32,226,544	6,132,390	0.19	26,423,348	4,431,284	0.17
1977	1,341,144	28,758,191	2,912,441	0.10	10,410,467	309,369	0.03
1978	4,149,288	182,442,540	2,991,655	0.02	32,294,536	2,151,024	0.07
1979	11,218,434	219,928,232	20,621,724	0.09	89,300,703	21,516,038	0.24
1980	22,505,268	150,421,026	4,534,253	0.03	76,244,773	8,508,770	0.11
1981	1,754,358	6,549,125	1,019,361	0.16	37,595,987	1,098,376	0.03
1982	1,134,840	51,893,988	995,144	0.02	1,937,408	663,241	0.34
1983	3,569,982	23,590,443	11,612,066	0.49	53,260,693	1,773,442	0.03
1984	10,490,670	83,470,460	4,455,429	0.05	331,384,545	19,478,848	0.06
1985	7,211,046	11,178,398	2,313,349	0.21	87,004,194	15,069,258	0.17
1986	1,179,322	13,126,363	1,791,108	0.14	6,830,717	2,722,727	0.40
1987	6,065,880	146,603,154	6,706,260	0.05	41,434,534	5,229,846	0.13
1988	4,065,216	46,569,569	4,982,204	0.11	34,266,421	4,961,033	0.14
1989	8,317,500	87,187,761	3,829,838	0.04	61,317,308	22,259,220	0.36
1990	6,970,020	18,172,700	2,740,515	0.15	204,626,879	22,351,535	0.11
1991	4,222,788	21,781,009	3,927,255	0.18	30,207,268	870,852	0.03
1992	4,725,864	53,638,204	655,398	0.01	11,034,144	750,314	0.07
1993	4,025,166	209,857,983	1,751,069	0.01	96,434,554	1,198,603	0.01
1994	8,337,840	276,731,978	3,018,338	0.01	94,049,964	4,056,157	0.04
1995	10,038,720	269,347,699	9,568,576	0.04	103,481,449	675,446 ^d	0.01 ^d
1996	1,450,578	191,989,401	1,567,340 ^d	0.01 ^d	12,200,727	18,480 ^d	
1997	1,503,732	131,342,488	129,084 ^d		23,859,650	0 ^d	
1998	2,296,074	106,178,999	0 ^d		94,513,599		
1999	6,196,279	231,401,352					
1985-1994 Max	8,337,840	276,731,978	6,706,260	0.21	204,626,879	22,351,535	0.40
1985-1994 Avg	5,512,064	88,484,712	3,171,533	0.09	66,720,598	7,946,955	0.15
1985-1994 Min	1,179,322	11,178,398	655,398	0.01	6,830,717	750,314	0.01

^a Kvichak River tower count only. Does not include aerial survey index counts from Branch River.

^b Includes estimates of adult returns through 2001.

^c Insufficient smolt samples collected to perform this calculation.

^d Future adult returns will increase these values.

Table 29. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of their total adult returns by brood year, 1981-1994.

Smolt Outmigration Year	Brood Years	Freshwater Age	Proportion of Total			Comments
			Smolt	Adult	Difference	
1983	1981	Age 1.	0.15	0.48	-0.33	Ice problems - (5/19-5/22), intermittent
	1980	Age 2.				
1984	1982	Age 1.	0.96	0.60	0.36	No ice problems noted.
	1981	Age 2.	0.85	0.52	0.33	
1985	1983	Age 1.	0.31	0.87	-0.56	Ice problems - 5/22-6/02, 6/06 intermittent, 6/3-6/5 continuous
	1982	Age 2.	0.04	0.40	-0.36	
1986	1984	Age 1.	0.20	0.19	0.01	No ice problems noted.
	1983	Age 2.	0.69	0.13	0.56	
1987	1985	Age 1.	0.11	0.13	-0.02	No ice problems noted.
	1984	Age 2.	0.80	0.81	-0.01	
1988	1986	Age 1.	0.66	0.40	0.26	No ice problems noted.
	1985	Age 2.	0.89	0.87	0.02	
1989	1987	Age 1.	0.78	0.56	0.22	No ice problems noted.
	1986	Age 2.	0.34	0.60	-0.26	
1990	1988	Age 1.	0.58	0.50	0.08	Ice problems prior to 5/21.
	1987	Age 2.	0.22	0.44	-0.22	
1991	1989	Age 1.	0.59	0.15	0.44	Ice problems - 5/22-5/26 intermittent, 5/27-5/29 continuous.
	1988	Age 2.	0.41	0.50	-0.09	
1992	1990	Age 1.	0.08	0.11	-0.03	Ice problems - 5/19-5/22 continuous, 5/24-5/26 and 5/31 intermittent.
	1989	Age 2.	0.41	0.85	-0.44	
1993	1991	Age 1.	0.42	0.82	-0.40	No ice problems. River ice-free 10 d before sonar activated.
	1990	Age 2.	0.92	0.89	0.03	
1994	1992	Age 1.	0.83	0.47	0.36	Ice problems - 5/17- 5/28 continuous.
	1991	Age 2.	0.58	0.18	0.40	
1995	1993	Age 1.	0.69	0.59	0.10	Ice problems - 5/17- 5/21 continuous.
	1992	Age 2.	0.17	0.53	-0.36	
1996	1994	Age 1.	0.75	0.43	0.32	No ice problems. River ice-free 8 d before sonar activated. Excellent Weather - 46 h disabled time
	1993	Age 2.	0.31	0.41	-0.10	
1997	1995	Age 1.	0.74	^a		No ice problems. River ice-free 7 d before sonar activated. Excellent Weather - 3 h disabled time
	1994	Age 2.	0.25	0.57	-0.32	

^a Incomplete adult return for brood year escapement.

Table 30. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Egegik River, 1956-2001.

Year of Migration	Age 1.				Age 2.				Age 3.				Total Estimate ^a
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	
1956	1954		101		1953		116		1952		123		
1957	1955		107		1954		120		1953		130		
1959	1957		99		1956		116		1955		123		
1960	1958		106		1957		115		1956		140		
1969	1967		99		1966		119		1965		115		
1977	1975		110	11.3	1974		116	13.3	1973				
1978	1976		104	10.1	1975		122	15.4	1974		130	18.1	
1981	1979		105	9.1	1978		122	16.6	1977		128	19.1	
1982	1980	77	104	9.2	1979	23	130	17.1	1978	0	145	23.5	63,970,160
1983	1981	12	101	9.3	1980	88	116	13.6	1979	0			18,766,889
1984	1982	35	106	10.1	1981	65	112	12.2	1980	0	134	20.2	49,667,432
1985	1983	83	106	10.4	1982	17	123	16.8	1981	0	138	24.1	66,073,548
1986	1984	32	101	9.0	1983	68	122	15.7	1982	0	140	22.6	44,197,865
1987	1985	9	107	11.6	1984	91	114	14.1	1983	0	128	18.9	49,868,710
1988	1986	74	103	10.2	1985	26	117	14.3	1984	0	136	21.2	48,961,215
1989	1987	73	99	8.9	1986	27	119	15.4	1985	0	135	21.1	99,886,786
1990	1988	7	87	6.1	1987	93	105	10.5	1986	0			56,095,226
1991	1989	5	102	10.3	1988	95	118	15.6	1987	0	140	24.4	94,095,226
1992	1990	26	104	10.2	1989	73	112	12.4	1988	1	127	17.6	23,748,278
1993	1991	35	102	9.3	1990	65	112	12.2	1989	0	138	22.1	57,960,399
1994	1992	58	104	9.6	1991	42	118	13.7	1990	0	125	14.6	94,086,989
1995	1993	13	103	9.3	1992	87	112	11.6	1991	0	126	14.9	57,385,790
1996	1994	71	106	10.5	1993	26	124	16.1	1992	3	141	21.4	31,270,793
1997	1995	45	103	9.5	1994	54	117	13.4	1993	1	135	18.4	27,050,113
1998	1996	64	105	9.0	1995	35	121	13.7	1994	1	132	16.2	78,791,125
1999	1997	9	107	9.9	1996	87	127	16.5	1995	2	140	19.2	8,592,482
2000	1998	4	103	10.1	1997	96	113	12.9	1996	0	128	18.7	32,465,479
Mean			103	9.7			118	14.2			132	19.8	
2001	1998	62	101	10.0	1998	36	116	14.5	1997	2	142	26.4	30,245,410
Difference from Mean			-2	0.3			-2	0.3			10	6.6	

^a No estimate of smolt numbers for 1939-1981 fyke net catches; estimates of smolt numbers from 1982 to present based on hydroacoustic techniques.

Table 31. Water temperatures at sockeye salmon smolt counting site, Egegik River, 1981-2001.

Year	Sample Period	Water Temp (C°)		
		Minimum	Mean	Maximum
1981	May 15 - June 08	7.0	8.2	10.0
1982	May 15 - June 16	2.5	4.9	8.5
1983	May 18 - June 10	5.2	7.9	10.5
1984	May 17 - June 11	5.5	7.9	10.0
1985	May 17 - June 12	2.0	4.6	7.0
1986	May 19 - June 12	1.0	4.6	7.0
1987	May 18 - June 13	4.5	6.7	9.0
1988	May 19 - June 14	3.0	7.1	11.0
1989	May 21 - June 10	3.0	5.8	8.8
1990	May 20 - June 11	3.5	7.3	9.5
1991	May 21 - June 12	1.0	4.8	8.5
1992	May 21 - June 12	5.0	7.8	10.0
1993	May 18 - June 09	4.0	6.6	11.0
1994	May 21 - June 10	1.5	6.1	11.0
1995	May 21 - June 13	2.0	7.0	12.5
1996	May 19 - June 13	2.0	5.8	10.5
1997	May 19 - June 10	3.5	7.9	13.0
1998	May 19 - June 11	2.5	4.9	7.0
1999	May 21 - June 14	0.0	2.2	8.0
2000	May 20 - June 11	2.5	5.8	10.0
Mean		3.1	6.2	9.6
2001	May 17 - June 09	4.0	7.3	12.5
Difference from Mean		0.9	1.1	2.9

Table 32. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1978-1999 brood years, Egegik River.

Brood Year	Total Spawning Escapement ^a	Number of Smolt Produced						Total	Per Spawner
		Age 1.	(% ^b)	Age 2.	(% ^b)	Age 3.	(% ^b)		
1978	895,698					225,522			
1979	1,032,042			14,287,075		0			
1980	1,060,860	49,457,563	75	16,524,563	25	197,429	0	66,179,555	62.4
1981	694,680	2,242,326	6	32,235,734	93	52,852	0	34,530,912	49.7
1982	1,034,628	17,234,269	60	11,434,848	40	564	0	28,669,681	27.7
1983	792,282	54,585,828	64	29,984,140	35	85,087	0	84,655,055	106.8 ^c
1984	1,165,345	14,016,441	24	45,386,536	76	80,931	0	59,483,908	51.0
1985	1,095,192	4,397,087	26	12,758,135	74	81,150	0	17,236,372	15.7
1986	1,151,320	36,122,149	57	27,347,612	43	0	0	63,469,761	55.1
1987	1,272,978	72,458,024	58	52,299,487	42	396,423	0	125,153,934	98.3 ^c
1988	1,612,680	3,795,739	4	89,162,038	96	361,128	0	93,318,905	57.9
1989	1,610,916	4,519,527	21	17,338,786	79	37,254	0	21,895,567	13.6
1990	2,191,362	6,048,364	14	37,719,609	86	19,196	0	43,787,169	20.0
1991	2,786,880	20,203,545	34	39,158,743	66	11,242	0	59,373,530	21.3
1992	1,945,332	54,909,050	52	49,962,265	47	1,067,697	1	105,939,012	54.5
1993	1,516,980	7,412,283	47	8,089,658	52	202,218	1	15,704,159	10.4
1994	1,897,932	22,113,438	58	14,630,756	39	1,119,575	3	37,863,769	20.0
1995	1,281,678	12,217,139	31	27,476,148	68	201,076	1	39,894,363	31.1
1996	1,075,596	50,195,402	87	7,616,295	13	85,639	0	57,897,336	53.8
1997	1,103,964	775,111	2	31,225,872	96	589,177	2	32,590,160	29.5
1998	1,110,882	1,153,968	10	10,861,187	90			12,015,155 ^d	10.8 ^d
1999	1,727,772	18,795,046							
1987-1996 Max	2,786,880	72,458,024	87	89,162,038	96	1,119,575	3	125,153,934	98.3
1987-1996 Avg	1,719,233	25,387,251	41	34,345,379	59	350,145	1	60,082,774	38.1
1987-1996 Min	1,075,596	3,795,739	4	7,616,295	13	11,242	0	15,704,159	10.4

^a Egegik River tower count only. Does not include aerial survey index counts from Shosky Creek or King Salmon River.

^b Percent of total smolt production

^c Smolt outmigration estimates for brood years with unusually high smolt per spawner ratios may be artificially low. During these years smolt may have passed undetected before, during, or after the operational dates of the smolt sonar.

^d Incomplete returns from brood year escapements.

Table 33. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1978-1999 brood years, Egegik River.

Brood Year	Age 1.				Age 2.			Age 3.		
	Total Spawning Escapement ^a	Number of Smolt	Adult Returns ^b	Adult Returns per Smolt	Number of Smolt	Adult Returns ^b	Adult Returns per Smolt	Number of Smolt	Adult Returns ^b	Adult Returns per Smolt
1978	895,698		908,379			8,264,740		225,522	33,395	0.15
1979	1,032,042		1,239,273		14,287,075	4,705,018	0.33	0	0	
1980	1,060,860	49,457,563	3,035,494	0.06	16,524,563	5,519,025	0.33	197,429	7,730	0.04
1981	694,680	2,242,326	1,508,516	0.67 ^c	32,235,734	4,785,803	0.15	52,852	16,119	0.30
1982	1,034,628	17,234,269	2,873,325	0.17	11,434,848	3,447,534	0.30	564	12,739	^d
1983	792,282	54,585,828	4,520,747	0.08	30,036,716	6,086,667	0.20	85,087	37,683	0.44 ^c
1984	1,165,345	14,160,585	1,597,084	0.11	45,386,536	11,665,474	0.26	80,931	256,616	^d
1985	1,095,192	4,397,087	1,980,826	0.45 ^c	12,758,135	5,652,082	0.44 ^c	81,150	25,976	0.32
1986	1,151,320	36,122,149	5,676,245	0.16	27,347,612	8,520,337	0.31	0	120,388	^d
1987	1,272,978	72,458,024	5,548,894	0.08	52,299,487	20,199,111	0.39	396,423	193,309	0.49 ^c
1988	1,612,680	3,795,739	1,695,748	0.45	89,162,038	16,775,951	0.19	361,128	412,775	^d
1989	1,610,916	4,519,527	974,486	0.22	17,338,786	10,076,582	0.58 ^c	37,245	201,466	^d
1990	2,191,362	6,048,364	1,273,444	0.21	37,719,609	14,413,452	0.38	19,196	50,934	^d
1991	2,786,880	20,203,545	5,384,844	0.27	39,158,743	5,741,882	0.15	11,242	27,130	^d
1992	1,945,332	54,909,050	1,457,300	0.03	49,962,265	8,131,994	0.16	1,067,697	72,020	0.07
1993	1,516,980	7,412,283	1,082,544	0.15	8,089,658	1,903,399	0.24	202,218	6,832	0.03
1994	1,897,932	22,113,438	1,358,164	0.06	14,630,756	7,387,378	0.50	1,119,575	19,597 ^e	0.02 ^e
1995	1,281,678	12,217,139	6,356,995	0.52	27,476,148	3,103,745 ^e	0.11 ^e	201,076	10,021 ^e	
1996	1,076,460	50,195,402	2,283,316 ^e	0.05 ^e	7,616,295	518,799 ^e		85,639	2,638 ^e	
1997	1,103,964	775,111	34,170 ^e		31,225,872	18,678 ^e		589,177		
1998	1,110,882	1,153,968	0 ^e		10,861,187					
1999	1,727,772	18,795,046								
1985-1994 Max	2,786,880	72,458,024	5,676,245	0.45	89,162,038	20,199,111	0.58	1,119,575	412,775	0.49
1985-1994 Avg	1,708,157	23,197,921	2,643,250	0.21	34,846,709	9,880,217	0.33	329,587	113,043	0.19
1985-1994 Min	1,095,192	3,795,739	974,486	0.03	8,089,658	1,903,399	0.15	0	6,832	0.02

^a Egegik River tower count only. Does not include aerial survey index counts from Shosky Creek or King Salmon River.

^b Includes estimates of adult returns through 2001.

^c Smolt outmigration estimates for brood years with unusually high adult return per smolt ratios may be artificially low. During these years smolt may have passed undetected before, during, or after the operational dates of the smolt sonar.

^d Insufficient Age 3. smolt sampled to perform this calculation.

^e Future adult returns will increase these values.

Table 34. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of their total adult returns by brood year, 1981-1994.

Smolt Outmigration Year	Brood Year	Freshwater Age	Proportion of Total		Difference	Comments
			Smolt	Adult		
1983	1981	Age 1.	0.06	0.24	-0.18	No ice problems noted.
	1980	Age 2.	.	.	.	
1984	1982	Age 1.	0.60	0.45	0.15	No ice problems noted.
	1981	Age 2.	0.93	0.76	0.17	
1985	1983	Age 1.	0.64	0.42	0.22	Ice present - 5/17-5/22 intermittent
	1982	Age 2.	0.40	0.54	-0.14	
1986	1984	Age 1.	0.24	0.12	0.12	Ice present - 5/19-5/25 intermittent
	1983	Age 2.	0.35	0.57	-0.22	
1987	1985	Age 1.	0.26	0.26	0.00	No ice problems noted.
	1984	Age 2.	0.76	0.86	-0.10	
1988	1986	Age 1.	0.57	0.40	0.17	No ice problems noted.
	1985	Age 2.	0.74	0.74	0.00	
1989	1987	Age 1.	0.58	0.21	0.37	No ice problems noted.
	1986	Age 2.	0.43	0.60	-0.17	
1990	1988	Age 1.	0.04	0.09	-0.05	Fair Weather - 118 h disabled time
	1987	Age 2.	0.42	0.78	-0.36	
1991	1989	Age 1.	0.21	0.09	0.12	Ice problems - 5/17-5/18 continuous.
	1988	Age 2.	0.96	0.89	0.07	
1992	1990	Age 1.	0.14	0.08	0.06	No ice problems noted.
	1989	Age 2.	0.79	0.90	-0.11	
1993	1991	Age 1.	0.34	0.48	-0.01	No ice problems noted.
	1990	Age 2.	0.86	0.92	-0.06	
1994	1992	Age 1.	0.52	0.15	0.37	Excellent Weather - no disabled time.
	1991	Age 2.	0.66	0.51	0.15	
1995	1993	Age 1.	0.47	0.36	0.11	Ice problems - 5/19-5/21 and 0100-0500 hours on 5/23; good weather thereafter
	1992	Age 2.	0.47	0.84	-0.37	
1996	1994	Age 1.	0.58	0.15	0.43	Excellent Weather - 26 h disabled time.
	1993	Age 2.	0.52	0.64	-0.12	
1997	1995	Age 1.	0.45	^a		Excellent Weather - less than 1 h disabled time.
	1994	Age 2.	0.39	0.84	-0.45	

^a Incomplete adult return for brood year escapement.

Table 35. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Ugashik River, 1958-2001.

Year of Migration	Age 1.				Age 2.				Age 3.				Total Estimate ^a
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	
1958	1956	-	93	6.4	1955	-	112	11.7	1954	-	-	-	-
1959	1957	-	90	6.1	1956	-	120	13.5	1955	-	-	-	-
1960	1958	-	90	6.6	1957	-	104	11.0	1956	-	-	-	-
1961	1959	-	90	6.7	1958	-	112	12.2	1957	-	-	-	-
1962	1960	-	88	6.1	1959	-	112	12.3	1958	-	-	-	-
1963	1961	-	90	6.1	1960	-	104	9.6	1959	-	-	-	-
1964	1962	-	92	6.9	1961	-	118	12.7	1960	-	-	-	-
1965	1963	-	94	6.9	1962	-	114	12.5	1961	-	-	-	-
1967	1965	-	88	6.0	1964	-	113	12.2	1963	-	-	-	-
1968	1966	-	93	6.5	1965	-	113	10.7	1964	-	-	-	-
1969	1967	-	97	7.5	1966	-	121	14.5	1965	-	-	-	-
1970	1968	-	97	7.7	1967	-	125	15.9	1966	-	-	-	-
1972	1970	-	81	5.0	1969	-	112	11.2	1968	-	129	14.3	-
1973	1971	-	93	7.2	1970	-	113	11.9	1969	-	132	20.1	-
1974	1972	-	94	7.4	1971	-	119	13.6	1970	-	-	-	-
1975	1973	-	96	7.2	1972	-	116	13.0	1971	-	125	16.7	-
1982	1980	-	88	6.3	1979	-	113	13.0	1978	-	138	22.5	-
1983	1981	71	89	7.6	1980	29	111	13.2	1979	-	-	-	44,033,811
1984	1982	48	87	6.8	1981	52	102	10.3	1980	0	103	11.7	158,174,626
1985	1983	37	94	8.3	1982	63	107	11.8	1981	-	-	-	34,101,390
1986	1984	71	87	5.8	1983	29	114	10.9	1982	-	-	-	53,076,253
1987	1985	20	94	7.9	1984	80	107	11.1	1983	0	138	24.1	26,947,225
1988	1986	85	87	5.7	1985	15	109	10.8	1984	0	128	15.6	215,968,015
1989	1987	74	90	6.5	1986	26	108	10.7	1985	-	-	-	126,298,122
1990	1988	28	90	6.7	1987	72	108	11.8	1986	-	-	-	53,627,347
1991	1989	35	92	7.7	1988	65	107	11.6	1987	-	-	-	73,769,877
1992 ^b	1990	-	-	-	1989	-	-	-	1988	-	-	-	-
1993	1991	83	92	8.0	1990	17	109	12.5	1989	-	-	-	70,747,074
1994	1992	81	89	6.7	1991	19	109	11.2	1990	-	-	-	30,030,624
1995	1993	31	93	7.8	1992	69	106	11.1	1991	-	-	-	22,234,137
1996	1994	44	101	9.9	1993	56	114	13.5	1992	-	-	-	2,576,812
1997	1995	92	92	7.9	1994	8	109	12.1	1993	-	-	-	15,519,783
1998	1996	82	91	6.4	1995	18	110	11.1	1994	-	-	-	12,624,441
1999	1997	99	91	6.8	1996	1	125	17.5	1995	-	-	-	10,631,631
2000	1998	18	95	8.4	1997	82	112	12.5	1996	-	-	-	10,880,559
Mean			91	7.0			112	12.2			128	17.9	
2001	1999	82	92	7.3	1998	18	108	11.5	1997	-	-	-	35,123,888
Difference from Mean			1	0.3			-4	-0.7					

^a No estimates of smolt numbers from 1958-1982 fyke net catches; estimates of smolt numbers from 1983-1991 and 1993-present based on hydroacoustic techniques.

^b Project not operated in 1992. No smolt data collected.

Table 36. Water temperatures at sockeye salmon smolt counting site, Ugashik River, 1983-2001.

Year	Sample Period	Water Temp (C°)		
		Minimum	Mean	Maximum
1983	May 23 - June 11	6.0	7.3	8.5
1984	May 20 - June 17	4.8	6.3	8.5
1985	May 17 - June 09	-1.0	4.3	7.0
1986	May 23 - June 28	2.0	5.6	7.0
1987	May 17 - June 13	4.0	5.9	9.0
1988	May 17 - June 13	3.5	6.6	10.0
1989	May 21 - June 16	3.0	5.8	8.8
1990	May 21 - June 14	3.0	5.9	8.0
1991	May 20 - June 14	4.0	5.9	8.5
1992	^a			
1993	May 18 - June 11	5.0	6.5	9.0
1994	May 20 - June 13	4.5	6.5	10.0
1995	May 23 - June 12	4.0	6.2	9.0
1996	May 19 - June 13	3.0	5.6	7.5
1997	May 10 - June 13	3.5	7.1	12.0
1998	May 18 - June 13	3.5	5.5	7.5
1999	May 18 - June 13	1.0	2.6	6.0
2000	May 20 - June 12	3.0	5.9	10.0
Mean		3.3	5.9	8.6
2001	May 20 - June 12	3.0	4.6	8.0
Difference from Mean		-0.3	-1.3	-0.6

^a Project not operated in 1992. No data collected.

Table 37. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1979-1999 brood years, Ugashik River.

Brood Year	Total Spawning Escapement ^a	Number of Smolt Produced					Total	Per Spawner
		Age 1. (% ^b)		Age 2. (% ^b)		Age 3. (% ^b)		
1979	1,700,904					0		
1980	3,321,384			12,736,379		26,384		
1981	1,326,762	31,297,432	27	82,656,993	73	0	113,954,425	85.9
1982	1,157,526	75,491,249	78	21,407,762	22	0	96,899,011	83.7
1983	1,000,614	12,693,628	46	15,186,101	54	1,677	27,881,406	27.9
1984	1,241,418	37,890,152	64	21,483,727	36	9,598	59,383,477	47.8
1985	998,232	5,461,821	14	33,238,739	86	0	38,700,560	38.8
1986	1,001,492	182,719,678	85	32,278,743	15	0	214,998,421	214.7
1987	668,964	94,019,379	71	38,789,387	29	0	132,808,766	198.5
1988	642,972	14,837,960	24	47,713,086	76	- ^c	62,551,046 ^d	97.3 ^d
1989	1,681,302	26,056,791		- ^c		0	^d	^d
1990	730,038	- ^c		12,415,518		0	^d	^d
1991	2,457,306	58,331,556	91	5,725,543	9	0	64,057,099	26.1
1992	2,173,692	24,305,081	61	15,272,807	39	0	39,577,888	18.2
1993	1,389,534	6,961,330	83	1,429,625	17	0	8,390,955	6.0
1994	1,080,858	1,147,187	49	1,199,949	51	0	2,347,136	2.2
1995	1,304,058	14,319,834	86	2,292,099	14	0	16,611,933	12.7
1996	667,518	10,332,342	99	56,184	1	0	10,388,526	15.6
1997	618,396	10,545,429	54	8,876,726	46	0	19,422,155	31.4
1998	890,508	2,003,833	24	6,248,929	76	^d	8,252,762 ^d	9.3 ^d
1999	1,651,572	28,874,959		^d		^d	^d	^d
1987-1996 Max	2,457,306	94,019,379	99	47,713,086	76		132,808,766	198.5
1987-1996 Avg	1,279,624	27,812,384	71	13,877,133	29		42,091,669	47.1
1987-1996 Min	642,972	1,147,187	24	56,184	1		2,347,136	2.2

^a Ugashik River tower count only. Does not include aerial survey index counts from King Salmon River or Dog Salmon River.

^b Percent of total smolt production.

^c No smolt data collected in 1992, therefore smolt production data for the 1988 (Age 3.), 1989 (Age 2.), and 1990 (Age 1.) brood years are incomplete.

^d Incomplete returns from brood year escapements.

Table 38. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1979-1999 brood years, Ugashik River.

Brood Year	Total Spawning Escapement ^a	Age 1.			Age 2.			Age 3.		
		Number of Smolt	Adult Returns ^b	Adult Returns per Smolt	Number of Smolt	Adult Returns ^b	Adult Returns per Smolt	Number of Smolt	Adult Returns ^b	Adult Returns per Smolt
1979	1,700,904		3,960,210			2,045,642		0		^c
1980	3,321,384		3,503,629		12,736,379	4,262,289	0.33	26,384	2,600	0.10
1981	1,326,762	31,297,432	4,241,375	0.14	82,656,993	3,215,237	0.04	0	1,682	^c
1982	1,157,526	75,491,249	1,146,491	0.02	21,407,762	1,345,244	0.06	0	0	
1983	1,000,614	12,693,628	995,579	0.08	15,186,101	957,765	0.06	1,677	957	^c
1984	1,241,418	37,890,152	1,052,692	0.03	21,483,727	4,399,295	0.20	9,598	6,732	^c
1985	998,232	5,461,821	1,233,686	0.23	33,238,739	1,454,422	0.04	0	0	
1986	1,001,492	182,719,678	3,001,968	0.02	32,278,743	3,639,400	0.11	0	4,459	^c
1987	668,964	94,019,379	2,478,649	0.03	38,789,387	4,215,483	0.11	0	34,612	^c
1988	642,972	14,837,960	1,193,721	0.08	47,713,086	4,426,031	0.09	^d	29,819	^c
1989	1,681,302	26,056,791	1,104,400	0.04	^d	3,449,364	^c	0	9,880	^c
1990	730,038	^d	1,057,589	^c	12,415,518	3,535,693	0.28	0	1,733	^c
1991	2,457,306	58,331,556	5,221,578	0.09	5,725,543	927,616	0.16	0	0	
1992	2,173,692	24,305,081	791,283	0.03	15,272,807	1,852,920	0.12	0	1,181	^c
1993	1,389,534	6,961,330	636,963	0.09	1,429,625	445,814	0.31	0	771	^c
1994	1,080,858	1,147,187	676,862	0.59	1,199,949	976,575	0.81	0	1093 ^e	^c
1995	1,304,058	14,319,834	4,405,520	0.31	2,292,099	268,343 ^e	0.12 ^e	0	237 ^e	
1996	667,518	10,332,342	1,206,375 ^e	0.12 ^c	56,184	35,450 ^e		0	0 ^e	
1997	618,396	10,575,429	232,135 ^e		8,876,726	55 ^e		0		
1998	890,508	2,003,833	659 ^e		6,248,929					
1999	1,651,572	28,874,959								
1985-1994 Max	2,457,306	182,719,678	5,221,578	0.59	47,713,086	4,426,031	0.81	0	34,612	^c
1985-1994 Avg	1,282,439	45,982,309	1,739,670	0.13	20,895,933	2,492,332	0.23	0	8,355	^c
1985-1994 Min	642,972	1,147,187	636,963	0.02	1,199,949	445,814	0.04	0	0	^c

^a Ugashik River tower count only. Does not include aerial survey index counts from King Salmon River or Dog Salmon River.

^b Includes estimates of adult returns through 2001.

^c Insufficient smolt data to complete this calculation.

^d No Ugashik River smolt enumeration project conducted in 1992. Therefore smolt estimates for 1988, 1989, and 1990 brood years are incomplete because no smolt data were collected in 1992.

^e Future adult returns will increase these values.

Table 39. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of their total adult returns by brood year, 1981-1994.

Smolt Outmigration Year	Brood Year	Freshwater Age	Proportion of Total			Comments
			Smolt	Adult	Difference	
1983	1981 1980	Age 1. Age 2.	0.27	0.57	-0.30	No ice or weather problems noted.
1984	1982 1981	Age 1. Age 2.	0.78 0.73	0.46 0.43	0.32 0.30	No ice or weather problems noted.
1985	1983 1982	Age 1. Age 2.	0.46 0.22	0.51 0.54	-0.05 -0.32	Ice present - 5/17-5/21 intermittent
1986	1984 1983	Age 1. Age 2.	0.64 0.54	0.19 0.49	0.45 0.05	No ice or weather problems noted.
1987	1985 1984	Age 1. Age 2.	0.14 0.36	0.46 0.81	-0.32 -0.45	No ice or weather problems noted.
1988	1986 1985	Age 1. Age 2.	0.85 0.86	0.45 0.54	0.40 0.32	No ice or weather problems noted.
1989	1987 1986	Age 1. Age 2.	0.71 0.15	0.37 0.55	0.34 -0.40	No ice or weather problems noted.
1990	1988 1987	Age 1. Age 2.	0.24 0.29	0.21 0.63	0.03 -0.34	Poor Weather - 199 h disabled time
1991	1989 1988	Age 1. Age 2.	^a 0.76	0.24 0.78	 -0.02	Poor Weather - 187 h disabled time
1992	1990 1989	Age 1. Age 2.	^b ^b	0.23 0.76		No smolt data.
1993	1991 1990	Age 1. Age 2.	0.91 ^c	0.85 0.77	0.06	Bad Weather - 264 h disabled time
1994	1992 1991	Age 1. Age 2.	0.61 0.09	0.30 0.15	0.31 -0.06	Good Weather - 42 h disabled time
1995	1993 1992	Age 1. Age 2.	0.83 0.39	0.59 0.70	0.24 -0.31	Excellent Weather - 21 h disabled time
1996	1994 1993	Age 1. Age 2.	0.49 0.17	0.41 0.41	0.08 -0.24	Fair Weather - 109 h disabled time
1997	1995 1994	Age 1. Age 2.	0.92 0.51	^d 0.59	 -0.08	Good Weather - 41 h disabled time

^a Unable to calculate the proportion of Age-1. smolt for brood year 1989 because the Age-2 smolt for brood year 1989 were not counted in 1992.

^b The Ugashik Smolt project was not operated in 1992; no smolt data collected that year.

^c Unable to calculate the proportion of Age-2. smolt for brood year 1990 because the Age-1 smolt for brood year 1990 were not counted in 1992.

^d Incomplete adult returns from brood year escapement.

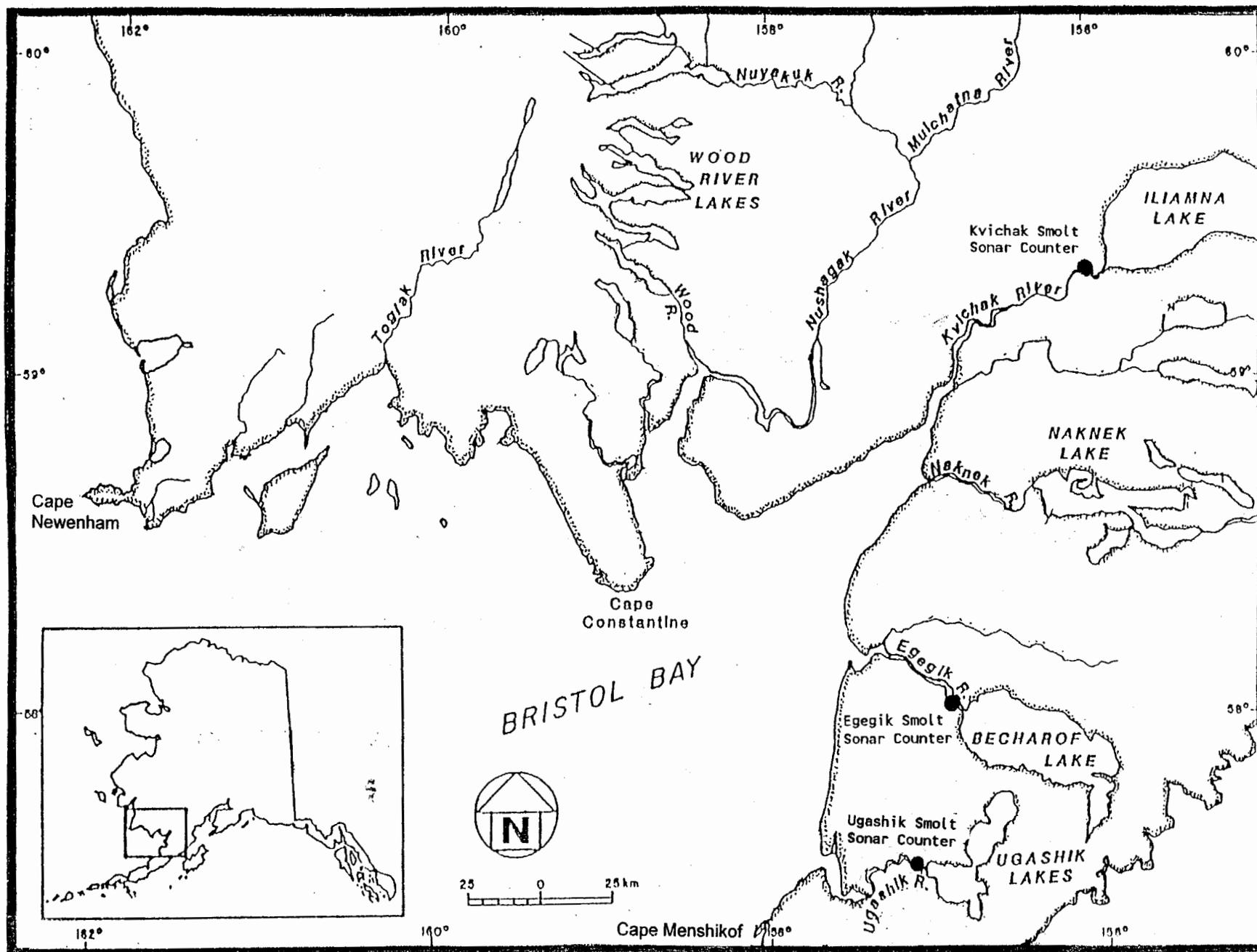


Figure 1. Locations of major rivers and smolt sonar counting sites in the Bristol Bay Management Area.

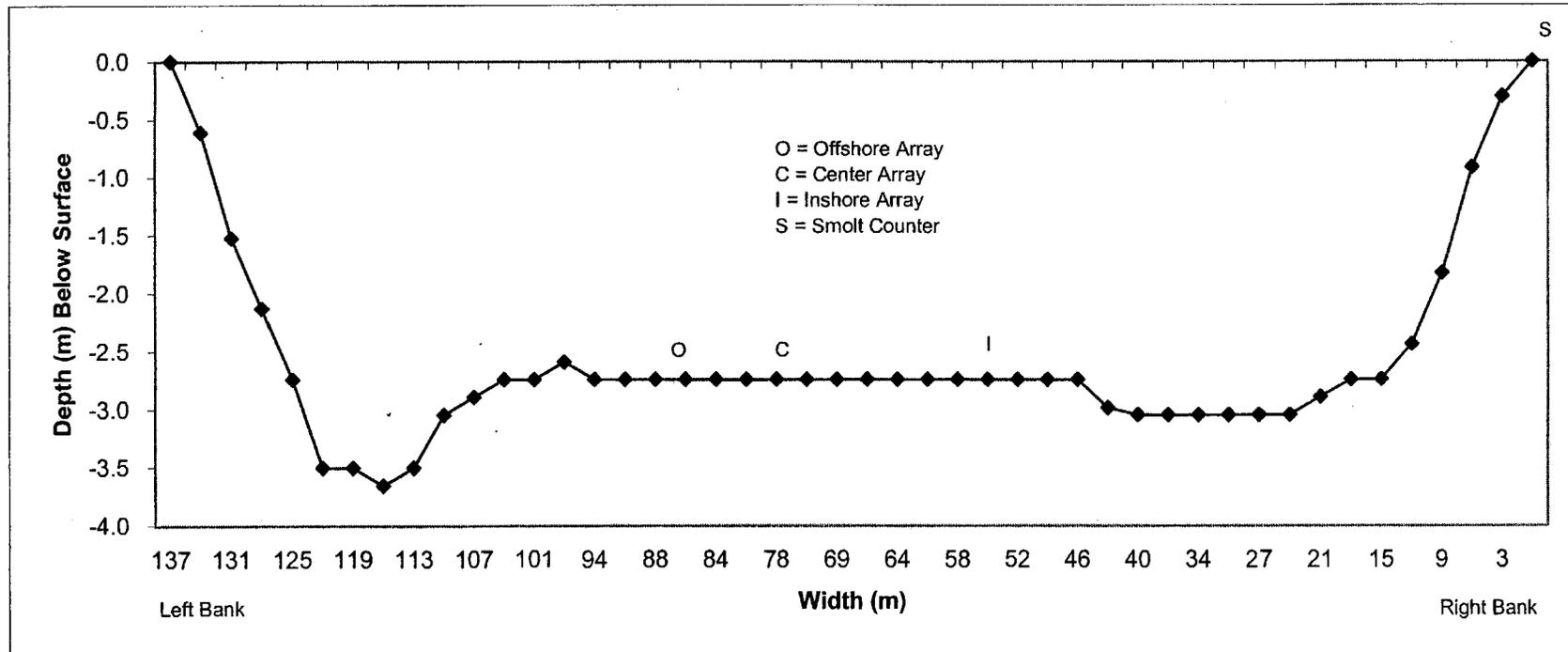


Figure 2. River bottom profile and sonar array placement at Kvichak River smolt sonar site, 2001.

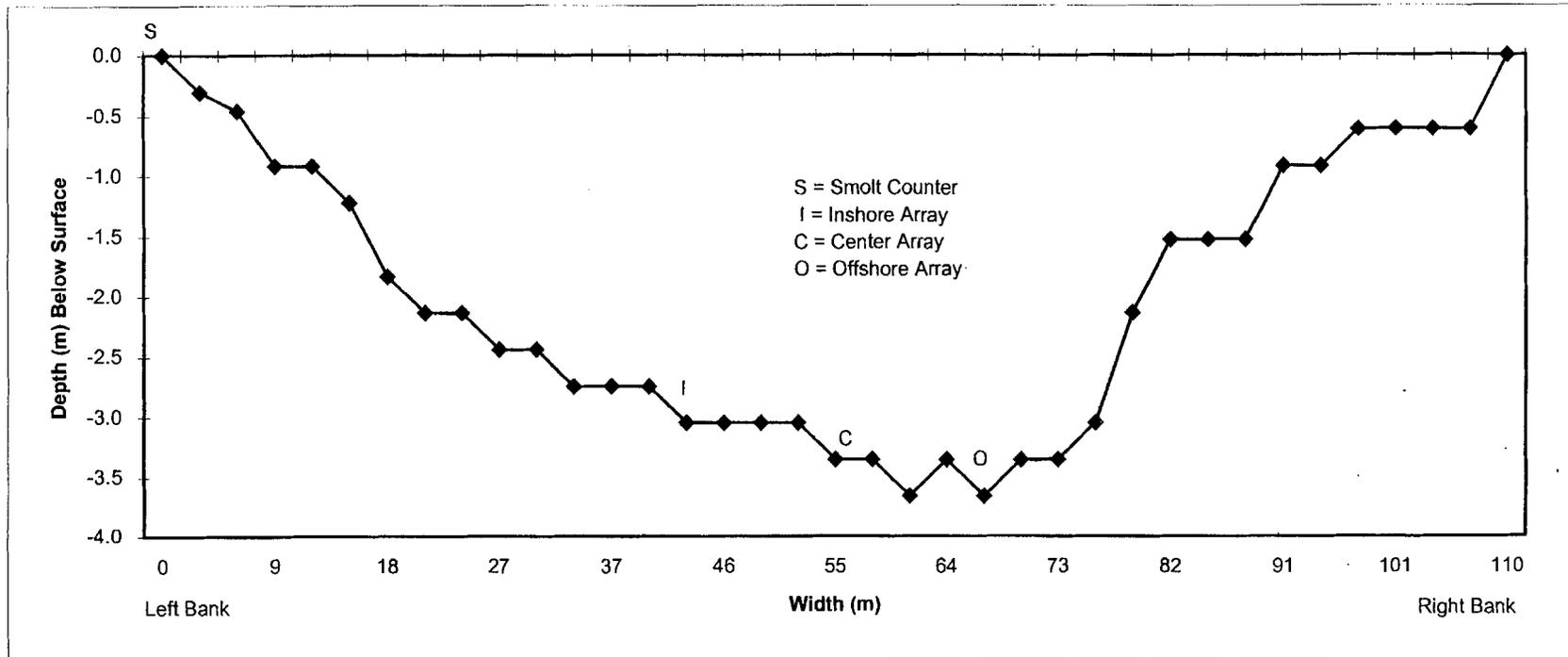


Figure 3. River bottom profile and sonar array placement at Egegik River smolt sonar site, 2001.

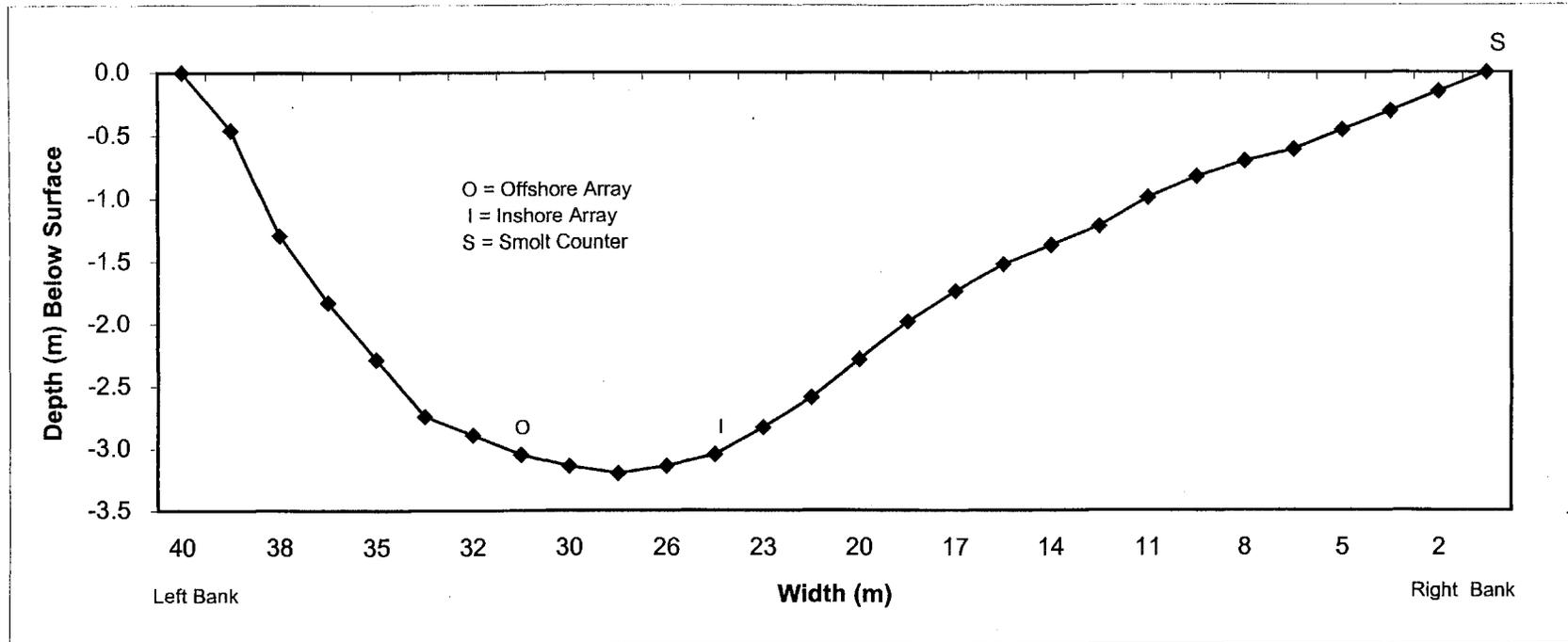


Figure 4. River bottom profile and sonar array placement at Ugashik River smolt sonar site, 2001.

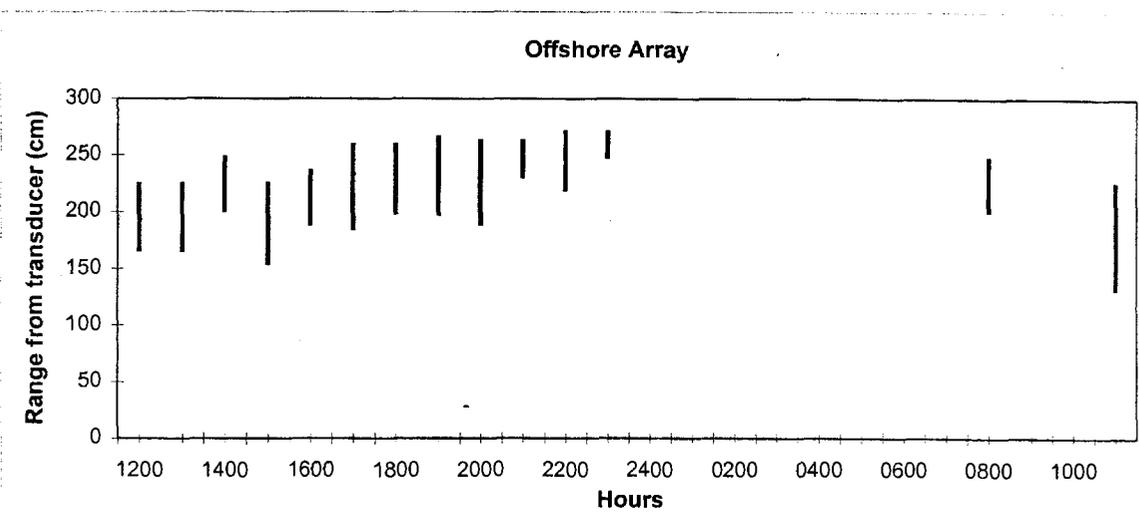
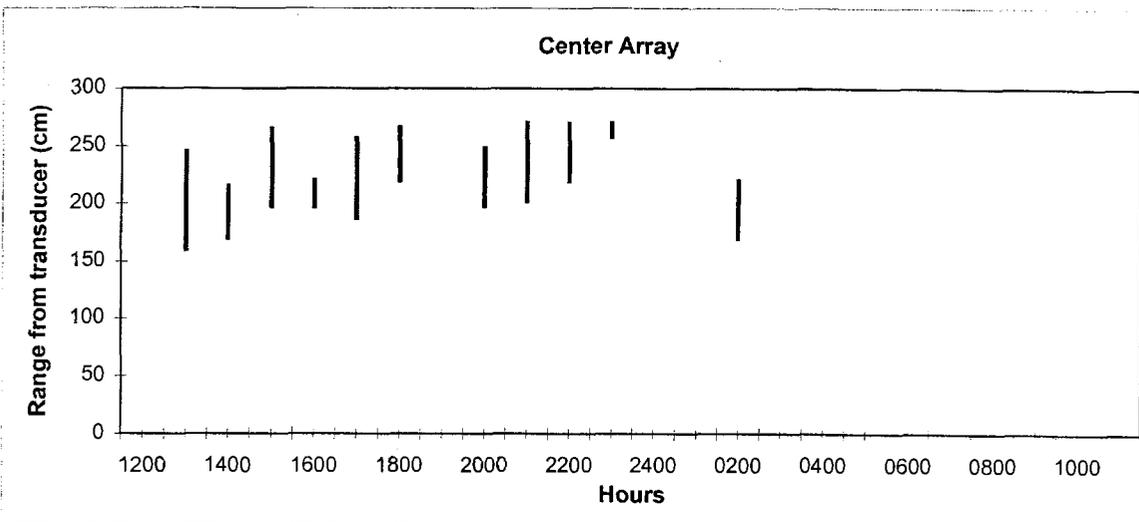
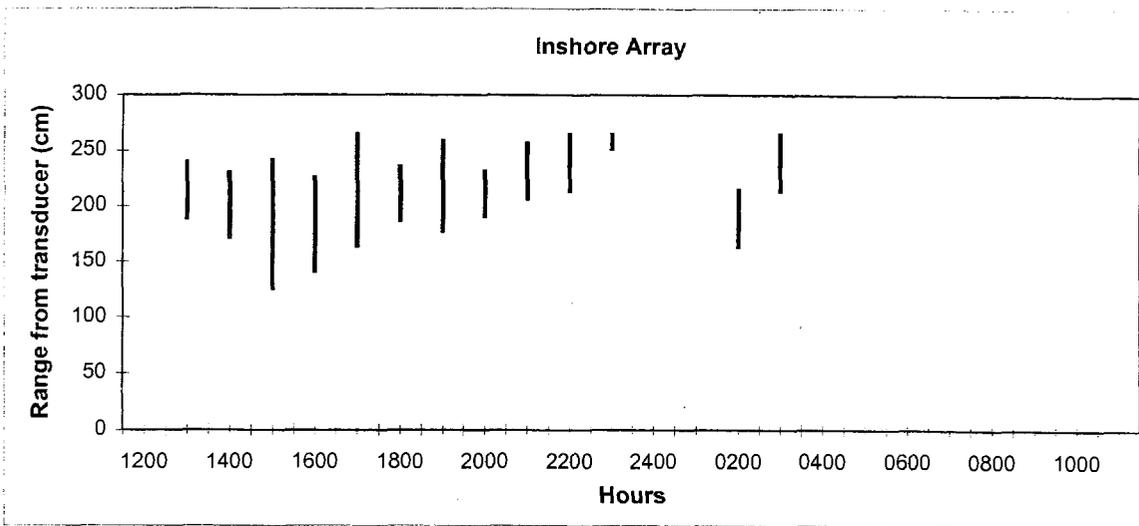


Figure 5. Range of smolt passage from the transducers summarized by hour, Kvichak River, May 17 to June 7, 2001.

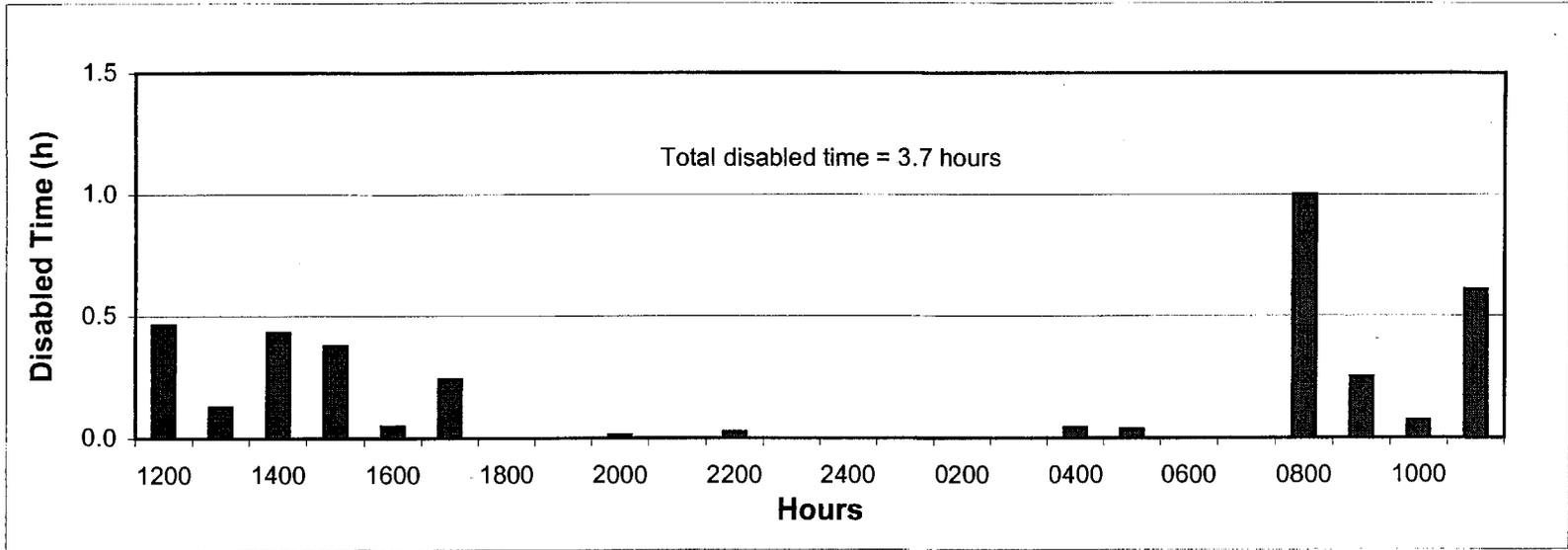
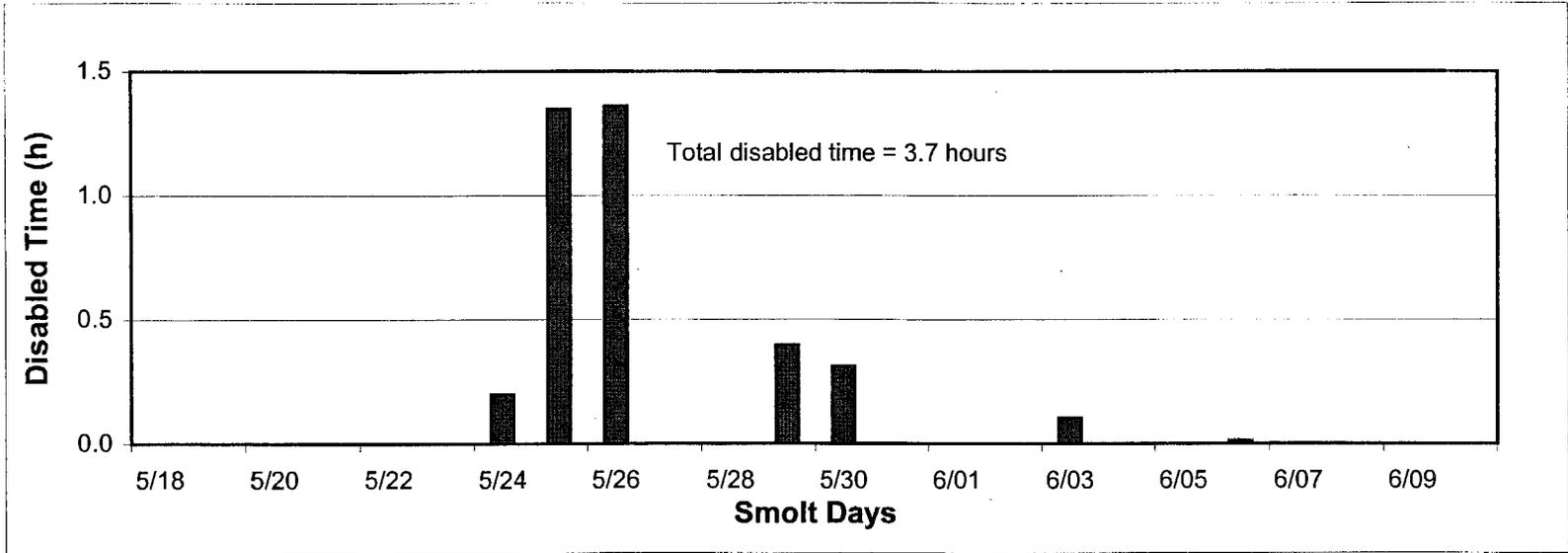
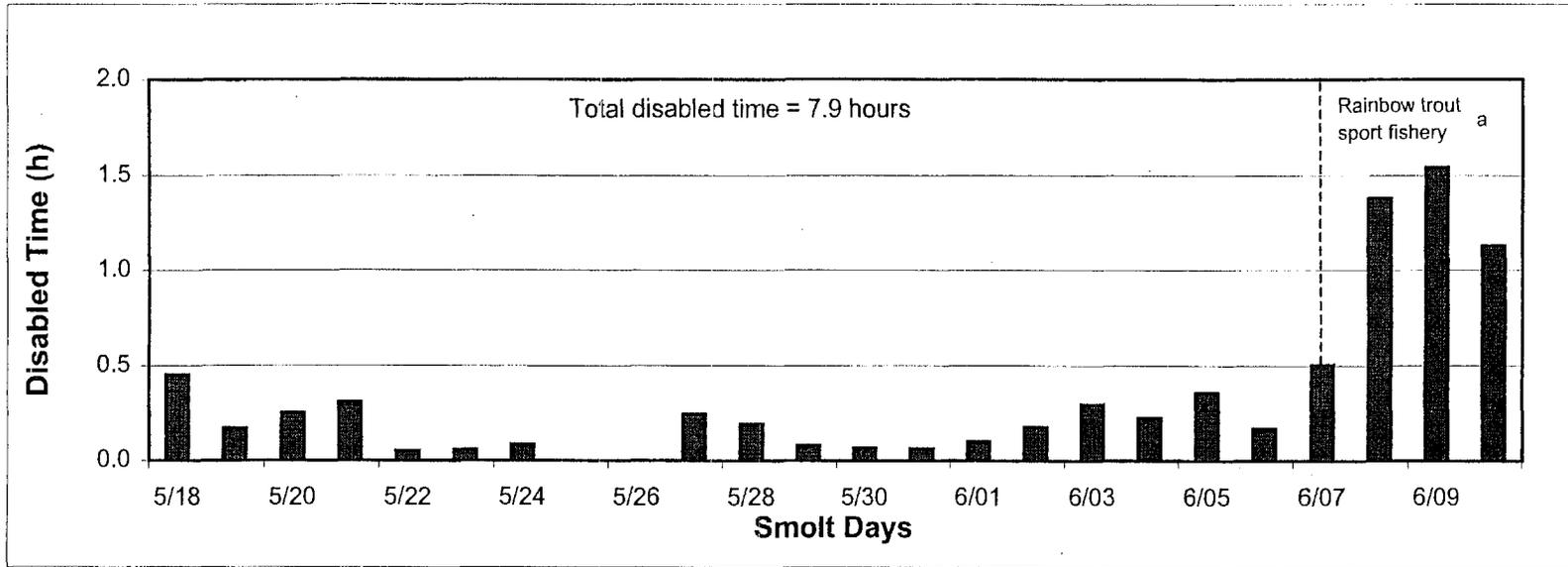


Figure 6. Kvichak River smolt sonar total disabled time because of weather by smolt day and hour, May 18 to June 10, 2001.



^a Open season for rainbow trout sport fishing as of 0001 hour on smolt day 6/07 (June 8).

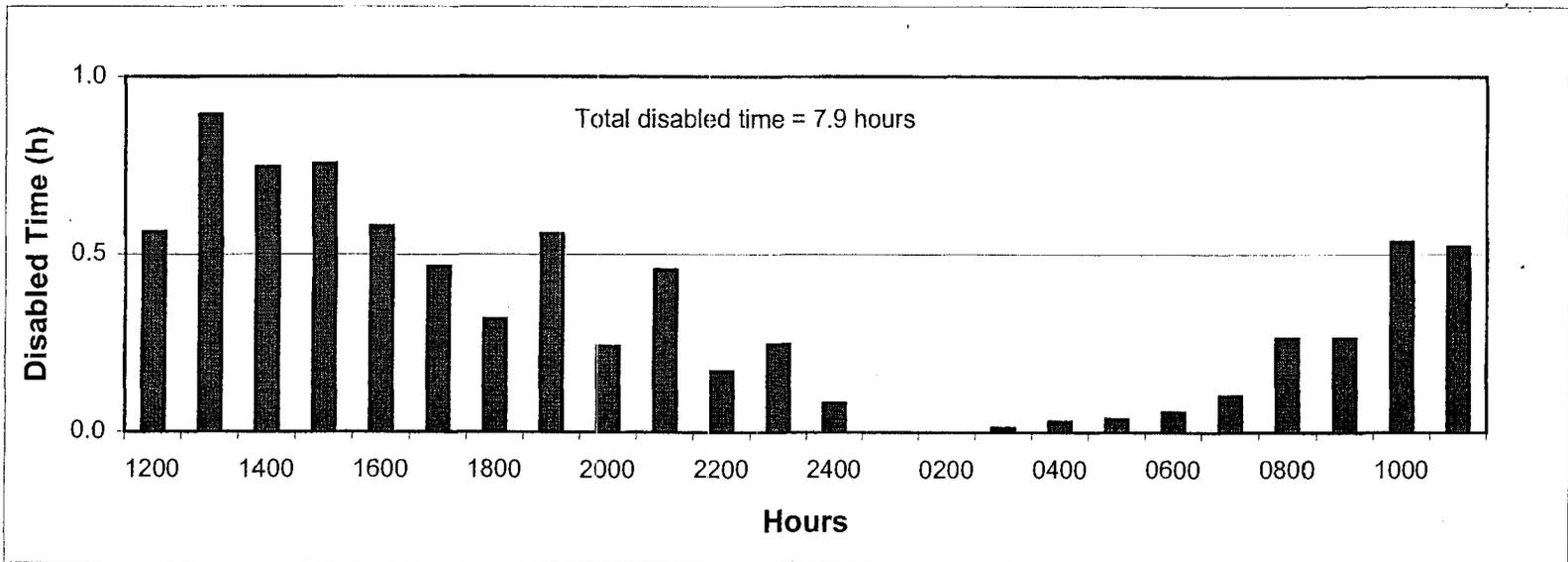


Figure 7. Kvichak River smolt sonar total disabled time because of boat traffic by smolt day and hour, May 18 to June 10, 2001.

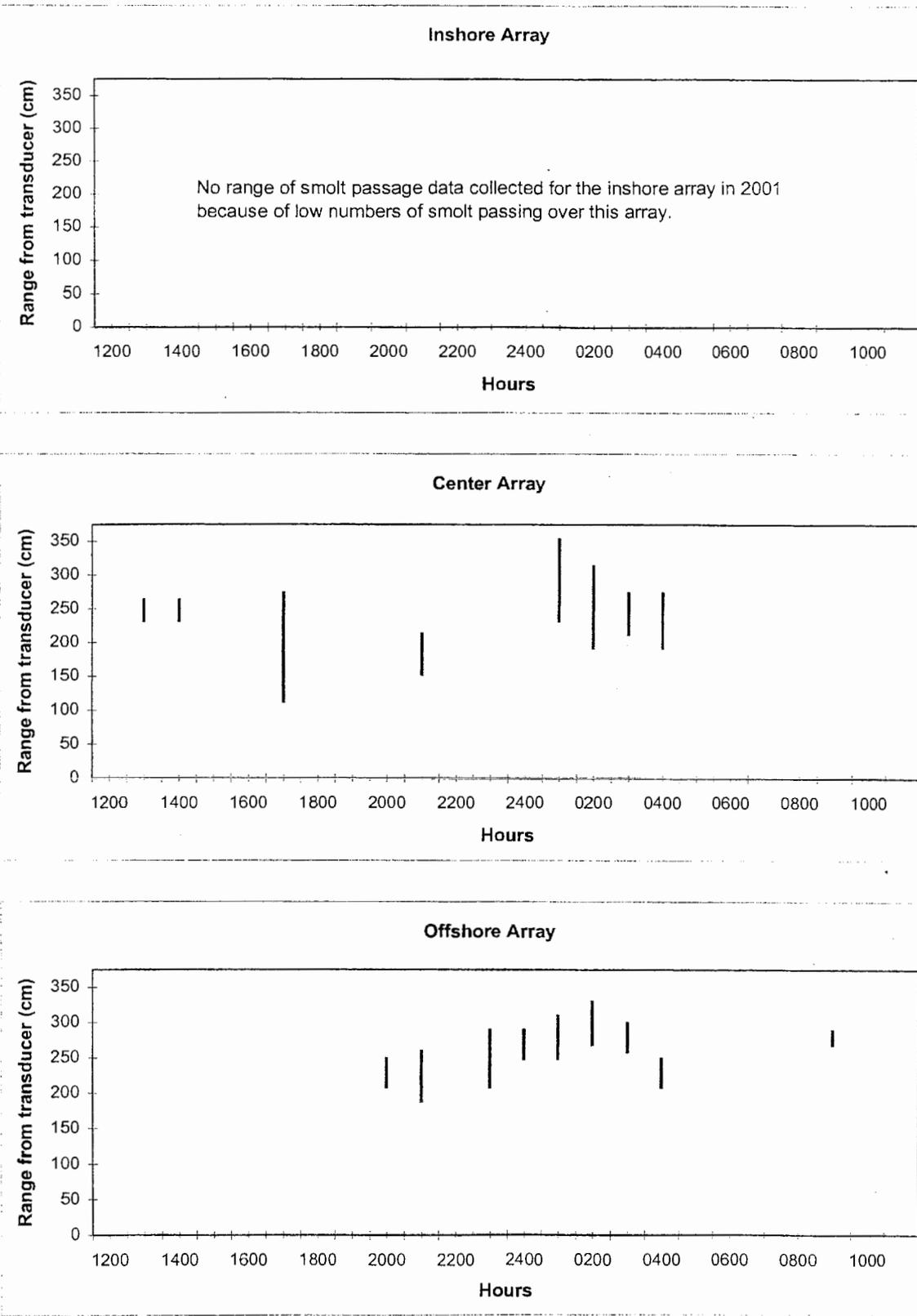


Figure 8. Range of smolt passage from the transducers summarized by hour, Egegik River, May 22 to June 8, 2001.

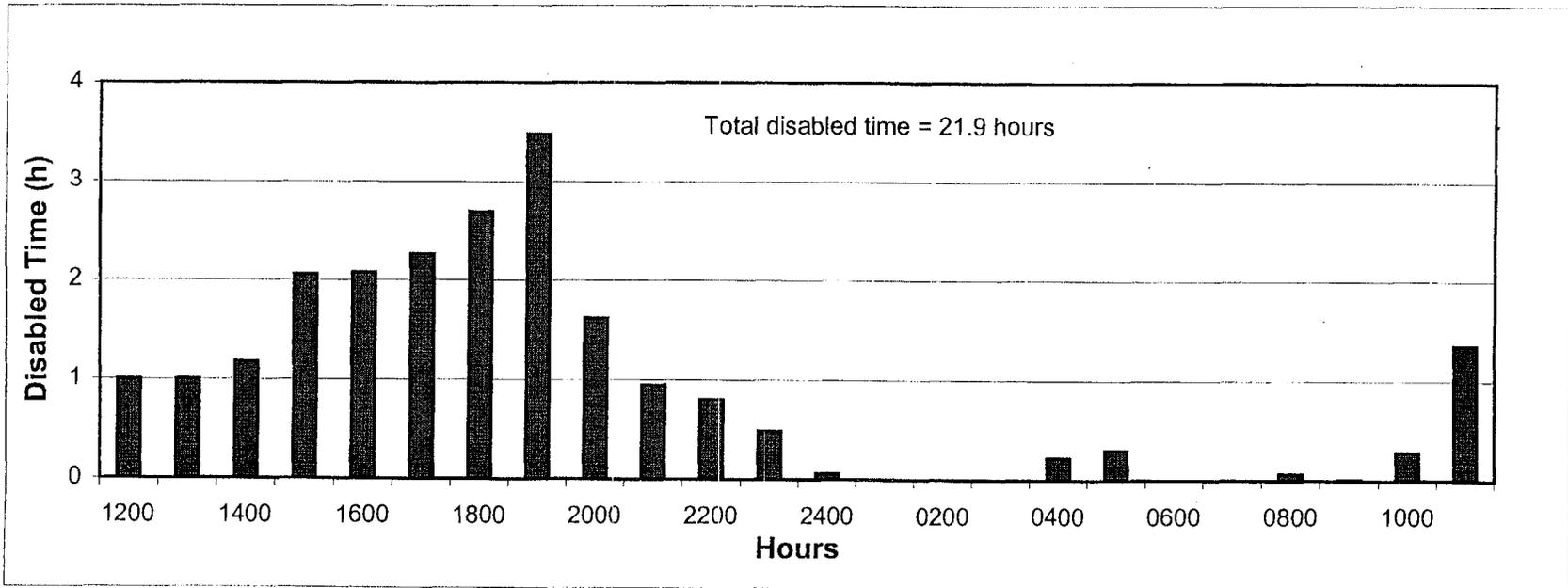
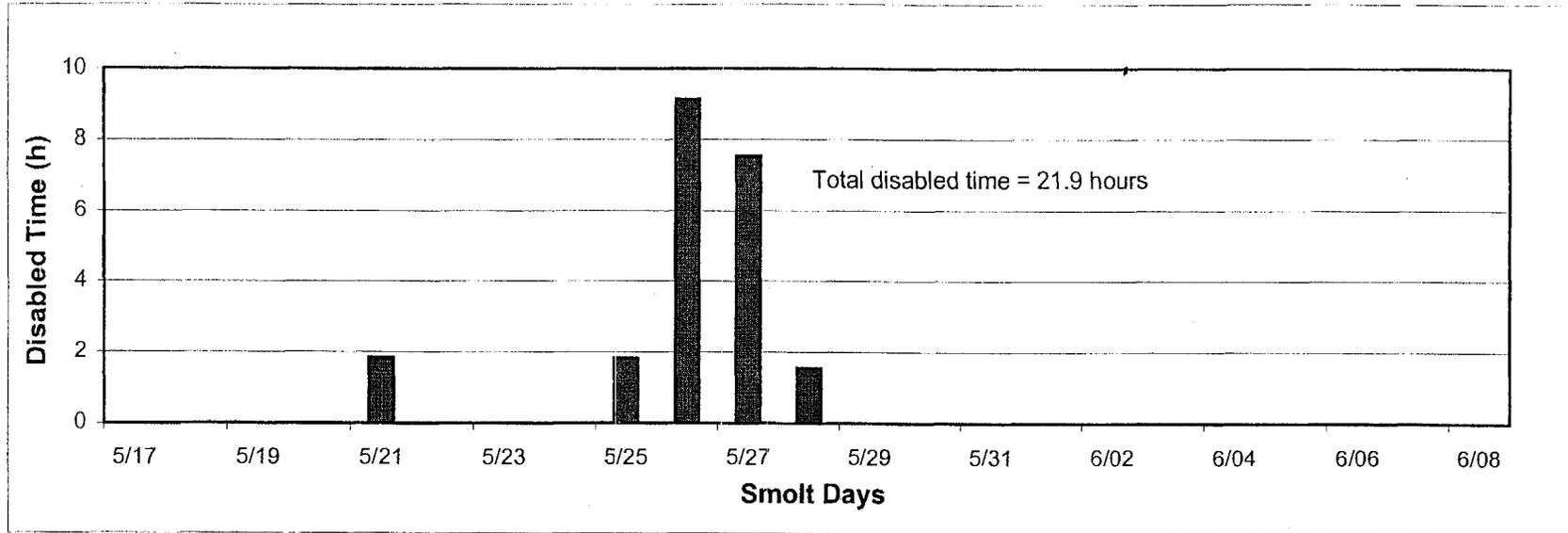


Figure 9. Egegik River smolt sonar total disabled time because of weather by smolt day and hour, May 17 to June 8, 2001.

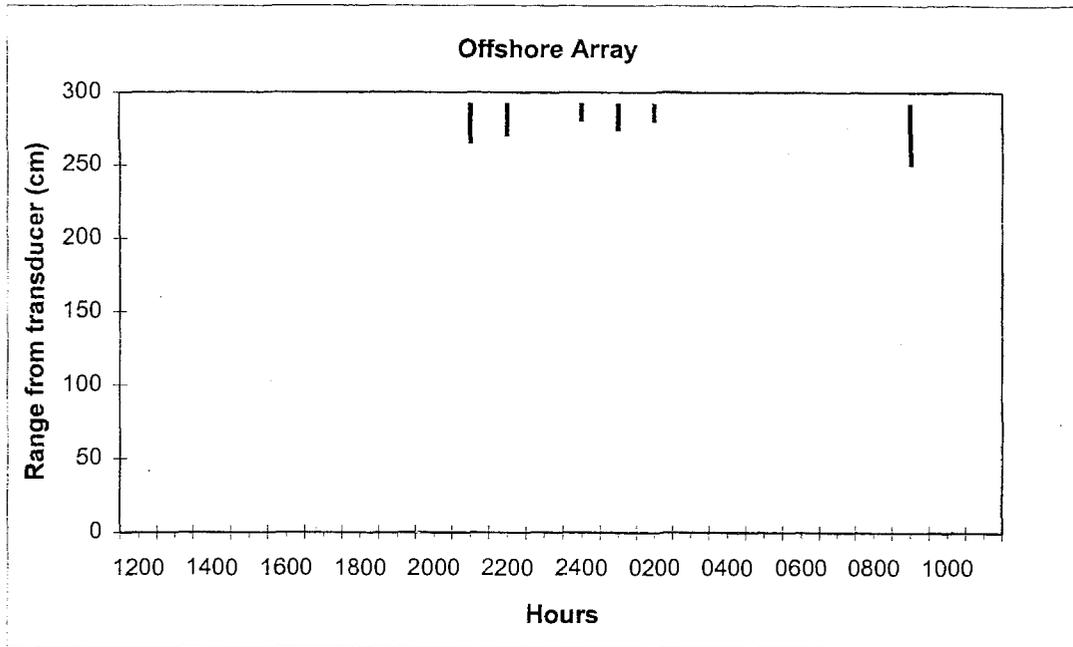
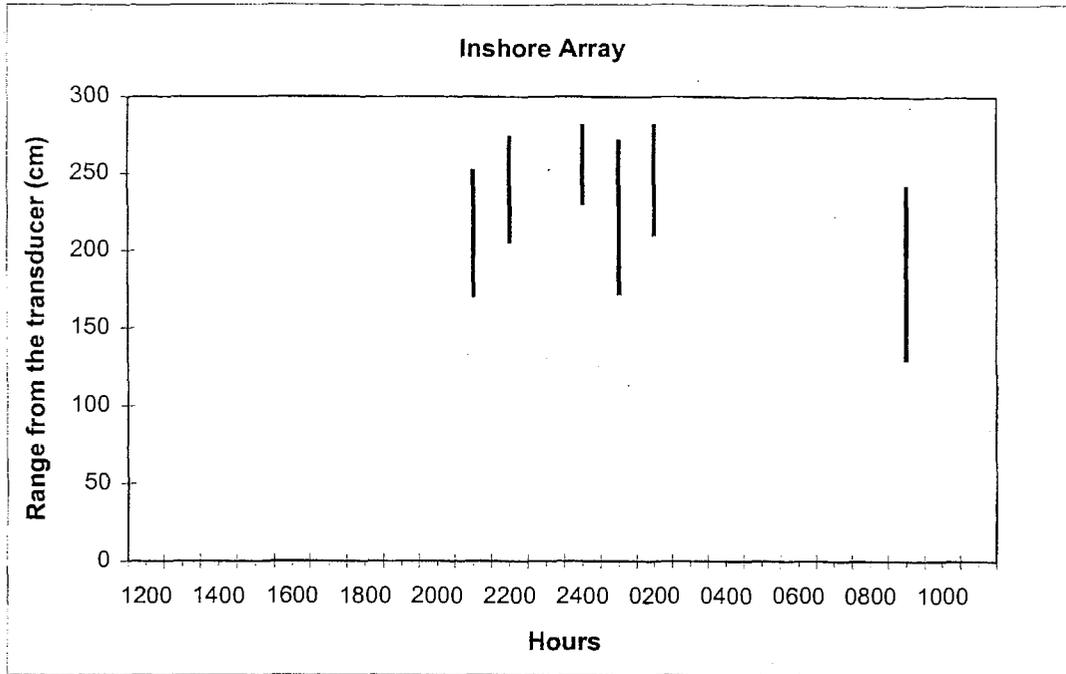


Figure 10. Range of smolt passage from the transducers summarized by hour, Ugashik River, May 24 to June 9, 2001.

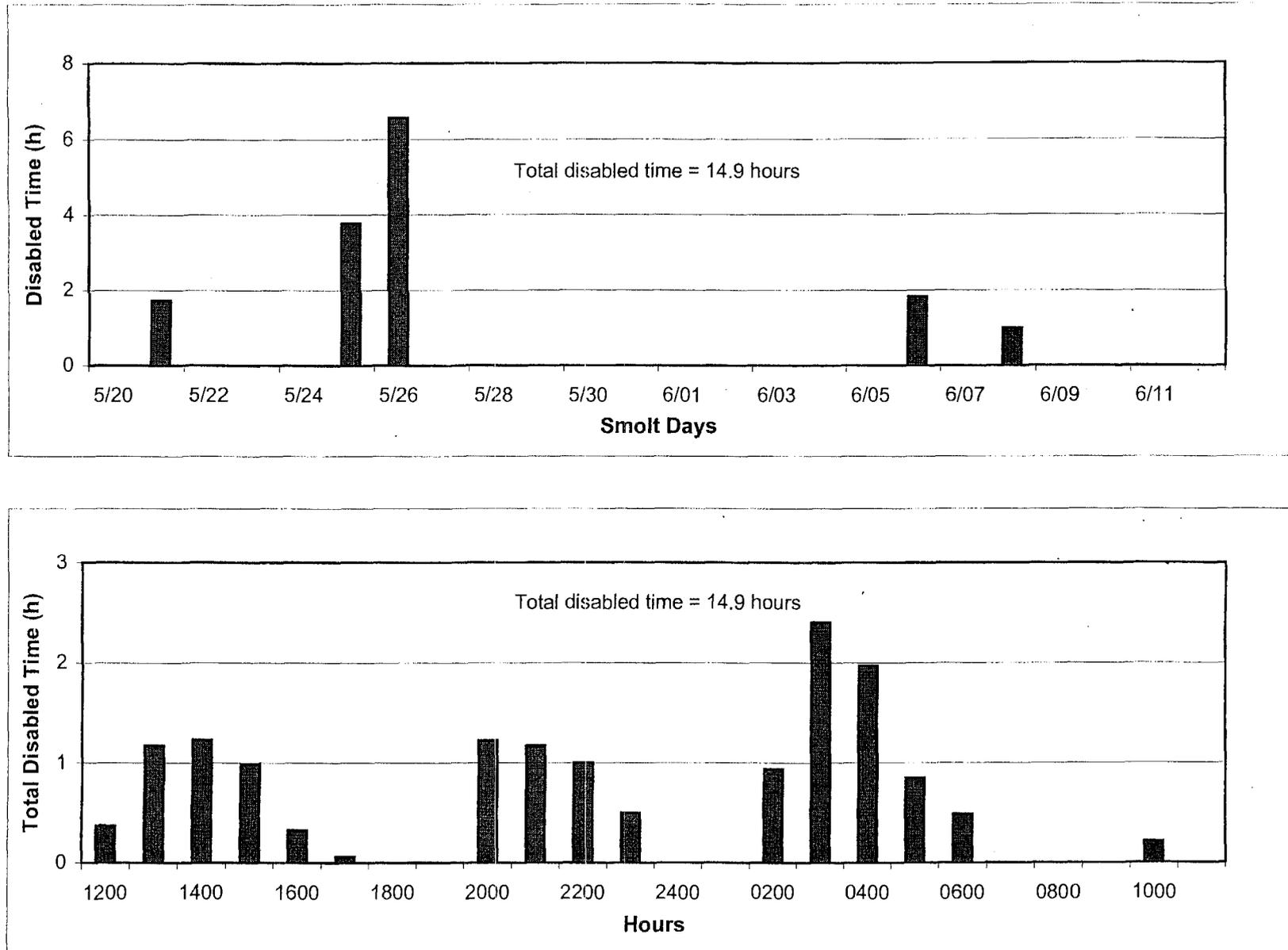


Figure 11. Ugashik River smolt sonar disabled time because of weather by smolt day and hour, May 20 to June 12, 2001.

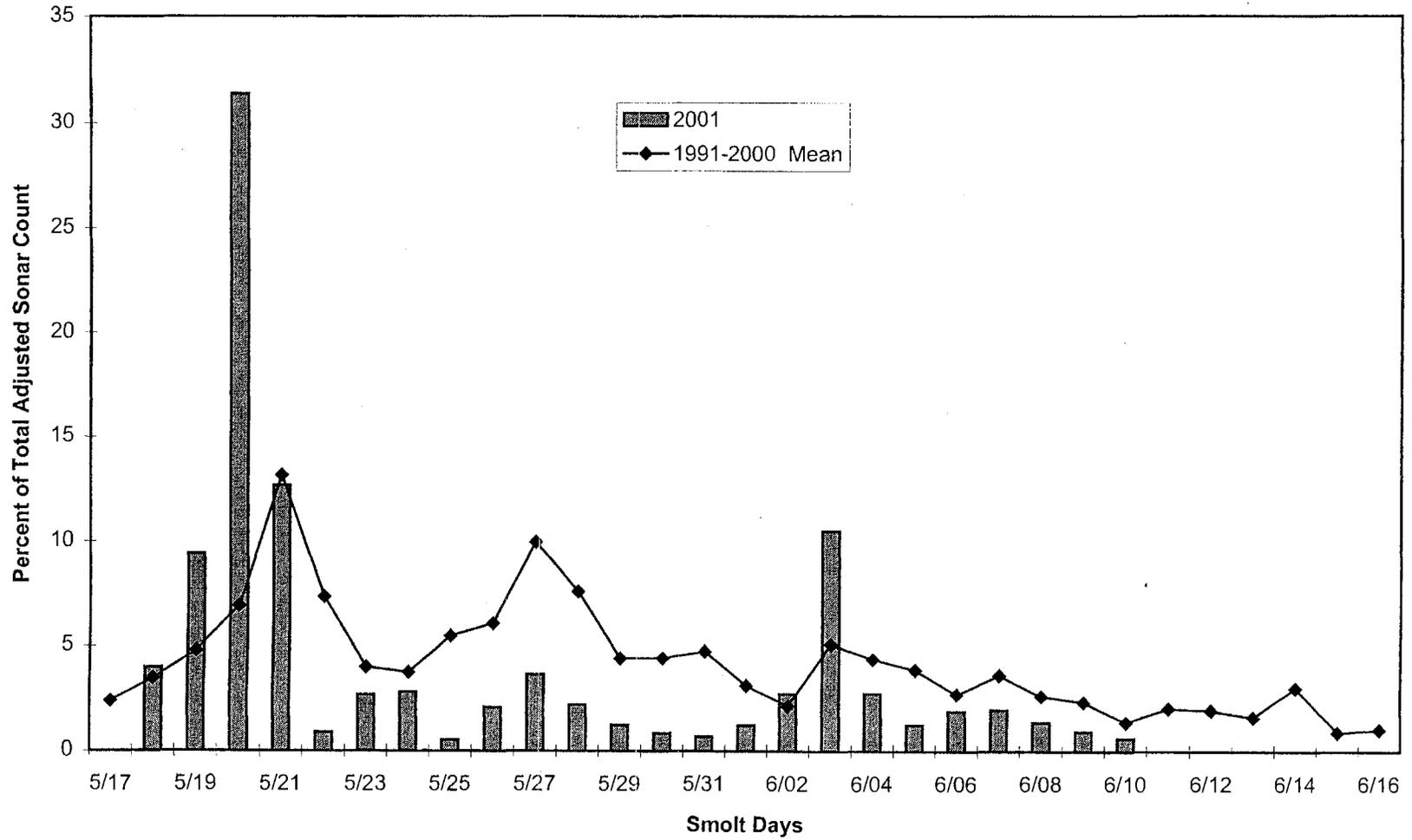


Figure 12. Comparison of the percent of the 2001 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1991-2000 mean.

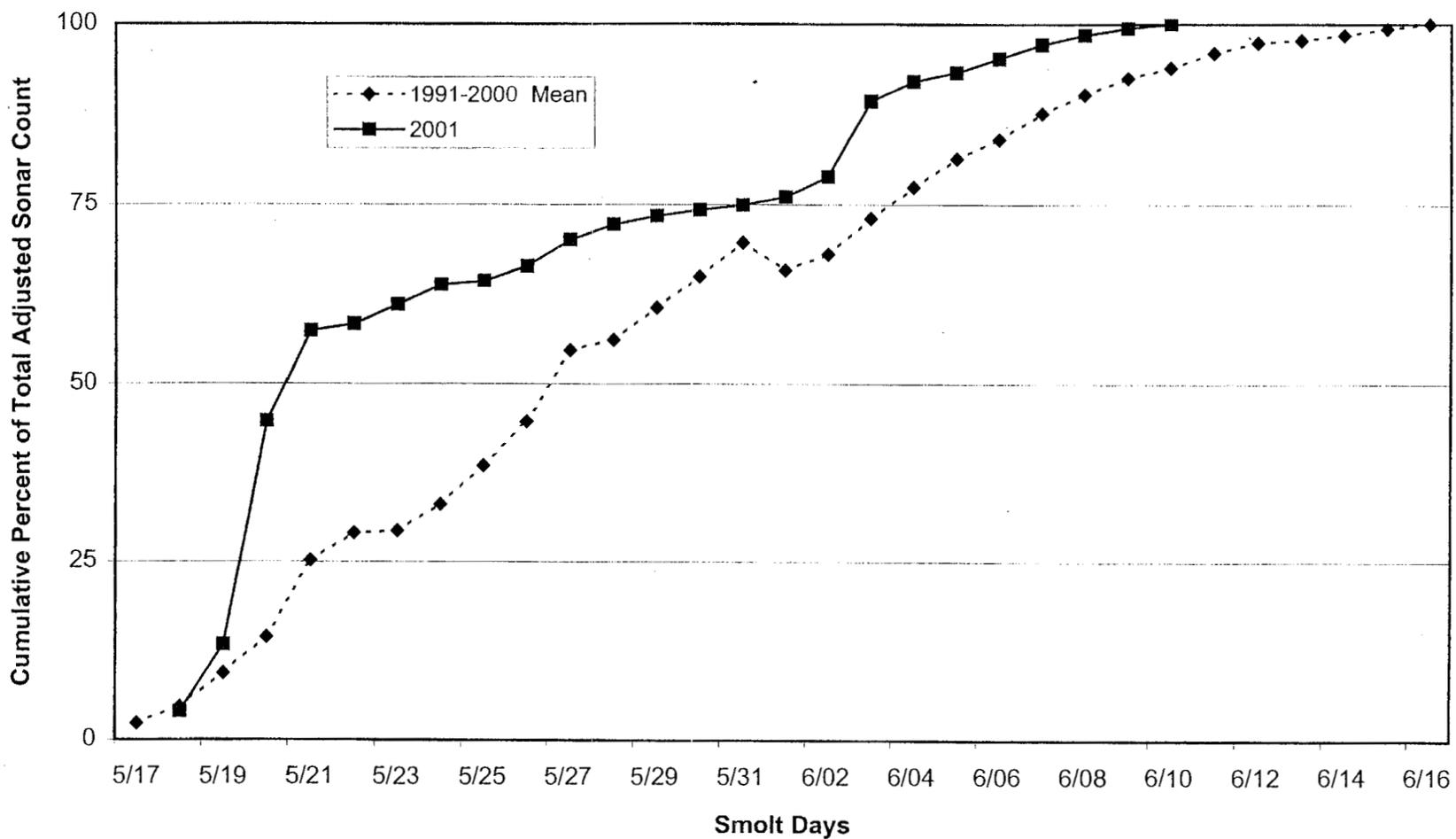


Figure 13. Comparison of the cumulative percent of the 2001 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1991-2000 mean.

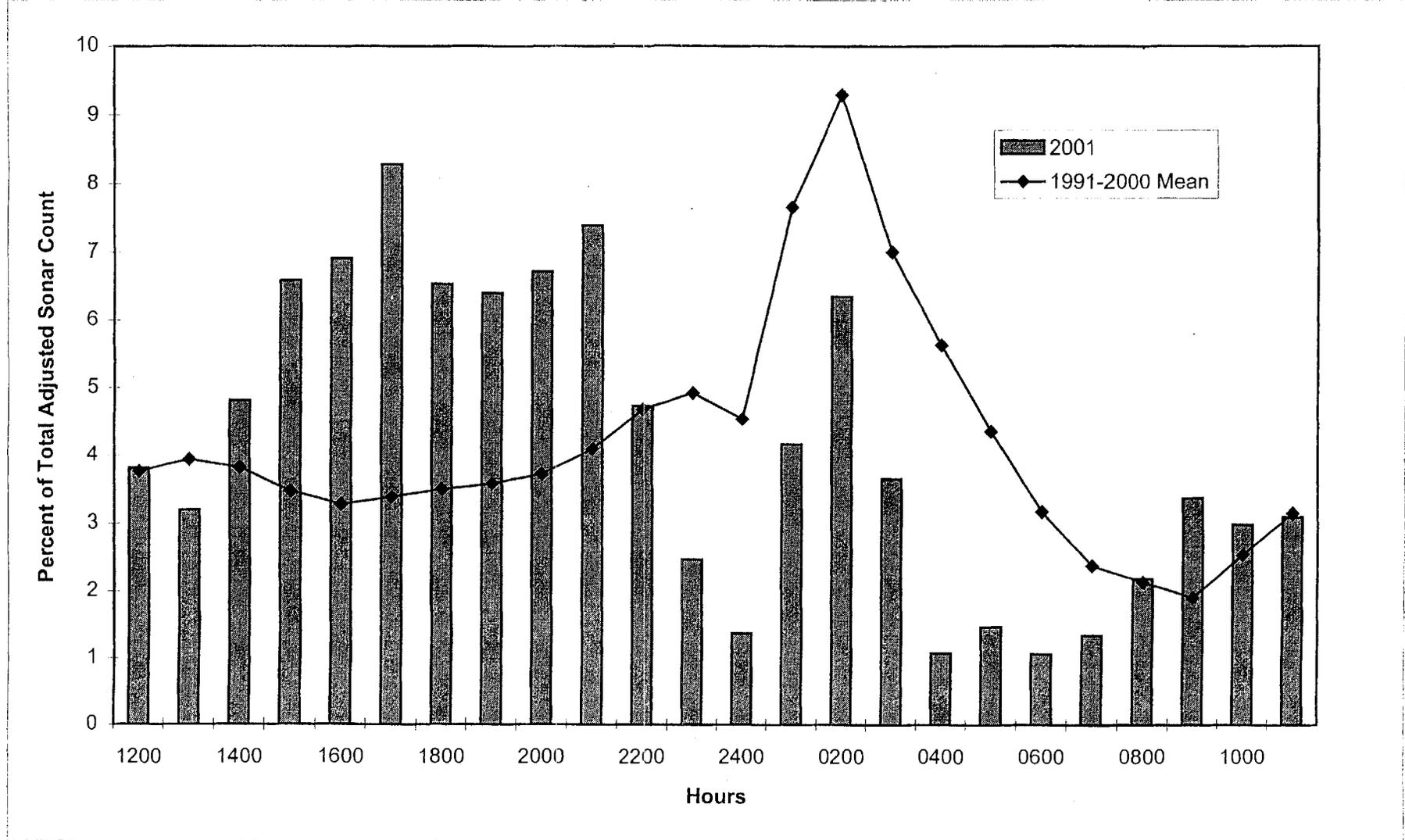


Figure 14. Comparison of the percent of the 2001 total adjusted sonar counts by hour at Kvichak River smolt sonar with the 1991-2000 mean.

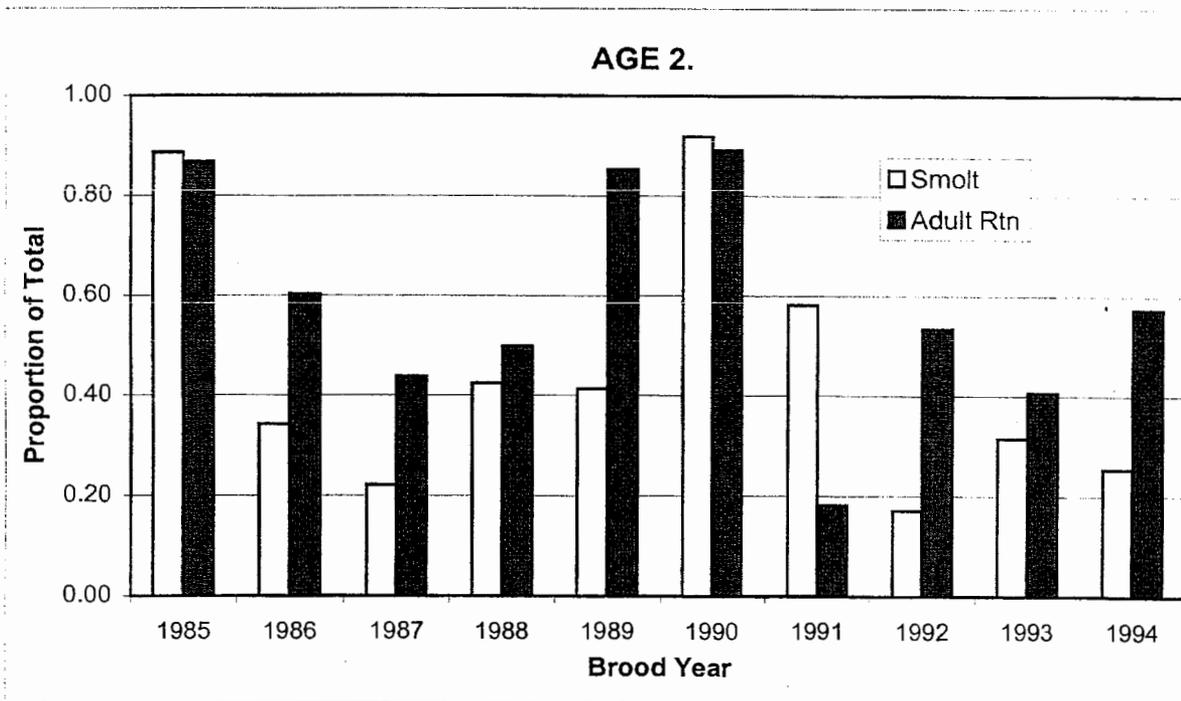
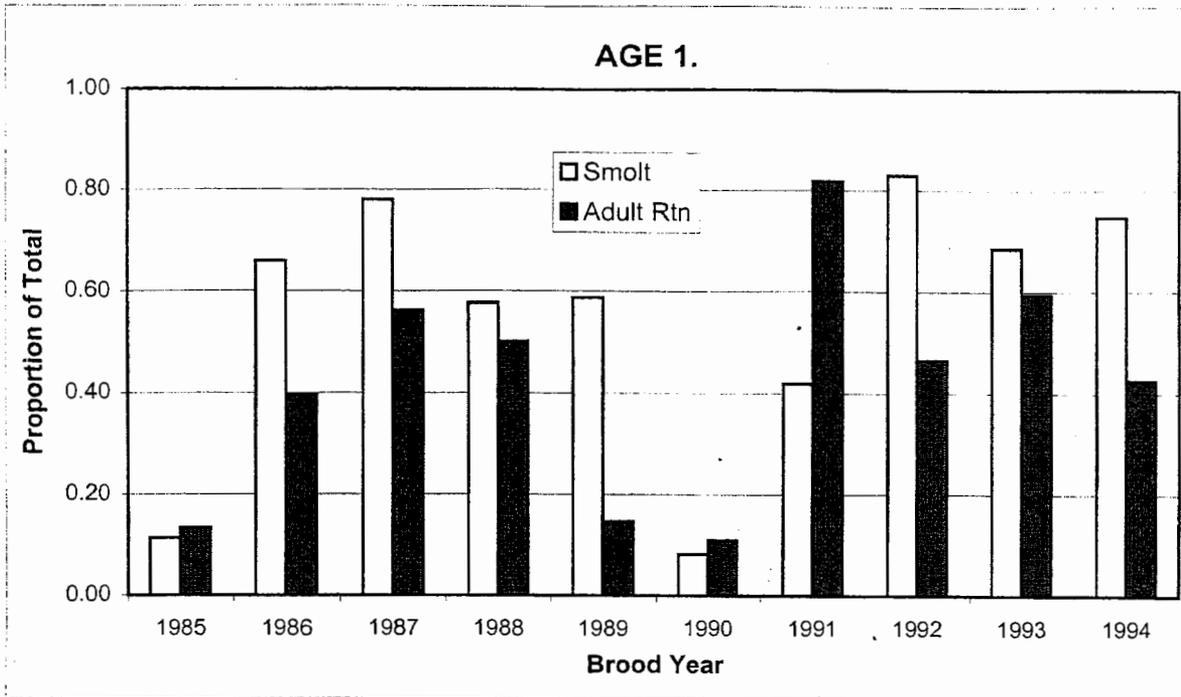


Figure 15. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of the total adult returns by brood year, 1985-1994.

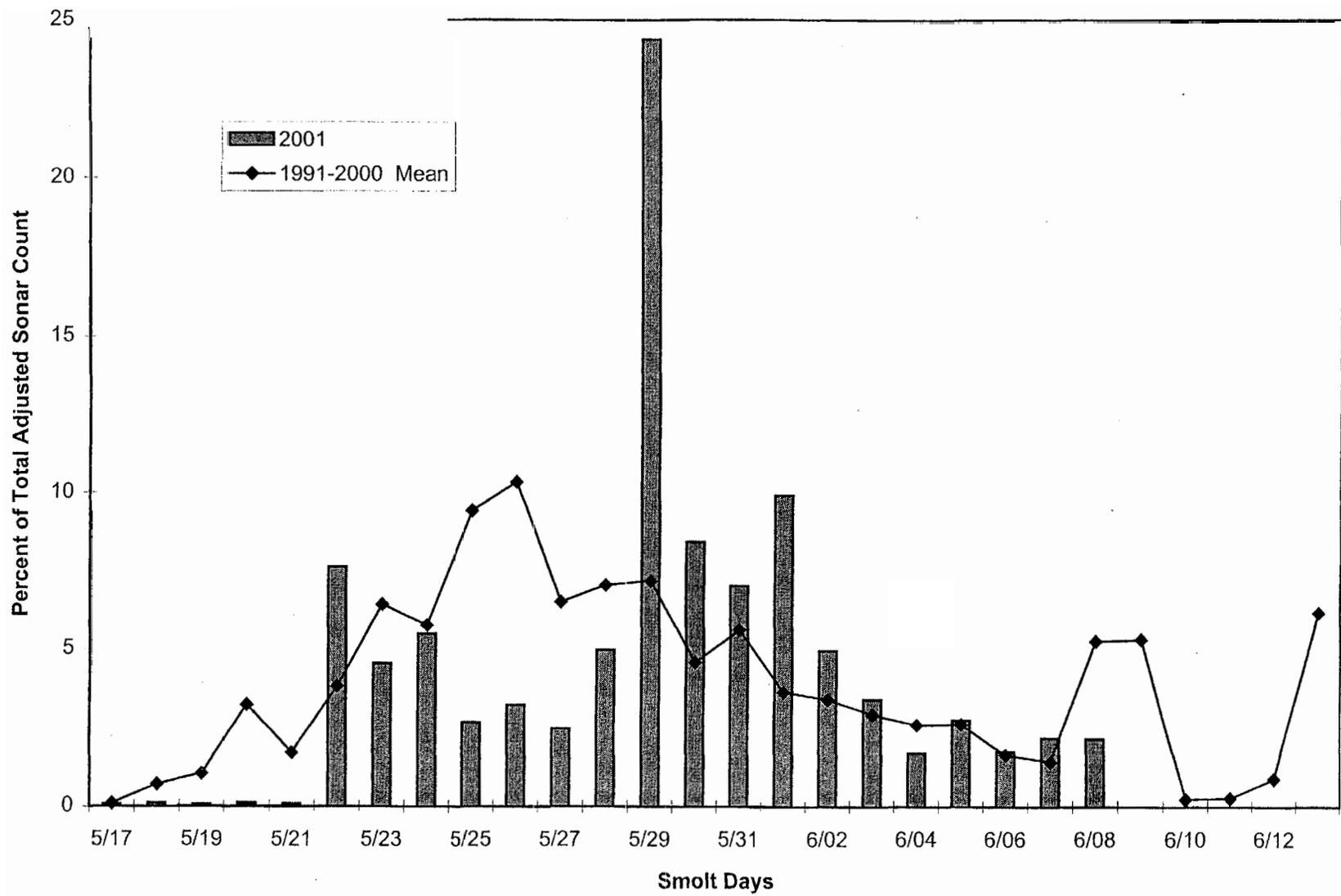


Figure 16. Comparison of the percent of the 2001 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1991-2000 mean.

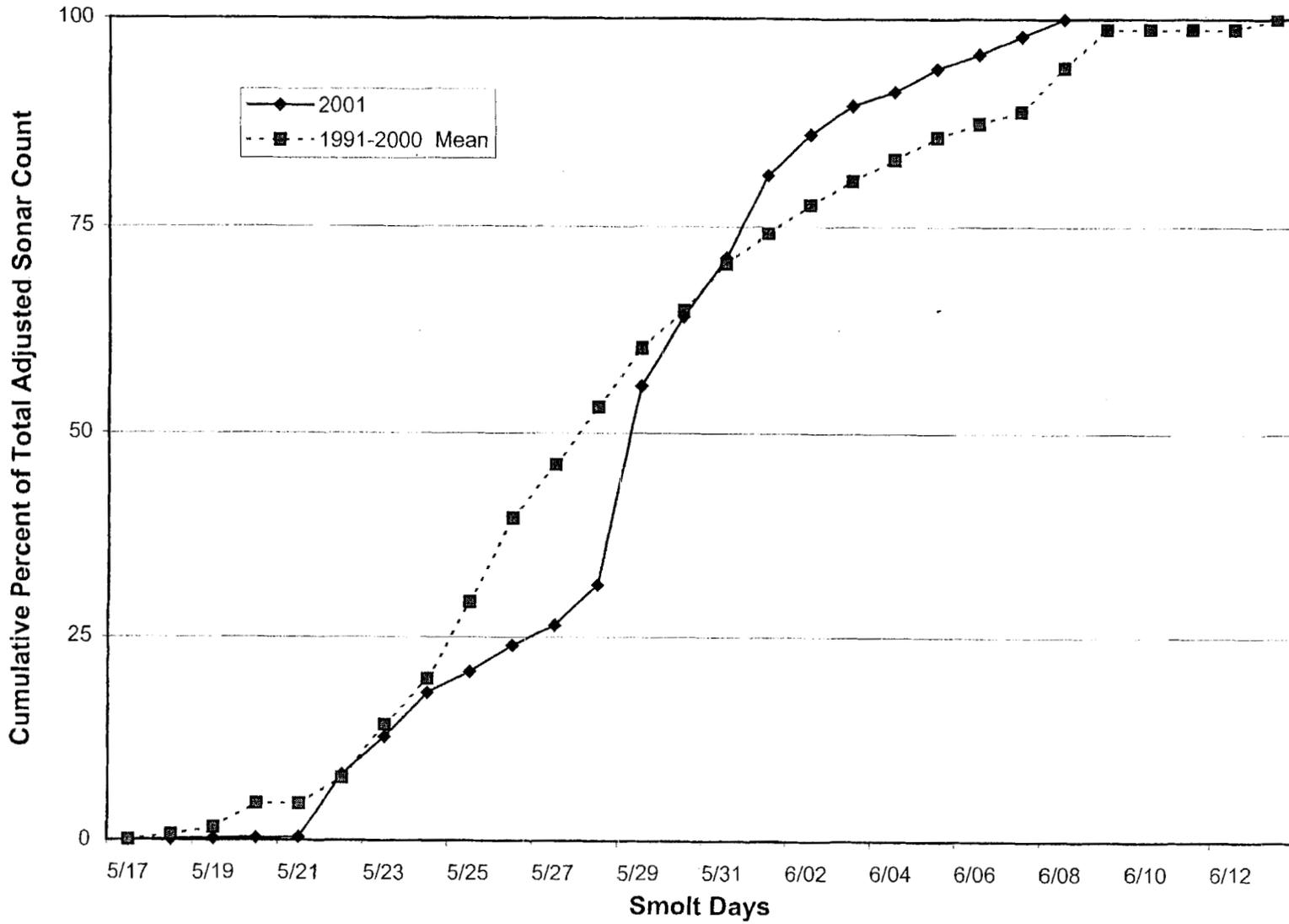


Figure 17. Comparison of the cumulative percent of the 2001 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1991-2000 mean.

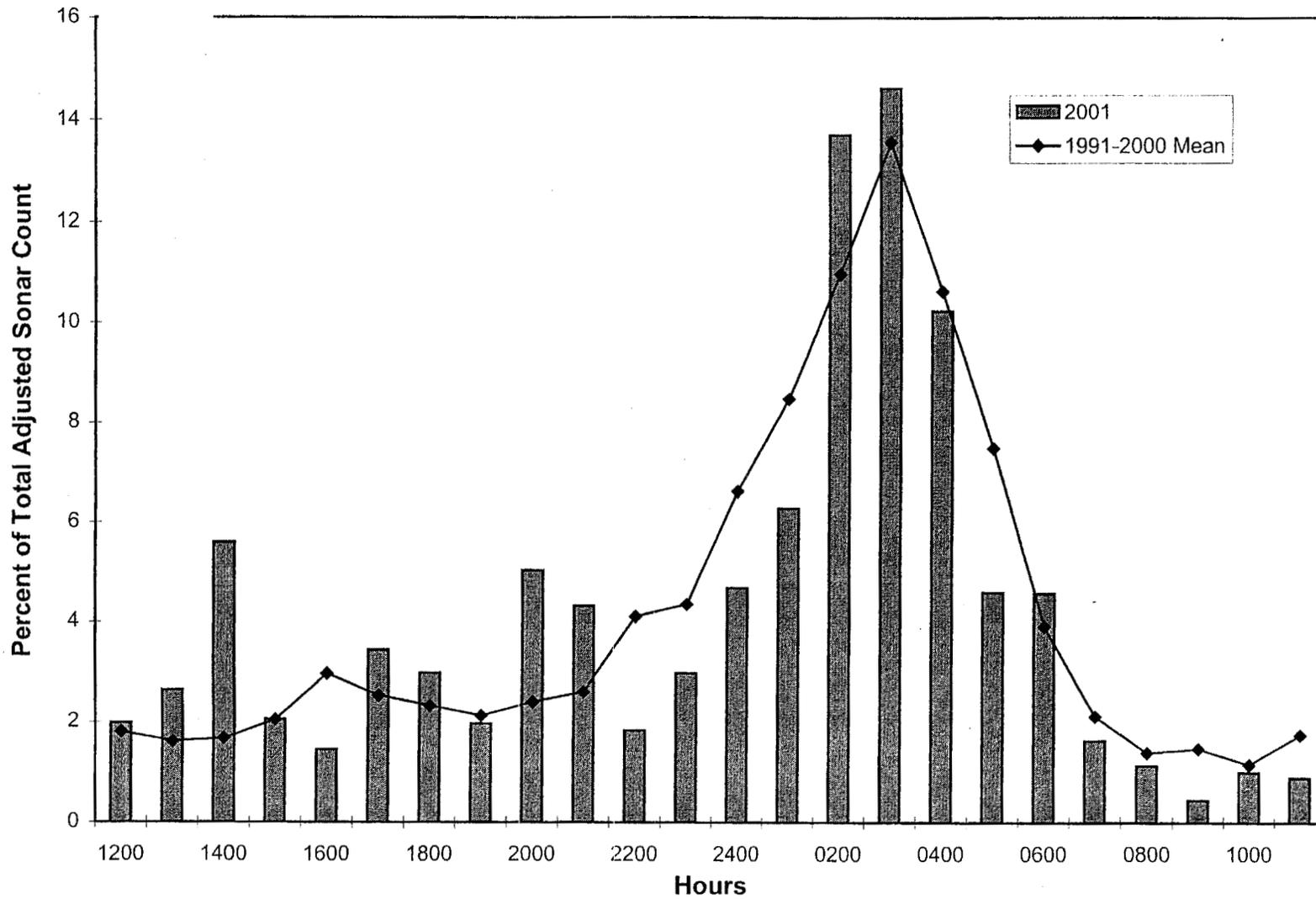


Figure 18. Comparison of the percent of the 2001 total adjusted sonar counts by hour at Egegik River smolt sonar with the 1991-2000 mean.

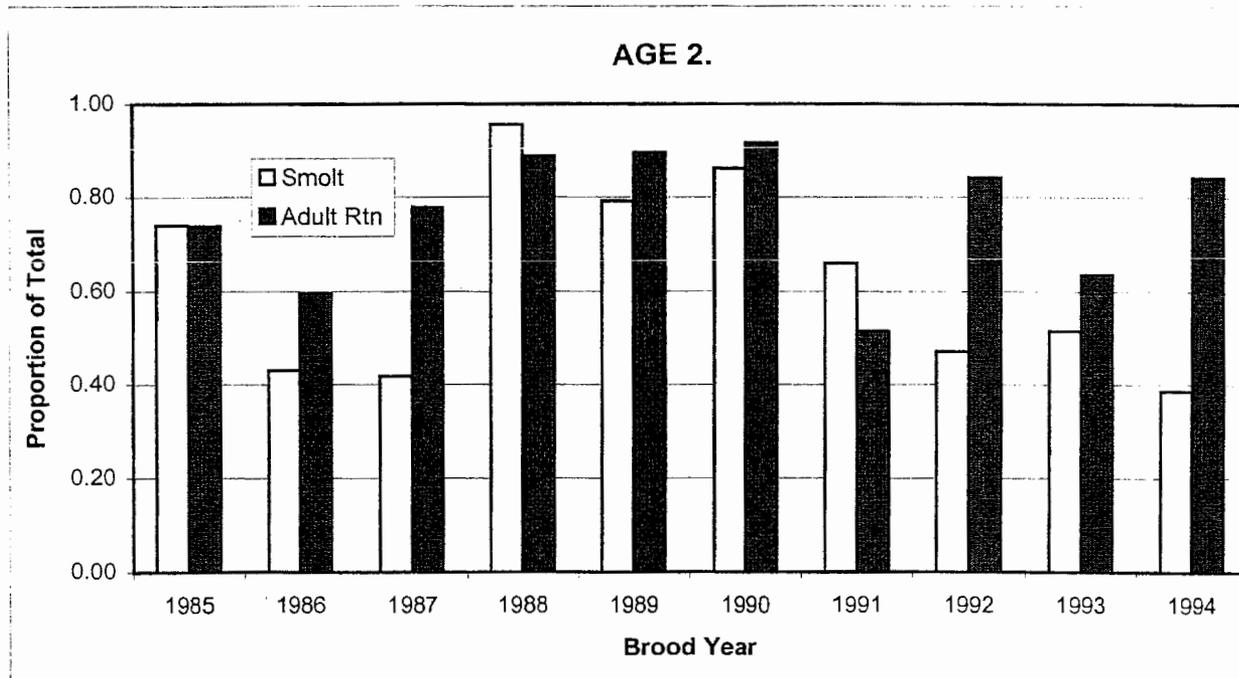
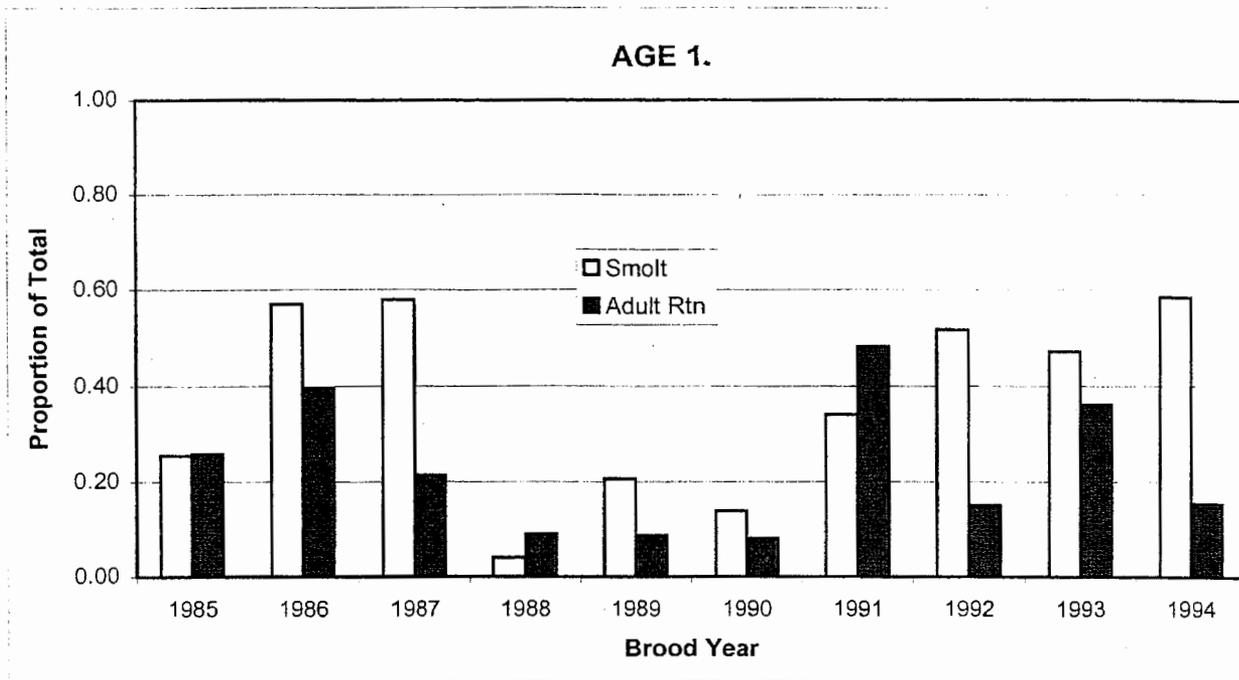


Figure 19. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of the total adult returns by brood year, 1985-1994.

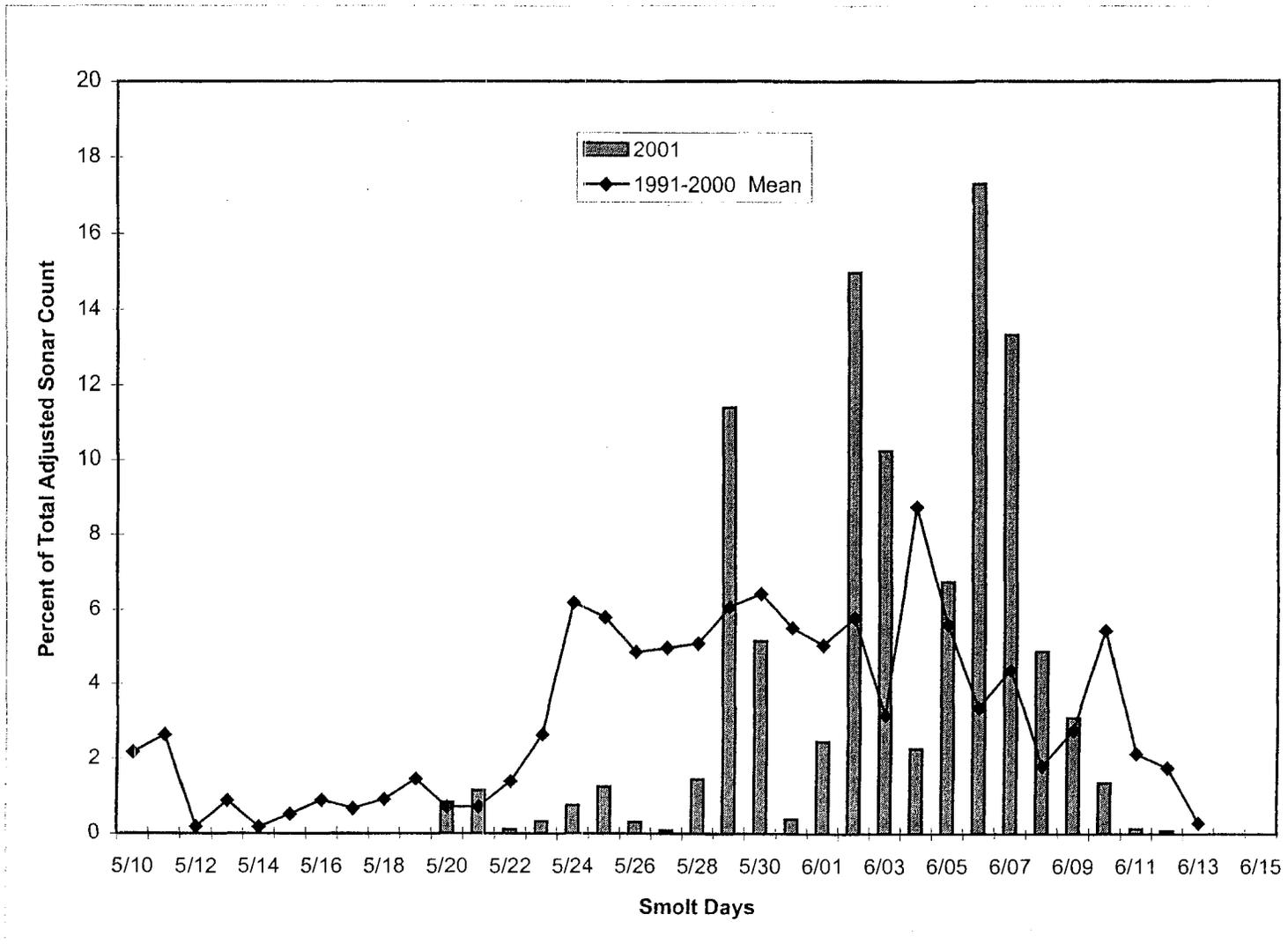


Figure 20. Comparison of the percent of the 2001 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1991-2000 mean.

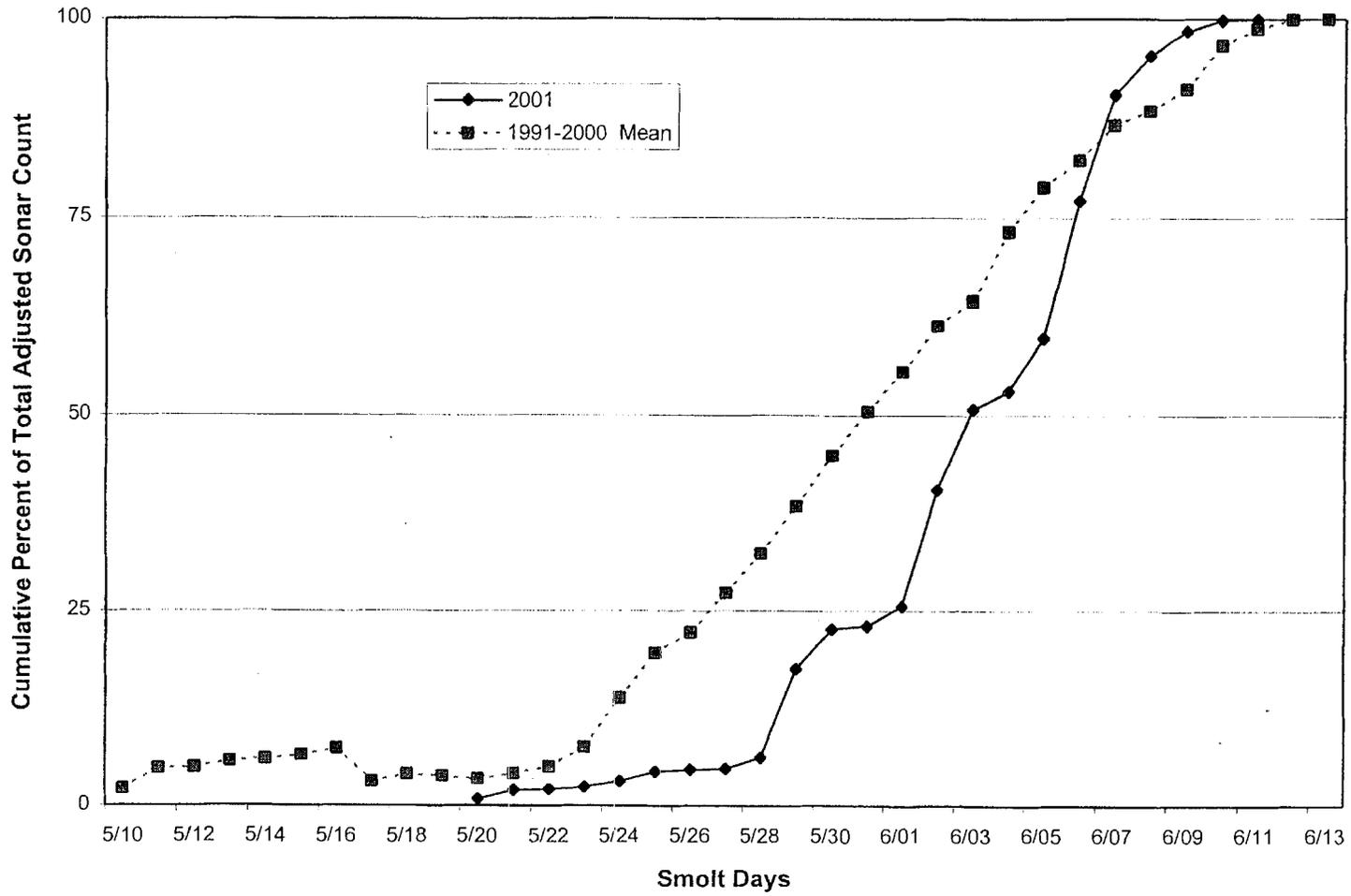


Figure 21. Comparison of the cumulative percent of the 2001 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1991-2000 mean.

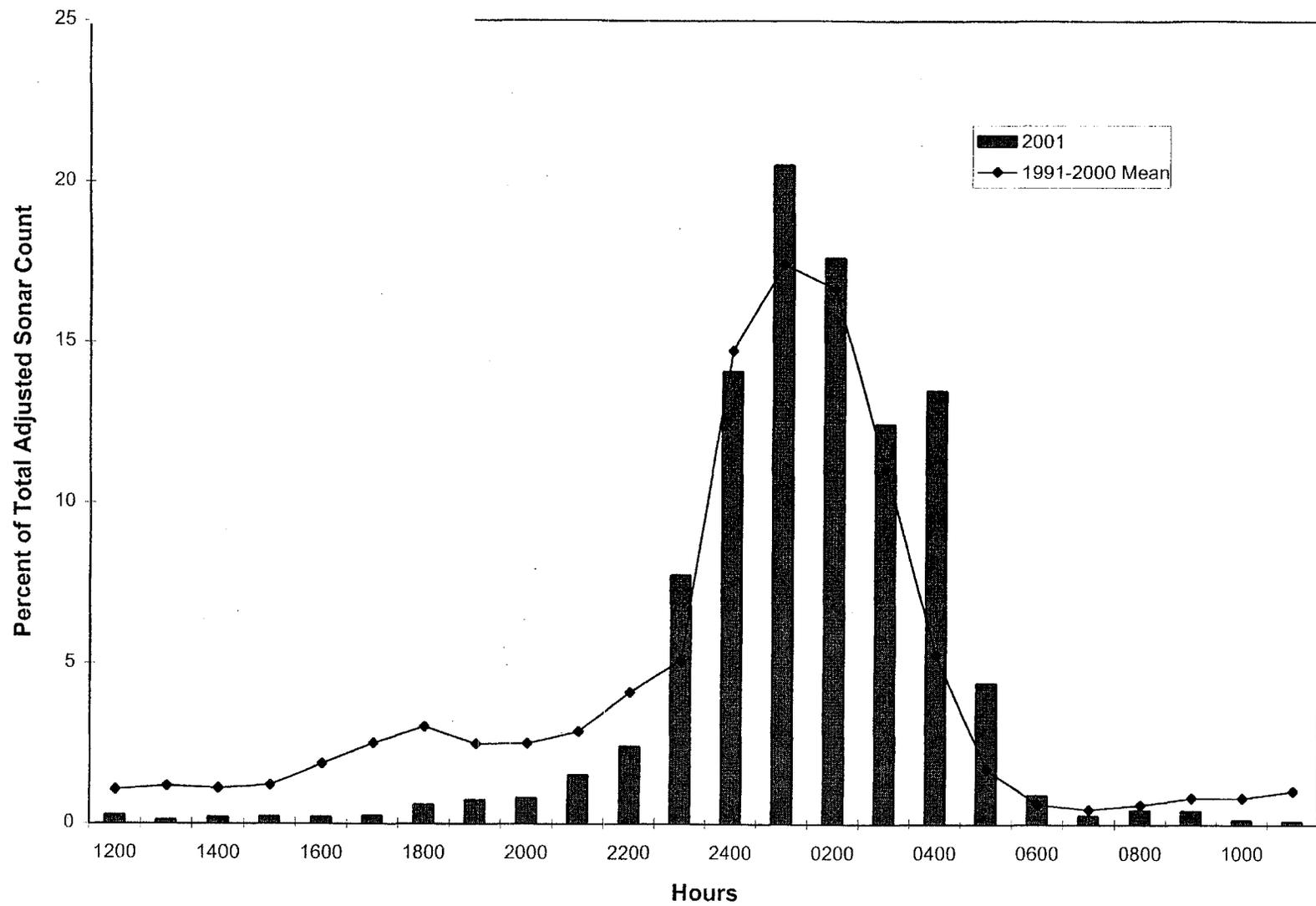


Figure 22. Comparison of the percent of the 2001 total adjusted sonar counts by hour at Ugashik River smolt sonar with the 1991-2000 mean.

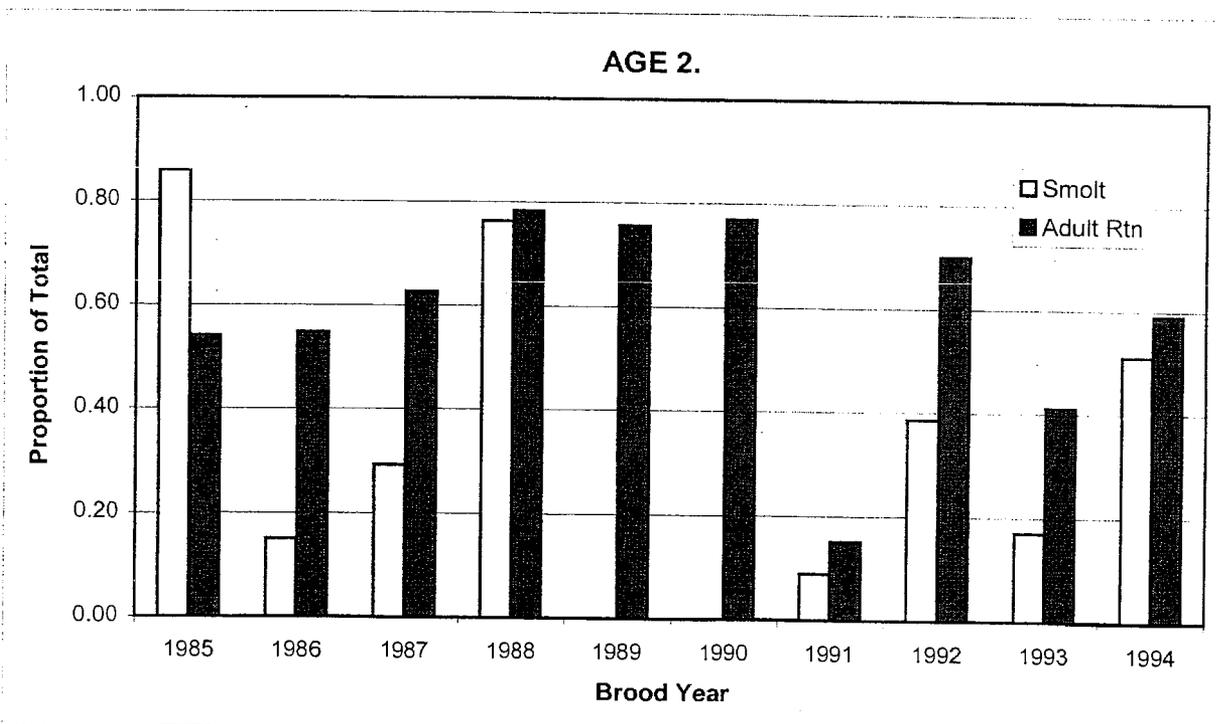
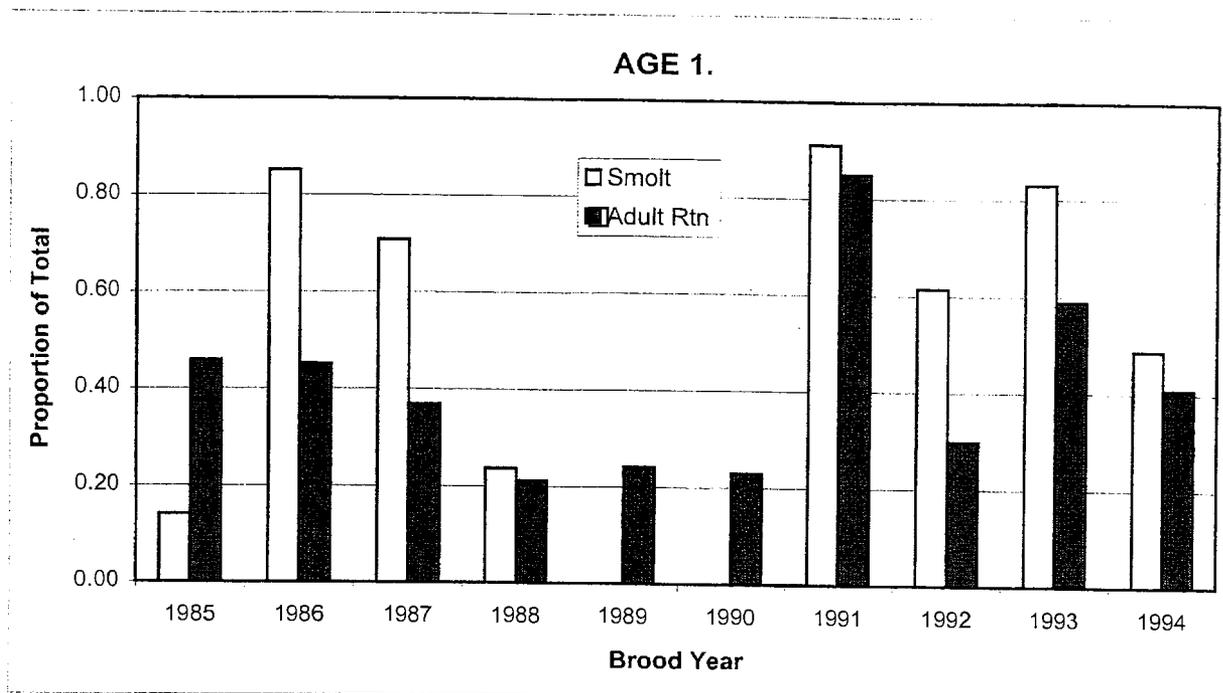


Figure 23. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of the total adult returns by brood year, 1985-1994.

Appendix A.1. River width and distance between arrays at Kvichak River smolt sonar site^a, 1989-2001.

Year	Distance (m)						
	Left Bank Shore	Offshore Limit Dead Zone	Offshore Array	Center Array	Inshore Array	Inshore Limit Dead Zone	Right Bank Shore
1989 ^b	123	119	72	55	23	12	0
1990	136	128 ^c	96	67	42	5 ^c	0
1991	134	126	97	78	56	5	0
1992	129	109	85	68	49	5	0
1993	125	116	93	70	52	12	0
1994	134	125	91	70	58	12	0
1995	135	125	100 ^d	72	61	12	0
1996	129	120	100	85 ^e	52	12	0
1997	126	117	93	80	62	18	0
1998	134	125	96	69	47	15	0
1999	134	125	81	69	48	18	0
2000	133	126	84	69	50	9	0
2001	137	128	85	78	55	9	0
1989-00 Max	136	128	100	85	62	18	0
1989-00 Avg	131	122	91	71	50	11	0
1989-00 Min	123	109	72	55	23	5	0

^a Since 1989, the Kvichak River smolt sonar site has been located 6 km downstream from the outlet of Lake Iliamna. The current site is 1 km downstream from the 1973-1988 smolt sonar site.

The smolt sonar tent is located on the right bank of the river at - 59°18.049' N latitude, 155°57.859' W longitude.

^b From 1989-1994 the cables for all sonar arrays were 101 m (330 ft) long.

^c Source - Huttunen and Skvorc (1991)

^d Offshore array cables extended 126 m (415 ft) prior to the 1995 field season to improve array placement and safety during deployment.

^e Center array cables extended from 126 m (415 ft) prior to the 1996 field season to improve array placement and safety during deployment.

Appendix A.2. River width and distance between arrays at Egegik River smolt sonar site^a, 1989-2001.

Year	Distance (m)						
	Left Bank Shore	Inshore Limit Dead Zone	Inshore Array	Center Array	Offshore Array	Offshore Limit Dead Zone	Right Bank Shore
1989	0	9	40	55	67	82	104
1990	0	9	40	55	67	82	104
1991	0	9	40	55	67	85	107
1992	0	21	43	55	73	101	110
1993	0	16	43	58	70	94	116
1994	0	12	40	55	67	90	112
1995	0	9	37	53	67	93	114
1996	0	12	40	55	67	89	112
1997	0	17	40	55	67	82	107
1998	0	9	40	55	67	85	108
1999	0	12	40	55	67	91	112
2000	0	9	40	55	67	85	108
2001	0	16	40	55	67	87	110
1989-00 Max	0	21	43	58	73	101	116
1989-00 Avg	0	12	40	55	68	88	109
1989-00 Min	0	9	37	53	67	82	104

^a The Egegik River smolt sonar site was located 4 km downstream from the outlet of Becharof Lake, 1982-2001. The smolt sonar tent is located on the left bank of the river at - 58°03.53' N latitude, 156°53.23' W longitude.

Appendix A.3. River width and distance between arrays at Ugashik River smolt sonar site^a, 1988-2001.

Year	Distance (m)					
	Left Bank Shore	Offshore Limit Dead Zone ^b	Offshore Array	Inshore Array	Inshore Limit Dead Zone ^b	Right Bank Shore
1988	49	na	29	23	na	0
1989	43	34	28	23	12	0
1990	43	37	31	26	12	0
1991	43	37	30	26	12	0
1992 ^c						
1993	43	35	30	26	12	0
1994	43	37	32	27	12	0
1995	43	37	30	24	12	0
1996	41	35	30	26	11	0
1997	42	38	32	27	11	0
1998	44	38	33	27	14	0
1999	44	38	31	27	12	0
2000	45	38	33	28	14	0
2001	40	34	30	24	12	0
1989-00 Max	45	38	33	28	14	0
1989-00 Avg	43	36	31	26	12	0
1989-00 Min	41	34	28	23	11	0

^a The Ugashik River smolt sonar site was located 50 m downstream from the outlet of Lower Ugashik Lake, 1988-2001. The smolt sonar tent is located on the right bank of the river at - 57°33.89' N latitude 156°59.90' W longitude.

^b na = not available

^c Due to budget cuts, the smolt outmigration was not monitored on the Ugashik River in 1992.

Appendix B.1. Ice-cover dates for Lake Iliamna, 1970-2001.

Winter of	Freeze-up Date ^a		Break-up Date ^a		Total Days of Ice Cover	Comments ^a
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1969-1970	1-Jan	1				
1970-1971	7-Jan	7	16-Jun	167	161	Long, cold winter.
1971-1972			5-Jun	157		
1972-1973			25-May	145		
1973-1974			21-May	141		
1974-1975	26-Dec	-5	4-Jun	155	161	
1975-1976			7-May	128		
1976-1977	4-Feb	35	2-May	122	88	Partially open 30-Mar
1977-1978			11-May	131		80% open 02-May
1978-1979			3-May	123		50% open 28-Apr
1979-1980			3-May	124		
1980-1981						
1981-1982	9-Jan	9	25-May	145	137	Started to reopen 10-Feb
1982-1983						
1983-1984						Still open 19-Dec
1984-1985	11-Feb	42	5-Jun	156	115	50% open 29-May
1985-1986	18-Jan	18	12-May	132	115	
1986-1987	13-Feb ^b	44	23-Mar	82	39	Still not frozen up by 13-Feb
1987-1988	26-Jan	26				Began re-opening 24-Feb; 75% open 01-Apr
1988-1989	13-Jan	13				50% open 20-Apr
1989-1990	9-Jan	9	22-May	142	134	
1990-1991	7-Jan	7				
1991-1992	27-Jan	27	4-May	125	98	
1992-1993	22-Jan	22	3-May	123	102	
1993-1994	16-Feb	47	5-May	125	79	Ice jammed along west shore; trickled out until 29-May
1994-1995	11-Jan ^b	11	22-May	142	132	Lake frozen briefly, 19-Dec, then reopened. Lake 95% open by 13-May
1995-1996	12-Jan	12	5-May	126	114	
1996-1997	23-Dec ^c	-8	8-May ^d	128	137	
1997-1998	5-Jan	5	26-Apr	117	112	
1998-1999	30-Dec	-1	28-May	148	150	
1999-2000	30-Dec	-1	6-May	126	128	
2000-2001		^e				
1970-2000 Min	23-Dec		23-Mar		39	
1970-2000 Avg	15-Jan		13-May		118	
1970-2000 Max	16-Feb		16-Jun		161	

^a Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

^b Last date area was observed with open water; may have frozen over later.

^c Mostly frozen 18-Dec, except several large holes.

^d Lake Iliamna was still ice covered on the evening of May 6. Subsequent southerly and westerly winds over the next several days caused the ice to break up, blow up the lake, and melt in place. By May 10 the lake was ice-free at Igiugig.

^e Some new (<5 cm thick), thin (5-15 cm thick), and medium (15-30 cm thick) ice formed on the protected bays and shores of Lake Iliamna from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits. However because of unseasonably warm temperatures and prevailing winds, open water was observed on most of lake throughout the winter of 2000-2001.

Appendix B.2. Ice-cover dates for Becharof Lake, 1976-2001.

Winter of	Freeze-up Date ^a		Break-up Date ^a		Total Days of Ice Cover	Comments ^a
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1975-1976			6-Apr	97		
1976-1977			6-Apr	96		Island Arm still frozen. Main basin opened earlier.
1977-1978						
1978-1979						
1979-1980						
1980-1981			13-May	133		May have opened earlier.
1981-1982			20-May	140		Still open 15-Dec. May have opened earlier than 20-May.
1982-1983	18-Jan	18				50% open 31-Mar
1983-1984	16-Jan ^b	16	16-May	137		Still open 16-Jan
1984-1985	11-Feb	42	3-May	123	82	
1985-1986	26-Feb	57	27-Apr	117	61	Still open 30-Jan
1986-1987	12-Mar ^b	71				Still open 12-Mar
1987-1988	24-Mar ^b	84				Still open 24-Mar
1988-1989	17-Jan	17	27-Apr	117	101	
1989-1990	21-Feb	52	25-Apr	115	64	
1990-1991	4-Feb	35	1-Apr	91	57	
1991-1992	27-Jan	27	10-May	131	105	
1992-1993	23-Jan	23	31-Mar	90	68	
1993-1994	25-Feb	56	4-Apr	94	39	
1994-1995	24-Jan	24	28-Apr	118	95	Wind driven ice lense blocked lake outlet on 19-May & 20-May
1995-1996	8-Jan	8	28-Mar	88	81	
1996-1997	13-Dec ^c	-18	19-Apr ^d	109	128	
1997-1998	6-Jan	6	4-Apr	94	89	
1998-1999	5-Feb ^e	36	28-May	148	113	Accumulated of ice at the lake outlet caused ice problems in the river from 27-May to 18-June.
1999-2000	2-Jan	2	12-Apr	103	101	
2000-2001		^f				
<hr/>						
1976-2000 Min	13-Dec		28-Mar		39	
1976-2000 Avg	30-Jan		22-Apr		87	
1976-2000 Max	24-Mar		28-May		128	

^a Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

^b Last date area was observed with open water; may have frozen over even later.

^c Mostly frozen on 13-Dec except a small section of shoreline near Whale Mt and two small sections in the NW half of the lake.

^d In a 19-Apr satellite photo the lake appears to be completely ice free (1 °C), scattered patches of windblown ice remain along the NE & W end of lake.

^e Estimated freeze-up date. West half of lake frozen on 08-Jan. Average temperatures in King Salmon were below -18°C (0°F) from 28-Jan to 12-Feb. The coldest days occurred from 30-Jan to 05-Feb with average daily temperatures of -29 to -34°C (-20 to -29 °F).

^f Some new (<5 cm thick), thin (5-15 cm thick), and medium (15-30 cm thick) ice may have formed on the protected bays and shores of Becharof Lake from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits. However because of unseasonably warm temperatures and prevailing winds, open water was observed on most of the lake throughout the winter of 2000-2001.

Appendix B.3. Ice-cover dates for Upper and Lower Ugashik Lakes, 1977-2001.

Winter of	Freeze-up Date ^a		Break-up Date ^a		Total Days of Ice Cover	Comments ^a
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1976-1977			6-Apr	96		
1977-1978						
1978-1979						
1979-1980						
1980-1981						Still open 16-Dec
1981-1982			12-May	132		
1982-1983	18-Jan	18				Partially open 31-Mar
1983-1984	16-Jan ^b	16				
1984-1985	11-Feb	42	14-May	134	93	
1985-1986	26-Feb	57	9-May	129	73	
1986-1987	12-Mar ^b	71				
1987-1988	9-Dec	-22	24-Mar	84	107	
1988-1989	17-Jan	17	10-May	130	114	
1989-1990	21-Feb	52	25-Apr	115	64	
1990-1991	8-Jan	8				
1991-1992	27-Jan	27	4-May	125	99	
1992-1993	20-Jan	20	31-Mar	90	71	
1993-1994	16-Feb	47	8-Apr	98	52	
1994-1995	24-Jan	24	28-Apr	118	95	
1995-1996	8-Jan	8	15-Apr	106	99	
1996-1997	13-Dec ^c	-18	26-Apr ^d	116	135	
1997-1998	5-Jan	5	4-Apr	94	90	
1998-1999	22-Jan	22	19-May	139	118	
1999-2000	25-Dec	-6	7-Apr	98	104	
2000-2001		^e				
<hr/>						
1977-2000 Min	9-Dec		24-Mar		52	
1977-2000 Avg	21-Jan		22-Apr		94	
1977-2000 Max	12-Mar		19-May		135	

^a Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

^b Last date area was observed with open water; may have frozen over even later.

^c Mostly frozen on 13-Dec except SW shoreline of Upper Ugashik Lake by Blue Mt and the NW shore of Lower Ugashik Lake between the outlet and the Narrows.

^d Upper Ugashik Lake ice free by 24-Apr. Lower Ugashik Lake 90% open by 26-April. Lake ice flows cleared in Ugashik River about 4-May.

^e Some new (<5 cm thick), thin (5-15 cm thick), and medium (15-30 cm thick) ice may have formed on the protected bays and shores of Upper and Lower Ugashik Lakes from March 18-25 and March 29-April 1, when King Salmon air temperatures dipped into the teens and single-digits. However because of unseasonably warm temperatures and prevailing winds, open water was observed on most of the lake throughout the winter of 2000-2001.

Appendix C.1. Kvichak River smolt fyke net catch log, 2001.

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/18	001	1850	1854	4		300		75
	002	1855	1858	3		150		50
	003	1922	1939	17	24	600	1050	35
5/19	004	2122	2129	7		350		50
	005	2131	2136	5		175		35
	006	2136	2146	10		132		13
	007	2213	2216	3		300		100
	008	2221	2226	5		123		25
	009	2231	2236	5	35	200	1280	40
5/20	010	1746	1759	13		113		9
	011	1802	1829	27		83		3
	012	2111	2116	5		119		24
	013	0001	0057	56		200		4
	014	0105	0627	322		50		0
	015	0900	0920	20	443	108	673	5
5/21	016	1944	2026	42		300		7
	017	2031	2203	92		110		1
	018	2205	2233	28		113		4
	019	2236	2357	81		200		2
	020	0002	0007	5		250		50
	021	0012	0015	3	251	121	1,094	40
5/22	022	1732	1914	102		108		1
	023	1919	2213	174		105		1
	024	2216	2222	6		102		17
	025	2224	2244	20		86		4
	026	2245	2302	17		109		6
	027	2304	0156	172	491	150	660	1
5/23	028	1814	1925	71		150		2
	029	1928	2041	73		300		4
	030	2044	2144	60		111		2
	031	2146	2244	58		250		4
	032	2247	2253	6		114		19
	033	2255	2258	3	271	150	1,075	50
5/24	034	1721	1842	81		200		2
	035	1844	1849	5		104		21
	036	1851	1900	9		140		16
	037	1902	2016	74		106		1
	038	2019	2106	47		800		17
	039	2107	2111	4	220	200	1,550	50
5/25	040	1628	1812	104		200		2
	041	1815	1914	59		150		3
	042	1916	2004	48		250		5
	043	2006	2045	39		130		3
	044	2047	2058	11		111		10
	045	2055	2100	5	266	109	950	22

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/26	046	1639	1938	179		150		1
	047	1940	0103	323		200		1
	048	0108	0742	394		300		1
	049	0747	0814	27		250		9
	050	0832	0849	17		600		35
	051	0854	0902	8	948	300	1,800	38
5/27	052	1716	1926	130		108		1
	053	1927	0109	342		102		0
	054	0114	0724	370		300		1
	055	0729	0743	14		110		8
	056	0747	0755	8		200		25
	057	0759	0802	3	867	108	928	36
5/28	058	1634	2125	291		300		1
	059	2128	2254	86		119		1
	060	2255	0033	98		110		1
	061	0038	0705	387		300		1
	062	0710	0720	10		150		15
	063	0725	0748	23	895	150	1,129	7
5/29	064	1719	0203	524		117		0
	065	0208	0746	338		107		0
	066	0751	1017	146		600		4
	067	1025	1100	35	1,043	150	974	4
5/30	068	1641	1853	132		103		1
	069	1854	2017	83		112		1
	070	2018	2113	55		108		2
	071	2116	2324	128		103		1
	072	2325	0058	93		125		1
	073	0103	0750	407	898	20	571	0
5/31	074	1603	0107	544		100		0
	075	0112	0410	178		107		1
	076	0415	0513	58		250		4
	077	0518	0618	60		250		4
	078	0623	0626	3		106		35
	079	0631	0635	4	847	125	938	31
6/01	080	1516	1532	16		300		19
	081	1537	1545	8		250		31
	082	1550	1555	5		150		30
	083	1809	1821	12		140		12
	084	1822	1907	45		200		4
	085	1909	1955	46	132	117	1,157	3
6/02	086	1557	1621	24		104		4
	087	1623	1741	78		140		2
	088	1744	1836	52		600		12
	089	1838	2117	159		113		1
	090	2119	2230	71		130		2
	091	2233	2355	82	466	600	1,687	7

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
6/03	092	1553	1554	1		107		107
	093	1622	1624	2		300		150
	094	1626	1646	20		112		6
	095	1647	1708	21		200		10
	096	1712	1745	33		125		4
	097	1747	1904	77	154	103	947	1
	6/04	098	1558	1631	33		300	
099		1634	1636	2		108		54
100		1638	1648	10		97		10
101		1711	1756	45		350		8
102		1759	1829	30		500		17
103		1831	1842	11	131	118	1,473	11
6/05		104	1603	1635	32		102	
	105	1637	1719	42		102		2
	106	1721	1809	48		100		2
	107	1810	1814	4		130		33
	108	1816	1821	5		120		24
	109	1832	1836	4	135	106	660	27
	6/06	110	1618	1913	175		97	
111		1916	2025	69		127		2
112		2039	2157	78		100		1
113		2200	2212	12		103		9
114		2214	2221	7		102		15
115		2241	0135	174	515	600	1,129	3
6/07		116	1556	1620	24		400	
	117	1624	1630	6		110		18
	118	1632	1641	9		112		12
	119	1643	1644	1		400		400
	120	1646	1652	6		116		19
	121	1654	1710	16	62	107	1,245	7
	6/08	122	1553	1704	71		300	
123		1705	1747	42		104		2
124		1749	1753	4		112		28
125		1754	1929	95		300		3
126		1931	2054	83		108		1
127		2055	2318	143	438	115	1,039	1
6/09		128	1601	1900	179		200	
	129	1903	2326	263		107		0
	130	2328	0754	506	948	105	412	0
Max					1,043	800	1,800	400
Avg					456	188	1,062	17
Min					24	20	412	0

^a Military time - 24 hour clock (hhmm).

^b CPUE = catch per unit effort

Appendix C.2. Kvichak River fyke net catches by species and smolt day, May 18 to June 9, 2001.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks ^a (Species)	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin ^b (Species)	Northern Pike (juv)
5/18	0.4	1,050	7	0	0	0	0	0	0	0	0	0	0
5/19	0.6	1,280	0	0	0	0	0	0	0	0	0	0	0
5/20	7.4	673	30	0	0	0	0	0	0	0	0	0	0
5/21	3.7	1,094	0	0	0	0	0	0	0	0	0	0	0
5/22	7.9	660	955	0	0	0	0	0	0	0	0	0	0
5/23	4.5	1,075	0	0	0	0	0	0	0	0	0	0	0
5/24	3.7	1,550	0	0	0	0	0	5	0	0	0	0	0
5/25	4.4	950	0	0	0	0	0	0	0	0	0	0	0
5/26	15.8	1,800	60	0	3	0	0	0	0	0	0	5	0
5/27	14.5	928	166	0	0	0	0	2	0	0	0	0	0
5/28	14.9	1,129	0	0	0	0	0	0	0	0	0	0	0
5/29	17.4	974	0	1	0	0	0	1	0	0	0	0	0
5/30	15.0	571	100	0	0	0	0	1	0	0	0	0	0
5/31	14.1	938	0	2	0	0	0	0	0	0	0	0	0
6/01	2.2	1,157	0	0	0	0	0	0	0	0	0	0	0
6/02	7.8	1,687	0	2	0	0	0	0	0	0	0	0	0
6/03	2.6	947	0	18	0	0	0	0	0	0	0	0	0
6/04	2.2	1,473	0	1	0	0	0	0	0	0	0	0	0
6/05	2.3	660	250	0	0	0	0	0	0	0	0	0	0
6/06	8.6	1,129	0	12	0	0	0	0	0	0	0	0	0
6/07	1.0	1,245	0	4	0	0	0	0	0	0	0	0	0
6/08	7.3	1,039	0	5	0	0	0	0	0	0	0	0	0
6/09	15.8	412	0	0	0	0	0	0	0	0	0	0	0
Total	173.9	24,421	1,568	45	3	0	0	9	0	0	0	5	0
Max	17.4	1,800	955										
Avg	8.3	1,071	77										
Min	1.0	412	0										

^a Most were threespine sticklebacks, however some ninespine sticklebacks were also caught.

^b Species unknown, however slimy sculpin and coastrange sculpin both occur in freshwater lakes and streams in Bristol Bay (Morrow 1980).

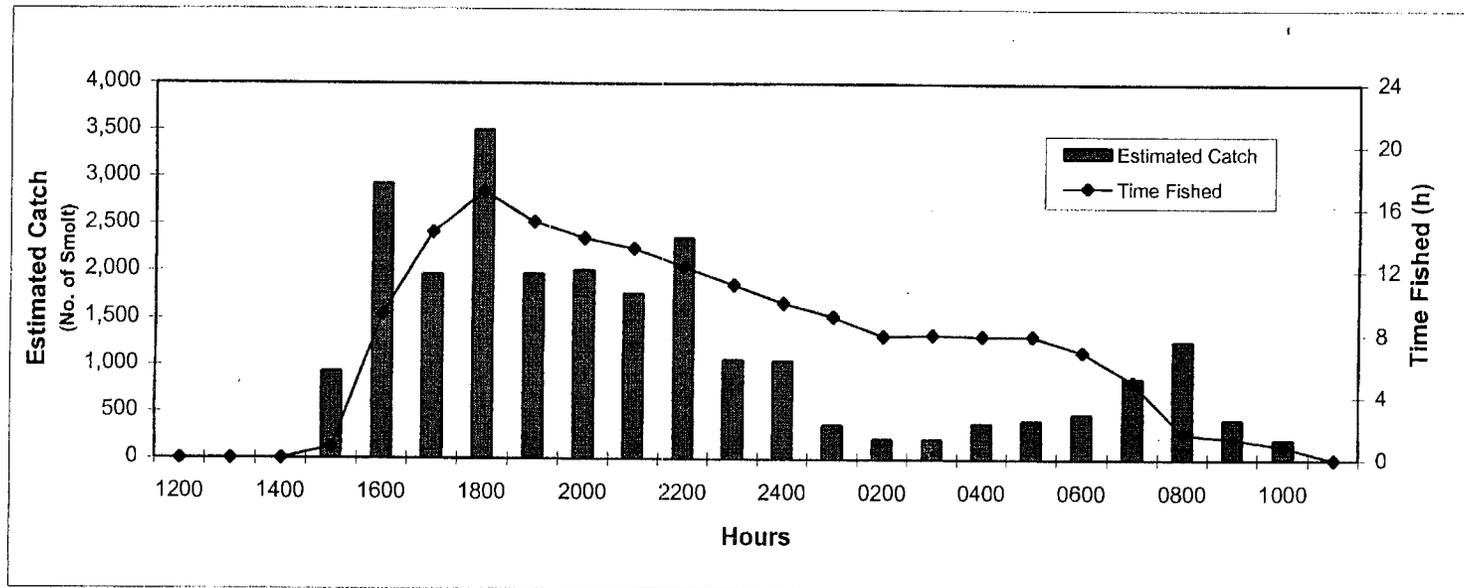
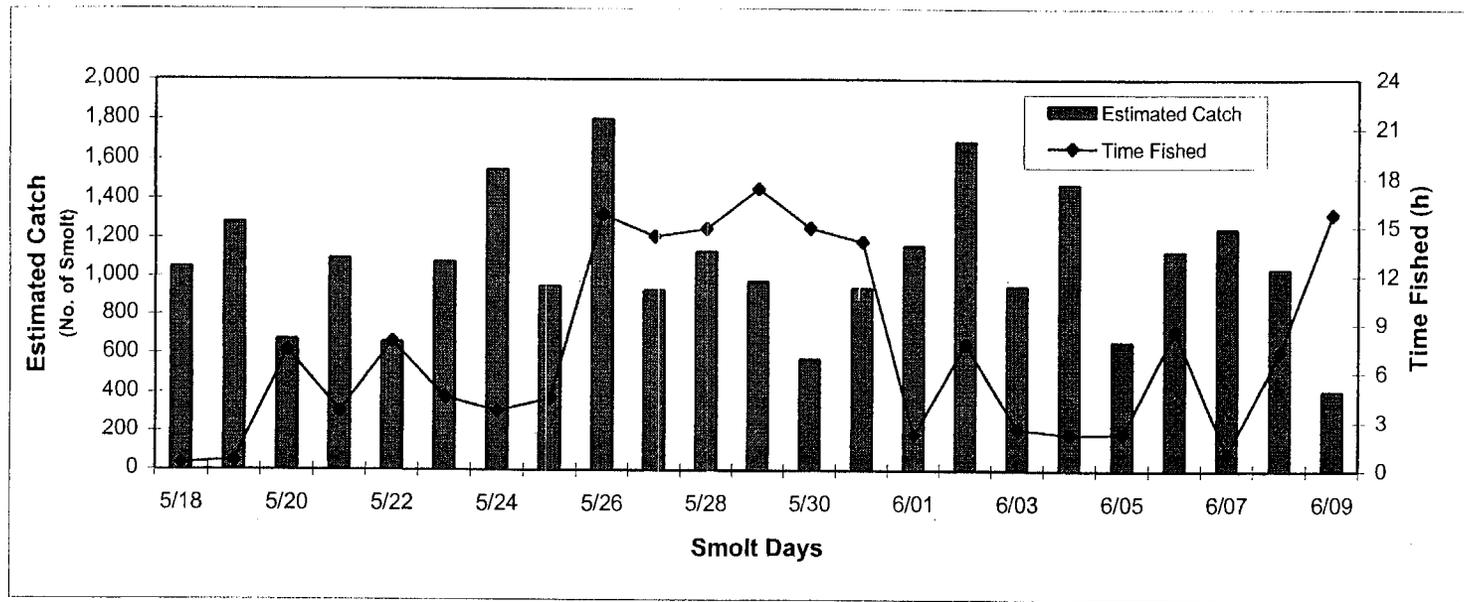
Appendix C.3. Kvichak River fyke net catches by species and hour, May 18 to June 9, 2001.

Hour ^a	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species)	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1500	0.8	935	0	0	0	0	0	0	0	0	0	0	0
1600	9.3	2,924	205	7	0	0	0	0	0	0	0	0	0
1700	14.4	1,960	67	4	1	0	0	1	0	0	0	0	0
1800	17.0	3,499	54	14	1	0	0	1	0	0	0	0	0
1900	15.1	1,967	82	3	1	0	0	1	0	0	0	0	0
2000	14.1	2,008	104	6	0	0	0	1	0	0	0	0	0
2100	13.4	1,764	103	9	0	0	0	1	0	0	0	0	0
2200	12.2	2,349	368	0	0	0	0	0	0	0	0	0	0
2300 ^b	11.1	1,062	94	0	0	0	0	0	0	0	0	0	0
2400 ^c	10.0	1,054	70	0	0	0	0	0	0	0	0	0	0
0100 ^c	9.1	368	116	0	0	0	0	1	0	0	0	0	0
0200 ^c	7.9	223	62	1	0	0	0	2	0	0	0	1	0
0300 ^c	8.0	223	62	0	0	0	0	1	0	0	0	1	0
0400 ^c	7.9	387	61	0	0	0	0	0	0	0	0	1	0
0500 ^c	7.9	418	61	0	0	0	0	0	0	0	0	1	0
0600 ^b	6.9	487	40	1	0	0	0	0	0	0	0	1	0
0700	5.0	868	19	0	0	0	0	0	0	0	0	0	0
0800	1.7	1,275	0	0	0	0	0	0	0	0	0	0	0
0900	1.4	430	0	0	0	0	0	0	0	0	0	0	0
1000	0.9	220	0	0	0	0	0	0	0	0	0	0	0
1100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Total	173.9	24,421	1,568	45	3	0	0	9	0	0	0	5	0

^a Daylight hours unless indicated otherwise

^b Twilight hours

^c Hours of darkness



Appendix C.4. Estimated sockeye salmon smolt fyke net catch and time fished by smolt day and hour at Kvichak River, 2001.

Appendix C.5. Egegik River smolt fyke net catch log, 2001.

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/17	001	0015	0230	135	135	0	0	0
5/18	002	0005	0200	115	115	0	0	0
5/19	003	0006	0205	119	119	2	2	0
5/20	004	0000	0201	121	121	2	2	0
5/21	005	0003	0200	117	117	0	0	0
5/22	006	0000	0120	80		100		1
	007	0125	0207	42	122	52	152	1
5/23	008	0018	0205	107	107	33	33	0
5/24	009	0022	0153	91		100		1
	010	0155	0210	15	106	52	152	3
5/25	011	0022	0200	98	98	55	55	1
5/26					0		0	
5/27	012	0023	0201	98	98	1	1	0
5/28	013	0008	0205	117	117	18	18	0
5/29	014	0032	0137	65		109		2
	015	0140	0146	6		217		36
	016	0148	0200	12		111		9
	017	0203	0210	7	90	110	547	16
5/30	018	0030	0051	21		124		6
	019	0056	0122	26		112		4
	020	0124	0139	15		117		8
	021	0140	0158	18		150		8
	022	0159	0206	7	87	33	536	5
5/31	023	0047	0104	17		168		10
	024	0105	0125	20		179		9
	025	0126	0153	27		172		6
	026	0154	0213	19	83	170	689	9
6/01	027	0030	0131	61		116		2
	028	0132	0134	2		132		66
	029	0137	0138	1		124		124
	030	0141	0142	1		123		123
	031	0144	0145	1		118		118
	032	0149	0150	1	67	50	663	50
6/02	033	0017	0207	110	110	30	30	0
6/03	034	0029	0118	49		127		3
	035	0119	0140	21		136		6
	036	0143	0208	25	95	116	379	5
6/04	037	0025	0207	102	102	100	100	1
6/05	038	0036	0201	85		100		1
	039	0204	0215	11	96	14	114	1
6/06	040	0023	0210	107	107	100	100	1
6/07	041	0022	0210	108	108	134	134	1
Max				135	135	217	689	124
Avg				54	100	90	169	16
Min				1	0	0	0	0

^a Military time - 24 hour clock (hhmm).^b CPUE = catch per unit effort

Appendix C.6. Egegik River fyke net catches by smolt day and species, May 17 to June 7, 2001.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Threespine Stickleback ^a	Chinook Smolt	Coho Juvenile	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
5/17	2.3	0	0	0	0	0	40	0	0	0	0	3	0
5/18	1.9	0	0	0	0	0	40	0	0	0	0	1	0
5/19	2.0	2	0	0	0	0	30	0	0	0	0	4	0
5/20	2.0	2	0	0	0	0	0	0	0	0	0	0	0
5/21	2.0	0	0	0	0	0	0	0	0	0	0	0	0
5/22	2.0	152	0	0	0	0	0	0	0	0	0	1	0
5/23	2.1	33	0	0	0	0	15	0	0	0	0	1	0
5/24	1.8	152	0	0	0	0	0	0	0	0	0	0	0
5/25	1.6	55	0	0	0	0	50	1	0	0	0	2	0
5/26	^b 0.0	0	0	0	0	0	0	0	0	0	0	0	0
5/27	1.6	1	0	0	0	0	20	0	0	0	0	3	0
5/28	2.0	18	0	0	0	0	20	2	0	0	0	3	0
5/29	1.5	547	0	0	0	0	0	1	0	0	0	0	0
5/30	1.4	536	0	0	0	0	0	0	0	0	0	0	0
5/31	1.4	689	0	0	0	0	0	0	0	0	0	0	0
6/01	1.1	663	0	0	0	0	0	0	0	0	0	0	0
6/02	1.8	30	0	0	0	0	0	0	0	0	0	0	0
6/03	1.6	379	0	0	0	0	0	0	0	0	0	0	0
6/04	1.7	100	0	0	0	0	0	0	0	0	0	0	0
6/05	1.6	114	0	0	0	0	0	0	0	0	0	0	0
6/06	1.8	100	0	0	0	0	0	0	0	0	0	0	0
6/07	1.8	134	0	0	0	0	0	0	0	0	0	0	0
Total	36.9	3,707	0	0	0	0	215	4	0	0	0	18	0
Max	2.3	689											
Avg	1.7	169											
Min	0.0	0											

^a An estimated 2-to-5 threespine sticklebacks were caught each night in the fyke net. The estimated total catch for this species ranged from 42-to-105 fish.

^b Did not fish the fyke net on smolt day 5/26 because of bad weather (e.g., snow, rain, and high winds W and SW 35-45).

Appendix C.7. Egegik River fyke net catches by hour and species, May 17 to June 7, 2001.

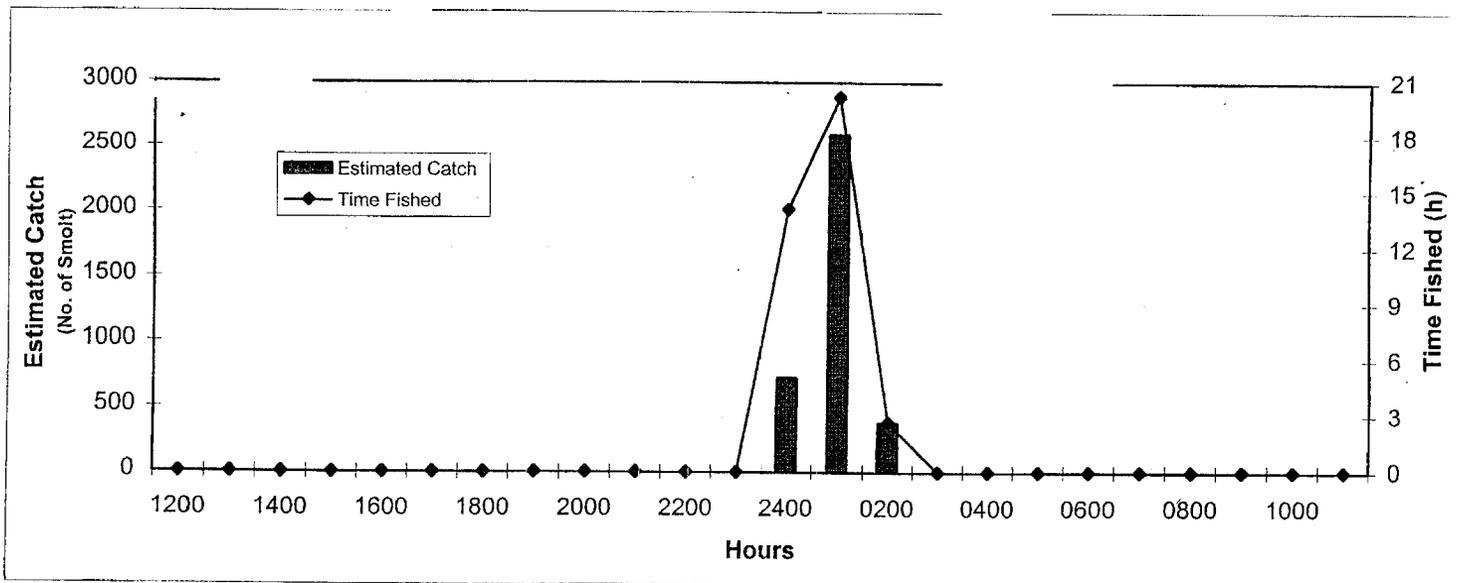
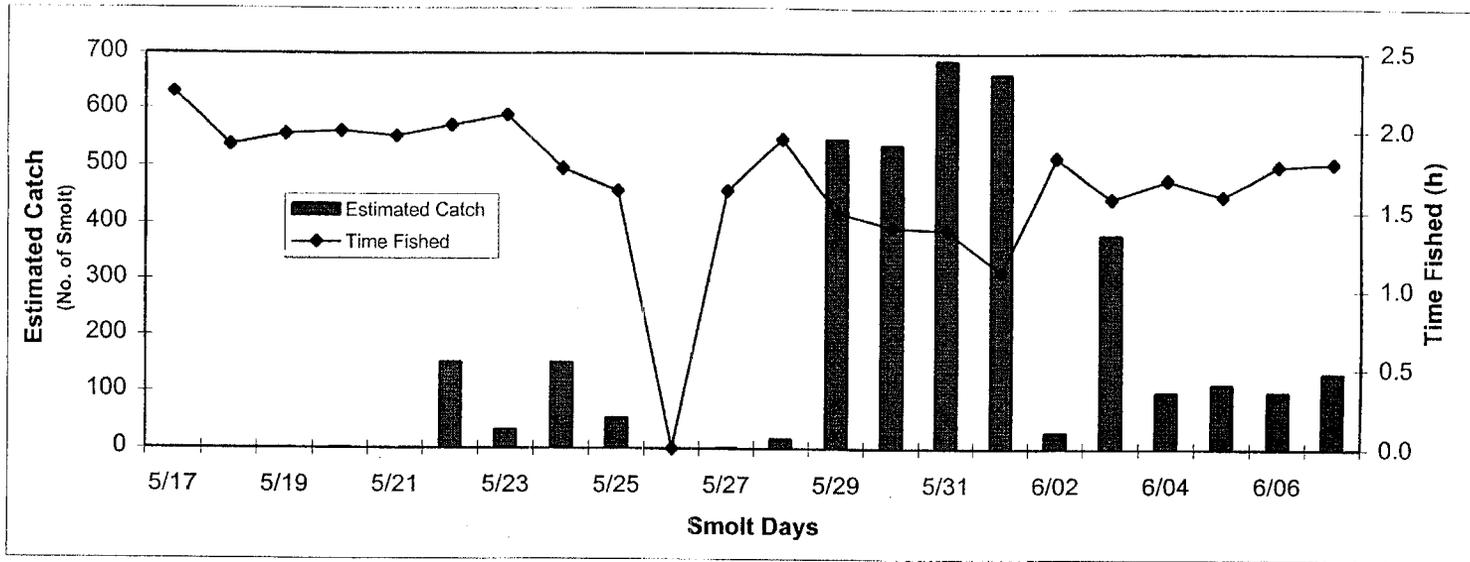
Hour	Time Fished (h) ^a	Catch Estimate (No. of Fish)												
		Sockeye Smolt	Threespine Stickleback ^b	Chinook Smolt	Coho Juvenile	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)	
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1500	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1600	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1700	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1800	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1900	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
2000	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
2100	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
2200	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
2300	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
2400	14.1	729	0	0	0	0	88	1	0	0	0	8	0	
0100	20.2	2596	0	0	0	0	115	3	0	0	0	9	0	
0200	2.7	382	0	0	0	0	12	0	0	0	0	1	0	
0300	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0400	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0500	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0600	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0700	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0800	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
0900	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1000	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
1100	0.0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	36.9	3,707	0	0	0	0	215	4	0	0	0	18	0	

^a Daylight hours unless indicated otherwise.

^b An estimated 2-to-5 threespine sticklebacks were caught each night in the fyke net. The estimated total catch for this species ranged from 42-to-105 fish.

^c Twilight hours

^d Hours of darkness



Appendix C.8. Estimated sockeye salmon smolt fyke net catch and time fished by smolt day and hour at Egegik River, 2001

Appendix C.9. Ugashik River smolt fyke net catch log, 2001.

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/20	001	2322	0042	80	80	66	66	1
5/21	002	2350	2357	7		300		43
	003	2359	0007	8		150		19
	004	0010	0016	6		118		20
	005	0018	0031	13		105		8
	006	0032	0040	8		150		19
	007	0041	0050	9	51	105	928	12
	5/22	008	2320	0049	89	89	38	38
5/23	009	2318	2354	36		106		3
	010	2354	0017	23		121		5
	011	0017	0024	7		118		17
	012	0024	0051	27	93	75	420	3
5/24	013	2317	0052	95	95	27	27	0
5/25	014	2312	0010	58		114		2
	015	0010	0020	10		102		10
	016	0020	0032	12		92		8
	017	0032	0045	13		107		8
	018	0045	0053	8	101	53	468	7
5/26	019	2312	0045	93		14		0
5/27	020	2323	2450	87	180	17	31	0
5/28	021	2317	0024	67		200		3
	022	0024	0033	9		150		17
	023	0035	0041	6		300		50
	024	0043	0045	2		300		150
	025	1146	0047	61		400		7
	026	0048	0049	1	146	250	1,600	250
	5/29	027	2321	2327	6		200	
028		2329	2330	1		150		150
029		2332	2349	17		200		12
030		2352	0002	10		300		30
031		0005	0012	7		350		50
032		0014	0016	2	43	500	1,700	250
5/30	033	2319	2325	6		600		100
	034	2327	2329	2		150		75
	035	2332	2336	4		200		50
	036	2339	0005	26		200		8
	037	0005	0021	16		600		38
	038	0024	0031	7	61	1,000	2,750	143
5/31	039	2321	2345	24		132		6
	040	2347	0035	48		105		2
	041	0036	0039	3		121		40
	042	0041	0050	9	84	45	403	5
6/01			0					
6/02	043	2325	2328	3		106		35
	044	2330	2345	15		109		7
	045	2349	2350	1		103		103
	046	2354	2355	1		103		103
	047	2358	2359	1		65		65
	048	0002	0003	1	22	116	602	116

Smolt Day	Cod End No.	Time ^a		Total Time Fished (min)		Smolt Catch		CPUE ^b
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
6/03	049	2326	2348	22		113		5
	050	2348	2351	3		102		34
	051	2354	0029	35		139		4
	052	0030	0039	9		128		14
	053	0041	0049	12	81	106	588	9
6/04	054	2318	2327	9		134		15
	055	2329	0002	33		132		4
	056	0004	0049	45		120		3
	057	0051	0055	4	91	83	469	21
6/05	058	2318	2324	6		105		18
	059	2326	2342	16		171		11
	060	2345	2353	8		107		13
	061	2355	0054	59	89	116	499	2
6/06	062	2317	2325	8		122		15
	063	2328	2331	3		113		38
	064	2334	0012	38		134		4
	065	0013	0038	25		109		4
	066	0048	0051	3	77	130	608	43
6/07	067	2313	2324	11		119		11
	068	2329	2334	5		138		28
	069	2337	2341	4		112		28
	070	2344	2350	6		124		21
	071	2352	2355	3		104		35
	072	2358	2400	2	31	114	711	57
6/08	073	2323	2332	9		146		16
	074	2335	2339	4		141		35
	075	2343	2346	3		113		38
	076	2349	2400	11		102		9
	077	0003	0007	4		110		28
	078	0011	0012	1	32	114	726	114
6/09	079	2330	0042	72		103		1
	080	0025	0055	30	102	60	163	2
6/10	081	2319	0015	56		109		2
	082	0018	0041	23		110		5
	083	0044	0050	6	85	114	333	19
Max				95	180	1,000	2,750	250
Avg				19	82	158	657	34
Min				0	22	14	27	0

^a Military time - 24 hour clock (hhmm).

^b CPUE = catch per unit effort

Appendix C.10. Ugashik River fyke net catches by smolt day and species , May 20 to June 10, 2001.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species)	Chinook Smolt	Coho Smolt ^a	Chum Fry ^a	Pink Fry ^a	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
5/20	1.3	66	0	0	0	0	0	0	0	0	0	0	0
5/21	0.9	928	0	0	0	0	0	0	0	0	0	0	0
5/22	1.5	38	0	0	0	0	0	0	0	0	0	0	0
5/23	1.6	420	0	0	0	0	0	0	0	0	0	0	0
5/24	1.6	27	0	0	0	0	0	0	0	0	0	0	0
5/25	1.7	468	0	0	0	0	0	0	0	0	0	0	0
5/26	1.6	14	0	0	0	0	0	0	0	0	0	0	0
5/27	1.5	17	0	0	0	0	0	0	0	0	0	0	0
5/28	1.4	1,600	0	0	0	0	0	0	0	0	0	0	0
5/29	0.7	1,700	0	0	0	0	0	0	0	0	0	0	0
5/30	1.0	2,750	0	0	0	0	0	0	0	0	0	0	0
5/31	1.4	403	0	0	0	0	0	0	0	0	0	0	0
6/01	0.0	0	0	0	0	0	0	0	0	0	0	0	0
6/02	0.4	602	0	0	0	0	0	0	0	0	0	0	0
6/03	1.3	588	0	0	0	0	0	0	0	0	0	0	0
6/04	1.5	469	0	0	0	0	0	0	0	0	0	0	0
6/05	1.5	499	0	0	0	0	0	0	0	0	0	0	0
6/06	1.3	608	0	0	0	0	0	0	0	0	0	0	0
6/07	0.5	711	0	0	0	0	0	0	0	0	0	0	0
6/08	0.5	727	0	0	0	0	0	0	0	0	0	0	0
6/09	1.4	163	0	0	0	0	0	0	0	0	0	0	0
6/10	1.4	333	0	0	0	0	0	0	0	0	0	0	0
6/11	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Total	25.8	13,131	0	0	0	0	0	0	0	0	0	0	0
Max	1.7	2,750											
Avg	1.1	571											
Min	0.0	0											

^a These species were present in 2001, but their catches were not recorded.

Appendix C.11. Ugashik River fyke net catches by hour and species, May 20 to June 10, 2001.

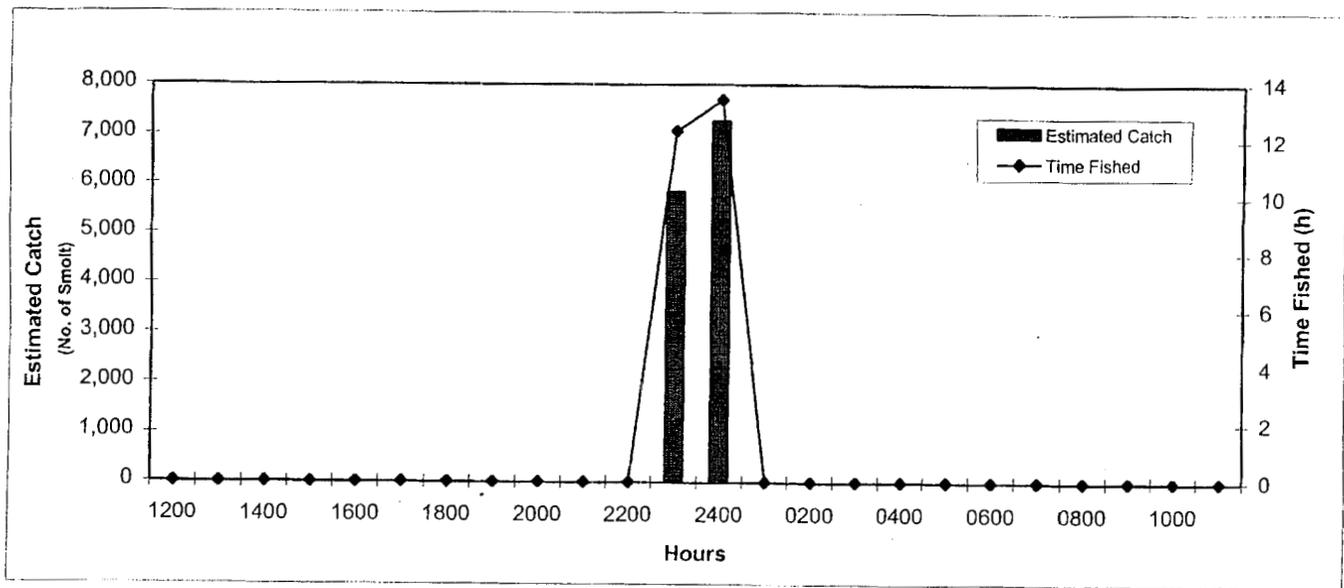
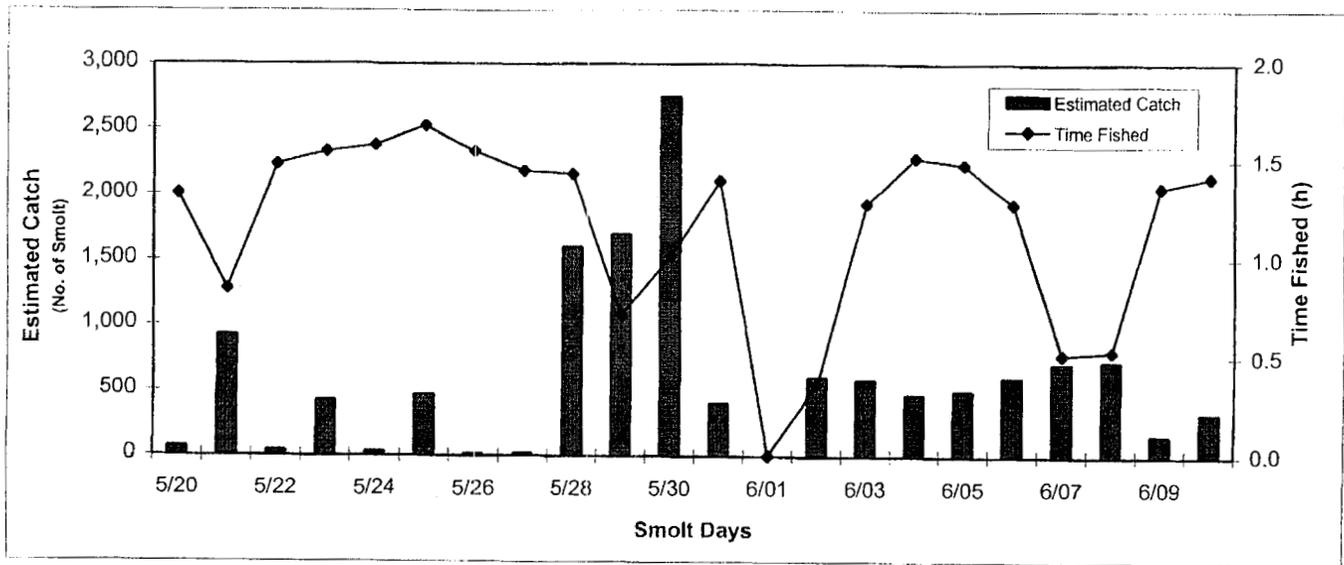
Hour	Time Fished ^a (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species)	Chinook Smolt	Coho Smolt ^b	Chum Fry ^b	Pink Fry ^b	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1500	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1600	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2300	^c 12.4	5,855	0	0	0	0	0	0	0	0	0	0	0
2400	^d 13.5	7,276	0	0	0	0	0	0	0	0	0	0	0
0100	^d 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0200	^d 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0300	^d 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0400	^d 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0500	^d 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0600	^c 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Total	25.8	13,131	0	0	0	0	0	0	0	0	0	0	0

^a Daylight hours unless indicated otherwise.

^b These species were present in 2001, but their catches were not recorded.

^c Twilight hours

^d Hours of darkness

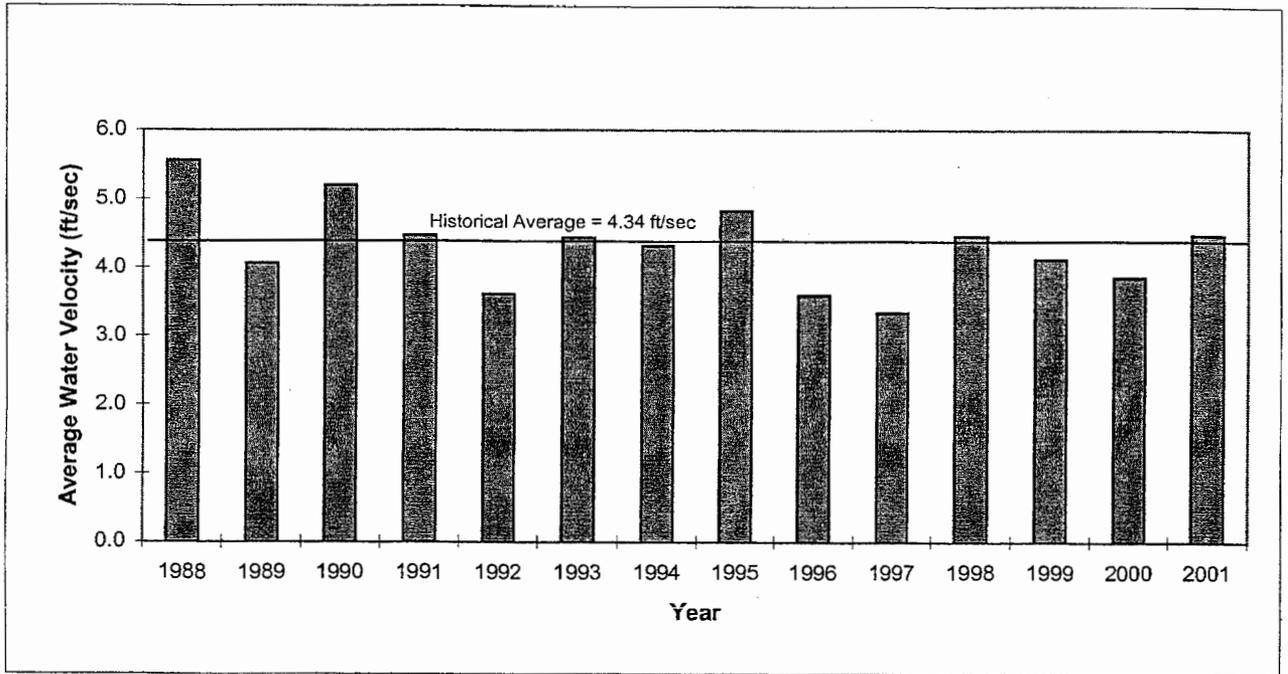


Appendix C.12. Estimated sockeye salmon smolt fyke net catch and time fished by smolt day and hour at Ugashik River, 2001.

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Appendix D.1. Kvichak River water velocity at the center smolt sonar array, 1987-2001.

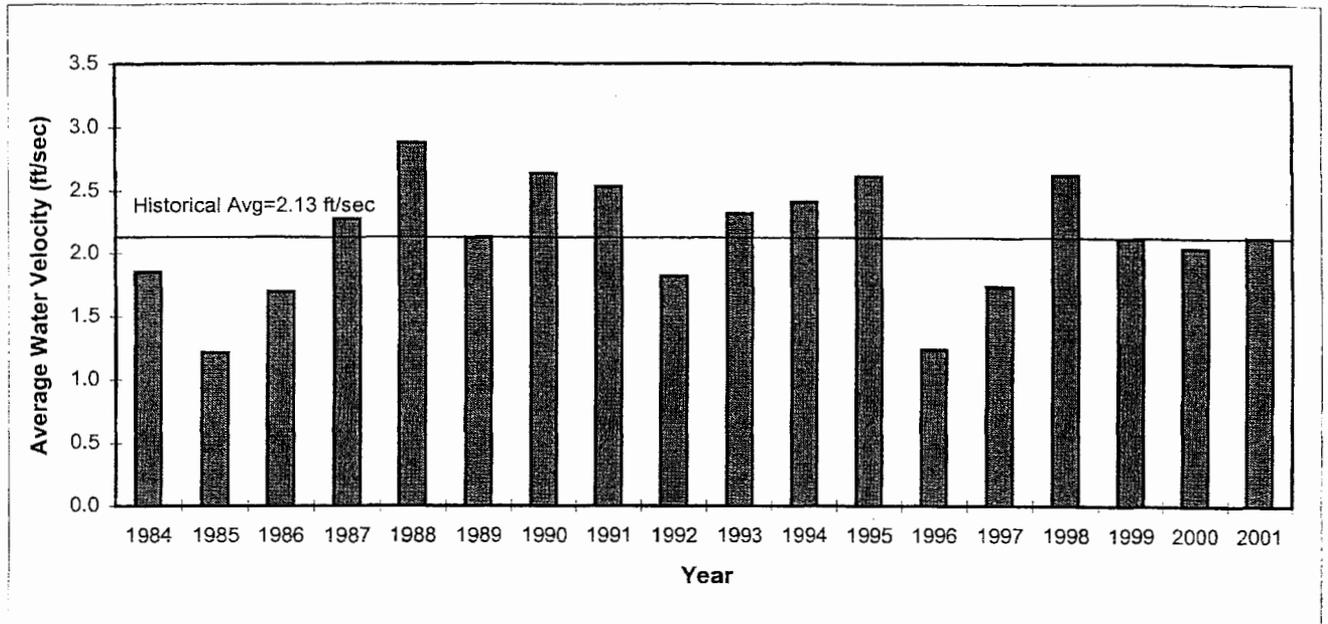
Date	Water Velocity (ft/sec)															1988-2000
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Average
5/16																
5/17											3.12	4.04				3.58
5/18							4.20			3.52					4.27	3.86
5/19			3.96											3.64		3.96
5/20																
5/21	4.96								4.82							4.89
5/22		5.38		5.01	4.27								3.57			4.56
5/23				4.99		3.43		4.27								4.23
5/24																
5/25																
5/26											3.27			3.71		3.49
5/27							4.35			3.63						3.99
5/28			3.95													3.95
5/29						3.53			4.72							4.13
5/30															4.30	
5/31		5.50										4.01				4.76
6/01					4.47											4.47
6/02				5.37												5.37
6/03											3.45		3.93			3.69
6/04								4.33		3.59				3.78		3.90
6/05																
6/06															4.64	
6/07						3.89										3.89
6/08		5.80							4.88							5.34
6/09							4.59									4.59
6/10			4.27	5.44	4.69							4.78				4.80
6/11													4.39		4.71	
6/12																
6/13							4.61	4.35		3.67	3.53	5.01				4.23
6/14														4.30		
6/15									4.90							4.90
6/16													4.60			
Max		5.80	4.27	5.44	4.69	3.89	4.61	4.35	4.90	3.67	3.53	5.01	4.60	4.30	4.71	5.80
Avg	4.96	5.56	4.06	5.20	4.48	3.62	4.44	4.32	4.83	3.60	3.34	4.46	4.12	3.86	4.48	4.34
Min		5.38	3.95	4.99	4.27	3.43	4.20	4.27	4.72	3.52	3.12	4.01	3.57	3.64	4.27	3.12



Appendix D.2. Average water velocity at Kvichak River smolt sonar center array, May 15 to June 15, 1988-2001.

Appendix D.3. Egegik River water velocity at the center smolt sonar array, 1984-2001.

Date	Water Velocity (ft/sec)																			1984-2000 Average
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001		
5/16																				
5/17				2.15						2.37									2.17	2.26
5/18					2.63										2.57					2.60
5/19							2.50													2.50
5/20	1.89					2.00		2.00					1.50	1.80			2.07		1.88	
5/21		1.16	1.83							2.30	2.68								1.99	
5/22									1.58										1.58	
5/23																				
5/24									1.70			2.62			2.42	1.85			2.15	
5/25					3.16								1.25	1.75				2.12	2.05	
5/26			1.53	2.14			2.68												2.12	
5/27											2.28								2.28	
5/28						2.09				2.30							2.05		2.15	
5/29								2.75											2.75	
5/30																				
5/31									2.02				1.28	1.67	2.47	2.20			1.93	
6/01			1.76	2.30	2.90							2.75							2.43	
6/02							2.73				2.43							2.09	2.58	
6/03	1.82									2.30									2.06	
6/04						2.30													2.30	
6/05								2.85									2.00		2.43	
6/06		1.16																	2.10	
6/07													0.90	1.72	3.03		2.30		1.64	
6/08												2.68							2.68	
6/09									1.98		2.25								2.12	
6/10			1.67	2.51	2.83														2.34	
6/11																				
6/12												2.40							2.40	
6/13		1.32																	1.32	
6/14																				
6/15																				
Max	1.89	1.32	1.83	2.51	3.16	2.30	2.73	2.85	2.02	2.37	2.68	2.75	1.50	1.80	3.03	2.30	2.07	2.17	3.16	
Avg	1.86	1.21	1.70	2.28	2.88	2.13	2.64	2.53	1.82	2.32	2.41	2.61	1.23	1.74	2.62	2.12	2.04	2.13	2.13	
Min	1.82	1.16	1.53	2.14	2.63	2.00	2.50	2.00	1.58	2.30	2.25	2.40	0.90	1.67	2.42	1.85	2.00	2.09	0.90	

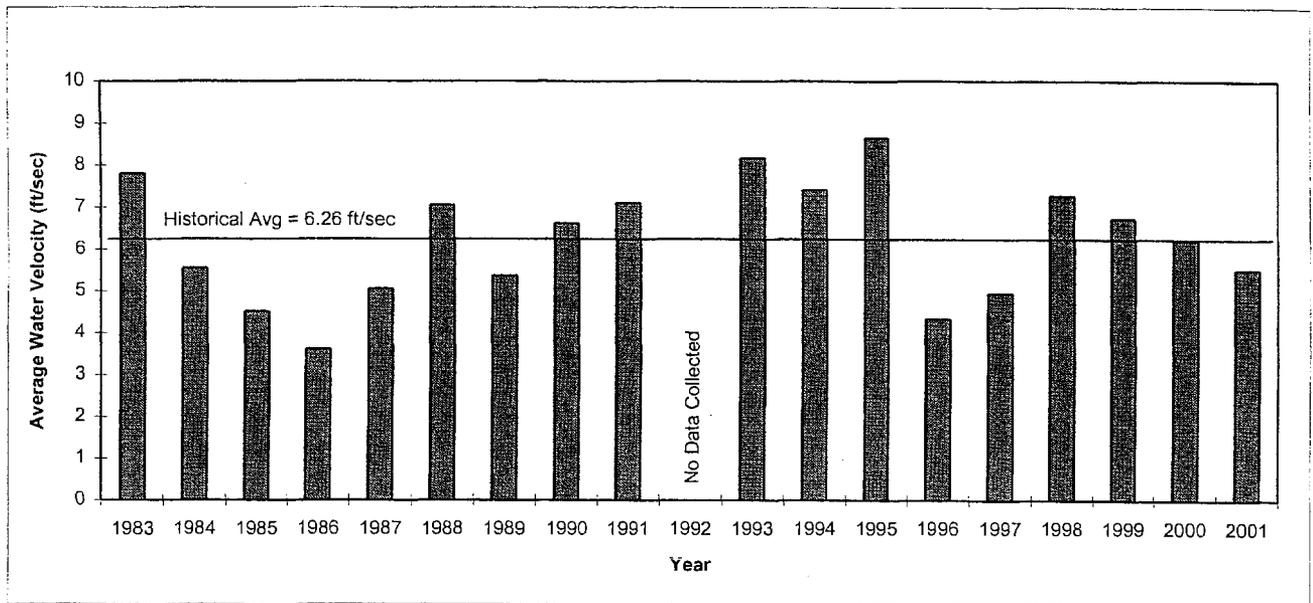


Appendix D.4. Average water velocity at Egegik River smolt sonar center array, May 15 to June 15, 1984-2001.

Appendix D.5. Ugashik River water velocity at the inshore smolt sonar array, 1983-2001.

Date	Water Velocity (ft/sec)																				1983-2000 Average	
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001			
5/05															4.99						4.99	
5/06																						
5/07																						
5/08																						
5/09																						
5/10																						
5/11																						
5/12																						
5/13																						
5/14																						
5/15																						
5/16															5.13							5.13
5/17					5.17	7.15					7.84					6.30						6.62
5/18																						
5/19														3.91	5.01			6.12				5.01
5/20								6.23	5.78			7.60								6.12		6.54
5/21																					5.38	
5/22	8.00			3.16			4.13						9.48									6.19
5/23			4.10												4.86							4.48
5/24																6.49	6.12					6.31
5/25	7.63										8.34	7.78						6.12				7.36
5/26												7.78		4.52								6.15
5/27																					5.38	
5/28		5.56						6.73	7.82					8.93								7.26
5/29															4.82							4.82
5/30							4.90															4.90
5/31				3.89													7.74	6.30	5.93			5.97
6/01											8.19											8.19
6/02								5.12				7.23		4.45								5.60
6/03																						
6/04			4.93					6.17	6.84					8.72		4.88					5.75	6.31
6/05										7.70												7.70
6/06																	8.59					8.59
6/07																			6.91			6.91
6/08											8.34											7.51
6/09												7.04	7.53	4.47						6.67		6.35
6/10																						
6/11				3.80														7.60				5.70
6/12								6.51	6.67													6.59
6/13																						
6/14					4.94																	4.94
6/15						6.95																6.95
Max	8.00	5.56	4.93	3.89	5.17	7.15	6.51	6.84	7.82		8.34	7.78	9.48	4.52	5.13	8.59	7.60	6.67	5.75		9.48	
Avg	7.82	5.56	4.51	3.62	5.06	7.05	5.37	6.62	7.10		8.18	7.41	8.67	4.34	4.95	7.28	6.73	6.21	5.50		6.26	
Min	7.63	5.56	4.10	3.16	4.94	6.95	4.13	6.23	5.78		7.84	7.04	7.53	3.91	4.82	6.30	6.12	5.93	5.38		3.16	

^a Project not conducted in 1992 because of a lack of funding. No data collected.



Appendix D.6. Average water velocity at Ugashik River smolt sonar inshore array, May 15 to June 15, 1983-2001.

Appendix E.1. Data files generated by the University of Washington, Applied Physics Laboratory, Smolt Counter digital storage application software (Version 1) at Kvichak River smolt sonar, May 21 to June 11, 2001

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count * (all arrays)	Comments	
					Inshore	Middle	Offshore			
5/21-5/22		Kvichak 21-May-2001 1200							No Kvichak 21-May-2001 1200.dat	
		Kvichak 21-May-2001 1300							No Kvichak 21-May-2001 1300.dat	
		Kvichak 21-May-2001 1400							No Kvichak 21-May-2001 1400.dat	
		Kvichak 21-May-2001 1500							No Kvichak 21-May-2001 1500.dat	
		Kvichak 21-May-2001 1600							No Kvichak 21-May-2001 1600.dat	
		Kvichak 21-May-2001 1700							No Kvichak 21-May-2001 1700.dat	
		Kvichak 21-May-2001 1800							No Kvichak 21-May-2001 1800.dat	
		Kvichak 21-May-2001 1933							No Kvichak 21-May-2001 1900.dat	
		Kvichak 21-May-2001 2001							No Kvichak 21-May-2001 2000.dat	
		Kvichak 21-May-2001 2100							No Kvichak 21-May-2001 2100.dat	
		Kvichak 21-May-2001 2200							No Kvichak 21-May-2001 2200.dat	
	1		Kvichak 21-May-2001 2357.dat	1	00:01	0	0	0	0	Setting up equipment, no data collected.
	1		Kvichak 22-May-2001 0012.dat	1	00:01	0	0	0	0	Setting up equipment, no data collected.
	1		Kvichak 22-May-2001 0017.dat	1	00:01	0	0	0	0	Setting up equipment, no data collected.
	1		Kvichak 22-May-2001 0018.dat	10	41:52	5,905	5,790	6,825	18,520	Partial hour count.
	1		Kvichak 22-May-2001 0100.dat	15	60:01	39,050	56,410	83,350	178,810	
	1		Kvichak 22-May-2001 0200.dat	15	60:00	73,520	114,255	97,665	285,440	
1		Kvichak 22-May-2001 0300.dat	15	60:01	48,915	64,665	19,535	133,115		
1		Kvichak 22-May-2001 0400.dat	15	60:00	19,805	9,585	13,305	42,695		
1		Kvichak 22-May-2001 0500.dat	15	60:01	12,885	4,180	6,775	23,840		
1		Kvichak 22-May-2001 0600.dat	15	60:00	2,935	2,780	5,115	10,830		
1		Kvichak 22-May-2001 0700.dat	15	60:01	6,090	13,115	13,635	32,840		
1		Kvichak 22-May-2001 0800.dat	15	60:00	10,235	22,200	45,265	77,700		
1		Kvichak 22-May-2001 0900.dat	15	60:01	50,050	67,745	111,935	229,730	5/22 0947: Spike on inshore & offshore when Micron Millennia PC was plugged back into the smolt counter.	
1		Kvichak 22-May-2001 1000.dat	15	60:01	60,815	73,615	142,425	276,855	It was unplugged for about 30 min.	
1		Kvichak 22-May-2001 1100.dat	15	60:00	11,015	8,130	25,455	44,600		
5/22-5/23	1	Kvichak 22-May-2001 1200.dat	15	60:01	230	1,480	9,975	11,685		
	1	Kvichak 22-May-2001 1300.dat	15	60:00	460	800	1,035	2,295		
	1	Kvichak 22-May-2001 1400.dat	15	60:01	3,290	1,450	500	5,240		
	1	Kvichak 22-May-2001 1500.dat	15	60:00	3,510	3,105	3,025	9,640		
	1	Kvichak 22-May-2001 1600.dat	15	60:01	1,555	3,255	1,670	6,480		
	1	Kvichak 22-May-2001 1700.dat	15	60:00	2,515	2,255	3,870	8,640		
	1	Kvichak 22-May-2001 1800.dat	15	60:01	3,805	5,755	3,155	12,715		
	1	Kvichak 22-May-2001 1900.dat	15	60:00	6,015	6,295	11,645	23,955		
	1	Kvichak 22-May-2001 2000.dat	15	60:01	3,990	3,915	7,985	15,890		
	1	Kvichak 22-May-2001 2100.dat	29	120:01	3,965	8,075	10,665	22,705	Double-hour count	
		Kvichak 22-May-2001 2200							No Kvichak 22-May-2001 0800.dat	
	1	Kvichak 22-May-2001 2300.dat	15	60:01	420	580	650	1,650		
	1	Kvichak 23-May-2001 0000.dat	15	60:00	4,790	715	3,345	8,850		
	1	Kvichak 23-May-2001 0100.dat	15	60:01	20,160	28,190	41,325	89,675		
	1	Kvichak 23-May-2001 0200.dat	15	60:00	19,445	18,275	9,055	46,775		
	1	Kvichak 23-May-2001 0300.dat	15	60:01	13,070	5,370	6,970	25,410		
	1	Kvichak 23-May-2001 0400.dat	15	60:00	3,255	3,120	1,635	8,010		
	1	Kvichak 23-May-2001 0500.dat	15	60:01	200	165	800	1,165		
	1	Kvichak 23-May-2001 0600.dat	15	60:00	190	185	1,455	1,830	5/23 0600 The audible alarm on the power inverter sounded...computer shut down...started recording again at 0620	
	1	Kvichak 23-May-2001 0700.dat	15	60:01	5	105	205	315		
1	Kvichak 23-May-2001 0800.dat	29	120:01	525	585	430	1,540	Double-hour count		
	Kvichak 23-May-2001 0900							No Kvichak 23-May-2001 0900.dat		
1	Kvichak 23-May-2001 1000.dat	15	60:01	160	65	205	430			
1	Kvichak 23-May-2001 1100.dat	15	60:00	490	235	200	925			

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count ^a (all arrays)	Comments
					Inshore	Middle	Offshore		
5/23-5/24	1	Kvichak 23-May-2001 1200.dat	15	60:01	230	0	200	430	
	1	Kvichak 23-May-2001 1300.dat	15	60:00	660	325	2,145	3,130	
	1	Kvichak 23-May-2001 1400.dat	15	60:01	6,490	3,045	7,435	16,970	
	1	Kvichak 23-May-2001 1500.dat	15	60:00	7,750	6,755	5,550	20,055	
	1	Kvichak 23-May-2001 1600.dat	15	60:01	7,780	6,075	6,530	20,385	
	1	Kvichak 23-May-2001 1700.dat	15	60:00	3,480	4,010	8,580	16,070	
	1	Kvichak 23-May-2001 1800.dat	15	60:01	2,390	6,985	24,635	34,010	
	1	Kvichak 23-May-2001 1900.dat	15	60:00	9,105	16,365	71,890	97,360	
	1	Kvichak 23-May-2001 2000.dat	15	60:01	5,590	11,430	36,735	53,755	
	1	Kvichak 23-May-2001 2100.dat	15	60:01	1,235	3,780	7,685	12,700	
	1	Kvichak 23-May-2001 2200.dat	15	60:00	3,730	5,465	15,535	24,730	
	1	Kvichak 23-May-2001 2300.dat	15	60:01	3,385	4,860	11,525	19,770	
	1	Kvichak 24-May-2001 0000.dat	15	60:00	1,965	2,050	4,120	8,135	
	1	Kvichak 24-May-2001 0100.dat	15	60:01	22,415	40,700	96,745	159,860	
	1	Kvichak 24-May-2001 0200.dat	15	60:00	60,520	102,210	141,125	303,855	
	1	Kvichak 24-May-2001 0300.dat	15	60:01	29,340	28,795	19,790	77,925	
	1	Kvichak 24-May-2001 0400.dat	15	60:00	2,650	1,455	1,055	5,160	
	1	Kvichak 24-May-2001 0500							No Kvichak 24-May-2001 0500.dat
	1	Kvichak 24-May-2001 0621.dat	9	38:22	130	505	65	700	Partial hour count
	1	Kvichak 24-May-2001 0700.dat	15	60:00	4,165	1,515	1,795	7,475	
1	Kvichak 24-May-2001 0800.dat	15	60:01	155	145	175	475		
1	Kvichak 24-May-2001 0900.dat	15	60:01	45	135	130	310		
1	Kvichak 24-May-2001 1000.dat	15	60:00	165	165	335	665		
1	Kvichak 24-May-2001 1100.dat	15	60:01	205	240	855	1,300		
5/24-5/25	1	Kvichak 24-May-2001 1200.dat	15	60:00	550	1,010	2,225	3,785	
	1	Kvichak 24-May-2001 1300.dat	15	60:01	6,365	4,990	7,535	18,890	
	1	Kvichak 24-May-2001 1400.dat	15	60:00	9,180	2,805	9,195	21,180	5/24 1538 Sonar counter disabled for WADG water velocity measurements - 1455 to 1500 hours
	1	Kvichak 24-May-2001 1500.dat	15	60:01	7,880	320	1,115	9,315	5/24 1538 Sonar counter disabled for WADG water velocity measurements - 1500 to 1540 hours
	1	Kvichak 24-May-2001 1600.dat	15	60:00	98,235	40,610	68,140	206,985	
	1	Kvichak 24-May-2001 1700.dat	15	60:01	24,330	29,330	29,190	82,850	
	1	Kvichak 24-May-2001 1800.dat	15	60:00	17,390	20,265	29,135	66,790	
	1	Kvichak 24-May-2001 1900.dat	15	60:01	7,415	2,675	28,055	38,145	
	1	Kvichak 24-May-2001 2000.dat	15	60:01	14,020	19,250	36,225	69,495	
	1	Kvichak 24-May-2001 2100.dat	15	60:00	6,395	12,415	18,075	36,885	
	1	Kvichak 24-May-2001 2200.dat	15	60:01	8,150	11,050	26,950	46,150	
	1	Kvichak 24-May-2001 2300.dat	29	120:01	17,940	16,855	38,165	72,960	Double-hour count
	1	Kvichak 25-May-2001 0000							No Kvichak 25-May-2001 0000.dat
	2	Kvichak 25-May-2001 0100.dat	15	60:00	29,990	11,775	46,425	88,190	
	2	Kvichak 25-May-2001 0200.dat	15	60:01	19,790	20,155	61,980	101,925	
	2	Kvichak 25-May-2001 0300.dat	15	60:00	59,700	21,560	65,055	146,315	
	2	Kvichak 25-May-2001 0400.dat	15	60:01	1,490	1,605	2,275	5,370	
	2	Kvichak 25-May-2001 0500.dat	15	60:00	475	270	250	995	
	2	Kvichak 25-May-2001 0600.dat	15	60:01	105	230	175	510	
	2	Kvichak 25-May-2001 0700.dat	15	60:00	1,270	445	2,960	4,675	
2	Kvichak 25-May-2001 0800.dat	15	60:01	140	20	75	235		
2	Kvichak 25-May-2001 0900.dat	15	60:01	110	30	85	225		
2	Kvichak 25-May-2001 1000.dat	15	60:00	510	30	90	630		
2	Kvichak 25-May-2001 1100.dat	15	60:01	140	50	20	210		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count # (all arrays)	Comments
					Inshore	Middle	Offshore		
5/25-5/26	2	Kvichak 25-May-2001 1200.dat	15	60:00	300	270	105	675	
	2	Kvichak 25-May-2001 1300.dat	15	60:01	295	350	485	1,130	5/25 1315 The audible alarm on the inverter went off again... changed batteries (11.5 V to 12.7 V charge)
	2	Kvichak 25-May-2001 1400.dat	15	60:00	470	200	360	1,030	
	2	Kvichak 25-May-2001 1500.dat	15	60:01	1,705	260	795	2,760	
	2	Kvichak 25-May-2001 1600.dat	15	60:00	645	320	445	1,410	
	2	Kvichak 25-May-2001 1700.dat	15	60:01	905	555	680	2,140	
	2	Kvichak 25-May-2001 1800.dat	15	60:00	4,875	1,350	2,460	8,685	
	2	Kvichak 25-May-2001 1900.dat	15	60:01	1,975	2,240	2,040	6,255	
	2	Kvichak 25-May-2001 2000.dat	15	60:01	2,145	3,595	8,345	14,085	
	2	Kvichak 25-May-2001 2100.dat	15	60:00	2,700	4,945	7,170	14,815	
	2	Kvichak 25-May-2001 2200.dat	15	60:01	3,690	1,835	5,150	10,675	
	2	Kvichak 25-May-2001 2300.dat	15	60:00	475	1,160	195	1,830	
	2	Kvichak 26-May-2001 0000.dat	15	60:01	9,340	5,640	8,210	23,190	
	2	Kvichak 26-May-2001 0100.dat	15	60:00	11,645	6,065	11,205	28,915	
	2	Kvichak 26-May-2001 0200.dat	15	60:01	8,545	4,765	4,145	17,455	
	2	Kvichak 26-May-2001 0300.dat	15	60:00	7,460	2,705	1,635	11,800	
	2	Kvichak 26-May-2001 0400.dat	15	60:01	1,690	415	80	2,185	
	2	Kvichak 26-May-2001 0500.dat	15	60:00	680	280	320	1,280	
	2	Kvichak 26-May-2001 0600.dat	15	60:01	29,900	25,580	26,975	82,455	
	2	Kvichak 26-May-2001 0700.dat	15	60:00	1,195	835	715	2,745	
	2	Kvichak 26-May-2001 0800.dat	15	60:01	150	50	140	340	
	2	Kvichak 26-May-2001 0900.dat	15	60:01	195	275	485	955	
	2	Kvichak 26-May-2001 1000.dat	15	60:00	2,230	965	435	3,630	
	2	Kvichak 26-May-2001 1100.dat	15	60:01	1,125	585	1,360	3,070	
5/26-5/27	2	Kvichak 26-May-2001 1200.dat	15	60:00	79,610	25,295	31,185	136,090	
	2	Kvichak 26-May-2001 1300.dat	15	60:01	570	710	245	1,525	
	2	Kvichak 26-May-2001 1400.dat	15	60:00	830	460	1,485	2,775	
	2	Kvichak 26-May-2001 1500.dat	15	60:01	2,715	3,375	6,380	12,470	
		Kvichak 26-May-2001 1600							No Kvichak 26-May-2001 1600.dat
		Kvichak 26-May-2001 1700							No Kvichak 26-May-2001 1700.dat
		Kvichak 26-May-2001 1800							No Kvichak 26-May-2001 1800.dat
		Kvichak 26-May-2001 1900							No Kvichak 26-May-2001 1900.dat
		Kvichak 26-May-2001 2000							No Kvichak 26-May-2001 2000.dat
		Kvichak 26-May-2001 2100							No Kvichak 26-May-2001 2100.dat
		Kvichak 26-May-2001 2200							No Kvichak 26-May-2001 2200.dat
		Kvichak 26-May-2001 2300							No Kvichak 26-May-2001 2300.dat
		Kvichak 27-May-2001 0000							No Kvichak 27-May-2001 0000.dat
		Kvichak 27-May-2001 0100							No Kvichak 27-May-2001 0100.dat
		Kvichak 27-May-2001 0200							No Kvichak 27-May-2001 0200.dat
		Kvichak 27-May-2001 0300							No Kvichak 27-May-2001 0300.dat
		Kvichak 27-May-2001 0400							No Kvichak 27-May-2001 0400.dat
		Kvichak 27-May-2001 0500							No Kvichak 27-May-2001 0500.dat
		Kvichak 27-May-2001 0600							No Kvichak 27-May-2001 0600.dat
		Kvichak 27-May-2001 0700							No Kvichak 27-May-2001 0700.dat
		Kvichak 27-May-2001 0800							No Kvichak 27-May-2001 0800.dat
		Kvichak 27-May-2001 0900							No Kvichak 27-May-2001 0900.dat
		Kvichak 27-May-2001 1000							No Kvichak 27-May-2001 1000.dat
		Kvichak 27-May-2001 1100							No Kvichak 27-May-2001 1000.dat

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count * (all arrays)	Comments
					Inshore	Middle	Offshore		
5/27-5/28	2	Kvichak 27-May-2001 1228.dat	8	31:51	6,475	2,280	25,155	33,910	Partial hour count
	2	Kvichak 27-May-2001 1300.dat	15	60:00	14,645	10,570	26,800	52,015	
	2	Kvichak 27-May-2001 1400.dat	15	60:01	8,665	16,480	56,445	81,590	
	2	Kvichak 27-May-2001 1500.dat	15	60:00	12,025	7,225	72,020	91,270	
	2	Kvichak 27-May-2001 1600.dat	15	60:01	14,100	35,335	145,385	194,820	
	2	Kvichak 27-May-2001 1700.dat	15	60:01	5,605	39,315	140,145	185,065	
	2	Kvichak 27-May-2001 1800.dat	15	60:00	10,390	18,190	91,040	119,620	
	2	Kvichak 27-May-2001 1900.dat	15	60:01	13,190	26,980	101,015	141,185	
	2	Kvichak 27-May-2001 2000.dat	15	60:00	7,955	20,190	53,115	81,260	
	2	Kvichak 27-May-2001 2100.dat	15	60:01	3,965	5,025	55,615	64,605	
	2	Kvichak 27-May-2001 2200.dat	15	60:00	3,255	3,270	18,650	25,175	
	2	Kvichak 27-May-2001 2300.dat	15	60:01	1,095	850	5,155	7,100	
	2	Kvichak 28-May-2001 0000.dat	15	60:00	345	590	915	1,850	
	2	Kvichak 28-May-2001 0100.dat	15	60:01	43,955	2,135	2,895	48,985	
	2	Kvichak 28-May-2001 0200.dat	15	60:00	4,595	11,390	6,080	22,065	
	2	Kvichak 28-May-2001 0300.dat	15	60:01	2,135	4,800	1,745	8,680	
	2	Kvichak 28-May-2001 0400.dat	15	60:00	7,705	3,155	2,520	13,380	
	2	Kvichak 28-May-2001 0500							No Kvichak 28-May-2001 0500.dat
	2	Kvichak 28-May-2001 0626.dat	15	33:15	480	940	2,480	3,900	Partial hour count
	2	Kvichak 28-May-2001 0700.dat	15	60:00	780	1,465	2,555	4,800	
	2	Kvichak 28-May-2001 0800.dat	15	60:01	1,015	265	965	2,245	
	2	Kvichak 28-May-2001 0900.dat	15	60:00	400	410	1,915	2,725	
	2	Kvichak 28-May-2001 1000.dat	15	60:01	1,055	490	605	2,150	
2	Kvichak 28-May-2001 1100.dat	15	60:01	1,745	915	1,895	4,555		
5/28-5/29	2	Kvichak 28-May-2001 1200.dat	15	60:00	2,170	1,310	5,665	9,145	
	2	Kvichak 28-May-2001 1300.dat	15	60:01	3,410	1,350	3,715	8,475	
	2	Kvichak 28-May-2001 1400.dat	15	60:00	4,550	3,875	1,755	10,180	
	2	Kvichak 28-May-2001 1500.dat	15	60:01	3,180	3,095	570	6,845	
	2	Kvichak 28-May-2001 1600.dat	15	60:00	3,000	5,900	7,155	16,055	
	2	Kvichak 28-May-2001 1700.dat	15	60:01	6,210	11,445	37,100	54,755	
	2	Kvichak 28-May-2001 1800.dat	15	60:00	1,545	6,250	11,225	19,020	
	2	Kvichak 28-May-2001 1900.dat	15	60:01	2,330	3,155	3,885	9,370	
	2	Kvichak 28-May-2001 2000.dat	15	60:00	7,950	1,800	2,985	12,735	
	2	Kvichak 28-May-2001 2100.dat	15	60:01	9,560	2,515	4,755	16,830	
	2	Kvichak 28-May-2001 2200.dat	15	60:00	1,705	2,680	7,130	11,515	
	2	Kvichak 28-May-2001 2300.dat	15	60:01	1,700	1,420	5,170	8,290	
	2	Kvichak 29-May-2001 0000.dat	15	60:01	735	360	2,395	3,490	
	2	Kvichak 29-May-2001 0100.dat	15	60:00	19,470	7,545	44,750	71,765	
	2	Kvichak 29-May-2001 0200.dat	15	60:01	84,045	105,545	76,215	265,805	
	2	Kvichak 29-May-2001 0300.dat	15	60:00	33,950	10,350	4,370	48,670	
	2	Kvichak 29-May-2001 0400.dat	15	60:01	18,975	2,180	2,695	23,850	
	2	Kvichak 29-May-2001 0500.dat	15	60:00	23,980	20,895	18,525	63,400	
	2	Kvichak 29-May-2001 0600.dat	15	60:01	3,005	15,115	8,100	26,220	
	2	Kvichak 29-May-2001 0700.dat	15	60:00	635	4,175	10,275	15,085	
2	Kvichak 29-May-2001 0800.dat	15	60:01	3,590	1,820	3,075	8,485		
2	Kvichak 29-May-2001 0900.dat	15	60:00	365	2,865	1,620	4,850		
2	Kvichak 29-May-2001 1000.dat	15	60:01	4,525	1,925	7,750	14,200		
2	Kvichak 29-May-2001 1100.dat	15	60:01	9,210	7,555	9,675	26,440		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count # (all arrays)	Comments
					Inshore	Middle	Offshore		
5/29-5/30	2	Kvichak 29-May-2001 1200.dat	15	60:00	320	0	0	320	
	2	Kvichak 29-May-2001 1300.dat	15	60:01	1,145	0	0	1,145	
	2	Kvichak 29-May-2001 1400.dat	15	60:00	240	200	0	440	
	2	Kvichak 29-May-2001 1500.dat	15	60:01	1,535	790	2,190	4,515	
	2	Kvichak 29-May-2001 1600.dat	15	60:00	2,365	915	645	3,925	
	2	Kvichak 29-May-2001 1700.dat	15	60:01	1,650	1,020	3,205	5,875	
	2	Kvichak 29-May-2001 1800.dat	15	60:00	1,350	2,695	760	4,805	
	2	Kvichak 29-May-2001 1900.dat	15	60:01	3,715	6,110	5,895	15,720	
	2	Kvichak 29-May-2001 2000.dat	15	60:00	3,225	2,195	2,620	8,040	
	2	Kvichak 29-May-2001 2100.dat	15	60:01	3,300	1,155	2,130	6,585	
	2	Kvichak 29-May-2001 2200.dat	15	60:01	5,785	2,295	2,265	10,345	
	2	Kvichak 29-May-2001 2300.dat	15	60:00	3,890	2,665	5,400	11,955	
	3	Kvichak 30-May-2001 0000.dat	15	60:01	3,630	2,865	4,715	11,210	
			Kvichak 30-May-2001 0100						No Kvichak 30-May-2001 0100.dat
	3	Kvichak 30-May-2001 0200.dat	14	59:13	16,590	49,790	108,265	174,645	Partial hour count
	3	Kvichak 30-May-2001 0300.dat	15	60:01	43,835	59,195	134,810	237,840	
	3	Kvichak 30-May-2001 0400.dat	15	60:00	3,185	4,955	8,410	16,550	
	3	Kvichak 30-May-2001 0500.dat	15	60:01	4,705	2,795	4,905	12,405	
	3	Kvichak 30-May-2001 0600.dat	15	60:00	360	570	1,190	2,120	
3	Kvichak 30-May-2001 0700.dat	15	60:01	95	65	345	505		
3	Kvichak 30-May-2001 0800.dat	15	60:00	125	870	485	1,480		
3	Kvichak 30-May-2001 0900.dat	15	60:01	3,075	950	2,565	6,590		
3	Kvichak 30-May-2001 1000.dat	15	60:00	5,045	2,120	2,240	9,405		
3	Kvichak 30-May-2001 1100.dat	15	60:01	740	235	4,045	5,020		
5/30-5/31	3	Kvichak 30-May-2001 1200.dat	15	60:01	200	995	270	1,465	
	3	Kvichak 30-May-2001 1300.dat	15	60:00	115	325	540	980	
	3	Kvichak 30-May-2001 1400.dat	15	60:01	320	20	335	675	
	3	Kvichak 30-May-2001 1500.dat	15	60:00	635	435	335	1,405	
	3	Kvichak 30-May-2001 1600.dat	15	60:01	505	260	410	1,175	
	3	Kvichak 30-May-2001 1700.dat	15	60:00	1,185	615	155	1,955	
	3	Kvichak 30-May-2001 1800.dat	15	60:01	3,070	5,945	2,810	11,825	
	3	Kvichak 30-May-2001 1900.dat	15	60:00	2,600	225	920	3,745	
	3	Kvichak 30-May-2001 2000.dat	15	60:01	5,985	6,620	5,565	18,170	
	3	Kvichak 30-May-2001 2100.dat	15	60:00	1,650	4,730	16,295	22,675	
	3	Kvichak 30-May-2001 2200.dat	15	60:01	1,600	1,470	5,460	8,530	
	3	Kvichak 30-May-2001 2300.dat	15	60:00	675	2,010	2,060	4,745	
	3	Kvichak 31-May-2001 0000.dat	15	60:01	15,425	5,040	11,855	32,320	
	3	Kvichak 31-May-2001 0100.dat	15	60:01	3,305	12,705	57,790	73,800	
	3	Kvichak 31-May-2001 0200.dat	15	60:00	10,720	26,890	48,110	85,720	
	3	Kvichak 31-May-2001 0300.dat	15	60:01	4,960	8,055	12,790	25,805	
	3	Kvichak 31-May-2001 0400.dat	15	60:00	670	3,530	1,555	5,755	
	3	Kvichak 31-May-2001 0500.dat	15	60:01	520	135	995	1,650	
	3	Kvichak 31-May-2001 0600.dat	15	60:00	75	15	390	480	
	3	Kvichak 31-May-2001 0700.dat	15	60:01	520	30	300	850	
3	Kvichak 31-May-2001 0800.dat	15	60:00	150	40	405	595		
3	Kvichak 31-May-2001 0900.dat	15	60:01	190	850	60	1,100		
3	Kvichak 31-May-2001 1000.dat	15	60:00	255	115	75	445		
3	Kvichak 31-May-2001 1100.dat	15	60:01	196,980	61,770	77,285	336,035		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count * (all-arrays)	Comments
					Inshore	Middle	Offshore		
5/31-6/01	3	Kvichak 31-May-2001 1200.dat	15	60:01	155	70	15	240	
	3	Kvichak 31-May-2001 1300.dat	15	60:00	375	25	100	500	
	3	Kvichak 31-May-2001 1400.dat	15	60:01	1,260	590	445	2,295	
	3	Kvichak 31-May-2001 1500.dat	15	60:00	1,780	305	1,510	3,595	
	3	Kvichak 31-May-2001 1600.dat	15	60:01	35	825	815	1,675	
	3	Kvichak 31-May-2001 1700.dat	15	60:00	495	90	185	770	
	3	Kvichak 31-May-2001 1800.dat	15	60:01	1,295	25	305	1,625	
	3	Kvichak 31-May-2001 1900.dat	15	60:00	435	120	395	950	
	3	Kvichak 31-May-2001 2000.dat	15	60:01	210	145	140	495	
	3	Kvichak 31-May-2001 2100.dat	15	60:00	1,530	60	1,360	2,950	
	3	Kvichak 31-May-2001 2200.dat	15	60:01	1,685	3,250	3,710	8,645	
	3	Kvichak 31-May-2001 2300.dat	15	60:01	5,545	5,560	10,200	21,305	
	3	Kvichak 01-June-2001 0000.dat	15	60:00	6,635	3,785	6,330	16,750	
	3	Kvichak 01-June-2001 0100.dat	15	60:01	1,575	2,365	5,560	9,500	
	3	Kvichak 01-June-2001 0200.dat	15	60:00	1,855	2,920	8,325	13,100	
	3	Kvichak 01-June-2001 0300.dat	15	60:01	1,400	3,765	20,825	25,990	
	3	Kvichak 01-June-2001 0400.dat	15	60:00	3,080	2,260	10,035	15,375	
	3	Kvichak 01-June-2001 0500.dat	15	60:01	8,575	2,855	6,185	17,615	
	3	Kvichak 01-June-2001 0600.dat	15	60:00	10,660	7,780	4,450	22,890	
	3	Kvichak 01-June-2001 0700.dat	15	60:01	2,625	2,245	9,250	14,120	
3	Kvichak 01-June-2001 0800.dat	15	60:00	2,225	3,775	6,325	12,325		
3	Kvichak 01-June-2001 0900.dat	15	60:01	5,550	2,175	4,935	12,660		
3	Kvichak 01-June-2001 1000.dat	15	60:00	3,505	3,140	4,650	11,295		
3	Kvichak 01-June-2001 1100.dat	15	60:01	8,950	3,040	4,010	16,000		
6/01-6/02	3	Kvichak 01-June-2001 1200.dat	15	60:01	9,745	4,825	3,990	18,560	
	3	Kvichak 01-June-2001 1300.dat	15	60:00	9,265	4,290	3,105	16,660	
	3	Kvichak 01-June-2001 1400.dat	15	60:01	7,545	1,940	2,080	11,565	
	3	Kvichak 01-June-2001 1500.dat	15	60:00	5,760	2,615	1,235	9,610	
	3	Kvichak 01-June-2001 1600.dat	15	60:01	15,125	3,375	4,800	23,300	
	3	Kvichak 01-June-2001 1700.dat	15	60:00	17,300	6,530	4,315	28,145	
	3	Kvichak 01-June-2001 1800.dat	15	60:01	17,195	6,200	8,075	31,470	
	3	Kvichak 01-June-2001 1900.dat	15	60:00	16,985	8,685	9,355	35,025	
	3	Kvichak 01-June-2001 2000.dat	15	60:01	13,535	12,530	15,755	41,820	
	3	Kvichak 01-June-2001 2100.dat	15	60:00	17,990	15,660	22,605	56,255	
	3	Kvichak 01-June-2001 2200.dat	15	60:01	10,125	9,540	18,090	37,755	
	3	Kvichak 01-June-2001 2300.dat	15	60:01	6,445	3,480	7,415	17,340	
	3	Kvichak 02-June-2001 0000.dat	15	60:00	6,840	2,375	4,240	13,455	
	3	Kvichak 02-June-2001 0100.dat	15	60:01	1,085	1,980	2,230	5,295	
	3	Kvichak 02-June-2001 0200.dat	15	60:00	3,095	3,335	3,870	10,300	
	3	Kvichak 02-June-2001 0300.dat	15	60:01	2,415	3,035	1,785	7,235	
	3	Kvichak 02-June-2001 0400.dat	15	60:00	4,020	630	555	5,205	
	3	Kvichak 02-June-2001 0500.dat	15	60:01	4,300	415	460	5,175	
	3	Kvichak 02-June-2001 0600.dat	15	60:00	3,200	1,655	2,360	7,215	
	3	Kvichak 02-June-2001 0700.dat	15	60:01	555	570	1,935	3,060	
3	Kvichak 02-June-2001 0800.dat	15	60:00	2,700	1,210	3,720	7,630		
3	Kvichak 02-June-2001 0900.dat	15	60:01	1,150	405	800	2,355		
3	Kvichak 02-June-2001 1000.dat	15	60:01	1,665	980	1,970	4,615		
		Kvichak 02-June-2001 1100						No Kvichak 02-June-2001 1100.dat	

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count ^a (all arrays)	Comments	
					Inshore	Middle	Offshore			
6/02-6/03		Kvichak 02-June-2001 1200						No Kvichak 02-June-2001 1200.dat		
		Kvichak 02-June-2001 1300						No Kvichak 02-June-2001 1300.dat		
		Kvichak 02-June-2001 1400						No Kvichak 02-June-2001 1400.dat		
		Kvichak 02-June-2001 1500						No Kvichak 02-June-2001 1500.dat		
		Kvichak 02-June-2001 1600						No Kvichak 02-June-2001 1600.dat		
		Kvichak 02-June-2001 1700						No Kvichak 02-June-2001 1700.dat		
		Kvichak 02-June-2001 1800						No Kvichak 02-June-2001 1800.dat		
		Kvichak 02-June-2001 1900						No Kvichak 02-June-2001 1900.dat		
	3		Kvichak 02-June-2001 2013.dat	11	46:15	19,665	31,115	18,075	68,855	Partial hour count
	3		Kvichak 02-June-2001 2100.dat	15	60:01	15,840	12,550	23,845	52,235	
	3		Kvichak 02-June-2001 2200.dat	29	120:01	13,585	7,610	17,395	38,590	Double-hour count
			Kvichak 02-June-2001 2300							No Kvichak 02-June-2001 2300.dat
	4		Kvichak 03-June-2001 0000.dat	15	60:00	6,860	3,050	7,635	17,545	
	4		Kvichak 03-June-2001 0100.dat	15	60:01	1,170	4,925	37,230	43,325	
	4		Kvichak 03-June-2001 0200.dat	15	60:00	6,185	15,225	67,935	89,345	
	4		Kvichak 03-June-2001 0300.dat	15	60:01	2,085	1,730	4,520	8,335	
	4		Kvichak 03-June-2001 0400.dat	15	60:00	9,185	4,070	4,905	18,160	
4		Kvichak 03-June-2001 0500.dat	15	60:01	16,140	2,005	940	19,085		
4		Kvichak 03-June-2001 0600.dat	15	60:00	24,930	9,415	11,075	45,420		
4		Kvichak 03-June-2001 0700.dat	15	60:01	21,635	11,685	15,100	48,420		
4		Kvichak 03-June-2001 0800.dat	15	60:01	15,540	9,955	34,540	60,035		
4		Kvichak 03-June-2001 0900.dat	15	60:00	15,030	10,115	28,345	53,490		
4		Kvichak 03-June-2001 1000.dat	15	60:01	8,425	8,045	20,440	36,910		
4		Kvichak 03-June-2001 1100.dat	15	60:00	16,095	7,440	72,365	95,900		
6/03-6/04	4		Kvichak 03-June-2001 1200.dat	15	60:01	8,525	20,310	184,315	213,150	
	4		Kvichak 03-June-2001 1300.dat	15	60:00	14,560	34,220	120,700	169,480	
	4		Kvichak 03-June-2001 1400.dat	15	60:01	88,675	103,140	111,575	303,390	
	4		Kvichak 03-June-2001 1500.dat	15	60:00	103,710	96,445	122,805	322,960	
	4		Kvichak 03-June-2001 1600.dat	15	60:01	50,775	111,500	219,030	381,305	
	4		Kvichak 03-June-2001 1700.dat	15	60:00	40,560	181,230	230,115	451,905	
	4		Kvichak 03-June-2001 1800.dat	15	60:01	16,830	73,570	242,615	333,015	
	4		Kvichak 03-June-2001 1900.dat	15	60:00	31,155	72,585	226,395	330,135	
	4		Kvichak 03-June-2001 2000.dat	15	60:01	28,565	45,830	203,950	278,345	
	4		Kvichak 03-June-2001 2100.dat	15	60:01	15,585	51,070	135,075	201,730	
	4		Kvichak 03-June-2001 2200.dat	15	60:00	13,815	8,670	44,705	67,190	
	4		Kvichak 03-June-2001 2300.dat	15	60:01	7,505	3,580	4,910	15,995	
	4		Kvichak 04-June-2001 0000.dat	15	60:00	8,100	2,235	4,535	14,870	
	4		Kvichak 04-June-2001 0100.dat	15	60:01	1,520	1,635	4,160	7,315	
	4		Kvichak 04-June-2001 0200.dat	15	60:00	3,925	11,245	71,540	86,710	
	4		Kvichak 04-June-2001 0300.dat	15	60:01	12,550	21,860	93,710	128,120	
	4		Kvichak 04-June-2001 0400.dat	15	60:00	2,650	1,760	3,815	8,225	
	4		Kvichak 04-June-2001 0500.dat	15	60:01	1,410	4,430	21,845	27,685	
	4		Kvichak 04-June-2001 0600.dat	15	60:00	4,100	7,490	28,970	40,560	
	4		Kvichak 04-June-2001 0700.dat	15	60:01	4,060	3,535	14,970	22,565	
4		Kvichak 04-June-2001 0800.dat	15	60:01	107,405	36,375	49,025	192,805		
4		Kvichak 04-June-2001 0900.dat	15	60:00	4,295	2,970	6,120	13,385		
4		Kvichak 04-June-2001 1000.dat	15	60:01	4,540	3,735	9,195	17,470		
4		Kvichak 04-June-2001 1100.dat	15	60:00	4,780	4,450	10,580	19,810		

Smolt Day (m/d-d-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count * (all arrays)	Comments	
					Inshore	Middle	Offshore			
6/04-6/05	4	Kvichak 04-June-2001 1200.dat	15	60:01	6,180	5,185	11,705	23,070		
	4	Kvichak 04-June-2001 1300.dat	15	60:00	5,785	12,920	24,930	43,635		
	4	Kvichak 04-June-2001 1400.dat	15	60:01	6,235	7,750	15,835	29,820		
	4	Kvichak 04-June-2001 1500.dat	15	60:00	12,965	11,165	26,240	50,370		
	4	Kvichak 04-June-2001 1600.dat	15	60:01	25,685	17,470	32,850	76,005		
	4	Kvichak 04-June-2001 1700.dat	15	60:00	18,830	20,335	15,295	54,460		
	4	Kvichak 04-June-2001 1800.dat	15	60:01	27,780	25,155	44,450	97,385		
	4	Kvichak 04-June-2001 1900.dat	15	60:00	33,290	29,990	50,625	113,905		
	4	Kvichak 04-June-2001 2000.dat	15	60:01	12,515	18,195	40,095	70,805		
	4	Kvichak 04-June-2001 2100.dat	15	60:01	10,170	18,200	46,045	74,415		
	4	Kvichak 04-June-2001 2200.dat	15	60:00	5,120	5,565	20,450	31,135		
	4	Kvichak 04-June-2001 2300.dat	15	60:01	7,540	3,350	5,290	16,180		
	4	Kvichak 05-June-2001 0000.dat	15	60:00	2,240	2,350	3,485	8,075		
	4	Kvichak 05-June-2001 0100.dat	15	60:01	2,675	1,755	2,345	6,775		
	4	Kvichak 05-June-2001 0200.dat	15	60:00	5,365	5,210	54,135	64,710		
	4	Kvichak 05-June-2001 0300.dat	15	60:01	2,275	3,260	11,520	17,055		
	4	Kvichak 05-June-2001 0400.dat	15	60:00	3,205	1,350	6,965	11,520		
	4	Kvichak 05-June-2001 0500.dat	15	60:01	2,010	2,880	13,260	18,150		
	4	Kvichak 05-June-2001 0600.dat	15	60:00	3,555	3,565	11,030	18,150		
	4	Kvichak 05-June-2001 0700.dat	15	60:01	5,855	7,060	17,915	30,830		
	4	Kvichak 05-June-2001 0800.dat	15	60:01	3,045	2,885	8,850	14,780		
	4	Kvichak 05-June-2001 0900.dat	15	60:00	2,425	2,110	7,545	12,080		
	4	Kvichak 05-June-2001 1000.dat	15	60:01	1,290	1,320	3,975	6,585		
	4	Kvichak 05-June-2001 1100.dat	15	60:00	2,470	645	4,350	7,465		
6/05-6/06	4	Kvichak 05-June-2001 1200.dat	15	60:01	3,105	1,290	4,580	8,975		
	4	Kvichak 05-June-2001 1300.dat	15	60:00	5,520	3,480	3,785	12,785		
	4	Kvichak 05-June-2001 1400.dat	15	60:01	9,755	5,940	4,955	20,650		
	4	Kvichak 05-June-2001 1500.dat	15	60:00	9,325	5,140	4,605	19,070		
	4	Kvichak 05-June-2001 1600.dat	15	60:01	12,770	6,410	4,905	24,085		
	4	Kvichak 05-June-2001 1700.dat	15	60:00	6,220	6,355	13,255	25,830		
	4	Kvichak 05-June-2001 1800.dat	15	60:01	15,700	9,695	23,845	49,240		
	4	Kvichak 05-June-2001 1900.dat	15	60:01	7,790	6,885	23,300	37,975		
	4	Kvichak 05-June-2001 2000.dat	15	60:00	5,700	4,525	10,130	20,355		
	4	Kvichak 05-June-2001 2100.dat	15	60:01	3,420	6,150	11,230	20,800		
	4	Kvichak 05-June-2001 2200.dat	15	60:00	8,785	5,805	6,920	21,510		
	4	Kvichak 05-June-2001 2300.dat	15	60:01	10,355	3,090	3,935	17,380		
			Kvichak 06-June-2001 0000						No Kvichak 06-June-2001 0000.dat	
			Kvichak 06-June-2001 0053.dat	1	00:01				No data found in this file.	
	4		Kvichak 06-June-2001 0100.dat	15	59:52	3,450	2,230	2,020	7,700	Partial hour count
	4		Kvichak 06-June-2001 0200.dat	15	60:01	2,880	2,295	5,155	10,330	
	4		Kvichak 06-June-2001 0300.dat	15	60:00	2,135	2,315	9,585	14,035	
	4		Kvichak 06-June-2001 0400.dat	15	60:01	3,655	2,035	6,470	12,160	
			Kvichak 06-June-2001 0500						0 No Kvichak 06-June-2001 0500.dat	
	4		Kvichak 06-June-2001 0559.dat	1	00:41	5	25	0	30	Partial hour count
	4		Kvichak 06-June-2001 0600.dat	15	60:00	1,865	3,440	6,250	11,555	
	4		Kvichak 06-June-2001 0700.dat	15	60:01	1,695	1,485	4,250	7,430	
	4		Kvichak 06-June-2001 0800.dat	15	60:00	585	1,260	2,145	3,990	
	4		Kvichak 06-June-2001 0900.dat	15	60:01	1,000	1,385	2,470	4,855	
4		Kvichak 06-June-2001 1000.dat	15	60:00	2,945	1,670	4,585	9,200		
4		Kvichak 06-June-2001 1100.dat	15	60:01	2,645	3,810	3,055	9,510		

Smolt Day (m/dd-ny/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count ^a (all arrays)	Comments
					Inshore	Middle	Offshore		
6/06-6/07	4	Kvichak 06-June-2001 1200.dat	15	60:00	4,310	0	15	4,325	
	4	Kvichak 06-June-2001 1300.dat	15	60:01	4,190	4,035	5,245	13,470	
	4	Kvichak 06-June-2001 1400.dat	15	60:00	6,495	7,820	9,560	23,875	
	4	Kvichak 06-June-2001 1500.dat	15	60:01	8,325	13,740	11,405	33,470	
	4	Kvichak 06-June-2001 1600.dat	29	120:01	11,505	20,220	27,380	59,105	Double-hour count
		Kvichak 06-June-2001 1700							No Kvichak 06-June-2001 1700.dat
	4	Kvichak 06-June-2001 1800.dat	15	60:01	7,760	13,580	14,370	35,710	
	4	Kvichak 06-June-2001 1900.dat	15	60:00	11,750	19,860	25,735	57,345	
	4	Kvichak 06-June-2001 2000.dat	15	60:01	10,825	15,040	17,805	43,670	
	4	Kvichak 06-June-2001 2100.dat	15	60:00	10,060	8,520	16,565	35,145	
	4	Kvichak 06-June-2001 2200.dat	15	60:01	7,160	5,000	39,110	51,270	
	4	Kvichak 06-June-2001 2300.dat	15	60:00	8,155	2,150	5,985	16,290	
	5	Kvichak 07-June-2001 0000.dat	15	60:01	6,095	2,570	4,580	13,245	
	5	Kvichak 07-June-2001 0100.dat	15	60:00	8,095	3,805	4,310	16,210	
	5	Kvichak 07-June-2001 0200.dat	15	60:01	4,785	2,860	2,985	10,630	
	5	Kvichak 07-June-2001 0300.dat	15	60:00	6,280	2,140	2,590	11,010	
	5	Kvichak 07-June-2001 0400.dat	15	60:01	9,555	2,700	10,075	22,330	
	5	Kvichak 07-June-2001 0500.dat	15	60:01	9,610	2,460	27,305	39,375	
	5	Kvichak 07-June-2001 0600.dat	15	60:00	3,510	3,570	23,230	30,310	
	5	Kvichak 07-June-2001 0700.dat	15	60:01	7,015	4,435	24,665	36,115	
5	Kvichak 07-June-2001 0800.dat	15	60:00	1,705	1,695	7,905	11,305		
5	Kvichak 07-June-2001 0900.dat	15	60:01	2,490	1,695	6,415	10,600		
5	Kvichak 07-June-2001 1000.dat	15	60:00	8,240	3,045	9,175	20,460		
5	Kvichak 07-June-2001 1100.dat	15	60:01	5,065	4,565	20,090	29,720		
6/07-6/08	5	Kvichak 07-June-2001 1200.dat	15	60:00	8,230	9,745	23,840	41,815	
	5	Kvichak 07-June-2001 1300.dat	15	60:01	20,915	7,950	4,965	33,830	
	5	Kvichak 07-June-2001 1400.dat	15	60:00	27,160	9,235	7,140	43,535	
	5	Kvichak 07-June-2001 1500.dat	15	60:01	20,785	9,710	3,275	33,770	
	5	Kvichak 07-June-2001 1600.dat	15	60:01	18,505	10,025	19,960	48,490	
	5	Kvichak 07-June-2001 1700.dat	15	60:00	13,535	46,530	35,550	95,615	
	5	Kvichak 07-June-2001 1800.dat	15	60:01	25,955	8,505	35,365	69,825	
	5	Kvichak 07-June-2001 1900.dat	15	60:00	12,575	4,835	26,970	44,380	
	5	Kvichak 07-June-2001 2000.dat	15	60:01	11,820	6,230	22,080	40,130	
	5	Kvichak 07-June-2001 2100.dat	15	60:00	5,195	2,420	15,530	23,145	
	5	Kvichak 07-June-2001 2200.dat	15	60:01	4,625	2,610	12,030	19,265	
	5	Kvichak 07-June-2001 2300.dat	15	60:00	4,095	2,310	5,465	11,870	
	5	Kvichak 08-June-2001 0000.dat	15	60:01	2,605	1,430	2,050	6,085	
	5	Kvichak 08-June-2001 0100.dat	15	60:00	6,120	2,400	2,080	10,600	
	5	Kvichak 08-June-2001 0200.dat	15	60:01	2,820	2,260	1,220	6,300	
	5	Kvichak 08-June-2001 0300.dat	15	60:01	1,915	1,245	1,515	4,675	
	5	Kvichak 08-June-2001 0400.dat	15	60:00	4,215	1,215	7,060	12,490	
	5	Kvichak 08-June-2001 0500.dat	15	60:01	7,605	6,540	48,835	62,980	
	5	Kvichak 08-June-2001 0600.dat	15	60:00	1,875	1,860	9,570	13,305	
	5	Kvichak 08-June-2001 0700.dat	15	60:01	1,850	1,530	8,420	11,800	
5	Kvichak 08-June-2001 0800.dat	15	60:00	96,160	29,715	41,090	166,965		
5	Kvichak 08-June-2001 0900.dat	15	60:01	6,140	5,150	2,960	14,250		
5	Kvichak 08-June-2001 1000.dat	15	60:00	4,240	1,650	4,145	10,035		
5	Kvichak 08-June-2001 1100.dat	15	60:01	2,665	2,240	8,960	13,865		

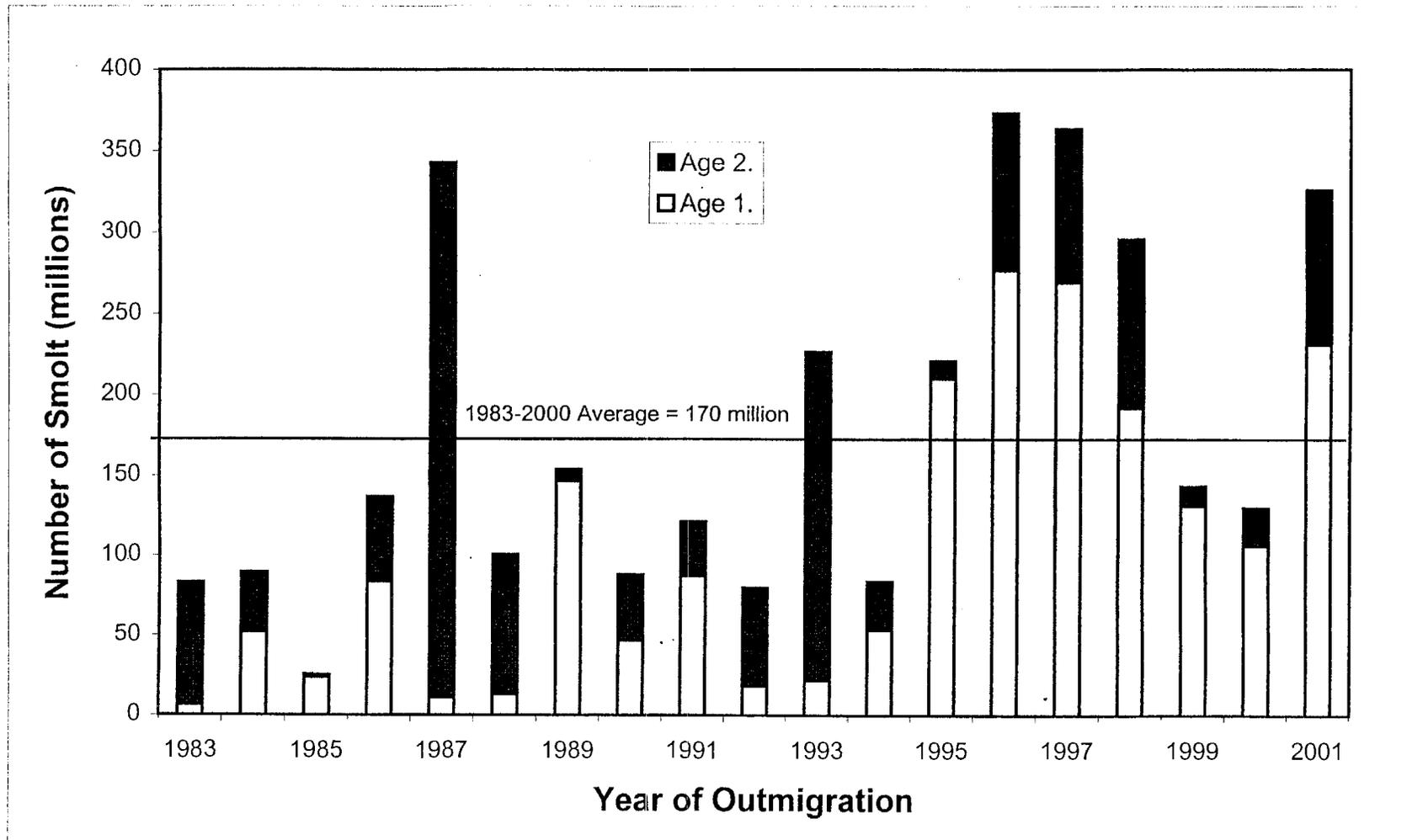
Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count ^a (all arrays)	Comments
					Inshore	Middle	Offshore		
6/08-6/09	5	Kvichak 08-June-2001 1200.dat	15	60:00	4,610	3,965	7,060	15,635	
	5	Kvichak 08-June-2001 1300.dat	15	60:01	6,385	10,970	15,145	32,500	
	5	Kvichak 08-June-2001 1400.dat	15	60:01	13,780	6,950	6,065	26,795	
	5	Kvichak 08-June-2001 1500.dat	15	60:00	13,430	3,370	5,585	22,385	
	5	Kvichak 08-June-2001 1600.dat	15	60:01	12,885	13,910	12,360	39,155	
	5	Kvichak 08-June-2001 1700.dat	15	60:00	8,720	6,520	9,575	24,815	
	5	Kvichak 08-June-2001 1800.dat	15	60:01	15,670	5,885	14,830	36,385	
	5	Kvichak 08-June-2001 1900.dat	15	60:00	16,100	13,970	27,445	57,515	
	5	Kvichak 08-June-2001 2000.dat	15	60:01	20,285	5,130	12,340	37,755	
	5	Kvichak 08-June-2001 2100.dat	15	60:00	12,070	2,950	8,050	23,070	
	5	Kvichak 08-June-2001 2200.dat	15	60:01	13,180	2,665	10,555	26,400	
	5	Kvichak 08-June-2001 2300.dat	15	60:00	4,285	2,230	8,695	15,210	
	6	Kvichak 09-June-2001 0000.dat	15	60:01	6,525	1,970	5,005	13,500	
	6	Kvichak 09-June-2001 0100.dat	15	60:00	6,710	1,965	1,400	10,075	
	6	Kvichak 09-June-2001 0200.dat	15	60:01	4,445	1,360	2,080	7,885	
	6	Kvichak 09-June-2001 0300.dat	15	60:01	5,340	1,290	945	7,575	
	6	Kvichak 09-June-2001 0400.dat	15	60:00	6,590	1,680	3,200	11,470	
	6	Kvichak 09-June-2001 0500.dat	15	60:01	3,715	2,700	3,395	9,810	
	6	Kvichak 09-June-2001 0600.dat	15	60:00	1,995	495	1,260	3,750	
	6	Kvichak 09-June-2001 0700.dat	15	60:01	405	345	490	1,240	
6	Kvichak 09-June-2001 0800.dat	15	60:00	1,650	485	1,740	3,875		
6	Kvichak 09-June-2001 0900.dat	15	60:01	10,735	955	1,615	13,305		
6	Kvichak 09-June-2001 1000.dat	15	60:00	7,120	380	1,695	9,195		
6	Kvichak 09-June-2001 1100.dat	15	60:01	5,680	855	1,115	7,650		
6/09-6/10	6	Kvichak 09-June-2001 1200.dat	15	60:00	3,885	1,770	2,725	8,380	
	6	Kvichak 09-June-2001 1300.dat	15	60:01	3,385	4,190	6,230	13,805	
	6	Kvichak 09-June-2001 1400.dat	15	60:01	10,335	9,345	4,720	24,400	
	6	Kvichak 09-June-2001 1500.dat	15	60:00	14,065	9,405	5,510	28,980	
	6	Kvichak 09-June-2001 1600.dat	15	60:01	8,405	7,545	4,365	20,315	
	6	Kvichak 09-June-2001 1700.dat	15	60:00	11,530	4,885	9,185	25,600	
	6	Kvichak 09-June-2001 1800.dat	15	60:01	15,320	13,035	13,675	42,030	
	6	Kvichak 09-June-2001 1900.dat	15	60:00	13,430	12,140	5,790	31,360	
	6	Kvichak 09-June-2001 2000.dat	15	60:01	2,555	4,180	3,240	9,975	
	6	Kvichak 09-June-2001 2100.dat	15	60:00	44,680	2,785	11,360	58,825	
	6	Kvichak 09-June-2001 2200.dat	15	60:01	3,680	1,675	3,580	8,935	
	6	Kvichak 09-June-2001 2300.dat	15	60:00	2,575	1,010	1,325	4,910	
	6	Kvichak 10-June-2001 0000.dat	15	60:01	2,985	1,915	1,795	6,695	
	6	Kvichak 10-June-2001 0100.dat	15	60:00	1,725	595	440	2,760	
	6	Kvichak 10-June-2001 0200.dat	15	60:01	3,615	1,860	3,450	8,925	
	6	Kvichak 10-June-2001 0300.dat	15	60:01	740	260	525	1,525	
	6	Kvichak 10-June-2001 0400.dat	15	60:00	2,580	615	755	3,950	
	6	Kvichak 10-June-2001 0500.dat	15	60:01	5,930	3,680	3,320	12,930	
	6	Kvichak 10-June-2001 0600.dat	15	60:00	1,515	465	560	2,540	
	6	Kvichak 10-June-2001 0700.dat	15	60:01	21,810	1,320	940	24,070	
6	Kvichak 10-June-2001 0800.dat	15	60:00	82,265	25,980	32,490	140,735		
6	Kvichak 10-June-2001 0900.dat	15	60:01	1,300	1,710	1,000	4,010		
6	Kvichak 10-June-2001 1000.dat	15	60:00	11,375	1,100	2,040	14,515		
6	Kvichak 10-June-2001 1100.dat	15	60:01	11,060	7,220	7,455	25,735		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count * (all arrays)	Comments
					Inshore	Middle	Offshore		
6/10-6/11	6	Kvichak 10-June-2001 1200.dat	15	60:00	4,840	2,125	3,495	10,460	
	6	Kvichak 10-June-2001 1300.dat	15	60:01	7,770	1,775	4,490	14,035	
	6	Kvichak 10-June-2001 1400.dat	15	60:01	9,895	3,425	5,755	19,075	
	6	Kvichak 10-June-2001 1500.dat	15	60:00	10,140	2,355	1,935	14,430	
	6	Kvichak 10-June-2001 1600.dat	15	60:01	5,115	3,005	2,835	10,955	
	6	Kvichak 10-June-2001 1700.dat	15	60:00	9,670	6,660	3,380	19,710	
	6	Kvichak 10-June-2001 1800.dat	15	60:01	4,940	2,470	6,885	14,295	
	6	Kvichak 10-June-2001 1900.dat	15	60:00	5,720	3,245	8,025	16,990	
	6	Kvichak 10-June-2001 2000.dat	15	60:01	5,840	2,650	4,510	13,000	
	6	Kvichak 10-June-2001 2100.dat	15	60:00	3,465	1,640	3,440	8,545	
	6	Kvichak 10-June-2001 2200.dat	15	60:01	2,295	1,050	1,770	5,115	
	6	Kvichak 10-June-2001 2300.dat	15	60:00	3,705	945	2,230	6,880	
	6	Kvichak 11-June-2001 0000.dat	15	60:01	2,100	800	3,535	6,435	
	6	Kvichak 11-June-2001 0100.dat	15	60:01	3,360	825	890	5,075	
	6	Kvichak 11-June-2001 0200.dat	15	60:00	1,835	935	1,335	4,105	
	6	Kvichak 11-June-2001 0300.dat	15	60:01	3,355	1,480	1,775	6,610	
	6	Kvichak 11-June-2001 0400.dat	15	60:00	1,785	645	990	3,420	
	6	Kvichak 11-June-2001 0500.dat	15	60:01	1,275	530	875	2,680	
	6	Kvichak 11-June-2001 0600.dat	15	60:00	18,065	5,360	6,935	30,360	
	6	Kvichak 11-June-2001 0700.dat	15	60:01	400	330	120	850	
	6	Kvichak 11-June-2001 0800.dat	15	60:00	1,255	650	390	2,295	
	6	Kvichak 11-June-2001 0900.dat	15	60:01	3,065	780	645	4,490	
	6	Kvichak 11-June-2001 1000.dat	15	60:00	910	335	590	1,835	
	6	Kvichak 11-June-2001 1100.dat	15	60:01	480	305	780	1,565	

^a The total counts for the smolt counter *.dat file have not been adjusted for false cts and disabled time in this table
The final adjusted sonar counts for the Bendix smolt counter were adjusted for false counts and disabled time.

Appendix F.1. Total smolt outmigration estimates for Kvichak River by outmigration year, 1983-2001.

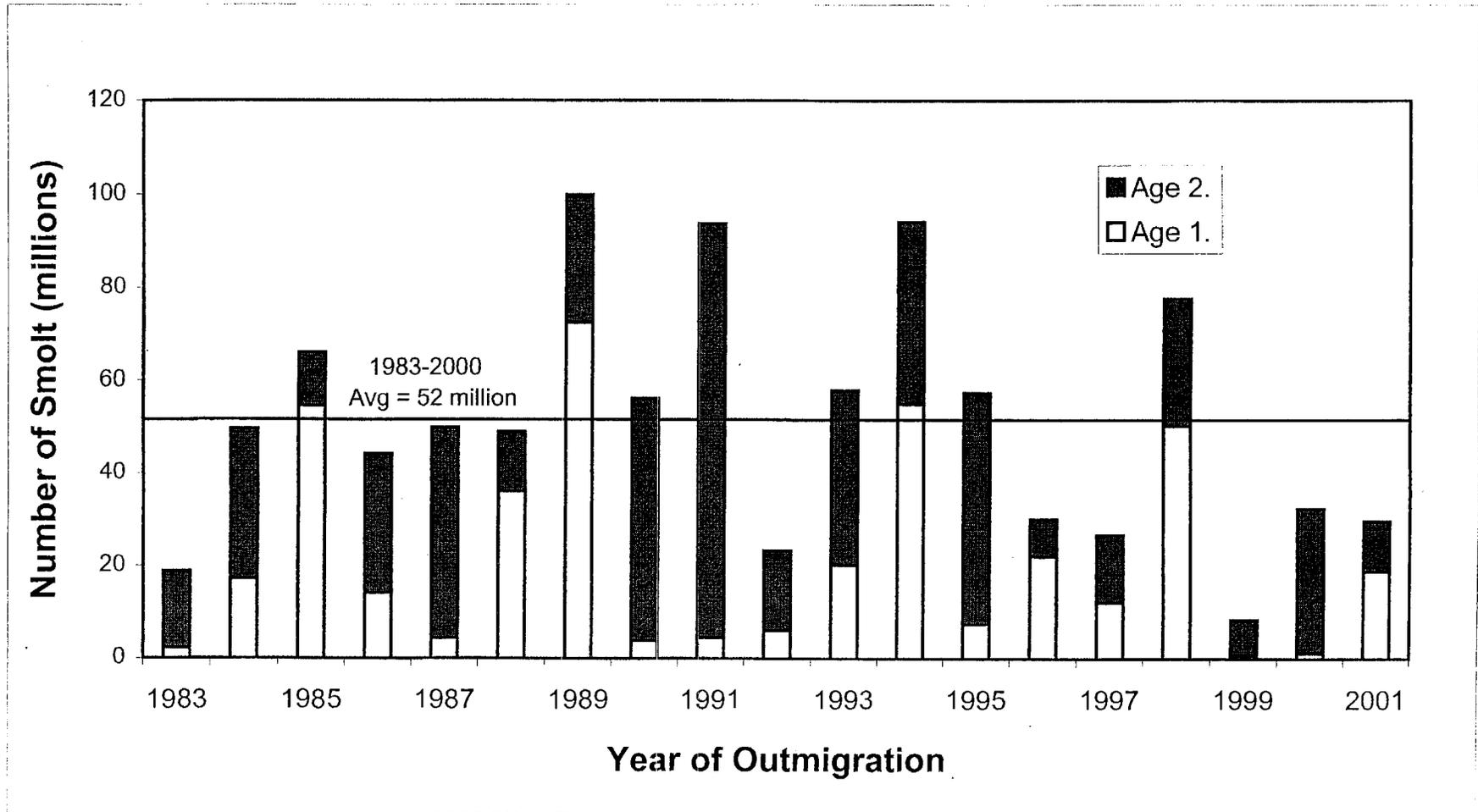
Year of Outmigration	Operating Dates	Total Days Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
			10%	50%	90%	Date	Smolt Estimate		
1983	5/19-6/13	26	5/23	5/26	6/05	5/24	14,258,463	82,793,899	Ice Problems - 5/19-5/22 intermittent
1984	5/18-6/10	24	5/21	5/27	6/05	5/27	13,184,162	89,489,975	
1985	5/22-6/19	29	6/06	6/10	6/17	6/09	6,059,204	25,527,851	Ice Problems - 5/22-6/02, 6/06 intermittent, 6/03-6/05 continuous
1986	5/21-6/12	23	5/28	6/05	6/06	6/06	58,591,781	136,733,218	
1987	5/21-6/13	24	5/24	5/28	6/09	5/28	45,657,674	342,686,918	
1988	5/22-6/16	26	5/23	6/01	6/13	6/01	15,490,767	100,173,692	
1989	5/19-6/15	28	5/29	6/03	6/10	6/03	26,318,761	153,464,216	New Site Location - 1 km downstream from 1974-1988 site
1990	5/21-6/14	25	5/22	5/25	6/10	5/27	11,721,914	88,004,103	Ice Problems - prior to 5/21
1991	5/22-6/16	26	5/30	5/28	6/10	6/04	19,885,424	121,454,182	Ice Problems - 5/22-5/26 intermittent, 5/27-5/29 continuous
1992	5/23-6/13	22	5/25	5/22	6/03	5/28	18,838,144	79,490,008	Ice Problems - 5/19-5/22 continuous, 5/24-5/26, 5/31 intermittent
1993	5/18-6/11	25	5/19	5/24	5/31	5/31	44,155,479	226,407,888	
1994	5/28-6/15	19	5/31	6/05	6/11	6/05	11,705,421	83,845,472	Ice Problems - 5/17-5/28 continuous
1995	5/21-6/13	24	5/21	5/25	6/03	5/22	40,060,740	220,892,127	Ice Problems - 5/17-5/21 continuous
1996	5/18-6/12	26	5/24	5/28	5/31	5/28	78,544,749	373,166,532	
1997	5/17-6/12	27	5/19	5/24	6/01	5/22	44,778,344	363,397,663	
1998	5/17-6/12	27	5/20	5/25	6/01	5/21	46,937,701	295,470,850	
1999	6/01-6/16	16	6/04	6/08	6/14	6/04	18,566,414	143,543,215	Ice Problems - 5/17-5/31 continuous threat from frozen lake
2000	5/20-6/13	25	5/21	5/27	6/07	5/21	27,239,013	130,038,649	
1983-00 Max		29	6/06	6/10	6/17	6/09	78,544,749	373,166,532	
1983-00 Avg		25	5/25	5/29	6/06	5/29	30,110,786	169,810,025	
1983-00 Min		16	5/19	5/22	5/31	5/21	6,059,204	25,527,851	
2001	5/18-6/10	24	5/19	5/21	6/04	5/20	87,480,984	325,914,951	



Appendix F.2. Age composition of smolt outmigration estimates for Kvichak River by outmigration year, 1983-2001.

Appendix F.3. Total smolt outmigration estimates for Egegik River by outmigration year, 1983-2001.

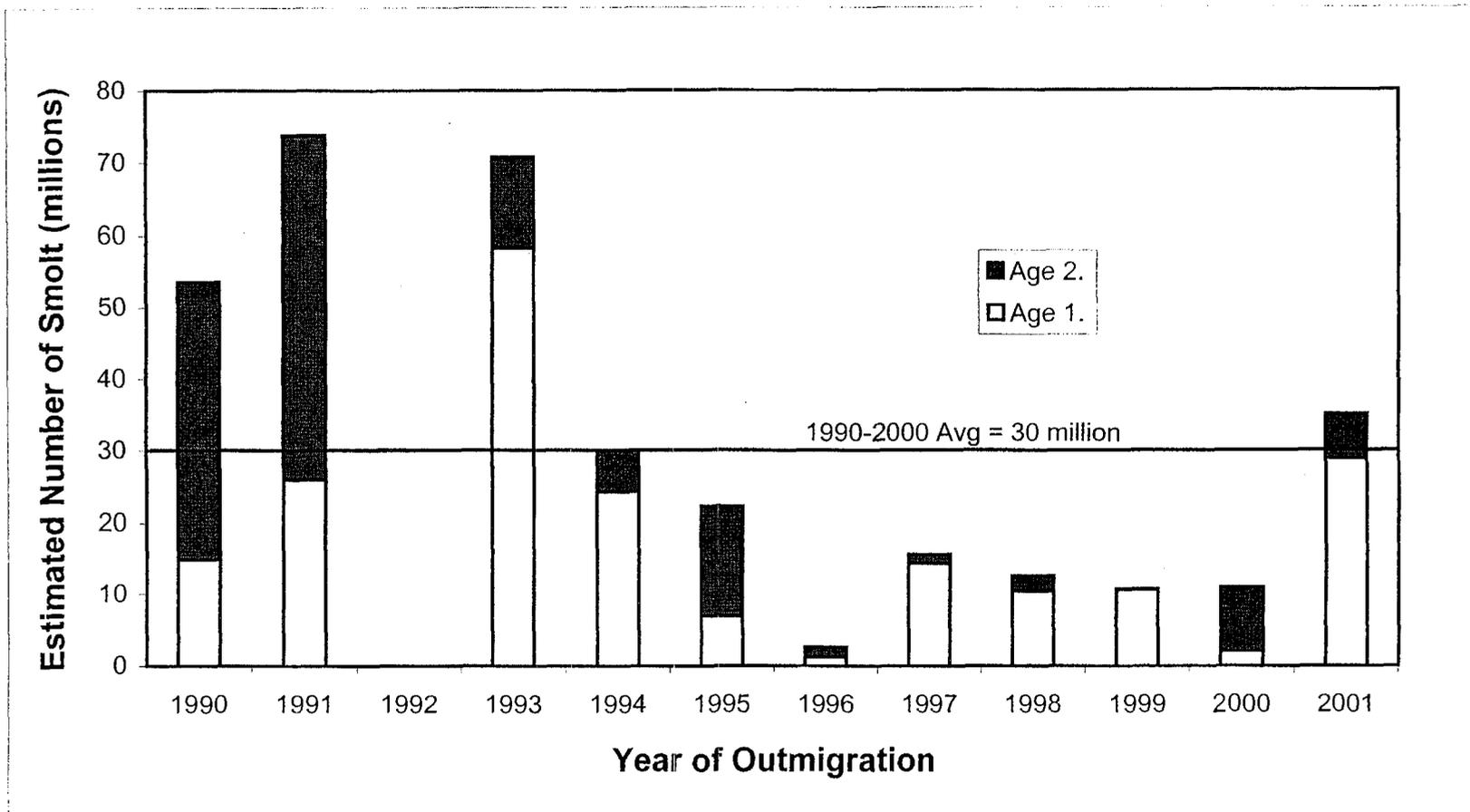
Year of Outmigration	Operating Dates	Total Days Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
			10%	50%	90%	Date	Smolt Estimate		
1983	5/17-6/10	25	5/21	5/27	5/31	5/29	5,377,393	18,766,889	
1984	5/19-6/10	23	5/26	5/26	5/30	5/26	23,006,014	49,667,432	
1985	5/19-6/11	24	5/27	5/29	6/01	5/27	24,392,451	66,073,548	Ice Present - 5/17-5/22 intermittent
1986	5/18-6/11	25	5/27	5/29	6/03	5/29	10,079,789	44,197,865	Ice Present - 5/19-5/25 intermittent
1987	5/19-6/13	26	5/21	5/24	6/08	5/22	9,088,350	49,868,710	
1988	5/18-6/13	27	5/23	5/26	6/05	5/24	9,963,520	48,961,215	
1989	5/20-6/09	21	5/25	5/27	5/31	5/27	21,494,695	99,886,786	
1990	5/19-6/11	24	5/23	5/25	5/29	5/25	17,366,276	56,095,226	Fair Weather - 118 h disabled time
1991	5/21-6/11	22	5/25	5/28	6/07	6/04	17,890,595	94,077,988	Ice Problems - 5/17-5/18 continuous
1992	5/22-6/11	21	5/26	5/27	6/02	5/26	7,935,493	23,748,278	
1993	5/17-6/08	23	5/20	5/24	5/27	5/25	11,674,298	57,960,399	
1994	5/21-6/09	20	5/24	5/31	6/05	5/31	14,215,785	94,086,989	
1995	5/21-6/12	23	5/22	5/23	5/29	5/23	19,428,442	57,385,790	Ice Problems - 5/19-5/21 continuous
1996	5/19-6/12	25	5/24	5/25	5/29	5/24	10,043,411	31,270,793	
1997	5/18-6/09	23	5/24	5/28	5/31	5/29	4,881,168	27,050,113	Excellent Weather - 1 hr disabled time
1998	5/18-6/10	24	5/26	5/29	6/04	5/29	17,439,907	78,791,125	Good Weather - 67 hr disabled time
1999	5/21-6/13	24	5/23	6/09	6/09	6/09	3,703,824	8,592,482	Ice Problems - 5/27-6/06 intermittent, 6/07-6/13 continuous
2000	5/20-6/10	22	5/21	6/01	6/03	6/01	6,801,716	32,465,479	Excellent Weather - 42 hr disabled time
1983-00 Max		27	5/27	6/09	6/09	6/09	24,392,451	99,886,786	
1983-00 Avg		23	5/23	5/27	6/02	5/27	13,043,507	52,163,728	
1983-00 Min		20	5/20	5/23	5/27	5/22	3,703,824	8,592,482	
2001	5/17-6/08	23	5/23	5/29	6/04	5/29	6,351,424	30,245,410	Excellent Weather - 22 hr disabled time



Appendix F.4. Age composition of smolt outmigration estimates for Egegik River by outmigration year, 1983-2001.

Appendix F.5. Total smolt outmigration estimates for Ugashik River by outmigration year, 1983-2001.

Year of Outmigration	Operating Dates	Total Day Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
			10%	50%	90%	Date	Smolt Estimate		
1983	5/21-6/16	27	5/26	6/01	6/13	6/07	5,355,409	44,033,811	
1984	5/22-6/16	26	5/24	6/01	6/08	6/01	26,771,956	158,174,626	
1985	5/22-6/17	27	5/24	6/05	6/11	6/04	5,498,113	34,101,390	Intermittent ice floes - 5/17-5/21
1986	5/21-6/13	24	5/30	6/02	6/10	5/30	9,142,549	53,076,253	
1987	5/17-6/13	28	5/21	6/03	6/06	6/03	4,944,521	26,947,225	
1988	5/17-6/13	28	5/28	6/06	6/10	6/07	55,816,902	215,968,015	
1989	5/22-6/15	25	5/25	5/31	6/09	5/25	22,376,115	126,298,122	
1990	5/20-6/13	25	5/26	5/30	6/07	5/29	13,459,723	53,627,347	Poor Weather - 199 h disabled time
1991	5/20-6/13	25	5/25	6/02	6/06	6/02	11,905,863	73,769,877	Poor Weather - 187 h disabled time
1992		0							
1993	5/17-6/11	26	5/26	5/30	6/06	5/26	12,360,357	70,747,074	Bad Weather - 264 h disabled time
1994	5/20-6/12	24	5/28	6/04	6/07	6/04	6,914,049	30,030,624	Excellent Weather - 44 h disabled time
1995	5/22-6/12	22	5/24	5/26	6/01	5/25	4,355,545	22,234,137	Excellent Weather - 21 h disabled time
1996	5/19-6/11	24	5/25	5/30	6/04	6/04	627,517	2,576,812	Fair Weather - 105 h disabled time
1997	5/10-6/12	34	5/18	5/24	5/30	5/24	4,065,127	15,519,783	Excellent Weather - 31 h disabled time
1998	5/17-6/12	27	5/27	6/05	6/11	6/05	2,058,183	12,624,441	Fair Weather - 148 h disabled time
1999	5/17-6/12	27	5/29	6/10	6/11	6/10	4,171,058	10,631,631	Intermittent to heavy ice floes - 5/18-5/23; Good Weather - 62 h disabled ti
2000	5/19-6/11	24	5/25	5/31	6/05	6/01	1,908,369	10,880,559	Good Weather - 88 h disabled time
1990-00 Max		34	5/29	6/10	6/11	6/10	13,459,723	73,769,877	
1990-00 Avg		23	5/25	5/31	6/05	5/31	6,182,579	30,264,229	
1990-00 Min		0	5/18	5/24	5/30	5/24	627,517	2,576,812	
2001	5/20-6/12	24	5/29	6/03	6/07	6/02	6,018,400	35,123,888	Excellent Weather - 15 h disabled time



Appendix F.6. Age composition of smolt outmigration estimates for Ugashik River by outmigration year, 1990-2001.

Appendix G.1. Comparison of Kvichak River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2001.

Year	Sonar Startup		Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C	Smolt Day	Mean Water Temperature °C
1984	18-May	5.5 ^a	27-May	6.8
1985	22-May	3.8 ^b	9-Jun	5.8
1986	21-May	4.5	6-Jun	7.0
1987	21-May	4.5	28-May	5.9
1988	22-May	3.8	1-Jun	6.3
1989	19-May	4.0	3-Jun	6.0
1990	21-May	3.5 ^c	27-May	5.3
1991	22-May	2.0	4-Jun	5.0
1992	23-May	5.8	28-May	7.5
1993	18-May	4.5 ^d	31-May	7.8
1994	28-May	3.8	5-Jun	6.5
1995	21-May	6.0	22-May	6.5
1996	18-May	8.3	28-May	7.5
1997	17-May	5.5	22-May	6.0
1998	18-May	3.3	25-May	4.8
1999	1-Jun	0.8	4-Jun	2.5
2000	20-May	6.5	21-May	6.5
Max		8.3		7.8
Avg		4.5		6.1
Min		0.8		2.5
2001	18-May	6.8	20-May	7.0

^a Water temperature recorded May 19, 1984.

^b Water temperature recorded May 23, 1985.

^c Water temperature recorded May 22, 1990.

^d Water temperature recorded May 19, 1993.

Appendix G.2. Comparison of Egegik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2001.

Year	Sonar Startup		Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C	Smolt Day	Mean Water Temperature °C
1984	19-May	7.0	26-May	7.5
1985	19-May	2.5	27-May	4.0
1986	18-May	3.0 ^a	29-May	4.7
1987	19-May	4.5	22-May	4.5
1988	18-May	4.9 ^b	24-May	6.3
1989	20-May	3.5 ^c	27-May	3.9
1990	19-May	3.5 ^d	25-May	4.0
1991	21-May	7.0	4-Jun	7.0
1992	22-May	7.0 ^e	26-May	6.5
1993	17-May	6.5 ^f	25-May	7.0
1994	21-May	4.5	31-May	5.8
1995	21-May	4.3 ^g	23-May	4.5
1996	19-May	5.0	24-May	5.5
1997	19-May	4.1	29-May	9.3
1998	18-May	4.5	29-May	5.3
1999	21-May	2.5	9-Jun	0.5
2000	20-May	5.5	1-Jun	5.3
Max		7.0		9.3
Avg		4.7		5.4
Min		2.5		0.5
2001	17-May	7.8	29-May	8.0

^a Water temperature recorded May 19, 1986.

^b Water temperature recorded May 19, 1988.

^c Water temperature recorded May 21, 1989.

^d Water temperature recorded May 20, 1990.

^e Water temperature recorded May 23, 1992.

^f Water temperature recorded May 18, 1993.

^g Water temperature recorded May 22, 1995.

Appendix G.3. Comparison of Ugashik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2001.

Year	Sonar Startup		Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C	Smolt Day	Mean Water Temperature °C
1984	22-May	4.5	1-Jun	6.5
1985	22-May	3.8	4-Jun	5.5
1986	21-May	3.0	30-May	5.3
1987	17-May	5.5	3-Jun	7.3
1988	17-May	6.0	7-Jun	8.3
1989	22-May	3.5	25-May	4.8
1990	20-May	3.0	29-May	6.8
1991	20-May	4.3	2-Jun	6.5
1992 ^a				
1993	17-May	6.0	26-May	7.5
1994	20-May	5.9	4-Jun	8.0
1995	22-May	4.5	25-May	5.3
1996	19-May	4.0	4-Jun	7.0
1997	10-May	6.0	24-May	6.5
1998	17-May	3.5	5-Jun	6.0
1999	21-May	1.0	10-Jun	5.0
2000	19-May	4.5	1-Jun	7.5
Max		6.0		8.3
Avg		4.3		6.5
Min		1.0		4.8
2001	20-May	4.5	6-Jun	5.0

^a Project not conducted. No data collected.

APPENDIX H. CLIMATOLOGICAL FACTORS THAT MAY HAVE AFFECTED THE FRESHWATER SURVIVAL OF 2001 SMOLT

The freshwater survival of sockeye salmon smolt from brood years 1997, 1998, and 1999 may have been affected by climatic factors outlined below; however, we have no direct information indicating the magnitude or direction of the effect.

Juvenile sockeye salmon life stages by 12 month periods				
Brood Year	July 1997 to June 1998	July 1998 to June 1999	July 1999 to June 2000	July 2000 to June 2001
1997	Egg / alevin / Age 0. fry/smolt	Age 1. fry/smolt	Age 2. fry/smolt	Age 3. smolt
1998		Egg / alevin / Age 0. fry/smolt	Age 1. fry/smolt	Age 2. smolt
1999			Egg / alevin / Age 0. fry/smolt	Age 1. smolt

Air Temperature

According to air temperature data collected by the National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f) the overall annual temperatures for King Salmon and vicinity from July through June in 1997-1998 was 1.1°F warmer, in 1998-1999 was -2.9 °F colder, in 1999-2000 was -1.4 °F colder, and in 2000-2001 was 4.1 °F warmer than the 30-year mean (Appendix H.1).

Average monthly temperatures for the same time periods are shown in (Appendix H.2). Some colder months which may have impacted salmon eggs, fry, and smolt in the Kvichak, Egegik, and Ugashik River drainages were October and December 1997 (5.4°F and 9.4°F below average), January, August, and December 1998 (2.6°F, 2.6°F, and 7.8 °F below average) and January, February, March, May, October, November, and December 1999 (4.4 °F, 11.2 °F, 9.6 °F, 3.3°F, 4.5°F, 4.3 °F, 15.0°F below average), and January 2000 (11.4°F below average). The remaining months were at or above the 30-year mean temperatures, which would have been favorable for the development and survival of juvenile salmon.

Air temperatures during the winter of 1997-1998 were milder than the prior year. Between October 1997 and April 1998 there were 130 d with average daily air temperatures less than or equal to 32 °F and 16 d with average daily temperatures less than 0 °F (Appendix H.3). This milder weather, especially in March and April, may have created more favorable rearing conditions for salmon eggs and fry from the 1997 brood year. The winter of 1997-1998 had 82 d with average daily air temperatures greater than 32 °F. Below normal temperatures predominated from mid-

October to early November (14 d), late November to early December (6 d), and mid-December to mid- January (22 d).

Air temperatures during the winter of 1998-1999 were more severe than 1997-1998. Between October 1998 and April 1999 there were 142 d with average daily air temperatures less than or equal to 32 °F and 45 d with average daily temperatures less than 0 °F (Appendix H.4). The winter of 1998-1999 had only 70 d with average daily air temperatures greater than 32 °F which may have slowed development of salmon eggs and fry from the 1998 brood year. Below normal temperatures predominated from late November to mid-December (18 d), late December to early January (10 d), mid-January to mid- February (22 d) and late February to mid-March (19d).

During the winter of 1999-2000, air temperatures from October through January were colder than 1998-1999, but the remainder of the winter was much warmer. Between October 1999 and April 2000 there were 137 d with average daily air temperatures less than or equal to 32 °F and 31 d with average daily temperatures less than 0 °F (Appendix H.5). The winter of 1999-2000 had 76 d with average daily air temperatures greater than 32 °F which may have benefited fry and smolt from the 1997-1998 brood year as well as salmon eggs and fry from the 1999 brood year. Below normal temperatures predominated from late October to mid-January (67 d), late January to early February (5 d), and late March to early April (7d).

The winter of 2000-2001 was one of the warmest winters in the last 30-years. Air temperatures from November through February were all well above normal. Between October 2000 and April 2001 there were 119 d with average air temperatures above 32 °F, 93 d with average daily air temperatures less than or equal to 32 °F and 2 d with average daily temperatures less than 0 °F (Appendix H.6). This milder weather may have created more favorable rearing conditions for salmon eggs and fry from the 2000 brood year as well as smolt and fry from the 1997-1999 brood years.

Precipitation

Precipitation data collected by the National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f) for King Salmon and vicinity from July through June in 1997-1998, 1998-1999, 1999-2000, and 2000-2001 were 0.4 in less, 1.0 in more, 1.0 in less, and 0.2 in less than the 30-year mean annual precipitation of 19.4 in (Appendix H.7).

Average monthly precipitations during the 1997-1998 season were greater than or equal to the 30-year mean in 6 out of 12 months (Appendix H.8). The months in which precipitation probably had the greatest impact upon freshwater survival of sockeye salmon in east side Bristol Bay river systems were August, September, May, and June. The average monthly precipitations for these months were 25%, 32%, 133%, and 37% greater than the 30-year means. The increase in precipitation may have caused some flooding, although we have no direct information that significant flooding occurred.

Average monthly precipitations during the 1998-1999 season fluctuated above and below the 30-year mean (Appendix H.8). The average monthly precipitations for August, September, and October were 3.59 in, 3.28 in, and 3.96 in; 21%, 22%, and 88% greater than the 30-year mean. This increased precipitation in the fall may have caused some flooding which could decrease freshwater survival of eggs from the 1998 brood year because of scouring and siltation of salmon redds. The months in which low precipitation may have impacted freshwater survival of sockeye salmon in east side Bristol Bay river systems were December, January, March, and April. The precipitation for these months was 40%, 53%, 58%, and 36% less than the 30-year mean. It is unknown how this increase followed by decreases in precipitation may have effected the age-1 fry/smolt (1997 brood year) and the eggs, alevin, and age-0 fry (1998 brood year).

Average monthly precipitations during the 1999-2000 season were less than the 30-year mean in 7 out of 12 months (Appendix H.8). The months in which precipitation probably did not impact the freshwater survival of sockeye salmon in east side Bristol Bay river systems were August through October, December through February, and June. The average monthly precipitations for the remaining 5 months were below the 30-year mean. Low water levels may have reduced access to and availability of suitable adult salmon spawning habitat and juvenile rearing habitat. Lower than usual precipitation in the spring may also have dewatered some smaller tributaries and prevented fry from entering rearing areas in the lakes.

Average monthly precipitations during the 2000-2001 season were greater than or equal to the 30-year mean in 6 out of 12 months (Appendix H.8). The months in which precipitation probably had the greatest impact upon freshwater survival of sockeye salmon in east side Bristol Bay river systems were July, September, November, February, and April. The average monthly precipitations for these months were 45%, 18%, 43%, 159%, and 41% greater than the 30-year means. The increase in precipitation may have caused some flooding, although we have no direct information that significant flooding occurred.

Snowfall

Snowfall data collected for King Salmon and vicinity by the National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f) from July through June in 1997-1998, 1998-1999, 1999-2000, and 2000-2001 were 4.4 in more, 8.5 in more, 9.8 in more, and 11.5 in less than the 30-year mean annual snowfall of 46.1 in. (Appendix H.9).

During the winter of 1997-1998 most of the snow fell early with above normal snowfalls in November (10.4 in), December (13.1 in), and January (17.3 in) (Appendix H.10). The monthly snowfall for the remainder of the winter was below normal, however the insulating qualities of the early snowfall may have protected developing eggs (1997 brood year) from exposure to severe temperatures.

Overall, snowfall during the winter of 1998-1999 season was above normal (Appendix H.10). The total monthly snowfalls for October, February, and April were 206%, 198%, and 230%

respectively, above the 30-year mean. The warm spell that occurred in late October and early November melted most if not all of the October snow. Snowfalls in November, December, January, and March were below normal. It is unknown how the lack of insulating snow in the early half of the winter may have affected the incubating salmon eggs (1998 brood year) and rearing fry in east side Bristol Bay streams and lakes.

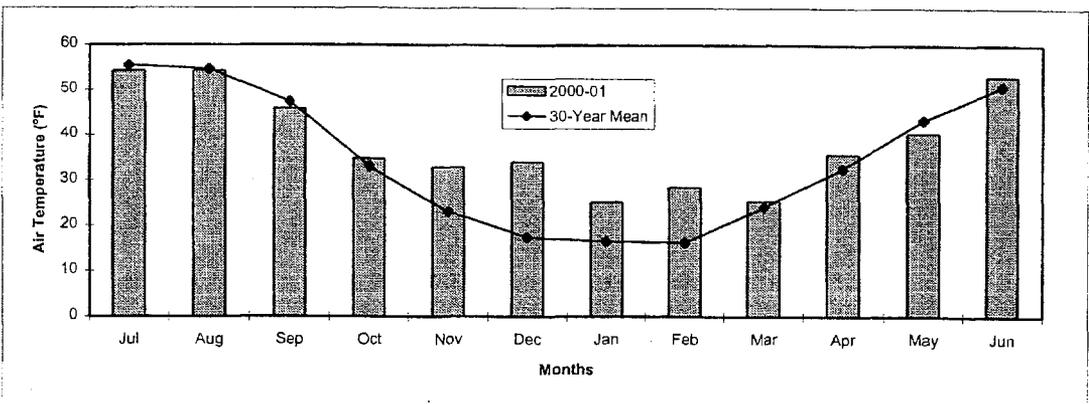
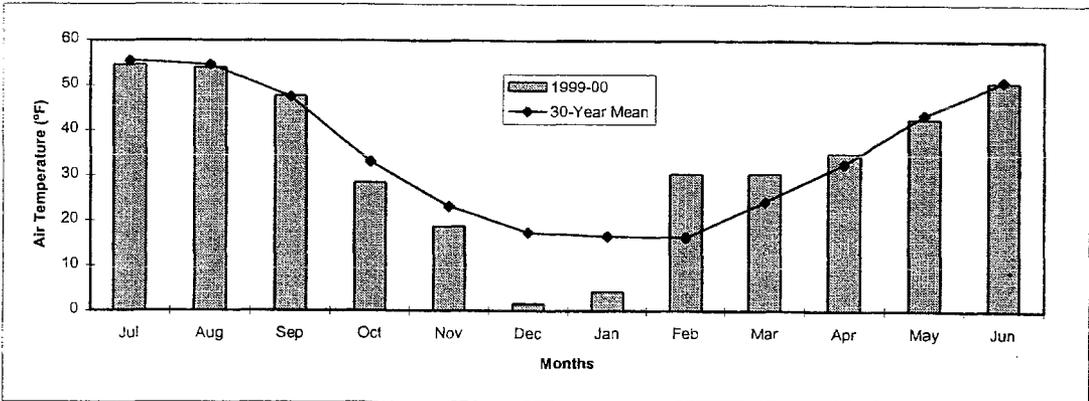
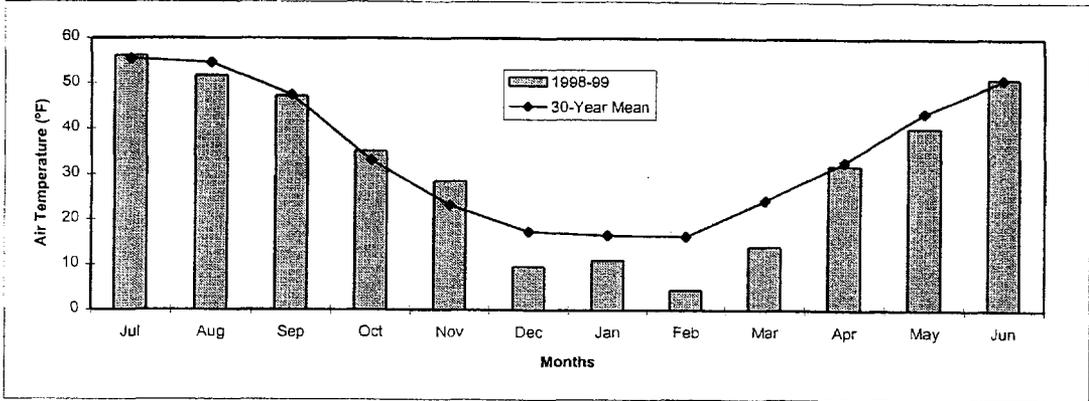
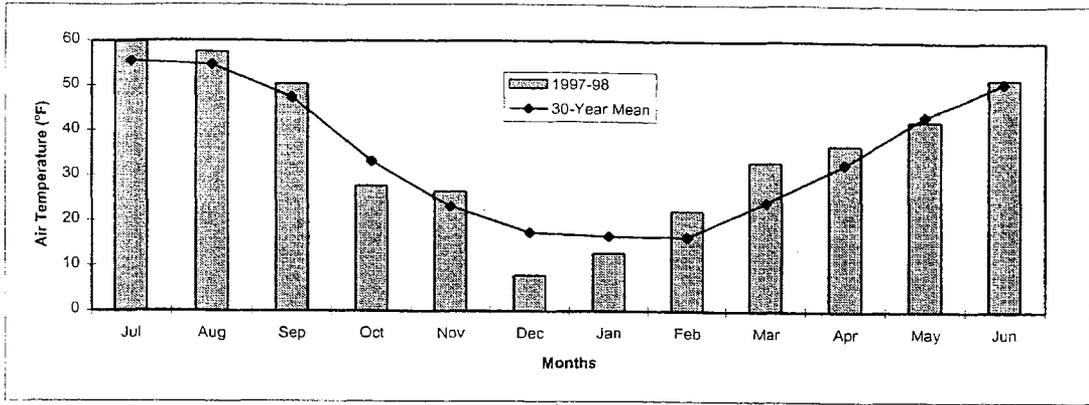
Average monthly snowfalls during the winter of 1999-2000 were above normal (Appendix H.10). The average monthly snowfalls during October and November were slightly less than normal, but were probably adequate to provide an insulating layer to protect developing salmon eggs and emerging fry (1999 brood year) from sharp changes in temperature. The insulating effects of the above average snowfall in December and January may have cancelled out the negative effects of the below normal temperatures (Appendix H.2).

During the winter of 2000-2001 the snowfall from October through January and the month of March were well below normal (Appendix H.10). Above average snowfalls did occur in February and April, however the insulating qualities of these later snowfalls and whether or not they provided any protection to developing eggs (2000 brood year) and rearing age-1. and -2. fry (1998 and 1999 brood years) from exposure to winter temperatures is unknown.

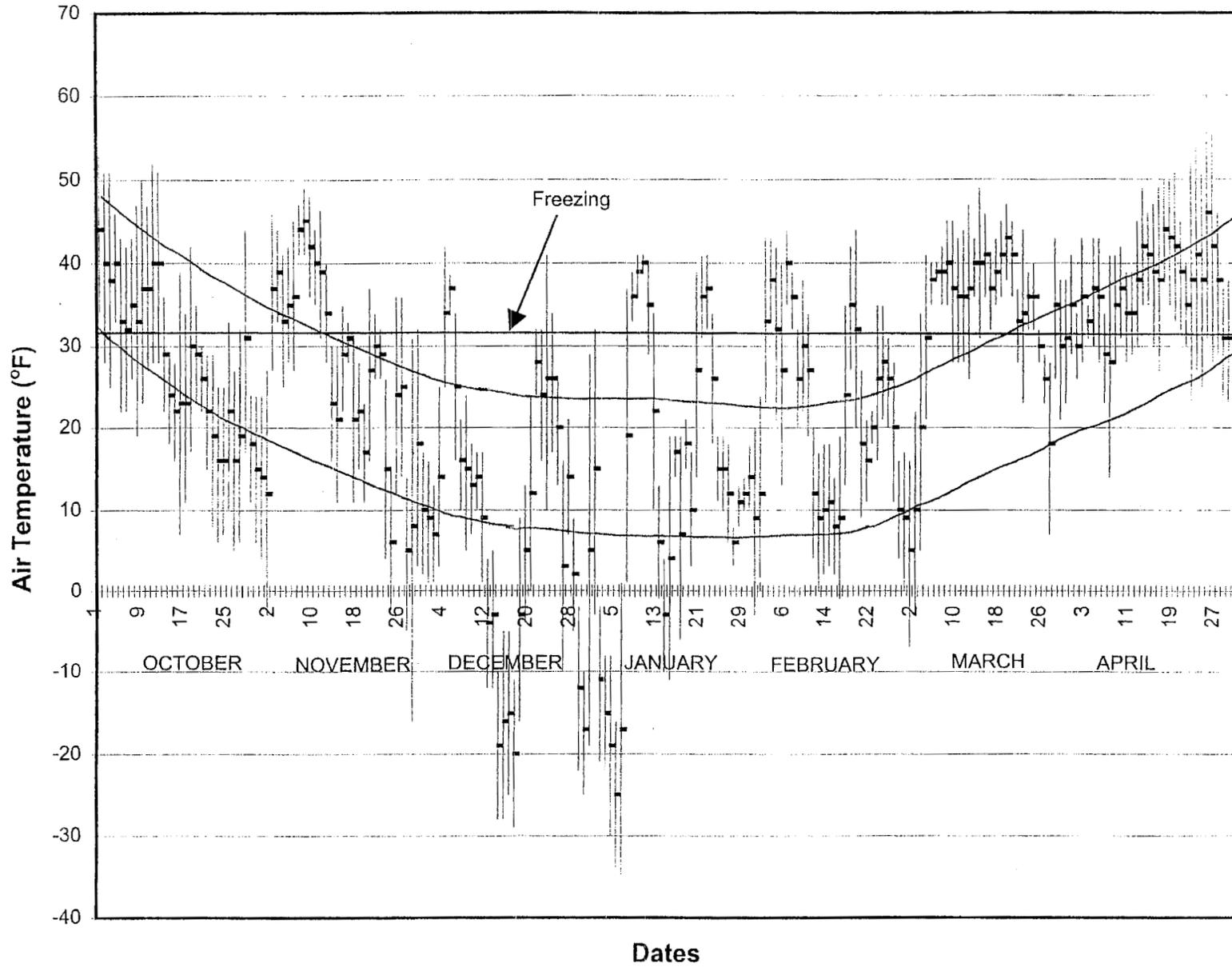
Appendix H.1. Average monthly air temperature for King Salmon, July 1971 to June 2001.

Smolt Year	Air Temperature (°F) ^a												Average Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1971-72	54.5	54.9	46.8	34.3	21.6	18.6	6.7	6.2	1.8	2.1	40.9	46.6	27.9
1972-73	55.2	54.4	45.5	36.0	25.4	16.2	1.8	19.5	19.3	35.9	42.9	51.4	33.6
1973-74	55.6	54.6	47.2	34.1	24.7	17.9	9.5	0.4	23.2	35.6	45.5	51.2	33.3
1974-75	55.4	57.0	50.6	33.4	20.1	8.0	4.7	3.9	14.5	25.0	39.4	47.1	29.9
1975-76	54.7	53.6	47.1	32.4	12.7	10.2	12.3	7.3	15.3	29.5	39.5	46.9	30.1
1976-77	53.2	53.1	45.3	31.5	24.2	19.3	34.4	30.1	18.8	25.7	39.5	50.5	35.5
1977-78	54.3	56.8	47.0	31.7	14.1	10.6	28.6	24.8	25.6	37.5	45.2	49.5	35.5
1978-79	54.2	57.1	47.7	36.5	30.0	28.0	30.1	6.2	30.3	39.6	47.3	52.0	38.3
1979-80	57.8	56.0	50.0	39.4	29.4	4.5	9.0	20.7	27.6	36.4	41.7	48.9	35.1
1980-81	55.1	51.1	47.0	35.2	26.3	5.3	29.8	21.9	34.4	35.8	46.8	50.3	36.6
1981-82	55.1	54.8	44.9	33.2	23.4	13.3	17.0	12.8	23.9	25.5	40.3	48.9	32.8
1982-83	51.5	52.3	46.2	28.1	26.1	24.0	11.9	18.7	33.2	36.5	46.6	53.8	35.7
1983-84	57.4	54.1	45.5	28.8	30.1	27.2	17.4	-2.1	36.3	29.2	43.0	52.3	34.9
1984-85	53.7	53.5	48.0	30.1	22.5	24.7	32.6	10.6	22.6	20.8	39.9	47.4	33.9
1985-86	54.3	52.4	47.4	26.7	25.1	34.2	16.9	22.1	21.5	28.1	42.1	49.9	35.1
1986-87	53.7	52.2	48.8	36.1	26.3	30.6	21.1	24.3	29.8	32.3	42.8	49.3	37.3
1987-88	55.9	57.0	45.4	37.5	16.5	9.4	25.6	26.6	24.8	31.1	44.5	52.8	35.6
1988-89	56.8	53.5	45.8	30.9	13.9	20.8	-2.9	28.8	23.6	36.1	42.0	51.6	33.4
1989-90	56.3	57.1	51.7	36.7	18.1	19.5	16.8	-1.8	25.4	39.3	45.8	51.4	34.7
1990-91	56.0	55.9	47.5	31.5	17.3	20.4	17.5	14.2	25.7	36.4	44.5	50.4	34.8
1991-92	55.2	53.7	50.7	37.2	23.1	15.1	17.7	3.1	22.0	32.4	42.7	52.6	33.8
1992-93	55.6	53.9	41.0	31.7	23.5	19.2	15.0	22.7	31.1	41.0	48.3	53.1	36.3
1993-94	57.9	56.0	48.6	38.1	29.6	24.6	21.2	14.3	19.5	36.0	45.4	51.7	36.9
1994-95	55.7	55.9	48.6	29.9	19.3	14.3	19.5	23.1	17.4	40.3	46.4	53.2	35.3
1995-96	57.3	54.8	52.5	35.1	18.4	25.0	15.2	14.0	33.1	34.9	46.5	52.0	36.6
1996-97	55.3	52.9	43.6	29.4	25.6	6.3	12.8	30.3	20.8	37.7	47.8	54.0	34.7
1997-98	59.8	57.4	50.4	27.6	26.4	7.8	12.7	22.1	33.1	36.9	42.3	51.7	35.7
1998-99	56.1	51.7	47.2	35.1	28.4	9.6	11.0	4.4	14.0	31.8	40.1	51.0	31.7
1999-00	54.5	53.9	47.6	28.4	18.7	1.6	4.2	30.3	30.4	34.9	42.5	50.6	33.1
2000-01	54.2	54.2	45.9	34.7	32.8	33.9	25.2	28.5	25.5	35.8	40.5	53.0	38.7
Max	59.8	57.4	52.5	39.4	32.8	34.2	34.4	30.3	36.3	41.0	48.3	54.0	38.7
30-Year Mean	55.4	54.5	47.4	33.0	23.1	17.3	16.5	16.3	24.2	32.7	43.4	50.8	34.6
Min	51.5	51.1	41.0	26.7	12.7	1.6	-2.9	-2.1	1.8	2.1	39.4	46.6	27.9

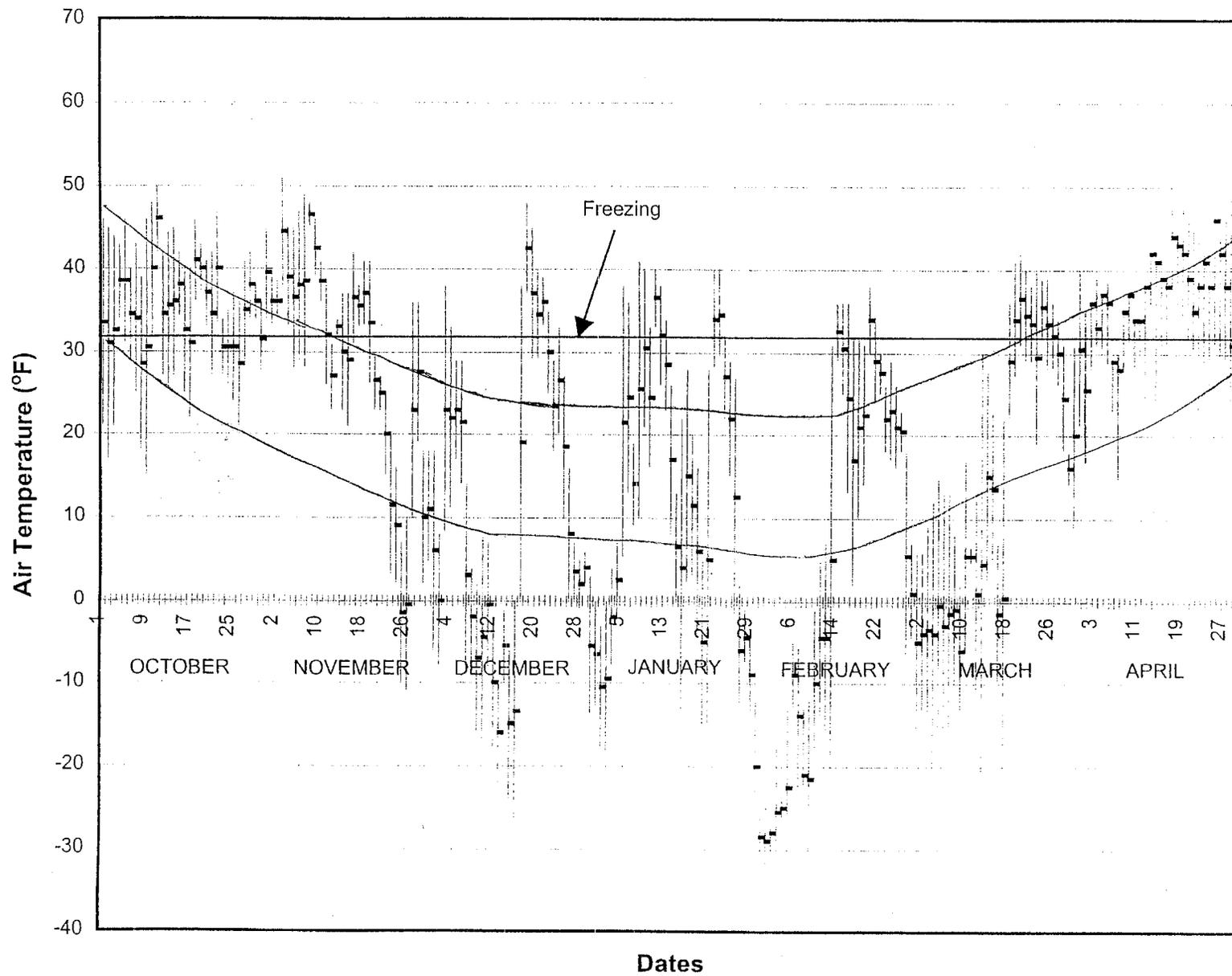
^a Source - National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f)



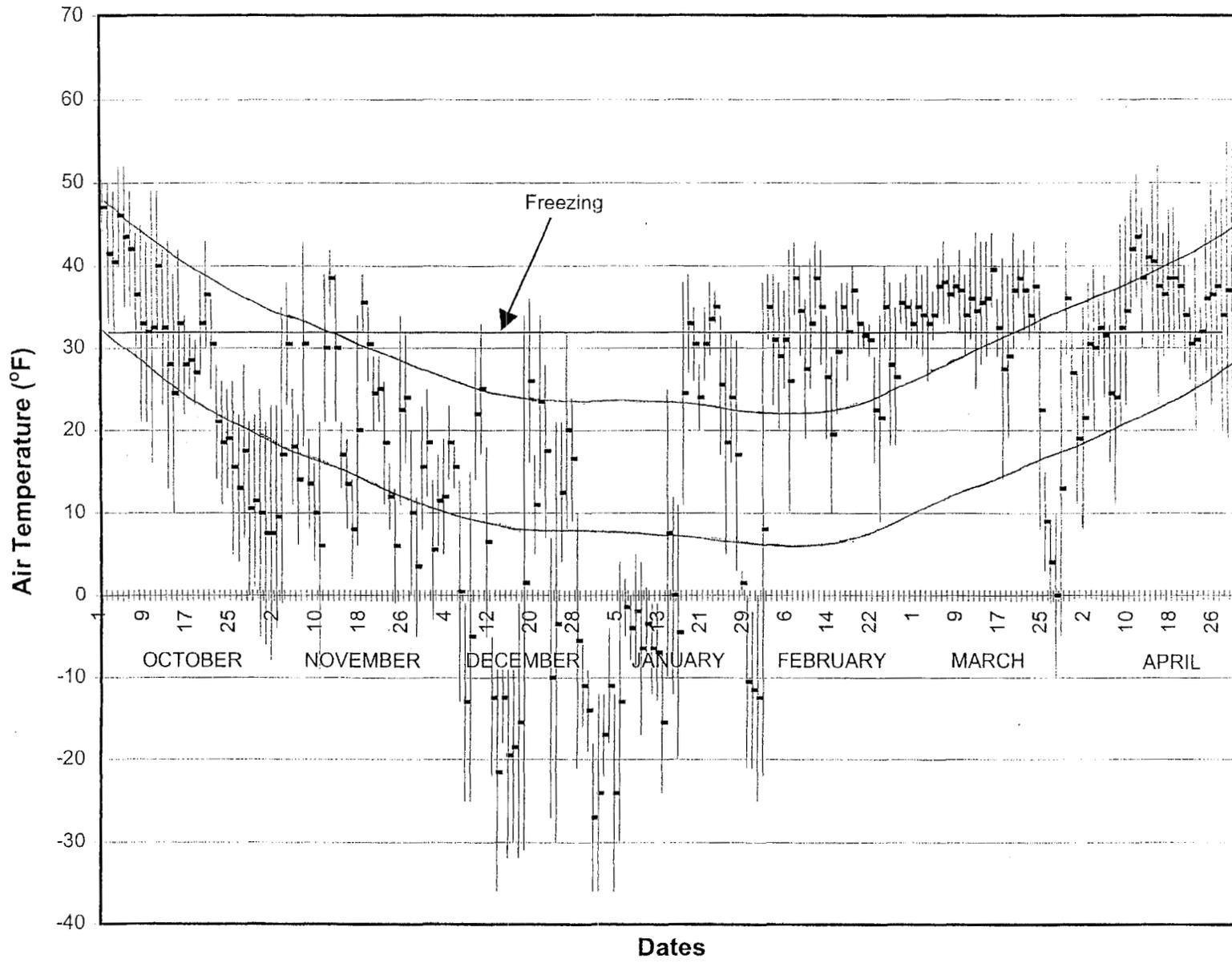
Appendix H.2. Comparison of monthly air temperature to the 30-year mean at King Salmon, July 1997 to June 2001.



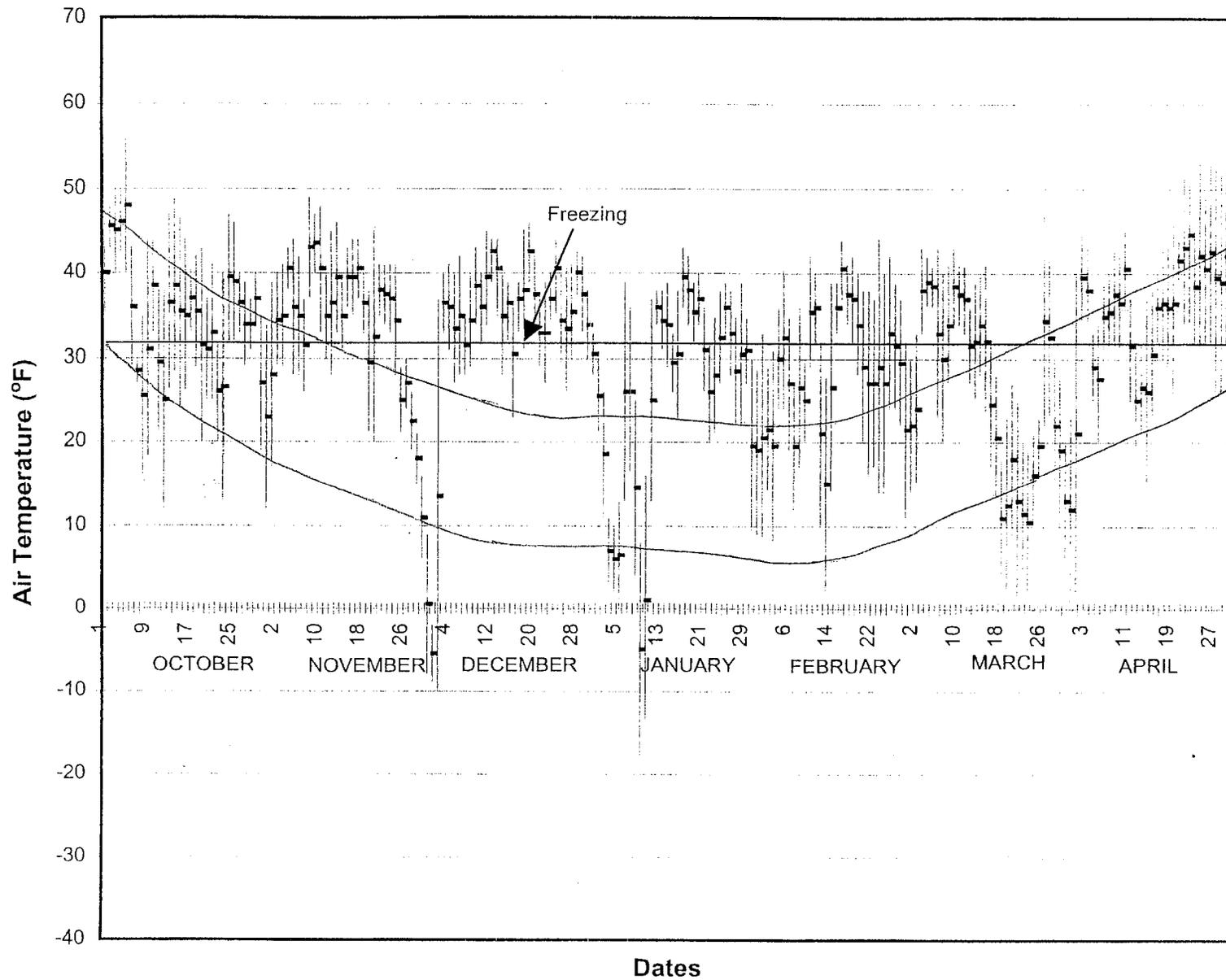
Appendix H.3. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1997 to April 1998.



Appendix H.4. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1998 to April 1999.



Appendix H.5. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1999 to April 2000.

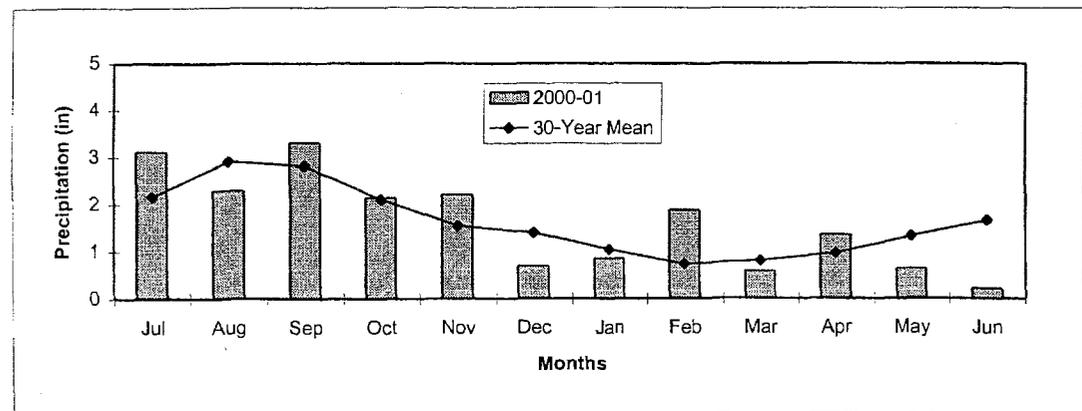
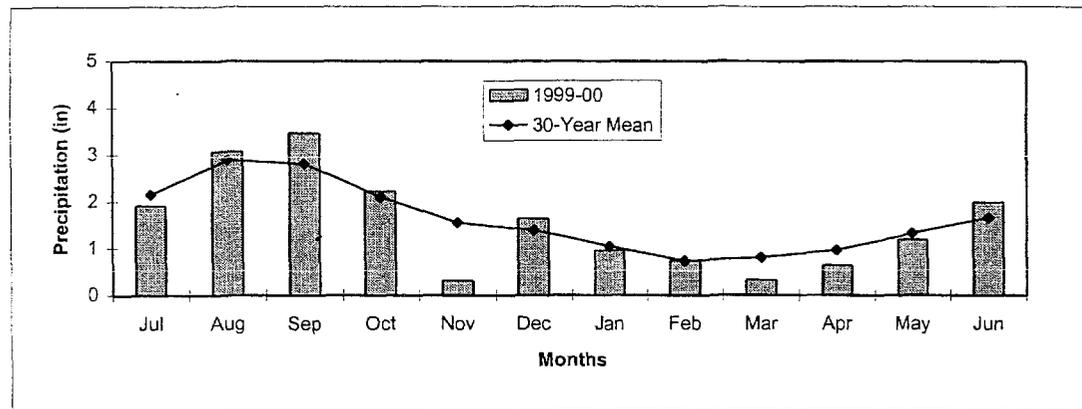
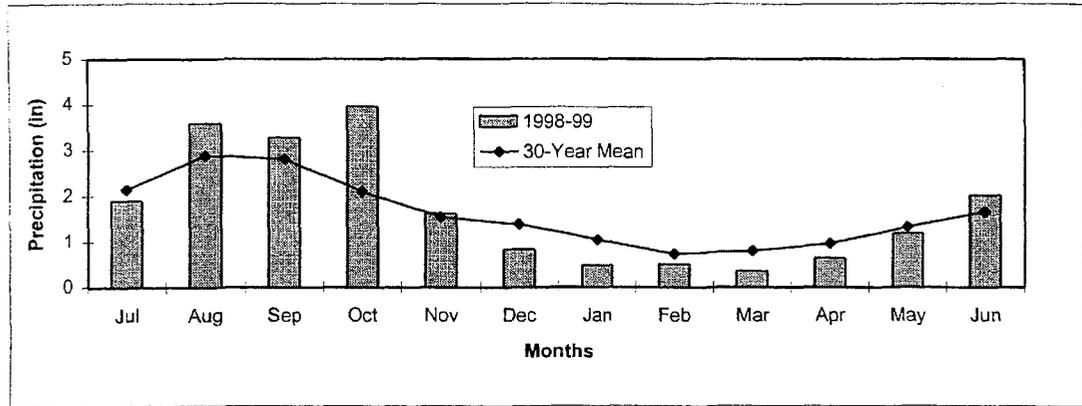
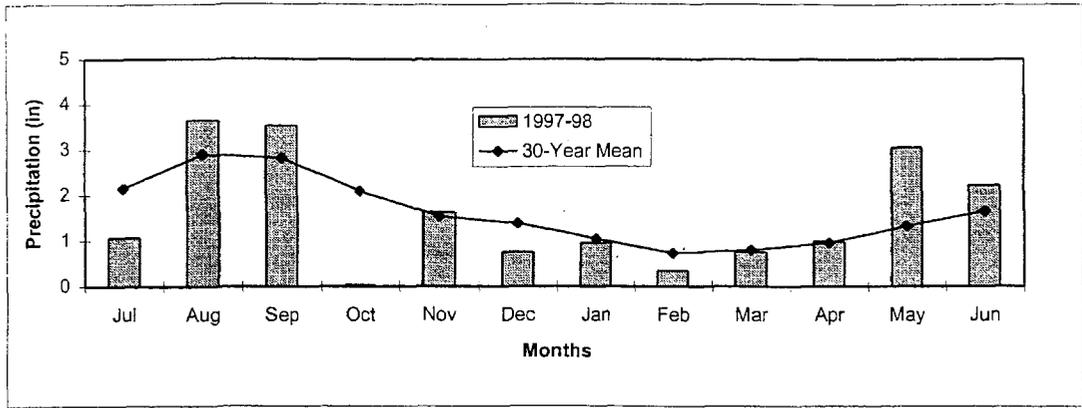


Appendix H.6. Daily air temperature (normal, mean and extreme) for King Salmon, October 2000 to April 2001.

Appendix H.7. Average monthly precipitation for King Salmon, July 1971 to June 2001.

Smolt Year	Precipitation (in) ^a												Total Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1971-72	3.25	4.30	3.40	2.72	1.13	3.42	1.30	0.21	0.17	1.37	1.29	1.62	24.18
1972-73	1.08	1.95	2.95	2.57	1.35	0.59	0.62	0.11	1.25	0.43	1.83	1.48	16.21
1973-74	2.43	3.80	1.41	1.52	0.97	1.10	0.86	0.55	1.27	1.18	0.57	2.40	18.06
1974-75	2.01	3.19	1.56	2.90	1.20	1.23	2.14	0.76	0.93	2.65	0.86	2.69	22.12
1975-76	0.74	1.05	3.90	2.10	0.46	1.38	1.24	0.97	0.78	0.58	1.47	1.34	16.01
1976-77	2.60	1.71	2.64	0.81	2.06	1.77	0.85	1.35	1.99	1.68	1.72	0.99	20.17
1977-78	1.60	3.16	2.58	3.29	0.58	1.04	0.70	0.28	0.26	0.58	0.98	2.81	17.86
1978-79	1.66	2.03	1.87	2.84	1.77	3.65	1.00	0.29	0.39	1.20	0.46	1.80	18.96
1979-80	2.24	2.50	0.91	2.71	2.89	1.09	1.46	0.83	1.51	0.42	1.61	2.19	20.36
1980-81	2.97	2.36	2.00	2.46	1.19	0.49	1.76	2.26	1.83	0.49	0.73	2.27	20.81
1981-82	2.17	3.93	1.82	1.59	1.31	0.59	1.48	0.15	1.37	1.20	1.55	3.04	20.20
1982-83	1.98	1.99	5.14	1.41	0.83	1.37	0.42	0.25	0.22	2.22	1.37	1.20	18.40
1983-84	1.53	2.33	2.36	2.82	0.98	0.48	1.17	0.55	0.44	0.43	1.08	1.59	15.76
1984-85	1.30	2.41	0.89	0.57	1.00	1.79	0.95	0.73	1.27	0.34	1.16	1.23	13.64
1985-86	1.31	3.24	2.64	2.29	3.35	1.58	1.33	0.19	0.24	0.98	1.01	0.93	19.09
1986-87	2.44	3.22	4.03	2.50	1.91	0.65	2.38	0.54	0.55	0.81	1.74	1.49	22.26
1987-88	1.94	2.73	2.99	2.47	2.75	1.07	0.56	0.75	0.74	1.02	2.95	1.11	21.08
1988-89	2.73	2.88	2.17	1.68	1.52	1.60	0.84	0.93	0.19	0.99	2.32	1.10	18.95
1989-90	3.04	3.15	5.90	2.86	1.58	1.31	1.44	1.61	1.71	0.89	1.52	1.22	26.23
1990-91	5.08	2.02	2.75	2.38	2.10	3.26	0.55	0.58	1.56	0.86	1.24	1.63	24.01
1991-92	1.02	1.79	2.10	1.99	1.34	1.26	0.79	0.92	1.40	0.19	0.74	2.53	16.07
1992-93	3.02	4.73	1.35	1.11	1.45	1.77	1.48	0.35	0.26	0.50	0.70	0.50	17.22
1993-94	1.01	3.21	4.53	1.98	3.00	2.15	1.35	1.22	0.91	1.35	1.74	1.71	24.16
1994-95	3.77	3.17	3.46	2.41	2.98	2.28	0.35	0.49	0.17	1.51	1.44	0.81	22.84
1995-96	2.27	4.73	2.74	1.46	0.13	0.14	0.70	0.75	0.38	0.87	0.84	2.41	17.42
1996-97	1.27	2.61	2.60	1.06	0.62	0.64	0.25	0.72	0.13	0.38	0.67	1.14	12.09
1997-98	1.07	3.65	3.52	0.03	1.63	0.75	0.95	0.34	0.75	0.98	3.05	2.22	18.94
1998-99	1.90	3.59	3.28	3.96	1.62	0.83	0.48	0.50	0.35	0.63	1.18	2.01	20.33
1999-00	1.91	3.07	3.46	2.22	0.31	1.63	0.95	0.73	0.32	0.63	1.18	1.99	18.40
2000-01	3.11	2.28	3.30	2.13	2.20	0.69	0.85	1.88	0.58	1.35	0.63	0.21	19.21
Max	5.08	4.73	5.90	3.96	3.35	3.65	2.38	2.26	1.99	2.65	3.05	3.04	26.23
30-Year Mean	2.15	2.89	2.81	2.09	1.54	1.39	1.04	0.73	0.80	0.96	1.32	1.66	19.37
Min	0.74	1.05	0.89	0.03	0.13	0.14	0.25	0.11	0.13	0.19	0.46	0.21	12.09

^a Source - National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f)



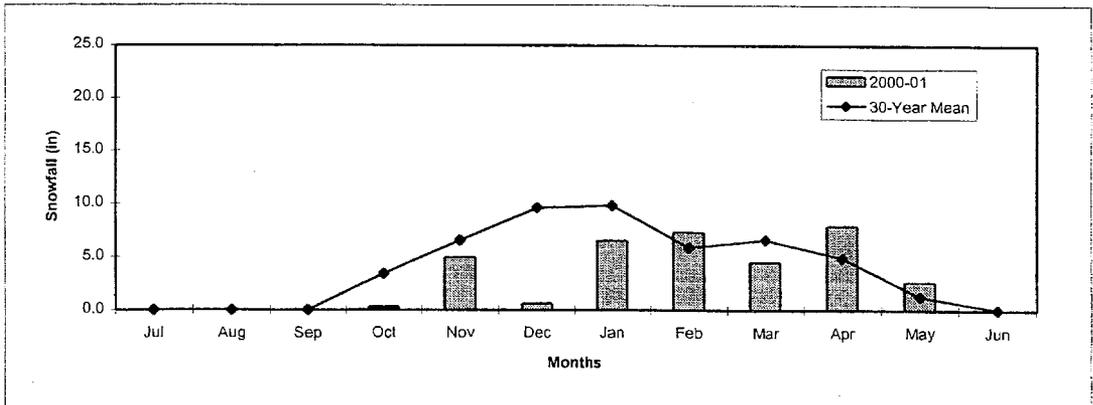
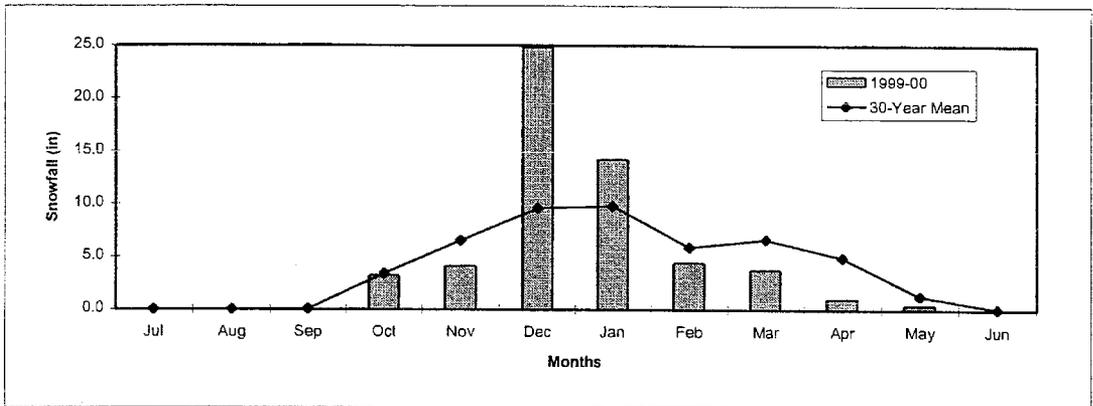
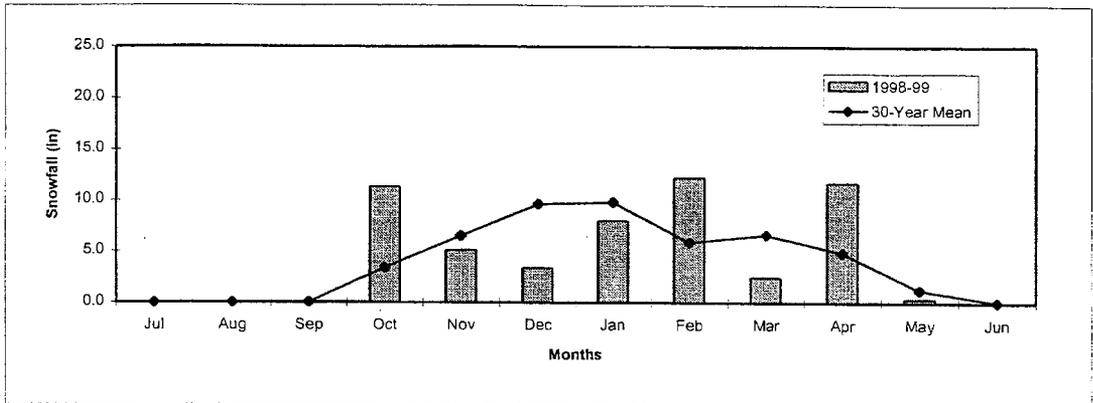
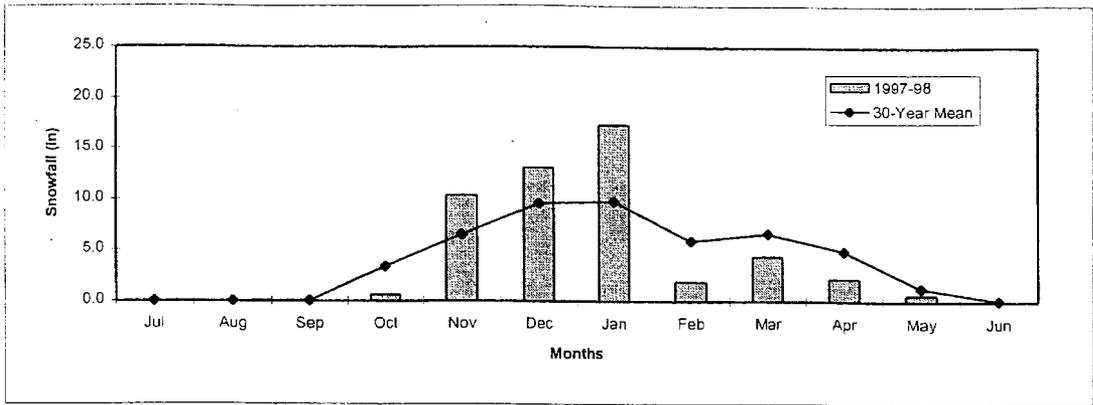
Appendix H.8. Comparison of monthly precipitation to the 30-year mean at King Salmon, July 1997 to June 2001.

Appendix H.9. Average monthly snowfall for King Salmon, July 1971 to June 2001.

Smolt Year	Snowfall (in) ^{a,b}												Total Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1971-72	0.0	0.0	0.0	7.9	3.9	15.1	11.7	2.1	1.9	8.7	0.1	1.3	52.7
1972-73	0.0	0.0	T	0.8	8.0	2.1	3.0	0.8	8.1	2.2	0.6	0.0	25.6
1973-74	0.0	0.0	T	2.0	2.1	12.7	11.9	5.3	4.6	5.1	T	0.0	43.7
1974-75	0.0	0.0	0.0	T	4.3	10.9	19.1	6.3	8.7	14.3	2.9	0.0	66.5
1975-76	0.0	0.0	0.0	0.8	3.9	13.9	12.0	3.2	6.7	6.2	3.2	0.0	49.9
1976-77	0.0	0.0	0.0	2.0	10.9	11.0	2.1	11.9	20.0	4.6	T	0.0	62.5
1977-78	0.0	0.0	T	4.3	5.3	4.5	3.9	3.7	2.2	0.6	T	0.0	24.5
1978-79	0.0	0.0	0.0	1.0	2.2	14.1	4.4	0.2	1.1	T	T	0.0	23.0
1979-80	0.0	0.0	0.0	T	8.5	9.7	11.5	11.1	9.0	T	0.8	0.0	50.6
1980-81	0.0	0.0	0.0	0.3	6.1	6.8	10.5	11.3	15.8	0.6	T	T	51.4
1981-82	0.0	0.0	0.5	0.3	4.8	5.9	5.7	T	8.3	8.3	T	0.0	33.8
1982-83	0.0	0.0	0.0	2.8	2.0	2.9	4.0	2.0	T	6.0	0.1	0.0	19.8
1983-84	0.0	0.0	T	9.9	2.3	2.8	8.4	5.5	T	4.0	0.3	0.0	33.2
1984-85	0.0	0.0	0.0	3.4	7.3	3.8	3.7	6.4	8.9	3.4	6.1	0.0	43.0
1985-86	0.0	0.0	0.0	2.5	9.3	3.6	13.5	1.8	2.5	9.8	1.3	0.0	44.3
1986-87	0.0	0.0	0.0	2.3	2.5	4.8	24.7	2.7	2.7	9.4	T	0.0	49.1
1987-88	0.0	0.0	T	0.1	13.2	8.9	3.3	10.1	9.4	4.4	1.2	0.0	50.6
1988-89	0.0	0.0	T	3.4	12.7	9.2	14.9	3.7	5.1	1.5	2.1	0.0	52.6
1989-90	0.0	0.0	T	0.4	12.3	12.4	14.9	20.3	13.5	3.4	0.2	0.0	77.4
1990-91	0.0	0.0	T	15.7	6.7	18.9	3.1	4.3	14.0	2.8	0.0	0.0	65.5
1991-92	0.0	0.0	0.0	T	9.0	9.4	7.2	8.6	8.7	0.5	T	T	43.4
1992-93	0.0	0.0	T	0.9	7.9	8.0	30.6	5.5	5.2	1.8	T	T	59.9
1993-94	0.0	0.0	0.1	2.0	5.1	28.4	11.0	3.2	7.7	5.6	0.2	0.1	63.4
1994-95	0.0	0.0	0.0	8.4	17.9	16.0	5.9	2.0	2.0	0.4	0.1	0.1	52.8
1995-96	0.0	0.0	0.0	2.1	2.4	1.5	2.9	7.3	1.7	5.7	1.9	0.3	25.8
1996-97	0.0	0.0	0.3	2.6	0.1	8.5	3.7	5.2	2.3	T	T	0.0	22.7
1997-98	0.0	0.0	0.0	0.6	10.4	13.1	17.3	1.9	4.4	2.2	0.6	0.0	50.5
1998-99	0.0	T	T	11.3	5.1	3.4	8.0	12.2	2.5	11.7	0.4	T	54.6
1999-00	0.0	0.0	0.0	3.2	4.1	24.9	14.2	4.4	3.7	1.0	0.4	0.0	55.9
2000-01	0.0	0.0	0.0	0.3	4.9	0.6	6.5	7.3	4.5	7.9	2.6	0.0	34.6
Max	0.0	0.0	0.5	15.7	17.9	28.4	30.6	20.3	20.0	14.3	6.1	1.3	77.4
30-Year Mean	0.0	0.0	0.0	3.4	6.5	9.6	9.8	5.9	6.6	4.9	1.3	0.1	46.1
Min	0.0	0.0	0.0	0.1	0.1	0.6	2.1	0.2	1.1	0.4	0.0	0.0	19.8

^a Source - National Weather Service (1997; 1998; 1999; 2000; 2001a,b,c,d,e,f)

^b T = trace



Appendix H.10. Comparison of monthly snowfall to the 30-year mean at King Salmon, July 1997 to June 2001.

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