Fishery Data Series No. 10-27

Contribution of Alaskan, Canadian, and Transboundary Sockeye Salmon Stocks to Catches in Southeast Alaska Purse Seine and Gillnet Fisheries, Districts 101–108, Based on Analysis of Scale Patterns, 2002

by

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April 2010

Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

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Weights and measures (metric)	
centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)	
fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics	
all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 10-27

CONTRIBUTION OF ALASKAN, CANADIAN, AND TRANSBOUNDARY SOCKEYE SALMON STOCKS TO CATCHES IN SOUTHEAST ALASKA PURSE SEINE AND GILLNET FISHERIES, DISTRICTS 101–108, BASED ON ANALYSIS OF SCALE PATTERNS, 2002

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April 2010

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This document should be cited as:
Bloomquist, R., A. Reynolds, and I. S. Frank. 2010. Contribution of Alaskan, Canadian, and transboundary sockeye salmon stocks to catches in Southeast Alaska purse seine and gillnet fisheries, Districts 101–108, based on analysis of scale patterns, 2002. Alaska Department of Fish and Game, Fishery Data Series No. 10–27, Anchorage.

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ABSTRACT

Sockeye salmon *(Oncorhynchus nerka)* harvested in 2002 in southern Southeast Alaska's gillnet and purse seine fisheries were classified to nation or stock group of origin by using linear discriminant function analysis of scale patterns, coupled with age composition data. The general groups were Alaskan, Canadian, and transboundary river stocks. Separate Canadian stock contribution estimates (Nass River, Skeena River, and other south-migrating stocks) are presented for some districts. Stock contribution estimates are presented by age class and week for all major fisheries. A total of 275,636 sockeye salmon were harvested in purse seine and gillnet fisheries in 2002, the smallest harvest since scale pattern analyses began in 1982. A total of 271,964 fish from the total harvest was classified to stock group of origin. An estimated 112,382 fish (41%) were of Alaska origin, 151,506 fish (56%) were of Canadian origin, and 8,076 fish (3%) were of Stikine River origin.

Key words: sockeye salmon, *Oncorhynchus nerka*, stock composition, linear discriminant function, scale pattern analysis, Southeast Alaska, Canada, U.S./Canada Boundary Area

INTRODUCTION

Commercial net fisheries conducted in southern Southeast Alaska harvest mixed stocks of sockeye salmon (*Oncorhynchus nerka*) that originate from numerous waterways in Southeast Alaska and northern British Columbia (Figure 1). These fisheries include drift gillnet fisheries that target primarily sockeye salmon in Alaska Statistical Area 101, and Districts 106 and 108, as well as purse seine fisheries in Alaska Districts 101 through 104, that primarily target other species and harvest sockeye salmon incidentally.

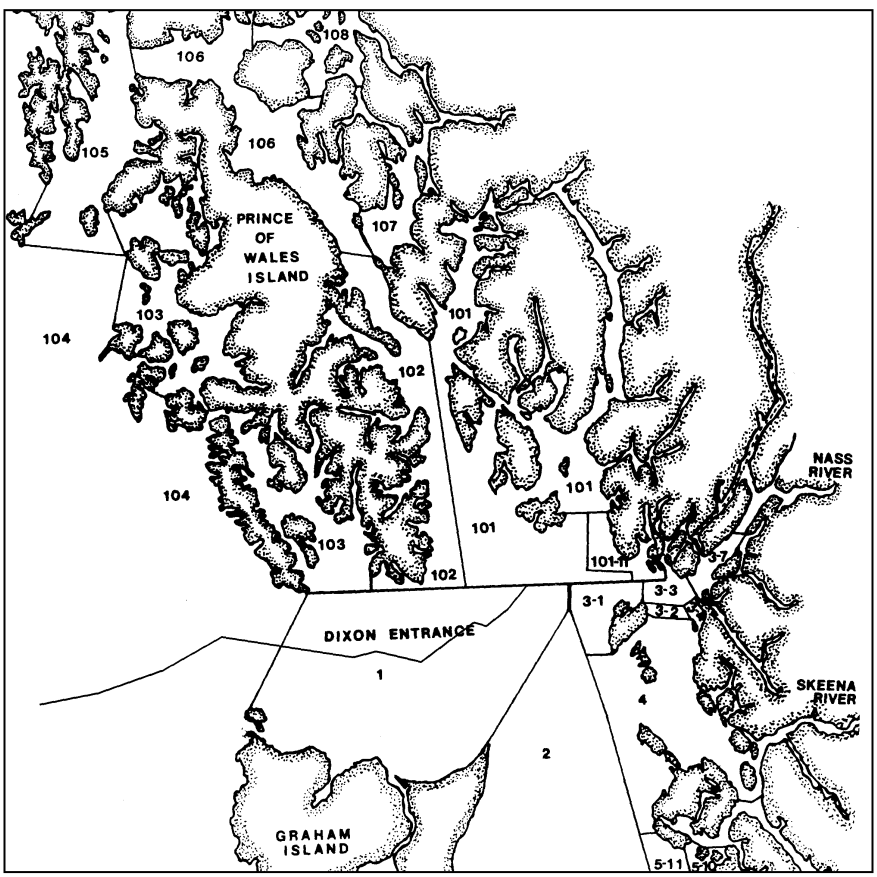

Figure 1.–Fishery management districts in southern Southeast Alaska and northern British Columbia waters.

The purpose of this study is to determine the national origin of major sockeye salmon stocks contributing to commercial gillnet and purse seine fishery catches in southern Southeast Alaska (Figure 1). Under the Pacific Salmon Treaty of 1985 and its later annexes, catches by fishermen of either country of their neighboring country's stocks are restricted in selected fisheries. In particular, the catches of Nass River and Skeena River (Figure 2) sockeye salmon occurring in Alaska District 101 gillnet and District 104 purse seine fisheries have been limited to a percentage of total return of these stocks over a 10-year period.

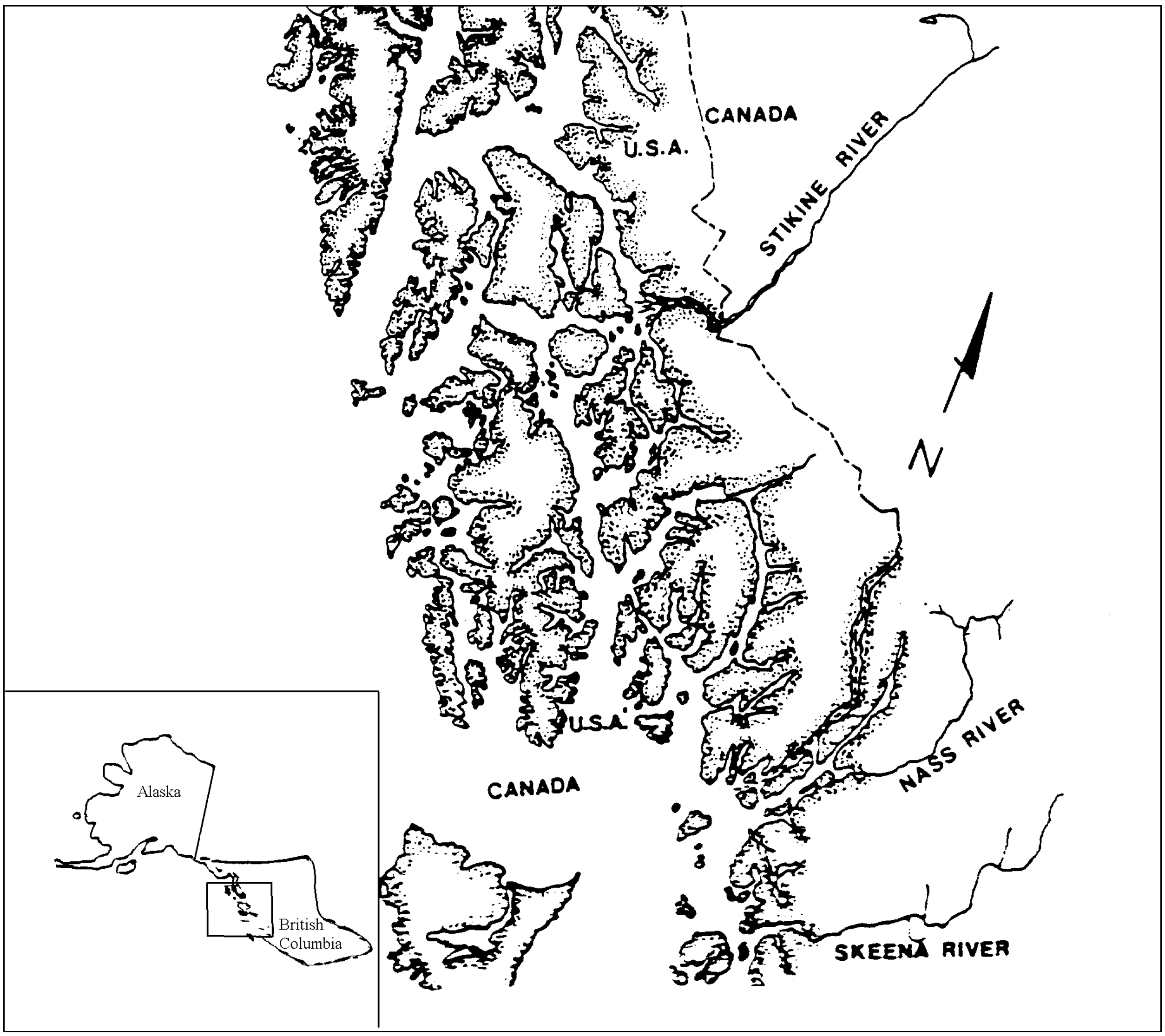

Figure 2.–The Canadian Nass and Skeena Rivers and the transboundary Stikine River.

Annual stock-specific run reconstructions (catch plus escapement) are required to accurately estimate relative contribution of each stock caught in these restricted fisheries. Estimates of national origin of contributing stocks from this study provide the most reliable information currently available to complete these run reconstructions, and are used to evaluate stock-specific productivity and to revise pre-season forecasts. This report is written annually to document estimated contribution of several general stock groups, to the harvest of sockeye salmon in Southeast Alaska.

Most sockeye salmon harvested in southern Southeast Alaskan commercial fisheries are bound for a variety of rivers that either lie entirely within Alaska, entirely within Canada, or that span both Alaska and Canada (Rich and Morton 1930; Verhoeven 1952; Norenberg 1959; Logan 1967; Simpson 1968; Hoffman et al. 1983). River systems that span both Alaska and Canada are commonly referred to as transboundary rivers. Sockeye-producing river systems located entirely within Alaska tend to be low- to moderately-productive systems in the immediate vicinity of the harvest. Of the (entirely) Canadian drainages that produce sockeye salmon harvested in Southeast Alaska, the Nass River (which flows into Portland Canal) and the Skeena River (which flows into Chatham Sound) are the major contributors. Several transboundary river systems contribute to sockeye salmon catches in Southeast Alaska, including the Taku, Stikine, and Alsek Rivers. In southern Southeast Alaska, the District 108 and 106 gillnet fisheries are the only ones that regularly harvest transboundary river sockeye stocks in quantifiable numbers, primarily stocks from the Stikine River drainage.

Sockeye harvests in southern Southeast Alaska may also include a few sockeye salmon bound for northern Southeast Alaska, Prince William Sound, and Washington State. However, their low numbers in the harvest preclude determining stock of origin. In some years, migration patterns change for sockeye salmon from southern British Columbia, and increased numbers are caught in the Alaska District 104 purse seine fishery, located along the outer coast of Alaska and just north of the Alaska-Canada border. These fish are thought to originate primarily from the Fraser River.

In 1982, the Alaska Department of Fish and Game began using scale pattern analysis to estimate the number of salmon bound for specific Canadian river systems caught in Southeast Alaska (Marshall et al. 1984; Figure 3). Scale pattern analysis is based on differences in patterns of arrangement of circuli on scales, which reflect average differences in fish growth history over broad geographic areas. Because most fish do not generate their own body heat, metabolism and growth is dependant upon ambient water temperature. Salmon rearing in river systems with radically different temperature regimes will exhibit different growth patterns in their scales during their freshwater phase. In addition, river systems with radically different temperature regimes often have different intrinsic productivities. For example, in coastal Alaska, summers tend to be cool, and scales from sockeye salmon rearing in coastal Alaskan systems generally form few circuli with relatively narrow spacing between each during freshwater residence. In contrast, most available salmon rearing habitat of large Canadian river systems occurs on the eastern side of the coastal range, where summers tend to be warmer than along the coast. According to Marshall et al. (1984), sockeye salmon rearing in drainages on the eastern side of the coastal range tend to form more scale circuli with wider spacing during freshwater residence than sockeye salmon rearing in coastal systems. Persistent differences in the number and spacing of circuli formed during out migration, as well as the first year of marine residence, also exist between Alaskan and Canadian stock groups.

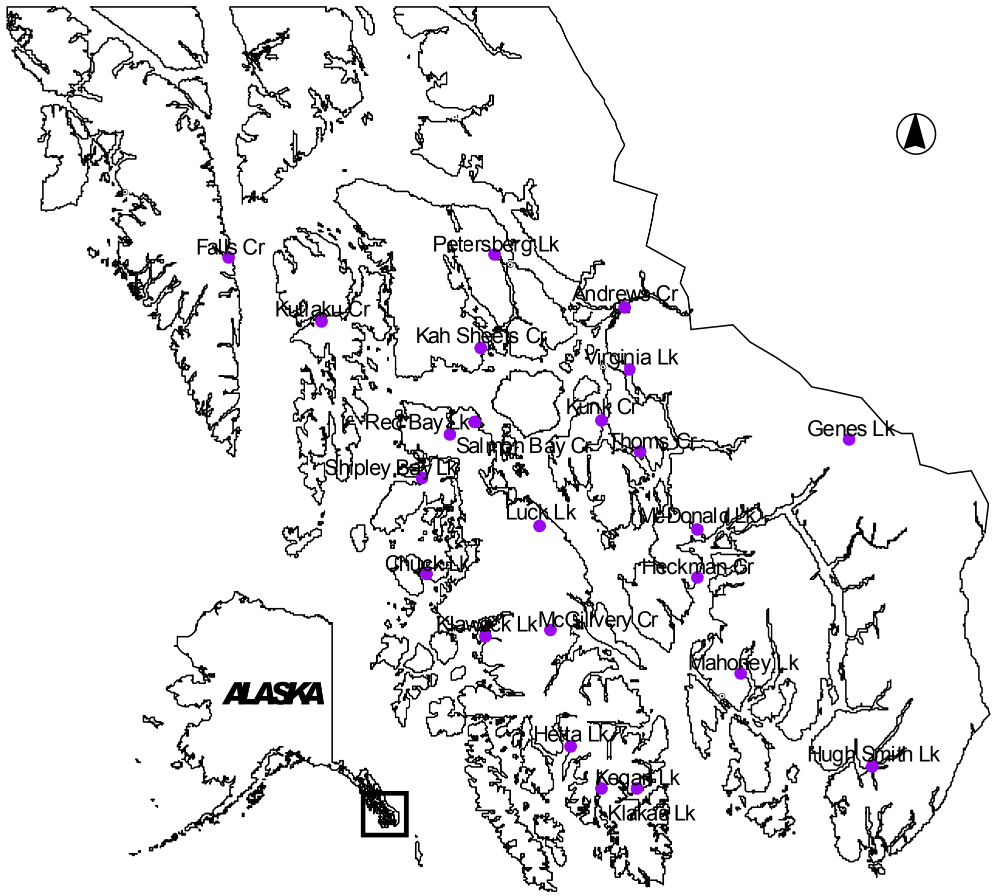

Figure 3.–Major sockeye salmon systems of Southeast Alaska sampled for scales used in stock discrimination method comparison studies, 2002.

Accuracy of distinguishing the separate circuli patterns is dependent on the degree of inherent differences among pattern groups. Scale samples collected from groups of fish whose stock of origin is known are used to characterize these inherent differences. Typically, scale samples are collected from escapements, or fish that have traveled upstream of a location such that they can be reasonably assumed to belong to a specific stock or group of stocks. These escapement scale samples must include fish from all stocks included in the analysis. Patterns of circuli are measured in several ways on each escapement scale examined, thereby building data sets of variables that describe the typical pattern for each group of stocks. Figure 4 presents examples of 2 typical scales of differing origin, and the zones on the scales used to differentiate between them. Next, the data sets from each group of stocks are compared against each other with statistical techniques to build a decision rule (discriminant function). The discriminant function is tested with scales from fish of known origin that were not used in building the decision rule. Correction factors are calculated from the errors made with the discriminant function. Finally, the discriminant function and its correction factors are used to classify fish of unknown origin from the catch to one of the stock groups for which the decision rule was developed. The incidence of fish classified to a specific group of stocks is the interception rate for that group.

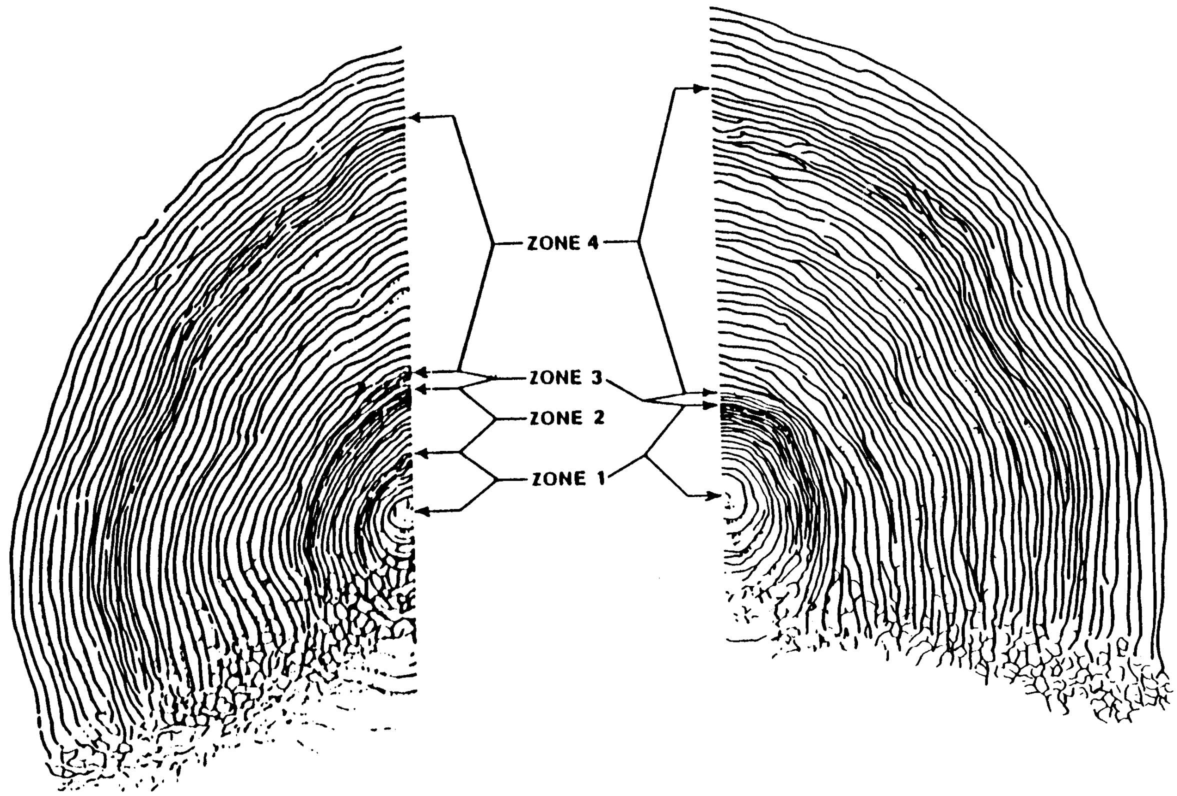

Figure 4.–Typical scales with one and 2 freshwater growth zones showing the zones used for scale pattern analysis.

Significant and persistent differences between sockeye salmon stock groups originating in Alaska and Canada have been documented in the patterns of scale growth during freshwater and early marine life history (Oliver et al. 1984; Oliver and Walls 1985; Oliver and Jensen 1986; Oliver et al. 1987; Oliver and Farrington 1989 and 1990; Farrington and Oliver 1994; Farrington et al. 1996a, 1996b, and 1996c; Farrington et al. 1998a and 1998b; Farrington et al. 1999a and 1999b). Although differences in scale patterns between Alaskan and Canadian stock groups are much greater than the differences within the groups, the differences between the Nass and Skeena stock groups are large enough to allow us to estimate contributions from these 2 river systems.

METHODS

COMMERCIAL HARVEST INFORMATION

The number of fish harvested by gear type, district, and week were obtained from an ADF&G statewide database, which contains information from commercial salmon sales receipts dating back to 1960. A database program, called *Alexander*, connects to a comprehensive regional database (Integrated Fishery Database or IFDB) that obtains the harvest information from the statewide database. Catches were summarized by statistical weeks, hereafter referred to as "weeks," which began on Sunday at 12:01 a.m. and ended the following Saturday at midnight. These weeks were numbered sequentially starting from the beginning of the calendar year.

BIOLOGICAL DATA COLLECTION AND PROCESSING

The ADFG Region I biometricians, in consultation with project biologists and port sampling supervisors, determined fish sample size objectives required to achieve acceptable precision in the stock identification analyses. Temporal sampling strata were determined, based on magnitude of catch, and the rapidity of change in the historical stock composition as the fishing season progresses. In general, a sample of 520 fish per stratum was sufficient to describe the estimated sockeye age composition with a precision of ± 5% and a probability of 0.10 (Thompson 1987).

Commercial gillnet and purse seine landings of sockeye salmon in southern Southeast Alaska were sampled for scales by ADFG Commercial Fisheries Division employees at fish processing facilities in Petersburg, Ketchikan, Craig, and Wrangell. For each fish sampled, ADF&G technicians determined gender from external sex characteristics, and recorded the gender. Mid-eye to fork-of-tail length was recorded for 25% of the fish sampled. District 101 and District 104 were exceptions; 100% of the sampled fish had a recorded length. Detailed age, gender, and length data for southern Southeast Alaska catches and escapements are not fully presented in this report.

Technicians used sampling protocols to ensure that samples were as representative of specific district catches as possible. Only deliveries originating from a single fishing district and a single gear type were sampled. To avoid overreliance on a single delivery for data, technicians sampled multiple deliveries for each fishing district. No more than 40 scale samples were taken from a single delivery. Fish stowed in a hold tend to mix completely until the hold is about half-full; subsequent additions tend to deposit in layers (David Evans, ADF&G biometrician, Anchorage, *personal communication*). To ensure that scale samples taken from a delivery were representative of the entire delivery, technicians would systematically take scale samples from the entire hold as it was being offloaded.

ADFG Commercial Fisheries Division personnel also collected scale samples from a variety of major sockeye escapements to lake and stream systems in southern Southeast Alaska. In northern British Columbia, Canadian Department of Fisheries and Oceans (CDFO) personnel collected scales from daily gillnet catches in test fisheries operating near or in the lower reaches of the Skeena River. LGL Ltd. personnel under contract to the Nisga'a First Nation in British Columbia, Canada, collected scale samples from daily fish wheel catches in test fishery in the lower Nass River. The Pacific Salmon Commission (PSC) provided commercial scale samples judged to be representative of south migrating sockeye salmon stocks that were collected from net fishery catches in British Columbia and Washington State waters.

Scales were sampled from the preferred area above the lateral line on the left side of the fish on a diagonal downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). Scales were mounted on gum cards and impressions made in cellulose acetate (Clutter and Whitesel 1956). Age determinations were based on examinations of scales under moderate (70 power) magnification. Criteria used to assign ages were similar to those of Mosher (1968), and ages were reported in European notation (Koo 1962).

DIGITIZING OF SCALES

Scale impressions were projected onto a digitizing tablet at 100x magnification using equipment similar to that described by Ryan and Christie (1976). Scale circuli were counted and incremental distances between circuli measured according to zones that represent distinct salmon life history stages (Figure 4). Counts and measurements were made on a selected radius along or near the longest axis of the scale (Anas and Murai 1969). Measurements of distances between circuli and growth zone information for each scale were transformed to a set of 33 standardized scale measurement and count characters (Appendix A).

DISCRIMINANT ANALYSIS

Linear discriminant function analysis (LDF; Fisher 1936) of scale patterns has been used to estimate stock contributions to southern Southeast Alaska mixed stock sockeye salmon fisheries, based on observed differences between stocks since 1982 (Marshall et al. 1984). The major assumptions underlying LDF analysis are: 1) the groupings investigated are discrete and identifiable; 2) the parent distributions of the measured variables are multivariate normal; and 3) the variance-covariance matrices for all groups are equal. Gilbert (1969) found LDF satisfactory if the variance-covariance matrices were similar. In addition, large sample sizes appear to make LDF robust concerning the assumption of a common variance-covariance matrix (Issacson 1954). The method also appears to be robust to violations of the assumption of normality for discrete distributions, although it is not robust for continuous non-Gaussian parent distributions (Lachenbruch et al. 1973; Krzanowski 1977).

Alaska Department of Fish and Game personnel used the statistical program SAS® to perform all LDF procedures (Figure 5). The programs written in SAS® for conducting LDF procedures have been in use since 1991. These consisted of 4 primary routines executed in sequence to perform the LDF analyses, and include the following steps: 1) calculate standardized scale measurement and count characters; 2) perform stepwise selection of useful variables; 3) compute linear or quadratic discriminant function rules; and, 4) apply discriminant function rules to classify unknown stock mixtures.

LDF statistical mixture models used to analyze measurements of scale patterns describe the probability of measurements from individuals in a mixture. If c baseline stock groups are considered possible in the mixture, the probability that the M individuals of the mixture have scale measurements, $\mathbf{X}_1,\ldots,\mathbf{X}_M$ is,

$$p(\mathbf{X}_1,\ldots,\mathbf{X}_M) \propto \prod_{j=1}^{M}\left(\sum_{i=1}^{c} p_i f(\mathbf{X}_j \mid i)\right). \tag{1}$$

The scale measurements of the j^th individual, $\mathbf{X}_j$, are used to estimate the relative frequencies of measurements in the source stock groups. The unknown stock group proportions composing the mixture are denoted by $p_i, \quad i=1,...,c$, and the density or relative frequency of the j^{th} individual's measurements in the i^{th} stock group, or stock, is denoted by $f(\mathbf{X} \mid i, \quad i=1,...,c)$. The so-called posterior source probabilities for the mixture individuals (Pella and Masuda 2004) are fundamental to classifying or assigning the individuals to their source stock groups. The posterior source probabilities for the j^{th} individual are calculated as follows:

$$p(i \mid \mathbf{X}_j) = \frac{p_i f(\mathbf{X}_j \mid i)}{\sum_{s=1}^{c} p_s f(\mathbf{X}_j \mid s)}, \qquad i=1,...,c.. \tag{2}$$

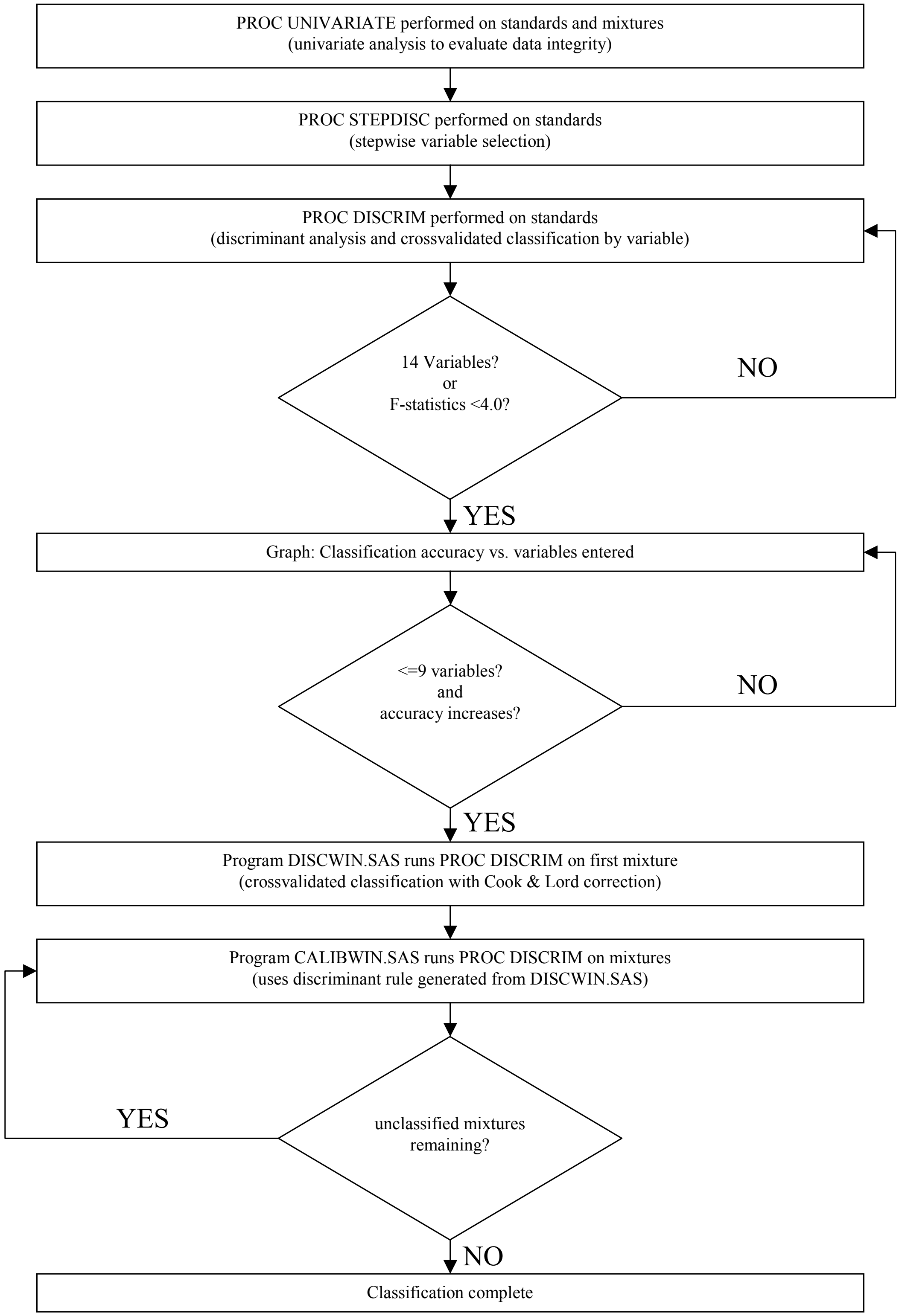

Figure 5.–Schematic of the classification process utilizing SAS linear discriminant function procedures.

The individuals are viewed as being drawn from a large underlying mixture. The posterior source probabilities are defined as the proportions of individuals in the underlying mixture with the same measurement as the j^{th} individual, $\mathbf{X}_j$, that come from each of the *c* stock groups. Given the estimated posterior source probabilities, the maximum *a posteriori* rule is used to assign individuals to the source for which their posterior source probability is greatest.

We performed analyses using age-specific models for each of the 4 most commonly encountered sockeye salmon age classes (1.2, 1.3, 2.2, and 2.4). Building each LDF model began with an initial selection of the potential scale character variables using a stepwise discriminant analysis of pooled stock group-specific baseline samples. Pooled baseline samples were assembled from individual escapement locations for the Southeast Alaskan stock group, or from daily test fishing catches for Canadian and South-migrating stock groups. Fish length was included as a variable additional to digitized scale variables to classify in some models, as it provided further discriminating power in separating South-migrating as well as Nass River sockeye salmon stocks.

Discriminant analysis of the pooled baselines was performed iteratively by variable. Up to 14 of the initially selected variables were entered sequentially into the LDF model until the partial F statistic of a variable available for entry into the model was less than 4.0, or until all variables had been entered. Successive classification accuracies were plotted against the respective variables. Variables were included in the model until accuracy peaked or became asymptotic for a total of up to twelve variables.

Sockeye salmon in mixed stock fishery samples were classified to stock of origin by a discriminant rule generated from age-specific LDF models. An almost unbiased estimate of classification accuracy for each LDF model was determined with a cross validation procedure similar to a leaving one out procedure (Lachenbruch 1967). Estimates of proportions of each stock group in mixture samples were computed by classification-based conditional maximum likelihood estimation assuming multivariate normality (Pella and Masuda 2004). Age-specific sets of selected scale variables were submitted to LDF procedures of the statistical program SAS® to compute the posterior source probabilities for individuals in the age-specific mixtures. Estimates from the conditional maximum likelihood procedure were constrained such that estimated proportions for a stock group must be equal to or greater than zero and equal to or less than 1.

The variance and 90% confidence intervals of the adjusted estimates of stock proportions were computed according to Pella and Robertson (1979). The variance-covariance matrices for the misclassification matrix and for the mixed stock proportion vector were determined from the multinomial probability distribution. These 2 variance-covariance matrices were combined to give variances and covariances for the second order estimates of stock proportions. The variances for the proportions of each stock were the diagonal elements of this combined matrix, i.e., they were an additive combination of; 1) the sampling variation in estimation of the probability of assignment of the known stock group and 2) the sampling variation in estimation of the assignment composition of the mixed stock group.

Age-specific LDF models were assembled from 2002 escapement samples, with different stocks potentially contributing to the different fisheries. Separate age-specific models were constructed for; 1) gillnet and purse seine fisheries in Districts 101, 102, and 103, 2) District 104 purse seine fishery and 3) Districts 106 and 108 drift gillnet fisheries. Contributing stocks included in each geographically separate model were selected from among available escapement samples based on stock-specific migration patterns observed in tagging studies from the early 1980s (Hoffman et al. 1983, English et al. 1984). Construction of separate age-specific models from potential contributing stock groups within the Districts 106 and 108 gillnet fisheries also considered observed run timing differences (K. A. Jensen, Commercial Fishery Research Biologist, ADFG, Douglas; *personal communication*).

CLASSIFICATION OF CATCHES

Weekly commercial catches in each district were classified to potential contributing stocks using age-specific linear discriminant models for the 4 major age groups (1.2, 1.3, 2.2 and 2.3) that generally comprise more than 98% of commercial catches. Up to 100 scales per temporal stratum for each major age class in a district and fishery were analyzed to provide estimates of stock proportions with a precision of ± 10% with probability of 0.10. The stock apportionment of the other (minor) age classes not directly classified using LDF assumes that the proportion of the minor ages belonging to any given stock is equal to the combined proportion of all classified age classes. Age specific models were used in the analysis for the following reasons: 1) to account for differences in age composition between stocks; 2) to remove potential bias due to differences in migratory timing of different age fish; and, 3) to eliminate the effect of different environmental conditions on the scale patterns of different age fish. Stock contributions were estimated for each week to track temporal patterns. Stock contribution estimates for weekly district catches for which no scale samples were collected (primarily early and late in the season), were generally approximated using the age and stock composition results from the nearest temporal stratum for that district. Stock contribution estimates for catches from some districts for which few samples were available for relatively small catches over a period of weeks, were approximated using stock composition results from an adjacent temporal stratum to estimate catch contributions for the weekly catches pooled.

Variances of weekly and seasonal stock composition estimates were approximated with the delta method (Seber 1982). Variance estimates were functions of the variances associated with the following weekly variables: 1) estimated age composition of the catch; 2) age specific stock composition estimates; 3) sample size of the age composition; and, 4) catch size. Use of a maximum likelihood procedure to constrain the stock proportion estimates did provide a variance estimate for stock(s) contributing zero fish.

RESULTS

NATIONAL ORIGIN OF SOUTHERN SOUTHEAST SOCKEYE SALMON CATCHES

The total sockeye salmon harvest in the southern Southeast Alaska (Districts 101 to 108) seine and gillnet fisheries in 2002 was 275,636 fish. For many of the net fisheries of southern Southeast Alaska, the catch was identified by nation of origin (Table 1). Of 271,964 fish classified to nation of origin, the estimated U.S. contribution was 112,382 fish (41%), estimated Canadian contribution was 151,506 fish (56%), and estimated transboundary contribution was 8,076 fish (3%).

STOCK COMPOSITION OF SOUTHERN SOUTHEAST SOCKEYE SALMON CATCHES

The total number of sockeye salmon classified to stock group of origin was 271,693 fish (Table 2). These fish were assigned as follows: 112,111 fish (41%) were of Alaska origin; 111,778 fish (41%) were Nass River origin; 39,070 (14%) were Skeena River origin; 658 (0.24%) were south-migrating stock origin (primarily Fraser River); 2,055 (1%) were transboundary Tahltan Lake origin; 1,963 (1%) were transboundary Stikine River origin; and 4,058 (1%) were transboundary Tuya Lake origin.

District 101 Gillnet Stock Composition

Weekly stock composition estimates comprised Alaska, Nass, and Skeena stock groupings. The estimated Alaskan contribution to this fishery was the seventh lowest since analyses began in 1982.Of the season catch of 120,353 sockeye salmon, the estimated stock contributions were: 14,462 fish from the Alaska stock grouping for 12% of the total; 90,556 Nass River fish (75%); and 15,335 Skeena River fish (13%; Table 3). Nass was the largest stock component in all weekly strata except for week 31, where Alaska was the largest stock component. A summary of the scale variables used, as well as associated entry F statistics is listed in Appendix B.

District 101 Purse Seine Stock Composition

Weekly and stock composition estimates were comprised of Alaska, Nass, and Skeena stock groupings. Early and late weekly strata were combined due to low sample sizes. Exclusive of 271 McDonald Lake fish (Alaska stock grouping) caught in the Yes Bay terminal fisheries, the season catch total was 25,418 sockeye. The estimated stock contributions were 16,296 fish from the Alaska stocks (64%), 5,003 fish from Nass River (20%), and 4,119 fish from Skeena River (16%; Table 4). Alaska was the largest stock component in all weekly time strata except during weeks 32 and 33, when Skeena River was the largest contributor.

District 102 Purse Seine Stock Composition

Weekly stock composition estimates were made, where possible, for Alaska, Nass, and Skeena stock groupings. Of the catch of 29,667 sockeye salmon through week 39, the estimated stock contributions were as follows: 23,759 fish from the Alaska stock grouping (80% of the total); 3,247 Nass River fish (11%); and 2,661 Skeena River fish (9%; Table 5).

District 103 Purse Seine Stock Composition

A total of 5,725 sockeye salmon were harvested in the District 103 purse seine fishery. The estimates for contributions by stock group were as follows: 4,670 fish from Alaska (82%); 518 fish from Nass River (9%); and 537 fish from Skeena River (9%; Table 6).

District 104 Purse Seine Stock Composition

Weekly stock compositions were comprised of Alaska, Nass, Skeena, and other south-migrating (e.g., Fraser River) stock groupings. Alaska was the dominant component in the fishery for week 28 and Skeena was the largest contributing stock in all other weeks. Of the season total of 34,187 sockeye salmon caught, the estimated stock contributions were as follows: 10,169 fish from the Alaska stock grouping (30%); 8,803 fish from Nass River (26%); 14,557 fish from Skeena River (43%); and 658 fish from the south-migrating stock grouping (2%; Table 7). A summary of the scale variables used, as well as associated entry F statistics is listed in Appendix C.

District 106 and 108 Gillnet Stock Composition

A total of 56,135 sockeye salmon were caught in the District 106 gillnet fishery, and 208 sockeye salmon in the District 108 gillnet fishery. These harvests were the lowest since 1983 for District 106, and lowest since several years of non-harvests in mid-1980s for District 108 (Table 1). Alaska contributed 45,573 fish (76%) to the 106 gillnet fishery and 182 fish (88%) to the 108 gillnet fishery. Canadian stocks contributed 5,487 fish (10%) to the 106 gillnet fishery and 25 fish (12%) to 108 gillnet. Transboundary stocks contributed 8,075 fish (14%) to 106 gillnet and 1 fish (less than 1%) to 108 gillnet.

DISCUSSION

The sockeye salmon catch in the boundary area net fisheries in 2002 was lower than in all of the previous 20 years that scale pattern analyses has been conducted (Table 1). Catches were below average in the District 101 to 103 seine fisheries, and were near average in the District 101 gillnet fishery. Catches were far below average for the fisheries that focus on transboundary stocks (Districts 106 and 108). The catch in the District 104 seine fishery was also considerably below average, with a low contribution (2%) from south-migrating stocks (predominately Fraser River) However, the overall percent contribution of U.S.-origin sockeye salmon to the harvest (43%) was the sixth highest for all years of available scale pattern analysis data (Table 1).

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TABLES

Table 1.–Estimated sockeye salmon contributions and percentages by nation of origin to southern Southeast Alaska Districts 101 to 108 net fisheries, 1982–2002.

			1982		1983		1984		1985		1986		1987		1988		1989	
District	**Type**	**Stock Group**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**+**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
101	**Gillnet**	**US**	69,483	36	48,905	36	34,843	39	30,946	18	12,738	9	25,073	23	14,796	13	31,406	22
		Canada	121,325	64	86,998	64	53,588	61	142,154	82	132,961	91	82,430	77	101,319	87	113,530	78
		Total	190,808		135,903		88,431		173,100		145,699		107,503		116,115		144,936	
101[a]	**Purse Seine**	**US**	39,518	56	20,376	43	49,348	60	82,311	69	50,313	67	30,071	69	12,799	41	37,236	32
		Canada	30,941	44	27,263	57	32,537	40	37,159	31	24,510	33	13,233	31	18,340	59	80,622	68
		Total	70,459		47,639		81,885		119,470		74,823		43,304		31,139		117,858	
102	**Purse Seine**	**US**	18,672	80	6,482	59	17,857	82	28,417	78	24,030	73	16,211	94	10,347	70	35,807	62
		Canada	4,542	20	4,498	41	3,808	18	7,887	22	8,681	27	1,064	6	4,455	30	21,834	38
		Total	23,214		10,980		21,665		36,304		32,711		17,275		14,802		57,641	
103	**Purse Seine**	**US**			7,098	68			19,560	74	9,883	72	1,401	98	790	33	20,551	96
		Canada			3,357	32			6,703	26	3,806	28	34	2	1,587	67	936	4
		Total			10,455				26,263		13,689		1,435		2,377		21,487	
104	**Purse Seine**	**US**	106,786	38	155,967	24	78,954	27	94,005	22	101,121	23	68,647	40	104,042	18	73,026	14
		Canada	176,572	62	487,301	76	215,208	73	337,648	78	343,550	77	102,332	60	487,243	82	443,575	86
		Total	283,358		643,268		294,162		431,653		444,671		170,979		591,285		516,601	
106	**Gillnet**	**US**	94,320	49	32,583	67	60,597	66	126,914	48	100,268	69	112,893	83	80,868	87	126,603	66
		Canada	62,063	32	10,582	22	24,755	27	111,017	42	42,756	29	21,190	15	9,784	11	59,959	31
		Transboundary	37,418	19	5,580	11	6,787	7	27,056	10	2,685	2	2,344	2	1,877	2	6,172	3
		Total	193,801		48,842		92,139		264,987		145,709		136,427		92,529		192,734	
108	**Gillnet**	**US**	1,784	25							930	22			265	21	1,180	12
		Canada	4,139	58							73	2			48	4	545	5
		Transboundary	1,213	17							3,184	76			933	75	8,358	83
		Total	7,136								4,185				1,246		10,083	
Total		**US**	330,562	43	271,411	30	241,599	42	382,152	36	299,284	35	254,296	53	223,907	27	325,809	31
		Canada	399,583	52	619,998	69	329,896	57	642,569	61	556,336	64	220,283	46	622,776	73	721,001	68
		Transboundary	38,631	5	5,580	1	6,787	1	27,056	3	5,869	1	2,344	1	2,810	0	14,530	1
		Total	768,776		896,989		578,282		1,051,777		861,489		476,923		849,493		1,061,340	

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Table 1.–Page 2 of 3.

			1990		1991		1992		1993		1994		1995		1996		1997	
District	**Type**	**Stock Group**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
101	**Gillnet**	**US**	13,862	16	13,599	10	49,771	20	42,337	11	14,008	14	13,056	8	29,745	14	32,028	19
		Canada	71,829	84	117,893	90	194,878	80	351,761	89	86,369	86	151,238	92	182,658	86	137,446	81
		Total	85,691		131,492		244,649		394,098		100,377		164,294		212,403		169,474	
101[a]	**Purse Seine**	**US**	29,498	51	34,193	57	83,065	74	246,662	75	18,991	33	63,279	29	396,178	89	84,519	80
		Canada	27,809	49	26,227	43	28,954	26	83,820	25	39,100	67	154,699	71	47,653	11	21,691	20
		Total	57,307		60,420		112,019		330,482		58,091		217,978		443,831		106,210	
102	**Purse Seine**	**US**	38,384	75	32,413	75	30,075	90	115,916	94	18,521	65	56,518	77	60,026	90	45,908	84
		Canada	12,838	25	10,841	25	3,377	10	7,991	6	10,158	35	16,907	23	6,767	10	8,503	16
		Total	51,222		43,254		33,452		123,907		28,679		73,425		66,793		54,411	
103	**Purse Seine**	**US**	14,226	74	13,867	74	3,277	74	37,251	74	11,242	74	7,532	74	24,009	99	24,666	82
		Canada	5,124	26	4,995	26	1,180	26	13,419	26	4,050	26	2,713	26	178	1	5,306	18
		Total	19,350		18,862		4,457		50,670		15,292		10,245		24,187		29,972	
104	**Purse Seine**	**US**	123,420	15	166,794	20	198,080	18	205,108	22	212,854	19	68,952	14	209,567	24	210,524	17
		Canada	673,378	85	683,037	80	873,959	82	740,177	78	923,284	81	428,193	86	650,872	76	1,034,156	83
		Total	796,798		849,831		1,072,039		945,285		1,136,138		497,145		860,439		1,244,680	
106	**Gillnet**	**US**	112,983	61	78,577	55	120,977	60	82,301	40	122,118	58	65,544	32	165,221	53	97,101	58
		Canada	68,921	37	47,695	33	47,207	23	69,616	34	53,683	25	116,075	56	83,271	27	45,665	27
		Transboundary	3,901	2	17,832	12	34,971	17	54,038	26	35,247	17	25,679	12	62,608	20	25,752	15
		Total	185,805		144,104		203,155		205,955		211,048		207,298		311,100		168,518	
108	**Gillnet**	**US**	4,576	40	3,116	17	8,604	16	17,758	23	31,715	33	10,374	14	15,755	10	5,381	6
		Canada	1,479	13	2,117	12	2,696	5	8,742	11	20,250	21	15,641	20	12,618	8	12,152	13
		Transboundary	5,519	48	12,754	71	41,417	79	50,374	66	45,259	47	50,741	66	125,777	82	75,506	81
		Total	11,574		17,987		52,717		76,874		97,224		76,756		154,150		93,039	
Total		**US**	336,949	28	342,560	27	493,849	29	747,333	35	429,450	26	285,255	23	900,501	43	500,127	27
		Canada	861,378	71	892,804	71	1,152,251	67	1,275,526	60	1,136,893	69	885,466	71	984,017	48	1,264,919	68
		Transboundary	9,420	1	30,585	2	76,388	4	104,412	5	80,506	5	76,420	6	188,385	9	101,258	5
		Total	1,207,747		1,265,950		1,722,488		2,127,271		1,646,849		1,247,141		2,072,903		1,866,304	

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District	Type	Stock Group	1998 Number	1998 %	1999 Number	1999 %	2000 Number	2000 %	2001 Number	2001 %	2002 Number	2002 %
101	**Gillnet**	**US**	15,884	10	15,030	9	16,727	18	10,915	14	14,462	12
		Canada	144,622	90	144,998	91	77,924	82	69,126	86	105,891	88
		Total	160,506		160,028		94,651		80,041		120,353	
101[a]	**Purse Seine**	**US**	47,485	67	77,174	88	71,168	56	96,511	61	16,567	64
		Canada	22,916	33	10,420	12	55,942	44	61,172	39	9,122	36
		Total	70,401		87,594		127,110		157,683		25,689	
102	**Purse Seine**	**US**	23,111	79	35,518	91	26,265	78	36,987	68	23,759	80
		Canada	6,303	21	3,591	9	7,305	22	17,045	32	5,908	20
		Total	29,414		39,109		33,570		54,032		29,667	
103	**Purse Seine**	**US**	14,873	85	7,925	100	14,240	86	11,393	42	4,670	82
		Canada	2,582	15	31	0	2,384	14	15,566	58	1,055	18
		Total	17,455		7,956		16,624		26,959		5,725	
104	**Purse Seine**	**US**	65,348	13	63,013	38	78,727	35	82,358	15	10,169	30
		Canada	421,882	87	101,844	62	148,312	65	454,276	85	24,018	70
		Total	487,230		164,857		227,039		536,634		34,187	
106	**Gillnet**	**US**	67,890	60	70,334	67	57,923	64	86,078	52	42,573	76
		Canada	34,811	31	9,692	9	21,007	23	54,512	33	5,487	10
		Transboundary	10,734	9	24,809	24	11,146	12	23,423	14	8,075	14
		Total	113,435		104,835		90,076		164,013		56,135	
108	**Gillnet**	**US**	2,541	12	5,263	14	3,319	21	473	78	182	88
		Canada	2,376	11	1,314	4	2,025	13	60	10	25	12
		Transboundary	17,114	78	30,024	82	10,489	66	77	13	1	0
		Total	22,031		36,601		15,833		610		208	
Total		**US**	237,132	26	274,257	46	268,369	44	324,715	32	112,382	41
		Canada	635,492	71	271,890	45	314,899	52	671,757	66	151,506	56
		Transboundary	27,848	3	54,833	9	21,635	4	23,500	2	8,076	3
		Total	900,472		600,980		604,903		1,019,972		271,964	

[a] Includes catches from Yes Bay (West Behm Canal) terminal area fisheries.

Table 2.–Estimated contribution by stock group of origin of sockeye salmon harvested in the net fisheries in Alaska's Districts 101 to 108, in 2002.

District	Type	Group	Number	Percent	Standard Error	90% confidence interval Lower	Upper
101	**Gillnet**	**Alaska**	14,462	12.0	1831.1	11,450	17,474
		Nass	90,556	75.2	2701.6	86,112	95,000
		Skeena	15,335	12.7	2253.0	11,629	19,041
		Total	120,353	100.0			
101	**Purse seine**	**Alaska**	16,296	64	831.0	14,929	17,663
		Nass	5,003	20	935.0	3,465	6,541
		Skeena	4,119	16	776.0	2,842	5,396
		Total	25,418				
102	**Purse seine**	**Alaska**	23,759	80	1,284.2	21,647	25,871
		Nass	3,247	11	1,330.0	1,059	5,435
		Skeena	2,661	9	1,675.0	0	5,416
		Total	29,667				
103	**Purse Seine**	**Alaska**	4,670	82	212.4	4,321	5,019
		Nass	518	9	205.3	180	856
		Skeena	537	9	177.9	244	830
		Total	5,725				
104	**Purse seine**	**Alaska**	10,169	30	699.7	9,018	11,320
		Nass	8,803	26	937.5	7,261	10,345
		Skeena	14,557	43	914.1	13,053	16,061
		S. migrating	658	2	501.8	0	1,483
		Total	34,187				
106	**Gillnet**	**Alaska I**	39,629	71	NA	NA	NA
		Alaska II	2,944	5	NA	NA	NA
		Nass	3,639	6	NA	NA	NA
		Skeena	1,848	3	NA	NA	NA
		Tahltan	2,055	4	NA	NA	NA
		Stikine	1,962	3	NA	NA	NA
		Tuya	4,058	7	NA	NA	NA
		Total	56,135		NA	NA	NA
108	**Gillnet**	**Alaska I**	166	80	NA	NA	NA
		Alaska II	16	8	NA	NA	NA
		Nass	12	6	NA	NA	NA
		Skeena	13	6	NA	NA	NA
		Tahltan	0	0	NA	NA	NA
		Stikine	1	1	NA	NA	NA
		Tuya	0	0	NA	NA	NA
		Total	208		NA	NA	NA
Total		**Alaska**	112,111	41	NA	NA	NA
		Nass	111,778	41	NA	NA	NA
		Skeena	39,070	14	NA	NA	NA
		S. Migrating	658	0	NA	NA	NA
		Tahltan	2,055	1	NA	NA	NA
		Stikine	1,963	1	NA	NA	NA
		Tuya	4,058	1	NA	NA	NA
		Total	271,693				

[a] The total sockeye salmon catch for the District 101 purse seine fishery was 25,689 fish, of which 271 were taken in the terminal fisheries at Yes Bay; the remainder was 25,418 fish.

Table 3.–Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 101 (Tree Point) drift gillnet fishery, in 2002.

		Catch By Age Class							Standard	90% Confidence Interval	
Date	**Group**	**1.2**	**1.3**	**2.2**	**2.3**	**Other**	**Total**	**Percent**	**Error**	**Lower**	**Upper**
Week 25	**Alaska**	736	121	0	0	3	860	6.2	444.8	128	1,592
(6/16–6/22)	**Nass**	5,901	2,189	3,306	432	45	11,873	85.5	663.3	10,782	12,964
	Skeena	0	0	914	232	4	1,150	8.3	528.9	280	2,020
	Total	6,637	2,310	4,220	664	52	13,883				
Week 26	**Alaska**	371	0	0	83	2	456	5	357.2	0	1,044
(6/23–6/29)	**Nass**	5,492	727	2,997	40	35	9,291	93	479.0	8,503	10,079
	Skeena	0	46	151	9	1	207	2	340.1	0	766
	Total	5,863	773	3,148	132	38	9,954				
Week 27	**Alaska**	3,659	283	332	0	53	4,327	10	1297.2	2,193	6,461
(6/30–7/6)	**Nass**	13,382	2,889	14,730	183	377	31,561	75	2006.7	28,260	34,862
	Skeena	1,069	2,362	1,539	1,075	73	6,118	15	1705.1	3,313	8,923
	Total	18,110	5,534	16,601	1,258	503	42,006				
Week 28	**Alaska**	2,292	334	785	95	0	3,506	12	1071.9	1,743	5,269
(7/7–7/13)	**Nass**	11,615	917	7,267	330	0	20,129	68	1495.4	17,669	22,589
	Skeena	1,472	2,984	1,477	231	0	6,164	21	1241.1	4,122	8,206
	Total	15,379	4,235	9,529	656	0	29,799				
Week 29	**Alaska**	965	652	525	117	21	2,280	26	345.6	1,711	2,849
(7/14–7/20)	**Nass**	3,151	450	1,804	158	48	5,611	65	420.5	4,919	6,303
	Skeena	269	396	0	58	6	729	8	303.3	230	1,228
	Total	4,385	1,498	2,329	333	75	8,620				
Week 30	**Alaska**	121	263	149	37	0	570	8	212.9	220	920
(7/21–7/20)	**Nass**	2,958	216	3,554	77	0	6,805	92	354.3	6,222	7,388
	Skeena	0	18	0	0	0	18	0	305.4	0	520
	Total	3,079	497	3,703	114	0	7,393				
Week 31	**Alaska**	778	331	144	188	12	1,453	48	121.4	1,253	1,653
(7/28–8/3)	**Nass**	484	0	567	69	10	1,130	37	142.1	896	1,364
	Skeena	47	287	111	0	4	449	15	107.7	272	626
	Total	1,309	618	822	257	26	3,032				
Week 32	**Alaska**	105	50	200	89	2	446	13	110.4	264	628
(8/4–8/10)	**Nass**	807	50	1,874	87	12	2,830	81	190.1	2,517	3,143
	Skeena	64	98	68	0	1	231	7	173.5	0	516
	Total	976	198	2,142	176	15	3,507				
Week 33	**Alaska**	114	51	49	54	1	269	20	48.3	190	348
(8/11–8/17)	**Nass**	196	22	617	9	4	848	65	69.2	734	962
	Skeena	68	128	0	0	1	197	15	62.7	94	300
	Total	378	201	666	63	6	1,314				
Week 34	**Alaska**	91	45	40	16	0	192	33	32.7	138	246
(8/18–8/24)	**Nass**	64	10	248	15	0	337	58	38.0	274	400
	Skeena	16	32	0	0	0	48	8	34.3	0	104
	Total	171	87	288	31	0	577				
Week 35	**Alaska**	31	11	12	4	2	60	38	19.0	29	91
(8/25–8/31)	**Nass**	24	8	48	0	3	83	53	23.4	45	121
	Skeena	7	0	6	1	1	15	9	19.1	0	46
	Total	62	19	66	5	6	158				
Week 36–38 [a]	**Alaska**	6	11	9	15	2	43	39	16.3	16	70
(9/1–9/21)	**Nass**	13	8	33	0	4	58	53	22.3	21	95
	Skeena	0	0	5	3	1	9	8	12.1	0	29
	Total	19	19	47	18	7	110				
Fishery	**Alaska**	9,269	2,152	2,245	698	98	14,462	12.0	1831.1	11,450	17,474
Total	**Nass**	44,087	7,486	37,045	1,400	538	90,556	75.2	2701.6	86,112	95,000
	Skeena	3,012	6,351	4,271	1,609	92	15,335	12.7	2253.0	11,629	19,041
	Total	56,368	15,989	43,561	3,707	728	120,353	100.0			

[a] There were only 6 samples taken in weeks 37 and 38. The 36 sockeye caught in these weeks were added to the week 36 catch.

Table 4.–Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 101 purse seine fishery, in 2002.

		Catch By Age Class							Standard	90% Confidence Interval	
Date	**Group**	**1.2**	**1.3**	**2.2**	**2.3**	**Other**	**Total**	**Percent**	**Error**	**Lower**	**Upper**
Week 27–29	**Alaska**	4025	1297	647	507	287	6,763	74	647.1	5,699	7,827
(6/30–7/20)	**Nass**	1213	84	209	112	72	1,690	19	669.0	589	2,791
	Skeena	176	398	73	0	29	676	7	486.9	0	1,477
	Total	5414	1779	929	619	388	9,129				
Week 30	**Alaska**	1597	853	345	0	154	2,949	62	240.8	2,553	3,345
(7/21–7/27)	**Nass**	882	0	449	144	81	1,556	33	263.5	1,123	1,989
	Skeena	62	12	142	15	13	244	5	181.3	0	542
	Total	2541	865	936	159	248	4,749				
Week 31	**Alaska**	2497	773	747	47	91	4,155	89	201.9	3,823	4,487
(7/28–8/3)	**Nass**	131	0	89	158	8	386	8	194.4	66	706
	Skeena	134	0	5	0	3	142	3	139.1	0	371
	Total	2762	773	841	205	102	4,683				
Week 32	**Alaska**	205	344	362	38	41	990	26	398.7	334	1,646
(8/4–8/10)	**Nass**	513	0	162	67	32	774	20	550.5	0	1,680
	Skeena	1703	191	0	63	84	2,041	54	547.5	1,140	2,942
	Total	2421	535	524	168	157	3,805				
Week 33	**Alaska**	243	63	55	35	14	410	29	53.3	322	498
(8/11–8/17)	**Nass**	110	22	100	25	9	266	19	71.9	148	384
	Skeena	235	494	0	0	26	755	53	70.9	638	872
	Total	588	579	155	60	49	1,431				
Week 34–36	**Alaska**	627	229	115	23	35	1,029	63	105.2	856	1,202
(8/18–9/7)	**Nass**	177	68	75	0	11	331	20	110.1	150	512
	Skeena	164	84	0	4	9	261	16	93.2	108	414
	Total	968	381	190	27	55	1,621				
Fishery	**Alaska**	9,194	3,559	2,271	650	622	16,296	64	831.0	14,929	17,663
Total [a]	**Nass**	3,026	174	1,084	506	213	5,003	20	935.0	3,465	6,541
	Skeena	2,474	1,179	220	82	164	4,119	16	776.0	2,842	5,396
	Total	14,694	4,912	3,575	1,238	999	25,418				

[a] These district 101 seine catches do not include the 271 sockeye caught in West Behm Canal. Sub-districts 80, 85, 90, and 95 are considered part of a "terminal area" dominated by Alaskan fish

Table 5.–Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 102 purse seine fishery, in 2002.

		Catch By Age Class							Standard	90% Confidence Interval	
Date	Group	1.2	1.3	2.2	2.3	Other	Total	Percent	Error	Lower	Upper
Week 26–27	**Alaska**	458	2,503	733	133	59	3,886	75	466.7	3,118	4,654
(6/23–7/6)	**Nass**	726	0	529	0	19	1,274	24	511.6	432	2,116
	Skeena	0	21	0	25	1	47	1	359.8	0	639
	Total	1,184	2,524	1,262	158	79	5,207				
Week 28	**Alaska**	1,695	486	675	106	0	2962	72	556.6	2,046	3,878
(7/7–7/13)	**Nass**	215	0	0	0	0	215	5	565.8	0	1,146
	Skeena	93	767	77	20	0	957	23	573.1	14	1,900
	Total	2,003	1,253	752	126	0	4,134				
Week 29	**Alaska**	1,184	567	543	44	26	2,364	84	326.7	1,827	2,901
(7/14–7/20)	**Nass**	70	0	6	34	1	111	4	363.5	0	709
	Skeena	30	265	30	7	4	336	12	1040.1	0	2,047
	Total	1,284	832	579	85	31	2,811				
Week 30	**Alaska**	839	402	385	31	19	1,676	84	231.6	1,295	2,057
(7/21–7/27)	**Nass**	50	0	4	24	1	79	4	258.7	0	505
	Skeena	21	188	21	5	3	238	12	736.8	0	1,450
	Total	910	590	410	60	23	1,993				
Week 31	**Alaska**	1,902	1,249	997	26	95	269	96	249.2	3,859	4,679
(7/28–8/3)	**Nass**	4	0	21	105	3	133	3	246.3	0	538
	Skeena	0	32	0	0	1	33	1	189.4	0	345
	Total	1,906	1,281	1,018	131	99	4,435				
Week 32	**Alaska**	1,191	841	1,348	0	0	3,380	62	867.4	1,953	4,807
(8/4–8/10)	**Nass**	1,138	0	154	0	0	1,292	24	887.3	0	2,752
	Skeena	675	97	0	0	0	772	14	762.7	0	2,027
	Total	3,004	938	1,502	0	0	5,444				
Week 33	**Alaska**	1,556	1,100	141	66	75	2,938	96	323.1	2,407	3,469
(8/11–8/17)	**Nass**	8	0	16	0	1	25	1	318.4	0	549
	Skeena	13	82	0	12	3	110	4	254.6	0	529
	Total	1,577	1,182	157	78	79	3,073				
Week 34	**Alaska**	908	398	63	26	56	1,451	91	185.3	1,146	1,756
(8/18–8/24)	**Nass**	0	0	59	27	3	89	6	181.7	0	388
	Skeena	8	32	0	8	2	50	3	189.0	0	361
	Total	916	430	122	61	61	1,590				
Week 35–39	**Alaska**	545	158	130	0	0	833	85	88.8	687	979
(8/25–8/28)	**Nass**	0	0	15	14	0	29	3	74.7	0	152
	Skeena	114	2	0	2	0	118	12	70.0	3	233
	Total	659	160	145	16	0	980				
Fishery	**Alaska**	10,278	7,704	5,015	432	330	23,759	80	1,284.2	21,647	25,871
Total	**Nass**	2,211	0	804	204	28	3,247	11	1,330.0	1,059	5,435
	Skeena	954	1,486	128	79	14	2,661	9	1,675.0	0	5,416
	Total	13,443	9,190	5,947	715	372	29,667				

Table 6.–Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 103 purse seine fishery, in 2002.

		Catch By Age Class							Standard	90% Confidence Interval	
Date	**Group**	**1.2**	**1.3**	**2.2**	**2.3**	**Other**	**Total**	**Percent**	**Error**	**Lower**	**Upper**
Week 32	**Alaska**	582	287	152	0	12	1,033	71	115.2	843	1,223
(8/4–8/10)	**Nass**	1	0	97	0	1	99	7	91.5	0	250
	Skeena	146	147	28	0	4	325	22	153.2	73	577
	Total	729	434	277	0	17	1,457				
Week 33	**Alaska**	1,169	283	207	16	68	1,743	84	113.5	1,556	1,930
(8/11–8/17)	**Nass**	0	60	129	34	9	232	11	87.5	88	376
	Skeena	90	0	0	0	4	94	5	147.1	0	336
	Total	1,259	343	336	50	81	2,069				
Week 34–36	**Alaska**	1,304	174	393	6	17	1,894	86	116.1	1,703	2,085
(8/18–9/7)	**Nass**	20	0	152	13	2	187	9	65.5	79	295
	Skeena	77	40	0	0	1	118	5	117.9	0	312
	Total	1401	214	545	19	20	2,199				
	Alaska	3,055	744	752	22	97	4,670	82	212.4	4,321	5,019
Fishery	**Nass**	21	60	378	47	12	518	9	205.3	180	856
Total	**Skeena**	313	187	28	0	9	537	9	177.9	244	830
	Total	3,389	991	1,158	69	118	5,725				

Table 7.–Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 104 purse seine fishery, in 2002.

		Catch By Age Class							Standard	90% Confidence Interval	
Date	**Group**	**1.2**	**1.3**	**2.2**	**2.3**	**Other**	**Total**	**Percent**	**Error**	**Lower**	**Upper**
	Alaska	1,413	614	386	146	12	2,571	45	287	2,099	3,043
Week 28	**Nass**	839	183	334	3	6	1,365	24	338.6	808	1,922
(7/7–7/13)	**Skeena**	644	950	115	34	8	1,751	31	313.8	1,235	2,267
	S. migrating	0	0	0	0	0	0	0	169.9	0	279
	Total	2,896	1,747	835	183	26	5,687				
	Alaska	1,497	1,206	272	67	54	3,096	30	441.6	2,370	3,822
Week 29	**Nass**	1,350	0	1,098	0	43	2,491	24	582.5	1,533	3,449
(7/14–7/20)	**Skeena**	1,767	2,236	242	153	78	4,476	43	575.7	3,529	5,423
	S. migrating	300	44	1	0	8	353	3	322	0	883
	Total	4,914	3,486	1,613	220	183	10,416				
	Alaska	1,148	733	197	14	58	2,150	21	343.6	1,585	2,715
Week 30	**Nass**	1,482	31	1,282	39	78	2,912	28	517.4	2,061	3,763
(7/21–7/27)	**Skeena**	2,187	2,911	0	147	144	5,389	52	505.1	4,558	6,220
	S. migrating	0	0	0	0	0	0	0	259.4	0	427
	Total	4,817	3,675	1,479	200	280	10,451				
	Alaska	1,236	669	277	148	22	2,352	31	306.6	1,848	2,856
Week 31–35	**Nass**	993	35	958	30	19	2,035	27	396.5	1,383	2,687
(7/28–8/31)	**Skeena**	1,125	1,728	0	60	28	2,941	39	388.1	2,303	3,579
	S. migrating	284	18	1	0	2	305	4	228	0	680
	Total	3,638	2,450	1,236	238	71	7,633				
Fishery	**Alaska**	5,294	3,222	1,132	375	146	10,169	30	699.7	9,018	11,320
Total	**Nass**	4,664	249	3,672	72	146	8,803	26	937.5	7,261	10,345
	Skeena	5,723	7,825	357	394	258	14,557	43	914.1	13,053	16,061
	S. migrating	584	62	2	0	10	658	2	501.8	0	1,483
	Total	16,265	11,358	5,163	841	560	34,187				

[a] South-migrating, mostly Fraser River origin. Numbers of south-migrating fish of age classes other than 1.2 are estimated from age composition proportions provided by the Pacific Salmon Technical Committee. The standard errors are minimum estimates computed only for the 1.2 age class which was estimated directly through scale pattern analysis.

APPENDICES

Appendix A.–Digitized scale variables for use in SAS linear discriminant function analysis.

Variable	1st Freshwater Annular Zone
Z1*	Number of circuli (NC1FW)
Z2*	Width of zone (S1FW)
Z3*	Distance from scale focus (C0) to circulus 2 (C2)
Z4*	Distance from scale focus to circulus 4 (C0–C4)
Z5*	Distance from scale focus to circulus 6 (C0–C6)
Z6*	Distance from scale focus to circulus 8 (C0–C8)
Z7	Distance from circulus 2 to circulus 4 (C2–C4)
Z8	Distance from circulus 2 to circulus 6 (C2–C6)
Z9	Distance from circulus 2 to circulus 8 (C2–C8)
Z10	Distance from circulus 4 to circulus 6 (C4–C6)
Z11	Distance from circulus 4 to circulus 8 (C4–C8)
Z12*	Distance from fourth-to-last circulus to end of zone, C(NC1FW–4)–EOZ
Z13*	Distance from second-to-last circulus to end of zone, C(NC1FW–2)–EOZ
Z14	Distance from circulus 2 to end of zone (C2–EOZ)
Z15	Distance from circulus 4 to end of zone (C2–EOZ)
Z16	Relative width, (variable 3)/S1FW
Z17	Relative width, (variable 4)/S1FW
Z18	Relative width, (variable 5)/S1FW
Z19	Relative width, (variable 6)/S1FW
Z20	Relative width, (variable 7)/S1FW
Z21	Relative width, (variable 8)/S1FW
Z22	Relative width, (variable 9)/S1FW
Z23	Relative width, (variable 10)/S1FW
Z24	Relative width, (variable 11)/S1FW
Z25	Relative width, (variable 12)/S1FW
Z26	Relative width, (variable 13)/S1FW
Z27	Average interval between circuli (S1FW/NC1FW)
Z28*	Number of circuli in first 3/4 of zone
Z29*	Maximum distance between 2 consecutive circuli
Z30	Relative width, (variable 29)/S1FW

–continued–

Variable	2nd Freshwater Annular Zone
Z31*	Number of circuli (NC2FW)
Z32*	Width of zone (S2FW)
Z33*	Distance from end of first annular zone (E1FW) to circulus 2 (C2)
Z34*	Distance from end of first annular zone to circulus 4 (E1FW–C4)
Z35*	Distance from end of first annular zone to circulus 6 (E1FW–C6)
Z36*	Distance from end of first annular zone to circulus 8 (E1FW–C8)
Z37	Distance from circulus 2 to circulus 4 (C2–C4)
Z38	Distance from circulus 2 to circulus 6 (C2–C6)
Z39	Distance from circulus 2 to circulus 8 (C2–C8)
Z40	Distance from circulus 4 to circulus 6 (C4–C6)
Z41	Distance from circulus 4 to circulus 8 (C4–C8)
Z42*	Distance from fourth-to-last circulus to end of zone, C(NC2FW–4)–EOZ
Z43*	Distance from second-to-last circulus to end of zone, C(NC2FW–2)–EOZ
Z44	Distance from circulus 2 to end of zone (C2–EOZ)
Z45	Distance from circulus 4 to end of zone (C4–EOZ)
Z46	Relative width, (variable 33)/S2FW
Z47	Relative width, (variable 34)/S2FW
Z48	Relative width, (variable 35)/S2FW
Z49	Relative width, (variable 36)/S2FW
Z50	Relative width, (variable 37)/S2FW
Z51	Relative width, (variable 38)/S2FW
Z52	Relative width, (variable 39)/S2FW
Z53	Relative width, (variable 40)/S2FW
Z54	Relative width, (variable 41)/S2FW
Z55	Relative width, (variable 42)/S2FW
Z56	Relative width, (variable 43)/S2FW
Z57	Average interval between circuli (S2FW/NC2FW)
Z58*	Number of circuli in first 3/4 of zone
Z59*	Maximum distance between 2 consecutive circuli
Z60	Relative width, (variable 59)/S2FW

Variable	Freshwater Plus Growth Zone
Z61*	Number of circuli (NCPGZ)
Z62*	Width of zone (SPGZ)

Variable	All Freshwater Zones
Z63	Total number of annular circuli (NC1FW + NC2FW)
Z64	Total width of annular zones (S1FW + S2FW)
Z65	Total number of freshwater circuli (NC1FW + NC2FW + NCPGZ)
Z66	Total width of freshwater zones (S1FW + S2FW + SPGZ)
Z67	Relative width, S1FW/(S1FW + S2FW + SPGZ)
Z68	Relative width, SPGZ/(S1FW + S2FW + SPGZ)
Z69	Relative width, S2FW/(S1FW + S2FW + SPGZ)

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Variable	**1st Marine Annular Zone**
Z70*	Number of circuli (NC1OZ)
Z71*	Width of zone (S1OZ)
Z72*	Distance from end of freshwater growth (EFW) to circulus 3 (C3)
Z73*	Distance from end of freshwater growth to circulus 6 (EFW–C6)
Z74*	Distance from end of freshwater growth to circulus 9 (EFW–C9)
Z75*	Distance from end of freshwater growth to circulus 12 (EFW–C12)
Z76*	Distance from end of freshwater growth to circulus 15 (EFW–C15)
Z77	Distance from circulus 3 to circulus 6 (C3–C6)
Z78	Distance from circulus 3 to circulus 9 (C3–C9)
Z79	Distance from circulus 3 to circulus 12 (C3–C12)
Z80	Distance from circulus 3 to circulus 15 (C3–C15)
Z81	Distance from circulus 6 to circulus 9 (C6–C9)
Z82	Distance from circulus 6 to circulus 12 (C6–C12)
Z83	Distance from circulus 6 to circulus 15 (C6–C15)
Z84	Distance from circulus 9 to circulus 15 (C9–C15)
Z85*	Distance from sixth-to-last circulus to end of zone, C(NC1OZ–6)–EOZ
Z86*	Distance from third-to-last circulus to end of zone, C(NC1OZ–3)–EOZ
Z87	Distance from circulus 3 to end of zone (C3–EOZ)
Z88	Distance from circulus 9 to end of zone (C9–EOZ)
Z89	Distance from circulus 15 to end of zone (C15–EOZ)
Z90	Relative width, (variable 72)/S1OZ
Z91	Relative width, (variable 73)/S1OZ
Z92	Relative width, (variable 74)/S1OZ
Z93	Relative width, (variable 75)/S1OZ
Z94	Relative width, (variable 76)/S1OZ
Z95	Relative width, (variable 77)/S1OZ
Z96	Relative width, (variable 78)/S1OZ
Z97	Relative width, (variable 79)/S1OZ
Z98	Relative width, (variable 80)/S1OZ
Z99	Relative width, (variable 81)/S1OZ
Z100	Relative width, (variable 82)/S1OZ
Z101	Relative width, (variable 83)/S1OZ
Z102	Relative width, (variable 84)/S1OZ
Z103	Relative width, (variable 85)/S1OZ
Z104	Relative width, (variable 86)/S1OZ
Z105	Average interval between circuli (S1OZ/NC1OZ)
Z106*	Number of circuli in first 1/2 of zone
Z107*	Maximum distance between 2 consecutive circuli
Z108	Relative width, (variable 107)/S1OZ

* discrete variables

Appendix B.–Scale variables with associated entry F-statistics and classification matrices for the linear discriminant function (LDF) models used to classify sockeye catch in the District 101 gillnet fishery.

Age-Specific Model Constructed		Stepwise Variable Selection		Misclassification Matrix				
				True Stock	Classified As (number and percent)			
Age Class	**Run**	**Variable**	**F-Statistic**		**Alaska**	**Nass**	**Skeena**	**Total**
1.2	**Total**	Z88	205.266	**Alaska**	162	26	12	
	Season	Z4	161.518		81%	13%	6%	200
		Z89	44.602	**Nass**	20	161	18	
		Z28	35.196		10.05%	80.90%	9.05%	199
		Z104	11.046	**Skeena**	7	20	172	
		length	8.899		3.52%	10.05%	86.43%	199
				Total	189	207	202	598
1.3	**Total**	Z5	267.211	**Alaska**	164	21	15	
	Season	Z71	46.641		82%	10.50%	7.50%	200
		Z84	12.501	**Nass**	14	61	19	
		length	11.621		14.89%	64.89%	20.21%	94
		Z98	7.526	**Skeena**	7	46	147	
					3.50%	23%	73.50%	200
				Total	185	128	181	494
2.2	**Total**	Z5	261.823	**Alaska**	133	9	6	
	Season	Z69	57.955		89.86%	6.08%	4.05%	148
		Z90	25.419	**Nass**	3	188	9	
		Z57	14.827		1.50%	94%	4.50%	200
		Z76	8.764	**Skeena**	3	12	17	
		Z50	8.274		9.38%	37.50%	53.13%	32
		length	6.431	**Total**	139	209	32	380
		Z80	5.707					
		Z101	10.412					
		Z77	6.236					
		Z95	6.82					
2.3	**Total**	Z91	23.003	**Alaska**	88	25	9	
	Season	length	16.142		72.13%	20.49%	7.38%	122
				Nass	2	9	3	
					14.29%	64.29%	21.43%	14
				Skeena	1	2	12	
					6.67%	13.33%	80%	15
				Total	91	36	24	151

Appendix C.–Scale variables with associated entry F-statistics and classification matrices for the linear discriminant function (LDF) models used to classify sockeye catch in the District 104 purse seine fishery.

Age-Specific Model Constructed		Stepwise Variable Selection		Misclassification Matrix					
					Classified As (number and percent)				
Age Class	Run Timing	Variable	F-Statistic	True Stock	Fraser	Alaska	Nass	Skeena	Total
1.2	**Total**	Z87	141.013	**Fraser**	122	146	23	12	
	Season	Z4	120.903		68.54%	73.74%	11.62%	6.06%	303
		Z85	57.097	**Alaska**	17	146	23	12	
		Z28	25.852		8.59%	73.74%	11.62%	6.06%	198
		Z84	23.383	**Nass**	31	8	147	13	
		Z98	24.121		15.58%	4.02%	73.87%	6.53%	199
		Z79	Z79	**Skeena**	16	3	24	157	
		Z102	Z102		8%	1.50%	12%	78.50%	200
		Z14	Z14	**Total**	186	303	217	194	900
		Z65	Z65						
		Z25	Z25						
1.3	**Total**	Z5	260.269	**Alaska**		164	27	19	
	Season	Z88	45.02			78.10%	12.86%	9.05%	210
		Z89	14.694	**Nass**		5	70	19	
		Z98	9.405			5.32%	74.47%	20.21%	94
				Skeena		6	50	144	
						3%	25%	72%	200
				Total		175	147	182	
						3%	25%	72%	504
2.2	**Total**	Z5	272.113	**Alaska**		141	5	11	
	Season	Z57	36.674			89.81%	3.18%	7.01%	157
		Z90	23.449	**Nass**		7	168	25	
		Z17	18.642			3.50%	84%	12.50%	200
		Z50	13.222	**Skeena**		3	9	20	
		Z72	9.054			9.38%	28.13%	62.50%	32
				Total		151	182	56	389
2.3	**Total**	Z91	22.844	**Alaska**		104	27	11	
	Season	Z67	11.402			73.24%	19.01%	7.75%	142
		Z27	6.893	**Nass**		3	9	2	
						21.43%	64.29%	14.29%	14
				Skeena		1	3	11	
						6.67%	20%	73.33%	15
				Total		108	39	24	171