SOCKEYE SALMON SMOLT INVESTIGATIONS ON THE CHIGNIK RIVER WATERSHED, 2001

By

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and

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COMMERCIAL VENDOR NAMES

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ABSTRACT

This paper provides the results from the eighth year of the Chignik River Sockeye Salmon Smolt Enumeration Project. Juvenile sockeye salmon *Oncorhynchus nerka* were captured in a rotary screw trap array and sockeye salmon smolt abundance was estimated using mark-recapture techniques. Sockeye salmon smolt were measured throughout the emigration for age, length, and weight data. In 2001, 25,009,358 sockeye salmon smolt were estimated to pass downstream of the traps from April 27 to July 12. Of these, 521,546 (2.1%) were age 0., 18,940,752 (75.7%) were age 1., 5,024,666 (20.1%) were age 2., 516,723 (2.1%) were age 3., and 5,671 (< 0.1%) were age 4. smolt. Smolt abundance data, by emigration year, were paired with 3-ocean returns from that emigration year to forecast the 2002 sockeye salmon run. Based on smolt data and historic age compositions, it was estimated that approximately 2.85 million sockeye salmon are expected to return in 2002. Because only four years' smolt and corresponding adult return data were used to produce this forecast, the confidence in this particular forecast is fair, but this technique shows promise if current statistical trends continue.

INTRODUCTION

Economically, sockeye salmon *Oncorhynchus nerka* is the most important commercial salmon species in the Chignik Management Area (CMA). The Chignik River watershed is the primary sockeye salmon producer in the CMA, and consists of a large, shallow lagoon, two large lakes (Chignik and Black Lakes), and several tributaries that provide both spawning and rearing habitat for juvenile sockeye salmon (Figure 1). The Chignik River watershed is also the largest sockeye producing watershed on the south side of the Alaska Peninsula (Owen et al. 2000). Two distinct runs of sockeye salmon exist in the Chignik River watershed. An early run, with an escapement goal of 350,000 to 400,000 sockeye salmon, spawn in Black Lake and its tributaries and enters the watershed from June to July. A later run, with an escapement goal of 200,000 to 250,000 sockeye salmon (through August 31), typically spawns in the tributaries and on the shoals of Chignik Lake. Sockeye salmon that spawn in Black Lake are genetically distinct from sockeye salmon that spawn in Chignik Lake (Templin et al. 1999). The interactions between the Black Lake (early run) and Chignik Lake (late run) stocks are not well understood. Specifically, Chignik Lake's role as a nursery area for the Black Lake stock is believed to be increasing with the natural sedimentation of Black Lake (Bumgarner 1993).

Forecasts of salmon runs are important to Alaska's commercial salmon fishing industry. Forecasts enable fish processors to estimate fish prices and help commercial fishers estimate personnel and equipment needs. Preseason forecast methods used for predicting adult runs to the Chignik River watershed currently employ historic age class relationships for the Black Lake and Chignik Lake stocks. Smolt emigration estimates by age, and potentially stock, are expected to improve the forecast models currently used. The growth rate of juvenile sockeye salmon within both Chignik and Black Lakes has been inversely related to the escapement to each of the two lakes (Burgner et al. 1969), suggesting intra-specific competition may influence smolt production in the Chignik River watershed.

Juvenile salmon are known to attain the smolt stage after certain size thresholds are met, during specific seasons, and under the influence of photoperiod and temperature (Clarke and Hirano 1995). Smolt migration is triggered by increasing springtime water temperatures (3-4 $^{\circ}$C), and increasing day length (Clarke and Hirano 1995). Variables affecting growth in juvenile salmonids include temperature, competition, food availability, and various water chemistry parameters (Moyle and Cech 1988). Annual growth of juvenile sockeye salmon often varies between lakes, years, and within individual populations (Bumgarner 1993). This variability in growth is due to fluctuations in one or more of the previously mentioned variables. Typically, if growth rates are not sufficient to achieve the threshold size necessary to smolt in the spring, the juvenile fish will remain in the lake feeding for another year, possibly further increasing competition among younger broods.

Typically, sockeye salmon smolt migrate quickly to saltwater from their nursery lakes and spend only enough time in the river to travel to the marine environment (Burgner 1991). However, not all juvenile sockeye salmon emigrating from Chignik and Black lakes have gone directly to sea. It has been speculated that a component of the rearing juveniles may have remained in the Chignik River in the summer to feed and subsequently returned to Chignik Lake in the fall (Roos 1957, 1959; Iverson 1966). Small young-of-the-year sockeye salmon have been captured in large numbers in the Chignik River and Chignik Lagoon during the summer months (Bouwens and Edwards 2001; Finkle and Bouwens 2001). Further studies are being conducted to investigate to what extent that juveniles might use the river and the lagoon as a rearing area (Bouwens et al. 2000b).

OBJECTIVES

The objectives for the 2001 season were:

(1) Estimate the total number of emigrating sockeye salmon smolt, by age class, from the Chignik River watershed;

(2) Describe sockeye salmon smolt emigration timing and growth characteristics (length, weight, and condition factor) by age class for the Chignik River watershed;

(3) Continue to build a smolt database to estimate smolt-to-adult survival and forecast future runs, and;

(4) Summarize the 2001 smolt emigration data in a report.

METHODS

Study Site and Trap Description

Two rotary-screw traps were operated side by side to capture smolt emigrating from Chignik Lake. The trapping site was located 8.6 km upstream from Chignik Lagoon (Mensis Point) and 1.9 km downstream from the outlet of Chignik Lake (56° 15' 26" N lat., 158° 43' 49" W long.; Figure 2). River width at this location was 47 m and the depth at the trap location ranged from 72 cm to 185 cm, depending on precipitation and snowmelt. The traps were located near a bend in the river and were positioned in that portion of the river with the highest current. Due to safety concerns about using steel cables in an area with high boat traffic, each trap was secured to the riparian vegetation with highly visible polypropylene line and a strobe light was attached to the top of the offshore trap.

Each trap consisted of a cone constructed of aluminum perforated plate (5 mm holes) mounted on two aluminum pontoons, with the large ends of the cones pointed upstream. The cone mouth diameter was 1.5 m on the small trap (placed inshore), and 2.4 m on the large trap (placed offshore). The small trap sampled approximately 0.73 m^2 and the large trap sampled approximately 2.02 m^2 of the river's profile. The current propelled an internal screw, which rotated the cone at approximately 3-9 revolutions per minute (rpm) during average water flow conditions, but ran up to 13 rpm during peak flow conditions. Fish were funneled through the cone into an approximately 0.7 m^3 rectangular live-box on the downstream end of each trap. A pair of adjustable aluminum support legs were utilized to maintain and adjust the traps' positions from the shore and their orientation in the current.

During the 2001 field season, the centers of the traps' cones averaged 6.25 m and 9.5 m offshore for the small and large traps, respectively. The traps fished approximately 8% (3.9 m) of the river's width. Both of the traps were operated continuously from 1230 hours on April 27 to 1215 hours, July 13, with the exception of when the cones were elevated to facilitate daily cleaning (<30 minutes per day). At the completion of the project, both the traps were disassembled and stored.

A floating platform for a 10'x12' weatherport was tied directly behind the traps and connected to the traps with a boardwalk. The weatherport provided shelter for the crew when processing samples taken from the traps.

Smolt Enumeration

Sampling days extended from noon to noon and were identified by the date of the noon-to-midnight period. The traps were checked hourly between 2400 hours and 0530 hours on the weekdays and from 2400 hours to 0400 hours on the weekends. The traps were also checked at the end of the smolt day at 1200 hours and again at 1800 hours.

Juvenile sockeye salmon greater than 45 mm in length fork length (FL; mid-eye-to-fork-of-tail) were considered smolt (Thedinga et al. 1994). All sockeye salmon smolt caught in the traps were counted. Fish were netted out of the traps' holding boxes, identified (Pollard et al. 1997; McConnell and Snyder 1972), and individually counted. Sockeye salmon smolt recaptured during mark-recapture experiments were recorded separately from unmarked smolt and excluded from daily total catch to prevent double counting. Sockeye salmon fry (< 45 mm FL), coho salmon *O. kisutch* juveniles, pink salmon fry *O. gorbuscha*, chinook salmon *O. tshawytscha* juveniles, Dolly Varden *Salvelinus malma*, stickleback of the family Gasterosteidae, pond smelt *Hypomesus olidus*, Pygmy whitefish *Prosopium coulteri*, starry flounder *Platichthys stellatus*, coastrange sculpin *Cottus aleutus*, and eulachon *Thaleichthys pacificus* were also counted. The isopod *Mesidotea entomon* was also identified according to Merrit and Cummings (1984) and Pennak (1989) and counted.

Age, Weight, and Length Sampling

A daily sample of 40 sockeye salmon smolt was collected for five days per statistical week and sampled for age-weight-length (AWL) data. All smolt sampling data reflected the smolt day in which the fish were captured, and samples were not mixed between days. A sample of smolt was collected hourly throughout the night's migration and held in an in-stream live box. The number of fish sampled hourly was proportional to the migration strength. Forty smolt were then randomly collected from the live box and sampled, and the remaining smolt were released downstream from the traps.

Tricaine methanesulfonate (MS-222) was used to anesthetize smolt prior to sampling. Fork length (FL) was measured to the nearest 1 mm, and weighed to the nearest 0.1 g. Scales were removed from the preferred area (INPFC 1963) and mounted on a microscope slide for age determination. After sampling, fish were held in aerated water until they recovered from the anesthetic, and subsequently were released downstream from the traps. Age was estimated from scales using a microfiche reader (EYECOM 3000) under 60X magnification. All data were recorded in European notation (Koo 1962).

Condition factor (Bagenal and Tesch 1978) for each smolt sampled was determined using:

$$K = \frac{W}{L^3} 10^5 , \qquad (1)$$

where K is smolt condition factor, W is weight in g, and L is FL in mm.

Trap Efficiency Estimates

Mark-recapture experiments were conducted weekly when sufficient smolt were available to determine trap efficiency. For each experiment, a goal of 3,000 sockeye salmon smolt (minimum of 1,000) were collected from the traps and transferred to a series of instream flow-through live boxes during the night of an experiment. Smolt were retained in the live boxes for up to two nights if insufficient numbers were captured the first night. After two nights all captured smolt were marked if the minimum sample size was met or released if the minimum was not met.

Sockeye salmon smolt were netted from the live boxes, counted, and marked in a repository containing an aerated Bismark Brown dye solution (3.9 g of dye to 75.5 L of water) for 15 minutes. Fresh water was then pumped into the container to slowly flush out the dye (45 min), after which the smolt were allowed to recover in the circulating water. At the end of the dying process, dead and stressed smolt were removed, counted, and disposed of below the mouth of the traps.

The remaining dyed smolt were taken to the release point. Smolt were transported upstream in aerated buckets and released evenly across the breadth of the river. All releases occurred 1.3 km upriver from the traps (Figure 2). The marking was performed so that the marked fish were released by 2400 hours.

Mark retention and delayed mortality experiments were conducted in conjunction with each mark-recapture test. A random sub-sample of approximately 200 sockeye salmon smolt were used in mark retention and delayed mortality experiments. Before marking fish, about 100 sockeye salmon smolt were removed from the transport tote and placed in an in-stream live box. These fish were handled the same as the fish that were marked, except they were not placed in the dye solution. After the marking and recovery period, approximately 100 additional marked smolt were placed in another in-stream live box. These smolt were examined each day during the mark-recapture test for mortalities and the number of mortalities from each group were recorded. These smolt were released downstream of the traps at the beginning of each new mark-recapture test or after five days, whichever came first. The Chignik River watershed smolt population was estimated by using methods described in Carlson et al. (1998).

Marine Survival Estimates and Future Run Forecasting

Estimates of smolt abundance, by age, were paired with corresponding adult returns from their respective brood year (BY). The total return to the Chignik River watershed was calculated by adding the total Chignik River sockeye escapement to the total catch from the CMA plus a portion of the sockeye salmon catch from the Southeastern District Mainland of the Alaska Peninsula Management Area and the Cape Igvak Section of the Kodiak Management Area, as described in Campbell and Witteveen (1999). Marine survival, by age, and the number of smolt produced per spawner from their respective BY was also calculated.

Regression relationships were explored between smolt abundance estimates and corresponding adult returns, by BY, and by emigration year, to investigate the potential of using smolt data to forecast future adult sockeye salmon runs. Standard regression diagnostic techniques were used. Regressions were developed between individual freshwater age classes and their corresponding adult returns (by freshwater age) and between total smolt emigration estimates and corresponding adult returns (by ocean age).

Statistically significant relationships were used to forecast the 3-ocean components (historically approximately 80% of the entire run) of the 2002, 2003, and 2004 adult sockeye salmon returns from the 1999, 2000, and 2001 smolt emigration data.

Climate and Hydrology

Trap revolutions (rpm), water depth (cm), and daily climate observations, including air and water temperature (°C), estimated cloud cover (%), and estimated wind velocity (mph) and direction were recorded daily at 1200 hours and again at the first trap-checking occasion each night.

RESULTS

Trapping Effort

Both the large and the small traps were in place for a total of 77 days beginning on April 27 and ending on July 12. The traps fished continuously for the duration of the study, except when they were removed for daily cleaning.

Trap Catch

A total of 134,977 sockeye salmon smolt were captured in the traps in 2001 (Appendix A). In addition to sockeye salmon smolt, a total of 104,339 sockeye salmon fry, 1,085 juvenile coho salmon, 191 pink salmon fry, 1,261 juvenile chinook salmon, 783 Dolly Varden char, 14,196 stickleback, 136 pond smelt, 60 pygmy whitefish, 5 starry flounders, 675 sculpin, 220 isopods, and 36 eulachon were captured (Appendix A). The larger, offshore trap was responsible for 87.6% of the sockeye salmon smolt captured in 2001 (Appendix B).

Age, Weight, and Length Sampling

A total of 2,195 sockeye salmon smolt were sampled for AWL data in 2001. Age 0. smolt from BY 2000 comprised 4.4% of the sample, 75.0% were age 1. (BY 99), 17.7% were age 2. (BY 98), and 2.8% were age 3. (BY 97; Table 1). One age 4. smolt was also sampled. The mean length and weight of age 0. smolt was 55.7 mm and 1.5 g. The mean length and weight of age 1. smolt was 64.5 mm and 2.1 g. The mean length and weight of age 2. smolt was 74.6 mm and 3.4 g. The mean length and weight of age 3. smolt was 90.4 mm and 6.9 g. The age 4. smolt was 125.0 mm long and weighed 18.8 g (Table 2). These statistics are listed with parallel data collected in previous years in Tables 3 and 4. Lengths of ages 0., 1., and 2., smolt were plotted in a length frequency histogram; age 3. and age 4. smolt were not included due to the small sample size of this age class (Figure 3).

Trap Efficiency Estimates

Mark-recapture experiments were conducted on nine occasions beginning on April 30 and ending on July 12. An unknown number of marked smolt were released for the first mark recapture test; therefore, a recapture rate could not be calculated from that test. As a result, this test was not used to estimate the total smolt population abundance. The remaining experiments resulted in trap efficiency estimates ranging from a low of 0.18% to a high of 1.97% (Table 5). The majority of the marked smolt were recaptured within two days of being released (Appendix A). Mark loss was not a factor in the calculation of trap efficiency, and mortality rates were deemed similar between marked and unmarked smolt during the 2001 trapping season (Table 6).

Sockeye Salmon Smolt Emigration and Timing

The estimated number of sockeye salmon smolt that emigrated in 2001 was 25,009,358 (±9,883,504; 95% C.I.; Table 7; Figures 4 and 5). The 2001 emigration consisted of 521,546 age 0., 18,940,752 age 1., 5,024,666 age 2., 516,723 age 3., and 5,671 age 4. sockeye salmon smolt (Tables 7 and 8; Figure 6). The migration began by the time the project was in place on April 27 and more than 50% of the migration had occurred by May 7, only 10 days into the trapping season (Figure 5). The majority of the age 1., 2., and 3., smolt had outmigrated by June 1, but after an initial spike, the age 0. smolt continued to emigrate through the end of the trapping season (Figures 7 and 8). The number of smolt produced in 2001 compared to previous years is shown in Figure 4.

Marine Survival Estimates and Future Run Forecasting

All adult sockeye salmon from BYs 1992, 1993, and 1994 have returned to the Chignik River, and the overall marine survival of smolt ranged from 16.6% for BY 1992 to 66.9% for BY 1993 (Table 9). When the data were presented by emigration year, however, the marine survivals ranged from 11.0% for emigration year 1998 to 197.2% for emigration year 1996, with 1996 being an obvious outlier (Table 10).

It was clear from the impossible marine survival estimate of emigration year 1996 that the smolt abundance was underestimated in this year. Therefore, data from 1996, and, since data from this emigration year spans several BYs, all data organized by BY were not included in the regression analyses for predicting future adult returns.

A significant regression relationship ($P=0.008$; $R^2=0.98$) was found between the total smolt emigration estimates, by year, and their subsequent 3-ocean returns (Figure 9). A marginally significant ($P=0.1004$; $R^2=0.80$) relationship was found between the total smolt emigration estimates and the entire resulting adult return. All other relationships examined (age 0. smolt vs. age 0.x adults, age 1. smolt vs. age 1.x adults, age 2. smolt vs. age 2.x adults, age 3. smolt vs. age 3.x adults, total smolt vs. ocean age 1, total smolt vs. ocean age 2, total smolt vs. ocean age 3) were non-significant.

Based upon the total smolt vs. 3-ocean regression estimate, the 3-ocean component of the 2002 adult run are estimated at 2,279,030 (± 447,848; 80% CI). In addition, it was possible to estimate the 3-ocean 2003 adult run at 1.62 million, and the 3-ocean 2004 adult run at 2.65 million

sockeye salmon. Based on smolt data alone and assuming that the 3-ocean component of the run will remain at 80% of the entire sockeye salmon run in future years, the 2002 total adult run forecast is 2.85 million sockeye salmon, the 2003 adult run forecast is about 2.02 million sockeye salmon, and the 2004 adult run forecast is about 3.31 million sockeye salmon.

Physical Data

After completing the bottom profile of the Chignik River at the trapping site, the mean depth across the width of the Chignik River was calculated. At the time of the stream survey on July 11, the Chignik River at the trapping site was 49 m wide and had a mean depth of 197 cm. The absolute depth of the river as measured at the benchmark varied during the course of the season from 182 cm to 295 cm. This was more than 30 cm less than in 2000, as discerned from benchmark data and daily river depth measurements (Bouwens and Edwards 2001). The flow rate of the river was variable during 2001, due to fluctuations in snowmelt and precipitation. The winter of 2001 was unusually mild, with little remaining snowpack at the onset of the field season and Chignik Lake reportedly did not freeze for more than one day at a time during the winter (Alvin Boskofsky, Chignik Lake resident, personal communication). Daily measurements of the depth and velocity (through trap RPM's) of the Chignik River, along with the climatological observations that were collected in 2001, are reported in Appendix C.

DISCUSSION

The winter of 2000-2001 was extremely mild in the Chignik area and along the rest of the Alaska Peninsula. The Bering Sea pack ice did not come as far south as in previous winters, and few of the sockeye salmon producing lakes on the Alaska Peninsula achieved below freezing temperatures for any length of time (Drew Crawford, Alaska Department of Fish and Game, Anchorage, personal communication). Chignik Lake did not freeze for more than a short time. As a result, the spring in 2001 was unusually early, and there was very little accumulated snowpack in the Chignik area at the deployment of the traps on April 27. This may have lead to the early smolt emigration timing in 2001. The mild winter may have also affected the survival rates of the sockeye salmon juveniles in the Chignik River watershed.

The age 1. smolt emigrating in 2001 were smaller than in any other year but 1995, and had the second lowest condition factor in the history of the project (Table 3), although they composed the largest component of the 2001 smolt emigration. The large component of age 1. smolt could have occurred this year as a result of higher over-winter juvenile survival due to mild conditions. Juveniles that would have normally died over the winter may have survived because of the early spring. These juveniles may have just barely survived, and would have had poor condition factors.

Fifty percent of the total smolt catch occurred by May 7, only 10 trapping days into the 2001 season. An unknown number of smolt may have migrated before the traps were in place. The only previous year since the beginning of this project where the majority of the emigration occurred this early was in 1996. Based on the information presented in Figure 5, though, it is likely that most of the emigrating smolt were sampled during 2001. Apart from early migrations, in past years smolt have continued to emigrate from Chignik Lake after funding limitations necessitated the end of the trapping season. Even with the variable emigration timing exhibited between years, it is preferable

to have a standardized trapping season, given the set funding structure of this project. The typical starting date of the project, the last week in April, usually coincides with lake ice-out. This strategy will avoid the dilemma of missing the smolt emigration either too early or too late by having to simply guess when the emigration will start.

A total of 104,339 sockeye salmon fry were captured during the 2001 field season. This number was nearly equal to the total number of smolts captured (Appendix A). Past data from the Chignik River smolt enumeration project and historical salmon research in the Chignik River watershed suggest that it is common for large numbers of sockeye salmon fry to emigrate during the smolt emigration season. A large number of these fish have been seen throughout the summer months in the Chignik Lagoon in beach seine catches, demonstrating that sockeye salmon of this size class have taken up residence in Chignik Lagoon, at least temporarily (Finkle and Bouwens, 2001). Sockeye salmon juveniles from some systems show a propensity for early entry into saltwater or estuarine habitats (Phinney 1968; Rice et al. 1994). The extent that the juvenile sockeye salmon found in the Chignik River and Lagoon survive and grow in the Chignik Lagoon is not well understood. Data are currently being collected that will help us better understand this stage of juvenile life. High numbers of sockeye salmon fry emigrating during the smolt emigration season are seldom seen in other systems in the Westward Region where smolt enumeration projects have occurred (Steve Honnold, Jim McCullough, Nick Sagalkin, Alaska Department of Fish and Game, Kodiak, personal communications). This suggests that juvenile sockeye salmon are likely using Chignik Lagoon to rear and grow until they are able to attain smolt status. Therefore these fish probably go uncounted as smolt through the traps, and are then not included in future run forecasting.

Before 1999, multiple modes in the length frequency distributions of the ages 1. and 2. smolt existed. The modes at the shorter lengths were interpreted to be Chignik Lake smolt and the modes at the longer lengths were interpreted to be Black Lake smolt, resulting from differential conditions between the two rearing lakes (Stopha and Barrett 1994; Vania and Swanton 1996; Kaplan and Swanton 1997, 1998; and Pérez-Fuentetaja et al. 1999). In the 1999, 2000, and 2001 emigrations, the length frequency distribution within age classes of ages 1. and 2. smolt were unimodal (Bouwens et al. 2000a, Bouwens and Edwards 2001). This change in the length frequency distributions may be evidence that the sockeye salmon smolt have been using the two rearing lakes in a different manner in recent years.

Preliminary results from current studies have shown promise in the use of stable isotope analysis to differentiate between sockeye salmon smolt originating from Chignik and Black Lakes. It may be possible to correlate these results with the physical characteristics of the emigrating smolt to estimate stock composition. These data could be helpful in further determining future run composition forecasts.

It is apparent from examination of marine survivals, by emigration year, that the smolt population size estimate of 1996 was severely underestimated (Table 10) as almost twice as many adults returned as were counted as emigrating smolt. Since the smolt that emigrated in 1996 were members of several BYs, the marine survival data, by BY, are not accurate. When the data were grouped by emigration year, however, it was possible to discard the data from 1996 and still have sufficient statistical power to estimate future runs. Further, the marine survivals from the remaining data were reasonable (Steve Honnold, Alaska Department of Fish and Game, Kodiak, personal communication) and relatively similar (Table 10). After discarding 1996, three complete life cycles' data remained in the data set.

In the evaluation of smolt data to predict future runs, the only regression relationship that was statistically significant was 3-ocean returns predicted from the total number of smolt that emigrated 3 years prior. This is reasonable, since the majority (about 80%) of the Chignik River watershed run consists of 3-ocean sockeye salmon, the small number of available years' data, and the variability in both the smolt and adult return data. This forecasting method does not have the resolution to forecast by run, but is adequate to forecast the combined runs.

Using these methods, the 3-ocean component of the 2002 run is forecast to be 2.28 million sockeye salmon (± 448,000; 80% CI). Assuming the 3-ocean component of the run remains at 80% in 2002, the contribution of ocean ages-1, -2, and -4 would increase the total forecast to approximately 2.85 million.

The smolt-based forecast is approximately 730,000 more sockeye salmon than was forecasted using sibling regression relationships to forecast specific age classes (e.g., age 2.3 abundance in 2002 from age 2.2 abundance in 2001) when possible and median values to forecast the abundance of age classes where sibling relationships did not exist. Because the smolt forecast is not run specific, it is not possible to break out the estimated harvest from the Cape Igvak and the Southeastern District Mainland fisheries.

In addition, because the adult forecast was based on smolt data that was grouped by emigration year, it was possible to estimate the 2003 run from the 2000 smolt data and the 2004 run from the 2001 smolt data. As next year's adult return data are added to the data set, assuming the smolt to 3-ocean return relationship remains strong, these forecasts will be updated and they may change. Nonetheless, assuming the same 80% 3-ocean contribution, the 2003 run (based on smolt data alone) is expected to be about 2.02 million sockeye salmon and the 2004 run is expected to be about 3.31 million sockeye salmon.

Because of the small data set and the characteristics of the data (high and low points with no intermediate data), our confidence in the smolt-based forecast is fair. If the current trends continue, however, forecasts incorporating smolt data may be more accurate than the forecasting methods using sibling relationships alone. Specifically, the variability in freshwater rearing success is removed from forecasts as smolt abundance is measured after the freshwater rearing period. Further, sibling regression relationships are marginal or non-significant for a number of age classes that compose a large portion of the Chignik runs. These age classes are forecasted based on the median returns of that age class. Currently, the smolt based forecast is limited in that it is not possible to forecast the magnitude of the separate runs.

LITERATURE CITED

Bagenal, T.B., and F.W. Tesch. 1978. Age and growth. pp. 101-136 *in*: T. Bagenal, editor. Methods for assessment of fish production in fresh waters. IBP Handbook No. 3, third edition. Blackwell Scientific Publications. London.

Bouwens, K.A., and I.J. Edwards. 2001. Sockeye salmon smolt investigations on the Chignik River System, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report 4K01-3, Kodiak.

Bouwens, K.A., Pérez-Fuentetaja, A. and I.J. Edwards. 2000a. Sockeye salmon smolt investigations on the Chignik River System, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report 4K00-35, Kodiak.

Bouwens, K.A., S. Schrof, and J.E. Andel. 2000b. Chignik operational plans, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Informational Report 4K00-48, Kodiak.

Bumgarner, J.D. 1993. Long-term trends in the growth of sockeye salmon from the Chignik Lakes, Alaska. Masters Thesis, University of Washington. Seattle, WA.

Burgner, R.L., C.J. DiCostanzo, R.J. Ellis, G.Y. Harry, Jr., W.L. Hartman, O.E. Kerns, Jr., O.A. Mathisen, and W.F. Royce. 1969. Biological studies and estimates of optimum escapements of sockeye salmon in the major river systems in Southwestern Alaska. Fishery Bulletin 67(2)405-459.

Burgner, R.L. 1991. Life history of sockeye salmon *(Oncorhynchus nerka). in* C. Groot and L. Margolis, eds. Pacific salmon life histories. UBC Press. University of British Colombia, Vancouver.

Campbell, R.D. and M.J. Witteveen. 1999. Southeastern District Mainland (Alaska Peninsula Area) salmon management plan. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report 4K99-30, Kodiak.

Carlson, S.R., L.G. Coggins Jr., and C.O. Swanton. 1998. A simple stratified design for mark-recapture estimation of salmon smolt abundance. Alaska Fishery Research Bulletin 5(2):88-102.

Clarke, W.C. and T. Hirano. 1995. Osmoregulation. *in*: Physiological ecology of pacific salmon. C. Groot, L. Margolis and W.C. Clarke (eds). UBC Press, Vancouver. BC.

Finkle, H. and K.A. Bouwens. 2001. Results of the Chignik Lakes ecological assessment project, 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Informational Report 4K01-51, Kodiak.

LITERATURE CITED (Cont.)

INPFC (International North Pacific Fisheries Commission). 1963. Annual report 1961. Vancouver, BC.

Iverson, R.W. 1966. Biology of juvenile sockeye salmon resident in Chignik River, Alaska. Masters Thesis, Oregon State University. Corvallis, OR.

Kaplan, D.F. and C.O. Swanton. 1997. Chignik Lakes sockeye smolt abundance, age composition, and size characteristics, 1996. Alaska Department of Fish and Game, Commercial Fish Management and Development Division. Regional Information Report 4K97-28. Kodiak.

Kaplan, D.F. and C.O. Swanton. 1998. Population estimates and biological attributes of the Chignik lakes sockeye salmon outmigration, 1997. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report 4K98-4, Kodiak.

Koo, T.S.Y. 1962. Age designation in salmon. *in*: Studies of Alaska red salmon. Univ. Wash. Publ. Fish. New Ser. 1. Seattle, WA.

McConnell, R.J. and G.R. Snyder. 1972. Key to field identification of anadromous juvenile salmonids in the Pacific Northwest. National Oceanic and Atmospheric Administration Technical Report, National Marine Fisheries Service Circular 366. Seattle, WA.

Merrit, R.W. and K.W. Cummings. 1984. An introduction to the aquatic insects of North America. Second ed. Kendall/Hall Publishing Co., Dubuque, IO.

Moyle, P.B. and J.J. Cech. 1988. Fishes: An introduction to ichthyology. Prentice Hall, Englewood Cliffs, NJ.

Owen, D.L., D.R. Sarafin, G.E. Pappas, and R.T. Baer. 2000. Chignik Management Area annual finfish management report, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Informational Report 4K00-41, Kodiak.

Pennak, R.W. 1989. Fresh-water invertebrates of the United States: Protozoa to Mollusca. Third ed. John Wiley & sons, Inc. New York, NY.

Pérez-Fuentetaja, A., D.F. Kaplan, and T. Doubt. 1999. Sockeye salmon emigration studies. Chignik Lakes System, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report 4K99-26. Kodiak.

Phinney, D.E. 1968. Distribution, abundance, and growth of postsmolt sockeye salmon in Chignik Lagoon, Alaska. Masters Thesis, University of Washington. Seattle, WA.

Pollard, W.R., G.F. Hartman, C. Groot, and P. Edgell. 1997. Field identification of coastal juvenile salmonids. Harbour Publishing, Madeira Park, British Colombia.

LITERATURE CITED (Cont.)

Rice, S. D., R. E. Thomas, and A. Moles. 1994. Physiological and growth differences in three stocks of underyearling sockeye salmon (*Oncorhynchus nerka*) on early entry into seawater. Can. J. Fish. Aquat. Sci. 51:974-980.

Roos, J. 1957. Report on Chignik adult red salmon studies, 1955-1956. University of Washington School of Fisheries, Fish. Res. Inst., MS. Seattle, WA.

Roos, J. 1959. Red salmon smolt studies at Chignik, Alaska in 1959. University of Washington School of Fisheries, Fish. Res. Inst., MS. Seattle, WA.

Stopha, M.E. and B.M. Barrett. 1994. Sockeye smolt and presmolt abundance, age composition, and condition, and the use of the parasite *Philomena oncorhynchi* as an inseason stock separation estimator for returning adult sockeye salmon, Chignik Lakes, 1994. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report 4K94-36, Kodiak.

Templin, W., L. Seeb, P. Crane, and J. Seeb. 1999. Genetic analysis of sockeye salmon populations from the Chignik Watershed. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report 5J99-08, Anchorage, AK.

Thedinga, J.F., M.L. Murphy, S.W. Johnson, J.M. Lorenz, and K.V. Koski. 1994. Salmonid smolt yield determined with rotary-screw traps in the Situk River, Alaska, to predict effects of glacial flooding. Draft. Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration Technical Report. Juneau, AK.

Vania, T.D. and C.O. Swanton. 1996. Chignik Lakes sockeye smolt abundance, age composition, and size characteristics, 1995. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division. Regional Information Report 4K96-22, Kodiak.

Table 1. Estimated age composition of Chignik River sockeye salmon smolt, by statistical week, 2001.

Stat Week	Sample Size		Age 0.	1.	2.	3.	4.	Total
18	160	Percent	1.9	82.5	15.0	0.6	0.0	100.0
		Numbers	3	132	24	1	0	160
19	200	Percent	2.5	80.0	17.0	0.5	0.0	100.0
		Numbers	5	160	34	1	0	200
20	200	Percent	0.0	63.5	31.5	5.0	0.0	100.0
		Numbers	0	127	63	10	0	200
21	199	Percent	0.0	61.8	32.2	6.0	0.0	100.0
		Numbers	0	123	64	12	0	199
22	200	Percent	1.0	58.0	33.5	7.0	0.5	100.0
		Numbers	2	116	67	14	1	200
23	200	Percent	2.5	70.0	22.5	5.0	0.0	100.0
		Numbers	5	140	45	10	0	200
24	200	Percent	3.5	76.0	16.0	4.5	0.0	100.0
		Numbers	7	152	32	9	0	200
25	200	Percent	0.5	92.5	5.0	2.0	0.0	100.0
		Numbers	1	185	10	4	0	200
26	200	Percent	2.5	92.5	4.5	0.5	0.0	100.0
		Numbers	5	185	9	1	0	200
27	199	Percent	8.0	84.4	7.5	0.0	0.0	100.0
		Numbers	16	168	15	0	0	199
28	197	Percent	20.8	68.0	11.2	0.0	0.0	100.0
		Numbers	41	134	22	0	0	197
29	40	Percent	27.5	62.5	10.0	0.0	0.0	100.0
		Numbers	11	25	4	0	0	40
Total	2,195	Percent	4.4	75.0	17.7	2.8	0.0	100.0
		Numbers	96	1,647	389	62	1	2,195

Table 2. Length, weight, and condition factor of Chignik River sockeye salmon smolt, by age and statistical week, 2001.

Age	Stat Week	Starting Date	Sample Size	Length (mm) Mean	Length (mm) Standard Error	Weight (g) Mean	Weight (g) Standard Error	Condition Factor Mean	Condition Factor Standard Error
0	18	4/26	3	56.7	0.88	1.4	0.12	0.75	0.037
0	19	5/3	5	58.2	2.67	1.4	0.20	0.71	0.044
0	22	5/24	2	57.0	1.00	1.3	0.05	0.73	0.065
0	23	5/31	5	57.8	0.86	1.5	0.07	0.76	0.030
0	24	6/7	7	61.4	3.30	1.7	0.31	0.70	0.019
0	25	6/14	1	59.0	NA	1.5	NA	0.73	NA
0	26	6/21	5	55.6	1.29	1.3	0.02	0.75	0.065
0	27	6/28	16	52.2	1.05	1.3	0.07	0.92	0.023
0	28	7/5	41	55.5	0.69	1.6	0.06	0.94	0.016
0	29	7/12	11	54.8	1.28	1.6	0.12	0.94	0.029
Total			96	55.7	0.51	1.5	0.04	0.88	0.014
1	18	4/26	132	64.2	0.46	2.0	0.04	0.76	0.007
1	19	5/3	160	62.6	0.39	1.8	0.03	0.72	0.006
1	20	5/10	127	67.9	0.62	2.2	0.06	0.70	0.011
1	21	5/17	123	65.4	0.49	2.1	0.05	0.72	0.008
1	22	5/24	116	66.2	0.52	2.1	0.06	0.72	0.006
1	23	5/31	140	64.4	0.45	2.0	0.06	0.72	0.006
1	24	6/7	152	63.6	0.43	2.0	0.06	0.77	0.008
1	25	6/14	185	63.9	0.31	2.1	0.03	0.78	0.006
1	26	6/21	185	62.5	0.27	1.9	0.03	0.76	0.007
1	27	6/28	168	64.0	0.38	2.1	0.05	0.79	0.007
1	28	7/5	134	65.9	0.48	2.5	0.06	0.87	0.011
1	29	7/12	25	67.5	1.53	2.8	0.18	0.91	0.027
Total			1,647	64.5	0.13	2.1	0.02	0.76	0.003
2	18	4/26	24	70.5	1.66	2.7	0.19	0.75	0.014
2	19	5/3	34	71.3	1.16	2.7	0.13	0.72	0.007
2	20	5/10	63	73.3	0.84	3.1	0.11	0.76	0.014
2	21	5/17	64	74.6	0.75	3.1	0.10	0.74	0.011
2	22	5/24	67	76.2	0.99	3.5	0.17	0.75	0.013
2	23	5/31	45	76.0	1.56	3.6	0.34	0.75	0.014
2	24	6/7	32	78.2	2.64	4.7	0.58	0.84	0.021
2	25	6/14	10	82.5	3.76	5.7	0.79	0.95	0.023
2	26	6/21	9	72.1	3.65	3.4	0.71	0.81	0.038
2	27	6/28	15	71.1	1.65	3.1	0.33	0.82	0.039
2	28	7/5	22	75.8	1.51	4.0	0.30	0.88	0.017
2	29	7/12	4	70.3	2.50	3.2	0.49	0.91	0.074
Total			389	74.6	0.45	3.4	0.09	0.77	0.006

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Table 2. (Page 2 of 2)

				Length (mm)		Weight (g)		Condition Factor	
Age	Stat Week	Starting Date	Sample Size	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
3	18	4/26	1	96.0	NA	6.9	NA	0.78	NA
3	19	5/3	1	85.0	NA	4.6	NA	0.75	NA
3	20	5/10	10	80.6	3.16	4.8	0.36	0.83	0.031
3	21	5/17	12	79.4	1.39	3.9	0.17	0.77	0.018
3	22	5/24	14	91.8	3.36	7.0	0.93	0.84	0.018
3	23	5/31	10	98.5	3.96	9.1	1.17	0.90	0.023
3	24	6/7	9	101.4	3.01	10.0	0.83	0.94	0.011
3	25	6/14	4	94.0	0.71	7.9	0.42	0.94	0.032
3	26	6/21	1	103.0	NA	10.5	NA	0.96	NA
Total			62	90.4	1.60	6.9	0.42	0.86	0.011
4	22	5/24	1	125.0	NA	18.8	NA	0.96	NA
Total			1	125.0	NA	18.8	NA	0.96	NA

Table 3. Mean length, weight, and condition factor of sockeye salmon smolt sampled from the Chignik River, by year and age, 1994 to 2001.

		Length (mm)			Weight (g)			Condition Factor		
Year	Age	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error
1995	0	272	46.4	0.18	272	0.7	0.01	272	0.74	0.007
1996	0	125	48.7	0.45	113	1.0	0.03	113	0.82	0.014
1997	0	195	46.4	0.22	195	0.8	0.01	195	0.83	0.008
1998	0	15	44.8	0.96	15	0.7	0.03	15	0.73	0.031
1999	0	40	51.8	0.79	40	1.3	0.06	40	0.97	0.032
2000	0	223	60.3	0.52	223	2.1	0.05	223	0.91	0.008
2001	0	96	55.7	0.51	96	1.5	0.04	96	0.88	0.014
1994	1	1,715	66.6	0.16	1,706	2.3	0.02	1,706	0.75	0.002
1995	1	1,272	60.2	0.34	1,272	2.0	0.04	1,272	0.82	0.002
1996	1	1,423	67.8	0.29	1,356	2.7	0.04	1,356	0.81	0.004
1997	1	1,673	63.4	0.35	1,673	2.4	0.04	1,673	0.81	0.002
1998	1	785	68.8	0.38	780	2.7	0.06	780	0.78	0.006
1999	1	1,344	77.0	0.17	1,344	4.1	0.03	1,344	0.89	0.003
2000	1	1,175	71.9	0.22	1,175	3.3	0.04	1,175	0.86	0.003
2001	1	1,647	64.5	0.13	1647	2.1	0.02	1647	0.76	0.003
1994	2	1,091	77.4	0.22	1,068	3.6	0.04	1,068	0.74	0.003
1995	2	1,008	75.1	0.23	1,008	3.5	0.04	1,008	0.80	0.002
1996	2	548	79.9	0.34	533	4.2	0.06	533	0.81	0.004
1997	2	772	83.3	0.25	772	4.7	0.05	772	0.80	0.003
1998	2	1,925	72.4	0.13	1,881	3.0	0.03	1,881	0.76	0.003
1999	2	784	80.8	0.28	784	4.8	0.07	784	0.89	0.003
2000	2	503	76.2	0.34	503	3.6	0.07	503	0.80	0.004
2001	2	389	74.6	0.45	387	3.4	0.09	387	0.77	0.006
1996	3	3	100.3	5.55	3	8.4	1.68	3	0.81	0.062
1997	3	12	87.3	1.34	12	5.2	0.35	12	0.77	0.019
1998	3	20	83.6	3.39	19	5.5	0.99	19	0.81	0.018
1999	3	7	90.1	5.76	7	6.8	1.66	7	0.85	0.028
2000	3	14	86.1	2.36	14	5.3	0.63	14	0.79	0.013
2001	3	62	90.4	1.6	61	6.9	0.42	61	0.86	0.011
2001	4	1	125	NA	1	18.8	NA	1	0.96	NA

Table 4. Estimated age composition of Chignik River sockeye salmon smolt, 1991 to 2001.

Year	Dates	Sample Size		Ages 0.	1.	2.	3.	4.	Total
1991	09/08	65	Percent	35.4	64.6	0.0	0.0	0.0	100.0
			Numbers	23	42	0	0	0	65
1994	05/06-06/30	2,806	Percent	0.0	61.1	38.9	0.0	0.0	100.0
			Numbers	0	1,715	1,091	0	0	2,806
1995	05/06-06/29	2,557	Percent	10.7	49.8	39.5	0.0	0.0	100.0
			Numbers	273	1,274	1,010	0	0	2,557
1996	05/06-07/28	2,099	Percent	6.0	67.8	26.1	0.1	0.0	100.0
			Numbers	125	1,423	548	3	0	2,099
1997	05/04-07/22	2,657	Percent	7.3	63.1	29.1	0.5	0.0	100.0
			Numbers	195	1,676	774	12	0	2,657
1998	05/02-07/30	2,745	Percent	0.5	28.6	70.1	0.7	0.0	100.0
			Numbers	15	785	1,925	20	0	2,745
1999	05/10-07/03	2,180	Percent	1.8	61.7	36.1	0.3	0.0	100.0
			Numbers	40	1,345	788	7	0	2,180
2000	04/22-07/20	1,915	Percent	11.6	61.4	26.3	0.7	0.0	100.0
			Numbers	223	1,175	503	14	0	1,915
2001	04/29-07/12	2,195	Percent	4.4	75.0	17.7	2.8	0	100.0
			Numbers	96	1,647	389	62	1	2,195

Table 5. Results from mark-recapture tests performed on sockeye salmon smolt migrating from the Chignik River, 2001.

Date	No. Released	Total Recoveries	Trap Efficiency
5/3/01	2,182	9	0.41%
5/10/01	2,215	4	0.18%
5/16/01	1,265	4	0.32%
5/24/01	1,058	9	0.85%
6/4/01	1,033	6	0.58%
6/11/01	1,065	21	1.97%
6/19/01	2,198	31	1.41%
7/9/01	1,052	16	1.52%
Total	12,068	100	0.83%

Table 6. Results of delayed mortality experiments performed on sockeye salmon smolt captured from the Chignik River, 2001.

				Marked		Unmarked	
Date Marked	Days held	Water temp. (C)	Dye Concenetration	Number Held	Mortalities	Number Held	Mortalities
3-May	1	3.0	0.05 g/L	109	3	113	0
	2	2.0			2		2
	3	2.0			1		1
	4	2.0			2		3
				Total Mortalities	8		6
				Percent Mortalities	7.3%		5.3%
10-May	1	3.0	0.05 g/L	128	1	118	0
	2	3.0			2		1
	3	4.0			0		1
	4	4.0			6		7
	5	4.0			5		13
				Total Mortalities	14		22
				Percent Mortalities	10.9%		18.6%
16-May	1	5.0	0.05 g/L	96	3	105	0
	2	5.0			1		1
	3	6.0			0		0
	4	5.0			2		5
	5	4.0			0		6
				Total Mortalities	6		12
				Percent Mortalities	6.3%		11.4%
24-May	1	4.0	0.05 g/L	55	1	120	3
	2	4.0			1		5
				Total Mortalities	2		8
				Percent Mortalities	3.6%		6.7%

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Table 6. (Page 2 of 2)

				Marked		Unmarked	
Date Marked	Days held	Water temp. (C)	Dye Concenetration	Number Held	Mortalities	Number Held	Mortalities
4-Jun	1	7	0.05 g/L	50	3	60	0
	2	6			5		1
	3	6			3		1
	4	7			1		3
	5	8			0		1
				Total Mortalities	12		6
				Percent Mortalities	24.0%		10.0%
12-Jun	1	8	0.05 g/L	58	15	65	3
	2	7			4		5
	3	7			0		1
	4	8			1		1
	5	8			1		4
				Total Mortalities	21		14
				Percent Mortalities	36.2%		21.5%

Table 7. Chignik River sockeye salmon smolt population estimates, by age class, 1994 to 2001.

Year		Number of Smolt						S.E.	95% C.I.	
		Age 0.	Age 1.	Age 2.	Age 3.	Age 4.	Total		Lower	Upper
1994	Numbers	0	7,263,054	4,270,636	0	0	11,533,690	1,332,321	8,922,341	14,145,038
	Percent	0.0	63.0	37.0	0.0	0.0	100.0			
1995	Numbers	735,916	2,843,222	5,178,450	0	0.0	8,757,588	1,753,022	5,321,664	12,193,512
	Percent	8.4	32.5	59.1	0.0	0.0	100.0			
1996	Numbers	80,245	1,200,793	731,099	5,018	0.0	2,017,155	318,522	1,392,852	2,641,459
	Percent	4.0	59.5	36.2	0.2	0.0	100.0			
1997	Numbers	528,846	11,172,150	13,738,356	122,289	0.0	25,561,641	2,962,497	19,755,145	31,368,136
	Percent	2.1	43.7	53.7	0.5	0.0	100.0			
1998	Numbers	75,560	5,790,587	20,374,245	158,056	0.0	26,398,448	3,834,506	18,882,817	33,914,080
	Percent	0.3	21.9	77.2	0.6	0.0	100.0			
1999	Numbers	73,364	12,705,935	8,221,631	78,798	0.0	21,079,728	3,070,060	15,062,412	27,097,045
	Percent	0.3	60.3	39.0	0.4	0.0	100.0			
2000	Numbers	1,270,101	8,047,526	4,645,121	160,017	0.0	14,122,765	1,924,922	10,349,918	17,895,611
	Percent	9.0	57.0	32.9	1.1	0.0	100.0			
2001	Numbers	521,546	18,940,752	5,024,666	516,723	5,671	25,009,358	5,042,604	15,125,854	34,892,862
	Percent	2.1	75.7	20.1	2.1	0.0	100.0			

Table 8. Estimated sockeye salmon smolt emigration from the Chignik River, by age class and statistical week, 2001.

Statistical Week	Starting Date	Age 0.	1.	2.	3.	4.	Total
18	4/26	60,071	2,643,111	480,566	20,024	0	3,203,771
19	5/3	316,082	10,114,625	2,149,358	63,216	0	12,643,281
20	5/10	0	1,991,926	988,121	156,845	0	3,136,891
21	5/17	0	1,385,655	720,991	135,186	0	2,241,833
22	5/24	11,343	657,891	379,989	79,401	5,671	1,134,295
23	5/31	13,545	379,247	121,901	27,089	0	541,782
24	6/7	16,918	367,369	77,341	21,752	0	483,381
25	6/14	2,777	513,666	27,766	11,106	0	555,315
26	6/21	10,521	389,271	18,938	2,104	0	420,834
27	6/28	28,057	294,594	26,303	0	0	348,954
28	7/5	58,714	191,894	31,505	0	0	282,113
29	7/12	3,519	11,502	1,888	0	0	16,910
Total		521,546	18,940,752	5,024,666	516,723	5,671	25,009,358

Table 9. Chingik River sockeye salmon escapement, estimated number of smolt by freshwater age, smolt per spawner, adult return by freshwater age, return per spawner, and return per smolt, by brood year, 1991 to 2001.

Brood		Smolt Produced						Smolt /	Adult Return						Return /	Marine
Year	Escapement	age 0.	age 1.	age 2.	age 3.	Other	Total smolt	spawner	Age 0.	Age 1.	Age 2.	Age 3.	Other	Total	spawner	Survival
1991	1,040,098	NA	NA	4,270,636	0	0	4,270,636	4.11	3,685	1,712,071	756,904	11,386	4,922	2,488,968	2.39	
1992	766,603	NA	7,263,054	5,178,450	5,018	0	12,446,522	16.24	137,960	665,793	1,163,834	98,618	983	2,067,188	2.70	16.6%
1993	697,377	0	2,843,222	731,099	122,289	0	3,696,610	5.30	17,774	419,474	2,027,308	7,638	170	2,472,364	3.55	66.9%
1994	964,354	735,916	1,200,793	13,738,356	158,056	0	15,833,121	16.42	319	1,814,140	1,463,080	2,341	792	3,280,672	3.40	20.7%
1995	739,920	80,254	11,172,150	20,374,245	78,798	0	31,705,447	42.85	38,370	2,409,074	957,157					
1996	735,112	528,846	5,790,587	8,221,631	160,017	5,671	14,706,752	20.01	128,822	1,934,237						
1997	775,618	75,560	12,705,935	4,645,121	515,246		17,941,862	23.13	14,751							
1998	701,128	73,364	8,047,526	5,025,307			13,146,197									
1999	715,966	1,270,101	18,939,482				20,209,583									
2000	805,275	523,303					523,303									
2001	1,136,918															

Table 10. Estimated marine survival of sockeye salmon smolt from the Chignik River, by emigration year and freshwater age, 1994 to 2001.

Smolt Year	Smolt Estimates					Adult Returns					Marine Survival
	Age 0.	Age 1.	Age 2.	Age 3.	Total	Age 0.x	Age 1.x	Age 2.x	Age 3.x	Total	
1994	0	7,263,054	4,270,636	0	11,533,690	17,774	665,793	756,904	25,341	1,465,812	12.7%
1995	735,916	2,843,222	5,178,450	0	8,757,588	319	419,474	1,163,834	11,386	1,595,013	18.2%
1996	80,245	1,200,793	731,099	5,018	2,017,155	38,370	1,814,140	2,027,308	98,618	3,978,436	197.2%
1997	528,846	11,172,150	13,738,356	122,289	25,561,641	128,822	2,409,074	1,463,080	7,638	4,008,614	15.7%
1998	75,560	5,790,587	20,374,245	158,056	26,398,448	14,751	1,934,237	957,157	2,341	2,908,486	11.0%
1999	73,364	12,705,935	8,221,631	78,798	21,079,728						
2000	1,270,101	8,047,526	4,645,121	160,017	14,122,765						
2001	521,546	18,940,752	5,024,666	516,723	25,003,687						

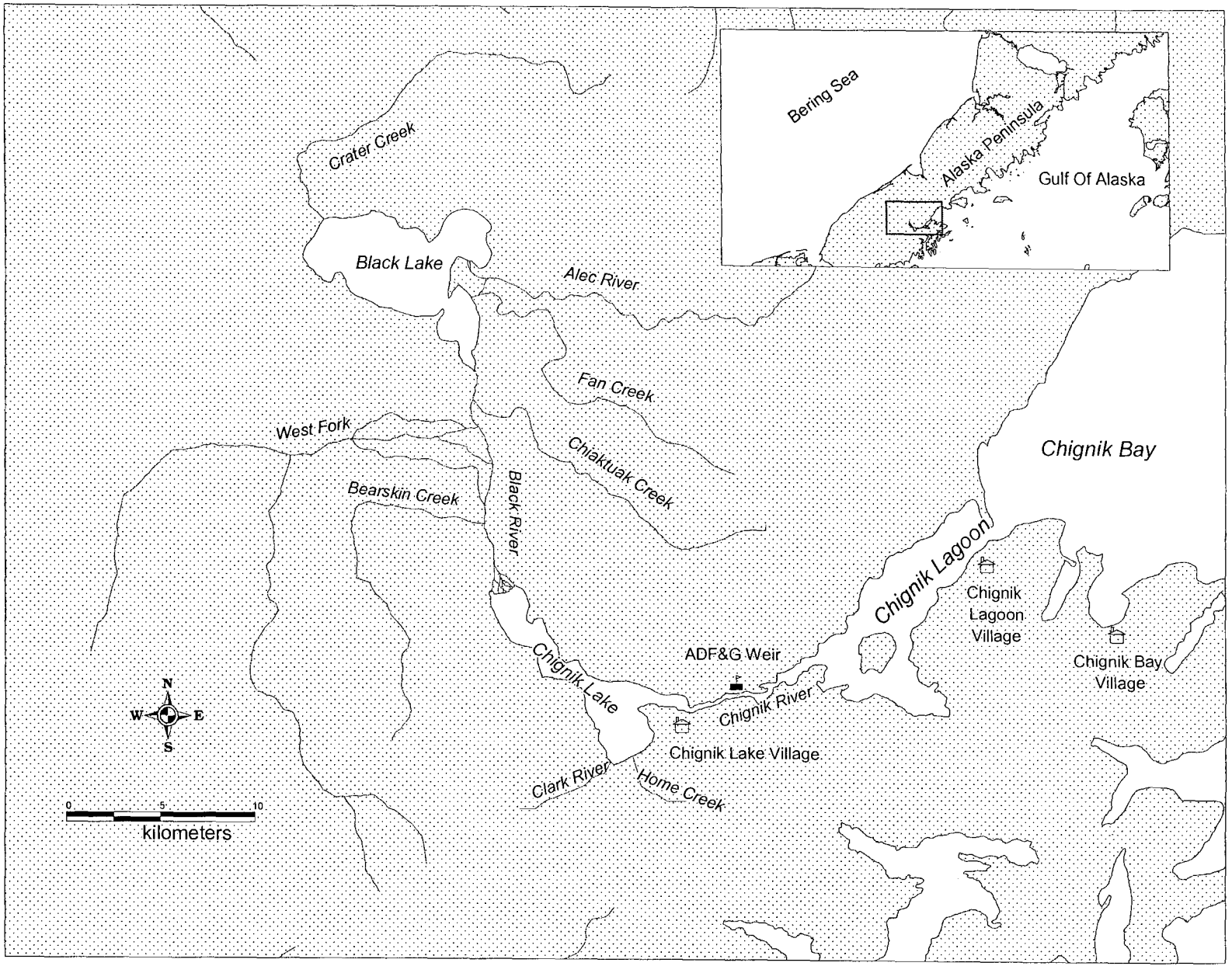

Figure 1. Map of the Chignik River watershed with inset of the Alaska Peninsula.

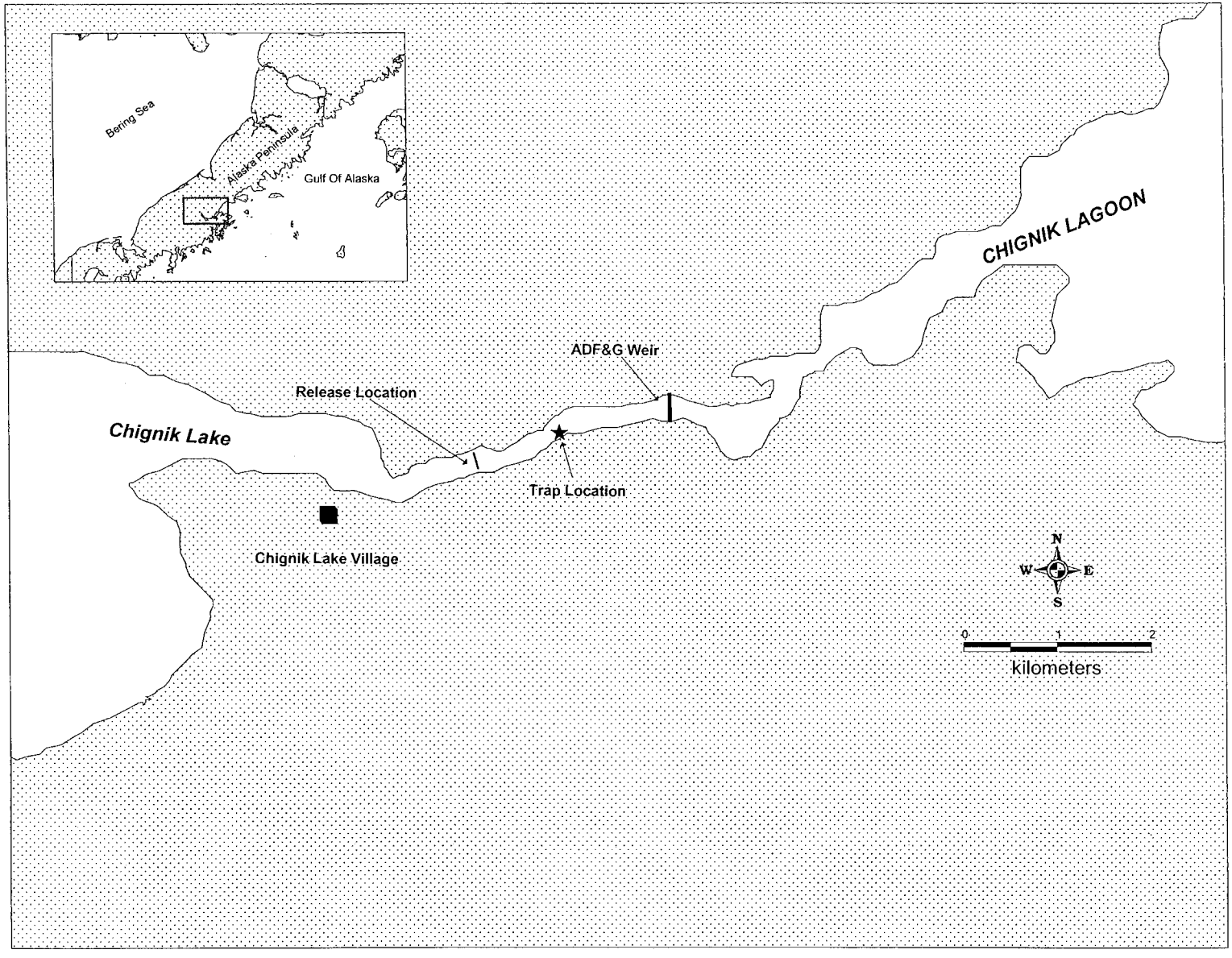

Figure 2. Location of the traps and the release site of marked smolt on the Chignik River, Alaska, 2001.

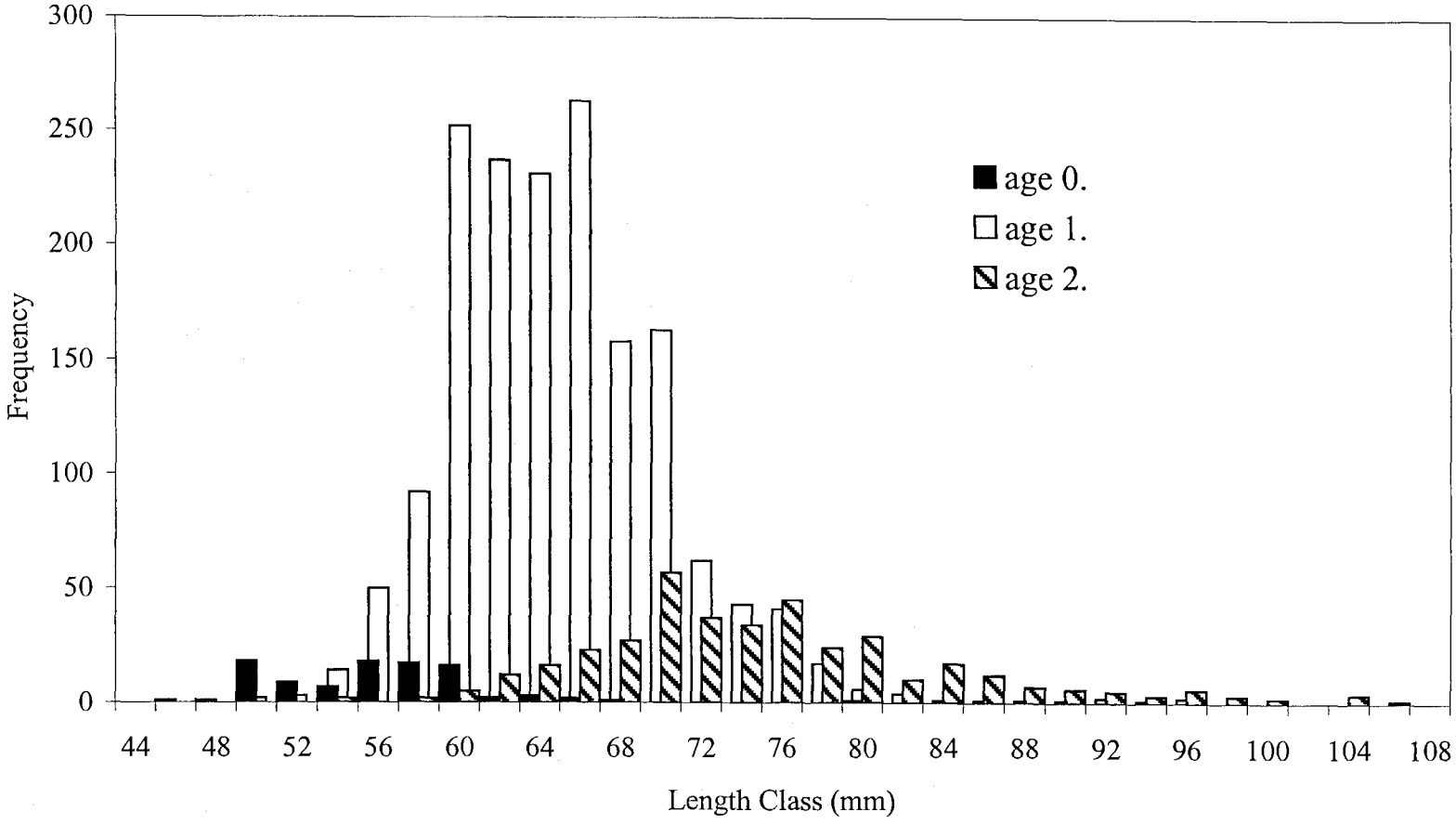

Figure 3. Length frequency histogram of age 0., 1., and 2. sockeye salmon smolt sampled from the Chignik River, 2001.

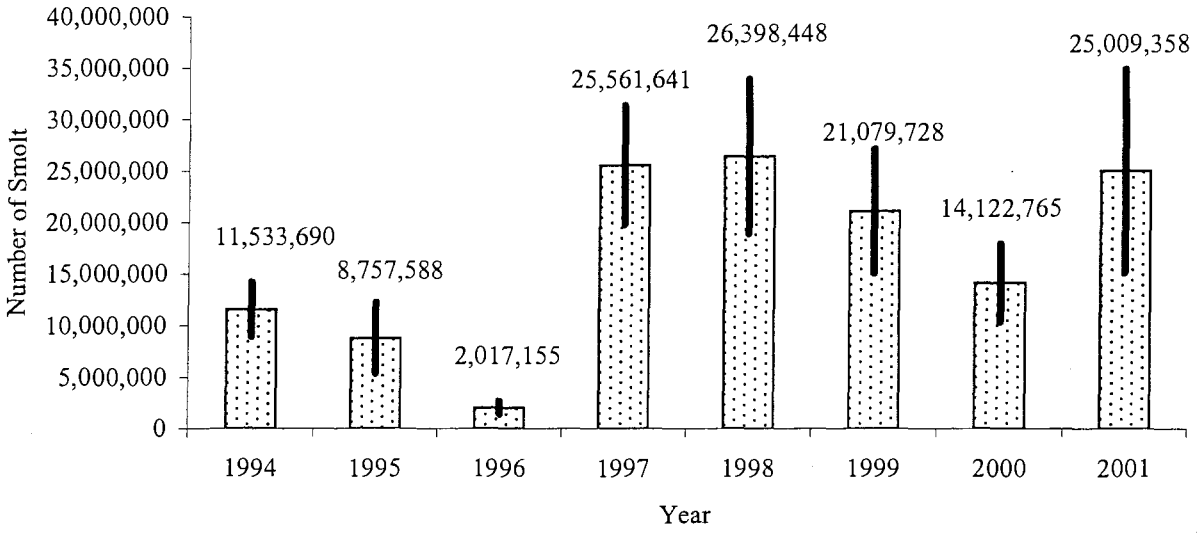

Figure 4. Annual Chignik River sockeye salmon smolt emigration estimates and corresponding 95% confidence intervals, 1994 to 2001.

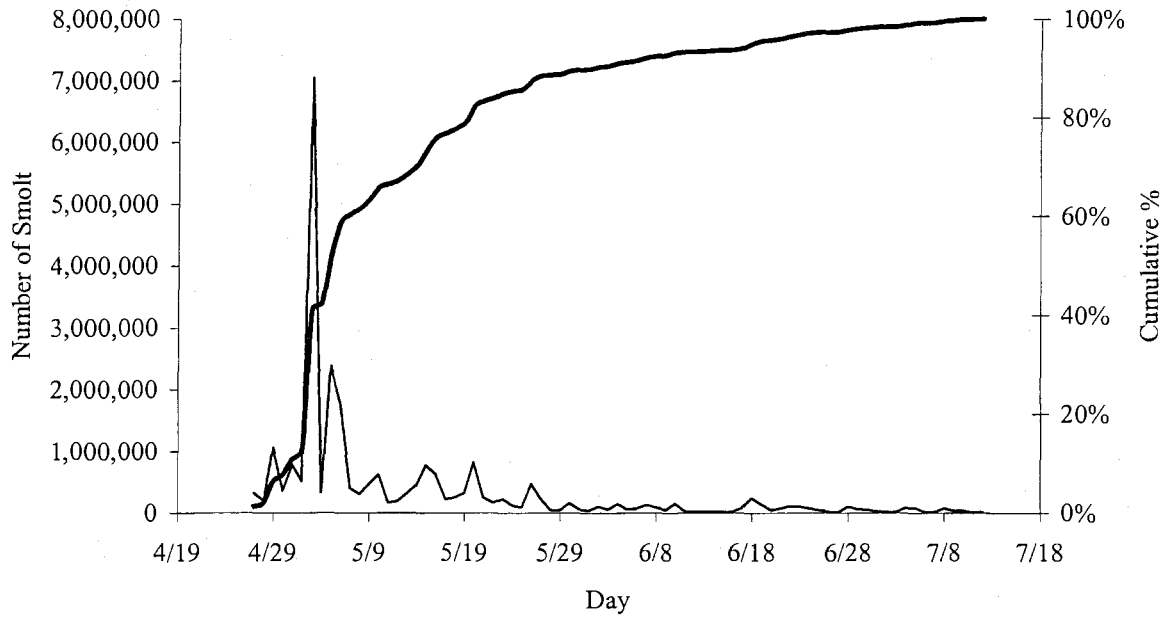

Figure 5. Estimated daily and corresponding cumulative percentage of the sockeye salmon smolt emigration from the Chignik River, 2001.

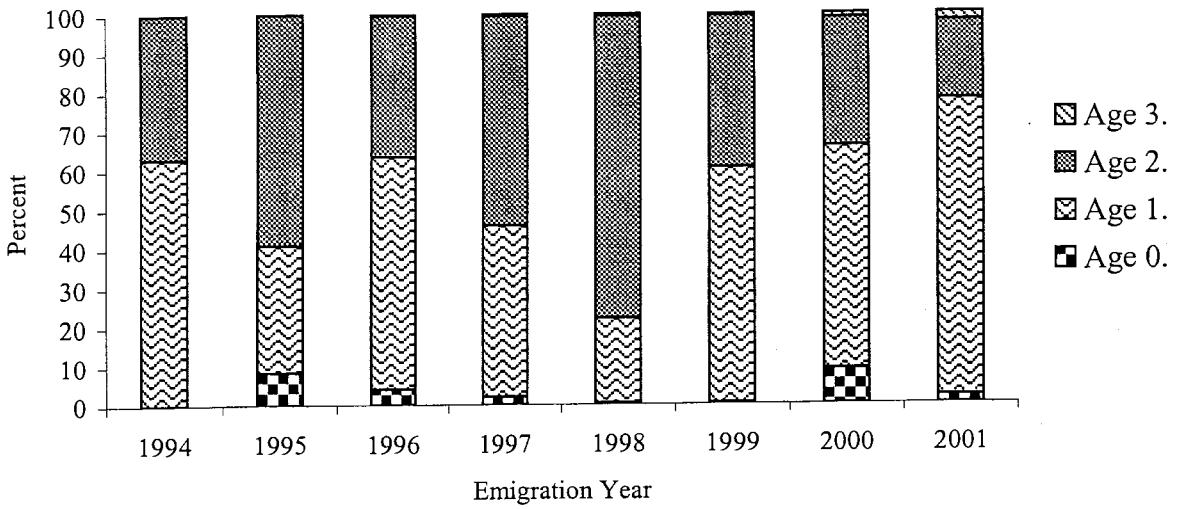

Figure 6. A comparison of the estimated age structure of age 0. to age 3. sockeye salmon smolt emigrations from the Chignik River, 1994 to 2001.

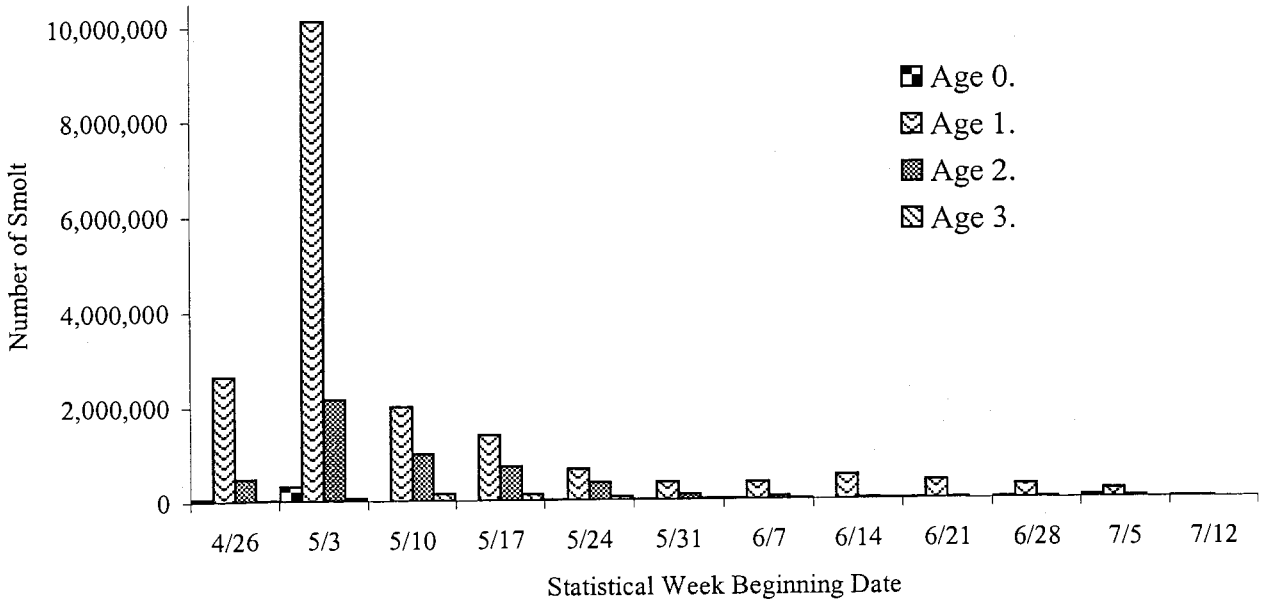

Figure 7. Estimated smolt emigration of age 0. to age 3. sockeye salmon smolt, by statistical week beginning date, from the Chignik River, 2001.

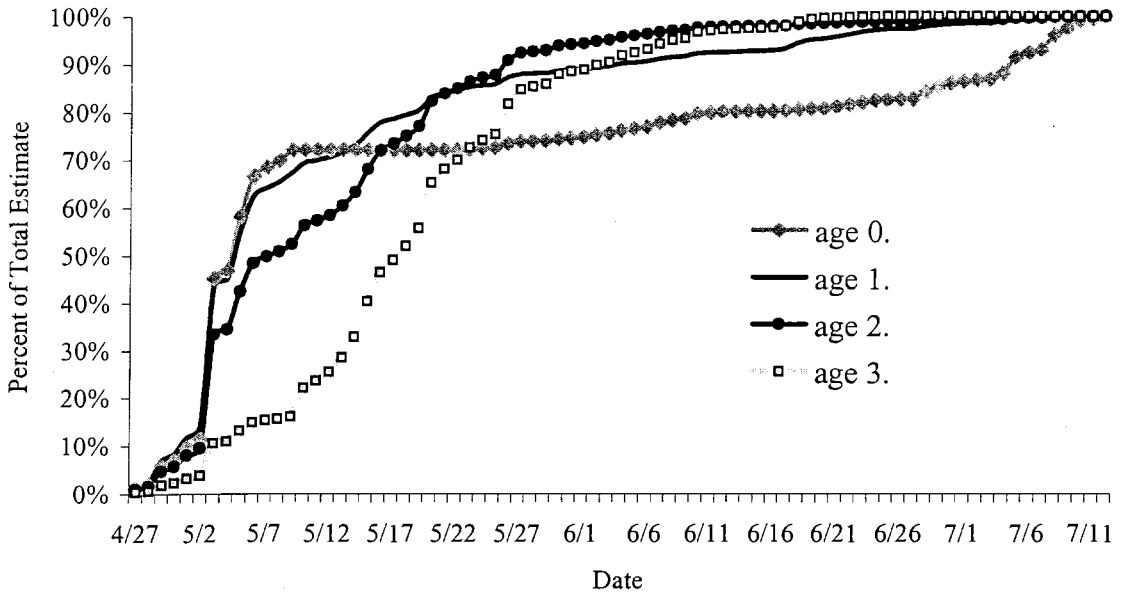

Figure 8. Cumulative percentage of the estimated Chignik River sockeye salmon smolt emigration, by age and date, 2001.

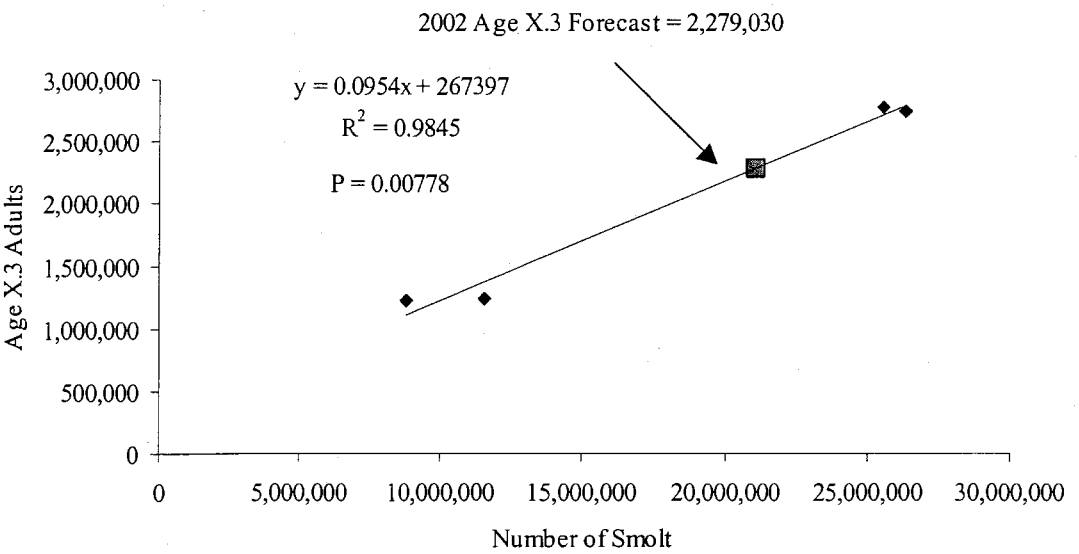

Figure 9. Regression relationship between the total Chingik River sockeye salmon smolt emigration estimate, by emigration year, and 3-ocean adult returns, with the predicted 2002 return indicated.

APPENDICES

Appendix A. Actual daily counts and trap efficiency data of the Chignik River Sockeye Salmon Smolt Project, 2001.

	Actual		Trap Efficiency Test				Incidental Catch[a]											
Date	Daily	Cum.	Marked	Daily Recoveries	Cum. Recoveries	Efficiency (%)	SoF	coho	pink	chnk	DV	SB	PS	PW	SF	SC	ISO	eulachon
04/27/01	1,473	1,473					1,937	2	2	0	0	371	2	0	0	4	2	0
04/28/01	890	2,363					1,038	4	53	1	3	104	3	0	0	16	4	0
04/29/01	4,829	7,192					4,225	36	102	0	13	323	13	3	0	18	6	1
04/30/01	1,600	8,792					5,201	2	1	0	3	168	3	1	0	7	0	0
05/01/01	3,556	12,348					3,748	34	1	5	1	395	13	0	1	0	0	0
05/02/01	2,328	14,676					3,371	15	10	6	6	256	2	2	0	1	2	1
05/03/01	32,232	46,908	2,182	8	8	0.37%	5,404	13	7	4	8	566	1	1	0	1	0	0
05/04/01	1,459	48,367		1	9	0.41%	3,664	3	0	0	7	193	0	0	0	0	8	0
05/05/01	10,900	59,267		0	9	0.41%	9,326	20	10	2	13	724	0	0	0	2	6	0
05/06/01	8,011	67,278		0	9	0.41%	5,625	29	0	0	18	878	0	0	0	0	11	0
05/07/01	1,819	69,097		0	9	0.41%	1,698	2	5	0	0	1,145	0	0	0	0	0	0
05/08/01	1,392	70,489		0	9	0.41%	817	6	0	0	1	121	0	0	0	0	0	0
05/09/01	2,104	72,593		0	9	0.41%	1,283	13	0	0	13	203	0	0	0	1	0	1
05/10/01	1,401	73,994	2,215	4	4	0.18%	712	9	0	1	6	109	1	0	0	1	0	1
05/11/01	358	74,352		0	4	0.18%	453	6	0	0	0	96	0	1	0	7	0	0
05/12/01	434	74,786		0	4	0.18%	238	5	0	0	0	51	0	0	0	2	0	0
05/13/01	717	75,503		0	4	0.18%	395	3	0	4	5	70	0	0	0	0	1	0
05/14/01	1,008	76,511		0	4	0.18%	284	1	0	2	7	88	0	0	0	10	0	0
05/15/01	1,739	78,250		0	4	0.18%	260	2	0	0	3	17	0	0	0	1	1	0
05/16/01	2,487	80,737	1,265	2	2	0.16%	371	2	0	0	9	41	0	0	0	20	3	0
05/17/01	885	81,622		2	4	0.32%	291	1	0	1	7	41	0	0	0	15	0	0
05/18/01	991	82,613		0	4	0.32%	194	5	0	2	5	36	0	0	0	13	0	0
05/19/01	1,271	83,884		0	4	0.32%	293	2	0	0	6	66	0	0	0	21	0	0
05/20/01	3,207	87,091		0	4	0.32%	184	13	0	25	21	144	0	0	0	22	0	0
05/21/01	973	88,064		0	4	0.32%	272	8	0	6	10	127	1	0	0	12	0	1
05/22/01	655	88,719		0	4	0.32%	231	4	0	1	2	74	0	1	0	0	0	0
05/23/01	872	89,591		0	4	0.32%	176	1	0	10	6	90	0	0	0	5	0	1
05/24/01	1,113	90,704	1,058	7	7	0.66%	189	2	0	0	4	65	0	0	0	33	0	1

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Appendix A. (page 2 of 3)

	Actual		Trap Efficiency Test				Incidental Catch[a]											
Date	Daily	Cum.	Marked	Daily Recoveries	Cum. Recoveries	Efficiency (%)	SoF	coho	pink	chnk	DV	SB	PS	PW	SF	SC	ISO	eulachon
05/25/01	835	91,539		0	7	0.66%	284	7	0	5	9	92	0	0	0	32	0	0
05/26/01	4,381	95,920		1	8	0.76%	3,938	70	0	23	89	595	0	0	1	63	0	2
05/27/01	2,124	98,044		1	9	0.85%	2,894	63	0	10	31	487	0	0	0	16	0	1
05/28/01	432	98,476		0	9	0.85%	1,090	12	0	5	5	260	0	0	1	9	0	4
05/29/01	372	98,848		0	9	0.85%	521	7	0	8	8	148	0	0	0	7	0	0
05/30/01	1,454	100,302		0	9	0.85%	1,068	18	0	12	23	194	0	0	0	10	0	2
05/31/01	551	100,853		0	9	0.85%	963	29	0	17	24	218	0	0	1	11	0	4
06/01/01	362	101,215		0	9	0.85%	329	18	0	6	11	96	0	0	0	17	0	1
06/02/01	1,000	102,215		0	9	0.85%	147	18	0	19	8	80	0	0	0	2	0	0
06/03/01	543	102,758		0	9	0.85%	230	8	0	7	8	59	0	0	0	6	0	1
06/04/01	977	103,735	1,033	6	6	0.58%	464	38	0	54	16	126	2	1	0	18	14	1
06/05/01	425	104,160		0	6	0.58%	535	24	0	25	5	155	0	0	0	0	0	0
06/06/01	505	104,665		0	6	0.58%	424	8	0	22	5	91	1	0	0	8	0	0
06/07/01	883	105,548		0	6	0.58%	1,236	16	0	20	9	268	2	1	0	8	0	0
06/08/01	588	106,136		0	6	0.58%	653	22	0	18	6	221	1	0	0	7	0	0
06/09/01	305	106,441		0	6	0.58%	861	19	0	11	16	147	0	7	0	3	1	0
06/10/01	1,006	107,447		0	6	0.58%	851	18	0	10	11	331	0	1	1	4	0	3
06/11/01	672	108,119	1,065	16	16	1.50%	1,047	29	0	33	19	262	3	3	0	4	0	4
06/12/01	446	108,565		5	21	1.97%	732	19	0	37	17	367	8	0	0	7	6	3
06/13/01	377	108,942		0	21	1.97%	309	14	0	11	10	138	1	0	0	1	0	2
06/14/01	463	109,405		0	21	1.97%	433	18	0	24	22	284	0	0	0	9	3	0
06/15/01	342	109,747		0	21	1.97%	391	14	0	43	5	145	0	0	0	11	1	0
06/16/01	369	110,116		0	21	1.97%	358	5	0	39	11	169	2	2	0	3	0	0
06/17/01	1,562	111,678		0	21	1.97%	319	8	0	28	17	241	4	3	0	14	17	0
06/18/01	4,867	116,545		0	21	1.97%	260	24	0	53	2	224	1	0	0	0	0	1
06/19/01	2,012	118,557	2,198	29	29	1.32%	378	30	0	45	7	108	1	0	0	9	5	0
06/20/01	708	119,265		0	29	1.32%	648	12	0	44	3	202	6	1	0	1	1	0
06/21/01	1,082	120,347		1	30	1.36%	3,702	15	0	36	3	171	3	0	0	15	1	0
06/22/01	1,551	121,898		1	31	1.41%	631	15	0	53	23	98	8	0	0	10	0	0
06/23/01	1,422	123,320		0	31	1.41%	3,329	11	0	49	7	101	0	0	0	6	3	0

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Appendix A. (page 3 of 3)

	Actual		Trap Efficiency Test				Incidental Catch[a]											
Date	Daily	Cum.	Marked	Daily Recoveries	Cum. Recoveries	Efficiency (%)	SoF	coho	pink	chnk	DV	SB	PS	PW	SF	SC	ISO	eulachon
06/24/01	1,089	124,409		0	31	1.41%	1,233	14	0	18	5	89	0	0	0	2	4	0
06/25/01	569	124,978		0	31	1.41%	827	4	0	9	3	86	0	0	0	1	0	0
06/26/01	290	125,268		0	31	1.41%	1,896	16	0	7	4	88	0	2	0	0	0	0
06/27/01	121	125,389		0	31	1.41%	618	2	0	4	1	18	1	0	0	0	0	0
06/28/01	1,489	126,878		0	31	1.41%	2,148	33	0	16	9	113	2	3	0	9	3	0
06/29/01	892	127,770		0	31	1.41%	233	16	0	4	10	84	4	0	0	7	3	0
06/30/01	756	128,526		0	31	1.41%	264	9	0	27	2	110	0	0	0	0	11	0
07/01/01	349	128,875		0	31	1.41%	579	18	0	5	4	83	0	0	0	7	8	0
07/02/01	234	129,109		0	31	1.41%	860	8	0	16	2	108	0	1	0	13	10	0
07/03/01	178	129,287		0	31	1.41%	436	16	0	18	16	103	1	11	0	0	6	0
07/04/01	1,180	130,467		0	31	1.41%	905	7	0	129	13	25	11	0	0	0	0	0
07/05/01	1,220	131,687		0	31	1.41%	5,036	17	0	54	27	110	0	3	0	13	13	0
07/06/01	335	132,022		0	31	1.41%	348	3	0	16	20	94	18	4	0	16	21	0
07/07/01	224	132,246		0	31	1.41%	496	2	0	6	5	40	0	2	0	10	9	0
07/08/01	1,123	133,369		0	31	1.41%	2,158	18	0	18	15	127	4	0	0	14	15	0
07/09/01	584	133,953	1,052	11	11	1.05%	1,500	9	0	0	7	81	0	0	0	14	8	0
07/10/01	663	134,616		5	16	1.52%	2,287	15	0	18	15	103	5	0	0	12	8	0
07/11/01	88	134,704		0	16	1.52%	303	8	0	10	5	46	2	0	0	1	5	0
07/12/01	273	134,977		0	16	1.52%	1,307	18	0	49	13	48	6	6	0	33	0	0
Total	134,977						104,339	1,085	191	1,261	783	14,196	136	60	5	675	220	36

[a] SoF = sockeye salmon fry, coho = juvenile coho salmon, pink = juvenile pink salmon, chnk = juvenile chinook salmon, DV = Dolly Varden, SB = stickleback, PS = pond smelt, PW = pigmy whitefish, SF = starry flounder, SC = sculpin, ISO = isopods.

Appendix B. Number of sockeye salmon smolt caught by trap, by day, from the Chignik River, April 27 to July 12, 2001.

	Small Trap		Large Trap		Combined		Percent Total	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Small	Large
04/27/01	443	443	1,030	1,030	1,473	1,473	30.1%	69.9%
04/28/01	327	770	563	1,593	890	2,363	36.7%	63.3%
04/29/01	778	1,548	4,051	5,644	4,829	7,192	0.0%	0.0%
04/30/01	138	1,686	1,462	7,106	1,600	8,792	8.6%	91.4%
05/01/01	378	2,064	3,178	10,284	3,556	12,348	10.6%	89.4%
05/02/01	334	2,398	1,994	12,278	2,328	14,676	14.3%	85.7%
05/03/01	2,261	4,659	29,971	42,249	32,232	46,908	7.0%	93.0%
05/04/01	211	4,870	1,248	43,497	1,459	48,367	14.5%	85.5%
05/05/01	627	5,497	10,273	53,770	10,900	59,267	5.8%	94.2%
05/06/01	768	6,265	7,243	61,013	8,011	67,278	0.0%	0.0%
05/07/01	304	6,569	1,515	62,528	1,819	69,097	0.0%	0.0%
05/08/01	258	6,827	1,134	63,662	1,392	70,489	18.5%	81.5%
05/09/01	265	7,092	1,839	65,501	2,104	72,593	12.6%	87.4%
05/10/01	204	7,296	1,197	66,698	1,401	73,994	14.6%	85.4%
05/11/01	50	7,346	308	67,006	358	74,352	14.0%	86.0%
05/12/01	99	7,445	335	67,341	434	74,786	22.8%	77.2%
05/13/01	193	7,638	524	67,865	717	75,503	26.9%	73.1%
05/14/01	135	7,773	873	68,738	1,008	76,511	13.4%	86.6%
05/15/01	282	8,055	1,457	70,195	1,739	78,250	16.2%	83.8%
05/16/01	246	8,301	2,241	72,436	2,487	80,737	9.9%	90.1%
05/17/01	151	8,452	734	73,170	885	81,622	17.1%	82.9%
05/18/01	87	8,539	904	74,074	991	82,613	8.8%	91.2%
05/19/01	182	8,721	1,089	75,163	1,271	83,884	14.3%	85.7%
05/20/01	160	8,881	3,047	78,210	3,207	87,091	5.0%	95.0%
05/21/01	117	8,998	856	79,066	973	88,064	12.0%	88.0%
05/22/01	100	9,098	555	79,621	655	88,719	15.3%	84.7%
05/23/01	42	9,140	830	80,451	872	89,591	4.8%	95.2%
05/24/01	94	9,234	1,019	81,470	1,113	90,704	8.4%	91.6%
05/25/01	145	9,379	690	82,160	835	91,539	17.4%	82.6%
05/26/01	545	9,924	3,836	85,996	4,381	95,920	12.4%	87.6%
05/27/01	239	10,163	1,885	87,881	2,124	98,044	11.3%	88.7%
05/28/01	47	10,210	385	88,266	432	98,476	10.9%	89.1%
05/29/01	48	10,258	324	88,590	372	98,848	12.9%	87.1%
05/30/01	108	10,366	1,346	89,936	1,454	100,302	7.4%	92.6%
05/31/01	113	10,479	438	90,374	551	100,853	20.5%	79.5%
06/01/01	48	10,527	314	90,688	362	101,215	13.3%	86.7%
06/02/01	96	10,623	904	91,592	1,000	102,215	9.6%	90.4%
06/03/01	106	10,729	437	92,029	543	102,758	19.5%	80.5%
06/04/01	144	10,873	833	92,862	977	103,735	14.7%	85.3%
06/05/01	82	10,955	343	93,205	425	104,160	19.3%	80.7%
06/06/01	80	11,035	425	93,630	505	104,665	15.8%	84.2%
06/07/01	101	11,136	782	94,412	883	105,548	11.4%	88.6%
06/08/01	86	11,222	502	94,914	588	106,136	14.6%	85.4%
06/09/01	82	11,304	223	95,137	305	106,441	26.9%	73.1%
06/10/01	144	11,448	862	95,999	1,006	107,447	14.3%	85.7%
06/11/01	148	11,596	524	96,523	672	108,119	22.0%	78.0%

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Appendix B. (page 2 of 2)

Date	Small Trap		Large Trap		Combined		Percent Total	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Small	Large
06/12/01	180	11,776	266	96,789	446	108,565	40.4%	59.6%
06/13/01	157	11,933	220	97,009	377	108,942	41.6%	58.4%
06/14/01	154	12,087	309	97,318	463	109,405	33.3%	66.7%
06/15/01	67	12,154	275	97,593	342	109,747	19.6%	80.4%
06/16/01	133	12,287	236	97,829	369	110,116	36.0%	64.0%
06/17/01	237	12,524	1,325	99,154	1,562	111,678	15.2%	84.8%
06/18/01	1,044	13,568	3,823	102,977	4,867	116,545	21.5%	78.5%
06/19/01	347	13,915	1,665	104,642	2,012	118,557	17.2%	82.8%
06/20/01	172	14,087	536	105,178	708	119,265	24.3%	75.7%
06/21/01	326	14,413	756	105,934	1,082	120,347	30.1%	69.9%
06/22/01	602	15,015	949	106,883	1,551	121,898	38.8%	61.2%
06/23/01	285	15,300	1,137	108,020	1,422	123,320	20.0%	80.0%
06/24/01	88	15,388	1,001	109,021	1,089	124,409	8.1%	91.9%
06/25/01	110	15,498	459	109,480	569	124,978	19.3%	80.7%
06/26/01	71	15,569	219	109,699	290	125,268	24.5%	75.5%
06/27/01	33	15,602	88	109,787	121	125,389	27.3%	72.7%
06/28/01	199	15,801	1,290	111,077	1,489	126,878	13.4%	86.6%
06/29/01	126	15,927	766	111,843	892	127,770	14.1%	85.9%
06/30/01	71	15,998	685	112,528	756	128,526	9.4%	90.6%
07/01/01	74	16,072	275	112,803	349	128,875	21.2%	78.8%
07/02/01	66	16,138	168	112,971	234	129,109	28.2%	71.8%
07/03/01	49	16,187	129	113,100	178	129,287	27.5%	72.5%
07/04/01	206	16,393	974	114,074	1,180	130,467	17.5%	82.5%
07/05/01	119	16,512	1,101	115,175	1,220	131,687	9.8%	90.2%
07/06/01	39	16,551	296	115,471	335	132,022	11.6%	88.4%
07/07/01	31	16,582	193	115,664	224	132,246	13.8%	86.2%
07/08/01	18	16,600	1,105	116,769	1,123	133,369	1.6%	98.4%
07/09/01	79	16,679	505	117,274	584	133,953	13.5%	86.5%
07/10/01	25	16,704	638	117,912	663	134,616	3.8%	96.2%
07/11/01	13	16,717	75	117,987	88	134,704	14.8%	85.2%
07/12/01	10	16,727	263	118,250	273	134,977	3.7%	96.3%
Total	16,727		118,250		134,977		12.4%	87.6%

Appendix C. Daily climatological observations for the Chignik River Sockeye Salmon Smolt Project, 2001.

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
04/27/01	12:30			10		0	4.25	5.250		traps are in, sunny
04/27/01	0:00	-1	4	5		0	4.00	4.875		calm
04/28/01	12:00	5	4	100	SE	15	5.00	5.750		overcast
04/28/01	0:00	4	4	90	NW	5	4.25	5.125		
04/29/01	12:05	7	4	90	SE	5	5.00	5.250		overcast
04/29/01	0:00	2	4	40	NW	15	5.25	5.000		calm
04/30/01	12:00	5	3	90	NW	10	5.25	5.125		snow
05/01/01	0:30	-3	3	5		0	5.25	5.000	75	calm
05/01/01	12:00	-1	3	5		0	5.25	5.250	75	calm
05/01/01	0:00	1	3	75	NW	5	5.25	5.000	75	cloudy
05/02/01	12:10	2	3	90	NW	20	5.50	5.250	75	snow
05/03/01	0:10	-1	2	90	NW	15	4.50	4.875	78	cloudy
05/03/01	12:40	-1	2	100	NW	15	4.50	4.750	89	ice and snow
05/04/01	0:20	-2	2	50	NW	10	5.25	4.750	80	icy
05/04/01	12:30	4	3	100		0	4.75	4.500	90	overcast
05/05/01	0:00	1	3	100	NW	20	5.00	4.750	91	snow
05/05/01	12:30	-1	2	100	NW	10	5.00	4.875	90	ice and snow
05/06/01	0:10	0	1	100	NW	10	4.50	4.000	95	snow
05/06/01	12:15	4	3	25	NW	15	4.50	4.500	95	sunny
05/07/01	0:10	-1	2	80	NW	50	4.50	4.250	99	windy
05/07/01	12:15	1	2	50	NW	30	4.25	4.500	98	windy and ice
05/08/01	0:10	1	3	75	NW	10	4.25	4.250	95	cloudy
05/08/01	12:10	4	3	100		0	4.75	4.000	90	cloudy
05/09/01	0:05	1	3	100		0	3.75	4.250	98	calm
05/09/01	12:10	4	3	100	NW	10	3.75	4.000	98	snow
05/09/01	0:00	0	3	100	NW	15	4.50	4.250	98	snow
05/10/01	12:15	4	3	90	NW	10	4.50	4.250	91	
05/10/01	23:58	1	3	75	NW	10	4.50	4.500	90	calm
05/11/01	12:00	8	4	5		0	3.50	3.625	81	sunny
05/11/01	0:00	3	4	80	SE	10	3.25	3.250	78	cloudy

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Appendix C. (page 2 of 6)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
05/12/01	12:10	4	4	100	SE	15	3.25	3.250	75	rain
05/12/01	23:10	4	3	100	SE	10	4.00	3.875	72	rain
05/13/01	12:15	6	4	90	SE	10	4.25	3.625	82	overcast
05/13/01	0:00	-1	3	10		0	3.75	4.000	78	calm
05/14/01	12:15	9	4	0	NW	10	3.75	4.000	75	CAVU
05/14/01	0:00	5	4	0	NW	10	3.75	4.000	78	CAVU
05/15/01	12:00	10	5	25	NW	5	3.75	4.000	78	sunny
05/16/01	0:10	4	4	75		0	3.75	4.250	78	overcast
05/16/01	12:15	8	4	50	NW	10	3.75	4.000	82	cloudy
05/17/01	0:20	3	4	20		0	3.50	4.000	82	calm
05/17/01	12:00	10	5	95	NW	5	3.50	3.875	85	cloudy
05/18/01	0:10	4	4	20		0	2.50	4.500	85	calm
05/18/01	12:10	6	5	100	NW	10	2.50	4.000	88	overcast
05/19/01	0:10	3	4	100	NW	5	3.50	3.625	88	
05/19/01	12:10	9	6	75	SE	10	3.50	3.750	90	cloudy
05/20/01	0:05	6	4	90	SE	10	3.50	3.750	90	cloudy
05/20/01	12:10	11	5	95	NW	5	3.50	3.750	90	overcast
05/21/01	0:00	5	4	100	NW	40	4.00	5.000	90	windy
05/21/01	11:50	5	4	50	NW	20	4.25	5.125	92	windy
05/22/01	0:30	3	4	90	NW	40	4.50	5.000	92	windy
05/22/01	12:10	7	5	0	NW	30	4.75	5.125	92	windy and CAVU
05/23/01	0:20	4	5	20	NW	10	5.00	5.000	98	calm
05/23/01	12:15	6	4	100	NW	10	5.00	5.500	100	overcast
05/24/01	0:00	4	4	100	NW	10	4.25	4.750	100	overcast
05/24/01	12:00	5	4	65		0	4.50	4.000	100	calm
05/25/01	0:00	4	4	80	NW	10	3.75	4.250	97	cloudy
05/25/01	12:00	13	6	50	NW	10	4.00	4.500	98	sunny
05/26/01	0:00	4	5	100		0	4.00	3.750	98	calm
05/27/01	0:30	0	3	100	NW	50	4.25	6.750	116	windy, snowy, water coming up
05/27/01	12:15	2	3	90	NW	40	4.75	6.000	102	windy

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Appendix C. (page 3 of 6)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
05/28/01	0:10	3	4	75	NW	30	4.25	5.250	102	windy
05/28/01	12:30	8	5	10	NW	20	4.25	5.375	101	windy and sunny
05/29/01	0:15	5	6	0	NW	15	5.50	6.000	100	CAVU
05/29/01	12:15	8	6	50	NW	30	5.50	5.875	100	windy
05/30/01	0:15	6	4	100	NW	10	5.00	5.000	100	overcast
05/30/01	15:15	12	6	10	NW	5	5.00	5.500	100	sunny
05/31/01	0:15	2	6	25	NW	30	5.50	6.375	102	windy
05/31/01	12:15	8	6	0	NW	30	5.50	6.000	108	windy and CAVU
06/01/01	0:10	4	6	45	NW	30	5.25	6.000	110	windy and clouds
06/01/01	12:15	7	6	0	NW	20	6.00	6.000	113	windy and CAVU
06/02/01	0:15	6	5	50	NW	10	6.25	6.375	105	
06/02/01	12:15	5	6	100	SE	5	6.00	6.500	112	rain
06/03/01	0:10	6	6	100	NW	15	6.50	5.500	113	rain
06/03/01	12:15	8	6	25	NW	10	6.50	5.500	125	sunny
06/04/01	0:05	8	6	45		0	6.00	5.750	120	calm
06/04/01	12:10	12	6	0	NW	5	5.75	6.000	130	CAVU
06/05/01	0:15	6	6	95	NW	10	5.75	6.500	135	cloudy
06/05/01	11:56	10	7	100	NW	10	6.00	6.375	132	rain
06/06/01	0:05	5	6	50	NW	5	5.75	6.750	135	calm
06/06/01	12:10	9	6	100	NW	5	5.75	6.625	131	cloudy
06/07/01	0:10	4	6	0		0	7.00	7.500	130	CAVU
06/07/01	12:10	10	6	100	SE	5	7.00	7.500	135	cloudy
06/08/01	0:10	5	7	25		0	6.75	6.375	137	calm
06/08/01	12:10	8	7	50	SE	5	6.75	6.500	130	sunny
06/09/01	0:30	4	6	0		0	6.50	6.125	130	CAVU
06/09/01	12:10	17	8	10		0	6.50	6.250	133	CAVU
06/10/01	0:10	9	8	25	NW	5	6.75	6.500	128	calm
06/10/01	12:10	8	8	25	NW	10	7.25	6.875	128	sunny
06/11/01	0:15	6	8	50	NW	15	7.25	6.500	125	windy
06/11/01	12:40	10	8	50	NW	20	7.25	6.750	125	windy

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Appendix C. (page 4 of 6)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
06/12/01	0:10	6	8	50	NW	15	7.00	6.375	131	windy
06/12/01	12:10	6	7	50	NW	20	7.00	6.500	135	windy
06/13/01	0:05	6	7	90	NW	10	6.50	6.375	125	cloudy
06/13/01	12:15	9	8	75	NW	10	6.50	6.250	135	cloudy
06/14/01	0:10	7	8	80	NW	10	6.50	6.250	130	cloudy
06/14/01	12:00	9	7	80	NW	10	6.50	6.500	130	cloudy
06/15/01	0:00	6	7	95	NW	20	7.50	6.750	130	windy and cloudy
06/15/01	12:10	6	7	50	NW	15	7.00	6.500	138	windy
06/16/01	0:10	7	7	0	NW	10	7.50	6.875	135	CAVU
06/16/01	12:10	12	8	0	NW	5	7.50	6.750	135	CAVU
06/17/01	0:10	9	8	0	SE	5	7.50	6.750	135	CAVU
06/17/01	12:15	13	8	50	SE	10	7.50	7.000	135	sunny
06/18/01	0:15	8	8	50		0	7.00	6.375	132	calm
06/18/01	12:15	8	8	75	SE	15	7.00	6.500	135	cloudy
06/19/01	0:10	8	8	100		0	7.50	6.375	135	calm
06/19/01	12:10	15	8	80	NW	5	7.25	6.500	141	cloudy
06/20/01	0:25	9	8	100	NW	10	7.25	7.500	150	cloudy
06/20/01	12:10	19	9	50	NW	15	7.50	7.250	155	windy
06/21/01	0:06	7	8	10	NW	20	6.75	7.000	178	windy and CAVU
06/21/01	13:00	13	9	0	NW	5	6.75	7.000	178	CAVU
06/22/01	0:10	9	9	0		0	7.50	7.000	170	CAVU
06/22/01	12:10	15	9	35	SE	10	7.75	7.000	150	sunny
06/23/01	0:10	9	9	100	SE	5	8.00	6.875	165	cloudy
06/23/01	12:05	10	8	100	SE	5	8.00	7.375	155	cloudy
06/24/01	0:10	8	9	10		0	10.25	7.250	170	cloudy
06/24/01	12:20	13	9	75		0	10.00	8.125	185	sunny
06/25/01	0:15	9	9	100	NW	15	9.50	8.000	170	cloudy
06/25/01	12:15	8	8	100	NW	10	9.00	7.750	170	cloudy
06/26/01	0:00	7	8	35	NW	15	9.50	8.125	160	windy
06/26/01	12:10	9	9	25	NW	30	11.00	9.750	165	windy and sunny

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Appendix C. (page 5 of 6)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
06/27/01	0:00	9	8	20	NW	20	8.25	8.000	165	windy
06/27/01	12:15	14	9	0	NW	15	8.50	8.500	165	windy and CAVU
06/28/01	0:10	10	9	25	NW	5	8.50	8.500	165	
06/28/01	12:15	12	9	10	NW	10	8.50	8.500	160	sunny
06/29/01	0:10	12	10	95		0	10.50	8.125	170	calm
06/29/01	12:15	11	9	100		0	10.50	8.875	175	rain
06/30/01	0:10	9	9	100	SE	10	9.00	9.500	175	rain
06/30/01	12:00	10	9	100	SE	5	9.50	8.375	165	rain
07/01/01	0:15	10	9	100	SE	5	10.00	8.000	178	rain
07/01/01	12:30	11	9	100	SE	5	9.50	8.000	175	cloudy
07/02/01	0:15	9	9	100		0	10.50	8.125	175	cloudy
07/02/01	12:30	12	10	100	NW	10	10.50	9.500	170	cloudy
07/03/01	0:20	9	9	50	NW	5	10.50	9.125	165	calm
07/03/01	12:15	11	9	80	NW	5	10.25	9.250	165	cloudy
07/04/01	0:10	10	9	100	NW	5	9.25	9.500	170	cloudy
07/04/01	12:00	10	9	100	NW	10	10.50	9.750	175	cloudy
07/05/01	0:07	9	9	100	NW	20	10.25	8.500	175	windy and cloudy
07/05/01	12:15	8	9	100	NW	30	10.50	9.750	175	windy and rain
07/06/01	0:10	6	9	90	NW	15	11.25	9.625	180	windy and rain
07/06/01	12:15	7	9	50	NW	20	11.00	9.500	180	windy
07/07/01	0:15	7	9	25	NW	15	9.25	8.500	175	windy
07/07/01	12:10	6	9	10	NW	5	11.25	8.500	168	sunny
07/08/01	0:20	7	9	10	NW	5	10.25	9.125	168	calm
07/08/01	12:15	11	9	75	NW	5	10.50	9.000	160	cloudy
07/09/01	0:30	8	9	100	NW	5	9.25	8.625	160	cloudy
07/09/01	12:15	12	10	100		0	9.25	9.000	155	calm and cloudy
07/10/01	0:00	9	9	100		0	9.00	8.500	160	rain
07/10/01	12:30	12	10	95		0	9.00	8.750	152	calm and cloudy
07/11/01	0:15	10	9	100	SE	5	8.75	8.250	158	rain
07/11/01	12:15	11	9	100	NW	5	8.50	8.000	145	rain
07/12/01	0:15	9	10	100	NW	5	8.75	7.500	151	cloudy
07/12/01	12:15	12	10	100	NW	5	8.50	7.500	140	cloudy

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Appendix C. (page 6 of 6)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Trap Revolutions (rpm) Large	Stream Gauge (cm)	Comments
07/13/01	0:15	10	9	100		0	8.00	6.000	148	calm and cloudy
07/13/01	12:15	12	10	100		0	8.00	6.000	135	calm and cloudy

[a] Actual calender dates.

[b] Based on observer estimates.

Appendix D. Distribution list.

Individual	Organization	Address	# of copies
Chuck McCallum	Chignik Regional Aquaculture Assn.	2731 Meridian #B Bellingham WA 98225	10
Hazel Nelson	Lake and Peninsula Borough	1577 C St. Suite 330 Anchorage AK 99501	1
Mark Witteveen	ADF&G	Kodiak ADF&G Office	1
Steve Honnold	ADF&G	Kodiak ADF&G Office	1
George Pappas	ADF&G	Kodiak ADF&G Office	1
Nick Sagalkin	ADF&G	Kodiak ADF&G Office	1
Kenneth Bouwens	ADF&G	Kodiak ADF&G Office	1
Jim McCullough	ADF&G	Kodiak ADF&G Office	1
Drew Crawford	ADF&G	Anchorage ADF&G Office	1
Ira Edwards	ADF&G	PO Box 148 Palmer AK 99645	1
Hector Bravo	ADF&G	Kodiak, AK 99615	1