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Origins of Sockeye Salmon in East Side Bristol Bay Fisheries in 1989 Based on Linear Discrimination Function Analysis of Scale Patterns

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ABSTRACT

We estimated stock compositions of the 1989 commercial harvest of sockeye salmon *Oncorhynchus nerka* in the Naknek-Kvichak, Egegik, and Ugashik Districts of Bristol Bay using scale pattern analysis and age composition. Scale measurements from escapements of age-2.2 sockeye salmon were used to build discriminant functions which allowed assignment of commercial catches to their river of origin. Origins of catches of sockeye salmon from other age groups were estimated by combining scale pattern analysis results with escapement age composition. Most sockeye salmon harvested in each fishing district originated from rivers within that district; however, interceptions of outside stocks occurred in every area. Of the estimated 13,878,778 sockeye salmon caught in Naknek-Kvichak District, 67% were from Kvichak River, 18% from Naknek River, 4% from Egegik River, and 11% from Ugashik River. The estimated 8,700,824 sockeye salmon caught in Egegik District comprised stocks from the following rivers: 60% Egegik, 17% Kvichak, 13% Naknek, and 10% Ugashik Rivers. The Ugashik District harvest of 3,185,062 sockeye salmon was 87% Ugashik River, 4% Kvichak River, 1% Naknek River, and 8% Egegik River. Sockeye runs to Ugashik and Naknek Rivers experienced the highest interception rates (35% and 24%) outside their districts. Runs to Egegik (11%) and Kvichak (8%) Rivers were intercepted outside their districts at much lower rates. Total exploitation rates inside and outside the district by stock were 56% for Kvichak River, 76% for Naknek River, 79% for Egegik River, and 76% for Ugashik River.

KEY WORDS: Sockeye salmon *Oncorhynchus nerka*, Bristol Bay, scale pattern analysis, linear discriminant analysis, stock composition estimates, exploitation rates

INTRODUCTION

In mixed-stock fisheries the weaker stock is always at the greatest risk of over exploitation. The Bristol Bay sockeye salmon *Oncorhynchus nerka* fishery has been constrained within districts and sections located near the mouths of spawning streams to minimize problems associated with mixed-stock fisheries (Figure 1). However, the relatively close proximity of spawning rivers and annual variations in migration routes cause some stock mixing even in areas close to river mouths.

The Bristol Bay Management Area can be divided into two general fisheries, the West and East Side fisheries. The East Side fishery is composed of three districts: Naknek-Kvichak, Egegik, and Ugashik (Figure 1). Naknek-Kvichak District is subdivided into the Naknek and Kvichak Sections. A tagging study conducted by Straty (1975) during 1955-57 documented that sockeye salmon from Kvichak, Naknek, Egegik, and Ugashik Rivers were intermixed to some degree in all three districts.

The degree of sockeye intermixing within East Side districts was not quantified until 1986. From 1956 to 1985 total runs of sockeye salmon to Egegik and Ugashik Rivers were estimated by adding the district catch to the escapement into each respective river within that district. Harvests within the Naknek-Kvichak District were assigned to rivers of origin based on age composition of the contributing river's escapements: Naknek, Kvichak, and Alagnak [Branch] Rivers. This method of estimating sockeye salmon runs by river for Bristol Bay, referred to as the standard method, operates under the assumption that all fish harvested in a district were returning to rivers within that district and that interception of fish from other districts did not occur (Yuen and Nelson 1987, Yuen and Bill 1989a, Yuen and Bill 1989b, Yuen and Bill 1990, Cross and Stratton 1988, Stratton and Cross 1990, Stratton 1990). Bernard (1983) evaluated the biases inherent with this procedure.

Decreased catches of sockeye salmon in the Kvichak Section in 1985 and 1986 accompanied by large catch increases in Egegik and Ugashik Districts prompted concerns about interceptions within East Side districts. In 1985 Fried and Yuen (1985) found scale pattern analysis useful in identifying sockeye salmon stocks within the East Side fisheries. Scale pattern studies were expanded, and contributions by river to East Side district catches were estimated in 1986 (Bue et al. 1986), 1987 (Cross and Stratton 1989), and 1988 (Cross and Stratton 1991).

The objectives of this ongoing investigation are to (1) estimate stock composition of the 1989 commercial harvests of sockeye salmon in Naknek-Kvichak, Egegik, and Ugashik Districts; (2) estimate total run by river; and (3) compare estimates of run by river obtained from scale pattern analysis with those developed from the standard method. Increased accuracy in estimates of catch composition should allow managers to more effectively regulate stock-specific harvest goals. More accurate estimates may also result in better preseason forecasts, a more accurate understanding of spawner-return relationships, and optimal escapement goals.

METHODS

Estimation Of Catch and Escapement

Commercial catch statistics documented in ADF&G (1990) were taken from final operation reports prepared by fish processors. These numbers may differ slightly from final Alaska Department of Fish and Game (ADF&G) catch statistics because minor errors may be detected and corrected. Sockeye salmon escapement estimates were based on visual counts made from towers on the banks of Kvichak, Naknek, Egegik and Ugashik Rivers (ADF&G 1990). Counts were made hourly on each river bank for 10 min according to a set schedule in which fish were counted from one bank on the hour and from the opposite bank immediately following. Each 10-min count was expanded into an hourly estimate and the daily estimate of escapement was the sum of the hourly estimates.

Estimation Of Age Composition

Age was determined by examining scales (Mosher 1968). Scales were collected from the left side of the fish approximately two rows above the lateral line in an area crossed by a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). Scales were mounted on gummed cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). We used European notation (Koo 1962) to record ages: numerals preceding the decimal refer to the number of freshwater annuli and numerals following the decimal refer to the number of marine annuli. Total age from time of egg deposition, or brood year, is the sum of these two numbers plus one to account for incubation time.

Age composition of sockeye salmon harvests by district was estimated with a stratified systematic sampling design (Cochran 1977). Thompson's (1987) work on the "worst-case" parameter value for the multinomial distribution shows that a sample size of 510 would result in simultaneously estimating the true percentage for each major age group within 5 percentage points 95% of the time. We set the desired sample size for each strata at 600 scales to account for scales which could not be aged due to scale reabsorption or regeneration. Catch sampling was stratified by district and through time. The number of time strata sampled from each district depended on the number of fishing periods. From 23 June through 17 July each district catch of sockeye salmon was sampled every fishing period, unless fishing periods were continuous, in which case samples were taken at least once every 3 d. Prior to 23 June and after 17 July district sockeye catches were sampled once. For dates not sampled, the age composition of sockeye salmon harvests was assumed to be the same as that estimated for the most recent date. Fish were measured to the nearest millimeter from the middle of the eye to the fork of the tail. Sex was determined from morphometric characteristics. Methods and results of sampling sockeye catches in Bristol Bay for age composition in 1989 are reported by Stratton (1990).

Escapement samples were taken from sockeye salmon captured by beach seine near counting tower sites. The goal for sampling escapements was set at 200 fish per day so that 600 samples were available every

3 d. In practice, this daily goal could only be obtained during the peak of the run. Successive daily age composition estimates were compared using chi-square tests. Successive dates were placed in the same strata if significant ($P < 0.05$) differences were not found. Detailed age, sex, and size data for the escapement into each river are reported by Stratton (1990).

Estimation Of Catch Composition

Linear discriminant analysis (Fisher 1936) of scale patterns combined with age composition data were used to determine the rivers of origin of sockeye salmon harvested within the East Side fishing districts in 1989.

Measurement Of Scale Patterns

Scale impressions were projected onto a digitizing tablet at 100X magnification using equipment similar to that described by Ryan and Christie (1976). To standardize each scale, measurements were taken along the anterior-posterior axis. This axis is approximately 20 degrees ventral of the long axis and perpendicular to the sculptured (anterior) field (Figure 2). Distances between growth rings (circuli) were measured. The numbers of circuli were counted from the following scale growth zones: (1) center of scale focus to the outside edge of the first freshwater annulus (first freshwater annular zone), (2) outside edge of the first freshwater annulus to the outside edge of the second freshwater annulus (second freshwater annular zone), (3) outside edge of the last freshwater annulus to the end of freshwater growth (freshwater plus growth zone), and (4) the last circulus of the freshwater plus growth zone to the outer edge of the first ocean annulus (first marine annular zone). In addition, the total distance from the outside edge of the first ocean annulus to the outside edge of the second ocean annulus (second marine annular zone) was recorded for age-1.3 sockeye salmon (Figure 2). A total of 75 variables for age-1.3 samples and 108 variables for age-2.2 samples were computed from the distance measurements and circuli counts (Table 1). We measured scale patterns of age-2.2 sockeye salmon because this age groups comprised 68% of the commercial catch. In addition, we measured scale patterns of age-1.3 sockeye salmon from the escapements; however, the age-1.3 discriminant model could not accurately identify the stocks.

Discriminant Analysis

Escapement samples from Kvichak, Naknek, Egegik, and Ugashik Rivers provided scales of known origin used to build the linear discriminant functions (LDF). Branch River a tributary of the Kvichak River, was not included in the Kvichak standard because it is numerically small compared to the numbers of sockeye salmon returning to Kvichak River: Kvichak escapement was 4,065,216; Branch River escapement was 196,760. Commercial catch samples provided scales of mixed origin and were classified with the discriminant functions to estimate the contribution of each river to the age-2.2 harvests. Escapement samples collected in 1989 were used to classify 1989 catches in the age-specific LDF models.

We examined frequency distribution plots for the principal scale variables of width and number of circuli for each growth zone. Differences between mean number of circuli and size of selected growth zones for

males and females were investigated using independent *t*-tests. The selection of scale variables for each discriminant model was made by a forward stepping procedure using partial F-statistics as the criteria for entry/removal of variables (Enslein et al. 1977). Variables were added until model accuracy ceased improving. We tested the equality of variance-covariance matrices using an *F*-statistic as described by Box (1949). A nearly unbiased estimate of classification accuracy for each LDF was determined using a "leaving-one-out procedure" (Lachenbruch 1967).

Construction of Age-2.2 Models. A four-way linear discriminant model was constructed from scale measurements of age-2.2 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Approximately 200 scale samples from each of the four rivers weighted by run strength through time were used to build the discriminant models. In addition, 100 age-2.2 scales from Branch River were measured. Branch River scale measurements were classified with the four-way (Kvichak, Naknek, Egegik, Ugashik) discriminant model to see if their scale patterns were similar to Kvichak River. The four-way discriminant model was used to classify district catches of age-2.2 sockeye salmon.

Classification of Age-2.2 Fish. Linear discriminant models were used to assign unknown samples--e.g., age-2.2 sockeye salmon from the commercial catches--to their river of origin. Model estimates of proportions by stock in the catch were adjusted for misclassification errors using the procedure of Cook and Lord (1978). The adjusted proportions were assumed to accurately reflect the true stock composition. The variance and 90% confidence intervals for the adjusted estimates were computed using the procedure of Pella and Robertson (1979). A catch sample was reclassified with a model representing fewer stocks if the adjusted proportion was ≤ 0 for one or more stocks in the original model.

Initially, 50 age-2.2 scales from each sample date for each fishery were measured and classified with the discriminant model. Successive stock composition estimates were compared with chi-squared tests. If significant ($P < 0.05$) differences were not found between stock estimates, scale measurements from consecutive fishing periods were combined to achieve the desired sample size of 100. If the estimated stock proportions for consecutive fishing periods were significantly different, we measured an additional 50 age-2.2 samples from the fishing period.

We calculated the numbers of age-2.2 sockeye salmon by stock, i, in a specific catch stratum, $\hat{C}_{i2.2}$, as follows:

$$\hat{C}_{i2.2} = C\left(\hat{P}_{2.2}\right)\left(\hat{S}_{i2.2}\right) \qquad (1)$$

where:

C = catch of sockeye salmon in a fishery at a given time,

$\hat{P}_{2.2}$ = estimated proportion of age-2.2 sockeye salmon in the catch; and

$\hat{S}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock i in the catch.

The variance of the estimated catch of age-2.2 sockeye salmon, $V[\hat{C}_{i2.2}]$, from each stock in a specific fishery at a given time was calculated as an exact variance of a product according to Goodman (1960):

$$V(\hat{C}_{i2.2}) = C^2 V(\hat{P}_{2.2}\hat{S}_{i2.2}) \tag{2}$$

$$V(\hat{P}_{2.2}\hat{S}_{i2.2}) = V(\hat{P}_{2.2})\hat{S}^2_{i2.2} + V(\hat{S}_{i2.2})\hat{P}^2_{2.2} - V(\hat{S}_{i2.2})V(\hat{P}_{2.2}) \tag{3}$$

The contributions by stock through time for a specific fishery were added to estimate the contribution to that fishery for the entire year. The variance of the yearly contribution was calculated as the sum of the variances for each period. Finally, the contributions by stock to each fishery were added to produce the total contribution by stock to the East Side age-2.2 sockeye salmon harvest, and the variance of the total contribution by stock was calculated as the sum of the variances for each fishery.

Construction of Age-1.3 Models. A four-way linear discriminant model was constructed from scale measurements of age-1.3 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Models were built from 100 age-1.3 scales from each river's escapement and were weighted through time based on tower counts. Due to the low accuracy of the age-1.3 model in classifying Naknek and Kvichak stocks, it was not used to classify age-1.3 catches to river of origin.

Estimation Of Stock Composition For Minor Age Groups

Estimates of stock composition for sockeye salmon of ages other than age-2.2 harvested in the East Side districts were based on scale pattern estimates for age-2.2 sockeye salmon. In addition, the ratio of age-2.2 sockeye salmon to sockeye salmon of other age groups within respective escapements was used.

$$\hat{S}_{ij} = \frac{\hat{S}_{i2.2}\left(\frac{\hat{E}_{ij}}{\hat{E}_{i2.2}}\right)}{\sum_{i=1}^{n}\hat{S}_{i2.2}\left(\frac{\hat{E}_{ij}}{\hat{E}_{i2.2}}\right)} \tag{4}$$

where:

$\hat{S}_{ij}$ = estimated proportion of stock i in the catches of sockeye salmon aged j;

$\hat{S}_{i2.2}$ = estimated proportion of stock i in the catch of age-2.2 sockeye salmon;

$\hat{E}_{ij}$ = estimated proportion of sockeye salmon aged j in the escapement of stock i;

$\hat{E}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon in the escapement of stock i;

E_i = numbers of sockeye salmon escaping in stock i; and

n = number of stocks.

Estimation Of Run Size

The size of the sockeye salmon run to each river was estimated by adding estimates of catch by stock to estimates of escapements. For each river, we computed the percentage that was (1) harvested within its natal district, (2) harvested outside the district, and (3) escaped into the river. Finally, we compared run sizes estimated from scale pattern analysis with those estimated with the standard method.

RESULTS

Catch and Escapement

In 1989 commercial fishermen harvested an estimated 25,764,664 sockeye salmon in East Side districts (Table 2) compared to an average catch of 17.5 million from 1979-88. Sockeye salmon caught in Naknek-Kvichak District (13,878,778) accounted for 54% of the East Side catch; catches in Egegik District (8,700,824) comprised 34% and Ugashik District (3,185,062) and 12%; respectively. Peak catches occurred in Naknek-Kvichak District during 26 June through 13 July, in Egegik District during 28 June through 13 July, and in Ugashik District from 6 to 16 July.

In 1989 an estimated 8,317,500 sockeye salmon escaped into Kvichak River, of which 84% were counted during 29 June through 10 July (Table 3). Escapement into Naknek River was estimated at 1,161,984 sockeye salmon, of which 77% occurred during 26 June through 6 July. An estimated 1,610,916 sockeye salmon escaped into Egegik River, approximately 85% from 29 June through 9 July. Escapement into Ugashik River was estimated at 1,681,302 sockeye salmon; 88% passed the counting tower from 5 to 18 July.

Age Composition

Four age groups made up 99.6% of the East Side catch: age-1.2 (7.4%), age-1.3 (12.7%), age-2.2 (67.8%), and age-2.3 (11.7%; Table 4). Although age-2.2 sockeye salmon predominated in all district catches, there were some age differences among catches. Naknek-Kvichak District catch mostly comprised age-2.2 (70.5%) and age-1.3 (15.1%) sockeye salmon. Egegik District catch was comprised of mostly age-2.2 (61.1%) and age-2.3 (23.5%) sockeye salmon. Age-2.2 sockeye salmon predominated (73.9%) in Ugashik District catch, followed by age-1.3 (11.1%) fish.

Age composition of sockeye salmon escaping into rivers varied considerably among runs (Table 5). Escapement into Kvichak River was predominantly age-2.2 sockeye salmon (87.1%) whereas the escapement into Naknek River was divided among ages 2.2 (44.3%), 1.3 (21.3%), and 1.2 (22.0%). Sockeye salmon escaping into Egegik River were mostly age-2.2 (52.7%) and age-2.3 (35.1). The escapement into Ugashik River was composed of age-2.2 (68.4%), age-1.2 (15.4%), and age-1.3 (11.8%).

Classification Models

Age 2.2

The greatest discrimination among stocks of age-2.2 sockeye salmon in the four-way model was provided by variable 65 (total number of circuli in first and second freshwater and plus growth), variable 64 (total size of first and second freshwater), and variable 27 (average interval between circuli in first freshwater). Freshwater growth of Egegik River sockeye salmon was greatest, followed by freshwater growth of Naknek, Ugashik, and Kvichak Rivers (Table 6). Frequency distribution plots of the total number of circuli in the freshwater growth zone showed Kvichak samples to be the most distinctive and Naknek and Egegik samples to be the most similar (Figure 3).

We computed *t*-statistics to test for differences in the mean values of the number of circuli and size of major growth zones for males and females by stock for Kvichak, Naknek, Egegik, and Ugashik Rivers (Table 7). We found significant differences between sexes for the size of first ocean growth zone for Kvichak and Ugashik Rivers. Because there were no growth zones which were consistently different between sexes for all stocks, we combined samples of males and females to build the models.

The mean proportion correctly classified by the four-way model of age-2.2 Kvichak, Naknek, Egegik, and Ugashik samples was 0.757 (Table 8). The correct classification for Kvichak River (0.915) was extremely high; those for Ugashik (0.760), Egegik (0.680), and Naknek (0.675) were similar to each other. Samples from Naknek River misclassified mostly to Egegik and Ugashik Rivers. The range of classification accuracies were 0.832 to 0.892 for three-way models and 0.937 to 0.955 for two-way models.

Age-2.2 scale samples from Branch River were classified with the four-way model. Branch River samples classified mostly (93%) to Kvichak River and some (7%) to Ugashik River. The fact that Branch River

scale patterns looked like those from Kvichak River supported the decision to simplify model construction and build the Kvichak model from the numerically superior escapement past the counting tower.

Age 1.3

Scale characters which differed the most among stocks of age-1.3 sockeye salmon were variable 2 (size of first freshwater), variable 22 (relative width among circuli from circulus 2 to circulus 8 in first freshwater), and variable 78 (distance from circulus 6 to circulus 9 in first marine; Table 9) The mean proportion correctly classified by the four-way age-1.3 model of Kvichak, Naknek, Egegik and Ugashik Rivers was only 0.615 (Table 10). Correct classification for Egegik River was the highest (0.727), followed by Kvichak (0.663), and Ugashik (0.583) Rivers. Classification accuracy for Naknek River was extremely low (0.485), a higher proportion misclassifying to other rivers. Consequently, we felt the age-1.3 model was not sufficiently accurate for catch identification and did not use it in the analysis.

Estimates Of Catch Composition

Age 2.2

Most age-2.2 sockeye salmon harvested in each district originated from rivers within the district (Table 11). Of the 9,784,766 age-2.2 sockeye salmon caught in Naknek-Kvichak District, 87.5% originated from within the district and 12.5% from outside the district (Figure 4). There were no strong temporal trends based on a non-statistical comparison (NSC) in the age-2.2 stock proportions in Naknek-Kvichak District catches. Of the estimated 5,316,915 age-2.2 sockeye salmon caught in Egegik District, 53% originated from Egegik River and 47% were produced outside the district (Figure 5). The percentages of Egegik age-2.2 fish harvested in Egegik District were low early in the season, increased during the peak of the season, then decreased towards the end of the season. The catch of age-2.2 sockeye salmon in Ugashik District was 2,354,551 fish, of which 89% originated in Ugashik River and 11% from stocks outside the district (Figure 6). The contribution of Ugashik River age-2.2 sockeye salmon to Ugashik District catch was low prior to 1 July, then increased greatly.

The 90% confidence intervals around stock composition point estimates of age-2.2 sockeye salmon varied because the accuracies of the classification models differed by stock (Table 11). Estimates for age-2.2 catch contributions for Kvichak and Ugashik Rivers were more precise than other rivers, 90% confidence intervals ranging from $\pm$0.06 to $\pm$0.15. The 90% confidence intervals for catch estimates of Naknek and Egegik River stocks ranged from $\pm$0.10 to $\pm$0.25.

Coefficients of variation for stock proportion estimates were lowest for the major contributors: 0.02 for Kvichak River, 0.05 for Ugashik River, and 0.06 for Egegik River (Table 12). The coefficient of variation was much larger for Naknek River (0.15) because it contributed fewer age-2.2 sockeye salmon to the catch and the model accuracy was lower for this system.

All Ages

The Naknek-Kvichak District sockeye salmon harvest comprised 9,228,945 fish from Kvichak River, 2,537,650 fish from Naknek River, 607,785 fish from Egegik River and 1,504,398 fish from Ugashik River (Table 13). Percent contribution by stock to the Naknek-Kvichak District total catch was: 66.5% Kvichak, 18.3% Naknek, 4.4% Egegik, and 10.8% Ugashik Rivers (Figure 7). In 1989 sockeye salmon harvested by set nets along selected beaches in Naknek Section were sampled and classified to river of origin. The run composition of sockeye salmon harvested from Libbyville to Pederson Point on Naknek Beach differed marginally (NSC) to those harvested from Pederson Point to the inside district marker (Table 14). For most dates sampled, there were slightly higher percentages (NSC) of Kvichak River sockeye salmon, and conversely lower percentages of Naknek River, in catches from Libbyville to Pederson Point compared to those from Pederson Point south to the inside marker. In addition, there were generally higher percentages of Egegik River and lower percentages of Ugashik River sockeye salmon in catches from Libbyville to Pederson Point compared to those south of Pederson Point.

Of the sockeye salmon caught in Egegik District an estimated 5,248,251 from Egegik River, 1,428,995 from Kvichak River, 1,132,804 from Naknek River, and 890,774 were from Ugashik River (Table 15). Percent catch contributions by stock in Egegik District were 60.4% Egegik, 16.4% Kvichak, 13.0% Naknek, and 10.2% Ugashik Rivers (Figure 8). Set nets along selected beaches in Egegik District were also sampled in 1989, and there were trends (NSC) in estimates of run composition for these sockeye harvests (Table 16). All set net catches sampled comprised smaller percentages of non-Egegik sockeye salmon, and conversely higher percentages of Egegik sockeye salmon than the total Egegik District catch which is primarily harvested by drift nets. Set net catches south of Bishop Creek (Bishop Creek to King Salmon River) comprised higher percentages of Egegik River sockeye salmon than those north of Bishop Creek (Big Creek to Bishop Creek). Finally, Ugashik River sockeye salmon comprised a very low percentage of the set net catches.

Ugashik River sockeye salmon predominated (2,773,739) in the Ugashik District catch, followed by 264,262 from Egegik River, 115,377 from Kvichak River, and 31,684 from Naknek River (Table 17). The total Ugashik District sockeye catch comprised 87.1% Ugashik River fish, 8.3% Egegik River fish, 3.6% Kvichak River fish, and 1.0% Naknek River fish (Figure 9).

Stock Interceptions By District

Of the 10,773,317 Kvichak River sockeye salmon harvested in 1989, 85.7% were taken in Naknek-Kvichak District, 13.3% in Egegik District, and 1.0% in Ugashik District (Table 18). Approximately 68.5% of the Naknek River sockeye salmon were harvested in Naknek-Kvichak District, followed by 30.6% in Egegik District and 0.9% in Ugashik District. Most Egegik River sockeye salmon were harvested in Egegik District, (85.8%) with only 9.9% taken in Naknek-Kvichak District and 4.3% in Ugashik District. The largest harvest of Ugashik River sockeye salmon occurred in Ugashik District, (53.7%) followed by Naknek-Kvichak District (29.1%) and Egegik District (17.2%).

An estimated 2,708,860 sockeye salmon destined for Kvichak and Naknek Rivers were intercepted in districts outside their natal district. Conversely, fishermen in Naknek-Kvichak District intercepted 2,112,183 sockeye salmon which were headed for other rivers; thus, Naknek-Kvichak District incurred a net loss of 596,677 fish. The number of Egegik River sockeye salmon intercepted in other districts was 872,047, while fishermen in Egegik District caught 3,452,573 sockeye salmon which originated in other districts. Therefore, in 1989 Egegik District fishermen realized a net gain of 2,580,526 sockeye salmon. An estimated 2,395,172 Ugashik River sockeye salmon were intercepted outside Ugashik District and 411,323 sockeye salmon from other rivers were caught in Ugashik District. This resulted in a net loss to Ugashik District fishermen of 1,983,849 sockeye salmon.

Runs By River System

The 1989 sockeye salmon run to Kvichak River was estimated at 19,090,816 fish: 43.6% escaped into the river, 48.3% were harvested within Naknek-Kvichak District, and 8.1% were harvested in other districts (Tables 19-20; Figure 10). Of the 4,864,122 sockeye salmon returning to Naknek River, 23.9% escaped into the river, 52.2% were caught in Naknek-Kvichak District, and 23.9% were caught in other districts (Figure 11). Distribution of the 7,731,214 sockeye salmon returning to Egegik River was 20.8% to escapement, 67.9% to Egegik District harvest, and 11.3% to harvests from other districts (Figure 12). Ugashik River had a sockeye salmon run estimated at 6,850,212 fish: 24.5% escaped into the river, 40.5% were harvested within Ugashik District, and 35.0% were harvested in other districts (Figure 13).

Exploitation Rates

Ugashik River (35%) and Naknek (23.9%) River's runs experienced the highest rates of exploitation outside their natal districts followed by Egegik River (11.3%) and Kvichak River (8.1%). Total exploitation rates inside and outside the district by stock were 56.4% for the Kvichak River, 76.1% for the Naknek River, 79.2% for the Egegik River, and 75.5% for the Ugashik River (Tables 19, 20).

Comparison Of Run Estimates

Interception of outside stocks within a district was not considered in past procedures used to estimate total runs for east side rivers. One of the objectives of this investigation was to determine the level of interception by district and to estimate run size by river. Run estimates developed from the standard method (STD) can not be compared directly to those developed with scale pattern analysis (SPA) because Branch River was included in STD and not in SPA. Therefore, we adjusted the run estimates developed by the STD method so that the Naknek-Kvichak District catch was divided between Kvichak and Naknek Rivers. The greatest differences in numbers of fish between STD and SPA were for runs returning to

Egegik and Ugashik Rivers (Table 21). The STD generated estimate for the Egegik River run was 2,580,526 fish larger than that of STD. Conversely, the STD run estimate for Ugashik River was 1,983,849 fish less than the SPA estimate. The STD and SPA estimates for Naknek River differed by 1,555,819 fish, the STD estimate being lower. The STD estimate of run size for Kvichak River was 959,142 fish higher than that estimated by SPA. These discrepancies indicate that failing to include interceptions of stocks outside their natal districts in 1989 would lead to over estimations of runs to Egegik and Kvichak Rivers and under estimations of runs to Naknek and Ugashik Rivers.

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Table 1. Scale variables screened for linear discriminant function analysis of age-2.2 and -1.3 sockeye salmon for the East Side of Bristol Bay, 1989.

Variable Number	Variable Name	Zone
		First Freshwater Annular Zone
1	NC1FW	Number of circuli first freshwater
2	S1FW	Size (width) of first freshwater
3 (16)	C0-C2	Distance, scale focus (C0) to circulus 2 (C2)
4 (17)	C0-C4	Distance, scale focus to circulus 4
5 (18)	C0-C6	Distance, scale focus to circulus 6
6 (19)	C0-C8	Distance, scale focus to circulus 8
7 (20)	C2-C4	Distance, circulus 2 to circulus 4
8 (21)	C2-C6	Distance, circulus 2 to circulus 6
9 (22)	C2-C8	Distance, circulus 2 to circulus 8
10 (23)	C4-C6	Distance, circulus 4 to circulus 6
11 (24)	C4-C8	Distance, circulus 4 to circulus 8
12 (25)	C(NC-4)-E1FW	Distance, circulus (number circuli first freshwater minus 2) to end first freshwater
13 (26)	C(NC-2)-E1FW	Distance, circulus (number circuli first freshwater minus 4) to end first freshwater
14	C2-E1FW	Distance, circulus 2 to end first freshwater
15	C4-E1FW	Distance, circulus 4 to end first freshwater
16 thru 26	C0-C2/S1FW ... C(NC-2)-E1FW/S1FW	Relative widths, (variables 3-13)/S1FW
27	S1FW/NC1FW	Average interval between circuli in first freshwater
28	NC 1ST 3/4	Number of circuli in first 3/4 of first freshwater
29	MAX DIST	Maximum distance between 2 consecutive circuli in first freshwater
30	MAX DIST/S1FW	Relative width, (variable 29)/S1FW

-Continued-

Table 1. (p 2 of 4).

Variable Number	Variable Name	Zone
		Second Freshwater Annular Zone
31	NC2FW	Number of circuli second freshwater
32	S2FW	Size (width) of second freshwater
33 (46)	E1FW-C2	Distance, end of first freshwater to circulus 2 (C2) in second freshwater
34 (47)	E1FW-C4	Distance, end of first freshwater to circulus 4
35 (48)	E1FW-C6	Distance, end of first freshwater to circulus 6
36 (49)	E1FW-C8	Distance, end of first freshwater to circulus 8
37 (50)	C2-C4	Distance, circulus 2 to circulus 4
38 (51)	C2-C6	Distance, circulus 2 to circulus 6
39 (52)	C2-C8	Distance, circulus 2 to circulus 8
40 (53)	C4-C6	Distance, circulus 4 to circulus 6
41 (54)	C4-C8	Distance, circulus 4 to circulus 8
42 (55)	C(NC-4)-E2FW	Distance, circulus (number circuli second freshwater minus 4) to end second freshwater
43 (56)	C(NC-2)-E2FW	Distance, circulus (number circuli second freshwater minus 2) to end second freshwater
44	C2-E2FW	Distance, circulus 2 to end second freshwater
45	C4-E2FW	Distance, circulus 4 to end second freshwater
46 thru 56	E1FW-C2/S2FW ... C(NC-2)-E2FW/S2FW	Relative widths, (variables 33-43)/S2FW
57	S2FW/NC2FW	Average interval between circuli in second freshwater
58	NC 1ST 3/4	Number of circuli in first 3/4 of second freshwater
59	MAX DIST	Maximum distance between 2 consecutive circuli in second freshwater
60	MAX DIST/S2FW	Relative width, (variable 59)/S2FW
		Plus Growth Zone
61	NCPG	Number of circuli in plus growth
62	SPGZ	Size (width) plus growth zone

-Continued-

Table 1. (p 3 of 4).

Variable Number	Variable Name	Zone
		Freshwater and Plus Growth Zones
63	NC1FW + NC2FW	Total number of circuli first and second freshwater
64	S1FW + S2FW	Total size (width) of first and second freshwater
65	NC1FW+NC2FW+NCPG	Total number of circuli first and second freshwaters and plus growth
66	S1FW+S2FW+SPGZ	Total size (width) first and second freshwaters and plus growth
67	S1FW/S1FW+S2FW+SPGZ	Relative width, (variable 2)/S1FW+S2FW+SPGZ
68	SPGZ/S1FW+S2FW+SPGZ	Relative width, (variable 62)/S1FW+S2FW+SPGZ
69	S2FW/S1FW+S2FW+SPGZ	Relative width, (variable 32)/S1FW+S2FW+SPGZ
		First Marine Annular Zone
70	NC1OZ	Number of circuli in first ocean zone
71	S1OZ	Size (width) first ocean zone
72 (90)	EFW-C3	Distance, end of freshwater growth to circulus 3
73 (91)	EFW-C6	Distance, end of freshwater growth to circulus 6
74 (92)	EFW-C9	Distance, end of freshwater growth to circulus 9
75 (93)	EFW-C12	Distance, end of freshwater growth to circulus 12
76 (94)	EFW-C15	Distance, end of freshwater growth to circulus 15
77 (95)	C3-C6	Distance, circulus 3 to circulus 6
78 (96)	C3-C9	Distance, circulus 3 to circulus 9
79 (97)	C3-C12	Distance, circulus 3 to circulus 12
80 (98)	C3-C15	Distance, circulus 3 to circulus 15
81 (99)	C6-C9	Distance, circulus 6 to circulus 9
82 (100)	C6-C12	Distance, circulus 6 to circulus 12
83 (101)	C6-C15	Distance, circulus 6 to circulus 15
84 (102)	C9-C15	Distance, circulus 9 to circulus 15
85 (103)	C(NC-6)-E1OZ	Distance, circulus (number circuli first ocean minus 6) to end first ocean
86 (104)	C(NC-3)-E13OZ	Distance, circulus (number circuli first ocean minus 3) to end first ocean

-Continued-

Table 1. (p 4 of 4).

Variable Number	Variable Name	Zone
		First Marine Annular Zone
87	C3-E1OZ	Distance, circulus 3 to end of first ocean
88	C9-E1OZ	Distance, circulus 9 to end of first ocean
89	C15-E1OZ	Distance, circulus 15 to end of first ocean
90 thru 104	EFW-C3/S1OZ ... C(NC-3)-E13OZ/S1OZ	Relative widths, (variables 72-86)/S1OZ
105	S1OZ/NC1OZ	Average interval between circuli in first ocean
106	NC 1ST 1/2	Number of circuli in first 1/2 of first ocean
107	MAX DIST	Maximum distance between 2 consecutive circuli in first ocean
108	MAX DIST/S1OZ	Relative width, (variable 107)/S1OZ
		Second Marine Annular Zone
109	S2OZ	Size (width) of second ocean zone

Table 2. Sockeye salmon commercial catch by district and date for the East Side of Bristol Bay, 1989.

Date	Catch (Nos. of Fish)[a]			
	Naknek/Kvichak	Egegik	Ugashik	East Side
6/05-6/10	8	430	10	448
6/12-6/17	7,763	57,665	7,153	72,581
6/18-6/23	950,129[b]	440,353	69,754	1,460,236
6/25		208,422		208,422
6/26	641,821			641,821
6/27		4,948[c]		4,948
6/28		1,229,123		1,229,123
6/29	1,462,338	6,715[c]		1,469,053
6/30		486,488		486,488
7/01	736,286	508[c]	12,323	749,117
7/02	1,905,054	1,107,282		3,012,336
7/03	601,082		1,582[c]	602,664
7/04	1,148,920	882,041	57,692	2,088,653
7/05	418,980		120,633	539,613
7/06	1,470,476	917,252	184,524	2,572,252
7/07	666,357	357,925	337,149	1,361,431
7/08	82,151	191,433	352,219	625,803
7/09	339,979	230,414	212,121	782,514
7/10	644,911	270,150		915,061
7/11	582,660	394,439	385,197	1,362,296
7/12	846,819	559,970	59,177	1,465,966
7/13	437,190	336,510	358,978	1,132,678
7/14	36,930	225,691	64,743	327,364
7/15	317,135	139,433	254,421	710,989
7/16	110,827	139,629	203,687	454,143
7/17	177,545	180,707	138,572	496,824
7/18-7/23	240,321	297,515	303,850	841,686
7/24-7/29	38,810	29,551	47,991	116,352
7/31-8/05	11,487	4,741	10,848	27,076
8/07-8/12	2,099	915	1,371	4,385
8/13-8/19	482	390	685	1,557
8/21-8/26	218	150	316	684
8/28-9/01	0	34	66	100
Totals	13,878,778	8,700,824	3,185,062	25,764,664

[a] Blanks indicate a district was closed.

[b] Includes 4,529 fish caught by an ADF&G test fishery.

[c] Represents fish caught by an ADF&G test fishery.

Table 3. Escapement of sockeye salmon by river and date for the East Side of Bristol Bay, 1989.

	Kvichak Escapement		Naknek Escapement		Egegik Escapement		Ugashik Escapement	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
06/21					13,914	13,914		
06/22			840	840	41,844	55,758		
06/23			972	1,812	34,860	90,618		
06/24			7,902	9,714	5,754	96,372		
06/25	57,516	57,516	28,800	38,514	11,838	108,210		
06/26	240,756	298,272	36,534	75,048	17,034	125,244		
06/27	226,830	525,102	6,030	81,078	7,152	132,396		
06/28	128,028	653,130	66,306	147,384	23,352	155,748		
06/29	239,034	892,164	226,428	373,812	14,040	169,788		
06/30	616,362	1,508,526	68,184	441,996	58,980	228,768		
07/01	543,372	2,051,898	72,564	514,560	58,740	287,508		
07/02	514,170	2,566,068	195,618	710,178	70,632	358,140		
07/03	721,308	3,287,376	121,878	832,056	222,378	580,518		
07/04	1,090,380	4,377,756	31,716	863,772	185,328	765,846	210	210
07/05	1,040,100	5,417,856	27,492	891,264	217,002	982,848	66,222	66,432
07/06	529,164	5,947,020	47,520	938,784	269,502	1,252,350	80,304	146,736
07/07	663,636	6,610,656	26,808	965,592	139,800	1,392,150	101,388	248,124
07/08	571,368	7,182,024	28,584	994,176	115,404	1,507,554	67,650	315,774
07/09	336,084	7,518,108	18,258	1,012,434	36,774	1,544,328	66,516	382,290
07/10	151,398	7,669,506	5,172	1,017,606	6,972	1,551,300	58,008	440,298
07/11	38,898	7,708,404	17,616	1,035,222	8,304	1,559,604	101,514	541,812
07/12	46,986	7,755,390	14,292	1,049,514	7,062	1,566,666	413,310	955,122
07/13	50,640	7,806,030	22,020	1,071,534	13,158	1,579,824	220,854	1,175,976
07/14	53,886	7,859,916	14,310	1,085,844	5,316	1,585,140	63,300	1,239,276
07/15	54,270	7,914,186	48,120	1,133,964	5,094	1,590,234	66,618	1,305,894
07/16	146,046	8,060,232	9,804	1,143,768	9,936	1,600,170	54,420	1,360,314
07/17	70,032	8,130,264	5,148	1,148,916	1,974	1,602,144	58,482	1,418,796
07/18	33,654	8,163,918	6,558	1,155,474	2,286	1,604,430	68,544	1,487,340
07/19	40,914	8,204,832	4,836	1,160,310	2,874	1,607,304	47,448	1,534,788
07/20	40,608	8,245,440	1,674	1,161,984	2,034	1,609,338	30,702	1,565,490
07/21	27,522	8,272,962			1,578	1,610,916	20,934	1,586,424
07/22	14,370	8,287,332					15,210	1,601,634
07/23	7,692	8,295,024					13,212	1,614,846
07/24	7,068	8,302,092					15,138	1,629,984
07/25	10,332	8,312,424					20,838	1,650,822
07/26	5,076	8,317,500					18,528	1,669,350
07/27							7,578	1,676,928
07/28							2,004	1,678,932
07/29							2,370	1,681,302
Total		8,317,500		1,161,984		1,610,916[a]		1,681,302[b]

[a] An additional 50 and 600 sockeye salmon were counted in Shosky Creek and King Salmon River drainages, respectively, bringing the Egegik District sockeye salmon escapement total to 1,611,566.

[b] An additional 6,505 and 25,480 sockeye salmon were counted in Dog Salmon and King Salmon River drainages, respectively, bringing the Ugashik District sockeye salmon escapement total to 1,713,287.

Table 4. Age composition by brood year of sockeye salmon commercial catches for the East Side of Bristol Bay, 1989.

District	Sample Size		1986	1985			1984				1983			1982		Total
			0.2	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	
Naknek-Kvichak	7,192	Numbers	6,523	29,057	1,203,951	675	1,180	2,097,898	9,784,766		4,971	744,470		5,287		13,878,778
		Percent	0.1	0.2	8.7	0.0[a]	0.0[a]	15.1	70.5		0.0[a]	5.4		0.0[a]		100.0
		SE	4,459	7,562	47,040	1,044	1,229	60,251	77,368		3,419	37,655		3,799		N/A
Egegik	7,480	Numbers		8,353	474,776	2,573		829,464	5,316,915	926	6,586	2,040,567	18,606	1,656	740	8,700,824
		Percent		0.1	5.5	0.0[a]		9.5	61.1	0.0[a]	0.1	23.5	0.2	0.0[a]	0.0	100.0
		SE		3,235	24,465	2,209		31,942	52,189	877	2,507	45,822	4,557	1,103	592	N/A
Ugashik	4,170	Numbers	2,296	4,071	233,789			352,268	2,354,551		3,216	232,310	883	1,678		3,185,062
		Percent	0.1	0.1	7.3			11.1	73.9		0.1	7.3	0.0[a]	0.1		100.0
		SE	1,149	1,805	13,810			16,831	23,277		1,667	13,422	1,088	1,371		N/A
Total	18,842	Numbers	8,819	41,481	1,912,516	3,248	1,180	3,279,630	17,456,232	926	14,773	3,017,347	19,489	8,621	740	25,764,664
		Percent	0.0[a]	0.2	7.4	0.0[a]	0.0[a]	12.7	67.8	0.0[a]	0.1	11.7	0.1	0.0[a]	0.0[a]	100.0

[a] Fish present, but represent less than 0.1%.

Table 5. Age composition by brood year of sockeye salmon escapement for the East Side of Bristol Bay, 1989.

River	Sample Size		1986		1985			1984			1983			1982		Total
			0.2	1.1	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	
Kvichak	2,992	Numbers	2,471		4,405	388,976	28,088	510,486	7,246,309		2,157	134,608				8,317,500
		Percent	0.0[a]		0.0[a]	4.7	0.4	6.2	87.1		0.0[a]	1.6				100.0
Naknek	1,732	Numbers		2,870	971	255,824	18,944	247,398	514,397		2,256	117,674		1,650		1,161,984
		Percent		0.3	0.1	22.0	1.6	21.3	44.3		0.2	10.1		0.1		100.0
Egegik	2,757	Numbers		1,623		65,304	28,302	97,474	849,506	1,720	263	565,677	818		229	1,610,916
		Percent		0.1		4.1	1.8	6.1	52.7	0.1	0.0[a]	35.1	0.0[a]		0.0[a]	100.0
Ugashik	3,709	Numbers	2,157	496	2,130	258,220	1,695	197,655	1,149,199			69,409		341		1,681,302
		Percent	0.1	0.0[a]	0.1	15.4	0.1	11.8	68.4			4.1		0.0[a]		100.0

[a] Fish present, but represent less than 0.1%.

Table 6. Mean and standard error of age-2.2 scale variables used to construct linear discriminant functions for the East Side of Bristol Bay, 1989.

Variable Number	Variable Name	Kvichak		Naknek		Egegik		Ugashik	
		Mean[a]	SE	Mean[a]	SE	Mean[a]	SE	Mean[a]	SE
First Freshwater Annular Zone									
7	C2-C4	23.35	0.333	25.47	0.269	25.75	0.268	21.41	0.231
17	CO-C4/S1FW	0.71	0.009	0.62	0.006	0.54	0.007	0.66	0.007
20	C2-C4/S1FW	0.23	0.003	0.22	0.002	0.18	0.002	0.22	0.003
25	(C(NC-4)-E1FW)/S1FW	0.38	0.011	0.30	0.006	0.25	0.004	0.32	0.006
26	(C(NC-2)-E1FW)/S1FW	0.15	0.003	0.13	0.002	0.11	0.002	0.14	0.003
27	S1FW/NC1FW	13.57	0.089	13.17	0.079	13.24	0.073	12.00	0.078
28	NC 1ST 3/4	4.00	0.088	5.11	0.086	6.38	0.122	4.63	0.086
Second Freshwater Annular Zone									
32	S2FW	97.88	1.222	117.39	1.265	118.04	1.297	110.41	1.213
35	E1FW-C6	67.30	0.416	69.16	0.503	70.02	0.494	70.30	0.528
40	C4-C6	21.91	0.270	22.75	0.227	23.62	0.249	23.55	0.240
42	C(NC-4)-E2FW	33.31	0.402	34.21	0.309	35.66	0.375	34.06	0.363
43	C(NC-2)-E2FW	14.32	0.179	14.70	0.182	14.97	0.200	14.04	0.193
44	C2-E2FW	75.89	1.238	94.90	1.255	95.70	1.318	87.67	1.188
49	E1FW-C8/S2FW	0.87	0.007	0.78	0.007	0.79	0.008	0.83	0.007
57	S2FW/NC2FW	10.07	0.062	10.36	0.054	10.67	0.065	10.51	0.066
Freshwater and Plus Growth Zones									
63	NC1+NC2	17.34	0.129	20.50	0.141	22.07	0.141	19.06	0.138
64	S1FW+S2FW	200.21	1.658	237.34	1.759	261.89	1.722	211.92	1.673
65	NC1FW+NC2FW+NCPG	18.31	0.115	23.15	0.135	23.97	0.132	21.96	0.137
66	S1FW+S2FW+SPGZ	210.12	1.559	266.69	1.717	282.24	1.648	245.81	1.709
67	S1FW/S1FW+S2FW+SPGZ	0.48	0.005	0.45	0.004	0.51	0.005	0.41	0.004
First Marine Annular Zone									
71	S1OZ	411.39	2.788	383.95	2.620	380.35	2.566	405.03	2.347
87	C3-E1OZ	345.34	2.820	318.69	2.577	312.62	2.670	337.84	2.361
103	(C(NC-6)-E1OZ)/S1OZ	0.20	0.002	0.21	0.002	0.20	0.002	0.20	0.002
107	MAX DIST	29.35	0.229	28.61	0.215	29.47	0.244	28.80	0.216
Sample Size		200		200		200		200	

[a] Scale images projected at 100x magnification and measured in 0.01 inches; therefore, variable means are in 0.0001 inches.

Table 7. Mean, variance, and *t*-statistic comparing males and females for selected scale variables of age-2.2 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers of Bristol Bay, 1989.

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S1OZ
Kvichak River	Male	Sample Size	72	72	50	72	72
		Mean	100.56	97.47	14.22	207.90	421.57
		Variance	515.52	216.59	48.75	578.03	1733.26
	Female	Sample Size	127	127	92	127	127
		Mean	103.28	98.25	13.68	211.45	405.53
		Variance	445.71	347.25	49.41	436.65	1384.68
	Combined	Sample Size	200[a]	200[a]	143[a]	200[a]	200[a]
		Mean	102.33	97.88	13.86	210.12	411.39
		Variance	468.02	298.90	48.57	486.12	1555.12
	T-Statistic		-0.85	-0.31	0.43	-1.09	2.80[b]
Naknek River	Male	Sample Size	98	98	95	98	98
		Mean	121.54	118.73	30.08	269.44	383.54
		Variance	390.62	273.89	150.29	563.96	1622.54
	Female	Sample Size	102	102	100	102	102
		Mean	118.42	116.09	30.12	264.04	384.34
		Variance	379.97	364.24	161.16	606.16	1146.78
	Combined	Sample Size	200	200	195	200	200
		Mean	119.95	117.39	30.10	266.69	383.95
		Variance	385.70	320.13	155.06	589.87	1373.08
	T-Statistic		1.12	1.05	-0.02	1.58	-0.15
Egegik River	Male	Sample Size	80	80	77	80	80
		Mean	139.51	118.34	21.60	278.64	379.70
		Variance	807.19	338.43	111.59	567.42	1796.62
	Female	Sample Size	118	118	113	118	118
		Mean	146.96	117.65	20.92	284.64	380.42
		Variance	748.57	339.75	95.63	525.80	1016.74
	Combined	Sample Size	200[c]	200[c]	192[c]	200[c]	200[c]
		Mean	143.85	118.04	21.20	282.24	380.35
		Variance	774.86	336.25	100.61	543.40	1316.90
	T-Statistic		-1.85	0.26	0.45	-1.78	-0.14

-Continued-

Table 7. (p 2 of 2).

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S10Z
Ugashik River	Male	Sample Size	101	101	100	101	101
		Mean	102.11	109.97	35.24	246.97	411.63
		Variance	417.20	255.71	118.47	529.51	1167.51
	Female	Sample Size	99	99	98	99	99
		Mean	100.90	110.86	33.19	244.62	398.28
		Variance	339.11	336.41	119.85	642.73	955.96
	Combined	Sample Size	200	200	198	200	200
		Mean	101.51	110.41	34.23	245.81	405.03
		Variance	377.01	294.36	119.60	584.00	1102.25
	T-Statistic		0.44	-0.37	1.32	0.69	2.90[b]

[a] Includes one unsexed sample.

[b] Significant, alpha = 0.05.

[c] Includes two unsexed samples.

Table 8. Classification matrices from discriminant analyses of age-2.2 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers of Bristol Bay, 1989.

Actual Group Of Origin	Sample Size	Classified Group of Origin			
		Kvichak	Naknek	Egegik	Ugashik
Kvichak	200	0.915	0.025	0.015	0.045
Naknek	200	0.055	0.675	0.150	0.120
Egegik	200	0.020	0.275	0.680	0.025
Ugashik	200	0.065	0.130	0.045	0.760

Mean proportion correctly classified = 0.757
Variables used: 65,64,27,71,7,35,67,20,32,25
Box's Test of Variance-Covariance Equality[a]
F-statistic = 8.57
D.F. = 165, 1,373,669

Actual Group Of Origin	Sample Size	Classified Group of Origin		
		Kvichak	Naknek	Ugashik
Kvichak	200	0.945	0.010	0.045
Naknek	200	0.050	0.805	0.145
Ugashik	200	0.080	0.175	0.745

Mean proportion correctly classified = 0.832
Variables used: 65,63,27,32,71,40,43,87
Box's Test of Variance-Covariance Equality
F-statistic = 1.81
D.F. = 72, 993,071

-Continued-

Table 8. (p 2 of 3).

Actual Group Of Origin	Sample Size	Classified Group of Origin		
		Kvichak	Egegik	Ugashik
Kvichak	200	0.945	0.020	0.035
Egegik	200	0.035	0.885	0.080
Ugashik	200	0.075	0.080	0.845

Mean proportion correctly classified = 0.892
Variables used: 65,64,57,71,42,27
Box's Test of Variance-Covariance Equality
F-statistic = 2.51
D.F. = 42, 1,058,103

Actual Group Of Origin	Sample Size	Classified Group of Origin	
		Kvichak	Naknek
Kvichak	200	0.970	0.030
Naknek	200	0.060	0.940

Mean proportion correctly classified = 0.955
Variables used: 65,63,32,71,44,87
Box's Test of Variance-Covariance Equality
F-statistic = 2.47
D.F. = 21, 582,609

-Continued-

Table 8. (p 3 of 3).

Actual Group Of Origin	Sample Size	Classified Group of Origin	
		Kvichak	Ugashik
Kvichak	200	0.965	0.035
Ugashik	200	0.075	0.925

Mean proportion correctly classified = 0.945
Variables used: 65,63,67,25,28
Box's Test of Variance-Covariance Equality
F-statistic = 6.63
D.F. = 15, 637,785

Actual Group Of Origin	Sample Size	Classified Group of Origin	
		Egegik	Ugashik
Egegik	199	0.945	0.055
Ugashik	198	0.071	0.929

Mean proportion correctly classified = 0.937
Variables used: 27,71,43,66,26,17,49,103,107
Box's Test of Variance-Covariance Equality
F-statistic = 2.25
D.F. = 45, 512,544

[a] The equality of the variance -covariance matrices tested with a procedure described by Box (1949).

Table 9. Mean and standard error of age-1.3 scale variables used to construct linear discriminant functions for the East Side of Bristol Bay, 1989.

Variable Number	Variable Name	Kvichak		Naknek		Egegik		Ugashik	
		Mean[a]	SE	Mean[a]	SE	Mean[a]	SE	Mean[a]	SE
First Freshwater Annular Zone									
2	S1FW	139.47	1.705	159.00	2.589	190.49	2.041	151.43	2.549
18	C0-C6/S1FW	0.72	0.009	0.64	0.009	0.57	0.006	0.64	0.007
22	C2-C8/S1FW	0.52	0.005	0.46	0.005	0.41	0.005	0.44	0.005
Second Freshwater Annular Zone									
78	C3-C9	112.31	2.082	103.54	2.206	124.07	1.551	116.07	1.934
96	C3-C9/S1OZ	0.27	0.006	0.24	0.006	0.30	0.005	0.27	0.005
Sample Size		95		97		88		96	

[a] Scale images projected at 100x magnification and measured in 0.01 inches; therefore, variable means are in 0.0001 inches.

Table 10. Classification matrix from a discriminant analysis of age-1.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers of Bristol Bay, 1989.

Actual Group Of Origin	Sample Size	Classified Group of Origin			
		Kvichak	Naknek	Egegik	Ugashik
Kvichak	95	0.663	0.168	0.021	0.147
Naknek	97	0.216	0.485	0.144	0.155
Egegik	88	0.045	0.114	0.727	0.114
Ugashik	96	0.146	0.146	0.125	0.583

Mean proportion correctly classified = 0.615
Variables used: 2,22,78,96,18
Box's Test of Variance-Covariance Equality[a]
F-statistic = 2.04
D.F. = 45, 338,929

[a] The equality of the variance-covariance matrices tested with a procedure described by Box (1949).

Table 11. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.2 sockeye salmon by fishery and date for the East Side of Bristol Bay, 1989.

		Kvichak		Naknek		Egegik		Ugashik	
Fishery	Date	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.
Naknek-Kvichak	6/05-6/23	0.781	(.666,.896)	0.178	(.039,.318)	0.010	(0,.094)	0.031	(0,.123)
	6/26	0.808	(.673,.942)	0.135	(0,.289)	0.008	(0,.101)	0.049	(0,.163)
	7/29-7/01	0.656	(.509,.803)	0.059	(0,.207)	0.045	(0,.151)	0.240	(0,.396)
	7/02	0.831	(.700,.962)	0.031	(0,.161)	0.075	(0,.188)	0.063	(0,.176)
	7/03	0.683	(.538,.827)	0.224	(.035,.413)	0.066	(0,.198)	0.027	(0,.136)
	7/04	0.866	(.739,.993)	0.035	(0,.153)	0.011	(0,.092)	0.088	(0,.209)
	7/05-7/06	0.775	(.637,.912)	0.077	(0,.224)	0.063	(0,.177)	0.085	(0,.206)
	7/07-7/09	0.778	(.668,.889)	0.117	(.018,.215)	0.000	Trace[a]	0.105	(0,.220)
	7/10	0.767	(.656,.879)	0.130	(.028,.231)	0.000	Trace	0.103	(0,.219)
	7/11-7/12	0.746	(.633,.860)	0.188	(.075,.300)	0.000	Trace	0.066	(0,.176)
	7/13-7/16	0.901	(.839,.963)	0.099	(.037,.161)	0.000	Trace	0.000	Trace
	7/17-8/26	0.824	(.719,.929)	0.097	(.006,.188)	0.000	Trace	0.079	(0,.188)
Egegik	6/05-6/22	0.498	(.376,.619)	0.000	Trace	0.447	(.319,.575)	0.055	(0,.143)
	6/23-6/26	0.354	(.258,.450)	0.000	Trace	0.582	(.472,.691)	0.064	(0,.143)
	6/27-6/28	0.532	(.386,.678)	0.040	(0,.239)	0.373	(.172,.574)	0.055	(0,.160)
	6/29-7/30	0.025	(0,.088)	0.000	Trace	0.921	(.807,1.00)	0.054	(0,.157)
	7/01-7/02	0.133	(.029,.238)	0.063	(0,.324)	0.619	(.384,.862)	0.185	(.045,.326)
	7/04	0.075	(0,.165)	0.156	(0,.432)	0.592	(.344,.838)	0.177	(.034,.321)
	7/06	0.060	(0,.145)	0.201	(0,.475)	0.529	(.288,.769)	0.210	(.058,.363)
	7/07-7/08	0.124	(.023,.225)	0.144	(0,.424)	0.652	(.400,.903)	0.080	(0,.196)
	7/09-7/10	0.341	(.205,.477)	0.129	(0,.377)	0.522	(.290,.755)	0.008	(0,.097)
	7/11-7/12	0.312	(.178,.446)	0.092	(0,.322)	0.433	(.215,.650)	0.163	(.026,.301)
	7/13-7/14	0.276	(.145,.406)	0.209	(0,.454)	0.379	(.165,.595)	0.136	(0,.271)
	7/15-8/31	0.167	(.055,.278)	0.198	(0,.469)	0.549	(.308,.792)	0.086	(0,.207)

-Continued-

Table 11. (p 2 of 2).

		Kvichak		Naknek		Egegik		Ugashik	
Fishery	Date	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.	Pt. Est.	90% C.I.
Ugashik	6/07-6/23	0.183	(.066,.300)	0.125	(0,.367)	0.421	(.202,.640)	0.271	(.111,.432)
	7/01-7/05	0.000	Trace	0.000	Trace	0.023	(0,.087)	0.977	(.913,1.00)
	7/06-7/07	0.000	Trace	0.000	Trace	0.148	(.067,.229)	0.852	(.771,.933)
	7/08-7/09	0.037	(0,.137)	0.012	(0,.216)	0.028	(0,.153)	0.923	(.719,1.00)
	7/11-7/12	0.023	(0,.104)	0.000	Trace	0.126	(.015,.237)	0.851	(.715,.987)
	7/13-7/14	0.073	(.001,.145)	0.000	Trace	0.000	Trace	0.927	(.855,.999)
	7/15-9/01	0.066	(0,.172)	0.006	(0,.201)	0.026	(0,.145)	0.902	(.702,1.00)

[a] Trace was recorded for systems that were originally included in the model used to classify the catch, their point estimates were zero, but the upper bounds of the 90% confidence interval was greater than zero.

Table 12. Estimated numbers of age-2.2 sockeye salmon by river of origin harvested in the East Side of Bristol Bay, 1989.

District	River	Estimated Proportion	Estimated Numbers	Standard Error of Estimate	Coefficient of Variation
Naknek-Kvichak	Kvichak	0.776	7,597,618	181,147	0.02
	Naknek	0.099	968,321	173,579	0.18
	Egegik	0.032	311,792	119,612	0.38
	Ugashik	0.093	907,035	160,697	0.18
	Total	1.000	9,784,766		
Egegik	Kvichak	0.227	1,208,200	78,485	0.06
	Naknek	0.120	635,528	166,323	0.26
	Egegik	0.530	2,818,725	155,652	0.06
	Ugashik	0.123	654,462	87,809	0.13
	Total	1.000	5,316,915		
Ugashik	Kvichak	0.044	102,652	40,708	0.40
	Naknek	0.006	13,555	67,634	4.99
	Egegik	0.060	141,934	48,433	0.34
	Ugashik	0.890	2,096,410	78,495	0.04
	Total	1.000	2,354,551		
Total East Side	Kvichak	0.510	8,908,470	201,572	0.02
	Naknek	0.093	1,617,404	249,735	0.15
	Egegik	0.187	3,272,452	202,189	0.06
	Ugashik	0.210	3,657,906	199,238	0.05
	Total	1.000	17,456,232		

Table 13. Run composition estimates of sockeye salmon catch by age group and date for Naknek-Kvichak District of Bristol Bay, 1989.

		0.2		0.3		1.2		1.3		2.2		2.3		Other[a]		Total	
Date	System	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/05[b]	Kvichak	0.0	0	54.7	941	30.3	16,559	37.4	67,642	78.1	446,488	22.8	33,379	8.6	205	59.0	565,214
thru	Naknek	0.0	0	38.7	665	64.1	34,965	58.2	105,246	17.8	101,760	63.9	93,664	90.4	2,163	35.3	338,464
6/23	Egegik	0.0	0	0.0	0	0.6	304	0.8	1,411	1.0	5,717	10.4	15,317	1.0	23	2.4	22,771
	Ugashik	0.0	0	6.6	113	5.0	2,751	3.6	6,555	3.1	17,722	2.9	4,307	0.0	3	3.3	31,452
	Total	0.0	0	100.0	1,719	100.0	54,579	100.0	180,854	100.0	571,687	100.0	146,667	100.0	2,394	100.0	957,900
6/26	Kvichak	0.0	0	58.8	693	35.5	19,273	43.4	80,368	80.8	280,268	27.7	14,711	0.0	0	61.7	396,006
	Naknek	0.0	0	30.4	359	55.0	29,833	49.5	91,669	13.5	46,827	57.0	30,261	0.0	0	31.0	199,308
	Egegik	0.0	0	0.0	0	0.5	273	0.7	1,296	0.8	2,775	9.8	5,220	0.0	0	1.5	9,564
	Ugashik	0.0	0	10.8	128	9.0	4,892	6.4	11,898	4.9	16,996	5.5	2,900	0.0	0	5.8	36,942
	Total	0.0	0	100.0	1,180	100.0	54,272	100.0	185,231	100.0	346,866	100.0	53,092	0.0	0	100.0	641,821
6/29	Kvichak	0.0	0	0.0	0	28.9	41,595	38.2	179,186	65.6	963,669	17.4	19,974	0.0	0	54.8	1,204,992
thru	Naknek	0.0	0	0.0	0	24.1	34,660	23.4	110,020	5.9	86,671	19.2	22,118	0.0	0	11.6	254,215
7/01	Egegik	0.0	0	0.0	0	2.8	4,086	4.3	20,019	4.5	66,105	42.7	49,106	0.0	0	6.3	139,357
	Ugashik	0.0	0	0.0	0	44.2	63,701	34.1	160,042	24.0	352,562	20.7	23,756	0.0	0	27.3	600,060
	Total	0.0	0	0.0	0	100.0	144,042	100.0	469,267	100.0	1,469,008	100.0	114,954	0.0	0	100.0	2,198,624
7/02	Kvichak	0.0	0	74.3	2,652	55.8	35,830	63.0	184,362	83.1	1,182,878	20.2	23,830	0.0	0	75.0	1,429,552
	Naknek	0.0	0	8.6	307	19.3	12,383	16.0	46,952	3.1	44,127	9.3	10,945	100.0	3,568	6.2	118,281
	Egegik	0.0	0	0.0	0	7.2	4,631	9.3	27,100	7.5	106,758	65.5	77,080	0.0	0	11.3	215,568
	Ugashik	0.0	0	17.1	610	17.7	11,371	11.7	34,122	6.3	89,677	5.0	5,873	0.0	0	7.4	141,652
	Total	0.0	0	100.0	3,568	100.0	64,215	100.0	292,536	100.0	1,423,439	100.0	117,728	100.0	3,568	100.0	1,905,054
7/03	Kvichak	0.0	0	46.8	702	23.0	10,542	28.6	22,988	68.3	300,857	11.6	3,826	0.0	0	56.4	338,916
	Naknek	0.0	0	47.6	714	70.0	32,031	64.1	51,469	22.4	98,671	46.8	15,450	0.0	0	33.0	198,334
	Egegik	0.0	0	0.0	0	3.2	1,459	4.5	3,618	6.6	29,073	40.1	13,251	0.0	0	7.9	47,400
	Ugashik	0.0	0	5.6	84	3.8	1,744	2.8	2,219	2.7	11,893	1.5	492	0.0	0	2.7	16,432
	Total	0.0	0	100.0	1,500	100.0	45,776	100.0	80,294	100.0	440,494	100.0	33,018	0.0	0	100.0	601,082

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Table 13. (p 2 of 3).

Date	System	0.2 %	0.2 Number	0.3 %	0.3 Number	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	2.3 %	2.3 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/04	Kvichak	0.0	0	69.8	3,107	55.0	80,834	64.7	123,966	86.6	651,740	43.8	23,405	0.0	0	76.9	883,052
	Naknek	0.0	0	8.7	389	20.6	30,267	17.9	34,204	3.5	26,341	21.8	11,647	0.0	0	9.0	102,847
	Egegik	0.0	0	0.0	0	1.0	1,470	1.3	2,565	1.1	8,278	19.9	10,655	0.0	0	2.0	22,968
	Ugashik	0.0	0	21.5	957	23.4	34,383	16.1	30,753	8.8	66,228	14.5	7,732	0.0	0	12.2	140,053
	Total	0.0	0	100.0	4,453	100.0	146,955	100.0	191,487	100.0	752,587	100.0	53,438	0.0	0	100.0	1,148,920
7/05	Kvichak	62.2	2,352	61.0	2,304	40.0	51,475	48.1	98,180	77.5	1,145,104	18.2	13,071	0.0	0	69.5	1,312,487
thru	Naknek	0.0	0	18.8	709	36.9	47,383	32.6	66,594	7.7	113,772	22.3	15,989	0.0	0	12.9	244,446
7/06	Egegik	0.0	0	0.0	0	4.7	5,992	6.4	12,999	6.3	93,086	53.0	38,080	0.0	0	7.9	150,157
	Ugashik	37.8	1,427	20.3	766	18.4	23,632	12.9	26,288	8.5	125,592	6.5	4,660	0.0	0	9.7	182,366
	Total	100.0	3,779	100.0	3,779	100.0	128,483	100.0	204,061	100.0	1,477,554	100.0	71,800	0.0	0	100.0	1,889,456
7/07	Kvichak	0.0	0	53.3	2,308	33.8	51,938	42.4	42,249	77.8	617,874	30.4	11,181	0.0	0	66.7	725,550
thru	Naknek	0.0	0	24.8	1,075	47.1	72,364	43.6	43,375	11.7	92,919	56.3	20,702	0.0	0	21.2	230,436
7/09	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	21.8	945	19.1	29,342	14.0	13,920	10.5	83,389	13.3	4,905	0.0	0	12.2	132,501
	Total	0.0	0	100.0	4,328	100.0	153,644	100.0	99,544	100.0	794,183	100.0	36,788	0.0	0	100.0	1,088,487
7/10	Kvichak	0.0	0	51.7	1,854	31.9	27,070	40.2	30,279	76.7	358,160	28.4	4,068	0.0	0	65.3	421,430
	Naknek	0.0	0	27.2	974	50.1	42,508	46.6	35,035	13.0	60,705	59.2	8,489	0.0	0	22.9	147,710
	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	21.1	755	17.9	15,217	13.2	9,927	10.3	48,097	12.4	1,776	0.0	0	11.7	75,771
	Total	0.0	0	100.0	3,583	100.0	84,794	100.0	75,240	100.0	466,962	100.0	14,332	0.0	0	100.0	644,911
7/11	Kvichak	67.2	1,843	0.0	0	27.0	42,209	34.1	52,325	74.6	796,211	22.8	10,624	0.0	0	63.2	903,798
thru	Naknek	0.0	0	0.0	0	63.0	98,551	58.6	90,022	18.8	200,654	70.7	32,964	0.0	0	29.7	424,349
7/12	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	32.8	901	0.0	0	10.0	15,632	7.4	11,302	6.6	70,442	6.5	3,055	0.0	0	7.1	101,332
	Total	100.0	2,744	0.0	0	100.0	156,392	100.0	153,649	100.0	1,067,307	100.0	46,643	0.0	0	100.0	1,429,479

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Table 13. (p 3 of 3).

Date	System	0.2 %	0.2 Number	0.3 %	0.3 Number	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	2.3 %	2.3 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/13	Kvichak	0.0	0	74.6	2,387	49.6	53,896	57.1	50,265	90.1	599,495	42.5	15,635	0.0	0	80.0	721,677
thru	Naknek	0.0	0	25.4	812	50.4	54,865	42.9	37,704	9.9	65,871	57.5	21,152	0.0	0	20.0	180,405
7/16	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	0.0	0	100.0	3,199	100.0	108,761	100.0	87,969	100.0	665,366	100.0	36,787	0.0	0	100.0	902,082
7/17[c]	Kvichak	0.0	0	60.4	1,056	40.1	24,895	49.1	38,164	82.4	254,874	36.2	6,962	0.0	0	69.3	326,272
thru	Naknek	0.0	0	22.0	385	43.8	27,152	39.4	30,670	9.7	30,003	52.5	10,091	0.0	0	21.0	98,854
8/26	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	17.6	307	16.1	9,991	11.5	8,932	7.9	24,436	11.3	2,170	0.0	0	9.7	45,836
	Total	0.0	0	100.0	1,748	100.0	62,038	100.0	77,766	100.0	309,313	100.0	19,223	0.0	0	100.0	470,962
Total	Kvichak	64.3	4,195	62.0	18,003	37.9	456,117	46.2	969,974	77.6	7,597,618	24.3	180,665	19.6	2,372	66.5	9,228,945
	Naknek	0.0	0	22.0	6,388	42.9	516,963	35.4	742,960	9.9	968,321	39.4	293,471	78.8	9,548	18.3	2,537,650
	Egegik	0.0	0	0.0	0	1.5	18,215	3.3	69,007	3.2	311,792	28.0	208,708	0.5	63	4.4	607,785
	Ugashik	35.7	2,328	16.1	4,665	17.7	212,656	15.1	315,958	9.3	907,035	8.3	61,626	1.1	130	10.8	1,504,398
	Total	100.0	6,523	100.0	29,057	100.0	1,203,951	100.0	2,097,898	100.0	9,784,766	100.0	744,470	100.0	12,113	100.0	13,878,778

[a] Includes age-2.1, age-0.4, age-1.4, and age-2.4.

[b] Scale samples were collected on 17, 19, 21, and 23 June. Stock composition estimates calculated for those dates were applied to 5 June through 23 June catches.

[c] Scale samples were collected on 17 July. Stock composition estimates calculated for 17 July were applied to 17 July through 26 August catches.

Table 14. Run composition estimates of sockeye salmon caught in set nets on selected beaches, Naknek Section, Naknek-Kvichak District, 1989.

Beach	Date	Percent Classification By Stock				
		Kvichak	Naknek	Egegik	Ugashik	Total
Libbyville	7/07	66.9	14.6	14.8	3.7	100.0
to	7/10	48.1	40.0	10.8	1.1	100.0
Pederson Pt.	7/13	71.0	14.0	6.6	8.4	100.0
Pederson Pt.	7/07	55.9	20.8	6.5	16.8	100.0
to	7/10	48.9	24.6	13.9	12.6	100.0
Inside Marker	7/13	48.4	42.0	3.6	6.0	100.0

Table 15. Run composition estimates of sockeye salmon catch by age group and date for Egegik District of Bristol Bay, 1989.

		0.3		1.2		1.3		2.2		1.4		2.3		3.2		Other[a]		Total	
Date	System	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/05[b]	Kvichak	74.9	410	36.4	2,004	36.6	10,284	49.8	42,929	51.9	284	3.0	3,346	0.0	0	7.2	40	25.4	59,295
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/22	Egegik	0.0	0	46.8	2,575	53.5	15,034	44.7	38,532	48.1	263	95.9	107,651	0.0	0	92.5	506	70.4	164,561
	Ugashik	25.1	137	16.8	926	9.9	2,773	5.5	4,741	0.0	0	1.1	1,201	0.0	0	0.3	2	4.2	9,780
	Total	100.0	547	100.0	5,505	100.0	28,090	100.0	86,202	100.0	547	100.0	112,199	0.0	0	100.0	547	100.0	233,637
6/23	Kvichak	64.6	468	24.3	10,215	24.3	19,518	35.4	60,744	0.0	0	1.7	2,930	0.0	0	0.0	0	19.8	93,874
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	57.3	724	0.2	724
6/26	Egegik	0.0	0	57.3	24,049	65.0	52,262	58.2	99,867	0.0	0	97.4	172,614	0.0	0	42.7	539	73.8	349,331
	Ugashik	35.4	256	18.4	7,730	10.7	8,615	6.4	10,982	0.0	0	1.0	1,722	0.0	0	0.0	0	6.2	29,305
	Total	100.0	724	100.0	41,994	100.0	80,395	100.0	171,592	0.0	0	100.0	177,265	0.0	0	100.0	1,263	100.0	473,233
6/27	Kvichak	64.7	2,217	31.9	18,052	34.4	64,254	53.2	357,442	0.0	0	3.7	11,452	0.0	0	0.0	0	36.7	453,415
thru	Naknek	15.1	516	22.2	12,575	17.6	32,981	4.0	26,875	0.0	0	3.4	10,601	0.0	0	0.0	0	6.8	83,549
6/28	Egegik	0.0	0	32.0	18,124	39.3	73,372	37.3	250,612	0.0	0	91.7	287,758	100.0	1,714	0.0	0	51.2	631,581
	Ugashik	20.3	695	13.8	7,812	8.7	16,217	5.5	36,954	0.0	0	1.2	3,849	0.0	0	0.0	0	5.3	65,526
	Total	100.0	3,428	100.0	56,562	100.0	186,824	100.0	671,883	0.0	0	100.0	313,660	100.0	1,714	0.0	0	100.0	1,234,071
6/29	Kvichak	0.0	0	1.6	399	1.5	828	2.5	5,370	0.0	0	0.1	149	0.0	0	0.3	3	1.4	6,749
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/30	Egegik	0.0	0	84.0	21,040	90.5	49,710	92.1	197,844	0.0	0	99.4	196,281	0.0	0	99.4	957	94.5	465,832
	Ugashik	0.0	0	14.4	3,606	8.0	4,369	5.4	11,600	0.0	0	0.5	1,044	0.0	0	0.3	2	4.2	20,621
	Total	0.0	0	100.0	25,045	100.0	54,907	100.0	214,814	0.0	0	100.0	197,474	0.0	0	100.0	963	100.0	493,203
7/01	Kvichak	0.0	0	5.6	3,120	6.6	8,667	13.3	83,951	7.9	199	0.6	1,608	0.0	0	0.0	0	8.8	97,545
thru	Naknek	0.0	0	24.6	13,692	21.3	28,027	6.3	39,766	54.4	1,379	3.3	9,377	0.0	0	0.0	0	8.3	92,241
7/02	Egegik	0.0	0	37.3	20,793	49.8	65,696	61.9	390,720	37.7	957	93.6	268,197	0.0	0	0.0	0	67.4	746,363
	Ugashik	0.0	0	32.6	18,165	22.3	29,431	18.5	116,774	0.0	0	2.5	7,271	0.0	0	0.0	0	15.5	171,641
	Total	0.0	0	100.0	55,770	100.0	131,820	100.0	631,212	100.0	2,535	100.0	286,453	0.0	0	0.0	0	100.0	1,107,790

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Table 15. (p 2 of 3).

Date	System	0.3 %	0.3 Number	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	3.2 %	3.2 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/04	Kvichak	0.0	0	2.4	1,006	3.0	1,943	7.5	42,933	0.0	0	0.3	629	0.0	0	1.1	14	5.3	46,526
	Naknek	0.0	0	46.5	19,386	42.0	27,592	15.6	89,301	0.0	0	8.1	16,121	0.0	0	22.1	279	17.3	152,679
	Egegik	0.0	0	27.3	11,371	38.0	24,980	59.2	338,886	0.0	0	89.2	178,079	100.0	1,264	75.8	958	63.0	555,538
	Ugashik	0.0	0	23.8	9,938	17.0	11,195	17.7	101,322	0.0	0	2.4	4,829	0.0	0	1.0	13	14.4	127,298
	Total	0.0	0	100.0	41,701	100.0	65,711	100.0	572,442	0.0	0	100.0	199,659	100.0	1,264	100.0	1,264	100.0	882,041
7/06	Kvichak	0.0	0	1.7	478	2.1	1,284	6.0	37,324	0.0	0	0.3	560	0.0	0	0.0	0	4.3	39,645
	Naknek	0.0	0	52.3	14,835	48.9	29,355	20.1	125,035	0.0	0	11.2	23,078	0.0	0	0.0	0	21.0	192,303
	Egegik	0.0	0	21.3	6,035	30.7	18,432	52.9	329,072	0.0	0	85.5	176,796	0.0	0	0.0	0	57.8	530,334
	Ugashik	0.0	0	24.7	7,003	18.3	10,968	21.0	130,633	0.0	0	3.1	6,366	0.0	0	0.0	0	16.9	154,970
	Total	0.0	0	100.0	28,351	100.0	60,038	100.0	622,064	0.0	0	100.0	206,799	0.0	0	0.0	0	100.0	917,252
7/07	Kvichak	15.3	131	4.5	1,093	5.2	1,396	12.4	46,939	0.0	0	0.5	567	0.0	0	0.0	0	9.1	50,126
thru	Naknek	54.9	471	48.9	11,760	41.6	11,064	14.4	54,510	0.0	0	7.0	8,109	0.0	0	0.0	0	15.6	85,914
7/08	Egegik	0.0	0	34.2	8,230	44.9	11,951	65.2	246,809	0.0	0	91.5	106,874	100.0	2,575	0.0	0	68.5	376,439
	Ugashik	29.9	256	12.3	2,952	8.3	2,198	8.0	30,283	0.0	0	1.0	1,189	0.0	0	0.0	0	6.7	36,879
	Total	100.0	858	100.0	24,035	100.0	26,609	100.0	378,542	0.0	0	100.0	116,739	100.0	2,575	0.0	0	100.0	549,358
7/09	Kvichak	44.6	1,246	14.7	4,939	16.3	6,232	34.1	124,285	0.0	0	1.7	969	0.0	0	0.0	0	27.5	137,670
thru	Naknek	52.3	1,461	51.6	17,309	42.1	16,093	12.9	47,017	0.0	0	7.7	4,514	0.0	0	100.0	932	17.4	87,326
7/10	Egegik	0.0	0	32.3	10,826	40.7	15,536	52.2	190,254	0.0	0	90.5	53,168	100.0	1,864	0.0	0	54.3	271,648
	Ugashik	3.2	89	1.4	485	0.9	357	0.8	2,916	0.0	0	0.1	74	0.0	0	0.0	0	0.8	3,920
	Total	100.0	2,796	100.0	33,558	100.0	38,218	100.0	364,471	0.0	0	100.0	58,725	100.0	1,864	100.0	932	100.0	500,564
7/11	Kvichak	0.0	0	12.6	8,033	15.3	11,009	31.2	202,980	0.0	0	1.8	2,939	0.0	0	0.0	0	23.6	224,962
thru	Naknek	0.0	0	34.6	21,946	30.7	22,161	9.2	59,853	0.0	0	6.5	10,671	0.0	0	0.0	0	12.0	114,632
7/12	Egegik	0.0	0	25.1	15,965	34.5	24,884	43.3	281,700	0.0	0	88.7	146,189	100.0	3,433	0.0	0	49.5	472,171
	Ugashik	0.0	0	27.7	17,568	19.5	14,041	16.3	106,044	0.0	0	3.0	4,992	0.0	0	0.0	0	14.9	142,645
	Total	0.0	0	100.0	63,513	100.0	72,095	100.0	650,578	0.0	0	100.0	164,790	100.0	3,433	0.0	0	100.0	954,409

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Table 15. (p 3 of 3).

Date	System	0.3 %	0.3 Number	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	3.2 %	3.2 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/13	Kvichak	0.0	0	8.3	4,175	10.4	3,489	27.6	111,749	7.4	191	1.6	1,139	0.0	0	0.0	0	21.5	120,743
thru	Naknek	0.0	0	58.2	29,292	53.8	18,037	20.9	84,622	82.1	2,116	15.2	10,618	0.0	0	0.0	0	25.7	144,685
7/14	Egegik	0.0	0	16.3	8,210	23.3	7,803	37.9	153,453	10.5	271	80.5	56,049	100.0	1,289	0.0	0	40.4	227,075
	Ugashik	0.0	0	17.1	8,612	12.5	4,197	13.6	55,065	0.0	0	2.6	1,824	0.0	0	0.0	0	12.4	69,698
	Total	0.0	0	100.0	50,289	100.0	33,526	100.0	404,889	100.0	2,578	100.0	69,630	100.0	1,289	0.0	0	100.0	562,201
7/15[c]	Kvichak	0.0	0	5.3	2,571	6.4	3,262	16.7	91,554	4.6	43	0.7	1,015	0.0	0	0.0	0	12.4	98,445
thru	Naknek	0.0	0	58.3	28,239	51.5	26,403	19.8	108,549	79.8	739	10.8	14,823	0.0	0	0.0	0	22.5	178,752
8/31	Egegik	0.0	0	25.0	12,102	34.1	17,465	54.9	300,976	15.6	145	87.3	119,636	100.0	6,129	100.0	926	57.7	457,379
	Ugashik	0.0	0	11.4	5,542	8.0	4,101	8.6	47,147	0.0	0	1.2	1,700	0.0	0	0.0	0	7.4	58,490
	Total	0.0	0	100.0	48,453	100.0	51,231	100.0	548,226	100.0	926	100.0	137,174	100.0	6,129	100.0	926	100.0	793,065
Total	Kvichak	53.5	4,471	11.8	56,083	15.9	132,165	22.7	1,208,200	10.9	716	1.3	27,303	0.0	0	1.0	57	16.4	1,428,995
	Naknek	29.3	2,448	35.6	169,033	25.5	211,714	12.0	635,528	64.3	4,234	5.3	107,912	0.0	0	32.8	1,935	13.0	1,132,804
	Egegik	0.0	0	33.6	159,321	45.5	377,124	53.0	2,818,725	24.8	1,636	91.6	1,869,291	100.0	18,268	65.9	3,886	60.4	5,248,251
	Ugashik	17.2	1,433	19.0	90,339	13.1	108,461	12.3	654,462	0.0	0	1.8	36,061	0.0	0	0.3	17	10.2	890,774
	Total	100.0	8,353	100.0	474,776	100.0	829,464	100.0	5,316,915	100.0	6,586	100.0	2,040,567	100.0	18,268	100.0	5,895	100.0	8,700,824

[a] Includes age-2.1, age-3.1, age-2.4, and age-3.3.

[b] Scale samples were collected from 16 June through 22 June. Stock composition estimates calculated for those dates were applied to 5 June through 22 June catches.

[c] Scale samples were collected on 15 and 18 July. Stock composition estimates calculated for those dates were applied to 15 July through 31 August catches.

Table 16. Run composition estimates of sockeye salmon caught in set nets on selected beaches, Egegik District, 1989.

Beach	Date	Percent Classification By Stock				
		Kvichak	Naknek	Egegik	Ugashik	Total
Big Creek	6/28	24.2	0.0	75.8	0.0	100.0
to	7/02	17.4	0.1	82.4	0.1	100.0
Bishop Creek	7/08	0.0	0.0	100.0	0.0	100.0
	7/09	11.5	9.8	77.2	1.5	100.0
	7/11-7/12	7.7	4.6	87.7	0.0	100.0
Bishop Creek	6/30	1.8	0.0	98.2	0.0	100.0
to	7/02	3.1	0.0	96.9	0.0	100.0
Coffee Point	7/09-7/10	1.7	0.0	98.3	0.0	100.0
	7/11-7/12	7.0	5.5	86.4	1.1	100.0
Coffee Point						
to	7/06	2.3	0.0	97.7	0.0	100.0
King Salmon River						

Table 17. Run composition estimates of sockeye salmon catch by age group and date for Ugashik District of Bristol Bay, 1989.

		0.3		1.2		1.3		2.2		1.4		2.3		Other[a]		Total	
Date	System	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/06[b]	Kvichak	13.1	120	5.9	226	7.7	770	18.3	5,786	7.5	11	1.0	314	0.0	0	9.4	7,228
thru	Naknek	27.8	254	37.6	1,430	35.8	3,592	12.5	3,952	74.7	114	8.7	2,645	0.0	0	15.6	11,986
6/23	Egegik	0.0	0	19.6	744	28.8	2,886	42.1	13,311	17.8	27	85.3	25,929	0.0	0	55.8	42,897
	Ugashik	59.0	538	36.9	1,400	27.8	2,785	27.1	8,568	0.0	0	5.0	1,514	0.0	0	19.2	14,806
	Total	100.0	912	100.0	3,800	100.0	10,033	100.0	31,618	100.0	152	100.0	30,402	0.0	0	100.0	76,917
7/01	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/05	Egegik	0.0	0	0.8	195	1.5	339	2.3	3,008	0.0	0	20.6	2,961	0.0	0	3.4	6,504
	Ugashik	100.0	359	99.2	24,238	98.5	21,579	97.7	127,781	0.0	0	79.4	11,411	100.0	359	96.6	185,726
	Total	100.0	359	100.0	24,433	100.0	21,918	100.0	130,789	0.0	0	100.0	14,372	100.0	359	100.0	192,230
7/06	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/07	Egegik	0.0	0	5.6	2,996	10.4	7,527	14.8	52,648	0.0	0	65.7	25,062	0.0	0	16.9	88,232
	Ugashik	100.0	1,908	94.4	50,411	89.6	64,954	85.2	303,081	0.0	0	34.3	13,086	0.0	0	83.1	433,441
	Total	100.0	1,908	100.0	53,407	100.0	72,481	100.0	355,729	0.0	0	100.0	38,148	0.0	0	100.0	521,673
7/08	Kvichak	1.3	11	0.9	391	1.5	805	3.7	15,900	0.0	0	0.9	339	0.0	0	3.1	17,445
thru	Naknek	1.3	12	2.7	1,174	3.4	1,782	1.2	5,157	0.0	0	3.5	1,352	0.0	0	1.7	9,477
7/09	Egegik	0.0	0	1.0	423	1.9	992	2.8	12,032	0.0	0	24.0	9,184	0.0	0	4.0	22,632
	Ugashik	97.4	869	95.4	40,806	93.2	49,021	92.3	396,630	0.0	0	71.6	27,461	0.0	0	91.2	514,786
	Total	100.0	892	100.0	42,794	100.0	52,600	100.0	429,718	0.0	0	100.0	38,336	0.0	0	100.0	564,340
7/11	Kvichak	0.0	0	0.6	233	1.0	412	2.3	7,606	15.0	119	0.3	103	0.0	0	1.9	8,473
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0	795	0.2	795
7/12	Egegik	0.0	0	4.8	1,828	8.9	3,679	12.6	41,668	85.0	676	61.8	20,148	0.0	0	15.3	67,998
	Ugashik	0.0	0	94.6	36,096	90.1	37,246	85.1	281,423	0.0	0	37.9	12,343	0.0	0	82.6	367,107
	Total	0.0	0	100.0	38,157	100.0	41,337	100.0	330,697	100.0	795	100.0	32,593	100.0	795	100.0	444,374

-Continued-

Table 17. (p 2 of 2).

Date	System	0.3 %	0.3 Number	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/13	Kvichak	0.0	0	1.8	435	3.1	1,322	7.3	24,452	100.0	1,386	2.4	508	0.0	0	6.6	28,103
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/14	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	98.2	23,144	96.9	40,981	92.7	310,503	0.0	0	97.6	20,990	0.0	0	93.4	395,618
	Total	0.0	0	100.0	23,579	100.0	42,303	100.0	334,955	100.0	1,386	100.0	21,498	0.0	0	100.0	423,721
7/15[c]	Kvichak	0.0	0	1.7	799	2.8	3,132	6.6	48,909	36.5	323	1.6	939	0.7	25	5.6	54,127
thru	Naknek	0.0	0	1.4	673	1.7	1,944	0.6	4,446	48.6	429	1.8	1,051	23.8	883	1.0	9,426
9/01	Egegik	0.0	0	0.9	451	1.8	2,010	2.6	19,267	14.9	131	23.3	13,256	23.8	883	3.7	35,998
	Ugashik	0.0	0	96.0	45,697	93.7	104,510	90.2	668,423	0.0	0	73.2	41,715	51.6	1,912	89.6	862,256
	Total	0.0	0	100.0	47,619	100.0	111,596	100.0	741,045	100.0	883	100.0	56,961	100.0	3,703	100.0	961,807
Total	Kvichak	3.2	131	0.9	2,084	1.8	6,442	4.4	102,652	57.2	1,839	0.9	2,203	0.5	25	3.6	115,377
	Naknek	6.5	265	1.4	3,277	2.1	7,318	0.6	13,555	16.9	543	2.2	5,048	34.5	1,678	1.0	31,684
	Egegik	0.0	0	2.8	6,638	4.9	17,433	6.0	141,934	25.9	834	41.6	96,540	18.2	883	8.3	264,262
	Ugashik	90.3	3,674	94.9	221,791	91.1	321,075	89.0	2,096,409	0.0	0	55.3	128,519	46.8	2,271	87.1	2,773,739
	Total	100.0	4,071	100.0	233,789	100.0	352,268	100.0	2,354,551	100.0	3,216	100.0	232,310	100.0	4,857	100.0	3,185,062

[a] Other includes age-0.2, age-3.2, and age-2.4.

[b] Scale samples were collected from 19 through 22 June. Stock composition estimates calculated from those dates were applied to 6 June through 23 June catches.

[c] Scale samples were collected from 15, 16, and 19 July. Stock composition estimates calculated from those dates were applied to 15 July through 1 September catches.

Table 18. Catch of sockeye salmon by run and district for the East Side of Bristol Bay, 1989.

Run		District			Total
		Nak-Kvi	Egegik	Ugashik	
Kvichak	Numbers	9,228,945	1,428,995	115,377	10,773,317
	Percent	85.7	13.3	1.0	100.0
Naknek	Numbers	2,537,650	1,132,804	31,684	3,702,138
	Percent	68.5	30.6	0.9	100.0
Egegik	Numbers	607,785	5,248,251	264,262	6,120,298
	Percent	9.9	85.8	4.3	100.0
Ugashik	Numbers	1,504,398	890,774	2,773,739	5,168,911
	Percent	29.1	17.2	53.7	100.0
Total East Side	Numbers	13,878,778	8,700,824	3,185,062	25,764,664
	Percent	53.9	33.8	12.3	100.0

Table 19. Percentages of sockeye salmon by run and age group for the East Side of Bristol Bay, 1989.

Run		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	Total
Kvichak	Escapement	0.01		0.02	2.04	0.15		2.67	37.96		0.01	0.71				43.57
	In District Catch			0.09	2.39	0.00[a]	0.00[a]	5.08	39.80		0.01	0.95				48.34
	Other Dist. Catch	0.02		0.02	0.30	0.00[a]		0.73	6.87		0.01	0.15				8.09
	Total Run	0.00[a]		0.14	4.73	0.15	0.00[a]	8.48	84.62		0.03	1.81				100.00
Naknek	Escapement		0.06	0.02	5.26	0.39		5.09	10.58		0.05	2.42		0.03		23.89
	In District Catch			0.13	10.63	0.01	0.01	15.27	19.91		0.07	6.03		0.11		52.17
	Other Dist. Catch			0.06	3.54	0.01		4.50	13.34		0.10	2.32		0.07		23.94
	Total Run		0.06	0.21	19.43	0.40	0.01	24.86	43.83		0.22	10.77		0.21		100.00
Egegik	Escapement		0.02		0.84	0.37		1.26	10.99	0.02	0.00[a]	7.32	0.01		0.00[a]	20.84
	In District Catch				2.06	0.03		4.88	36.46	0.01	0.02	24.18	0.24		0.01	67.88
	Other Dist. Catch				0.32	0.00[a]		1.12	5.87		0.01	3.95	0.01			11.28
	Total Run		0.02		3.23	0.40		7.26	53.32	0.03	0.04	35.44	0.26		0.01	100.00
Ugashik	Escapement	0.03	0.01	0.03	3.77	0.02		2.89	16.78			1.01		0.00[a]		24.54
	In District Catch	0.03		0.05	3.24			4.69	30.60			1.88				40.49
	Other Dist. Catch	0.03		0.09	4.42	0.00[a]	0.00[a]	6.20	22.79			1.43				34.96
	Total Run	0.10	0.01	0.17	11.43	0.03	0.00[a]	13.77	70.17			4.32		0.00[a]		100.00

[a] Fish present, but represent less than 0.01%.

Table 20. Numbers of sockeye salmon by run and age group for the East Side of Bristol Bay, 1989.

Run		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	Total
Kvichak	Escapement	2,471		4,405	388,976	28,088		510,486	7,246,309		2,157	134,608				8,317,500
	In District Catch	4,195		18,003	456,117	205	694	969,974	7,597,618		1,473	180,665				9,228,945
	Other Dist. Catch	25		4,602	58,167	57		138,607	1,310,852		2,555	29,506				1,544,371
	Total Run	6,691		27,010	903,260	28,350	694	1,619,067	16,154,779		6,185	344,779				19,090,816
Naknek	Escapement		2,870	971	255,824	18,944		247,398	514,397		2,256	117,674		1,650		1,161,984
	In District Catch			6,388	516,963	444	359	742,960	968,321		3,458	293,471		5,287		2,537,650
	Other Dist. Catch			2,713	172,310	279		219,032	649,083		4,777	112,960		3,334		1,164,488
	Total Run		2,870	10,072	945,097	19,667	359	1,2093908	2,131,801		10,491	524,105		10,271		4,864,122
Egegik	Escapement		1,623		65,304	28,302		97,474	849,506	1,720	263	565,677	818		229	1,610,916
	In District Catch				159,321	2,220		377,124	2,818,725	926	1,636	1,869,291	18,268		740	5,248,251
	Other Dist. Catch				24,853	23		86,440	453,726		874	305,248	883			872,047
	Total Run		1,623		249,478	30,545		561,038	4,121,957	2,646	2,773	2,740,216	19,969		969	7,731,214
Ugashik	Escapement	2,157	496	2,130	258,220	1,695		197,655	1,149,199			69,409		341		1,681,302
	In District Catch	2,271		3,674	221,791			321,075	2,096,409			128,519				2,773,739
	Other Dist. Catch	2,328		6,098	302,995	20	127	424,419	1,561,497			97,687				2,395,171
	Total Run	6,756	496	11,902	783,006	1,715	127	943,149	4,807,105			295,615		341		6,850,212

Table 21. Comparison of sockeye salmon run estimates for the east side of Bristol Bay, 1989.

Stock	Estimated Run		
	Standard Method[a]	Scale Pattern Analysis	Difference
Kvichak	20,049,958	19,090,816	959,142
Naknek	3,308,304	4,864,123	-1,555,819
Egegik	10,311,740	7,731,214	2,580,526
Ugashik	4,866,364	6,850,213	-1,983,849
Total East Side	38,536,366	38,536,366	

[a] Standard method assumes fish harvested in a district originated within that district, and divides the Naknek-Kvichak District catch between Naknek and Kvichak Rivers based on escapement age composition (Stratton 1990). These numbers have been adjusted to include Branch River.

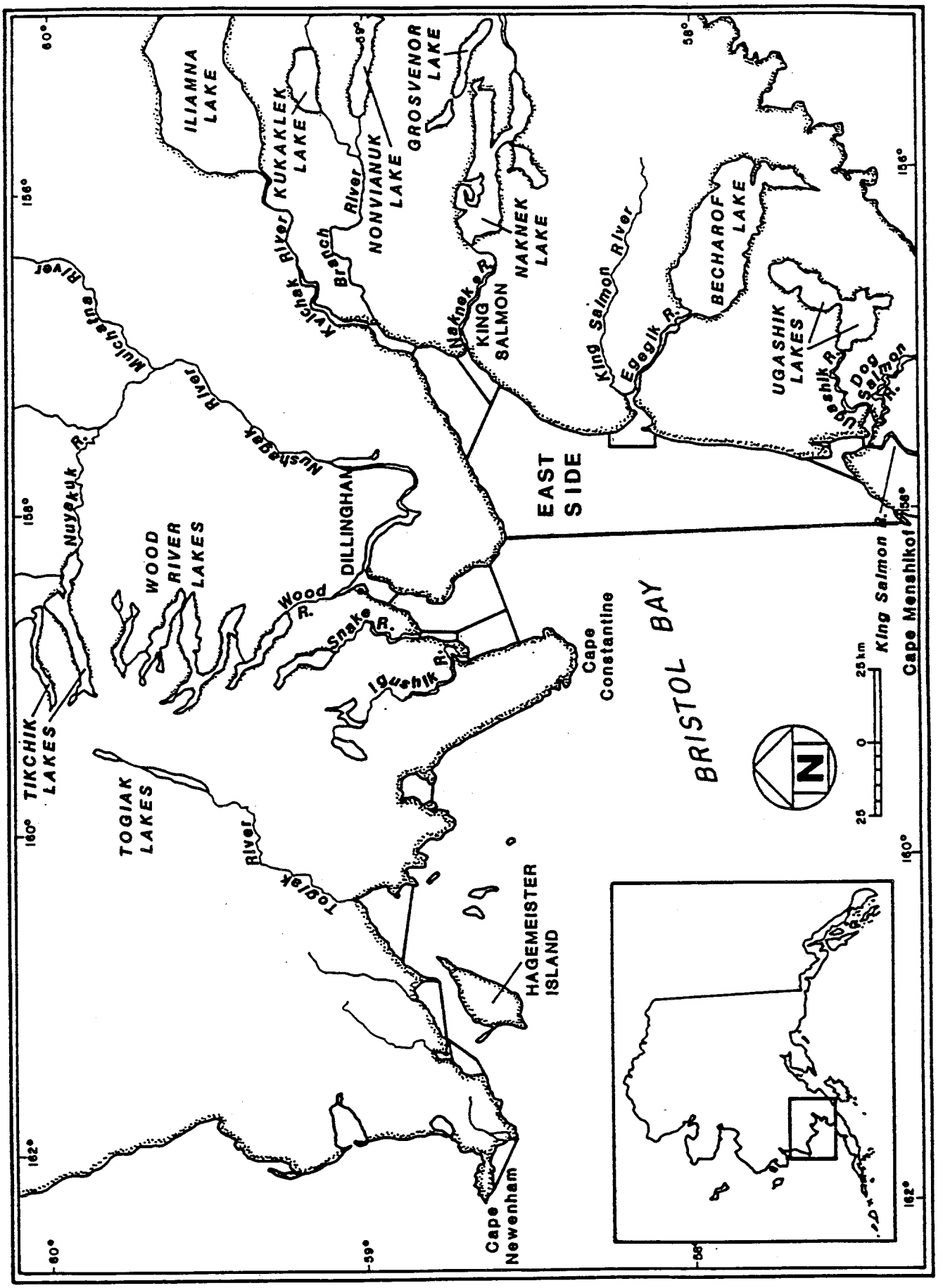


Figure 1. Map of Bristol Bay showing fishing districts and major rivers.

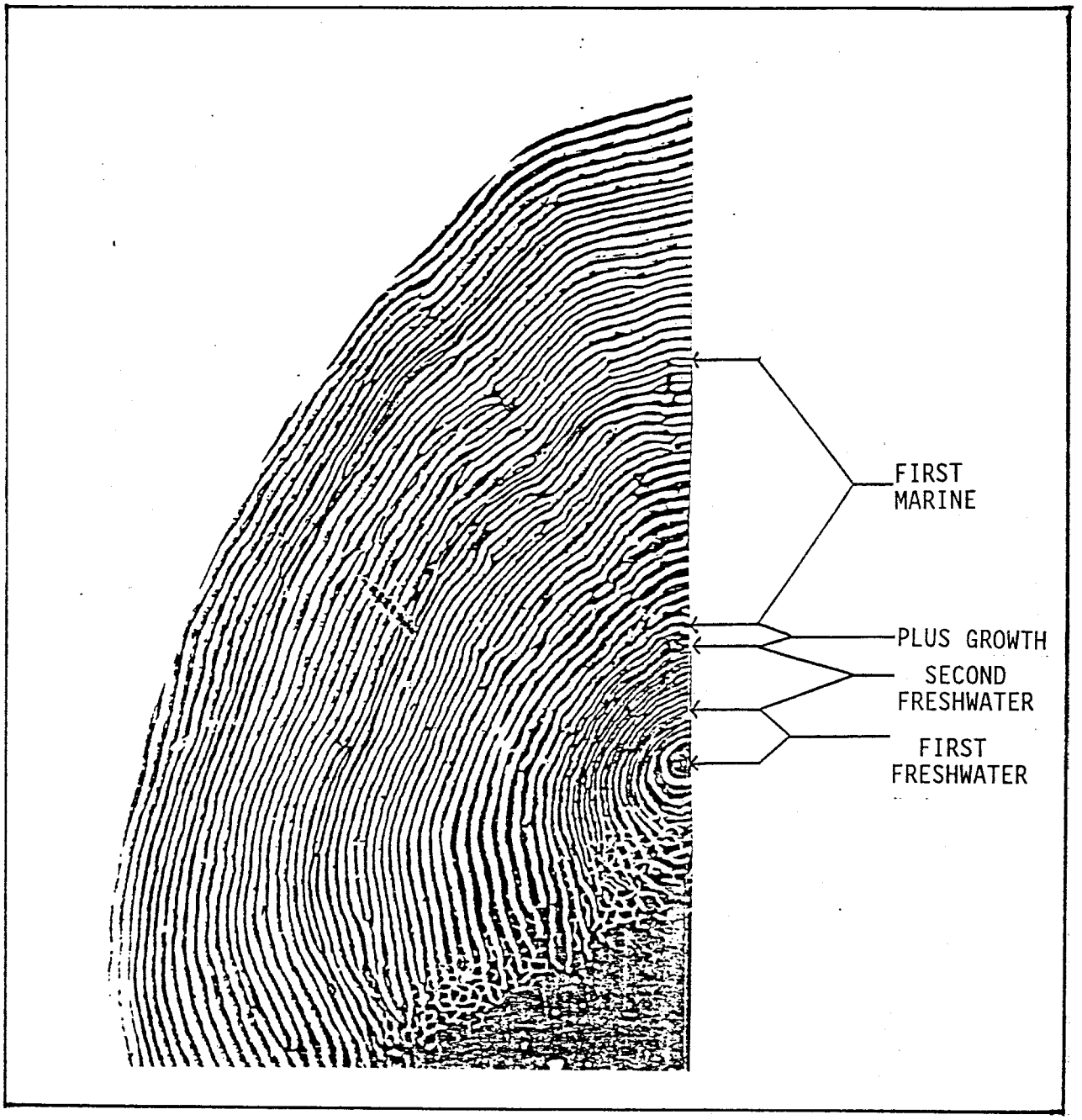


Figure 2. Age-2.2 sockeye salmon scale showing the growth zones measured to generate variables to build linear discriminant functions.

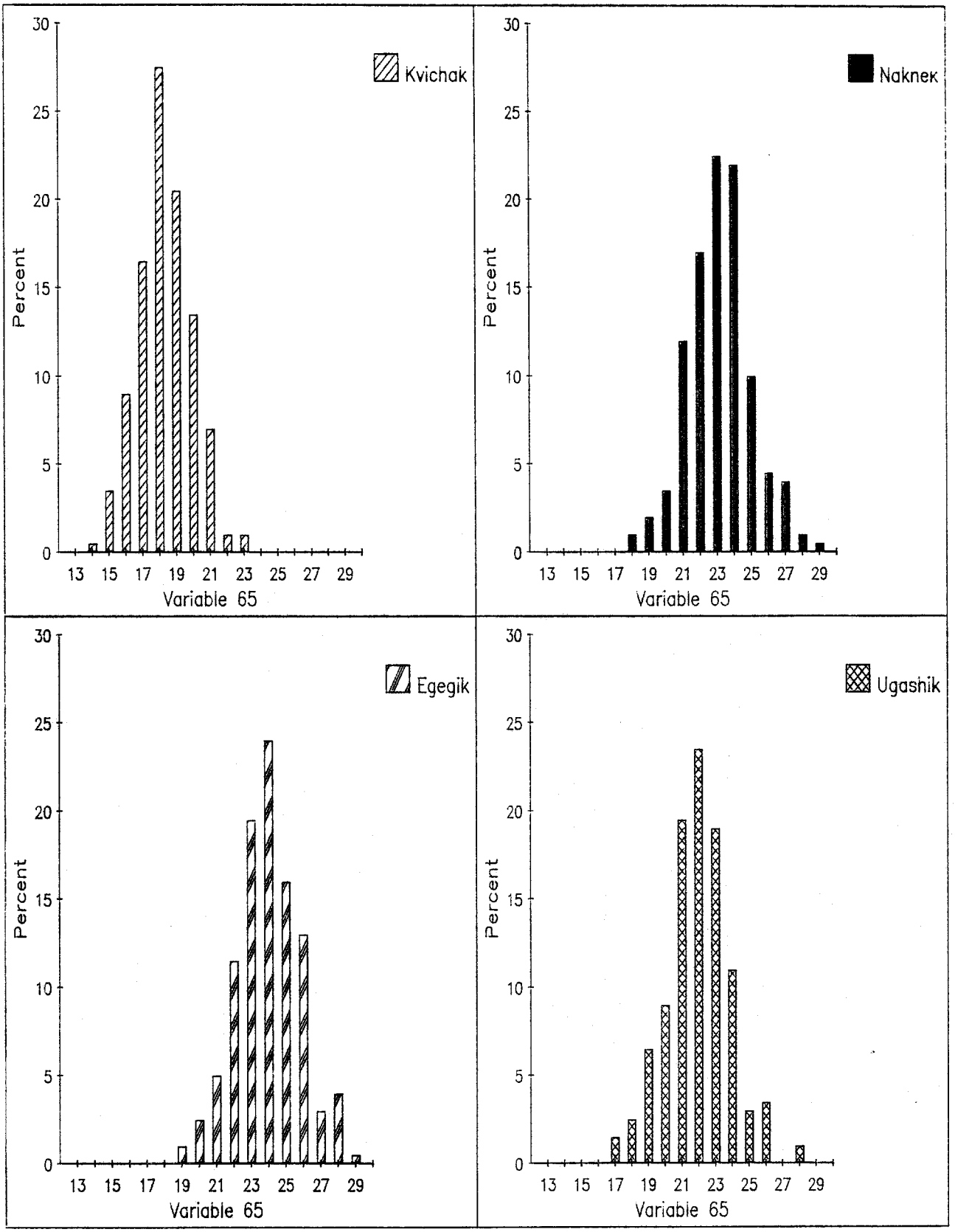


Figure 3. Number of circuli in total freshwater (NC1FW+NC2FW+NCPGZ) growth zone measured from age-2.2 scales taken from escapements of sockeye salmon in Kvichak, Naknek, Egegik, and Ugashik Rivers in 1989.

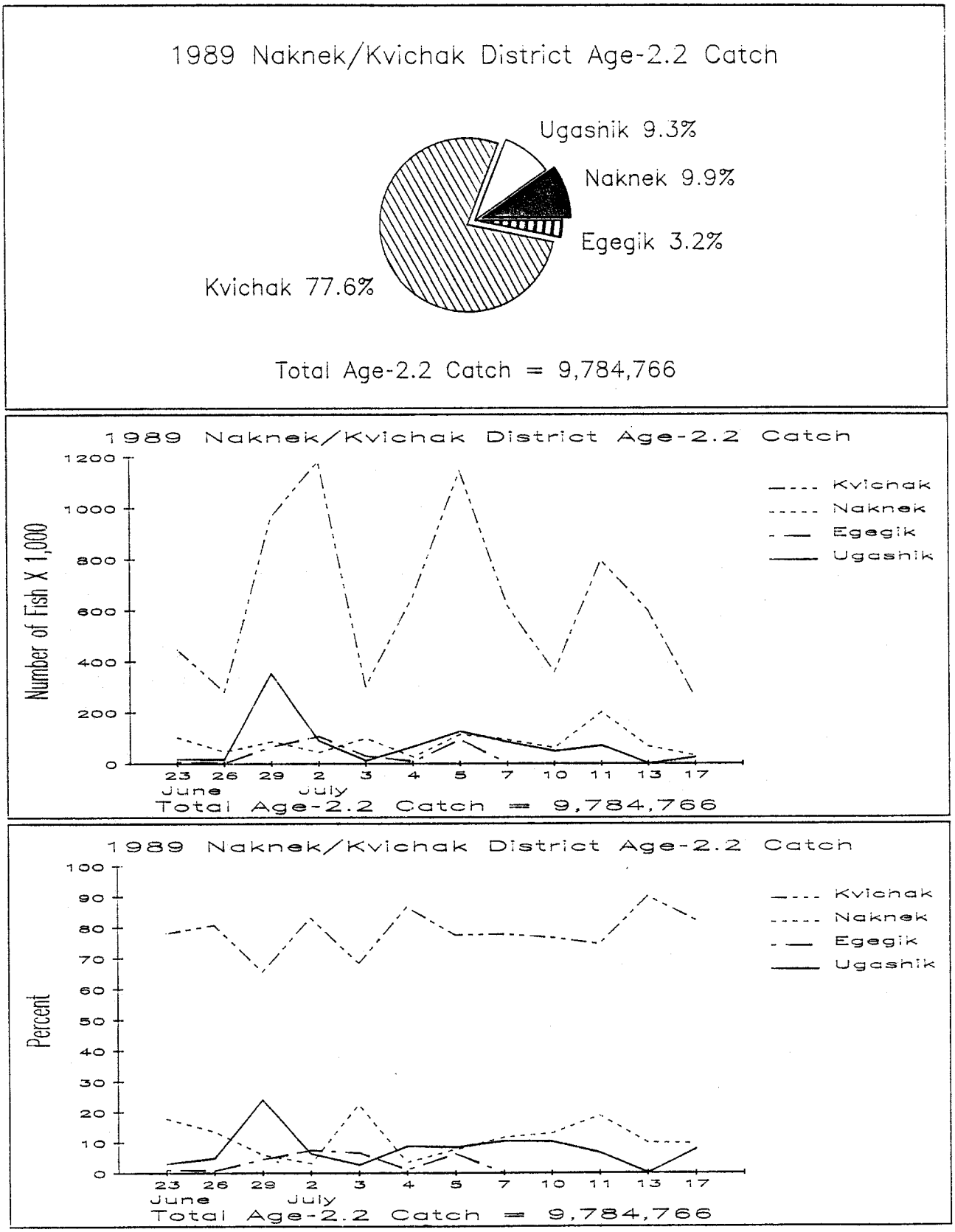
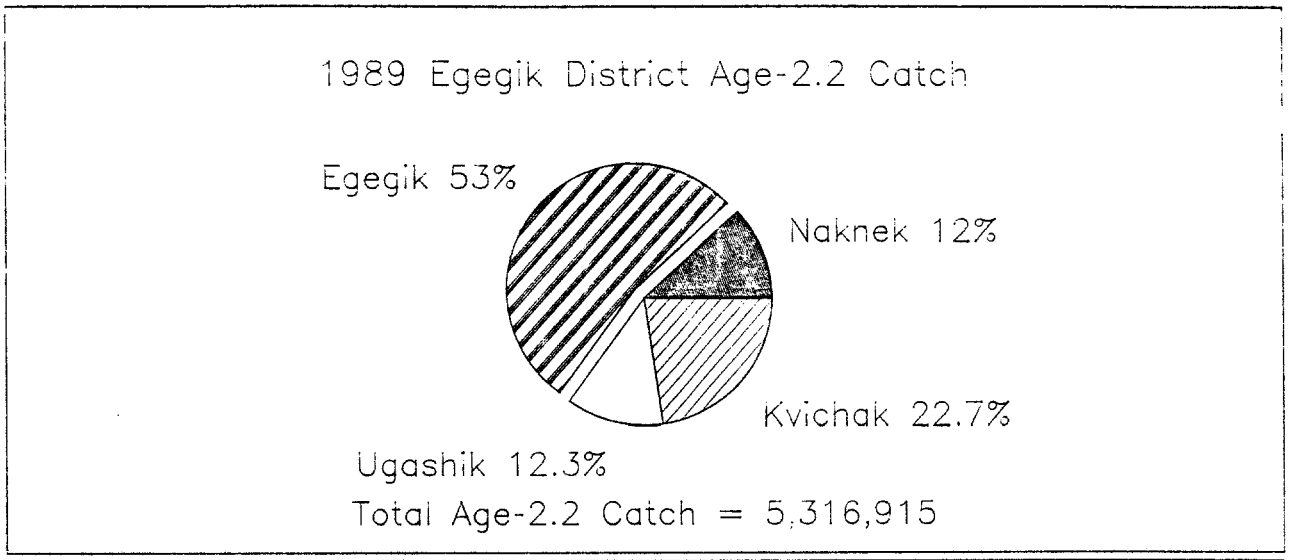
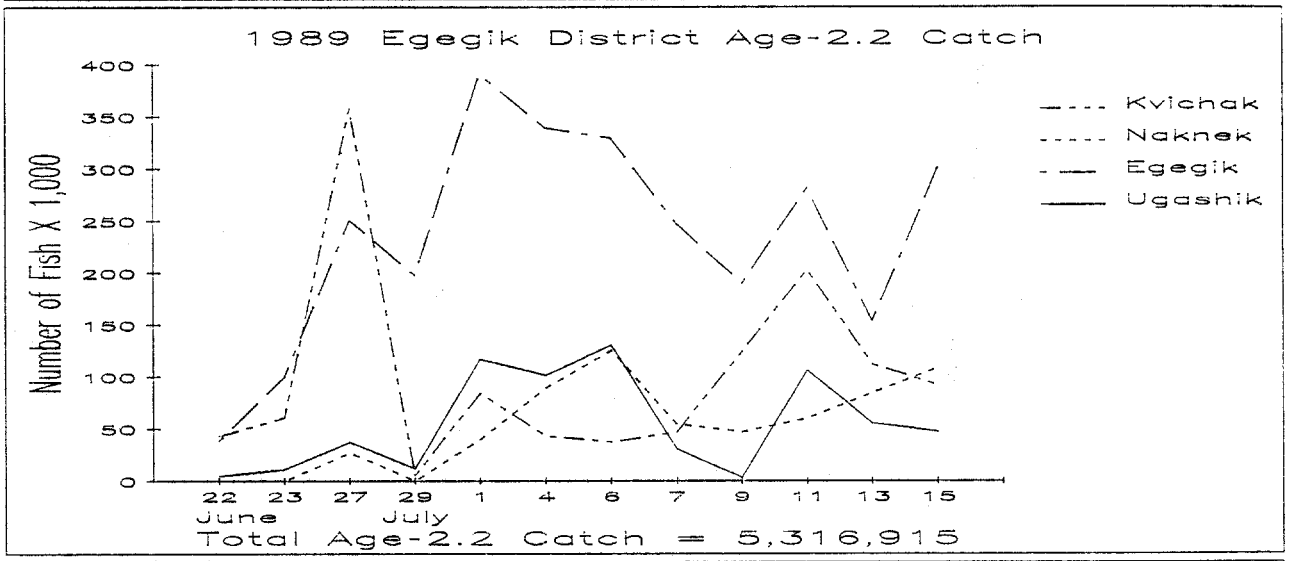


Figure 4. Estimates of stock composition for the 1989 catch of age-2.2 sockeye salmon in Naknek-Kvichak District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.





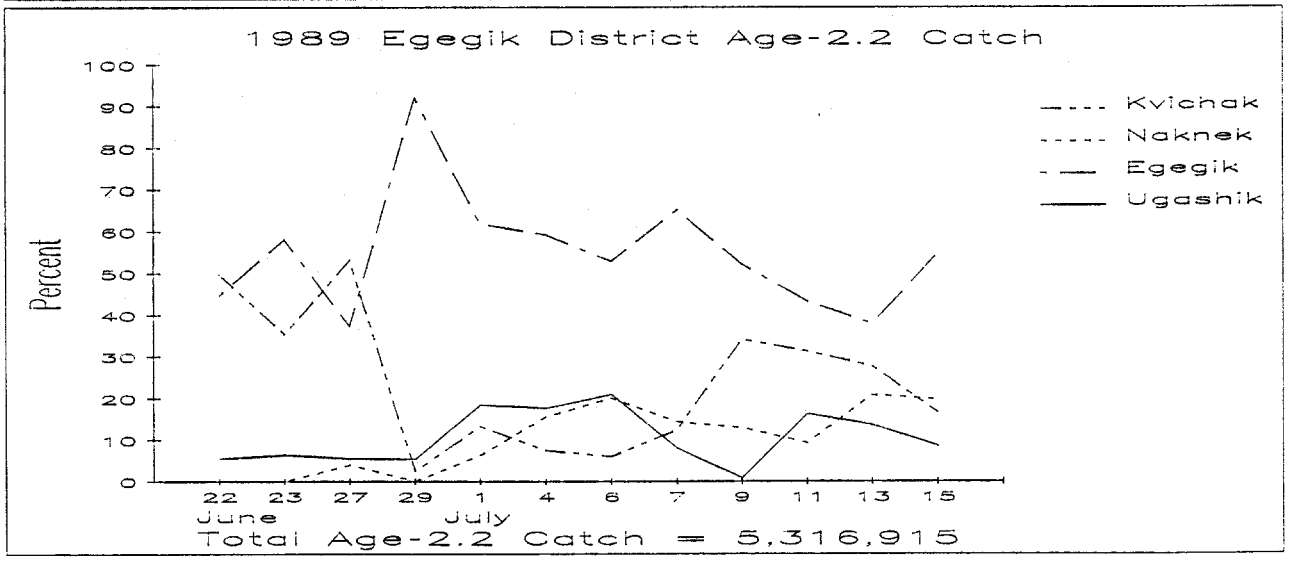


Figure 5. Estimates of stock composition for the 1989 catch of age-2.2 sockeye salmon in Egegik District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.

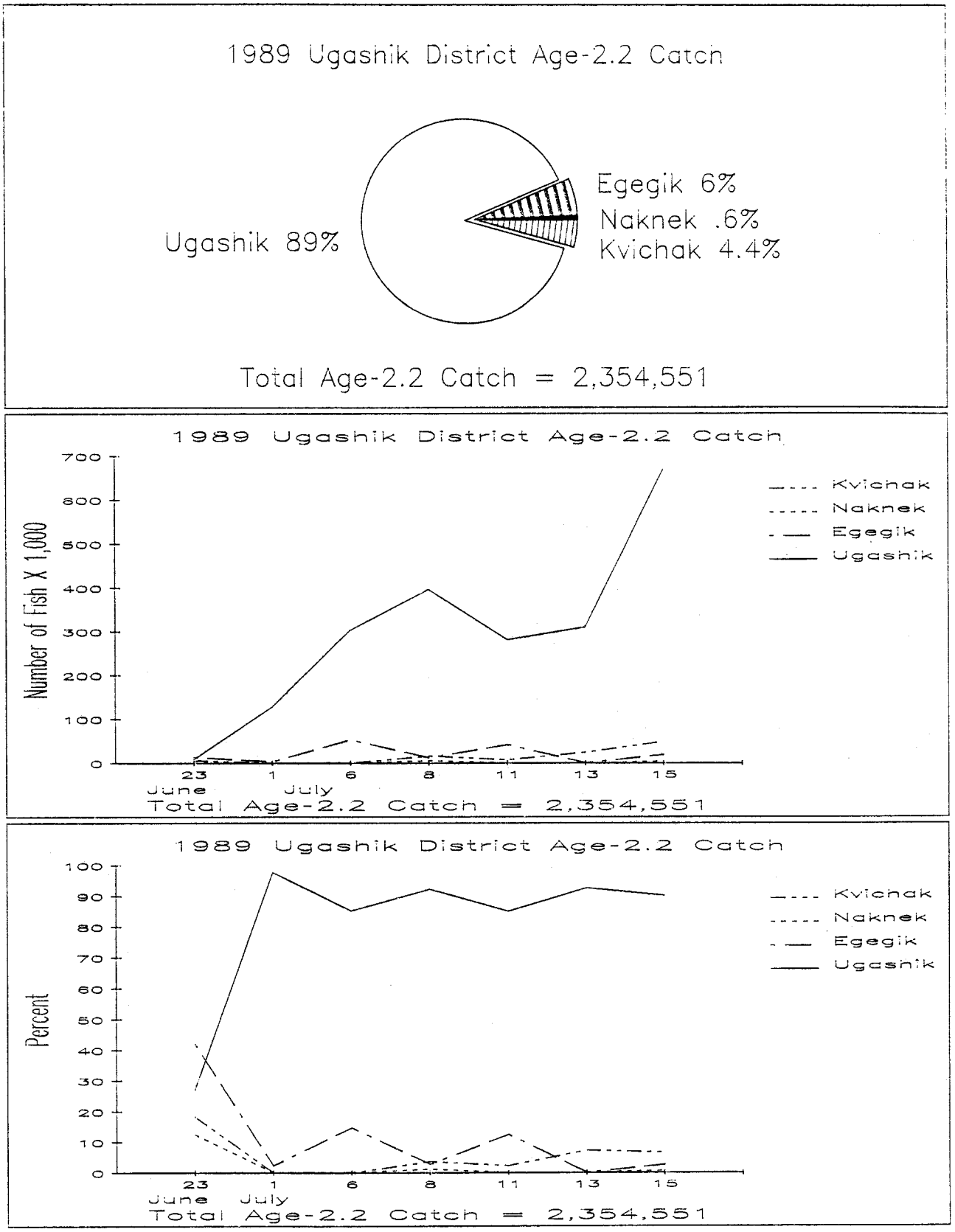
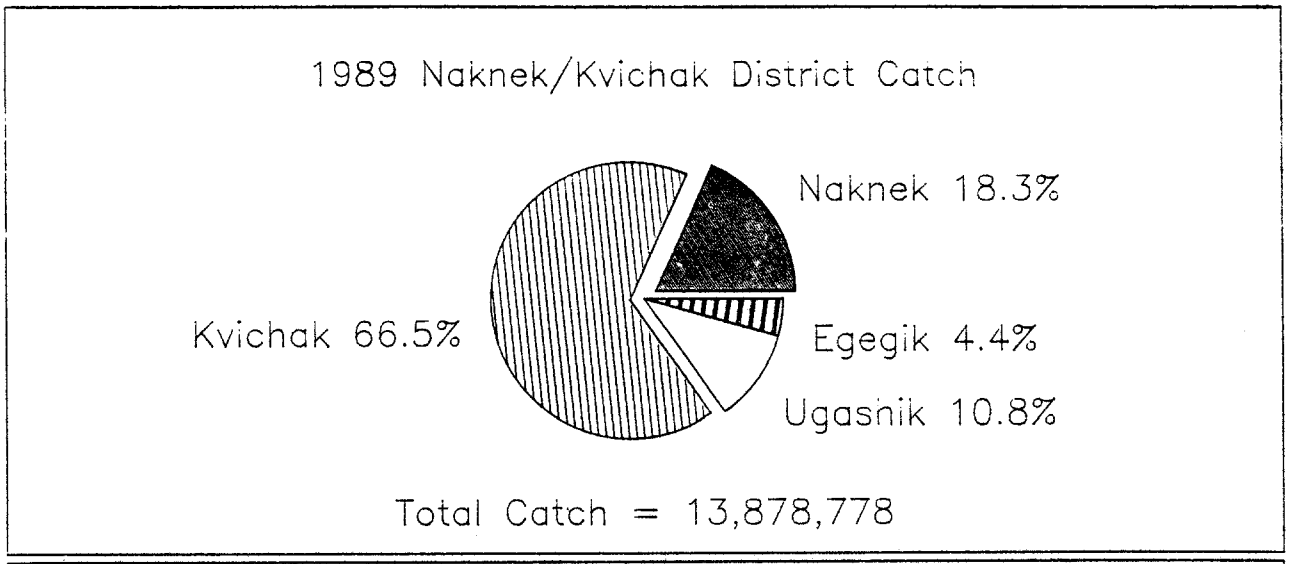
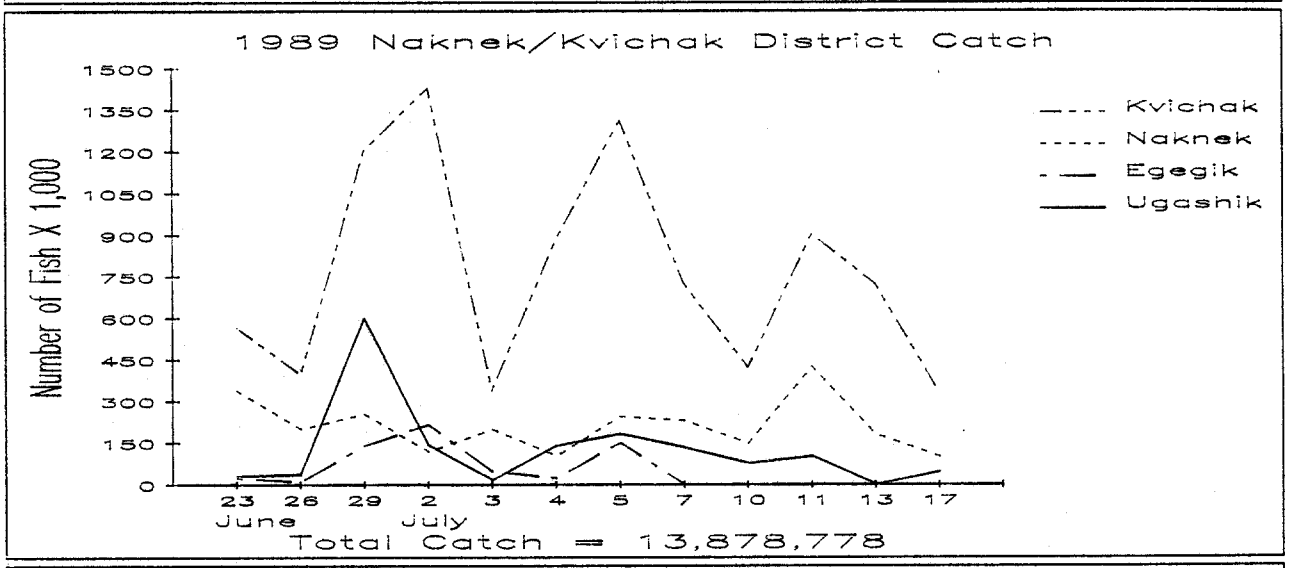


Figure 6. Estimates of stock composition for the 1989 catch of age-2.2 sockeye salmon in Ugashik District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.





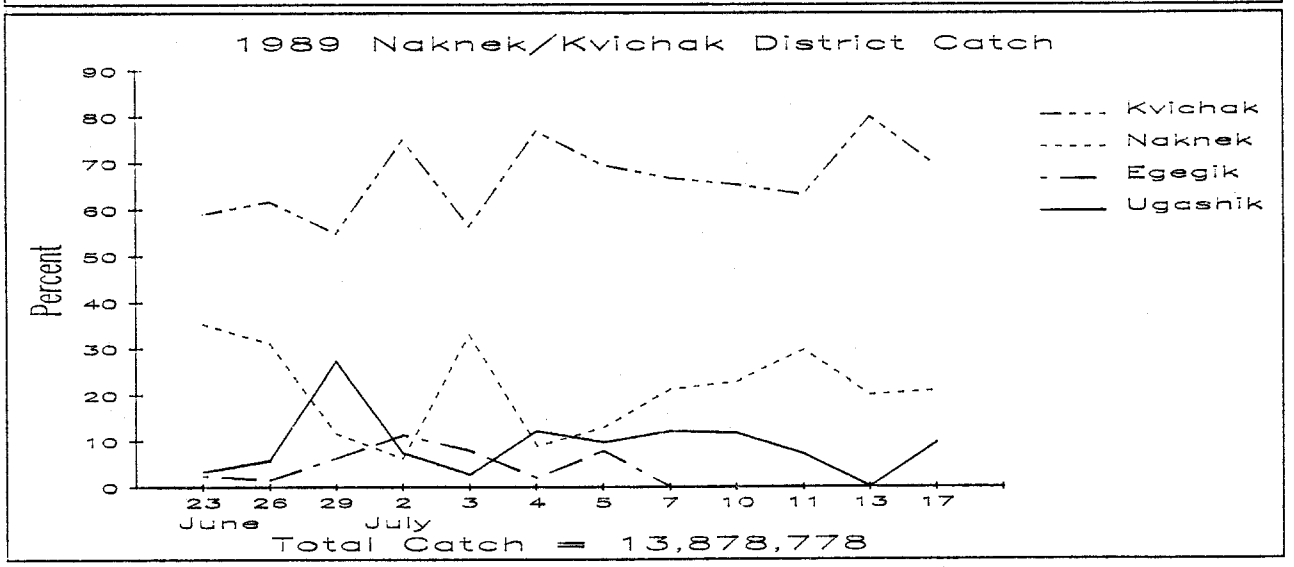


Figure 7. Estimates of stock composition for the 1989 total catch of sockeye salmon in Naknek-Kvichak District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.

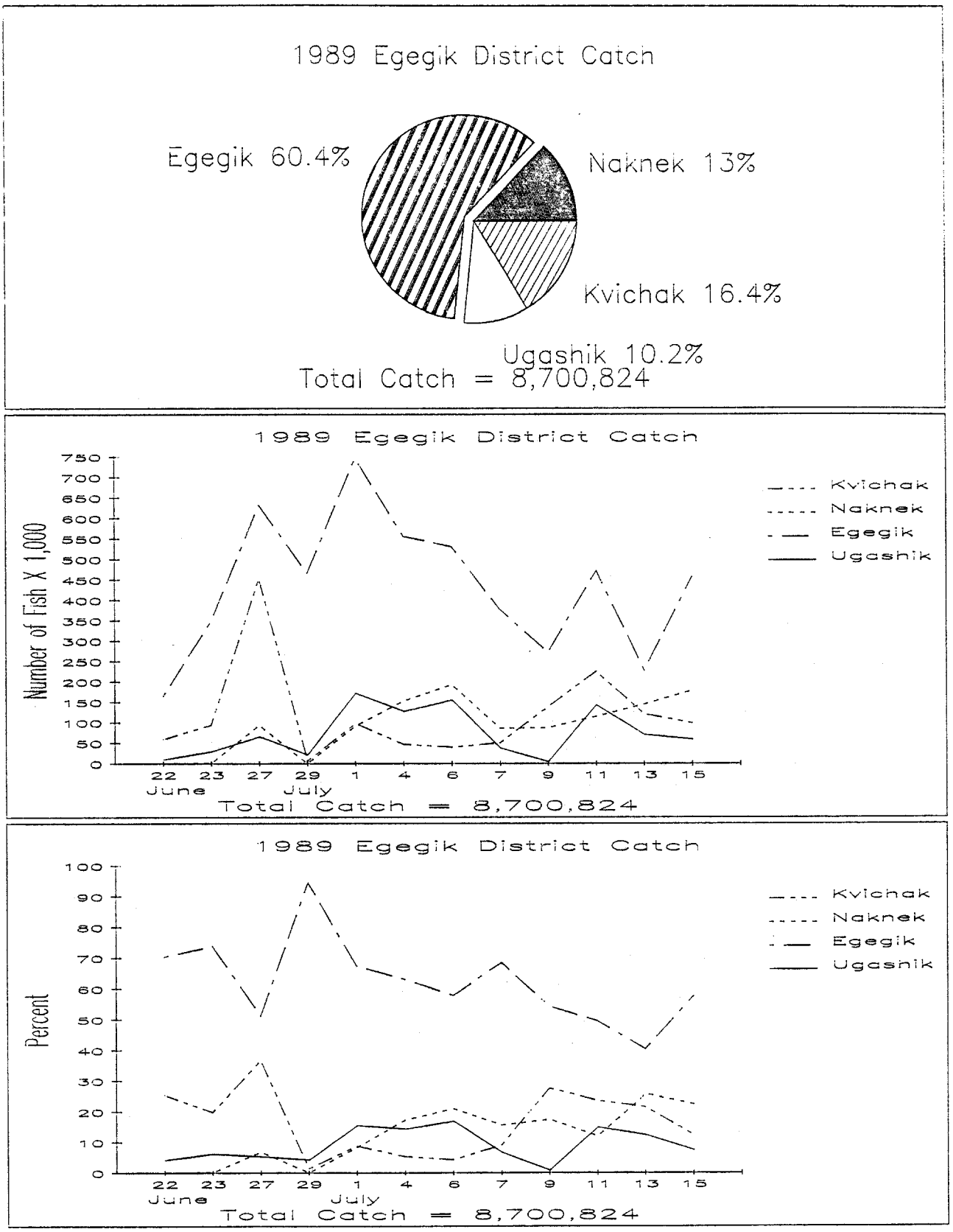
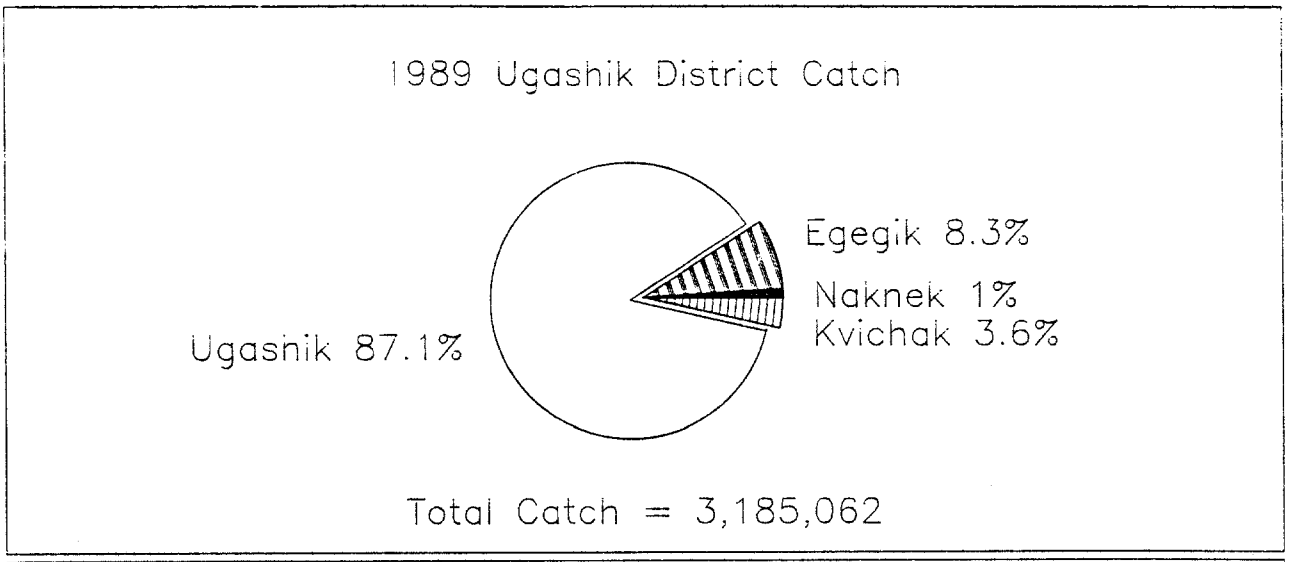
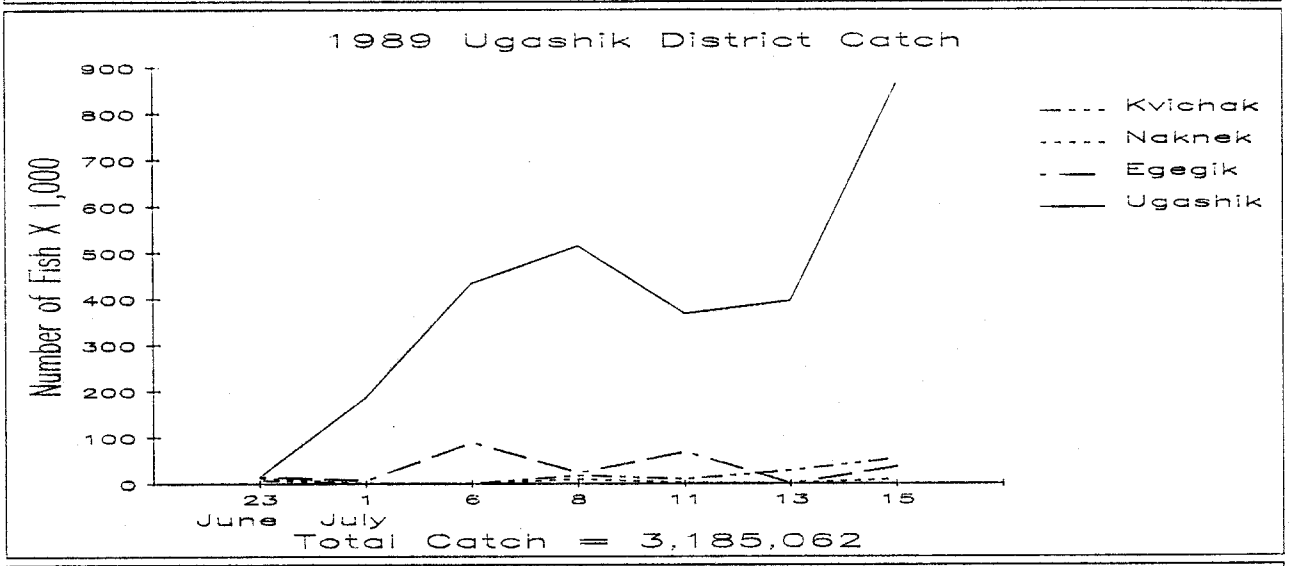


Figure 8. Estimates of stock composition for the 1989 total catch of sockeye salmon in Egegik District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.





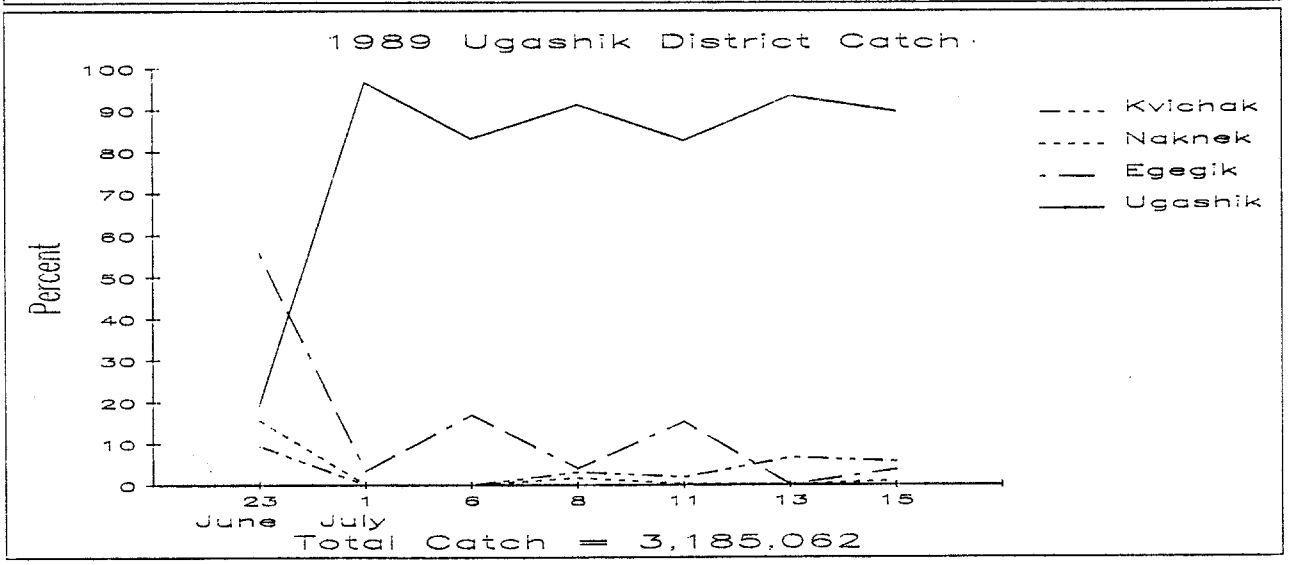


Figure 9. Estimates of stock composition for the 1989 total catch of sockeye salmon in Ugashik District (top) and expressed in numbers of fish (middle) and percentages (bottom) through time.

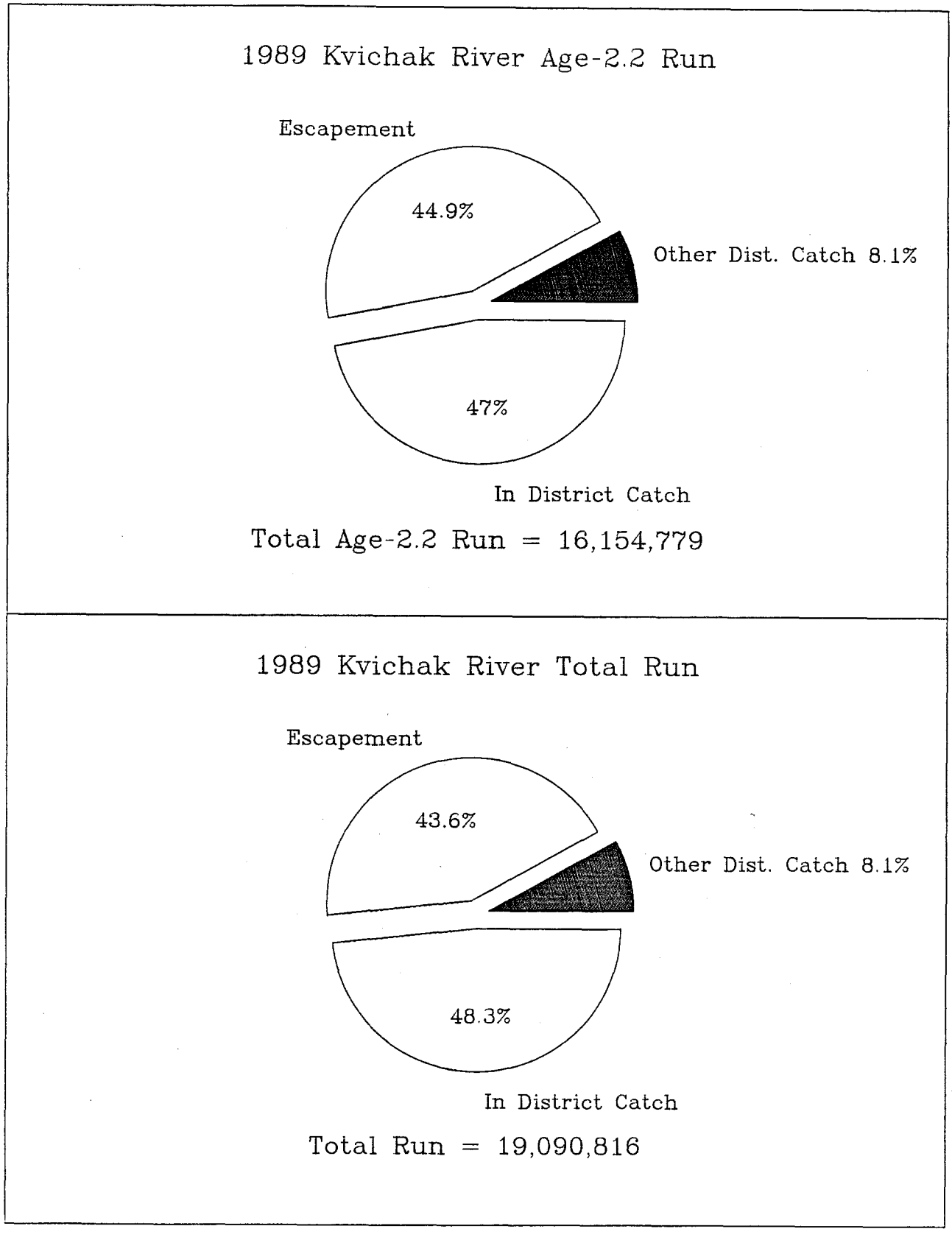


Figure 10. Estimated age-2.2 (top) and total run (bottom) of sockeye salmon to Kvichak River in 1989 by escapement, in district catch, and other district catch.

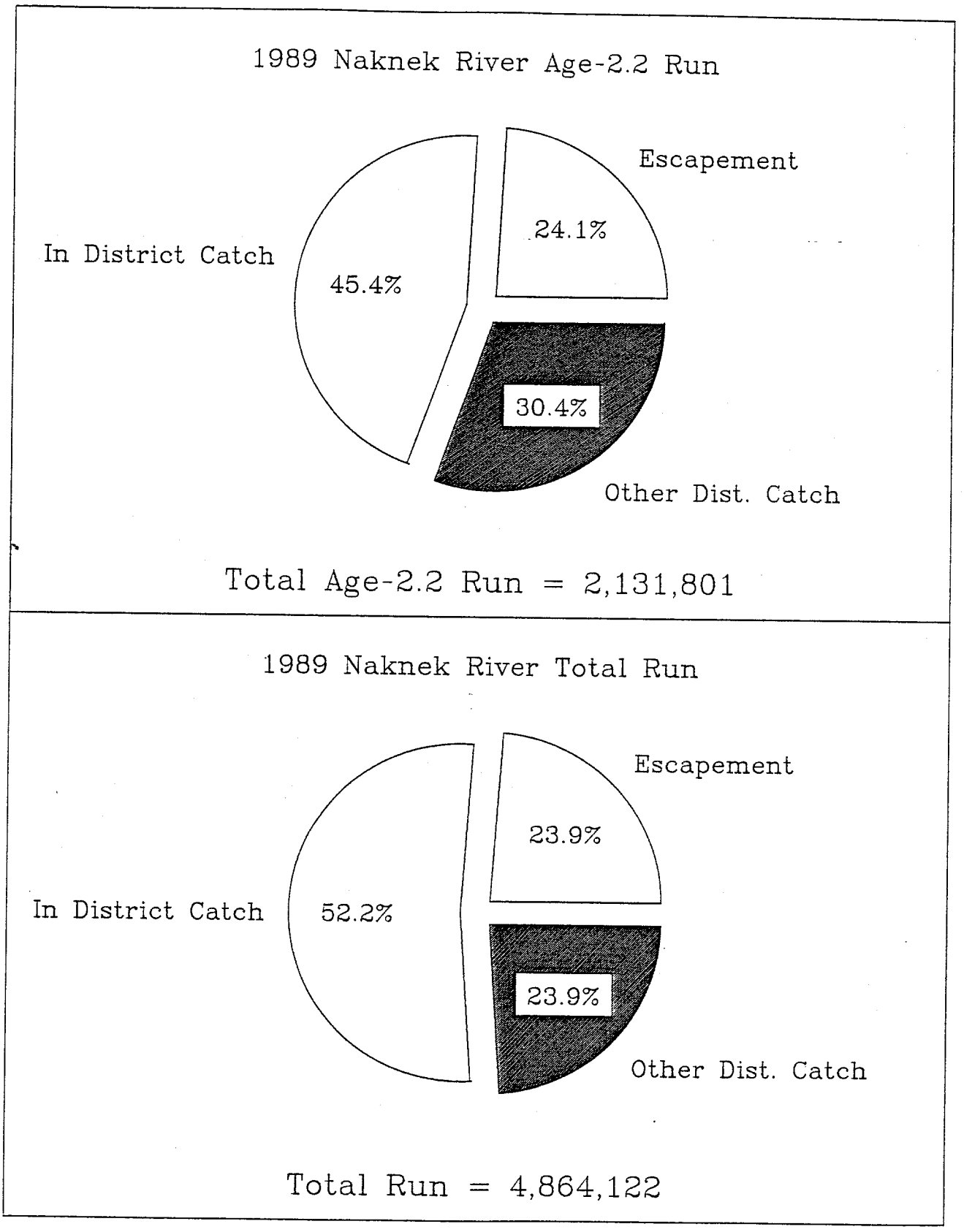
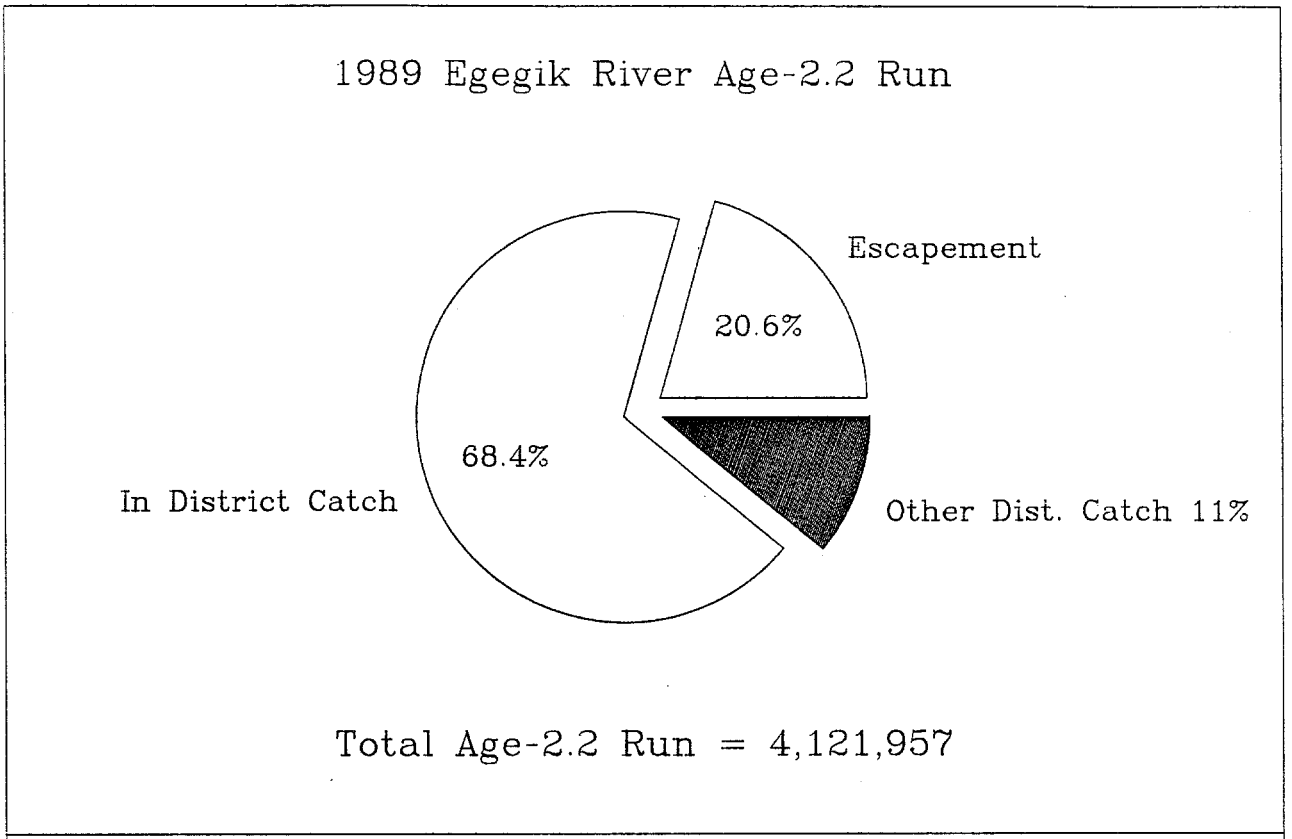


Figure 11. Estimated age-2.2 (top) and total run (bottom) of sockeye salmon to Naknek River in 1989 by escapement, in district catch, and other district catch.



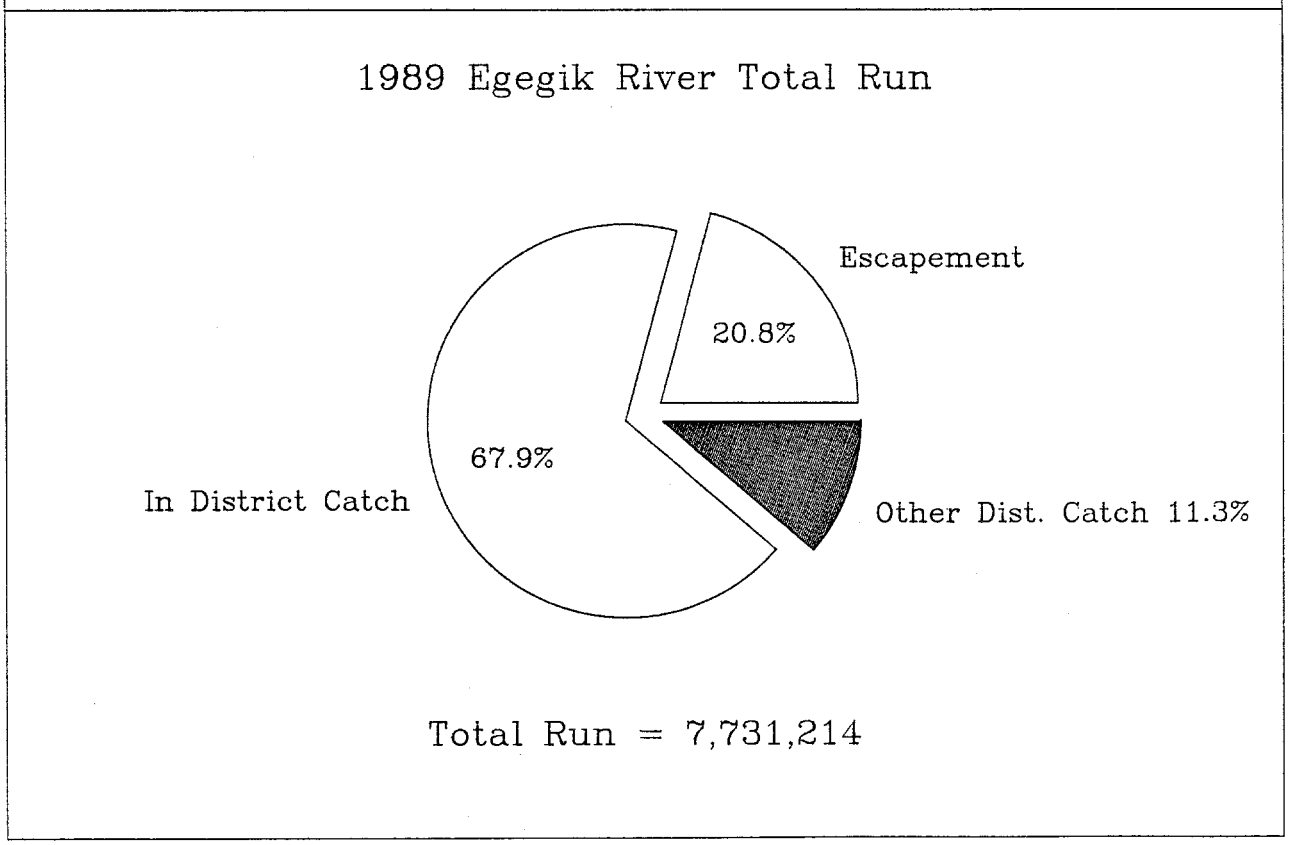
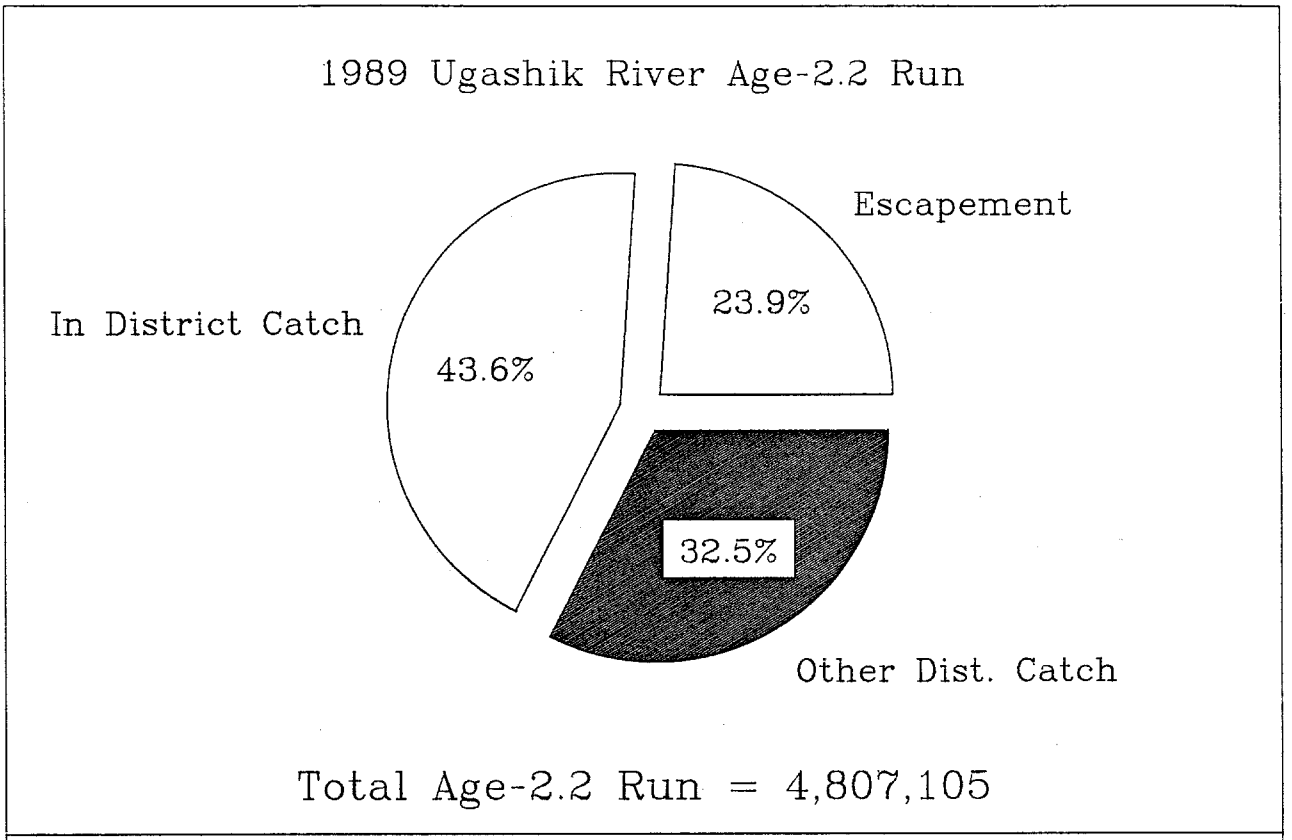


Figure 12. Estimated age-2.2 (top) and total run (bottom) of sockeye salmon to Egegik River in 1989 by escapement, in district catch, and other district catch.



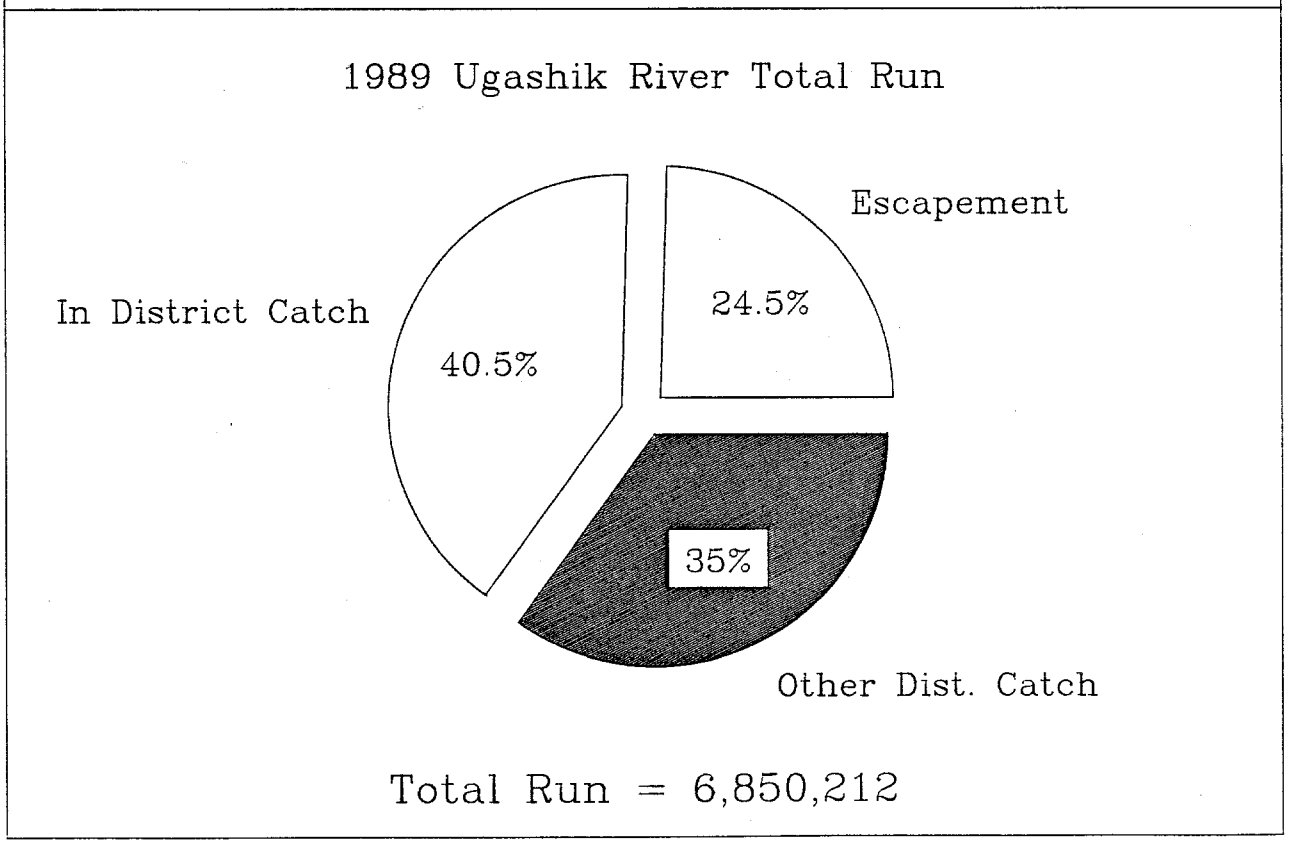


Figure 13. Estimated age-2.2 (top) and total run (bottom) of sockeye salmon to Ugashik River in 1989 by escapement, in district catch, and other district catch.