ADF&G TECHNICAL DATA REPORT NO. 141
(Limited Distribution)

STATE OF ALASKA
Bill Sheffield, Governor

PINK (*Oncorhynchus gorbuscha*) AND CHUM SALMON (*O. keta*) INVESTIGATIONS IN SOUTHEASTERN ALASKA, 1982-1983

By:
Jesse D. Jones
Gregory Thomason
Jim Dangel
and
Karl Hofmeister

March 1985

ALASKA DEPARTMENT OF FISH AND GAME
P.O. Box 3-2000, Juneau, Alaska 99802

Don W. Collinsworth
Commissioner

ADF&G TECHNICAL DATA REPORTS

This series of reports is designed to facilitate prompt reporting of data from studies conducted by the Alaska Department of Fish and Game, especially studies which may be of direct and immediate interest to scientists of other agencies.

The primary purpose of these reports is presentation of data. Description of programs and data collection methods is included only to the extent required for interpretation of the data. Analysis is generally limited to that necessary for clarification of data collection methods and interpretation of the basic data. No attempt is made in these reports to present analysis of the data relative to its ultimate or intended use.

Data presented in these reports is intended to be final, however, some revisions may occasionally be necessary. Minor revision will be made via errata sheets. Major revisions will be made in the form of revised reports.

PINK *(Oncorhynchus gorbuscha)* AND CHUM SALMON *(O. keta)* INVESTIGATIONS IN SOUTHEASTERN ALASKA, 1982-1983[1]

By

Jesse D. Jones

Gregory Thomason

Jim Dangel

and

Karl Hofmeister

Alaska Department of Fish and Game
Division of Commercial Fisheries
Juneau, Alaska 99802

March 1985

[1] This investigation was partially financed by the Anadromous Fish Conservation Act (P.L. 89-304 as amended) under Project No. AFC-71.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Data collection, data base development, and forecast analysis continued as the pink *(Oncorhynchus gorbuscha)* and chum *(O. keta)* salmon project's primary activities. The 1983 pink salmon return was very strong in both the northern and southern areas of the Southeastern Alaska region with a total combined return of almost 50 million fish. Both harvests and escapements were excellent in most areas. The area with the majority of the harvest was District 104 with a 16.8 million harvest, almost four times the previous high catch for that district and double the harvest of any other single district in 1983. Escapements were generally very good with total escapements in southern Southeastern exceeding any in the past 23 years, and the northern Southeastern's escapement was second only to 1979 during the same period. Early marine survival studies of pink and chum salmon continued for the seventh year in Tenakee Inlet, and for the third consecutive year in the Ketchikan and Sitka areas. In Tenakee Inlet, for 1978-83, there was a significant positive correlation between pink fry average length in May and subsequent adult return per spawner ($r = 0.88$, $P < 0.05$). Spotlighting at night has proven to be a very effective tool for sampling pink and chum fry. In the Ketchikan area, 1982 fry averaged the smallest of all fry from 1981 through 1983, which would portend poor survival, yet they returned as adults in unusually large numbers in 1983. Warmer water temperatures caused by the El Niño current phenomenon may have played a part in this excellent survival. Work on optimum escapements (published in a separate report) centered on determining stream life of adult salmon which can be used to greatly improve estimates of spawning populations.

KEY WORDS: Pink salmon, *Oncorhynchus gorbuscha*, chum salmon, *O. keta*, forecast, return, early marine survival.

INTRODUCTION

The Pink and Chum Salmon Investigations primary objective is to assist fisheries managers in obtaining the optimum number of pink *(Oncorhynchus gorbuscha)* and chum *(O. keta)* salmon into the streams by projecting the size, distribution, and general timing of the return. Specific project objectives are as follows:

1) Continue developing techniques and background data for accurate forecasts of the pink salmon returns to the benefit of the resource, fishermen, processors, and fisheries managers;

2) Determine optimum escapement levels for pink and chum salmon by stream system for each stream in Southeastern Alaska, and if time allowed;

3) Investigate the relationship of estuarine enviromental conditions with the survival of juvenile pink and chum salmon. Once yearly marine survival can be estimated it can be utilized to help improve forecast estimates of the return.

This report describes studies directed at achieving the above objectives during the period from July 1, 1982 through June 30, 1983.

PINK SALMON FORECAST DEVELOPMENT

1983 Forecast

The 1983 pink salmon return was very strong in both northern and southern Southeastern Alaska with an estimated total return of 49.9 million. Harvests in the region totaled 37.3 million fish (Figure 1) with 31.4 coming from the southern districts (Districts 1 through 8), and 5.9 million from the northern areas (Districts 9 through 15, Figure 2).

Southern Southeastern:

The 1983 pink salmon return to southern Southeastern Alaska of 40.6 million (Appendix Table 1) was over twice the expected forecasted return of 18.4 million. The reason for this large return is largely unknown. Parent year escapements of 5.6 million in 1981 (Appendix Table 2) were the third highest since 1960 (Figures 3 and 4), but were slightly less than those that produced the disappointing return in 1982. Winter temperatures, which have in previous years shown a high correlation with survival, were only average. Even with the benefit of hindsight there was no apparent combination of variables which would have produced a prediction close to the actual return which occurred in 1983.

Pink salmon harvests in all districts except District 4 were slightly above expectations. The catch in District 4 was 16.8 million (Appendix Table 3), almost four times the previous high catch of 4.6 million in 1982. If the majority of the catch from this district was from fish destined for southern Southeastern streams then one explanation could be unexpected high ocean survival, but at this point it is unclear whether the forecast error was the result of external, previously unmeasured effects (oceanic conditions) or an underestimation of the freshwater

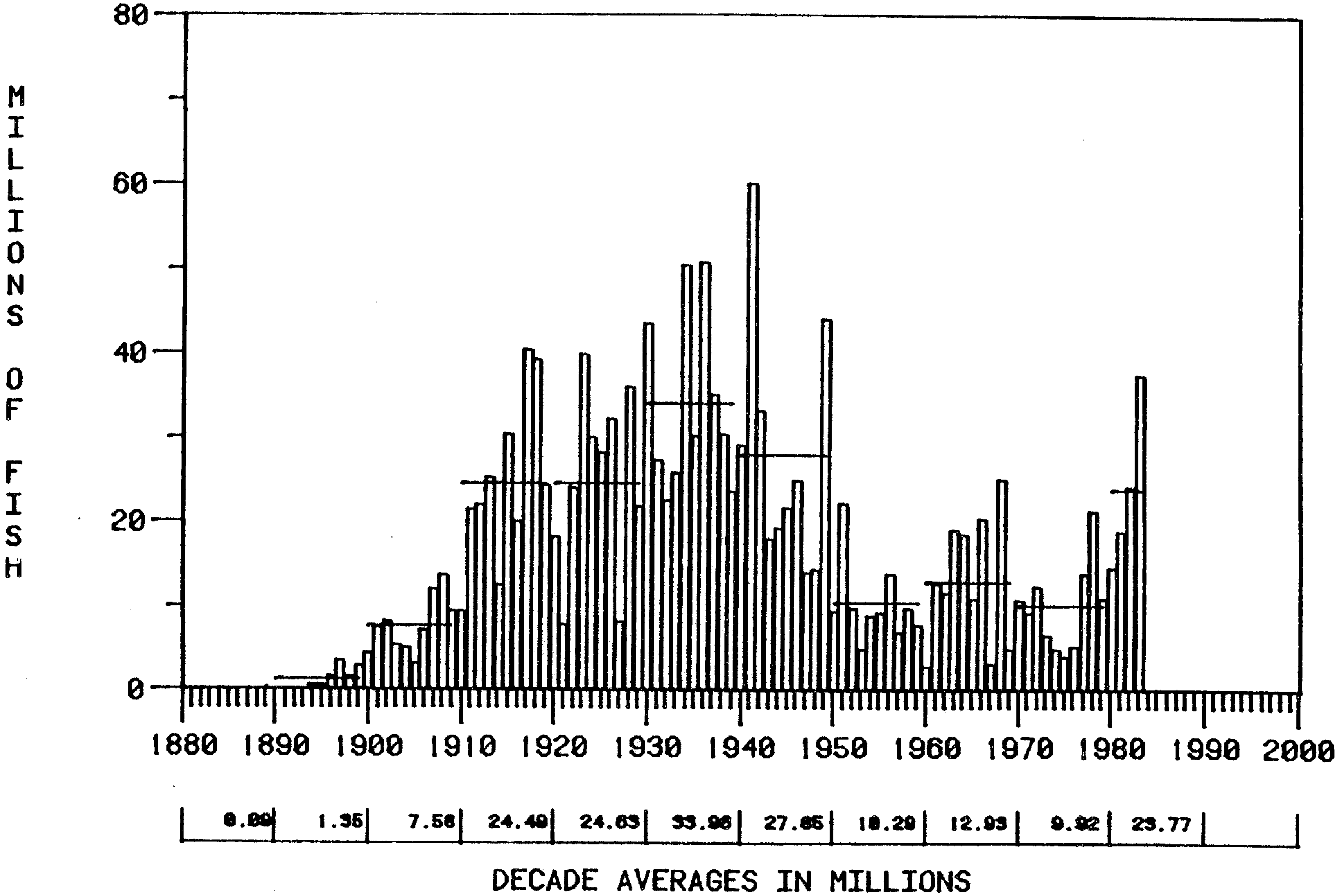

Figure 1. Southeastern Alaska region historical commercial pink salmon catches by all gear, 1889 to present.

Prepared: ADF&G 8/21/84.

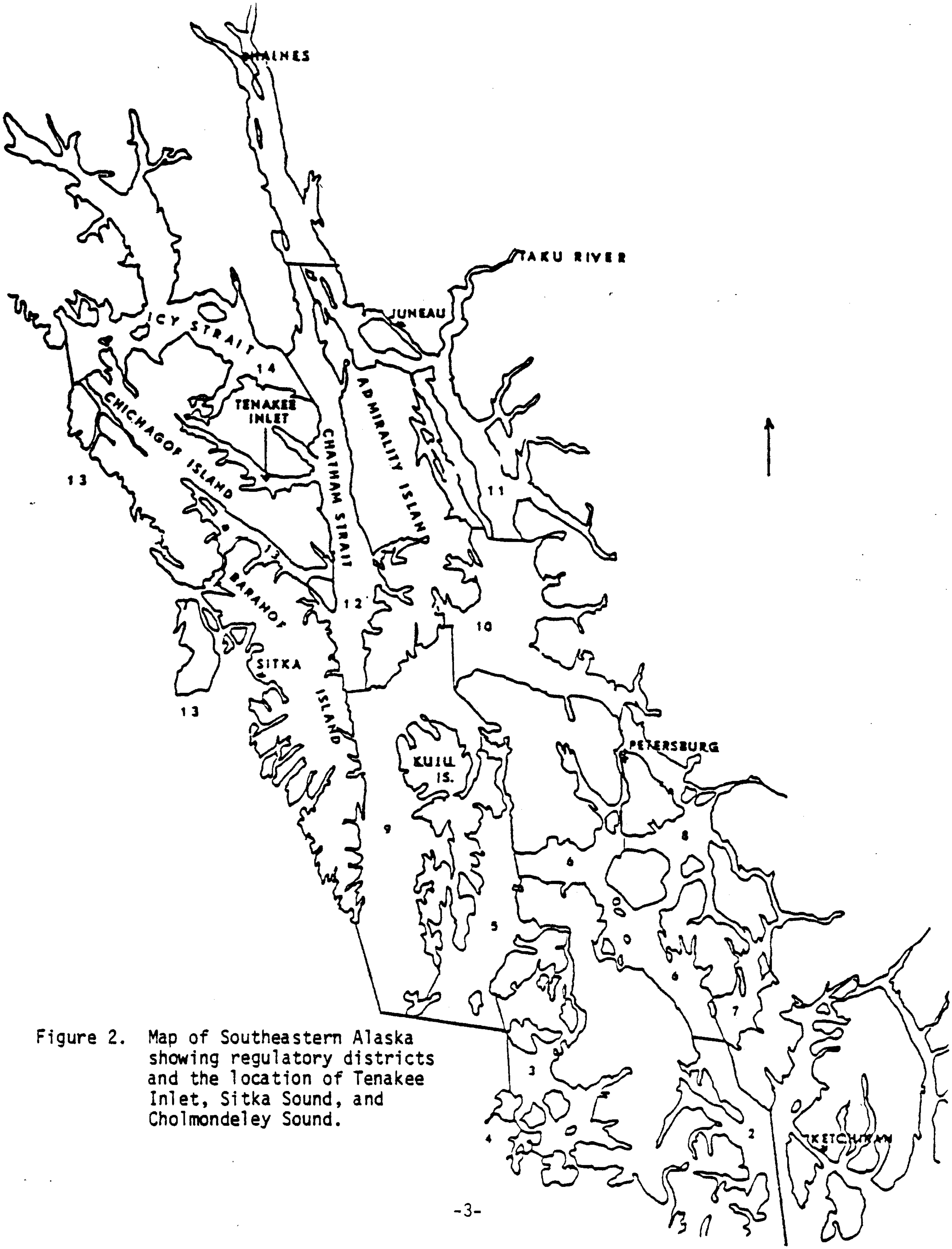

Figure 2. Map of Southeastern Alaska showing regulatory districts and the location of Tenakee Inlet, Sitka Sound, and Cholmondeley Sound.

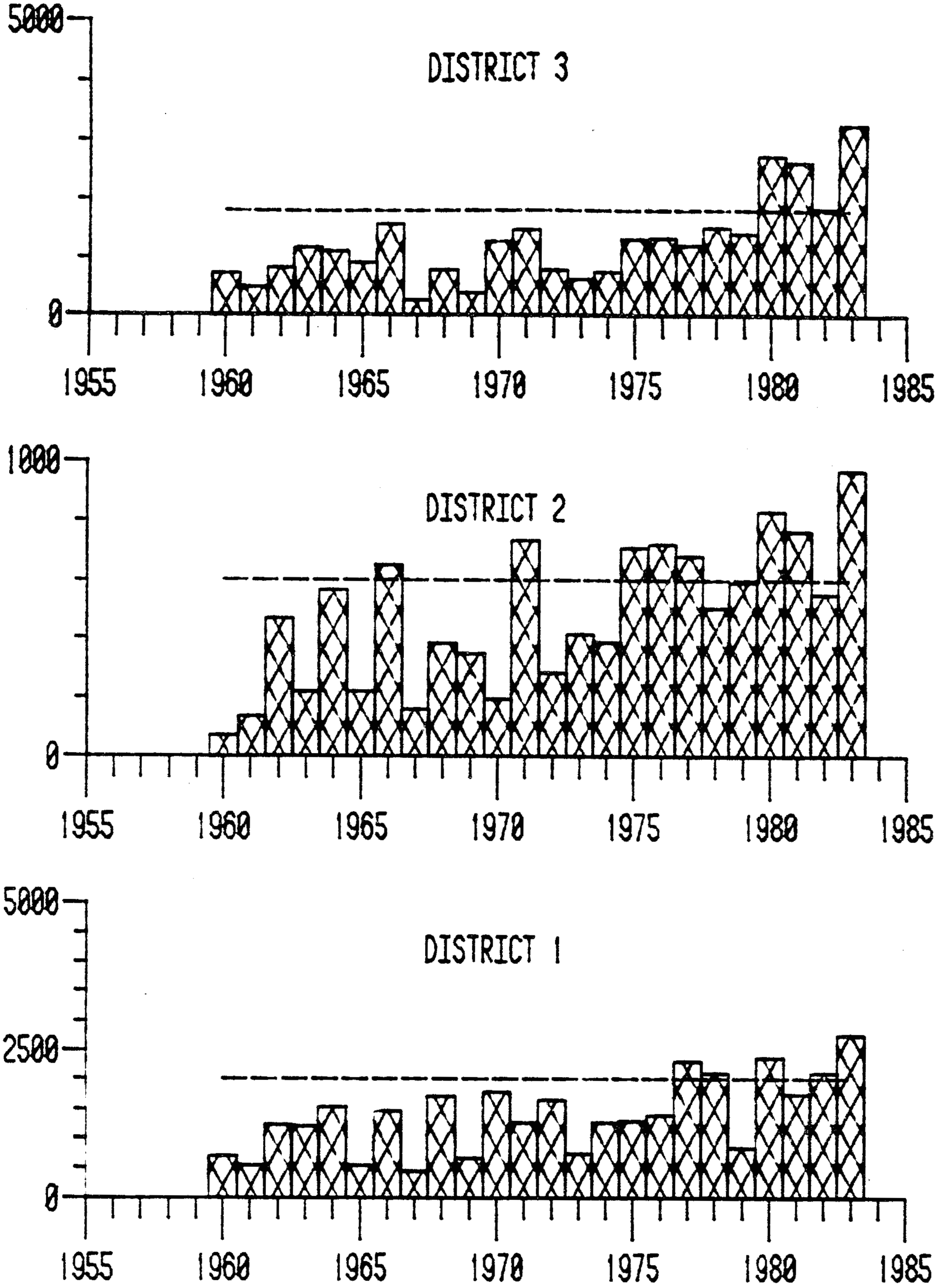

Figure 3. District escapement and escapement goals for Districts 1, 2, and 3.

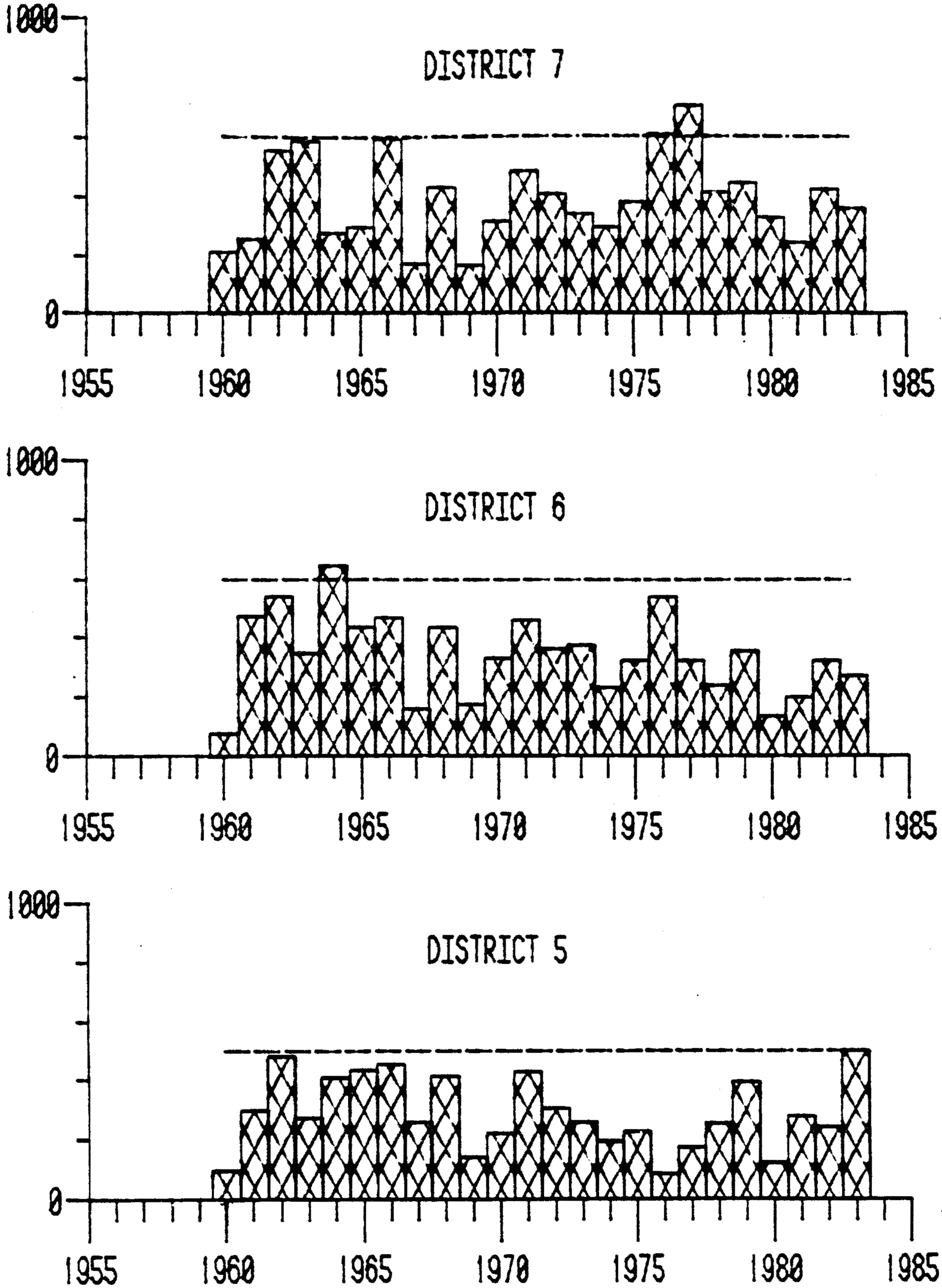

Figure 4. District escapement and escapement goals for Districts 5, 6, and 7.

overwinter and early marine survival rates from the near record escapement in 1982.

Northern Southeastern:

The return to the northern districts was also well over expected levels at 10.5 million salmon (Appendix Table 1). However, had the coastal upwelling index (which was unavailable at the time of forecast publication) off the coast of Baranof Island been included in the forecast regression the pre-season forecast would have been very close to the actual return.

The total escapement of 4.7 million (Appendix Table 4) in the northern districts met, exactly, the desired goal of 4.6 million fish. Escapements to five of the six northern districts (Districts 9, 10, 11, 12, and 14) (Figures 5 and 6) improved over parent year levels in 1981. The District 13 escapement of approximately 1.9 million (Appendix Table 4), while somewhat below parent year levels, did meet the goal set for that district.

Harvests in northern Southeastern were strongest in District 13, as forecast, with a catch of 2.4 million pink salmon in the purse seine fishery and 0.2 million in the troll fishery (Appendix Table 3). Another 114 thousand pink salmon were harvested from hatchery returns in District 13. District 12 had a harvest of 1.9 million pink salmon, primarily in the purse seine fishery, and Districts 9 and 14 had catches of 0.6 and 0.5 million salmon, respectively.

1984 Forecast

The 1984 forecast for both northern and southern Southeastern is strong as a result of excellent escapements and good overwinter conditions.

Southern Southeastern:

A total of 26.0 million pink salmon are expected to return to southern Southeastern, (Districts 101 through 108) in 1984. Although winter air temperatures were not included in the prediction because of a low correlation, they did account for two of the three largest hindcast errors. An overestimation of 8.5 million which occurred in 1973 corresponded to the lower winter temperatures of the study period. The largest underestimate was 6.1 million which occurred in a year when winter temperatures were the third highest of the period and almost identical to those which have affected the 1984 return. Consequently, it is possible the return will come in near the upper end of the range.

The distribution of the return is expected to be similar to 1983, with the majority of the harvest occurring on the west coast of Prince of Wales Island. The return to District 101 should produce a somewhat larger proportion of the overall harvest than it did in 1983, as it had the largest escapement index in the parent year.

Caution will again have to be exercised in Districts 105 and 108 as the extended fishing times, which will be required to harvest the excess fish returning to the southern portions of southern Southeastern, will intercept many of the fish returning to the northern portions of southern Southeastern.

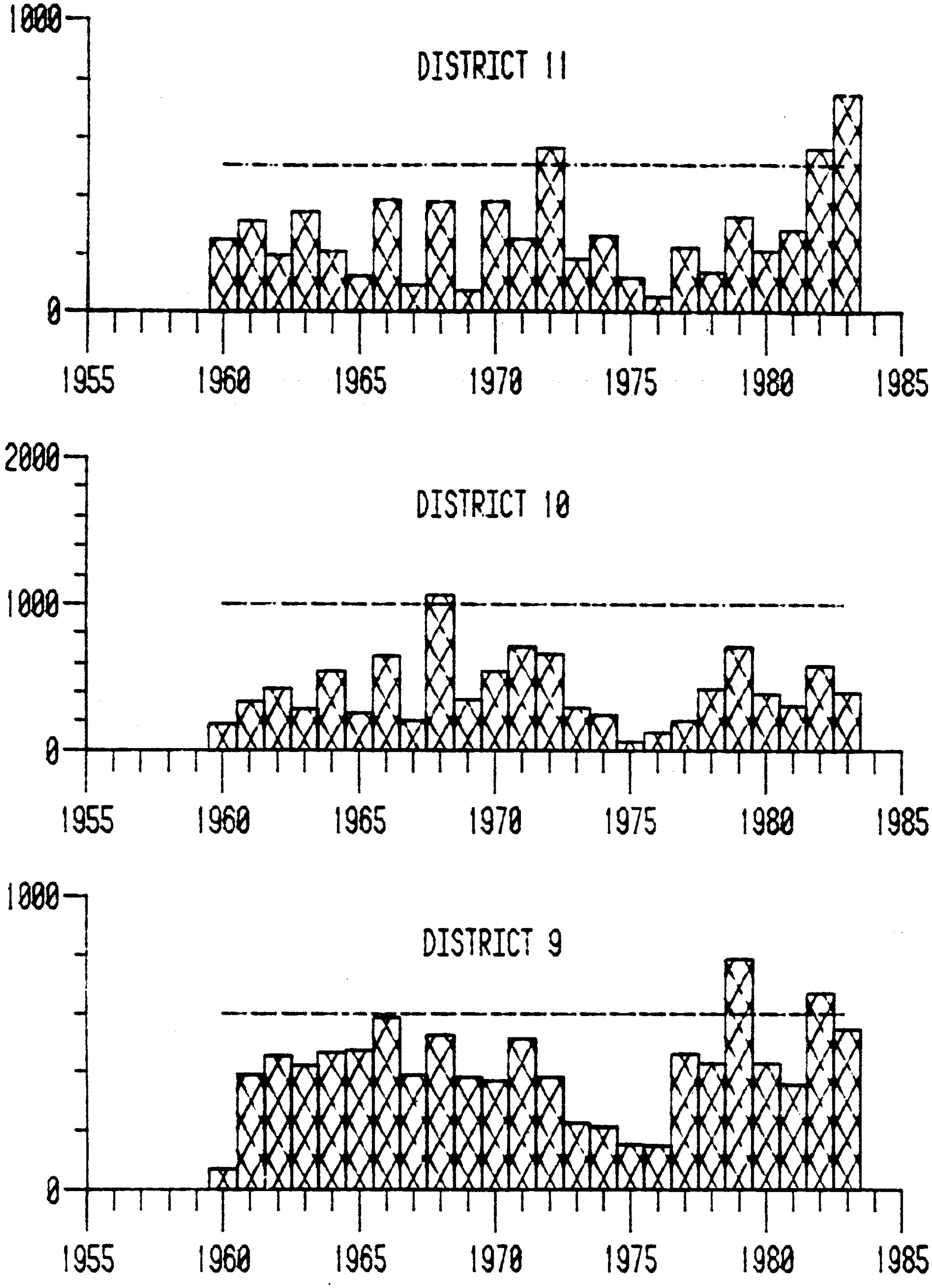

Figure 5. District escapement and escapement goals for Districts 9, 10, and 11.

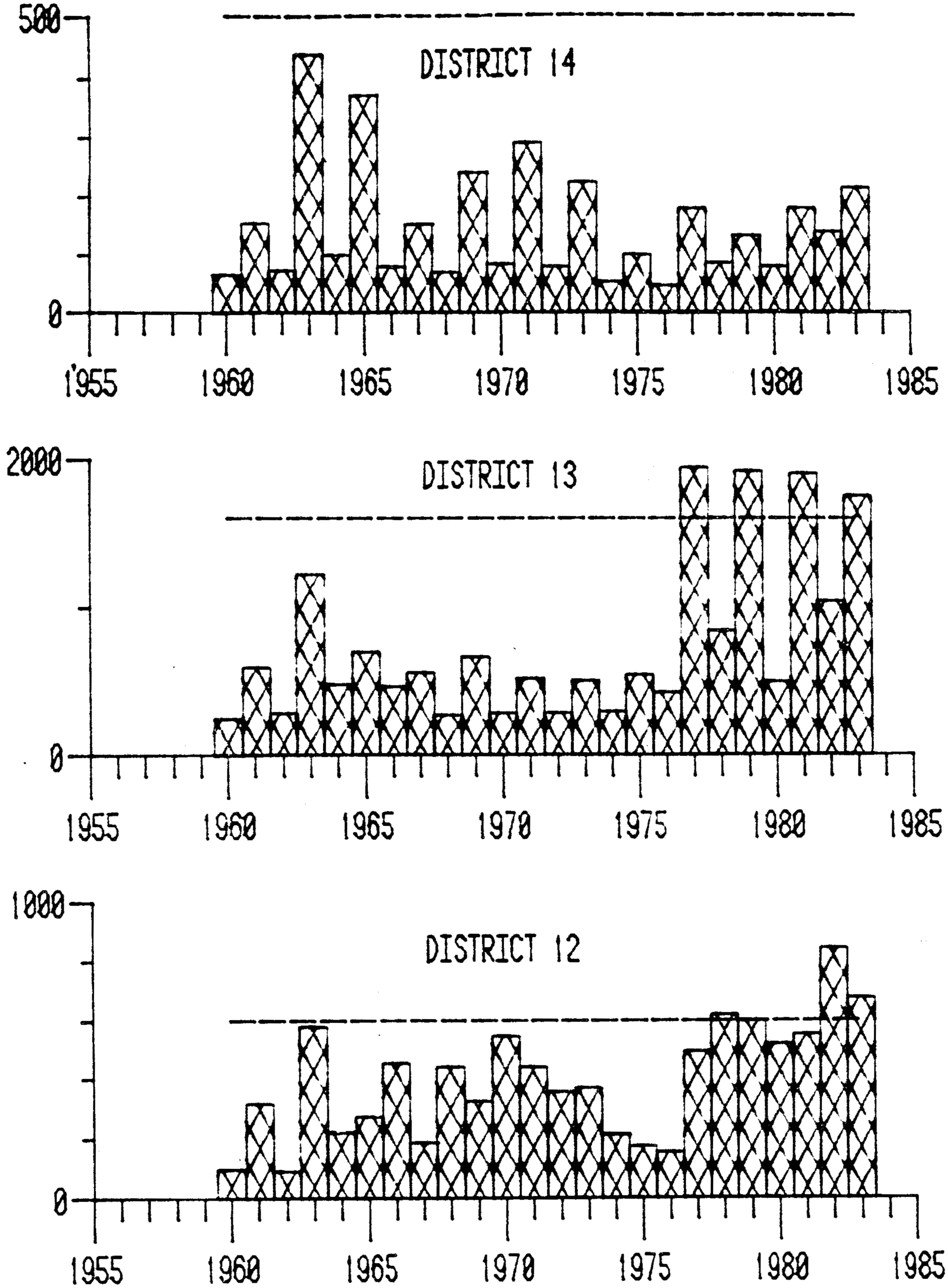

Figure 6. District escapement and escapement goals for Districts 12, 13, and 14.

Northern Southeastern:

The high forecast of 14.2 million pink salmon for northern Southeastern is a result of excellent parent year escapements in 1982. Escapements were particularly good in Districts 109, 111, 112, and District 113 but were somewhat below desired levels in Districts 110 and 114. The overall escapement of 4.1 million in northern Southeastern was the second largest since 1960 and this, combined with the very mild winter and favorable spring conditions, should produce very strong returns to the inside areas.

Overall escapements to District 109 were the second best since 1960, at 708,000, but the overall district fry index of 117.9 fry-per-meter was somewhat disappointing. Escapements in the lower Baranof Island streams were good; the highest since 1963, and the pre-emergent fry index was better than any since 1977, hence some harvestable surplus is expected from the streams in this area. Escapements in the other areas of the district were also fairly strong and some harvest is likely.

District 110 had an overall escapement below desired levels but the resulting fry index was one of the best ever. Overall escapements to the mainland streams were the second best in the past 20 years and harvestable surpluses are expected from these stocks. Escapements to the District 110 streams on Admiralty Island were somewhat below the recent 22-year average but the fry indices were fairly high indicating good overwinter survival. Chances are fair for harvestable surpluses from these stocks in 1984.

District 111 escapements were very strong, overall, and the pre-emergent fry index was over double that for any other year since the program was initiated in 1966. The Seymour Canal streams had average escapements but pre-emergent fry values were excellent, so that possibility of harvestable returns is good. The Taku River systems had very good escapements in the parent year and are also expected to produce good returns. The pre-emergent fry program does not include any sampling on the Taku systems, however, so no overwinter survival estimates are available.

Escapements and pre-emergent fry values were generally good in District 112. The west Admiralty streams, in particular, had strong escapements and very good pre-emergent values. Tenakee Inlet had good escapements and the overall fry index for the inlet was the best since 1971.

District 113 had the best even-year escapement ever recorded, with a total escapement of over one million pink salmon in the parent year. Escapements to the outside areas were strong but the fry index was disappointing. The Peril Strait streams had very strong escapements and a good fry index, so they are expected to produce some commercial harvest.

District 114 escapements were poor and the overall fry index was correspondingly low. Any harvest from this district will be minimal.

OPTIMUM ESCAPEMENT STUDIES

No funds were specifically allocated for optimum escapement studies during the study period. Work was conducted by this project, however, in conjunction with the U.S./Canada Salmon Interception Studies on stream life of pink salmon (Thomason and Jones 1984) which will directly benefit optimum escapement work in the region.

The current escapement index method uses the largest single survey during the season as an indicator of the total escapement for the year. Often the streams are not surveyed during the peak of the run and frequently the largest survey must be used, regardless of when it occurred relative to the peak of the run, as an indicator of that stream's escapement. This method can result in a serious underestimate of a stream's escapement by as much as 50%.

Using stream life, a mathematical model is being developed to calculate an estimate of total stream escapement which will then allow much finer adjustment of optimum escapement levels.

EARLY MARINE SURVIVAL STUDIES

Introduction

Early marine survival studies of pink and chum salmon continued in 1983 for the seventh year in Tenakee Inlet, the sixth year in the Ketchikan area, and the third year in the Sitka area. The primary purpose of these studies is to improve the reliability of the pink salmon adult return forecast.

Pink salmon returns to Southeastern Alaska have been forecast since 1967 with variable success. Through 1983, the forecast has been based on egg to fry survival from approximately 5,800 samples of pre-emergent fry from 95 streams in the region. One of the weaknesses of the current forecast is that, because of a lack of data, marine survival must be assumed to be constant. We know, however, that it is not constant and can vary greatly from year to year. The early marine survival studies of fry are intended to help improve the forecasts by providing an estimate of how much and why early marine survival varies from year to year.

Objectives

The objectives of the early marine survival studies in all three areas are as follows:

1) To determine the outmigration timing, abundance, and size of pink and chum salmon fry migrating from selected streams, and relate this to abundance of returning adult salmon.

2) To measure abundance, distribution, and growth of pink and chum salmon fry in marine nursery areas associated with the selected streams, and relate this to abundance of returning adults.

3) To measure changes in selected environmental parameters and to determine if any relationship exists among these parameters and pink and chum fry migration timing, abundance and size, and/or the subsequent abundance of returning adults.

For purposes of clarity and continuity each of the three areas will be covered separately with its own methods, results, and discussion sections.

Tenakee Inlet

In 1983 the early marine survival studies were continued in the Tenakee Inlet area.

Methods:

Our methods in 1983 in Tenakee Inlet fell into two categories: those for monitoring fry populations, and those for monitoring physical parameters.

Timing, Abundance, and Size of Fry: Pink and chum salmon fry migrating from the Kadashan River, which drains into Tenakee Inlet (Figure 7), were sampled three to four times per week, from 5 April to 26 May. Sampling occurred in the east fork only, with a 46 by 91 cm, 6.0 mm stretched mesh standard fyke net with a detachable live box.

During 1983 we sprayed-marked 38,000 pink and chum salmon fry, caught in the Kadashan River fyke net, with fluorescent dye colors. This was the third year of spray-marking. Our purpose was to recapture the fry later in Tenakee Inlet and measure their growth, migration rates and directions. Colors used were orange, red, and green. Orange was applied on 13 and 14 April, red on 19 and 20 April, and green on 26 April. Tagging and recovery methods are described in Jones et al. (1982) and Gray et al. (1978).

The fyke net was fished from 1900 to 0100 hrs in a vertical position except on the dates mentioned above, when it was fished from 1900 to 0700 hrs in a horizontal position to ensure capture of as many fry as possible. Catch data from the longer time periods (horizontal positions) were converted later to a standard time period and vertical position equivalent to retain comparability of catch data from year to year.

Fry were removed from the live box at regular intervals throughout the night and placed in a holding pen. The following morning, they were either counted directly (if less than 1000± were present), or their total number estimated volumetrically. Species composition was determined from a subsample. When marking was scheduled fry were spray-marked with the fluorescent dye. We marked 50-100 at a time, from a distance of 10-12 inches with SCUBA tanks as our pressurized (100 psi) air source (Thomason 1982). The fry were marked early in the morning and held until late evening darkness (fry normally migrate only after dark), when all mortalities were noted, and they were then released.

Samples of pink and chum salmon fry for length and weight analysis were taken twice each week during the netting period and preserved in 10% formalin. Following a minimum of 40 days in the formalin solution the fry were removed, rinsed, dried with paper towels to remove excess water, then wet-weighed (mg) and measured (to 0.1 mm). Length and weight data were later entered into a computer data file for analysis.

Fry abundance in Tenakee Inlet was monitored at least once each week by conducting visual surveys along an index transect at Cannery Point (Figure 7). The peak

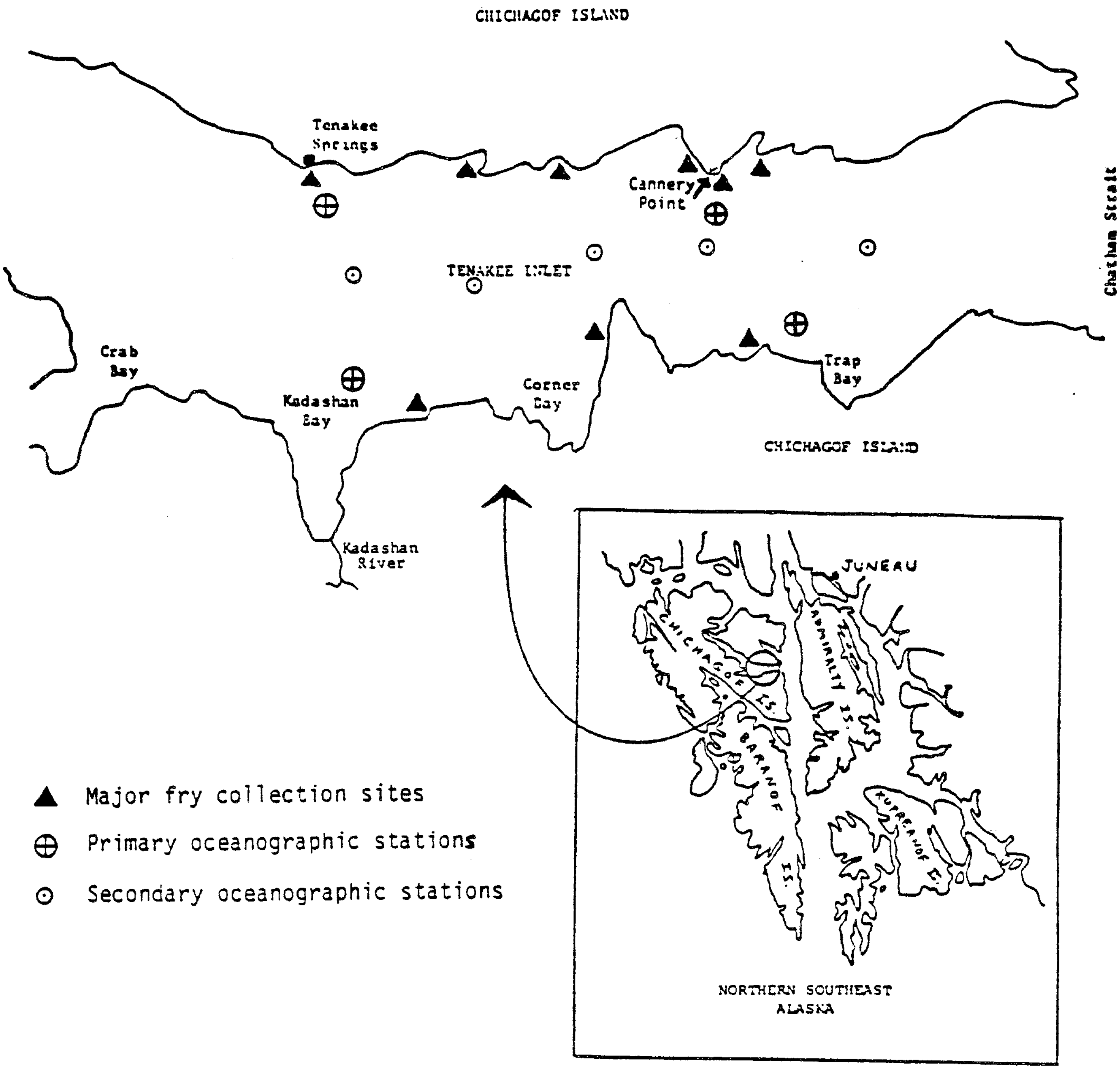

Figure 7. Major fry collection sites, primary and secondary oceanographic stations, and the location of Cannery Point, Tenakee Inlet, April-June, 1983.

Cannery Point count was expanded by a factor of 4.63 to obtain a peak count comparable with previous years' peak counts of combined transects (Jones et al. 1982). Fry were counted by one person wearing polarized sunglasses and standing in the bow of a 4 m skiff. The skiff was driven along the shoreline in water as shallow as possible, at speeds less than 6 knots. Numbers and locations of fry were recorded directly on maps at the time of observation. When the species composition of schools of fry could not be determined visually, or when fry samples were needed for growth determination, a dip net, beach seine, or purse seine was used to collect the fish for identification or preservation. The beach seine measured 38.5 m long by 1.8 m deep, with a uniform rectangular mesh of 3.2 x 6.4 mm. The purse seine was 46.1 m long, with a depth of 3.0 m in the center section (which was 15.2 m long, one-third of the total length). The outer two sections on each end of the seine (each also 15.2 m long) tapered from a maximum depth of 3.0 m closest to center, out to a depth of 0.9 m at each end of the net. The purse seine mesh was uniform 3.2 mm bar mesh throughout.

Fry were regularly collected from several locations in Tenakee Inlet including Cannery Point. They were processed in a manner identical to that of fry from the river, i.e., preserved in formalin for a minimum of 40 days, then weighed and measured, with the data entered on a computer file.

Physical Parameters: The Kadashan River water temperature (°C) and level (cm) were monitored daily at 1900 hrs at the fyke net site, throughout the sampling period.

The Tenakee Inlet water temperature, salinity, and clarity (secchi disc readings) are monitored twice weekly from early April to late May at the primary and secondary oceanographic stations shown in Figure 7. Temperatures and salinities were measured with a Beckman RS5-3 temperature/salinity/conductivity meter with a 15 m probe. Recordings were taken at 1 m intervals from the surface down to 10 meters, then at 12 and 14 meters.

Temperatures and salinities taken at least weekly at 2 m depth were used in data analysis, as readings at this depth are more stable than at shallower readings, yet still well above the thermocline/halocline and, therefore, quite representative of waters inhabited by fry. Clarity was measured with a 20 cm diameter secchi disc.

Results:

Results are presented here from our two main areas of study: fry populations (including the marking study) and physical parameters.

Timing, Abundance, and Size of Fry: In 1983, as in all the previous study years, the fry outmigration in the Kadashan River was already in progress (though in its earliest stage) when fyke netting began on 5 April (Appendix Table 5). The catch of both pink and chum salmon fry peaked on 2 May. The average water temperature for the major portion of the fry sampling periods was 5.8°C (Appendix Table 5). In 1983, 90% of the season's fyke net catch of pink salmon fry was caught by 9 May, that of chum salmon fry by 7 May. Pink salmon fry in the fyke net catches increased from 32.6 mm to 32.8 mm in length from April to May and from 220.6 mg to 222.8 mg in weight (Appendix Table 6). Chum salmon increased from 37.8 mm to 38.7 mm in length from April to May and from 395.4 mg to 429.3 mg in weight (Appendix Table 7).

The peak number of pink salmon fry observed in Tenakee Inlet in 1983 (extrapolated from Cannery Point index counts) was 717,650, the second lowest peak number of fry seen in the 7 years of this study. No chum salmon fry were observed or collected at Cannery Point in 1983. Neither were chum fry ever seen from the boat at locations other than Cannery Point during the searches for schools to sample for lengths and weights. Nevertheless, chum fry were collected, always in association with pink salmon fry, which reinforces the previously documented unreliability of visual estimates for identifying chum fry in large schools of mixed species (Jones et al. 1982).

Pink salmon fry sampled in Tenakee Inlet increased from an average length and weight of 33.5 mm and 229.7 mg, respectively, in April to 39.9 mm and 436.2 mg in May (Appendix Table 6). Chum salmon fry grew from an average length and weight of 40.5 mm and 392.4 mg, respectively, in April, to 43.8 mm and 621.7 mg in May (Appendix Table 7).

In 1983, we plotted the average pink fry fork length in May for 1977-1982 in Tenakee Inlet against the subsequent total adult pink salmon return per spawner ("return" is the escapement to all major spawning streams plus the commercial catch in subdistricts 112-42 and 112-45 of Tenakee Inlet. We found a significant positive relationship between these parameters $r = 0.88$, $P < 0.05$, $n = 6$) (Table 1, Figure 8). Thus, it appears that the average length of pink fry in Tenakee Inlet in May can be used to predict the following year's return of adult pink salmon with a high degree of confidence.

On 5 May 1983 we repeated the nighttime spotlighting observations of salmon fry along shorelines in Tenakee Inlet which began in 1982. In 1983, the 300,000 candlepower spotlight attracted fry in large numbers, and did this consistently over all shorelines transversed, throughout the entire period of darkness (roughly 2230 hours to 0300 hours). These results are in sharp contrast to those in 1982, when the same spotlight on 10 June failed to attract fry. Because spotlighting in 1983 occurred on 5 May, more than a month earlier than in 1982, we were dealing with fry that, on average, were smaller, younger, and in greater numbers in 1983 than in 1982. Whether these differences were really responsible for the attraction to light we observed in 1983, and if so, how these differences resulted in the attraction to the spotlight, is unknown.

Another result associated with attempted light attraction was that fry sampled at night 30 m offshore (at Sunshine Pt., using the spotlight and dip net) were significantly longer and heavier (both $P = 0.0001$) than fry collected next to shore at the same time and location, using the same dip net and spotlight. Thus, apparently larger fry were moving offshore at least at night, as the season progressed. These night observations verified our previous daytime sightings and purse seine collections of larger fry offshore (Jones et al. 1982).

Our recovery efforts in Tenakee Inlet in relation to the fluorescent tagging study conducted in Kadashan River netted only three marked salmon fry in 1983. These were too few recoveries to make any valid conclusions about fry movements or growth rates.

Table 1. Pink salmon fry average fork length in May and following-year adult return per spawner (R/S), Tenakee Inlet, for fry years 1977-1982.

Fry Year (Year Y)	Average Fry Fork Length (mm) in May (Year Y)	Adult Return per Spawner (R/S, Year Y+1)
1977	45.4	6.99
1978	46.9	1.77
1979	37.2	0.68
1980	37.7	1.55
1981	41.2	3.51
1982	37.0	1.51

$\hat{Y} = -21.7037 + 0.6083\ X$ ($\hat{Y}$ = estimate of R/S, X = fry fork length)

$r = 0.883$

$P < 0.05$, $n = 6$

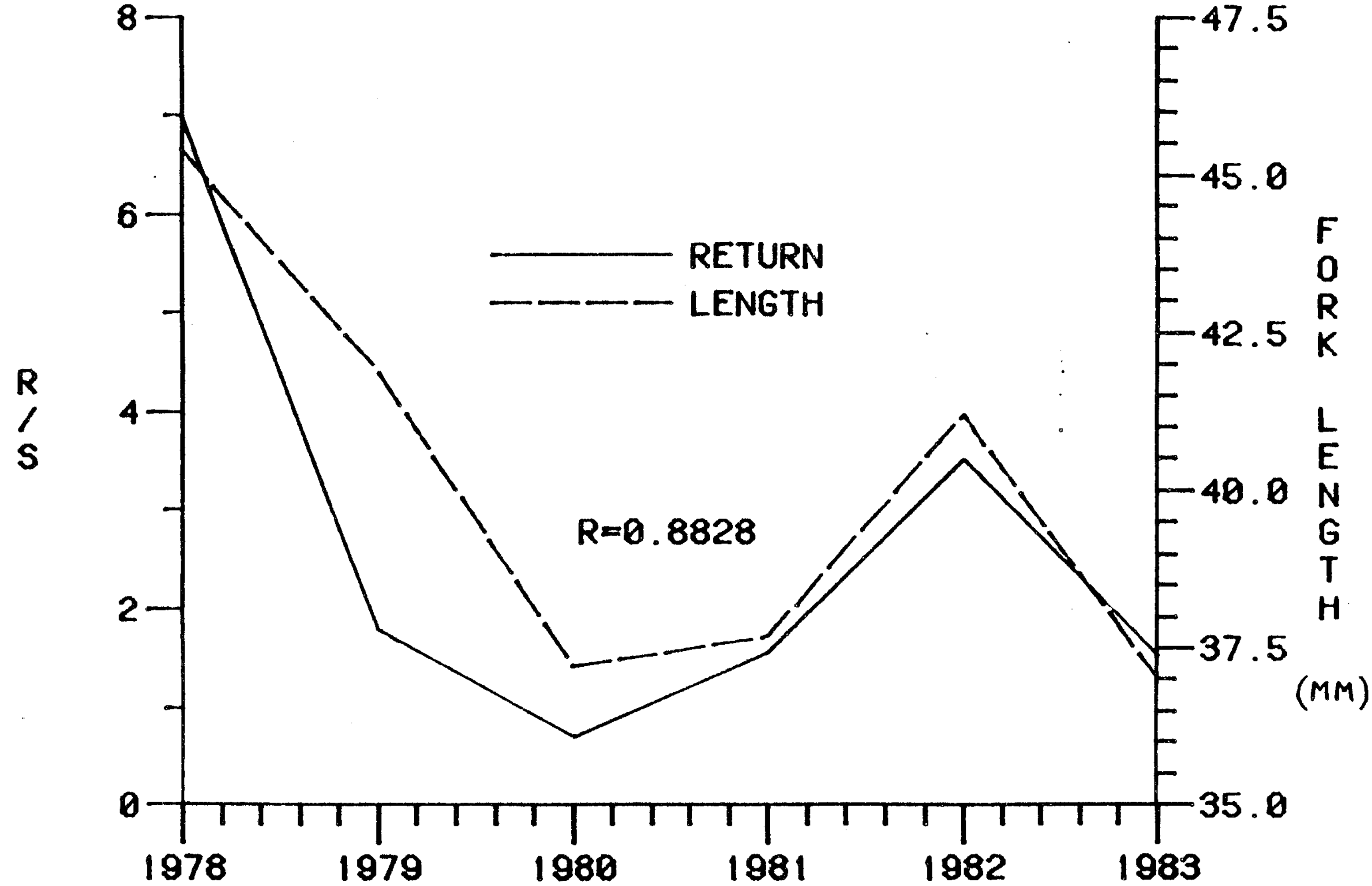

Figure 8. Tenakee Inlet average pink fry fork length in May and subsequent return per spawner (R/S), 1978-1983.

Physical Parameters: Water temperatures in Kadashan River fluctuated between 3.0° and 8.0°C for the 14 April - 25 May period in 1983 (Appendix Table 5). Average temperature for this period was 5.8°C, very close to that for 1981 (5.6°C), but much warmer than for the same period in 1982 (2.8°C). Water levels in the river fluctuated widely.

Water temperatures and salinities at 2 m depth, and associated secchi disc readings from Tenakee Inlet for May for both nearshore (primary) and offshore (secondary) stations, showed that the average temperature over all stations was 8.5°C, average salinity 29.4°/₀₀ (Appendix Table 8). Nearshore stations showed greater variability than offshore stations in both temperature and salinity readings throughout May. Temperature and salinity, as in all previous years, remained very significantly negatively correlated ($r = -0.84$, $P < 0.01$, $n = 59$ (Appendix Table 8).

The correlations found in previous years (Jones et al. 1983) among pink fry length and weight and water temperature and salinity in Tenakee Inlet weakened, with the addition of 1983 data, to the point at which they are considered no longer useful. The strongest relationship was, and remains, that between salinity and average fry length in May. For 1977-1983, this had a correlation coefficient (r) of only 0.58.

Discussion:

The most important results evident from our work in Tenakee Inlet in 1983 were the strong correlation between fry length and subsequent adult return-per-spawner, and the effectiveness of a spotlight for attracting fry.

The fry length/return-per-spawner relationship is the strongest correlation found to date in our search for either fry parameters (length, weight, etc.) or physical parameters (temperature, salinity, etc.) which correlate strongly with adult return. This correlation should be most useful for prediction and stock analysis purposes.

The attracting effect of the spotlight on fry has two advantages: it makes fry sampling (1) much easier than with beach seine or purse seine; and (2) potentially more representative and random, because fry do not avoid the dip net while in the spotlight as they do in daylight. Sampling fry with the dip net at night, however, also has two drawbacks. The first is that it must be done very carefully if a representative sample is to be obtained. This is because at night the fry population appears to segregate itself, with larger fry moving offshore, smaller fry remaining inshore. Any night fry sampling at any one location must include a sample from both nearshore and offshore locations. The second drawback of nighttime dipnetting is that night time operations is more hazardous and less efficient than daytime operation. The purse seine or beach seine overcome the two drawbacks of spotlighting just mentioned, because, in addition to being used in daylight and therefore safer, the small and large fry are not widely separated during the day as they are at night. A well-executed, efficient purse seine or beach seine haul will regularly collect a sample of fry representative of all size groups present. However, each seine type has its own drawbacks. The purse seine is cumbersome, heavy, difficult to set efficiently from the 4 m whaler, and more often than not, without much practice, the crew setting the seine will only succeed in frightening away whatever fry they are attempting to capture. The beach seine is actually slightly more effective than the purse seine at collecting a representative fry sample (Jones et al. 1982) but it must be long enough to enable the set to reach at least 10 m or so from shore while at the same time, extending a good distance along the shore. At present, considering all positive and negative factors together, the beach seine, if set at least 10 m from shore, is the optimum salmon fry collection method.

In 1984 we intend to experiment further with the purse and beach seines and night time dipnetting in Tenakee Inlet in order to determine fairly conclusively the optimum gear for fry sampling.

Sitka Area

In 1983 the early marine survival studies were continued in the Sitka area (Figure 9). Survey areas remained the same as in 1982, i.e., Silver Bay, Katlian Bay, and around Middle Island.

Methods:

Fry abundance and distribution were monitored by visual surveys in Katlian and Silver Bays from 14 April to 26 May 1983. Estimates of fry were made in the same manner as in Tenakee Inlet. Samples were collected by dipnet and roundhaul seine. Species composition was determined from the sample.

Growth of fry collected during the surveys was measured in the same manner as that for Tenakee Inlet fry.

Results:

Observations on number of fry seen by area and date are presented in Appendix Table 9 and are summarized by peak survey, species, and location in Table 2. The numbers of fry were lower than the previous year as expected as a result of lower parent year escapements. Average lengths and weight of pink and chum salmon fry presented in Appendix Tables 6 and 7 show that fry in Sitka marine areas were larger than those found in the Tenakee or Ketchikan areas.

Discussion:

In 1983 larger numbers of pink salmon fry were encountered, overall, than in the previous 2 years, though Middle Island transects had fewer fry than in 1982. Chum salmon were fewer in number than in 1980-1982 in most areas.

Since 1980, the number of pink salmon fry in the study areas (Appendix Tables 10 and 11) has not corresponded ($r = -0.26$, $n = 6$) with prior year peak escapement counts. Very limited chum salmon data, however, shows a strong positive relationship between parent year escapements and subsequent numbers of fry ($r = 0.71$, $n = 3$). These findings verify those from Tenakee Inlet where there is often little or no correlation between pink salmon adult return size and numbers of fry counted in the early marine environment during the following spring. This is probably due either to the timing of fry and adult surveys or skill in separating pink and chum salmon in both adult aerial surveys and fry surveys. Foot surveys would improve the accuracy of the escapement data. More extensive fry surveys and sampling would improve accuracy of fry surveys.

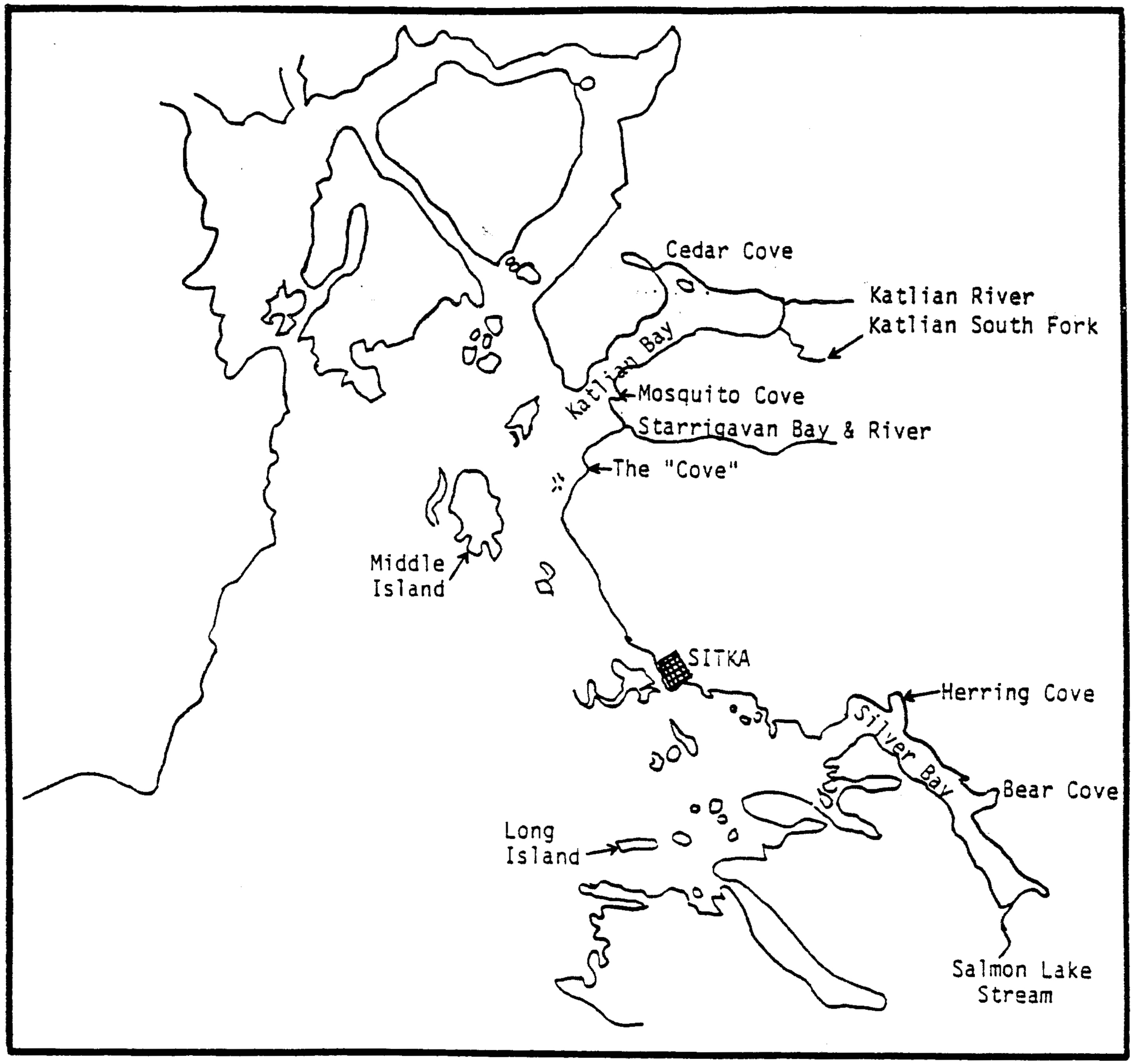

Figure 9. Juvenile salmon survey areas, Sitka Sound, April - May, 1983.

Table 2. Peak abundance estimates of pink and chum salmon fry in Sitka Sound, 1983.

Area	Species	Date	Pink Estimates
Katlian Bay	Pink	May 10	86,490
	Chum	May 10	6,510
Middle Island	Pink	April 22	52,920
	Chum	May 10	1,350
Silver Bay	Pink	April 26	242,970
	Chum	May 9	54,000

Ketchikan Area

Early marine survival studies in the Ketchikan area continued for the sixth year in 1983 in Cholmondeley and Moira Sounds, Smeaton Bay and Boca de Quadra. Studies were conducted previously from 1976 through 1978, and in 1981 and 1982 (Jones et al. 1982). The emphasis since 1981 has been to obtain fry samples and temperature/salinity data from several estuaries to calculate a condition index for comparing fry robustness among years and areas, and to relate this to environmental factors.

Methods:

The timing and abundance of outmigrant fry from Sunny Creek, in Cholmondeley Sound, was monitored from 14 April to 27 May using a 0.45 m by 0.90 m fyke net placed to trap a column of water 0.45 m wide. The net was placed in the same location used during the last half of the 1982 study. All fyke net fry enumeration was conducted by direct counting rather than extrapolation from subsample weights as had been done during the early years of the study. A sample for length-weight analysis was preserved in a 10% buffered (sodium borate) formalin solution. The fry were measured and weighed 40 or more days after capture.

Fry in the estuaries were captured with both round haul seine and dip net from April through June. Dip netting was conducted after dark using a 200,000 candle power spotlight from the bow of a 5.2 m skiff. During the 1982 and 1983 sample years only dip netting was conducted, as previous analysis indicated that the round haul seine was not capturing a representative sample of the fry (Jones et al. 1982). Only those samples which were collected by dip net were used for comparison of fry length-weight data between areas and years in this report.

Temperature and salinity data by depth interval were collected from mid-channel in the four major estuaries, approximately 1 mile inside their confluences with Behm Canal, Revillagigedo Channel or Clarence Strait; in 1983 a second station at Divide Head was added to Cholmondeley Sound measurements.

Results:

The pink salmon fry outmigration from Sunny Creek peaked with 1,436 fish on 5 May, which was normal timing for the system (Appendix Table 12). Chum salmon peaked with 606 fry on 18 May. Water temperatures in Sunny Creek were the warmest of the study period in April, then uncharacteristically dropped during May. The average size of pink salmon outmigrants in 1983 of 32.7 mm was smaller than either 1981 or 1982.

May is the only month in which there is sufficient data to compare the early marine fry size for the three recent study years (1981-83). Analysis of this data shows that fry from Smeaton Bay (mainland systems) were, in all 3 years, larger than fry from both Moira Sound and Cholmondeley Sound (Prince of Wales Island systems). Boca de Quadra (also mainland) fry were larger than fry from Cholmondeley Sound in all 3 years and larger than Moira Sound fry in 2 of the 3 years.

In all areas sampled in southern Southeastern Alaska, sea water temperatures generally exhibited the same trend as Sunny Creek, with record high temperatures during April and early May, and average temperatures throughout the rest of May (Appendix Table 13).

Discussion:

The larger size of mainland fry, when compared to Prince of Wales Island fry, may be the result of differences in outmigrant timing, as fry from Boca de Quadra and Smeaton Bay generally appear at the mouths of their estuaries in large numbers prior to fry from Cholmondeley or Moira Sounds. Adult return timing is also earlier in eastern Behm Canal (including Smeaton Bay and Boca de Quadra) than on eastern Prince of Wales Island.

In addition to the above size differences among areas there may be an environmentally-influenced size difference between years. Fry in all areas sampled were smallest in 1982, in three of four areas fry in 1981 were the next largest, and fry from 1983 were the largest. However, the large 1983 adult return testified to the excellent survival of the 1982 outmigrants, contrary to what would be expected due to their small size. The effects of El Niño (the warming trend of surface waters caused by a shift in global wind patterns) are suspect as the cause of this excellent survival.

LITERATURE CITED

Gray, P.L., K.R. Florey, J.F. Koerner, and R.A. Marriott. 1978. Coho salmon *(Oncorhynchus kisutch)* fluorescent pigment mark-recovery program for the Taku, Berner, and Chilkat Rivers in Southeast Alaska (1972-1974). Alaska Dept. of Fish and Game, Informational Leaflet #176. 75 pp.

Jones, D., G. Thomason, J. Dangel, and K. Hofmeister. 1982. Pink salmon stock predictions - S.E. Alaska. Alaska Dept. of Fish and Game, Project No. AFC-59-3, Anadromous Fish Conservation Act, Technical Report for period July 1, 1980 to June 30, 1981. 67 pp.

Jones, J.D., G. Thomason, J. Dangel, and K. Hofmeister. 1983. Pink salmon stock predictions - S.E. Alaska. Alaska Dept. of Fish and Game, Project No. AFC-59-3, Anadromous Fish Conservation Act, Completion Report for period July 1, 1977 to June 30, 1982. 62 pp.

Thomason, G. 1982. Kadashan Creek pink and chum fry mark-recapture study proposal, 1982. Unpublished report. Alaska Dept. of Fish and Game, Juneau.

Thomason, G. and D. Jones. 1984. Southeastern Alaska pink salmon *(Oncorhynchus gorbuscha)* stream life studies, 1983. Alaska Dept. of Fish and Game, Informational Leaflet #236. 15 pp.

APPENDICES

Appendix Table 1. Northern and Southern Southeastern return escapement, and return/spawner, 1960-1983.

	Northern Southeastern			Southern Southeastern		
	Return	Escapement	RTN/SP	Return	Escapement	RTN/SP
1960	2438.5	1009.3		3324.8	1782.9	
1961	11092.8	2395.0		5859.6	1985.0	
1962	2049.8	1499.6	2.03	14541.2	3533.9	8.16
1963	17446.6	3525.7	7.28	8544.9	3399.7	4.30
1964	9636.1	2354.0	6.43	15437.9	4178.9	4.37
1965	7742.2	2577.1	2.20	8677.8	2967.3	2.55
1966	7529.6	2742.5	3.20	20282.9	4633.2	4.85
1967	3938.7	1501.5	1.53	2074.1	1432.6	0.70
1968	12856.6	2974.2	4.69	19843.3	4642.6	4.28
1969	5643.5	2035.4	3.76	3026.2	1828.5	2.11
1970	7638.3	2396.7	2.57	9251.5	3839.9	1.99
1971	5796.7	2779.8	2.85	10811.0	4563.4	5.91
1972	5854.8	2611.1	2.44	12816.4	3663.3	3.34
1973	3862.2	1979.2	1.39	7443.5	2888.4	1.63
1974	2187.5	1524.0	0.84	7551.7	3330.8	2.06
1975	1874.6	1258.4	0.95	7780.2	4450.0	2.69
1976	1244.0	1100.4	0.82	10088.1	4930.7	3.03
1977	6387.3	3864.2	5.08	17092.2	5850.0	3.84
1978	5761.1	2979.2	5.24	23636.0	5211.0	4.79
1979	8716.8	4884.8	2.26	11561.5	4544.0	1.98
1980	3773.9	2345.6	1.27	18890.7	5985.6	3.63
1981	9241.7	3881.3	1.89	19197.8	5728.5	4.22
1982	15387.2	4092.0	6.56	18938.7	6021.8	3.16
1983	10546.7	4655.1	2.72	40637.0	9191.0	7.09

Appendix Table 2. Southern Southeastern pink salmon escapement by district and year in thousands of fish, 1960-1983.

Year	District 101	District 102	District 103	District 104	District 105	District 106	District 107	District 108	Total	Harvest	Total Return
1960	503.6	12.0	837.6	10.0	120.0	55.7	195.0	49.0	1,782.9	1,541.9	3,324.8
1961	366.9	44.5	610.0	11.0	261.9	398.4	142.3	150.0	1,985.0	3,874.6	5,859.6
1962	931.8	262.6	1,084.0	18.0	422.6	381.0	404.9	29.0	3,533.9	11,007.3	14,541.2
1963	864.2	213.8	1,036.0	9.0	350.7	374.5	455.5	96.0	3,399.7	5,145.2	8,544.9
1964	1,097.8	445.6	983.0	19.0	530.5	615.6	362.4	125.0	4,178.9	11,259.0	15,437.9
1965	538.3	194.8	978.9	9.0	552.0	429.4	238.9	26.0	2,967.3	5,710.5	8,677.8
1966	1,290.6	521.6	1,249.4	19.0	520.1	589.9	442.6	0.0	4,633.2	15,649.7	20,282.9
1967	421.1	64.0	256.8	12.0	329.2	143.4	126.1	80.0	1,432.6	641.5	2,074.1
1968	1,725.1	420.5	1,087.7	68.0	504.3	371.4	344.6	121.0	4,642.6	15,200.7	19,843.3
1969	682.1	261.2	330.7	40.0	171.3	143.6	149.6	50.0	1,828.5	1,197.7	3,026.2
1970	1,410.5	208.5	1,312.3	42.0	230.2	273.6	292.8	70.0	3,839.9	5,411.6	9,251.5
1971	1,135.4	627.4	1,508.7	60.0	354.2	374.0	467.7	36.0	4,563.4	6,247.6	10,811.0
1972	1,565.3	324.9	798.1	26.0	261.2	189.8	397.0	101.0	3,663.3	9,153.1	12,816.4
1973	710.1	439.7	637.1	60.0	254.3	359.0	371.2	57.0	2,888.4	4,555.1	7,443.5
1974	1,229.3	354.8	1,020.4	60.0	149.0	196.3	291.0	30.0	3,330.8	4,220.9	7,551.7
1975	1,298.2	601.2	1,397.3	60.0	280.7	358.9	438.7	15.0	4,450.0	3,330.2	7,780.2
1976	1,424.0	645.5	1,386.9	60.0	115.1	613.7	677.5	8.0	4,930.7	5,157.4	10,088.1
1977	2,150.2	626.4	1,463.2	60.0	230.6	351.6	928.0	40.0	5,850.0	11,242.2	17,092.2
1978	2,071.0	512.6	1,564.4	60.0	281.5	293.7	410.8	17.0	5,211.0	18,425.0	23,636.0
1979	916.8	619.9	1,512.7	60.0	475.3	403.2	462.1	94.0	4,544.0	7,017.5	11,561.5
1980	2,120.4	603.2	2,554.7	60.0	133.3	158.7	334.3	21.0	5,985.6	12,905.1	18,890.7
1981	1,819.4	573.7	2,345.8	60.0	375.4	246.7	272.5	35.0	5,728.5	13,469.3	19,197.8
1982	2,182.9	613.6	2,025.7	60.0	256.0	361.4	446.2	76.0	6,021.8	12,916.9	18,938.7
1983	3,079.1	1,247.6	3,572.4	60.0	548.5	290.1	359.3	34.0	9,191.0	31,446.0	40,637.0

Appendix Table 3. Southeastern 1983 pink salmon harvest by district and fishery.

District	Gillnet	Seine	Hand Troll	Power Troll	Trap	Other	Total
1	984,376	6,244,927	1,920	14,616	802,700	692	8,049,231
2		1,789,419	3,805	7,185		2,160	1,802,569
3		2,691,478	3,703	4,798			2,699,979
4		16,765,288	4,307	46,622			16,816,217
5		240,249	8,501	4,994			253,744
6	208,167	891,487	8,466	3,211		103	1,111,434
7		682,880	387	259			683,526
8	4,171		209				4,380
9		570,274	20,830	23,836			614,940
10		182,918	752	799			184,469
11	66,080					7,157	73,237
12		1,876,781	4,297	1,518		4,953	1,887,549
13		2,370,242	12,598	168,304		114,142	2,665,286
14		328,934	64,008	66,301			459,243
15	157,781		106	91			157,978
16			2,547	14,527		8	17,082
SSE 152				8			8
NSE 154				1,355			1,355
SSE TOTAL	1,196,714	29,305,728	31,298	81,693	802,700	2,955	31,421,088
NSE TOTAL	223,861	5,329,149	105,138	276,731		126,260	6,061,139
TOTAL	1,420,575	34,634,877	136,436	358,424	802,700	129,215	

Appendix Table 4. Northern Southeastern pink salmon escapements by district and year in thousands of fish, 1960-1983.

Year	District 109	District 110	District 111	District 112	District 113	District 114	Total Escapement	Harvest	Total Return
1960	57.4	227.6	275.4	107.9	258.0	83.0	1,009.3	1,429.2	2,438.5
1961	388.0	410.3	383.0	450.2	604.7	158.8	2,395.0	8,697.8	11,092.8
1962	331.7	416.5	236.6	138.8	285.9	90.1	1,499.6	550.2	2,049.8
1963	401.4	296.8	391.5	711.7	1,243.0	481.3	3,525.7	13,920.9	17,446.6
1964	587.6	484.0	312.7	382.5	482.3	104.9	2,354.0	7,282.1	9,636.1
1965	602.6	245.6	254.9	390.3	707.0	376.7	2,577.1	5,165.1	7,742.2
1966	577.1	586.8	430.2	584.7	478.1	85.6	2,742.5	4,787.1	7,529.6
1967	190.3	166.0	171.2	270.7	551.3	152.0	1,501.5	2,437.2	3,938.7
1968	656.6	994.7	451.1	500.4	279.5	91.9	2,974.2	9,882.4	12,856.6
1969	277.0	270.0	146.4	436.5	662.5	243.0	2,035.4	3,608.1	5,643.5
1970	375.6	526.5	432.6	642.8	290.0	129.2	2,396.7	5,241.6	7,638.3
1971	458.4	571.9	265.3	579.0	534.4	370.8	2,779.8	3,016.9	5,796.7
1972	378.3	704.9	586.8	534.7	289.3	117.1	2,611.1	3,243.7	5,854.8
1973	226.0	300.0	213.1	474.3	522.3	243.5	1,979.2	1,883.0	3,862.2
1974	207.6	271.8	340.2	315.4	309.0	80.0	1,524.0	663.5	2,187.5
1975	157.0	69.4	133.9	229.1	546.5	122.5	1,258.4	616.2	1,874.6
1976	151.7	161.9	63.5	229.1	428.4	65.8	1,100.4	143.6	1,244.0
1977	469.0	231.0	310.6	680.5	1,979.5	193.6	3,864.2	2,523.1	6,387.3
1978	410.4	425.5	168.1	998.7	843.2	133.3	2,979.2	2,781.9	5,761.1
1979	771.2	735.5	454.4	800.9	1,935.1	187.7	4,884.8	3,832.0	8,716.8
1980	420.4	403.8	268.3	614.2	495.8	143.1	2,345.6	1,428.3	3,773.9
1981	394.7	365.8	254.9	741.5	1,914.7	209.7	3,881.3	5,360.4	9,241.7
1982	708.0	604.0	701.2	831.6	1,096.8	150.4	4,092.0	11,295.2	15,387.2
1983	554.1	390.8	797.5	830.8	1,854.0	227.9	4,655.1	5,891.6	10,546.7

Appendix Table 5. Numbers of pink and chum salmon fry caught in the fyke net with concomitant creek water temperatures and levels, Kadashan River, 1983 (all catches are equivalents of, or actual standard 1900 hrs - 0100 hrs vertical net sets).

Date	Pink	Chum	Water Temp. (°C)	Water Level (cm)
April 5	1,899	286	2.5	54
8	995	313	3.0	37
10	2,600	100	3.0	34
12	4,004	58	3.5	59
13	1,823	60	4.0	67
18	1,889	46	3.0	54
19	4,470	85	4.0	49
20	7,233	181	4.5	48
22	12,302	55	4.5	46
24	17,608	585	5.8	47
25	6,081	145	6.0	52
26	21,520	483	6.0	55
28	9,640	211	6.0	50
May 2	30,377	636	5.0	55
5	13,897	328	6.0	54
7	11,947	394	6.5	53
9	7,918	84	6.5	48
11	4,045	73	6.5	43
14	4,582	77	8.0	43
16	1,420	30	6.0	40
18	12	0	6.0	70
20	49	2	7.0	74
22	12	0	7.0	72
23	215	3	7.0	51
26	55	3	7.0	52
Total	166,250	4,230		

		Pink	Chum
Peak outmigration date	-	May 2	May 2
Date when 90% caught	-	May 9	May 7
Pink: Chum ratio		39.3:1	
Average water temp. (4/14 to 5/25)	-	5.8°	[1]

[1] From daily readings, including days when fyke net was not set.

Appendix Table 6. Average length and weight of pink salmon fry from the freshwater and marine environments of the three study areas in Southeastern Alaska, April-May 1983 (in-transformed data).

	Tenakee Inlet		Ketchikan		Sitka	
	April	May	April	May	April	May
Length (mm)						
Freshwater	32.6 (32.5-32.7,[1] n=763[2])	32.8 (32.7-32.9, n=466)	32.8 (32.5-33.1, n=83)	32.6 (32.4-32.8, n=137)	-	-
Marine	33.5 (33.4-33.6, n=1457)	39.9 (39.8-40.0, n=5991)	39.5 (39.2-39.8, n=854)	44.7 (44.1-45.2, n=805)	36.2 (36.0-36.3, n=2100)	40.4 (40.1-40.6, n=1766)
Weight (mg)						
Freshwater	220.6 (218.9-222.4, n=763)	222.8 (220.5-225.2, n=466)	264.0 (255.1-273.2, n=83)	262.9 (258.5-267.3, n=137)	-	-
Marine	229.7 (226.1-233.4, n=1457)	436.2 (430.2-442.4, n=5991)	528.3 (514.2-542.8, n=854)	779.2 (746.1-813.7, n=805)	365.6 (361.2-370.2, n=2100)	517.3 (507.2-527.6, n=1766)

[1] 95% confidence interval.

[2] Sample size.

Appendix Table 7. Average length and weight of chum salmon fry from the freshwater and marine environments of the three study areas in Southeastern Alaska, April-May 1983 (in-transformed data).

	Tenakee Inlet		Ketchikan		Sitka	
	April	May	April	May	April	May
Length (mm)						
Freshwater	37.8 (37.4-38.2[1] n=169[2])	38.7 (38.5-38.8, n=308)	37.0 (36.6-37.4, n=90)	36.1 (35.8-36.3, n=148)	-	-
Marine	40.5 (37.2-44.0, n=9)	43.8 (40.9-46.9, n=29)	39.6 (38.6-40.6, n=85)	41.8 (40.7-42.9, n=109)	42.3 (41.8-42.9, n=751)	54.6 (53.6-55.5, n=214)
Weight (mg)						
Freshwater	395.4 (382.2-409.5, n=169)	429.3 (423.0-435.7, n=308)	411.9 (400.0-424.3, n=90)	386.9 (378.7-395.3, n=148)	-	-
Marine	392.4 (365.5-421.3, n=9)	621.7 (493.0-784.1, n=29)	560.4 (509.8-616.0, n=85)	675.5 (616.9-739.7, n=109)	697.4 (684.6-710.5, n=751)	1640.6 (922.4-2,918.0, n=214)

[1] 95% confidence interval.

[2] Sample size.

Appendix Table 8. Water temperatures and salinities at two meters depth, and associated secchi disc readings, Tenakee Inlet, May 1983 (P = primary nearshore station, S = secondary offshore station).

Station and Date	Temperature (°C)	Salinity (°/₀₀)	Secchi (m)
Primary Stations:			
Kadashan (P)			
May 3	7.18	31.00	5.75
6	7.08	31.24	8.5
9	9.16	28.16	9.5
12	10.27	27.72	7.5
14	11.37	24.04	9.0
17	9.60	27.30	6.0
23	9.40	27.62	14.0
28	8.12	29.96	6.0
31	10.36[1]	24.83[1]	5.0
Mean ($\bar{x}$)	9.02	28.38	
Standard Deviation (s)	1.49	2.35	
Coefficient of variation (c.v.)	16.52	8.27	
Sample Size (n)	8	8	
Tenakee (P)			
May 3	7.87	30.21	-
6	8.35	28.83	7.5
9	8.70	30.16	9.5
12	8.93	30.33	6.5
14	11.72	26.61	8.0
17	9.70	28.15	6.5
23	9.18	29.64	12.0
26	7.63	28.75	14.0
28	7.16	32.02	5.5
31	10.91[1]	23.87[1]	6.0
$\bar{x}$	8.0	29.41	
s	1.35	1.55	
c.v.	15.37	5.26	
n	9	9	

-Continued-

Appendix Table 8. Water temperatures and salinities at two meters depth, and associated secchi disc readings, Tenakee Inlet, May 1983 (P = primary nearshore station, S = secondary offshore station) - continued.

Station and Date	Temperature (°C)	Salinity (°/₀₀)	Secchi (m)
Cannery Point (P)			
May 3	7.49	30.01	5.0
6	7.68	30.42	7.5
9	7.87	30.62	6.0
12	8.44	30.85	7.0
14	9.41	29.95	8.25
17	8.46	28.90	5.5
19	7.68	31.81	10.5
23	7.18	30.54	10.0
26	6.11	31.39	20.0
28	7.45[1]	24.88[1]	4.0
31	8.42	29.10	-
$\bar{x}$	7.47	30.36	
s	0.89	0.91	
c.v.	11.32	3.01	
n	10	10	
Trap Bay Point (P)			
May 3	7.22	30.90	6.0
6	7.54	30.87	7.0
9	8.78	27.78	7.5
12	9.44	28.72	8.0
14	11.07	27.03	8.0
17	9.22	27.80	7.0
19	7.56	31.13	10.5
23	9.26	27.47	12.0
25	7.40	29.89	17.0
28	7.22[1]	23.64[1]	4.5
31	11.16[1]	22.56[1]	5.5
$\bar{x}$	8.61	29.07	
s	1.28	1.64	
c.v.	14.92	5.66	
n	9	9	

-Continued-

Appendix Table 8. Water temperatures and salinities at two meters depth, and associated secchi disc readings, Tenakee Inlet, May 1983 (P = primary nearshore station, S = secondary offshore station) - continued.

Station and Date	Temperature (°C)	Salinity (°/oo)	Secchi (m)
For All Primary (Nearshore) Stations, 1983:			
Mean ($\bar{x}$)	8.55	29.36	
Standard deviation (s)	1.28	1.73	
Standard error of mean ($S\bar{x}$)	0.214	0.289	
95% C.I. of mean	8.13 - 8.97	28.79 - 29.93	
Coefficient of variation (c.v.)	14.97	5.89	
Number of data points (n)	36	36	

Temperature - Salinity Regression (x=salinity)

$\hat{Y} = 27.05 - 0.6304\ x$

$r = -0.8532$, $n=36$, $P < 0.01$

Station and Date	Temperature (°C)	Salinity (°/oo)	Secchi (m)
Secondary Stations:			
Tenakee-Kadashan (S)			
May 3	8.36	27.73	-
6	8.00	29.91	7.5
10	8.83	28.88	10.5
14	11.36	25.88	9.0
17	9.86	28.37	5.5
31	10.98[1]	24.26[1]	5.5
$\bar{x}$	9.28	28.15	
s	1.36	1.50	
c.v.	14.61	5.33	
n	5	5	

-Continued-

Appendix Table 8. Water temperatures and salinities at two meters depth, and associated secchi disc readings, Tenakee Inlet, May 1983 (P = primary nearshore station, S = secondary offshore station) - continued.

Station and Date	Temperature (°C)	Salinity (°/₀₀)	Secchi (m)
Sunshine Point (S)			
May 3	7.70	30.25	5.5
6	7.95	30.14	8.0
10	9.72	26.64	9.0
19	9.05	29.96	8.0
26	7.66	30.21	19.0
31	10.57[1]	24.51[1]	4.5
$\bar{x}$	8.42	29.44	
s	0.92	1.57	
c.v.	10.96	5.33	
n	5	5	
Hill Point (S)			
May 3	6.92	30.83	4.5
6	7.58	30.66	6.5
9	8.60	29.08	7.5
14	10.14	28.63	8.5
17	8.31	30.04	5.5
19	7.42	31.23	9.0
23	8.13	28.14	13.0
26	7.60	29.42	14.0
31	9.10[1]	27.94[1]	4.5
$\bar{x}$	8.09	29.75	
s	0.99	1.11	
c.v.	12.21	3.74	
n	8	8	
Columbia Point (Foo Pt.) (S)			
May 3	7.16	30.77	5.5
6	7.86	30.42	8.0
10	9.30	26.58	7.5
18	8.50	30.64	8.0
26	6.61	30.80	17.0
31	10.42[1]	24.61[1]	5.5

-Continued-

Appendix Table 8. Water temperatures and salinities at two meters depth, and associated secchi disc readings, Tenakee Inlet, May 1983 (P = primary nearshore station, S = secondary offshore station) - continued.

Station and Date	Temperature (°C)	Salinity (°/₀₀)	Secchi (m)
$\bar{x}$	7.89	29.84	
s	1.06	1.83	
c.v.	13.49	6.13	
n	5	5	
For All Secondary (Offshore) Stations, 1983:			
Mean ($\bar{x}$)	8.37	29.36	
Standard deviation (s)	1.1301	1.517	
Standard error of mean ($S\bar{x}$)	0.2356	0.3163	
95% C.I. of mean	7.91 - 8.83	28.74 - 29.98	
Coefficient of variation (c.v.)	13.50	5.17	
Number of data points (n)	23	23	

Temperature - salinity regression (x=salinity)

$\hat{Y} = 25.9825 - 0.5998X$

$r = -0.805$, $n = 23$, $P < 0.01$

For All Primary and Secondary Stations Together, 1983:			
Mean ($\bar{x}$)	8.48	29.36	
Standard deviation (s)	1.2177	1.6398	
Standard error of mean ($S\bar{x}$)	0.1585	0.2135	
95% C.I. of mean	8.17 - 8.79	28.94 - 29.78	
Coefficient of variation (c.v.)	14.36	5.59	
Number of data points (n)	59	59	

$\hat{Y} = 26.6933 - 0.6204\ X$ (x=salinity)

$r = -0.8355$, $n = 59$, $P < 0.01$

[1] Rain fell every day from 16 May through 26 in Tenakee Inlet; rain was heavy and prolonged at times. Unusually low salinities probably reflect this heavy rainfall and subsequent runoff from land. These values are considered anomalies and are not used, therefore, in temperature-salinity-fry length regression analysis.

Appendix Table 9. Sitka Sound pink and chum salmon fry observations in 1983.

Date and Location	Pink Salmon (%)	Chum Salmon (%)	Total Observed
Katlian Bay			
April 18	12,690 (94%)	810 (6%)	13,500
April 25	15,047 (82%)	3,303 (18%)	18,350
May 6	26,390 (91%)	2,610 (9%)	29,000
May 10	86,490 (93%)	6,510 (7%)	93,000
May 23	930 (93%)	70 (7%)	1,000
Totals	141,547 (90%)	13,303 (10%)	154,850
Silver Bay			
April 14	38,745 (63%)	22,755 (37%)	61,500
April 20	16,275 (31%)	36,225 (69%)	52,500
April 11	242,970 (89%)	30,030 (11%)	273,000
May 9	66,000 (55%)	54,000 (45%)	120,000
May 16	420 (14%)	2,580 (86%)	3,000
May 26	224 (14%)	1,376 (86%)	1,600
Totals	364,634 (56%)	146,966 (44%)	511,600
Middle Island Area			
April 22	52,920 (98%)	1,080 (2%)	54,000
April 29	49,980 (98%)	1,020 (2%)	51,000
May 6	34,300 (98%)	700 (2%)	35,000
May 10	25,650 (95%)	1,350 (5%)	27,000
May 23	15,770 (95%)	830 (5%)	16,600
Totals	178,620 (97%)	4,980 (3%)	183,600
Grand Total	684,801 (79%)	165,249 (21%)	850,050

Appendix Table 10. Salmon escapement peak counts in the Sitka sampling area, 1980-1983 brood years.

Stream	1980	1981	1982	1983
Katlian Bay (113-44-005)	4,000 Pink 4,000 Chum	90,000 Pink 300 Chum	27,000 Pink No Chum Counted	101,000 Pink No Chum Counted
Silver Bay (113-41-032)	5,000 Pink No Chum Counted	45,000 Pink No Chum Counted	3,000 Pink 4,781 Chum	20,000 Pink 2,557 Chum

Appendix Table 11. Salmon fry peak counts in the Sitka sampling area 1980-1982 brood years.

Location	1980 Brood	1981 Brood	1982 Brood
Katlian Bay	26,800 Pink 15,648 Chum	42,630 Pink 10,850 Chum	86,490 Pink 6,510 Chum
Middle Island	200 Pink No Chum	94,050 Pink 950 Chum	52,920 Pink 1,350 Chum
Silver Bay	12,918 Pink 86,452 Chum	70,455 Pink 45,045 Chum	242,970 Pink 54,000 Chum

Appendix Table 12. Number of pink and chum salmon fry caught in fyke nets in Sunny Creek, and stream temperatures, Cholmondeley Sound, 1983.

Date	Pink	Chum	Water Temp. (°C)
April 14	41	17	6.0
21	205	410	7.5
29	120	367	11.0
30	465	523	11.0
May 4	1,051	417	6.5
5	1,436	468	7.5
11	621	255	10.0
12	820	438	7.0
18	148	606	7.0
19	236	468	7.0
27	22	119	9.0

Appendix Table 13. Temperature and salinity data from southern Southeastern Alaska, April and May 1983.

Date	Depth (m)	Temperature (°C)	Salinity (°/₀₀)
		Cholmondeley Sound	
4/21	0	8.0	23.0
	2	8.0	25.0
	6	8.0	25.0
	12	7.0	27.0
4/30	0	12.0	24.0
	2	11.0	26.0
	6	10.0	27.0
	12	9.0	28.0
5/ 5	0	11.0	25.0
	2	11.0	24.5
	6	10.0	26.0
	12	8.0	26.0
5/12	0	12.0	22.0
	2	10.0	25.0
	6	10.0	25.0
	12	9.0	25.0
5/19	0	11.0	24.0
	2	11.0	24.0
	6	10.0	25.0
	12	9.0	25.0
5/27	0	10.0	25.0
	2	9.0	25.0
	6	9.0	25.0
	12	9.0	25.0
		Boca de Quadra	
4/21	0	9.0	18.0
	2	9.0	26.0
	6	8.0	27.0
	12	8.0	27.0
5/ 7	0	10.0	25.0
	2	10.0	25.0
	6	10.0	25.0
	12	10.0	26.0
5/22	0	11.0	13.0
	2	11.0	20.0
	6	11.0	23.0
	12	10.0	25.0

-Continued-

Appendix Table 13. Temperature and salinity data from southern Southeastern Alaska, April and May 1983 (continued).

Date	Depth (m)	Temperature (°C)	Salinity (°/₀₀)
		Smeaton Bay	
4/25	0	9.0	24.0
	2	9.0	25.0
	6	9.0	25.0
	12	8.0	27.0
5/ 8	0	11.0	13.0
	2	10.0	16.0
	6	10.0	23.0
	12	10.0	23.0
5/23	0	10.5	15.0
	2	11.0	21.0
	6	10.0	24.0
	12	10.0	24.0
		Moira Sound	
4/22	0	9.0	18.0
	2	8.0	27.0
	6	8.0	27.0
	12	8.0	27.0
4/28	0	10.0	27.0
	2	10.0	27.0
	6	10.0	27.0
	12	10.0	27.0
5/ 6	0	10.0	26.0
	2	9.0	26.0
	6	9.0	26.0
	12	9.0	26.0
5/21	0	10.0	24.0
	2	10.0	25.0
	6	9.0	25.0
	12	9.0	25.0
5/28	0	10.0	25.0
	2	10.0	25.0
	6	9.0	26.0
	12	9.0	26.0