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CHIGNIK SOCKEYE STUDIES

Annual Report - Anadromous Fish Project

by

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OVERVIEW

A number of fishery investigations in Chignik (Fig. 1) were initiated in 1985. This report presents the results of an aerial survey designed to estimate distribution and number of spawning coho salmon along the southern Alaska Peninsula and the Chignik lakes in fall, 1984. This survey was a joint effort by Alaska Department of Fish and Game (ADF&G) and Fisheries Research Institute (FRI). The Appendices include a post season stock identification analysis of the 1984 sockeye run prepared by ADF&G and FRI, and an analysis of the 1985 sockeye run and 1986 forecast of sockeye salmon.

A variety of other studies are in progress, but are not reported here. These studies include predator-prey interactions between piscivorous coho salmon and juvenile sockeye salmon in the Chignik lakes, a spawner/return analysis of sockeye to assess the effect of the escapement levels and goals established in the mid-1960's, a yearly comparison of townet catches of juvenile sockeye in the Chignik lakes, mortality estimates of juvenile sockeye caused by piscivorous coho, and an analysis of coho predation on returns of adult sockeye.

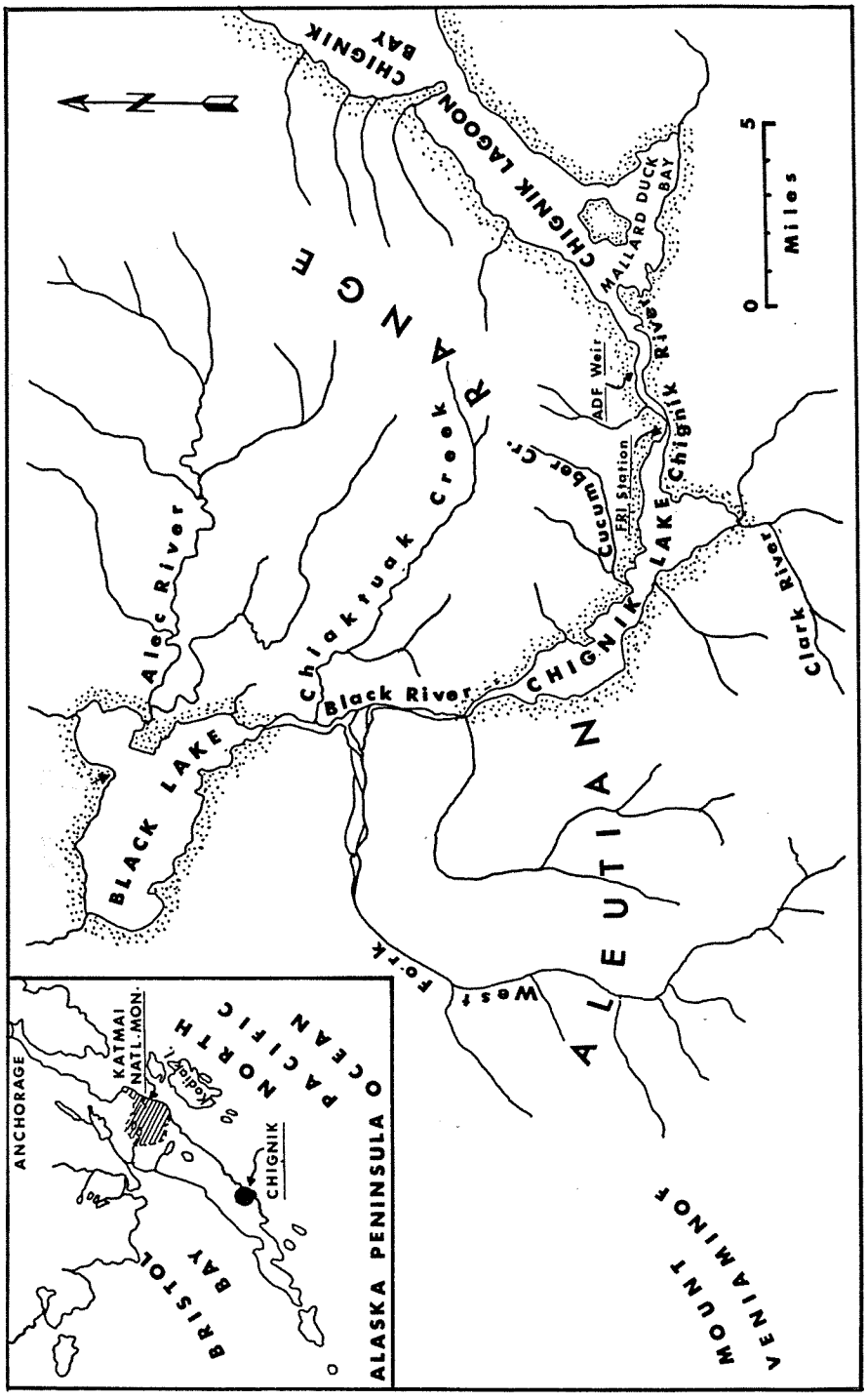

Fig. 1. Location of the Chignik Lake system on the Alaska Peninsula.

AERIAL SURVEY OF SPAWNING COHO SALMON

Introduction

Knowledge of salmon spawning location and density are important to management of salmon stocks and fisheries. Each spawning location is generally utilized by a single salmon stock and spawning density (or escapement) represents the potential for strong returns of adult salmon. Management of the fishery to achieve the escapement goal of a specific stock is of major importance to future production.

Along the southern side of the Alaska Peninsula, including the Chignik lakes, coho salmon are becoming increasingly important to the commercial fishery. Since 1980 approximately 146,000 coho have been harvested per year compared to an annual harvest of 31,000 fish during the 1970's. In spite of the great value of the fishery for coho salmon, little is known about spawning location or spawning density of coho. Parker and Rogers (1984) estimated coho spawning escapement from fishing effort, but this estimate assumed that coho migration behavior in the fishery is similar to that of sockeye salmon. Essentially, no information on spawning density and spawning locations of adult coho in Alaska Peninsula coastal streams has been collected. In the Chignik lakes, where coho are most abundant, two aerial surveys and a ground survey were conducted on coho spawning grounds in 1970 and 1971.

The objectives of this joint 1984 ADF&G/FRI investigation were to:

1) Count numbers of coho in coastal streams and tributaries of the Chignik lakes during mid-October; and

2) assess the relative importance of each stream to spawning coho.

Materials and Methods

The aerial survey of spawning coho salmon was conducted on 16 October, 1984. Mid-October was chosen for the aerial survey because many coho were believed to have already entered the spawning streams and weather conditions were favorable. The plan was to survey 19 coastal streams along the Alaska Peninsula (Fig. 2) and 16 streams in the Chignik lakes during one day of good weather. The plane used for the survey was an ADF&G Piper Super Cub. Polarized sunglasses were used to observe salmon. Data collected during the survey included percent of each stream surveyed, time of day, number of live or dead coho or other salmon, water visibility, and fish distribution characteristics (i.e., spawning or migration distribution).

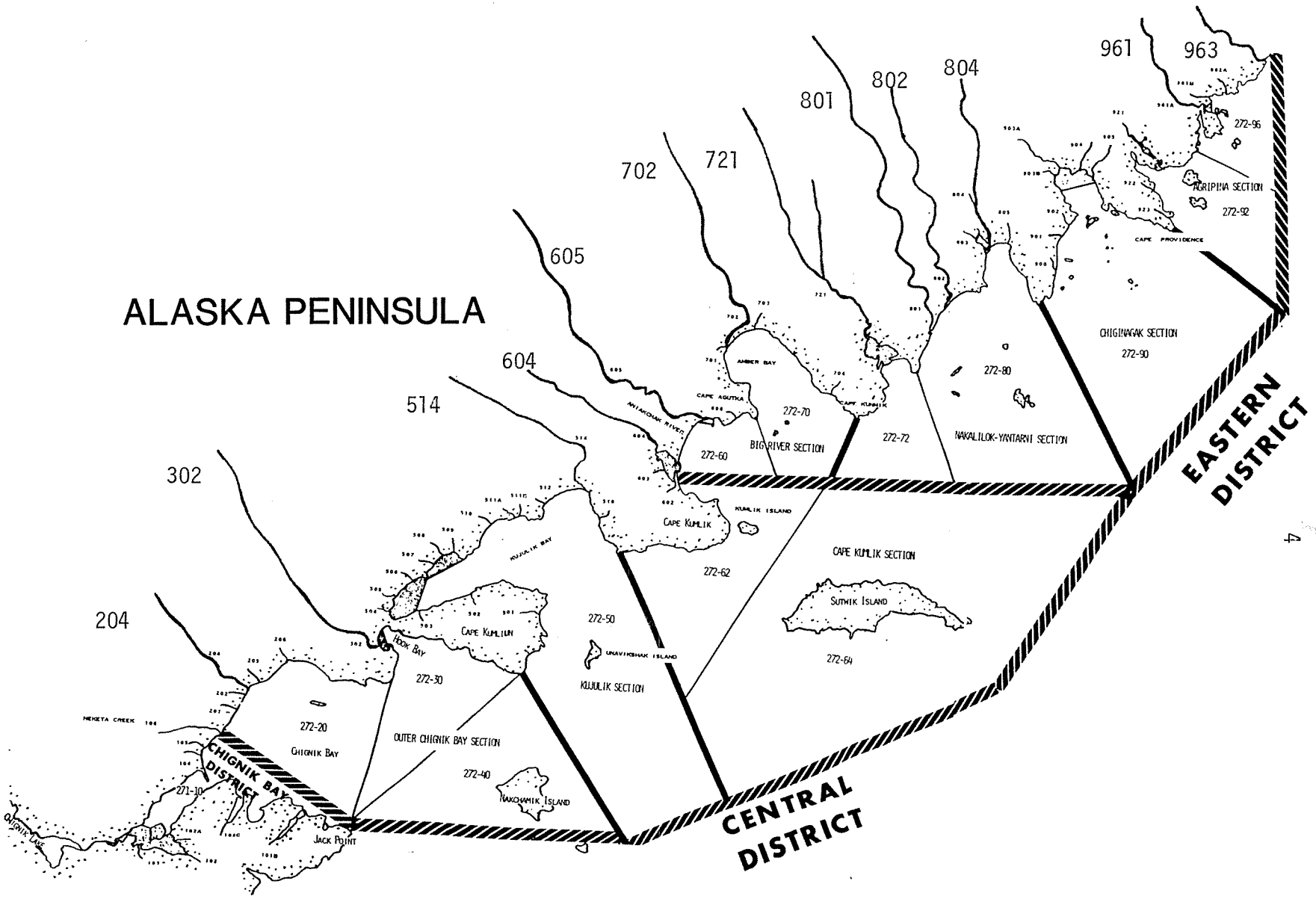

Fig. 2. Location of coho spawning streams in the Chignik management area of the Alaska Peninsula surveyed by plane on 16 October, 1984. Numbers adjacent to streams represent ADF&G stream codes.

Results

The weather conditions during the survey were excellent: clear skies and usually little wind (<5 mph). After leaving Kodiak airport at 0700 hrs, we crossed Shelikof Strait and began surveying coastal streams at 0900 hrs, the time when light was suitable for observing fish. Altitude during most of the survey was 300-600 ft. Only 12 of the coastal streams and 10 streams in the Chignik lakes streams were surveyed. Several of the Alec River tributaries were not surveyed because of strong air turbulence and the seven coastal streams west of Chignik were not surveyed because of time constraints.

Greatest counts of coho salmon among coastal streams occurred in the Nakalikok and Amber Bay areas. These areas represented approximately 80% of the coastal fish counts (Table 1). The largest coho count among coastal streams was 5,570 fish, located in Nakalikok Bay (Stream 804). Water visibility in most streams was good, allowing relatively easy enumeration of fish. Coho were schooled together rather than in pairs, indicating spawning had yet to begin. The only dead fish were in Aniakchak Bay (Stream 604), but these fish were not clearly identified as coho.

In the Chignik lakes the greatest number of clearly identified coho occurred in the upper reaches of the mainstem Alec River, which drains into Black Lake, where a maximum of 1,275 coho was counted (Table 2). Most of the Alec River tributaries were not observed because of air turbulence. In Chiaktuak Creek, a Black River tributary, up to 250 coho were identified in the lower areas of suitable spawning habitat. Interestingly, up to 600 sockeye (identified by red body and dark head) were observed schooled (non-spawning distribution) in the head waters of Chiaktuak Creek and were separated from the coho salmon. Clark River, which drains into Chignik Lake, was occupied by approximately 5,000 sockeye distributed in spawning pairs. Approximately 9,500 fish were schooled off the mouth of Clark River and Home Creek and another 9,000 fish were schooled along the western shore of Clark Bay. These fish were believed to be coho, although they could not be clearly identified because of the somewhat turbid lake water. Other large schools of fish that may have been coho were located immediately downriver of the ADF&G camp on Chignik River (i.e., above the islands) and near the mouth of Black River. Approximately 1,000 spawning sockeye were dispersed along Hatchery Beach.

Discussion

Counts of adult coho in spawning streams provide an index of abundance rather than total spawning density. Coho likely enter the streams and spawn over a period of time, thus a survey covering only one day would not include those fish that had yet to enter the stream or those that had died and were washed away. The primary usefulness of this one-day survey is to identify and compare relative spawning densities of coho, assuming that peak spawn timing is similar for each stream. Based

Table 1. Summary of aerial survey for coho salmon in Alaska Peninsula streams, October 16, 1984.

Area surveyed	Percent surveyed	Number counted GR[a]	Number counted AT[a]	Water visibility	Remarks
Agripina Cr. (963)[b]	100	0	0	-	River dry
Agripina Cr. (961)	20	0	0	Poor	Wind; count from 1,000 ft elevation
Nakalikok Bay Cr. (804)	100	2675	5570	Good	All fish above RM 3 (schooled)
Nakalikok Bay Cr. (802)	100	475	1485	Good	Schooled
Nakalikok Bay Cr. (801)	100	170	420	Good	Fish above RM 0.5 (schooled)
Yantarni R. (721)	90	1435	800+	Good	Schooled, all above RM 1.3, low water flow
Amber Bay Cr. (702)	90	2315	2450	Good	Fish above RM 3
Aniakchak R. (605)	80	60	70	Poor	All fish above RM 10
Aniakchak Bay Cr. (604)	80	30	60	Good	All dead coho?; 100 fish in lagoon during late September
Kujulik R. (514) (North Fork)	80	50	20	Good	Schooled, above RM 2
Hook Bay (302)	90	660	750	Good	Three large schools above RM 3
Thompson Cr. (204)	200	0	0	Good	Subterrainean after RM 5

[a]GR: G. Ruggerone; AT: A. Thompson.
[b]ADF&G Stream Code.

Table 2. Summary of aerial survey for coho salmon in spawning grounds of the Chignik watershed, October 16, 1984.

Area surveyed	Percent surveyed	Number counted GR[a]	Number counted AT[a]	Water visibility	Remarks
Chignik Lake					
Chignik River	100	No[b]	500	Fair	One large coho? school below weir
Home Creek	100	20	10	Good	Schooled, lower 1 mile
Home Creek mouth	100	1500	1500	Good	Coho?
Clark River	90	3350	5000	Good	All spawning, below major fork in river
Clark R. mouth	100	8000	8000	Fair	Coho?, schooled.
Clark Bay	100	9000	5500	Fair	Schooled, west side of Bay, coho?
Hatchery Beach	100	1000	No	Poor	Spawning sockeye
Cucumber Creek	100	0	0	Fair	None off mouth
Black River					
Black R. mouth	100	No	1050	Fair	Coho?
Bearskin Creek	90	70	No	Good	No fish in lower 6 miles
West Fork	50	0	No	Fair	Surveyed 4 miles above confluence with turbid stream
Chiaktuak Creek	100	50	250	Good	Coho; all fish above RM 5
		110	600		Sockeye, 10 bears
Black Lake					
Black Lake mouth	100	1250	1550	Fair	Schooled; coho?
Fan Creek	100	125	170	Good	All above RM 3
Boulevard Creek	5	20	No	Good	Turbulence; surveyed lower ½ mile
Alec River	90	715	1275	Good	Most coho within 2 miles of Boulevard Cr.

[a] GR: G. Ruggerone; AT: A. Thompson.
[b] Not observed.

on this survey, Nakalikok and Amber Bay tributaries along the coast and the Alec River drainage, and possibly Clark River in the Chignik lakes, were major producers of coho salmon in 1984. In contrast, the survey during late October, 1970 observed 85% (1,226 coho) of the Chignik lakes spawners in the Black River/Black Lake area, with over half of these coho in the mainstem Alec River (Burgner and Marshall 1974). The total Chignik count of coho during 1984 (23,375 coho) was considerably larger than that of 1970 (1,442 coho), which may reflect a larger return and escapement.

The schooled distribution of coho in coastal and Chignik Lake system streams suggests that spawning had yet to begin and that some coho may not have yet entered the spawning stream. This is especially true in the Chignik Lake system where several large schools were located in Chignik Lake and, to a lesser extent, in Black Lake. Burgner and Marshall (1974) reported no coho spawning activity in Alec River during late November, 1971. Spawning of coho in Clark River, if it occurs, may be later than other Chignik Lake streams because development rate of eggs and alevins is likely much greater in this apparently thermally-heated stream.[1] Residents of Chignik Lake village indicate sockeye are present in Clark River through January; however, they have not observed coho salmon in the river. Possibly, coho and sockeye avoid simultaneous use of a spawning habitat through habitat partitioning in time (e.g., Clark River) or space (e.g., Chiaktuak Creek).

Characteristics of coho spawning and rearing habitat among coastal streams is much different from that of Chignik streams. In general, the coastal streams flow over broad alluvial plains. Spawning gravel appears to be good, but the substrate tends to be unstable as indicated by numerous braided channels and relatively steep gradient. Some streams are intermittent or emerge from springs. Coastal streams probably experience high flows that periodically disrupt incubating salmon eggs or carry away alevins and fry. Rearing habitat could also limit coho production in coastal streams as few pools, boulders, or overhanging vegetation were available for cover. Most rearing of juvenile coho probably occurs near the confluence of the stream with the ocean where pools are more numerous. In contrast, most Chignik streams have gentle gradients and good rearing cover. Rearing habitat in the lakes is excellent for coho as food is abundant and consumption of juvenile sockeye fry provides excellent conditioning for subsequent, piscivorous feeding behavior of coho in the ocean.

The recent, large harvests (e.g., up to 300,000 fish) of coho suggest that continued effort should be placed on coho research. A prime concern is accurate estimations of coho escapement, especially in the Chignik lakes where most coho production occurs. Direct enumeration of

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[1]Clark River appears to be influenced by discharges of thermally heated water. Evidence is water temperature measurements of 7.5°C on 25 May, 1985, 5 days after ice left Chignik Lake. Clark River drains snow covered mountains.

coho spawning escapement by counts from a weir or hydroacoustic equipment would be most useful. Several aerial surveys during the spawning period would suffice if direct counts could not be made. If aerial surveys are conducted, they should begin in late October and continue through at least late November. Obviously, weather is a major difficulty during this time of year; therefore, survey teams should be prepared for action during sudden improvement in weather. Two or more days should be allowed for each survey. Finally, further investigation by foot or air is needed to positively identify coho spawning locations in Chignik Lake (e.g., Clark River).

ACKNOWLEDGMENTS

We would like to thank Pete Probasco, the ADF&G Chignik area management biologist, and his field crew for their logistic support. Fisheries Research Institute personnel Tim Watson and Tom Nelson assisted with data collection. These investigations gained benefit from discussions with Steve Parker.

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APPENDIX A

ADF&G TECHNICAL DATA REPORT NO. 151
(Limited Distribution)

STATE OF ALASKA
Bill Sheffield, Governor

STOCK COMPOSITION OF THE 1984 SOCKEYE SALMON (Oncorhynchus nerka) RUN TO THE CHIGNIK LAKES ESTIMATED USING SCALE PATTERNS AND LINEAR DISCRIMINANT FUNCTIONS

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July 1985

ALASKA DEPARTMENT OF FISH AND GAME
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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.

STOCK COMPOSITION OF THE 1984 SOCKEYE SALMON *(Oncorhynchus nerka)* RUN TO THE CHIGNIK LAKES ESTIMATED USING SCALE PATTERNS AND LINEAR DISCRIMINANT FUNCTIONS

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ABSTRACT

The stock composition of the 1984 sockeye salmon *(Oncorhynchus nerka)* run to the Chignik lakes, Alaska was estimated using scale patterns and linear discriminant function analysis. Scale samples collected in Chignik Lagoon were used to estimate the age and stock composition of the commercial catch and daily escapements. The stock composition of the 1.3 and 2.3 age groups was monitored throughout the period of transition from Black Lake stock to Chignik Lake stock (5 June to 24 July). Mean classification accuracies of the age-specific linear discriminant functions for the 1.3 and 2.3 age groups were 84% and 82%, respectively. The total return of sockeye salmon to the Chignik lakes in 1984 was 3,992,875 fish, which was the largest return since 1947 and the third largest ever recorded. The estimated escapement and commercial catch totals for each stock were: Black Lake, 597,712 escapement, 2,621,304 catch, and 3,219,016 total run; and Chignik Lake, 268,496 escapement, 505,363 catch, and 773,859 total run. The Black Lake run was the second largest ever recorded.

KEY WORDS: sockeye salmon, *Oncorhynchus nerka*, stock composition, analysis of scale patterns, Chignik Lake, Black Lake, catch, escapement.

INTRODUCTION

The Chignik lakes watershed is 274 km southwest of Kodiak Island on the south side of the Alaska Peninsula. The major features of the watershed are two large, interconnected lakes, Black Lake and Chignik Lake, with a single outlet river which empties into a nearly enclosed estuary, Chignik Lagoon (Figure 1). There are two major sockeye salmon *(Oncorhynchus nerka* Walbaum) stocks in the Chignik system. The stocks spawn in different areas of the system and have a different time of spawning migration, length of freshwater residence as juveniles, and age at maturity (Higgins 1934; Narver 1963). The majority of the returning adults of one stock pass through the fishery in June and spawn in the tributaries to Black Lake (Black Lake stock). Adults from the other stock enter the fishery in late June and continue until late September with the period of peak abundance usually occurring during the third week of July. The adults from this stock spawn in the tributaries to Chignik Lake, Chignik Lake beach areas, and Black River tributaries (Chignik Lake stock).

Narver (1966) and Dahlberg (1968) independently estimated the optimum escapement goals for the Chignik sockeye salmon stocks as 400,000 fish for Black Lake and 200,000 fish for Chignik Lake. The sockeye salmon run to Chignik has been managed to ensure that these escapement goals are met since 1966. The effectiveness of this management strategy is evident from the increases in the Chignik runs during the last 30 years (Figure 2). For the three most recent ten-year periods, the average total annual returns are:

1954-1963	0.89 million;
1964-1973	1.35 million;
1974-1983	2.16 million.

Although the periods of peak passage of the Chignik sockeye salmon stocks are usually between two and four weeks apart, enumerating the catch and escapement of each stock is complicated because there is a period of overlap, from about mid-June to mid-July, when both stocks pass through the fishery and enter the escapement. Inseason estimates of the numbers of each stock in the daily escapements are required to manage the run for optimum escapements. Post-season estimates of the total catch and escapement of each stock, and the age composition of each of these components, are needed to compile brood-year tables and to forecast the return by stock in subsequent years.

Dahlberg (1968) developed the first technique for separating the two stocks in the catch and escapement using data from tagging experiments conducted from 1962-1966. The proportion of each stock present on each day of the run was estimated by fitting a logistic curve to a year's tagging data. These curves are usually referred to as time-of-entry (TOE) curves. A TOE curve calculated from the 1962-1969 tagging experiments was used to estimate the stock composition of the Chignik sockeye salmon runs for the years 1970-1977.

Conrad (1984a) developed an alternate method for estimating the stock composition of the Chignik sockeye salmon run using scale patterns and linear dis-

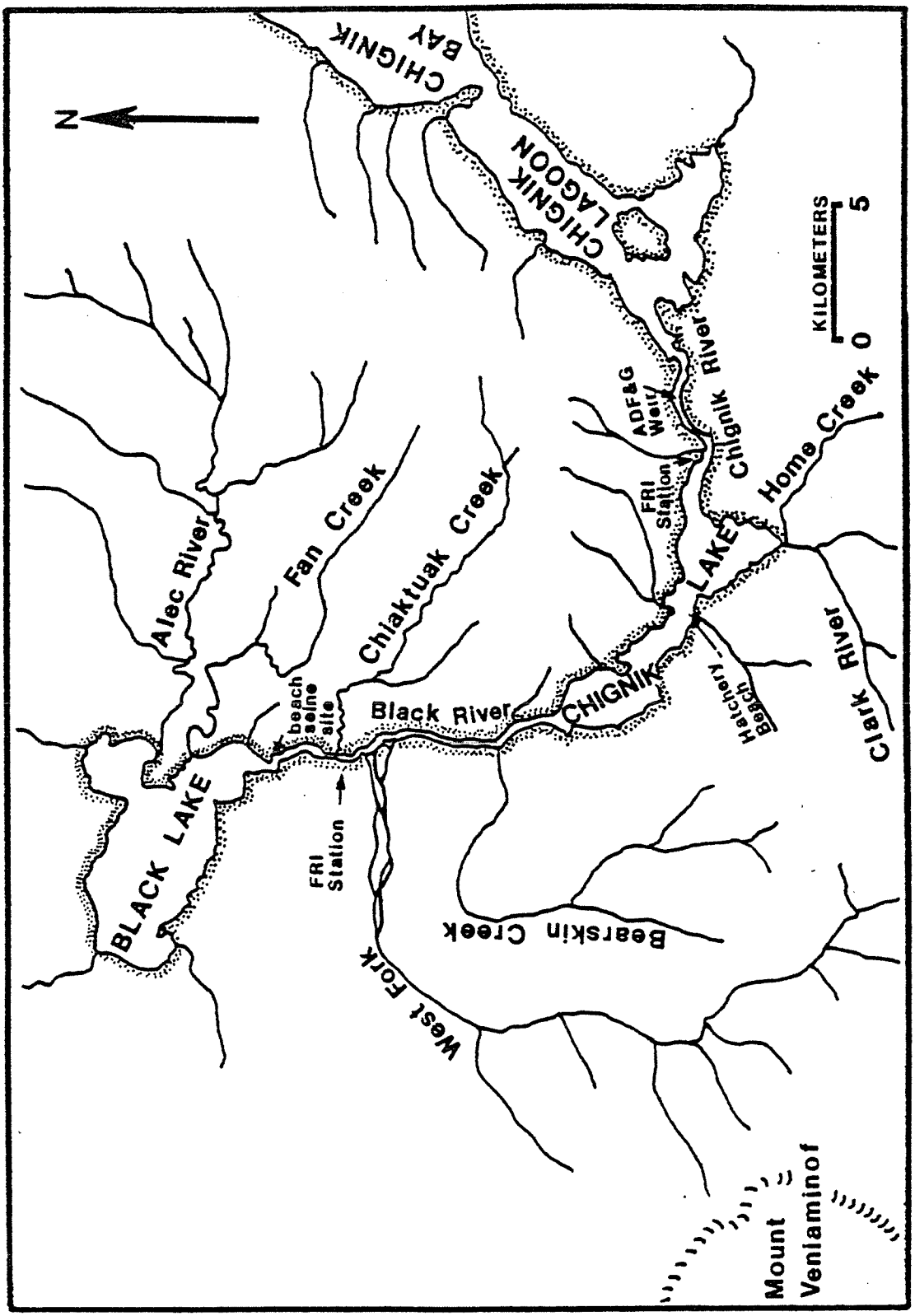

Figure 1. The Chignik lakes watershed.

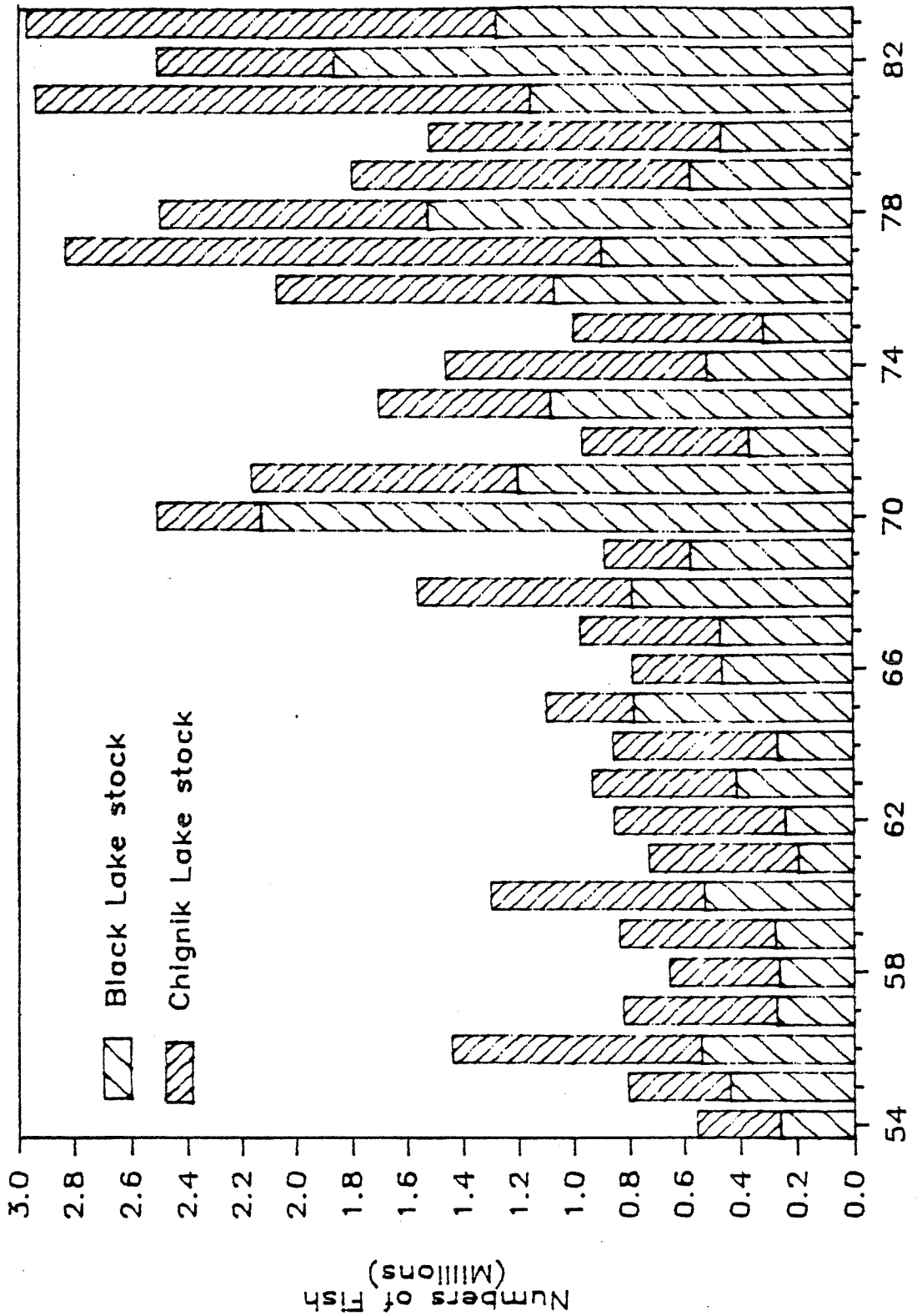

Figure 2. Total annual return of sockeye salmon to the Chignik lakes, 1954-1983.

criminant function analysis. This method estimates the stock composition of the run using scale data collected throughout the main portion of the run. The Chignik sockeye salmon runs from 1978-1983 were analysed with this procedure (Conrad 1984a, 1984b), and an inseason application of the technique was evaluated (Conrad 1984a).

This report presents the results of the post-season scale pattern analysis of the 1984 sockeye salmon run to Chignik. Basic run statistics and the results of the intermediate steps of the scale pattern analysis method of separating the stocks are given. Estimates of the numbers of fish from each stock in the catch and escapement, and the age composition of each component, are presented.

METHODS

Daily Abundance in Chignik Lagoon

The Chignik management area is divided into four management districts. For this report the Central District is divided into two smaller sub-districts, Hook Bay/Kujulik and Aniakchak (Figure 3). Commercial fishing in the Chignik management area is exclusively by purse seine. The daily sockeye salmon catch in each district or sub-district is summarized from fish ticket information from the salmon processors. Traditionally, 80% of the sockeye salmon caught by the Cape Igvak purse seine fishery have been allocated to the Chignik run and that procedure is followed for this report. Although sockeye salmon catches in the Stepovak/Balboa area southwest of Chignik are thought to be primarily of Chignik origin, they are not included in this report because of the lack of sufficient historical data to estimate the Chignik contribution (approximately 539,000 sockeye salmon were harvested in the Stepovak/Balboa area in 1984).

The Alaska Department of Fish and Game operates a weir on Chignik River to enumerate the sockeye salmon escapement (Figure 1). The escapement is estimated from two ten-minute counts made during each hour the weir is open. The weir was removed on 6 August and the escapements after this date were estimated using catch information and abundance relationships from the period prior to weir removal (B.A. Johnson, personal communication).

The scale samples used to estimate the age and stock composition of the Chignik run were collected from boats fishing in the immediate Chignik Lagoon area. The commercial catch in areas outside of Chignik Lagoon and the escapement to Chignik River were adjusted to coincide with the daily catch in the Lagoon before applying the age and stock composition estimates. The following migration times from the outside areas were assumed; Hook Bay/Kujulik, 1 day; Aniakchak, 2 days; Western, 2 days; Eastern, 3 days; Perryville, 3 days; and Cape Igvak, 5 days (Conrad 1984a). A one-day migration time from Chignik Lagoon to the weir was used to adjust the escapement estimates. To estimate the total daily run abundance, each escapement estimate and catch from an outside area was adjusted to coincide with a Chignik Lagoon date and then summed for each day of the run.

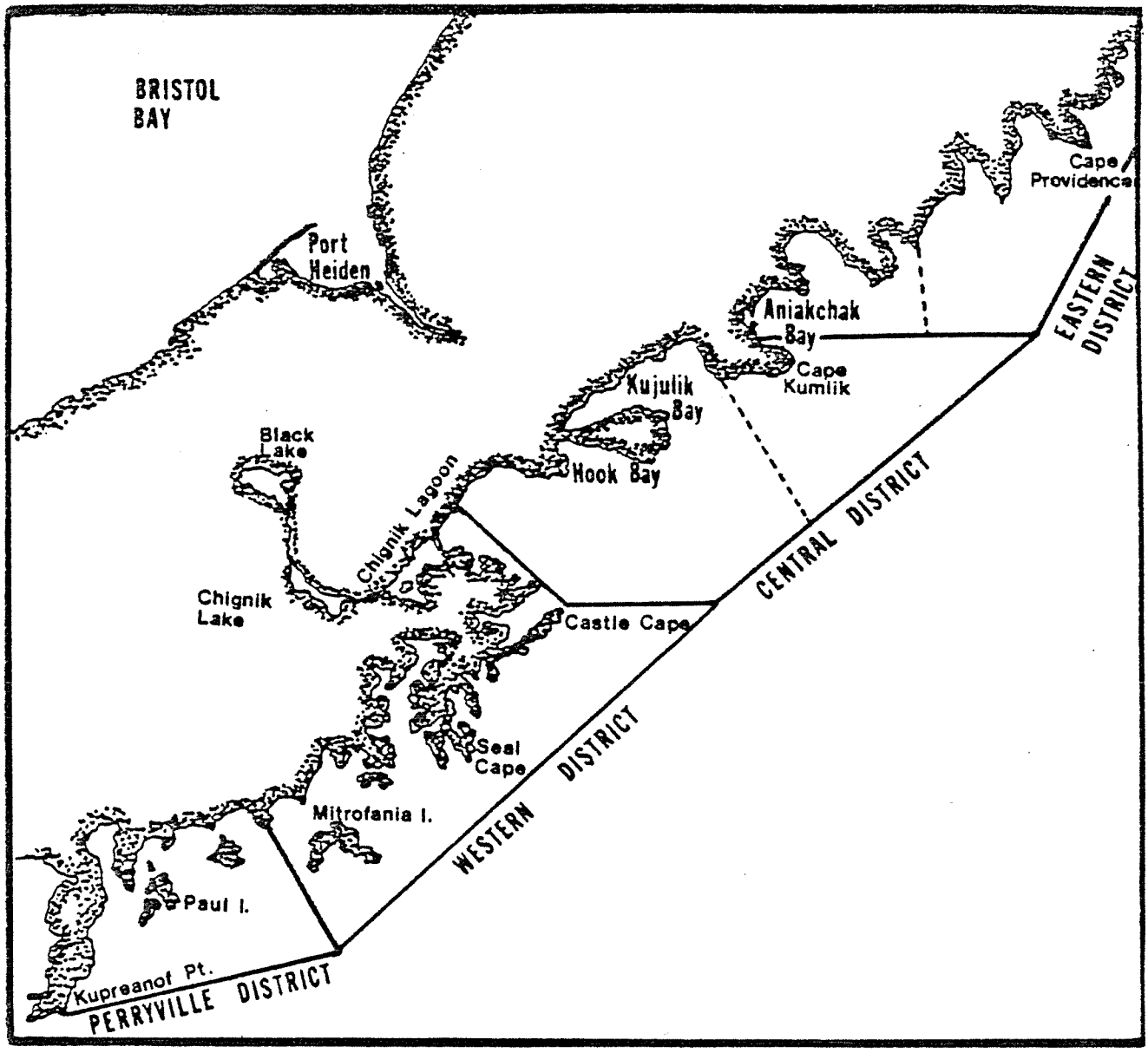

Figure 3. The Chignik area fishing districts and the modifications made for this report.

Age Composition

Scale samples needed to monitor the age and stock composition of the run were periodically collected in Chignik Lagoon throughout June, July, August, and early September. During June and July samples were collected about every five to seven days. This is the period when the predominant stock in the run changes from Black Lake to Chignik Lake. Scale samples were collected from the catches made by two or three boats as they delivered to tenders in Chignik Lagoon. If the fishery was closed and scale samples were needed, a boat was chartered and two or three areas of the Lagoon were sampled.

Approximately 600 scales were collected during each sampling session in June and July. About 300 scales were collected during each sampling session in August and September. The preferred scale (Clutter and Whitesel 1956), or a scale near it, was removed from the left side of each fish sampled. Each scale was mounted on a gummed card, and the sex and mideye-to-fork-of-tail length of the fish was recorded. A permanent impression of each gummed card was later made in cellulose acetate.

Scale samples representing the Black Lake spawners were collected with a beach seine at the outlet of Black Lake (Figure 1) during five sampling sessions in June and early July. Scales were processed following the same procedures used for the catch samples.

Scale images were projected at 82X on a microfiche reader to determine the age of each fish sampled. The total catch or escapement on each day of the run (adjusted to Chignik Lagoon date) was allocated by age class using the daily age composition estimates. The age composition of the run on days between sampling dates was estimated by linear interpolation.

Stock Composition

Linear discriminant function (LDF) analysis (Fisher 1936) and measurements made in the lacustrine zone of the scales were used to estimate the stock composition of the Chignik sockeye salmon run. Scale impressions were projected at 210X and detailed measurements of the lacustrine zone were made using a microcomputer controlled digitizing system. For each lacustrine annular zone, the total number of circuli in the zone, the total width of the zone, and the distance from the scale focus to each circulus in the annular zone were recorded. The number of circuli of lacustrine plus growth (Mosher 1969) and the width of the zone of lacustrine plus growth were recorded, also. The scale characters examined for the LDF analysis included those measured directly from each scale and combinations of these characters (Conrad 1984a).

Scale samples representative of the Black Lake and Chignik Lake stocks (standards) were constructed for the 1.3[1] and 2.3 age groups. Scales for the Chignik Lake standards were randomly selected from the samples collected in

[1] European formula: number of freshwater annuli, decimal point, number of marine annuli. The total age is the sum of these two numbers plus one.

Chignik Lagoon after 24 July. Scales for the Black Lake standards were randomly selected from the samples collected by beach seining at the outlet of Black Lake. A subset of approximately 25 scale measurement characters was selected for each analysis from the initial set of more than 80 scale characters. The scale characters selected had either a large F-statistic or were negatively correlated with a character having a large F-statistic. Variables selected for a linear discriminant function anslysis using these criteria usually contain a subset which will give the "best" LDF (Cochran 1964). Scale characters to be included in each age-specific LDF were selected by a stepwise procedure using the partial F-statistic as the criterion for variable entry/removal into the model (Enslein et al. 1977). A nearly unbiased estimate of the classification accuracy of each age-specific LDF was determined using a leaving-one-out procedure (Lachenbruch 1967).

Scale samples collected in Chignik Lagoon during the period of transition (5 June to 24 July) were used to estimate the proportion of each stock in the catch. A maximum of 100 scales were measured for each age class on a sample date. If less than 25 scales for an age class were available, that age class was omitted for that sample date. For each age class, the appropriate LDF was used to classify the scales of unknown stock composition. The estimates of the proportion of Black Lake and Chignik Lake stocks present on a sample date for an age class were adjusted by the procedure of Cook and Lord (1978), and the variance of each adjusted stock composition estimate calculated (Pella and Robertson 1979). The adjusted stock composition estimates for each age class were then smoothed by a moving average of three sample dates (Conrad 1984a) to reduce the effects of any bias from unrepresentative sampling in the Lagoon. Prior to smoothing, it was assumed that 100% of the run on 23 May was of Black Lake origin and 100% of the run on 31 July and later was of Chignik Lake origin. The stock composition on days between sampling dates was estimated by linear interpolation of the smoothed estimates.

Catch and Escapement by Stock

Catch and escapement by age class for each stock was estimated for each day of the run as the product of the smoothed age-specific stock composition estimate and the estimate of the numbers of fish in the age class. The average of the available stock composition estimates was used for those age classes which had no age-specific estimates. The daily estimates of total abundance by stock were used to calculate the mean date and variance of the migration (Mundy 1982). Seasonal estimates of catch and escapement by stock were the sum of the daily estimates.

RESULTS

Daily Abundance

The total sockeye salmon return (escapement plus catch) to Chignik in 1984 was 3,992,875 fish. This is the largest total return since 1947 and the third largest ever recorded. In three of the last four years, the total return has exceeded all previous returns since the historical record return

of more than 5.8 million fish in 1947. For the period 1981 to 1984, the total annual sockeye salmon return to the Chignik lakes averaged about 3.1 million fish.

The estimated escapement of sockeye salmon was 866,208 fish and the catch was 3,126,667 fish (Appendix Table 1). More than 77% of the commercial catch occurred in the Chignik Lagoon and Hook Bay/Kujulik areas. Typically there are two distinct periods of large daily abundances in the Chignik sockeye salmon run, one in June and one in July. In 1984, the early-arriving Black Lake stock was much more abundant than the late-arriving Chignik Lake stock. There were two distinct peaks in the daily abundance in June, the first on 7 June (242,180 fish) and the second on 14 June (199,873 fish) (Figure 4). The daily abundance estimates exceeded 100,000 fish on 14 consecutive days from 9 June to 22 June. The estimated daily abundance declined rapidly in late June and after 28 June there were only two days with an abundance of more than 50,000 sockeye salmon. The peak daily abundance after 1 July was 55,711 fish on 14 July.

Age Composition

Thirteen separate scale samples were collected in Chignik Lagoon between 5 June and 3 September (Appendix Table 2). Sampling was evenly distributed throughout the periods of peak daily abundance in June and July. Age 1.3 fish were the most abundant age group in the catch during June (Figure 5). The abundance of the 1.3 age group declined rapidly in early July as the abundance of the 2.3 age group increased. Fish aged 2.3 were the most abundant age group in the catch from 12 July until the last sample on 3 September. The largest contribution of an age group other than 1.3 or 2.3 were 15.9% by the 2.2 age group on 3 September.

The 1.3 and 2.3 age groups represented more than 90% of the fish in the total catch and escapement. There were 524,447 (60.5%) fish aged 1.3 and 270,709 (31.3%) fish aged 2.3 in the escapement (Appendix Table 3). In the catch, the estimated contributions of the 1.3 and 2.3 age groups were 2,503,385 (80.1%) fish and 373,375 (11.9%) fish, respectively (Appendix Table 4).

The decline in abundance of age 1-freshwater adults during the season, paralleled by an increase in abundance of age 2-freshwater adults, is consistent with past observations of the Chignik run (Conrad 1984a). The majority of the early arriving segment of the run consists of Black Lake stock which produces primarily age 1-freshwater sockeye salmon, and the later arriving segment of the run consists mostly of Chignik Lake stock which produces the majority of the age 2-freshwater fish.

Scale samples were collected at Black Lake outlet on five separate occasions between 15 June and 14 July (Appendix Table 5). Fish aged 1.3 were the predominant age group in these samples accounting for 87.8% of the scales collected. The 2.3 and 1.2 age groups were the next most abundant with contributions of 6.1% and 3.5%, respectively.

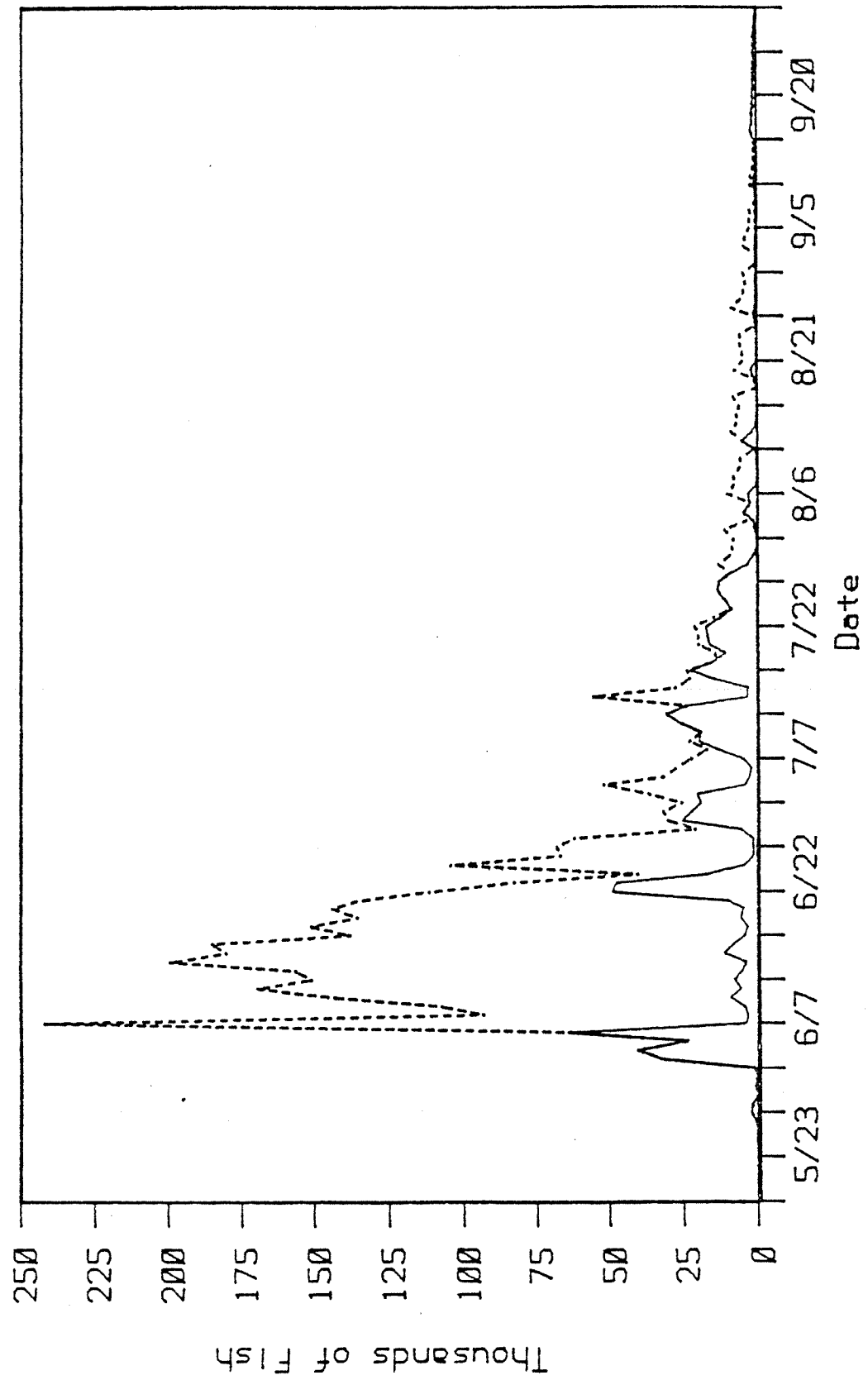

Figure 4. Daily escapement (——) and total daily abundance (- -) of sockeye salmon, adjusted to Chignik Lagoon date.

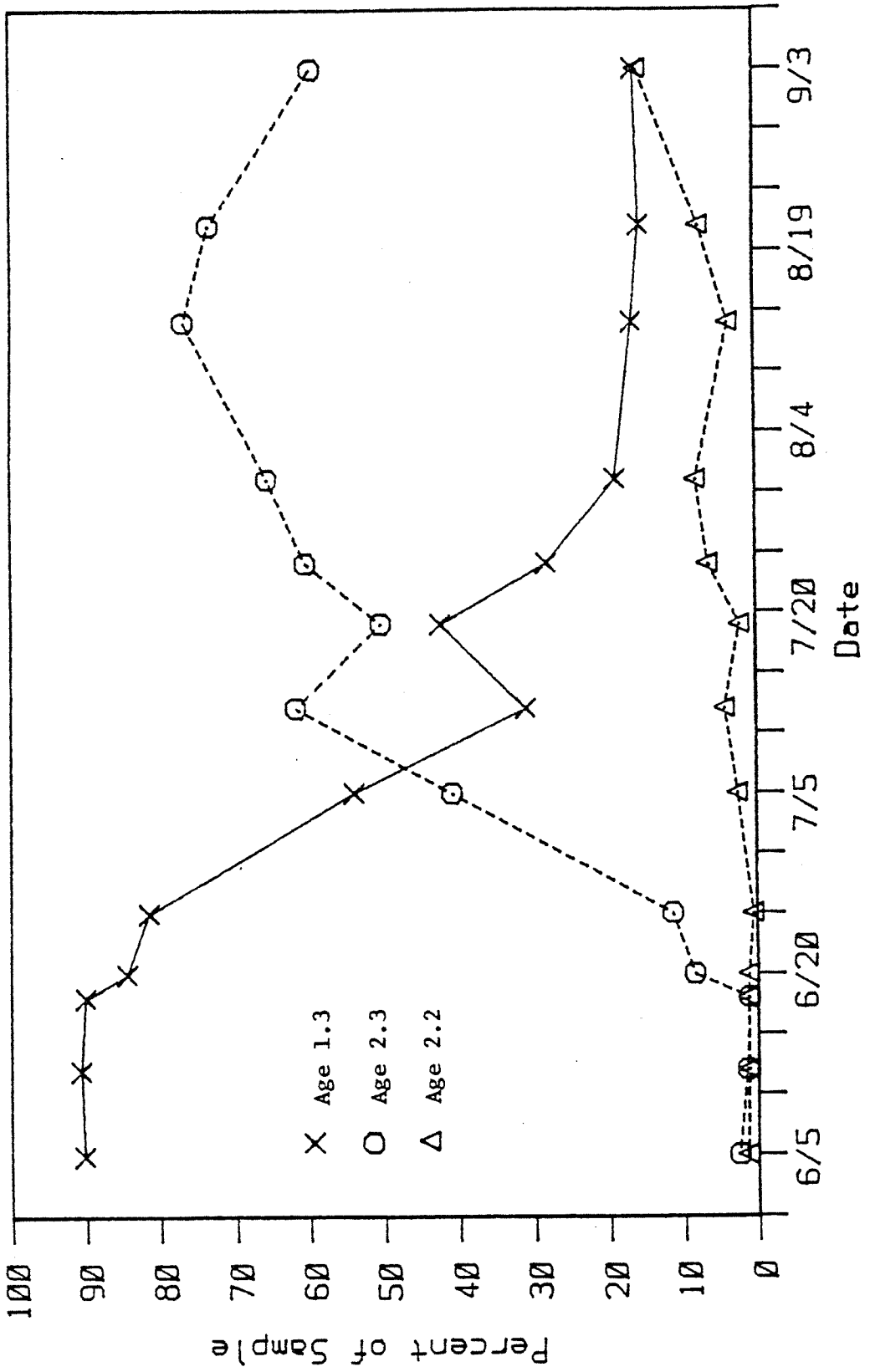

Figure 5. Age composition of scale samples collected in Chignik Lagoon. Minor age groups are not shown.

Stock Composition

Mean classification accuracies of the linear discriminant functions for the 1.3 and 2.3 age groups are 84.3% and 81.8%, respectively (Table 1). The accuracy for the 1.3 age group was the highest ever achieved. Scale samples of unknown stock composition collected in Chignik Lagoon between 5 June and 24 July were classified using the appropriate age-specific LDF. The adjusted stock composition estimates, the smoothed estimates, and their standard errors are presented for each age group in Tables 2 and 3. The stock composition of the 2.3 age group could not be estimated prior to 20 June because there were not sufficient numbers of scales belonging to that age group available for analysis.

The temporal change in the stock composition of the 1.3 and 2.3 age groups was very similar (Figure 6). For the 1.3 age group, (Table 2) the smoothed estimates of the proportion of the Black Lake stock present were greater than 80% throughout June. The estimated proportional contribution of the Chignik Lake stock did not begin to increase until early July for the 1.3 age group and the sample on 24 July had the largest proportion estimated for the Chignik Lake stock (0.588). For the 2.3 age group (Table 3), the smoothed estimates of the proportion of Chignik Lake stock in the run increased from 0.284 on 5 June to 0.672 for the last sample on 24 July. For both age groups, the majority of the run was estimated to belong to the Black Lake stock until mid-July. It is assumed that all sockeye salmon in the catch or escapement after 30 July belonged to the Chignik Lake stock.

Catch and Escapement by Stock

The results of allocating the daily sockeye salmon catch and escapement using the age-specific stock composition estimates are summarized by age group and stock in Table 4. The Black Lake run was 3,219,016 sockeye salmon consisting of an escapement of 597,712 fish and catch of 2,621,304 fish. This was the largest sockeye salmon run to Black Lake since the historical record of more than 3.7 million in 1947. Approximately 83% of the Black Lake run was assigned to the 1.3 age group. The 2.3 age group was the next most abundant age group and representd about 9% of the Black Lake run.

The Chignik Lake run was 773,859 fish (Table 4). The escapement to Chignik Lake spawning areas was 268,496 fish and there were 505,373 fish of Chignik Lake origin in the catch. Fish aged 1.3 (45.4%) and 2.3 (44.8%) were nearly equally abundant in the Chignik Lake run. No other age class contributed more than 5% to the run.

The daily escapement, catch, total daily abundance, and migratory timing statistics for the sockeye salmon run to Black Lake and to Chignik Lake are presented in Tables 5 and 6, respectively. The mean date for the Black Lake run was 18 June and for the Chignik Lake run 16 July. The total daily abundance by stock is shown in Figure 7.

Table 1. Classification matrices for ages 1.3 and 2.3 sockeye salmon.

Age 1.3

Actual Stock of Origin	Sample Size	Classified Stock of Origin: Black Lake	Classified Stock of Origin: Chignik Lake
Black Lake	208	0.846	0.154
Chignik Lake	113	0.159	0.841

Mean classification accuracy = 0.843

Age 2.3

Actual Stock of Origin	Sample Size	Classified Stock of Origin: Black Lake	Classified Stock of Origin: Chignik Lake
Black Lake	117	0.829	0.171
Chignik Lake	207	0.193	0.807

Mean classification accuracy = 0.818

Table 2. Stock composition estimates from the analysis of scale patterns of the 1.3 age group.

Sample Date	Sample Size	Stock	Original Estimate	Standard Error[1]	Smoothed Estimate	Standard Error
6/ 5	71	Black Lake	1.081	0.06495	0.961[2]	0.03166
		Chignik Lake	-0.081		0.039	
6/12	102	Black Lake	0.882	0.06931	0.936	0.03875
		Chignik Lake	0.118		0.064	
6/18	103	Black Lake	0.927	0.06703	0.936	0.03847
		Chignik Lake	0.073		0.064	
6/20	103	Black Lake	0.998	0.06341	0.912	0.03902
		Chignik Lake	0.002		0.088	
6/25	102	Black Lake	0.810	0.07203	0.839	0.04060
		Chignik Lake	0.190		0.161	
7/ 5	102	Black Lake	0.710	0.07499	0.711	0.04376
		Chignik Lake	0.290		0.289	
7/12	93	Black Lake	0.614	0.08013	0.665	0.04460
		Chignik Lake	0.386		0.335	
7/19	100	Black Lake	0.671	0.07656	0.617	0.04500
		Chignik Lake	0.329		0.383	
7/24	104	Black Lake	0.566	0.07709	0.412[3]	0.03622
		Chignik Lake	0.434		0.588	

[1] Standard error is the same for both proportions.

[2] The first two estimates are smoothed with the assumption that the first fish counted at the weir are entirely Black Lake stock (a proportion of 1.00 Black Lake stock and 0.0 variance are assumed).

[3] The last two estimates are smoothed with the assumption that all fish after 30 July are entirely Chignik Lake stock (a proportion of 1.00 Chignik Lake stock and 0.0 variance are assumed).

Table 3. Stock composition estimates from the analysis of scale patterns of the 2.3 age group.

Sample Date	Sample Size	Stock	Original Estimate	Standard Error[1]	Smoothed Estimate	Standard Error
6/20[2]	45	Black Lake	0.815	0.11549		
		Chignik Lake	0.185			
6/25	59	Black Lake	0.603	0.10776	0.716	0.05992
		Chignik Lake	0.397		0.284	
7/ 5	99	Black Lake	0.729	0.08578	0.605	0.05424
		Chignik Lake	0.271		0.395	
7/12	98	Black Lake	0.483	0.08662	0.593	0.04969
		Chignik Lake	0.517		0.407	
7/19	101	Black Lake	0.568	0.08580	0.489	0.04928
		Chignik Lake	0.432		0.511	
7/24	105	Black Lake	0.415	0.08364	0.328[3]	0.03994
		Chignik Lake	0.585		0.672	

[1] Standard error is the same for both proportions.

[2] There were insufficient numbers of the 2.3 age group prior to 20 June for analysis.

[3] The last two estimates are smoothed with the assumption that all fish after 30 July are entirely Chignik Lake stock (a proportion of 1.00 Chignik Lake stock and 0.0 variance are assumed).

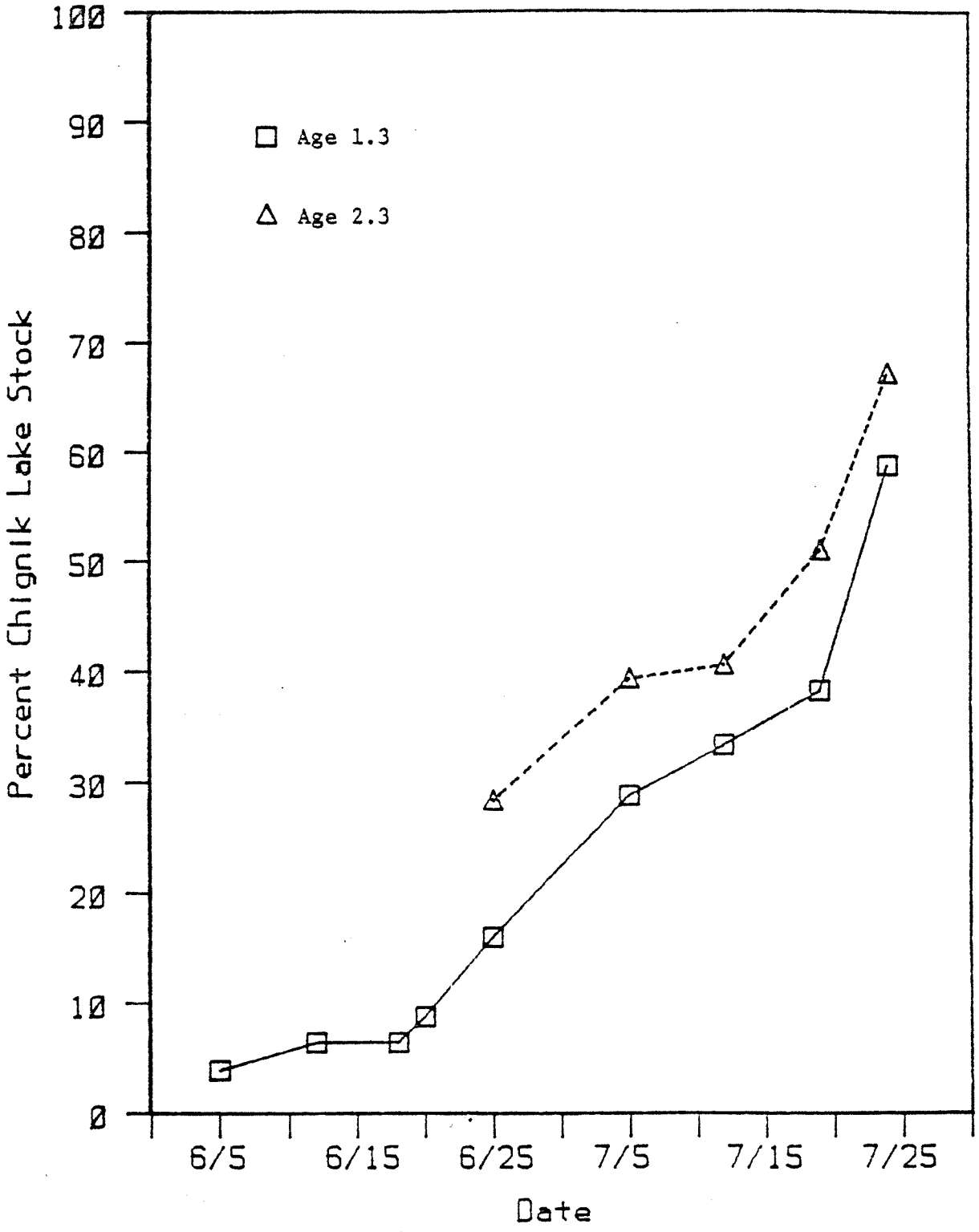

Figure 6. Daily stock composition during the period of transition for the age-specific stock composition estimates smoothed by a moving average of three sample dates.

Table 4. The escapement, catch, and total return by age group and stock estimated by analysis of scale patterns.

Component	Age Group[1] 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
Black Lake													
Escapement	299	13,018	14,840	694	428,424	12,580	623	125,201	0	1,146	627	260	597,712
%	0.05	2.18	2.48	0.12	71.69	2.10	0.10	20.95	0.00	0.19	0.10	0.04	100.00
Catch	147	87,845	68,910	300	2,248,381	35,292	4,959	172,061	0	1,779	759	871	2,621,304
%	0.01	3.35	2.63	0.01	85.77	1.35	0.19	6.56	0.00	0.07	0.03	0.03	100.00
St. Error	53	3,982	3,470	64	18,445	2,401	915	4,293	0	394	141	253	2,621,304
Total	446	100,863	83,750	994	2,676,805	47,872	5,582	297,262	0	2,925	1,386	1,131	3,219,016
%	0.01	3.13	2.60	0.03	83.17	1.49	0.17	9.23	0.00	0.09	0.04	0.04	100.00
Chignik Lake													
Escapement	496	1,978	5,512	2,681	96,023	13,907	406	145,508	248	1,184	491	62	268,496
%	0.18	0.74	2.05	1.00	35.76	5.18	0.15	54.21	0.09	0.44	0.18	0.02	100.00
Catch	894	8,341	10,946	4,865	255,004	21,113	448	201,314	362	1,349	491	236	505,363
%	0.18	1.65	2.17	0.96	50.46	4.18	0.09	39.82	0.07	0.27	0.10	0.05	100.00
St. Error	171	785	659	321	17,236	641	80	2,616	57	190	79	73	2,621,304
Total	1,390	10,319	16,458	7,546	351,027	35,020	854	346,822	610	2,533	982	298	773,859
%	0.18	1.33	2.13	0.98	45.35	4.53	0.11	44.81	0.08	0.33	0.13	0.04	100.00

[1] The stock composition of ages other than 1.3 and 2.3 estimated by averaging the composition of these ages.

Table 5. Daily and cumulative return of sockeye salmon to Black Lake (adjusted to Chignik Lagoon date).

Date	Escapement	Numbers of Fish Catch	Total	Cumulative Return	Cumulative Proportion
5/23	72	0	72	72	0.000
5/24	154	0	154	226	0.000
5/25	429	0	429	655	0.000
5/26	357	0	357	1,012	0.000
5/27	898	0	898	1,910	0.001
5/28	2,505	0	2,505	4,415	0.001
5/29	1,986	0	1,986	6,401	0.002
5/30	47	0	47	6,448	0.002
5/31	1,205	0	1,205	7,653	0.002
6/ 1	654	0	654	8,307	0.003
6/ 2	1,493	0	1,493	9,800	0.003
6/ 3	31,797	0	31,797	41,597	0.013
6/ 4	39,349	0	39,349	80,946	0.025
6/ 5	22,801	0	22,801	103,747	0.032
6/ 6	61,351	0	61,351	165,098	0.051
6/ 7	3,757	227,215	230,972	396,070	0.123
6/ 8	3,269	85,480	88,749	484,819	0.151
6/ 9	4,286	97,396	101,682	586,501	0.182
6/10	8,957	126,531	135,488	721,989	0.224
6/11	5,202	154,445	159,647	881,636	0.274
6/12	7,579	133,817	141,396	1,023,032	0.318
6/13	4,861	141,815	146,676	1,169,708	0.363
6/14	3,765	183,338	187,103	1,356,811	0.421
6/15	10,531	158,409	168,940	1,525,751	0.474
6/16	7,615	165,709	173,324	1,699,075	0.528
6/17	3,873	125,064	128,937	1,828,012	0.568
6/18	3,155	138,622	141,777	1,969,789	0.612
6/19	5,367	119,921	125,288	2,095,077	0.651
6/20	4,113	127,431	131,544	2,226,621	0.692
6/21	9,081	112,851	121,932	2,348,553	0.730
6/22	43,765	54,708	98,473	2,447,026	0.760
6/23	41,278	30,511	71,789	2,518,815	0.782
6/24	14,702	20,002	34,704	2,553,519	0.793
6/25	3,555	82,390	85,945	2,639,464	0.820
6/26	1,213	52,469	53,682	2,693,146	0.837
6/27	1,408	52,458	53,866	2,747,012	0.853
6/28	1,373	46,535	47,908	2,794,920	0.868
6/29	4,240	11,436	15,676	2,810,596	0.873
6/30	18,977	3,666	22,643	2,833,239	0.880
7/ 1	16,075	7,214	23,289	2,856,528	0.887
7/ 2	13,347	4,829	18,176	2,874,704	0.893
7/ 3	14,248	11,617	25,865	2,900,569	0.901
7/ 4	2,830	32,773	35,603	2,936,172	0.912

-Continued-

Table 5. Daily and cumulative return of sockeye salmon to Black Lake (adjusted to Chignik Lagoon date) - continued.

Date	Escapement	Numbers of Fish Catch	Numbers of Fish Total	Cumulative Return	Cumulative Proportion
7/ 5	1,917	19,081	20,998	2,957,170	0.919
7/ 6	1,307	16,856	18,163	2,975,333	0.924
7/ 7	3,242	11,211	14,453	2,989,786	0.929
7/ 8	8,470	2,652	11,122	3,000,908	0.932
7/ 9	12,639	2,093	14,732	3,015,640	0.937
7/10	11,922	0	11,922	3,027,562	0.941
7/11	16,353	0	16,353	3,043,915	0.946
7/12	19,015	0	19,015	3,062,930	0.952
7/13	14,548	0	14,548	3,077,478	0.956
7/14	1,798	31,443	33,241	3,110,719	0.966
7/15	1,811	14,329	16,140	3,126,859	0.971
7/16	8,302	4,821	13,123	3,139,982	0.975
7/17	12,752	785	13,537	3,153,519	0.980
7/18	8,324	21	8,345	3,161,864	0.982
7/19	5,748	1,867	7,615	3,169,479	0.985
7/20	8,046	1,996	10,042	3,179,521	0.988
7/21	7,793	1,507	9,300	3,188,821	0.991
7/22	7,434	1,641	9,075	3,197,896	0.993
7/23	4,744	959	5,703	3,203,599	0.995
7/24	3,026	0	3,026	3,206,625	0.996
7/25	3,303	0	3,303	3,209,928	0.997
7/26	3,386	0	3,386	3,213,314	0.998
7/27	2,563	3	2,566	3,215,880	0.999
7/28	1,385	0	1,385	3,217,265	0.999
7/29	304	999	1,303	3,218,568	1.000
7/30	60	388	448	3,219,016	1.000
Total	597,712	2,621,304	3,219,016	Mean Day	June 18
				Variance	109.1

Table 6. Daily and cumulative return of sockeye salmon to Chignik Lake (adjusted to Chignik Lagoon date).

Date	Escapement	Numbers of Fish Catch	Numbers of Fish Total	Cumulative Return	Cumulative Proportion
5/25	2	0	2	2	0.000
5/26	3	0	3	5	0.000
5/27	10	0	10	15	0.000
5/28	39	0	39	54	0.000
5/29	37	0	37	91	0.000
5/30	1	0	1	92	0.000
5/31	30	0	30	122	0.000
6/ 1	18	0	18	140	0.000
6/ 2	46	0	46	186	0.000
6/ 3	1,094	0	1,094	1,280	0.002
6/ 4	1,482	0	1,482	2,762	0.004
6/ 5	933	0	933	3,695	0.005
6/ 6	2,745	0	2,745	6,440	0.008
6/ 7	181	11,027	11,208	17,648	0.023
6/ 8	172	4,477	4,649	22,297	0.029
6/ 9	242	5,477	5,719	28,016	0.036
6/10	539	7,608	8,147	36,163	0.047
6/11	333	9,893	10,226	46,389	0.060
6/12	515	9,099	9,614	56,003	0.072
6/13	331	9,660	9,991	65,994	0.085
6/14	257	12,513	12,770	78,764	0.102
6/15	719	10,833	11,552	90,316	0.117
6/16	522	11,350	11,872	102,188	0.132
6/17	267	8,582	8,849	111,037	0.143
6/18	217	9,531	9,748	120,785	0.156
6/19	443	9,912	10,355	131,140	0.169
6/20	399	12,346	12,745	143,885	0.186
6/21	1,039	12,930	13,969	157,854	0.204
6/22	5,815	7,268	13,083	170,937	0.221
6/23	6,262	4,629	10,891	181,828	0.235
6/24	2,517	3,425	5,942	187,770	0.243
6/25	777	17,990	18,767	206,537	0.267
6/26	294	12,729	13,023	219,560	0.284
6/27	377	14,040	14,417	233,977	0.302
6/28	404	13,660	14,064	248,041	0.321
6/29	1,359	3,662	5,021	253,062	0.327
6/30	6,608	1,277	7,885	260,947	0.337
7/ 1	6,061	2,722	8,783	269,730	0.349
7/ 2	5,431	1,965	7,396	277,126	0.358
7/ 3	6,240	5,084	11,324	288,450	0.373
7/ 4	1,329	15,407	16,736	305,186	0.394
7/ 5	966	9,607	10,573	315,759	0.408
7/ 6	679	8,778	9,457	325,216	0.420

-Continued-

Table 6. Daily and cumulative return of sockeye salmon to Chignik Lake (adjusted to Chignik Lagoon date) - continued.

Date	Escapement	Numbers of Fish Catch	Total	Cumulative Return	Cumulative Proportion
7/ 7	1,744	6,035	7,779	332,995	0.430
7/ 8	4,698	1,469	6,167	339,162	0.438
7/ 9	7,220	1,196	8,416	347,578	0.449
7/10	7,004	0	7,004	354,582	0.458
7/11	9,859	0	9,859	364,441	0.471
7/12	11,747	0	11,747	376,188	0.486
7/13	9,407	0	9,407	385,595	0.498
7/14	1,216	21,254	22,470	408,065	0.527
7/15	1,277	10,110	11,387	419,452	0.542
7/16	6,104	3,541	9,645	429,097	0.554
7/17	9,757	601	10,358	439,455	0.568
7/18	6,621	14	6,635	446,090	0.576
7/19	4,745	1,540	6,285	452,375	0.585
7/20	7,774	1,928	9,702	462,077	0.597
7/21	8,789	1,699	10,488	472,565	0.611
7/22	9,789	2,163	11,952	484,517	0.626
7/23	7,306	1,476	8,782	493,299	0.637
7/24	5,465	0	5,465	498,764	0.645
7/25	7,536	0	7,536	506,300	0.654
7/26	9,989	0	9,989	516,289	0.667
7/27	10,121	13	10,134	526,423	0.680
7/28	7,771	0	7,771	534,194	0.690
7/29	2,703	8,947	11,650	545,844	0.705
7/30	1,119	7,346	8,465	554,309	0.716
7/31	111	8,142	8,253	562,562	0.727
8/ 1	32	8,160	8,192	570,754	0.738
8/ 2	894	10,261	11,155	581,909	0.752
8/ 3	1,357	1,969	3,326	585,235	0.756
8/ 4	4,416	280	4,696	589,931	0.762
8/ 5	2,208	0	2,208	592,139	0.765
8/ 6	3,155	7,093	10,248	602,387	0.778
8/ 7	349	7,292	7,641	610,028	0.788
8/ 8	93	8,053	8,146	618,174	0.799
8/ 9	109	5,774	5,883	624,057	0.806
8/10	142	5,300	5,442	629,499	0.813
8/11	641	349	990	630,489	0.815
8/12	5,167	36	5,203	635,692	0.821
8/13	1,708	7,221	8,929	644,621	0.833
8/14	226	6,583	6,809	651,430	0.842
8/15	67	6,787	6,854	658,284	0.851
8/16	78	5,934	6,012	664,296	0.858
8/17	59	8,373	8,432	672,728	0.869
8/18	172	486	658	673,386	0.870

-Continued-

Table 6. Daily and cumulative return of sockeye salmon to Chignik Lake (adjusted to Chignik Lagoon date) - continued.

Date	Escapement	Numbers of Fish Catch	Total	Cumulative Return	Cumulative Proportion
8/19	817	131	948	674,334	0.871
8/20	2,002	5,682	7,684	682,018	0.881
8/21	331	4,400	4,731	686,749	0.887
8/22	98	4,966	5,064	691,813	0.894
8/23	104	5,760	5,864	697,677	0.902
8/24	79	5,587	5,666	703,343	0.909
8/25	449	92	541	703,884	0.910
8/26	797	0	797	704,681	0.911
8/27	486	8,145	8,631	713,312	0.922
8/28	283	5,032	5,315	718,627	0.929
8/29	198	4,060	4,258	722,885	0.934
8/30	251	3,621	3,872	726,757	0.939
8/31	243	4,195	4,438	731,195	0.945
9/ 1	343	0	343	731,538	0.945
9/ 2	583	0	583	732,121	0.946
9/ 3	585	3,858	4,443	736,564	0.952
9/ 4	279	3,622	3,901	740,465	0.957
9/ 5	197	2,278	2,475	742,940	0.960
9/ 6	217	2,280	2,497	745,437	0.963
9/ 7	236	2,013	2,249	747,686	0.966
9/ 8	325	366	691	748,377	0.967
9/ 9	587	0	587	748,964	0.968
9/10	1,188	1,084	2,272	751,236	0.971
9/11	466	1,469	1,935	753,171	0.973
9/12	328	798	1,126	754,297	0.975
9/13	345	670	1,015	755,312	0.976
9/14	515	348	863	756,175	0.977
9/15	847	0	847	757,022	0.978
9/16	2,276	0	2,276	759,298	0.981
9/17	1,656	0	1,656	760,954	0.983
9/18	1,529	0	1,529	762,483	0.985
9/19	1,411	0	1,411	763,894	0.987
9/20	1,303	0	1,303	765,197	0.989
9/21	1,203	0	1,203	766,400	0.990
9/22	1,110	0	1,110	767,510	0.992
9/23	1,025	0	1,025	768,535	0.993
9/24	946	0	946	769,481	0.994
9/25	873	0	873	770,354	0.995
9/26	806	0	806	771,160	0.997
9/27	744	0	744	771,904	0.997
9/28	687	0	687	772,591	0.998
9/29	634	0	634	773,225	0.999
9/30	634	0	634	773,859	1.000
Total	268,496	505,363	773,859	Mean Day	July 16
				Variance	695.9

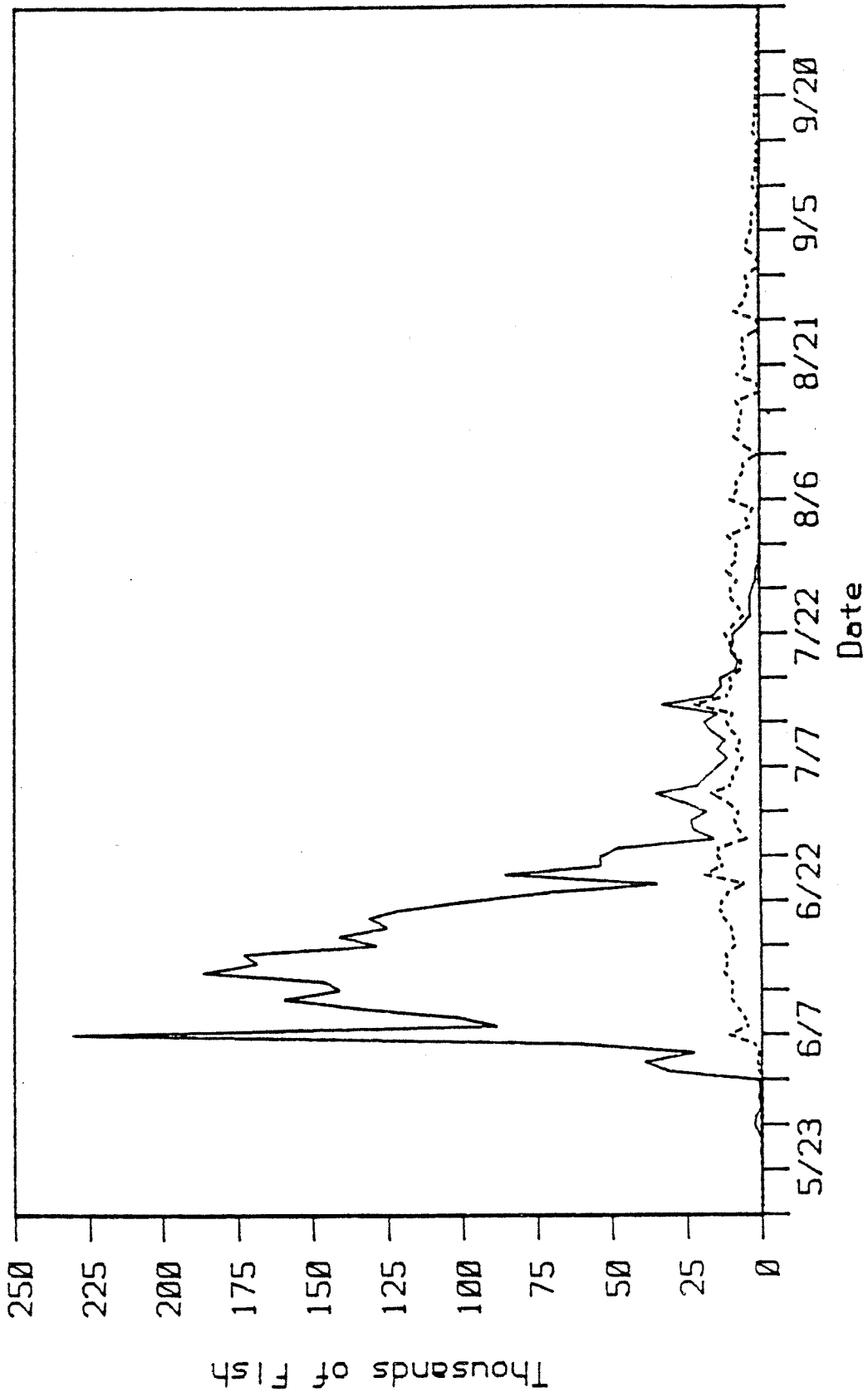

Figure 7. Daily abundance of the Black Lake (——) and Chignik Lake (- -) stocks.

DISCUSSION

The temporal change in stock composition, as estimated by analysis of the scale patterns of the 1.3 and 2.3 age groups, was very different than those estimated for the Chignik sockeye salmon runs for the years 1978 to 1983 (Figure 8). In 1984, fish of Black Lake origin were more abundant than fish of Chignik Lake origin in the total daily run until 21 July. Previously, the latest date which the change from a majority of Black Lake stock to a majority of Chignik Lake stock in the daily run had occurred was 7 July. The late date of change in dominance of the stocks in 1984 was due to the numerical superiority of the Black Lake stock, which was more than four times as abundant as the Chignik Lake stock. Although only 10% of the Black Lake run occurred between 3 July and 31 July, this small fraction of the Black Lake stock still accounted for the majority of the fish in the total daily run until 21 July.

In the previous analyses of scale patterns of the Chignik sockeye salmon run, the unadjusted age-specific stock composition estimates (before smoothing) of the proportion of Chignik Lake stock in samples collected after 15 July ranged from about 0.70 to 1.00. In 1984, the unadjusted estimated of the proportion of Chignik Lake stock in the samples collected on 19 and 24 July ranged from 0.33 to 0.59 (Tables 2 and 3). These are much smaller estimates for the proportion of Chignik Lake stock than are typically seen for late July samples. These low estimates may indicate that the assumption that all fish after 30 July are of Chignik Lake origin may be in error. It was necessary to make this assumption for the scale pattern analysis to achieve adequate sample sizes for the Chignik Lake standards. The numbers of Black Lake stock in late July and early August may be underestimated if this assumption was violated. However, because of the relatively small numbers of fish in the run after 30 July (only 6% of the total Chignik sockeye salmon run occurred between 31 July and 30 September), we feel this was not a major source of error.

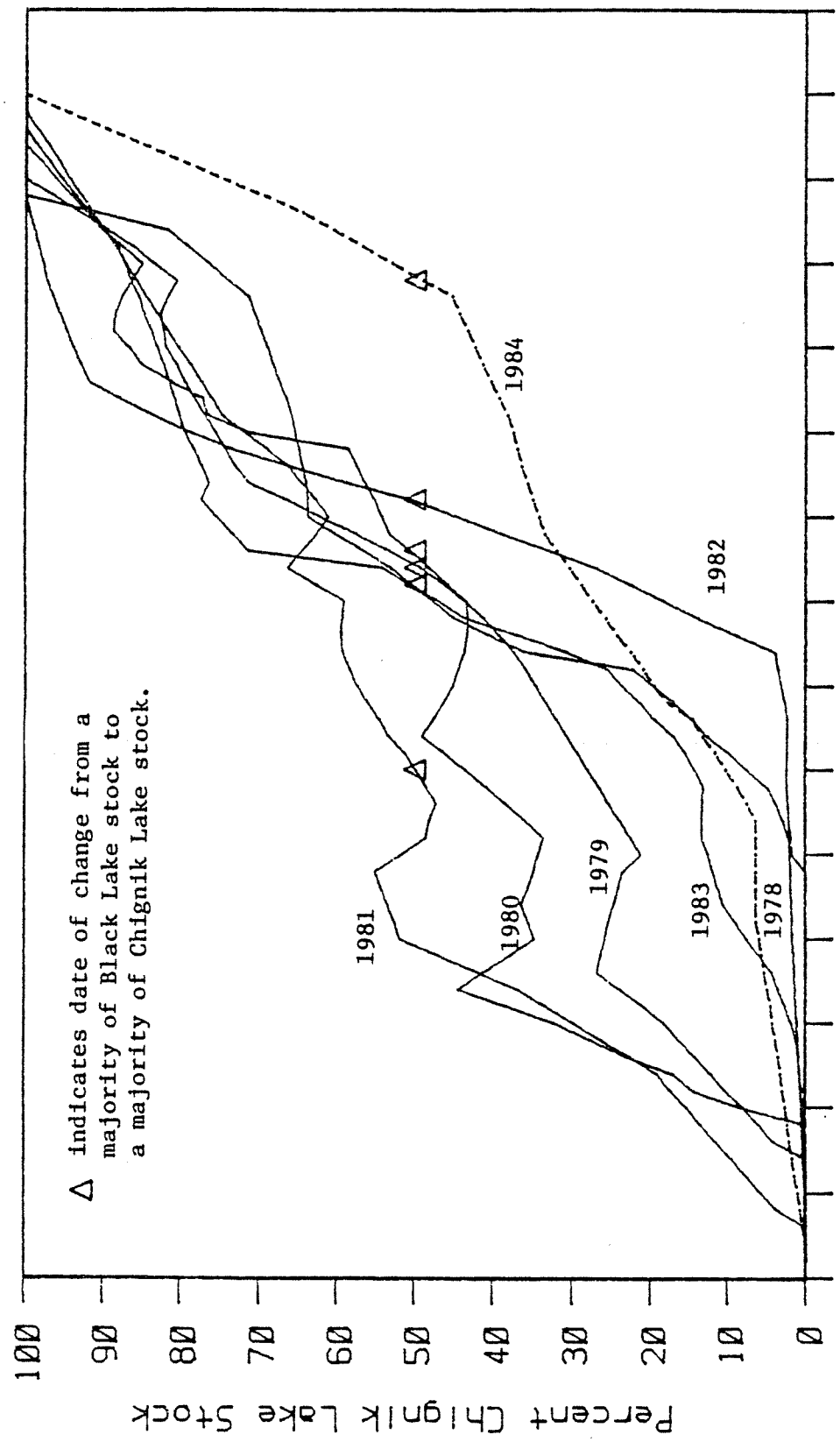

Figure 8. Daily stock composition estimated by analysis of scale patterns for the Chignik sockeye salmon runs, 1978-1984.

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APPENDICES

Appendix Table 1. Daily sockeye salmon escapement, catch by area, and total run in 1984, adjusted to Chignik Lagoon date.

Date	Escapement	Chignik Lagoon	Hook Bay/ Kujulik	Aniakchak	Eastern District	Cape Igvak	Western District	Perryville District	Daily Total
5/20	0	0	0	0	0	0	0	0	0
5/21	0	0	0	0	0	0	0	0	0
5/22	0	0	0	0	0	0	0	0	0
5/23	72	0	0	0	0	0	0	0	72
5/24	154	0	0	0	0	0	0	0	154
5/25	431	0	0	0	0	0	0	0	431
5/26	360	0	0	0	0	0	0	0	360
5/27	908	0	0	0	0	0	0	0	908
5/28	2,544	0	0	0	0	0	0	0	2,544
5/29	2,023	0	0	0	0	0	0	0	2,023
5/30	48	0	0	0	0	0	0	0	48
5/31	1,235	0	0	0	0	0	0	0	1,235
6/ 1	672	0	0	0	0	0	0	0	672
6/ 2	1,539	0	0	0	0	0	0	0	1,539
6/ 3	32,891	0	0	0	0	0	0	0	32,891
6/ 4	40,831	0	0	0	0	0	0	0	40,831
6/ 5	23,734	0	0	0	0	0	0	0	23,734
6/ 6	64,096	0	0	0	0	0	0	0	64,096
6/ 7	3,938	238,242	0	0	0	0	0	0	242,180
6/ 8	3,441	87,847	2,110	0	0	0	0	0	93,398
6/ 9	4,528	86,952	11,753	4,168	0	0	0	0	107,401
6/10	9,496	104,737	14,725	14,677	0	0	0	0	143,635
6/11	5,535	97,115	13,532	52,974	717	0	0	0	169,873
6/12	8,094	113,634	27,064	0	2,218	0	0	0	151,010
6/13	5,192	87,263	24,428	6,122	4,240	29,422	0	0	156,667
6/14	4,022	98,349	37,283	24,236	0	35,983	0	0	199,873
6/15	11,250	91,235	35,925	12,902	0	29,180	0	0	180,492
6/16	8,137	124,933	22,556	21,805	0	7,765	0	0	185,196
6/17	4,140	75,906	37,795	19,945	0	0	0	0	137,786
6/18	3,372	89,093	36,806	13,896	0	8,358	0	0	151,525
6/19	5,810	51,925	42,170	3,808	0	31,930	0	0	135,643

-Continued-

Appendix Table 1. Daily sockeye salmon escapement, catch by area, and total run in 1984, adjusted to Chignik Lagoon date (continued).

Date	Escapement	Chignik Lagoon	Hook Bay/ Kujulik	Aniakchak	Eastern District	Cape Igvak	Western District	Perryville District	Daily Total
6/20	4,512	41,305	43,781	4,377	0	50,314	0	0	144,289
6/21	10,120	24,859	43,450	22,614	0	34,858	0	0	135,901
6/22	49,580	600	22,938	2,184	0	36,254	0	0	111,556
6/23	47,540	0	0	582	0	34,558	0	0	82,680
6/24	17,219	0	0	0	0	23,427	0	0	40,646
6/25	4,332	75,821	0	0	0	24,559	0	0	104,712
6/26	1,507	38,254	8,682	0	0	18,262	0	0	66,705
6/27	1,785	33,677	13,325	3,316	0	16,180	0	0	68,283
6/28	1,777	21,760	13,955	2,408	0	21,768	304	0	61,972
6/29	5,599	0	3,874	1,975	0	9,249	0	0	20,697
6/30	25,585	0	0	930	0	4,013	0	0	30,528
7/ 1	22,136	0	0	0	0	9,936	0	0	32,072
7/ 2	18,778	0	0	0	0	6,794	0	0	25,572
7/ 3	20,488	6,999	0	0	0	9,702	0	0	37,189
7/ 4	4,159	43,250	0	0	0	4,930	0	0	52,339
7/ 5	2,883	27,459	1,131	98	0	0	0	0	31,571
7/ 6	1,986	22,042	1,079	574	0	0	1,939	0	27,620
7/ 7	4,986	12,258	1,080	2,004	0	0	1,904	0	22,232
7/ 8	13,168	0	262	1,505	0	0	2,354	0	17,289
7/ 9	19,859	0	0	406	0	0	2,883	0	23,148
7/10	18,926	0	0	0	0	0	0	0	18,926
7/11	26,212	0	0	0	0	0	0	0	26,212
7/12	30,762	0	0	0	0	0	0	0	30,762
7/13	23,955	0	0	0	0	0	0	0	23,955
7/14	3,014	52,697	0	0	0	0	0	0	55,711
7/15	3,088	20,664	3,775	0	0	0	0	0	27,527
7/16	14,406	1,535	4,824	2,003	0	0	0	0	22,768
7/17	22,509	0	883	503	0	0	0	0	23,895
7/18	14,945	0	0	35	0	0	0	0	14,980
7/19	10,493	0	0	0	32	3,375	0	0	13,900
7/20	15,820	0	0	0	0	3,924	0	0	19,744

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Appendix Table 1. Daily sockeye salmon escapement, catch by area, and total run in 1984, adjusted to Chignik Lagoon date (continued).

Date	Escapement	Chignik Lagoon	Hook Bay/ Kujulik	Aniakchak	Eastern District	Cape Igvak	Western District	Perryville District	Daily Total
7/21	16,582	0	0	0	0	3,206	0	0	19,788
7/22	17,223	0	0	0	0	3,804	0	0	21,027
7/23	12,050	0	0	0	0	2,435	0	0	14,485
7/24	8,491	0	0	0	0	0	0	0	8,491
7/25	10,839	0	0	0	0	0	0	0	10,839
7/26	13,375	0	0	0	0	0	0	0	13,375
7/27	12,684	0	0	0	0	16	0	0	12,700
7/28	9,156	0	0	0	0	0	0	0	9,156
7/29	3,007	9,930	0	0	0	16	0	0	12,953
7/30	1,179	7,502	232	0	0	0	0	0	8,913
7/31	111	6,756	434	717	0	0	235	0	8,253
8/ 1	32	6,691	0	1,219	22	0	228	0	8,192
8/ 2	894	6,259	899	626	1,981	0	496	0	11,155
8/ 3	1,357	568	1,075	0	0	0	326	0	3,326
8/ 4	4,416	0	0	0	0	0	280	0	4,696
8/ 5	2,208[1]	0	0	0	0	0	0	0	2,208
8/ 6	3,155	7,093	0	0	0	0	0	0	10,248
8/ 7	349	7,292	0	0	0	0	0	0	7,641
8/ 8	93	7,376	0	0	0	0	677	0	8,146
8/ 9	109	5,436	0	0	0	0	338	0	5,883
8/10	142	5,127	0	0	0	0	173	0	5,442
8/11	641	0	0	0	0	0	349	0	990
8/12	5,167	0	0	0	0	0	36	0	5,203
8/13	1,708	7,221	0	0	0	0	0	0	8,929
8/14	226	6,583	0	0	0	0	0	0	6,809
8/15	67	6,386	0	0	0	0	401	0	6,854
8/16	78	5,716	0	0	0	0	218	0	6,012
8/17	59	7,867	0	0	0	0	506	0	8,432
8/18	172	0	0	0	0	0	486	0	658
8/19	817	0	0	0	0	0	131	0	948
8/20	2,002	5,682	0	0	0	0	0	0	7,684

-Continued-

Appendix Table 1. Daily sockeye salmon escapement, catch by area, and total run in 1984, adjusted to Chignik Lagoon date (continued).

Date	Escapement	Chignik Lagoon	Hook Bay/ Kujulik	Aniakchak	Eastern District	Cape Igvak	Western District	Perryville District	Daily Total
8/21	331	4,400	0	0	0	0	0	0	4,731
8/22	98	4,673	0	0	0	0	293	0	5,064
8/23	104	4,972	0	0	0	0	609	179	5,864
8/24	79	5,375	0	0	0	0	212	0	5,666
8/25	449	0	0	0	0	0	92	0	541
8/26	797	0	0	0	0	0	0	0	797
8/27	486	8,145	0	0	0	0	0	0	8,631
8/28	283	4,777	255	0	0	0	0	0	5,315
8/29	198	4,060	0	0	0	0	0	0	4,258
8/30	251	3,543	0	78	0	0	0	0	3,872
8/31	243	4,195	0	0	0	0	0	0	4,438
9/ 1	343	0	0	0	0	0	0	0	343
9/ 2	583	0	0	0	0	0	0	0	583
9/ 3	585	3,858	0	0	0	0	0	0	4,443
9/ 4	279	3,622	0	0	0	0	0	0	3,901
9/ 5	197	2,278	0	0	0	0	0	0	2,475
9/ 6	217	2,280	0	0	0	0	0	0	2,497
9/ 7	236	2,013	0	0	0	0	0	0	2,249
9/ 8	325	366	0	0	0	0	0	0	691
9/ 9	587	0	0	0	0	0	0	0	587
9/10	1,188	1,084	0	0	0	0	0	0	2,272
9/11	466	1,469	0	0	0	0	0	0	1,935
9/12	328	798	0	0	0	0	0	0	1,126
9/13	345	670	0	0	0	0	0	0	1,015
9/14	515	348	0	0	0	0	0	0	863
9/15	847	0	0	0	0	0	0	0	847
9/16	2,276	0	0	0	0	0	0	0	2,276
9/17	1,656	0	0	0	0	0	0	0	1,656
9/18	1,529	0	0	0	0	0	0	0	1,529
9/19	1,411	0	0	0	0	0	0	0	1,411
9/20	1,303	0	0	0	0	0	0	0	1,303

-Continued-

Appendix Table 1. Daily sockeye salmon escapement, catch by area, and total run in 1984, adjusted to Chignik Lagoon date (continued).

Date	Escapement	Chignik Lagoon	Hook Bay/ Kujulik	Aniakchak	Eastern District	Cape Igvak	Western District	Perryville District	Daily Total
9/21	1,203	0	0	0	0	0	0	0	1,203
9/22	1,110	0	0	0	0	0	0	0	1,110
9/23	1,025	0	0	0	0	0	0	0	1,025
9/24	946	0	0	0	0	0	0	0	946
9/25	873	0	0	0	0	0	0	0	873
9/26	806	0	0	0	0	0	0	0	806
9/27	744	0	0	0	0	0	0	0	744
9/28	687	0	0	0	0	0	0	0	687
9/29	634	0	0	0	0	0	0	0	634
9/30	634	0	0	0	0	0	0	0	634
Total	866,208	1,942,822	472,081	222,687	9,210	464,218	15,470	179	3,992,875[2]

[1] Weir removed on 5 August.

[2] Does not include the Stepovak/Balboa catch.

Appendix Table 2. Age composition of sockeye salmon scale samples collected in Chignik Lagoon, 1984.

Sample Date	Sample Size	Percent Composition by Age Group											
		1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other
6/ 5	282	0.0	3.2	2.8	0.0	90.1	1.4	0.0	2.5	0.0	0.0	0.0	0.0
6/12	567	0.0	3.4	2.8	0.0	90.6	1.2	0.4	1.6	0.0	0.0	0.0	0.0
6/18	583	0.0	5.0	2.2	0.0	90.0	1.4	0.2	1.2	0.0	0.0	0.0	0.0
6/20	589	0.0	2.7	3.1	0.0	84.3	1.2	0.0	8.5	0.0	0.2	0.0	0.0
6/25	580	0.0	2.9	3.1	0.0	81.4	0.7	0.0	11.4	0.0	0.2	0.0	0.3
7/ 5	563	0.0	0.5	1.2	0.0	54.0	2.7	0.0	40.9	0.0	0.2	0.5	0.0
7/12	539	0.2	0.3	1.3	0.2	31.0	4.3	0.2	61.8	0.0	0.5	0.2	0.0
7/19	570	0.2	0.3	3.2	0.7	42.3	2.3	0.3	50.3	0.0	0.2	0.2	0.0
7/24	503	0.0	0.8	2.2	0.4	28.2	6.6	0.4	60.4	0.0	0.8	0.2	0.0
7/31	158	1.3	0.0	1.3	3.2	19.0	8.2	0.0	65.7	0.0	1.3	0.0	0.0
8/13	245	0.0	0.0	0.8	2.0	16.7	3.7	0.0	76.8	0.0	0.0	0.0	0.0
8/21	278	0.3	0.3	1.8	1.1	15.5	7.6	0.0	73.4	0.0	0.0	0.0	0.0
9/ 3	289	0.0	0.0	2.4	4.2	16.3	15.9	0.0	59.6	1.0	0.3	0.3	0.0

Appendix Table 3. Allocation by age group of the Chignik sockeye salmon estimated daily escapement, 1984.

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
5/20	0	0	0	0	0	0	0	0	0	0	0	0	0
5/21	0	0	0	0	0	0	0	0	0	0	0	0	0
5/22	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23	0	2	2	0	65	1	0	2	0	0	0	0	72
5/24	0	5	4	0	139	2	0	4	0	0	0	0	154
5/25	0	14	12	0	388	6	0	11	0	0	0	0	431
5/26	0	12	10	0	324	5	0	9	0	0	0	0	360
5/27	0	29	25	0	818	13	0	23	0	0	0	0	908
5/28	0	81	71	0	2,292	36	0	64	0	0	0	0	2,544
5/29	0	65	57	0	1,822	28	0	51	0	0	0	0	2,023
5/30	0	2	1	0	43	1	0	1	0	0	0	0	48
5/31	0	40	35	0	1,112	17	0	31	0	0	0	0	1,235
6/ 1	0	22	19	0	605	9	0	17	0	0	0	0	672
6/ 2	0	49	43	0	1,387	22	0	38	0	0	0	0	1,539
6/ 3	0	1,053	921	0	29,635	460	0	822	0	0	0	0	32,891
6/ 4	0	1,307	1,143	0	36,788	572	0	1,021	0	0	0	0	40,831
6/ 5	0	759	665	0	21,385	332	0	593	0	0	0	0	23,734
6/ 6	0	2,069	1,795	0	57,796	879	37	1,520	0	0	0	0	64,096
6/ 7	0	128	110	0	3,554	53	5	88	0	0	0	0	3,938
6/ 8	0	113	96	0	3,108	45	6	73	0	0	0	0	3,441
6/ 9	0	150	127	0	4,093	58	10	90	0	0	0	0	4,528
6/10	0	317	266	0	8,591	119	27	176	0	0	0	0	9,496
6/11	0	187	155	0	5,010	68	19	96	0	0	0	0	5,535
6/12	0	275	227	0	7,333	97	32	130	0	0	0	0	8,094
6/13	0	190	140	0	4,699	64	19	80	0	0	0	0	5,192
6/14	0	158	105	0	3,636	51	13	59	0	0	0	0	4,022
6/15	0	472	281	0	10,160	146	34	157	0	0	0	0	11,250
6/16	0	363	195	0	7,341	108	22	108	0	0	0	0	8,137
6/17	0	196	95	0	3,730	57	10	52	0	0	0	0	4,140
6/18	0	169	74	0	3,035	47	7	40	0	0	0	0	3,372

-Continued-

Appendix Table 3. Allocation by age group of the Chignik sockeye salmon estimated daily escapement, 1984 (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
6/19	0	224	154	0	5,062	76	6	282	0	6	0	0	5,810
6/20	0	122	140	0	3,803	54	0	384	0	9	0	0	4,512
6/21	0	277	314	0	8,473	111	0	919	0	20	0	6	10,120
6/22	0	1,378	1,537	0	41,222	496	0	4,789	0	99	0	59	49,580
6/23	0	1,341	1,474	0	39,248	428	0	4,868	0	95	0	86	47,540
6/24	0	492	534	0	14,117	138	0	1,863	0	34	0	41	17,219
6/25	0	126	134	0	3,526	30	0	494	0	9	0	13	4,332
6/26	0	40	44	0	1,185	14	0	216	0	3	1	4	1,507
6/27	0	43	49	0	1,354	20	0	309	0	4	2	4	1,785
6/28	0	39	45	0	1,299	23	0	360	0	4	3	4	1,777
6/29	0	109	131	0	3,944	84	0	1,299	0	11	11	10	5,599
6/30	0	435	550	0	17,322	435	0	6,690	0	51	64	38	25,585
7/ 1	0	323	434	0	14,379	421	0	6,442	0	44	66	27	22,136
7/ 2	0	229	332	0	11,684	394	0	6,018	0	38	66	17	18,778
7/ 3	0	201	324	0	12,186	471	0	7,171	0	41	82	12	20,488
7/ 4	0	31	58	0	2,360	104	0	1,578	0	8	19	1	4,159
7/ 5	0	14	35	0	1,557	78	0	1,179	0	6	14	0	2,883
7/ 6	1	9	24	1	1,006	58	1	872	0	5	9	0	1,986
7/ 7	3	22	61	3	2,365	157	3	2,337	0	14	21	0	4,986
7/ 8	11	55	164	11	5,813	446	11	6,565	0	43	49	0	13,168
7/ 9	23	77	250	23	8,114	718	23	10,492	0	74	65	0	19,859
7/10	27	68	241	27	7,111	727	27	10,566	0	78	54	0	18,926
7/11	45	86	337	45	8,987	1,067	45	15,416	0	120	64	0	26,212
7/12	62	92	400	62	9,536	1,323	62	19,009	0	154	62	0	30,762
7/13	48	72	376	65	7,813	962	51	14,410	0	110	48	0	23,955
7/14	6	9	56	10	1,032	112	7	1,764	0	12	6	0	3,014
7/15	6	9	65	13	1,107	106	7	1,758	0	11	6	0	3,088
7/16	29	43	344	70	5,396	455	37	7,956	0	47	29	0	14,406
7/17	45	68	598	125	8,795	646	61	12,062	0	64	45	0	22,509
7/18	30	45	438	94	6,080	386	43	7,763	0	36	30	0	14,945

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Appendix Table 3. Allocation by age group of the Chignik sockeye salmon estimated daily escapement, 1984 (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
7/19	21	31	336	73	4,439	241	31	5,279	0	21	21	0	10,493
7/20	25	63	475	101	6,246	500	51	8,276	0	51	32	0	15,820
7/21	20	83	464	96	6,079	667	56	9,011	0	73	33	0	16,582
7/22	14	103	448	90	5,828	840	62	9,708	0	96	34	0	17,223
7/23	5	84	289	55	3,738	692	46	7,035	0	82	24	0	12,050
7/24	0	68	187	34	2,394	560	34	5,129	0	68	17	0	8,491
7/25	20	74	225	87	2,914	740	37	6,629	0	94	19	0	10,839
7/26	50	76	260	160	3,420	944	38	8,282	0	126	19	0	13,375
7/27	71	58	230	203	3,077	924	29	7,949	0	129	14	0	12,684
7/28	68	31	154	183	2,101	688	16	5,808	0	99	8	0	9,156
7/29	28	7	47	72	650	233	3	1,930	0	35	2	0	3,007
7/30	13	1	17	33	240	94	1	766	0	14	0	0	1,179
7/31	1	0	1	4	21	9	0	74	0	1	0	0	111
8/ 1	0	0	0	1	6	3	0	22	0	0	0	0	32
8/ 2	10	0	11	27	167	67	0	602	0	10	0	0	894
8/ 3	14	0	16	40	251	97	0	925	0	14	0	0	1,357
8/ 4	40	0	51	125	808	301	0	3,051	0	40	0	0	4,416
8/ 5	18	0	24	60	400	143	0	1,545	0	18	0	0	2,208
8/ 6[1]	22	0	34	83	566	193	0	2,235	0	22	0	0	3,155
8/ 7	2	0	4	9	62	20	0	250	0	2	0	0	349
8/ 8	0	0	1	2	16	5	0	69	0	0	0	0	93
8/ 9	0	0	1	3	19	6	0	80	0	0	0	0	109
8/10	0	0	1	3	24	7	0	107	0	0	0	0	142
8/11	1	0	6	14	109	28	0	482	0	1	0	0	641
8/12	5	0	43	108	872	209	0	3,925	0	5	0	0	5,167
8/13	0	0	14	34	285	63	0	1,312	0	0	0	0	1,708
8/14	0	0	2	4	37	9	0	174	0	0	0	0	226
8/15	0	0	1	1	11	3	0	51	0	0	0	0	67
8/16	0	0	1	1	13	4	0	59	0	0	0	0	78
8/17	0	0	1	1	9	3	0	45	0	0	0	0	59

-Continued-

Appendix Table 3. Allocation by age group of the Chignik sockeye salmon estimated daily escapement, 1984 (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
8/18	0	0	2	2	27	11	0	130	0	0	0	0	172
8/19	2	2	13	11	129	54	0	606	0	0	0	0	817
8/20	5	5	34	24	313	142	0	1,479	0	0	0	0	2,002
8/21	1	1	6	4	51	25	0	243	0	0	0	0	331
8/22	0	0	2	1	15	8	0	72	0	0	0	0	98
8/23	0	0	2	2	16	9	0	75	0	0	0	0	104
8/24	0	0	2	1	12	8	0	56	0	0	0	0	79
8/25	1	1	9	9	71	46	0	311	1	0	0	0	449
8/26	1	1	16	18	126	86	0	544	3	1	1	0	797
8/27	1	1	10	12	77	56	0	325	2	1	1	0	486
8/28	0	0	6	8	45	34	0	188	2	0	0	0	283
8/29	0	0	4	6	32	25	0	130	1	0	0	0	198
8/30	0	0	6	8	40	33	0	160	2	1	1	0	251
8/31	0	0	5	8	39	34	0	153	2	1	1	0	243
9/ 1	0	0	8	13	55	50	0	212	3	1	1	0	343
9/ 2	0	0	14	23	95	89	0	353	5	2	2	0	583
9/ 3	0	0	14	25	95	93	0	348	6	2	2	0	585
9/ 4	0	0	7	12	45	44	0	166	3	1	1	0	279
9/ 5	0	0	5	8	32	31	0	117	2	1	1	0	197
9/ 6	0	0	5	9	35	35	0	129	2	1	1	0	217
9/ 7	0	0	6	10	38	38	0	140	2	1	1	0	236
9/ 8	0	0	8	14	53	52	0	193	3	1	1	0	325
9/ 9	0	0	14	25	96	93	0	349	6	2	2	0	587
9/10	0	0	29	50	194	189	0	706	12	4	4	0	1,188
9/11	0	0	11	20	76	74	0	278	5	1	1	0	466
9/12	0	0	8	14	53	52	0	196	3	1	1	0	328
9/13	0	0	8	14	56	55	0	207	3	1	1	0	345
9/14	0	0	12	22	84	82	0	306	5	2	2	0	515
9/15	0	0	20	36	138	135	0	504	8	3	3	0	847
9/16	0	0	55	96	371	362	0	1,355	23	7	7	0	2,276

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Appendix Table 3. Allocation by age group of the Chignik sockeye salmon estimated daily escapement, 1984 (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
9/17	0	0	40	70	270	263	0	986	17	5	5	0	1,656
9/18	0	0	37	64	249	243	0	911	15	5	5	0	1,529
9/19	0	0	34	59	230	224	0	842	14	4	4	0	1,411
9/20	0	0	31	55	212	207	0	777	13	4	4	0	1,303
9/21	0	0	29	51	196	191	0	716	12	4	4	0	1,203
9/22	0	0	27	47	181	176	0	662	11	3	3	0	1,110
9/23	0	0	25	43	167	163	0	611	10	3	3	0	1,025
9/24	0	0	23	40	154	150	0	564	9	3	3	0	946
9/25	0	0	21	37	142	139	0	519	9	3	3	0	873
9/26	0	0	19	34	131	128	0	482	8	2	2	0	806
9/27	0	0	18	31	121	118	0	445	7	2	2	0	744
9/28	0	0	16	29	112	109	0	410	7	2	2	0	687
9/29	0	0	15	27	103	101	0	378	6	2	2	0	634
9/30	0	0	15	27	103	101	0	378	6	2	2	0	634
Total	795	14,996	20,352	3,375	524,447	26,487	1,029	270,709	248	2,330	1,118	322	866,208
S. E.[2]	140	952	978	223	2,225	874	143	1,830	30	236	152	94	

[1] Weir removed on 5 August.

[2] Standard errors do not include the variance associated with the escapement estimates.

Appendix Table 4. Allocation by age group of the Chignik sockeye salmon daily catch, 1984. Includes catch from all areas adjusted to Chignik Lagoon date.

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
6/ 1	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 2	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 3	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 4	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 5	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 6	0	0	0	0	0	0	0	0	0	0	0	0	0
6/ 7	0	7,760	6,671	0	214,997	3,199	272	5,343	0	0	0	0	238,242
6/ 8	0	2,956	2,519	0	81,244	1,182	154	1,902	0	0	0	0	89,957
6/ 9	0	3,410	2,880	0	92,982	1,323	235	2,043	0	0	0	0	102,873
6/10	0	4,484	3,756	0	121,339	1,686	383	2,491	0	0	0	0	134,139
6/11	0	5,541	4,601	0	148,773	2,019	563	2,841	0	0	0	0	164,338
6/12	0	4,859	4,002	0	129,481	1,715	572	2,287	0	0	0	0	142,916
6/13	0	5,554	4,090	0	137,085	1,868	555	2,323	0	0	0	0	151,475
6/14	0	7,703	5,092	0	177,050	2,481	653	2,872	0	0	0	0	195,851
6/15	0	7,108	4,231	0	152,826	2,200	508	2,369	0	0	0	0	169,242
6/16	0	7,909	4,249	0	159,707	2,361	472	2,361	0	0	0	0	177,059
6/17	0	6,326	3,074	0	120,415	1,826	312	1,693	0	0	0	0	133,646
6/18	0	7,408	3,259	0	133,338	2,074	296	1,778	0	0	0	0	148,153
6/19	0	4,999	3,441	0	113,148	1,688	130	6,297	0	130	0	0	129,833
6/20	0	3,774	4,333	0	117,832	1,677	0	11,881	0	280	0	0	139,777
6/21	0	3,446	3,899	0	105,304	1,384	0	11,421	0	252	0	75	125,781
6/22	0	1,723	1,921	0	51,527	620	0	5,987	0	124	0	74	61,976
6/23	0	991	1,089	0	29,013	316	0	3,598	0	70	0	63	35,140
6/24	0	670	726	0	19,206	187	0	2,535	0	47	0	56	23,427
6/25	0	2,911	3,112	0	81,709	703	0	11,443	0	201	0	301	100,380
6/26	0	1,734	1,897	0	51,285	587	0	9,356	0	130	33	176	65,198
6/27	0	1,609	1,809	0	50,486	731	0	11,504	0	133	66	160	66,498
6/28	0	1,312	1,523	0	44,052	783	0	12,189	0	120	90	126	60,195
6/29	0	293	353	0	10,636	226	0	3,503	0	30	30	27	15,098
6/30	0	84	106	0	3,347	84	0	1,293	0	10	12	7	4,943

-Continued-

Appendix Table 4. Allocation by age group of the Chignik sockeye salmon daily catch, 1984. Includes catch from all areas adjusted to Chignik Lagoon date (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
7/ 1	0	145	195	0	6,454	189	0	2,891	0	20	30	12	9,936
7/ 2	0	83	120	0	4,227	143	0	2,177	0	14	24	6	6,794
7/ 3	0	164	264	0	9,934	384	0	5,845	0	33	67	10	16,701
7/ 4	0	357	670	0	27,338	1,204	0	18,284	0	96	217	14	48,180
7/ 5	0	143	344	0	15,493	775	0	11,733	0	57	143	0	28,688
7/ 6	7	121	311	7	13,001	751	7	11,250	0	62	117	0	25,634
7/ 7	10	76	212	10	8,181	544	10	8,083	0	49	71	0	17,246
7/ 8	4	17	51	4	1,819	140	4	2,053	0	14	15	0	4,121
7/ 9	4	13	41	4	1,344	119	4	1,737	0	12	11	0	3,289
7/10	0	0	0	0	0	0	0	0	0	0	0	0	0
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	0	0	0	0	0	0	0
7/14	105	158	971	181	18,037	1,965	120	30,837	0	218	105	0	52,697
7/15	49	73	517	101	8,760	841	59	13,899	0	91	49	0	24,439
7/16	17	25	199	41	3,132	264	22	4,618	0	27	17	0	8,362
7/17	3	4	37	8	542	40	4	741	0	4	3	0	1,386
7/18	0	0	1	0	14	1	0	19	0	0	0	0	35
7/19	7	10	109	24	1,441	78	10	1,714	0	7	7	0	3,407
7/20	6	16	118	25	1,549	124	13	2,052	0	13	8	0	3,924
7/21	4	16	90	19	1,175	129	11	1,742	0	14	6	0	3,206
7/22	3	23	99	20	1,287	186	14	2,143	0	21	8	0	3,804
7/23	1	17	58	11	755	140	9	1,422	0	17	5	0	2,435
7/24	0	0	0	0	0	0	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	0	0	0	0	0	0	0
7/27	0	0	0	0	4	1	0	11	0	0	0	0	16
7/28	0	0	0	0	0	0	0	0	0	0	0	0	0
7/29	92	23	155	239	2,151	770	11	6,384	0	115	6	0	9,946
7/30	86	9	110	217	1,571	617	4	5,023	0	95	2	0	7,734

-Continued-

Appendix Table 4. Allocation by age group of the Chignik sockeye salmon daily catch, 1984. Includes catch from all areas adjusted to Chignik Lagoon date (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
7/31	106	0	106	261	1,547	668	0	5,348	0	106	0	0	8,142
8/ 1	98	0	103	254	1,536	641	0	5,430	0	98	0	0	8,160
8/ 2	113	0	125	309	1,913	770	0	6,918	0	113	0	0	10,261
8/ 3	20	0	23	58	364	141	0	1,343	0	20	0	0	1,969
8/ 4	3	0	3	8	51	19	0	193	0	3	0	0	280
8/ 5	0	0	0	0	0	0	0	0	0	0	0	0	0
8/ 6	50	0	76	188	1,272	434	0	5,023	0	50	0	0	7,093
8/ 7	44	0	75	186	1,295	421	0	5,227	0	44	0	0	7,292
8/ 8	40	0	80	198	1,416	437	0	5,842	0	40	0	0	8,053
8/ 9	23	0	55	137	1,005	294	0	4,237	0	23	0	0	5,774
8/10	16	0	49	121	913	251	0	3,934	0	16	0	0	5,300
8/11	1	0	3	8	60	15	0	261	0	1	0	0	349
8/12	0	0	0	1	6	1	0	28	0	0	0	0	36
8/13	0	0	58	144	1,206	267	0	5,546	0	0	0	0	7,221
8/14	2	2	61	124	1,089	276	0	5,029	0	0	0	0	6,583
8/15	5	5	71	120	1,113	317	0	5,156	0	0	0	0	6,787
8/16	7	7	70	99	964	306	0	4,481	0	0	0	0	5,934
8/17	13	13	109	130	1,348	473	0	6,287	0	0	0	0	8,373
8/18	1	1	7	7	78	30	0	362	0	0	0	0	486
8/19	0	0	2	2	21	9	0	97	0	0	0	0	131
8/20	15	15	95	69	889	404	0	4,195	0	0	0	0	5,682
8/21	13	13	79	48	682	334	0	3,231	0	0	0	0	4,400
8/22	14	14	92	66	773	409	0	3,592	4	1	1	0	4,966
8/23	15	15	109	91	900	511	0	4,104	9	3	3	0	5,760
8/24	13	13	108	101	876	532	0	3,923	13	4	4	0	5,587
8/25	0	0	2	2	14	9	0	65	0	0	0	0	92
8/26	0	0	0	0	0	0	0	0	0	0	0	0	0
8/27	13	13	169	206	1,293	931	0	5,460	38	11	11	0	8,145
8/28	7	7	107	139	802	607	0	3,320	27	8	8	0	5,032
8/29	5	5	88	122	649	516	0	2,636	25	7	7	0	4,060

-Continued-

Appendix Table 4. Allocation by age group of the Chignik sockeye salmon daily catch, 1984. Includes catch from all areas adjusted to Chignik Lagoon date (continued).

Date	Age Group 1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Other	Total
8/30	3	3	80	118	581	483	0	2,312	25	8	8	0	3,621
8/31	3	3	95	146	676	587	0	2,633	32	10	10	0	4,195
9/ 1	0	0	0	0	0	0	0	0	0	0	0	0	0
9/ 2	0	0	0	0	0	0	0	0	0	0	0	0	0
9/ 3	0	0	93	162	629	613	0	2,298	39	12	12	0	3,858
9/ 4	0	0	87	152	590	576	0	2,159	36	11	11	0	3,622
9/ 5	0	0	55	96	371	362	0	1,357	23	7	7	0	2,278
9/ 6	0	0	55	96	372	363	0	1,357	23	7	7	0	2,280
9/ 7	0	0	48	85	328	320	0	1,200	20	6	6	0	2,013
9/ 8	0	0	9	15	60	58	0	218	4	1	1	0	366
9/ 9	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10	0	0	26	46	177	172	0	646	11	3	3	0	1,084
9/11	0	0	35	62	239	234	0	876	15	4	4	0	1,469
9/12	0	0	19	34	130	127	0	476	8	2	2	0	798
9/13	0	0	16	28	109	107	0	399	7	2	2	0	670
9/14	0	0	8	15	57	55	0	208	3	1	1	0	348
9/15	0	0	0	0	0	0	0	0	0	0	0	0	0
9/16	0	0	0	0	0	0	0	0	0	0	0	0	0
9/17	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19	0	0	0	0	0	0	0	0	0	0	0	0	0
9/20	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,041	96,186	79,856	5,165	2,503,385	56,405	5,407	373,375	362	3,128	1,250	1,107	3,126,667
S. E.	192	4,219	3,723	339	7,304	2,649	978	4,365	57	501	213	324	

Appendix Table 5. Age composition of sockeye salmon scale samples collected at the outlet of Black Lake, 1984.

Sample Date(s)	Sample Size	Percent Composition by Age Class						
		0.2	0.3	1.2	2.1	1.3	2.2	2.3
6/15-16	382	0.0	2.9	4.5	0.0	87.1	0.0	5.5
6/21-22	548	0.2	2.4	5.3	0.0	84.6	0.2	7.3
6/27-28	582	0.0	1.0	2.2	0.0	91.4	0.2	5.2
7/ 7-8	563	0.0	2.8	2.5	0.5	87.3	0.0	6.9
7/14	140	0.0	3.6	3.6	0.0	89.3	0.0	3.6

APPENDIX B

Synopsis of 1985 Chignik Area Harvest and 1986 Forecast of Sockeye Salmon

The 1985 return of sockeye salmon to the Chignik lakes was similar to the average return during the past 20 years. Preliminary estimates indicate that 658,000 sockeye were harvested from the early Black Lake run and 484,000 sockeye were harvested from the Chignik Lake run. Total return (harvest and escapement) of sockeye to Black Lake and Chignik Lake was approximately 1.0 million and 870,000 sockeye, respectively. During the past 20 years the average return of sockeye to Black Lake and Chignik Lake was 1.0 million and 880,000 sockeye, respectively. Sockeye escapements to the spawning grounds were adequate in 1985, thereby providing the potential for good returns in the future given that environmental conditions are favorable. In contrast to the moderate harvest of sockeye, the harvest of coho was the second highest on record and surpassed 200,000 fish.

The average size of sockeye during 1985 was exceptionally small (5.9 lbs/fish). Small average fish size resulted primarily from an unusually large percentage of 2-ocean fish (fish spending 2 yrs at sea) compared to the normally dominant 3-ocean age group. A large number of age 1.2 sockeye returned to Black Lake, suggesting a good return in 1986. The large return of age 2.2 sockeye (up to 60% of total harvest in early August) was unusual. Age composition data from the spawning grounds indicate these fish returned to Black River tributaries and Chignik Lake. The number of returning 2.2 sockeye has not been a reliable forecast variable for Chignik Lake.

We have reviewed the forecast of the 1985 return to Black Lake. The 1985 forecast provided by ADF&G was for 1.5 million sockeye compared to the actual run of 1.0 million sockeye. This forecast error of about 500,000 sockeye was apparently caused by an error in the application of the model rather than in the model itself. We reforecasted a run of 1.1 million sockeye to Black Lake, based on the same data that was available for the 1985 run, and thus obtained a forecast quite close to the actual run size.

Review of the preliminary ADF&G forecast of the 1986 return of sockeye salmon to Chignik and Black lakes indicates an above average return. The strong return in 1986 is suggested by a large number of age 1.2 sockeye (1 yr in freshwater, 2 yrs in ocean) to Black Lake in 1985. ADF&G estimates a total return of 1.9 million sockeye to Black Lake (expected harvest is 1.5 million sockeye). Our analysis suggests a return of approximately 1.7 million sockeye after removing the interfering effect of the large 1985 return of age 2.2 sockeye. While all indicators suggest a good return to Black Lake, accuracy of these predictions is weakened this year by reliance on the in-season stock analysis. Generally, post-season analysis of stock composition is used to separate both 1.3 and 2.3 age groups which provides a more accurate basis for stock separation, whereas the in-season analysis relies only on the 2.3 age group. In 1985, the 2.3 age group represented a small fraction of

the total return, making in-season stock separation less reliable than normal.

The forecast of the Chignik Lake return is less reliable than the Black Lake forecast. ADF&G estimates a return of 0.91 million sockeye (expected harvest is 660,000 sockeye), which is similar to our estimated return.