CONTRIBUTION OF ALASKAN, CANADIAN, AND TRANSBOUNDARY SOCKEYE STOCKS TO CATCHES IN SOUTHEAST ALASKA PURSE SEINE AND GILLNET FISHERIES, DISTRICTS 101-108, 1987 BASED ON ANALYSIS OF SCALE PATTERNS

By

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Volume IV
1987
FINAL REPORTS
For
Pacific Salmon Treaty-Related Research
Conducted in Southeast Alaska
By the Alaska Department of Fish and Game
In Cooperation with the National Marine Fisheries Service

Contract No. NA-87-ABH-00025

Regional Information Report[1] No. 1J87-06

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

October 1988

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ACKNOWLEDGEMENTS

We are grateful to personnel of the Port Sampling Project of the Division of Commercial Fisheries, Southeast Region, Alaska Department of Fish and Game and to personnel of the Canadian Department of Fisheries and Oceans for their assistance in gathering samples from catches and escapements. In particular we would like to thank Jan Weller, Karl Hoffmeister, Lane Johnson, Jerry Koerner, Keith Pahlke and Kathy Robinson for their advice, logistical support, and sampling efforts. Kathleen Jensen provided District 106 and 108 analyses, scale aging and digitizing advice, and statistical support. Scott McPherson trained and supervised scale agers and provided statistical support. Iris Frank digitized scales and provided organizational skills. Lisa Jones digitized scales. Robert Conrad developed custom software used to digitize and analyze scales. Larry Talley and Norma Jean Sands refined the digitizing software. Ben Van Alen and Norma Jean Sands provided editing assistance.

PROJECT SPONSORSHIP

This investigation was partially funded with Anadromous Fish Conservation Act (P.L. 89-304 as amended) funds under Project No. AFC-72 and with U.S.-Canada Pacific Salmon Treaty funds under Cooperative Agreement NA-87-ABH-00025.

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ABSTRACT

Sockeye salmon (*Oncorhynchus nerka*) harvested in southern Southeast Alaska's 1987 gill net and purse seine fisheries were classified to nation and/or stock of origin using linear discriminant function analysis of scale patterns and age composition data. We estimated that 255 thousand (53%) of the classified catch was of Alaskan origin, 221 thousand (46%) were bound for the Canadian Nass and Skeena Rivers, and 2 thousand (<1%) were of transboundary Stikine River (including Tahltan Lake stock) origin. Of the 255 thousand Alaskan sockeye approximately 119 thousand were Alaska II type (mostly McDonald Lake) fish while 135 thousand were from other Alaskan systems. Separate Nass and Skeena River contribution estimates are presented for some districts. Stock contribution estimates are presented by age class and week for all major fisheries.

KEY WORDS: sockeye salmon, (*Oncorhynchus nerka*), stock composition, linear discriminant function analysis, scale pattern analysis, Southeast Alaska, northern British Columbia, Canada, Boundary Area.

INTRODUCTION

Commercial net fisheries in southern Southeast Alaska harvest mixed stocks of sockeye salmon (*Oncorhynchus nerka*) that originate from lakes, rivers and streams in Southeast Alaska and northern British Columbia (Rich and Morton 1930; Verhoeven 1952; Norenberg 1959; Logan 1967; Simpson 1968; Hoffman et al. 1983, 1984). The Alaska sockeye originate from numerous relatively small or moderately productive Alaskan systems in the immediate vicinity (Figure 1). The Canadian sockeye originate principally from the Nass and Skeena Rivers. The Nass and Skeena Rivers lie entirely within British Columbia and flow into Chatham Sound just south of the Alaska border (Figure 2). Transboundary Stikine River sockeye, which are typically found in identifiable numbers only in Districts 106 and 108, contribute relatively minor numbers of fish to area catches. In some years south-migrating stocks of sockeye salmon, thought to be predominately bound for the Fraser River in southern British Columbia, may be caught in some Southeast Alaskan fisheries. Contributions of these south-migrating stocks are estimated separately in years when they are present in substantial numbers. Rarely, a few sockeye salmon returning to northern Southeast Alaska and to systems as distant as Prince William Sound, Alaska, and Washington State may also be taken but they are so uncommon that separate contribution estimates of these stocks are not feasible.

The purpose of this study is to determine the contributions of major sockeye stocks to the Alaskan commercial purse seine and gill net fishery catches in Districts 101 through 108 (Figure 3). Reliable estimates of the relative Alaskan and Canadian stock compositions of sockeye salmon harvested in Southeast Alaska waters are valuable for implementation of the U.S.-Canada Pacific Salmon Treaty. This information is useful for evaluating interceptions, calculating productivity, as well as determining migratory timing and entry patterns. National equity, or benefits equal to production, requires that accurate rates of interceptions of one nations stocks by the other nations fisheries be determined. Linear discriminant function analysis of scale patterns is used to distinguish the stock groups. Significant and persistent differences between stock groups

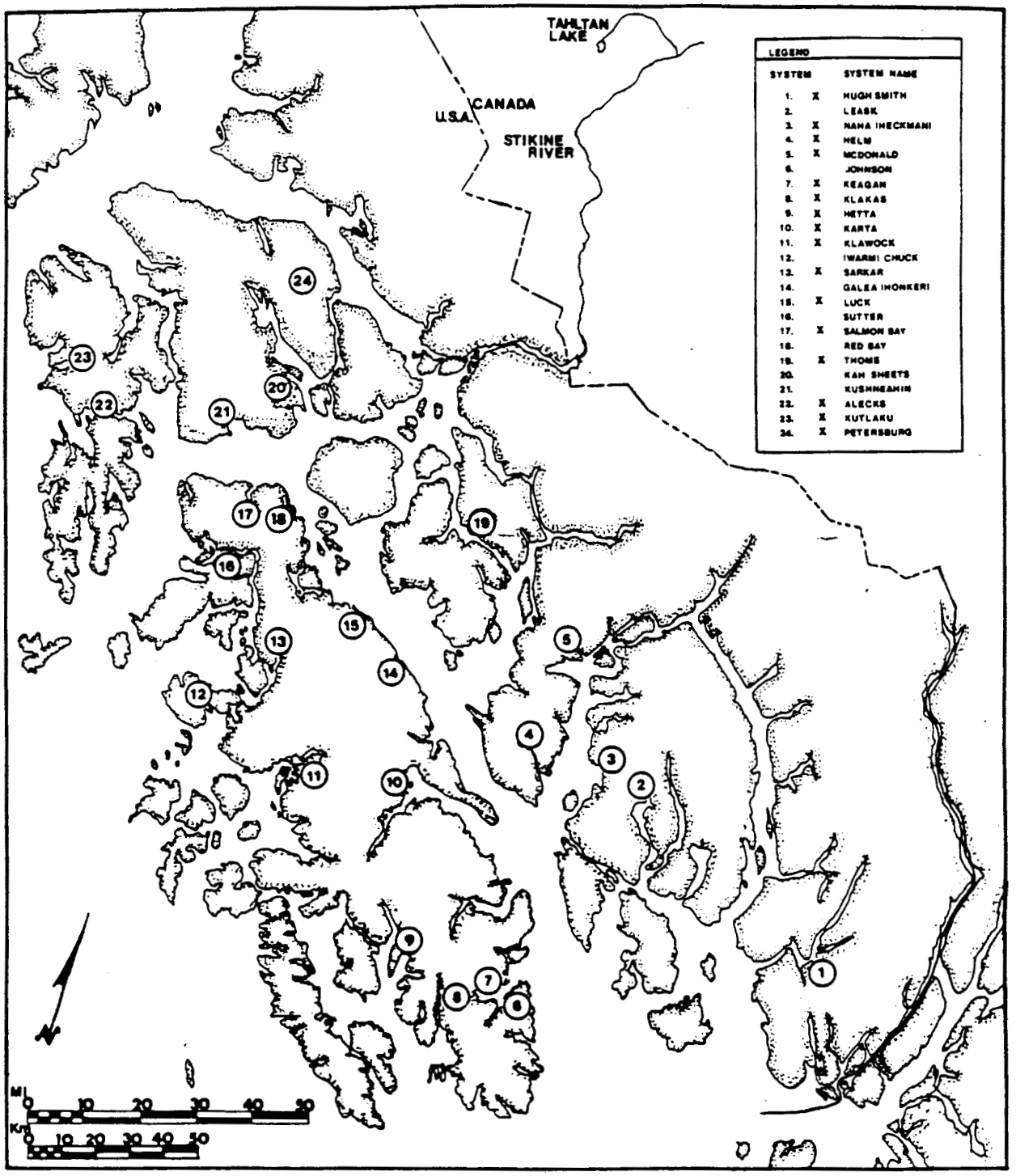

Figure 1. Major sockeye salmon systems of Southeast Alaska and the transboundary Stikine; numbers identify Alaskan systems where scales are commonly collected while 'x' in the legend identifies Alaska stocks sampled in 1987.

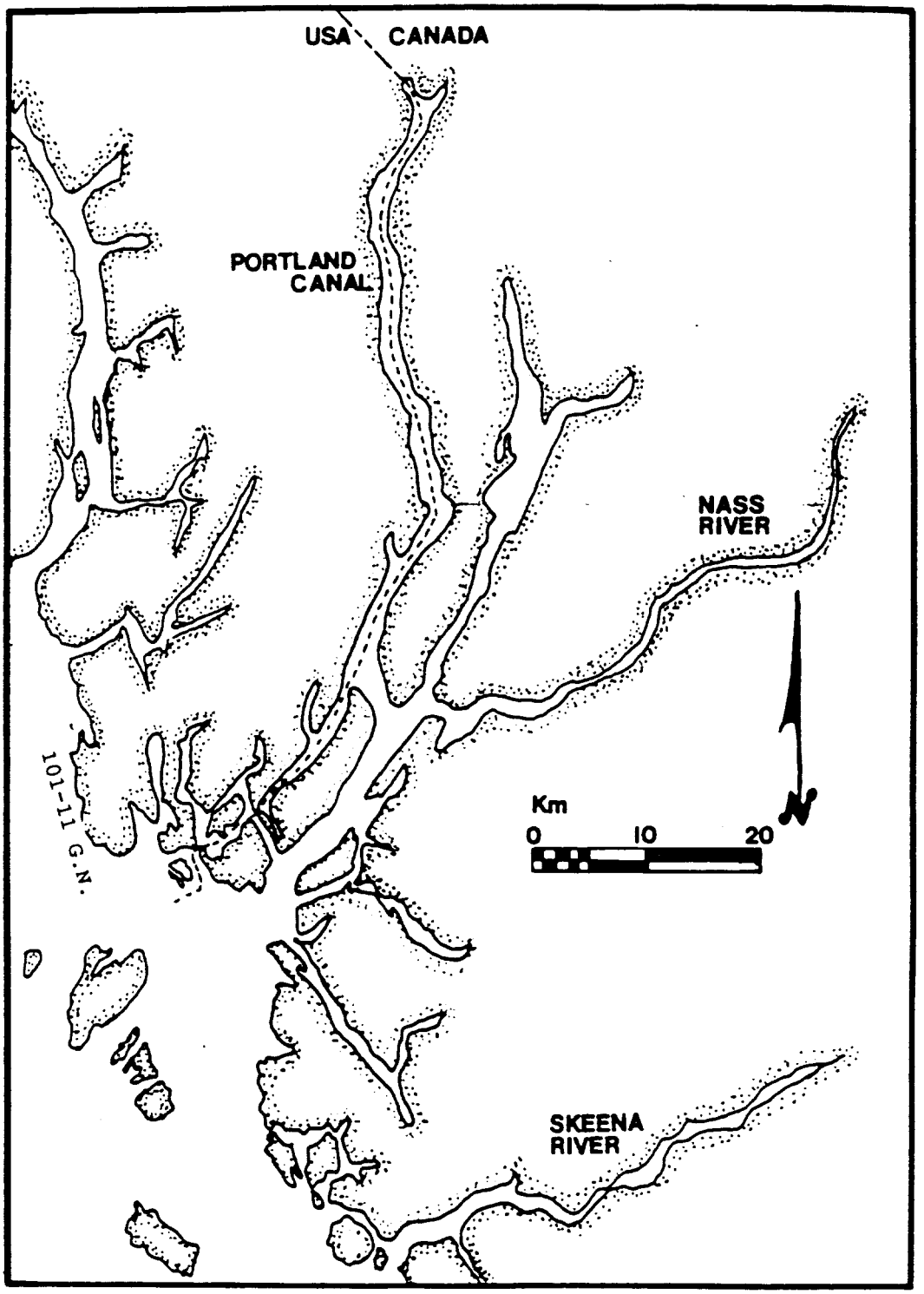

Figure 2. The Canadian Nass and Skeena Rivers.

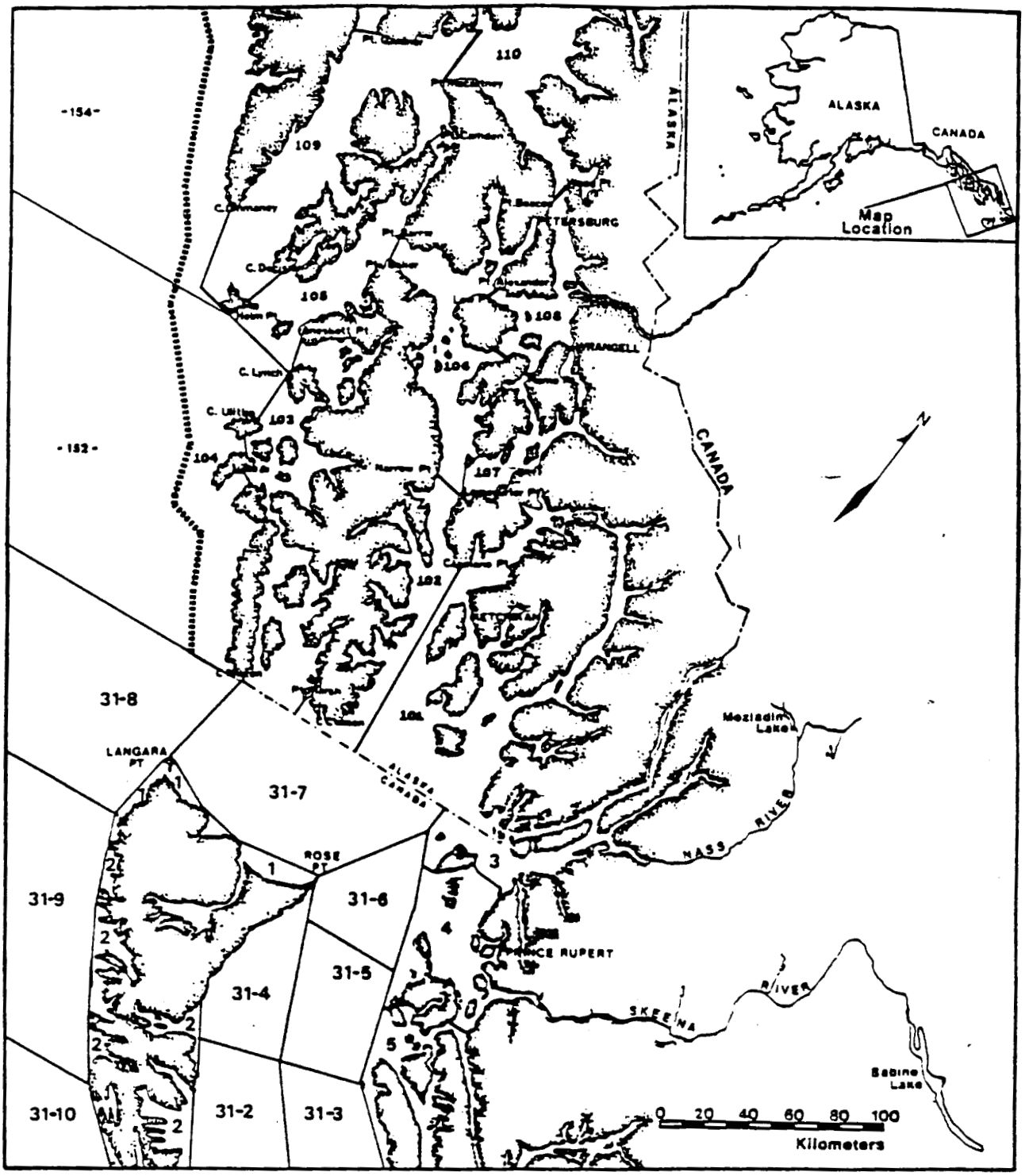

Figure 3. Fishery management districts in southern Southeast Alaska and northern British Columbia waters.

originating in Alaska and Canada continue to be documented in the patterns of growth during freshwater and early marine life history (Marshall et al. 1984; Oliver et al. 1983, 1984; Oliver and Walls 1985; Oliver and Jensen 1986; Oliver and McGregor 1986; Oliver et al. 1987; Oliver et al 1987). Sockeye salmon from Alaskan stocks grow slower during their lacustrine residence than do fish from Canadian stocks. Persistent differences in the number and spacing of circuli in the spring "plus growth" and first marine zones also exist between stock groups. These differences in growth allow easy and accurate separation of Canadian and Alaskan stocks (Oliver et al. 1983; Marshall et al. 1984, 1986). While the differences in scale patterns between Alaskan and Canadian groups of stocks is much greater than the differences within these groups, further separation of component stocks is possible. Alaskan stocks have been divided into "Alaskan I" and "Alaskan II" types based on their scale patterns: Alaska I consists of many different streams in southeast Alaska. The Alaska II pattern is typified by fish from McDonald Lake, currently the largest single producer of sockeye salmon in southern Southeast Alaska. Nass and Skeena River contributions are also estimated separately except for Districts 106 and 108, where accurate estimation of Tahltan Lake sockeye is important.

The reader is referred to McPherson (1988) for detailed information on the abundance, age, sex, and length composition of 1987 Southeast Alaska sockeye salmon catches and escapements. For detailed analyses of transboundary Stikine sockeye catches in Districts 106, 108, and Canadian Stikine River fisheries see Jensen and Frank (1988). For analyses of transboundary Taku sockeye catches in District 111 and Canadian Taku River fisheries see McGregor and Jones (1988).

METHODS

Numbers of Fish Caught

We obtained estimates of the hours open, number of boats fishing, and number of fish harvested by gear type, district, and week

from the ADF&G, Division of Commercial Fisheries, fish ticket data base RUNTIME program. Catches were summarized by "statistical week". Statistical weeks, hereafter referred to as "weeks", began on Sunday at 12:01 A.M. and end the following Saturday at midnight. These statistical weeks were numbered sequentially beginning with the first Sunday of the calendar year.

Scale Collection and Processing

Commercial gill net and purse seine landings of sockeye salmon in southern Southeast Alaska were sampled for scales by ADF&G, Commercial Fisheries Division employees at fish processing facilities in Petersburg, Ketchikan, Craig, Klawock, Hydaburg, and Wrangell. Some sampling was also conducted at several smaller buying stations and aboard tenders or individual fishing vessels. Gender was determined and recorded for each fish sampled as well as mid-eye to fork-of-tail length.

Efforts were made to sample landings as representatively as possible. Fish were sampled at random from all deliveries, at all major ports of landing and from multiple vessels and tenders. Deliveries with fish of mixed gear types, districts, or weeks were not sampled.

One to three scales from each fish were sampled from up to 700 sockeye salmon caught in each district for each weeks open gill net and seine fisheries. The sampling goal was intended to yield 560 ageable samples for each gear type/district/week strata which would allow accurate estimation of relative numbers of each major age class within plus or minus 5 percentage points 90% of the time based on standard binomial formulae (Cochran 1977). We assume that 20% of the scales will be unageable due to regeneration or other causes. Recent work by Thompson (1987) in simultaneously estimating parameters of a multinomial population indicates that 510 ageable scales of four major age classes yields age proportion estimates with a precision of plus or minus 5% and a probability of 95%. Detailed age, gender, and length data for Southeast Alaskan catches and escapements are not

presented in this report, but can be found in McPherson et al. (1988).

Escapements to 16 lake systems in southern Southeast Alaska (Figure 1) were sampled by ADF&G, Commercial Fisheries Division, personnel. Approximately 1000 to 1500 scales were collected each from test fisheries operating in the lower reaches of the Nass and Skeena Rivers by Canadian Department of Fisheries and Oceans Canada personnel (CDFO)(Figure 2). CDFO personnel also sampled approximately 1000 sockeye from the Tahltan Lake weir and 200 from non-Tahltan Stikine escapements.

Scales were sampled from the preferred area above the lateral line on the left side of the fish on a diagonal downward from the rear of the dorsal fin to the front 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 (40 to 60 power) magnification. Criteria used to assign ages were similar to those of Mosher (1968). Ages are reported in European notation. Scale circuli were counted and incremental distances measured or "digitized" according to zones that parallel the age of the fish (Figure 4). Scale impressions were projected onto a digitizing tablet at 100 power magnification using equipment similar to that described by Bilton (1970) and modified by Ryan and Christie (1976). Counts and measurements were made along a line starting at the scale focus (center) at an angle approximately 20 degrees from the long axis and perpendicular to the sculptured field.

Discriminant Analysis

The ability to differentiate salmon stocks based on scale patterns depends upon the degree of difference in the scale characters between stocks (Marshall et al. 1987). Linear discriminant function (LDF) (Fisher 1936) analysis of scale patterns has been used to estimate stock contributions to southern Southeast Alaska mixed stock sockeye salmon fisheries

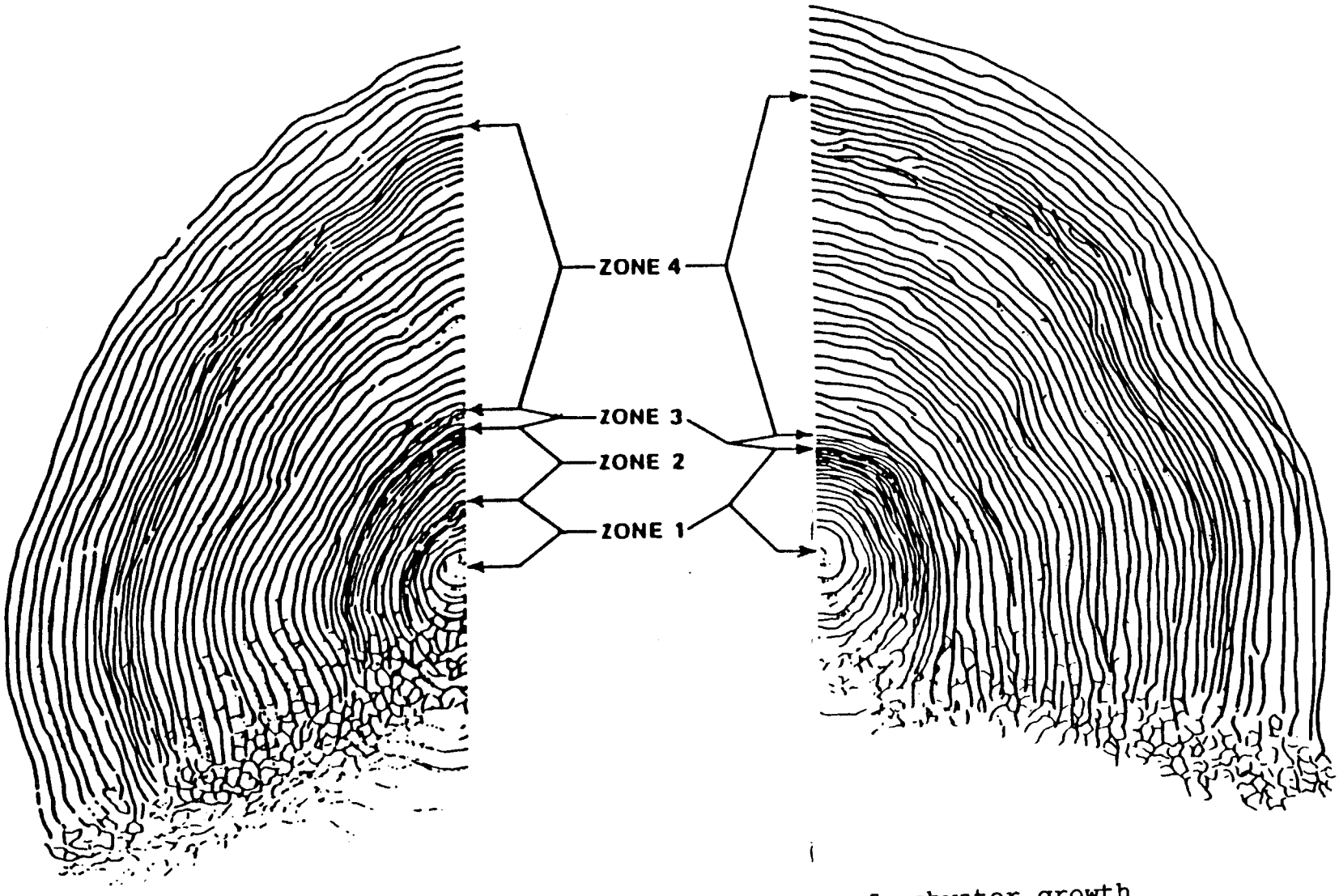

Figure 4. Typical scales with one and two freshwater growth zones showing the zones used for scale pattern analysis.

since 1982 (Oliver et al. 1987; Oliver and Jensen 1986; Oliver and Walls 1985; Oliver 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 not too different. In addition, large sample sizes appear to make LDF robust to the assumption of common variance-covariance matrices (Issacson 1954; Anas and Murai 1969). The method also appears to be robust to violations of the normality assumption for discrete distributions.

Scale variables to be used in the LDF are selected with a stepwise regression. In this process, variables are added until the partial F-statistic of all variables available for entry into the model is less than 4.00 (Enslein et al. 1977). An almost unbiased estimate of classification accuracy for each LDF was determined using a leaving-one-out procedure (Lachenbruch 1967). One sample is 'left-out', the discriminant rule is estimated, and the 'left-out' sample is classified using the discriminant rule and checked to see if it was classified correctly. This procedure is repeated for all samples. Thus, when an LDF is run using the leaving-one-out procedure, a classification matrix is developed which gives the proportion of correctly identified fish and the proportion of misclassification of each stock to each of the other stocks.

When more than two stock groups are being analyzed the stepwise regression procedure does not always result in maximum classification accuracies or the most balanced classification matrix. Frequently, well-separated groups are separated even further while poorly separated groups remain poorly separated (Habbema and Hermans 1977). Scale variables that provided the best discrimination between the groups that most often misclassified as each other were occasionally added to or substituted for other variables used in the LDF to provide either a better balance to the classification matrix or to increase the mean classification accuracy.

The proportional estimates of stock composition in the mixed stock harvests, referred to as first order estimates, were adjusted with a classification matrix correction procedure (Cook and Lord 1978). The fish in the mixed stock composition sample are classified with the LDF. The vector of proportional estimates for each stock or stock group is multiplied by the classification matrix to give new estimates, referred to as adjusted estimates, for the true proportions of stocks and stock groups in the mixed stock fishery. In cases where adjusted estimated proportions for a stock group were less than zero, the entire catch sample was reclassified with a model excluding that stock group. This process was repeated until all adjusted estimated proportions were positive.

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 are determined from the multinomial probability distribution. These two variance-covariance matrices are combined to give variances and covariances for the second order estimates of stock proportions. The variances for the proportions of each stock are the diagonal elements of this combined matrix, i.e. they are 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.

Classification of Catches

The commercial catches are classified by stock composition based on standards assembled from the 1986 escapements. Four major age groups, 1.2, 1.3, 2.2, and 2.3 (European notation), generally contribute more than 98% of the commercial catches. Whenever possible, standards were built for each age class. Standards are not built for age classes which contributed only a minor fraction of the escapement for a given stock or stock group since

insufficient scales were available to build them. In 1987 no age 2.2 Alaska II standard or age 2.3 Skeena standard could be built. Age specific models are used in the analysis to: 1) account for differences in age composition between stocks, 2) remove potential bias due to differences in migratory timing of different age fish, and 3) 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, however, in some weeks catches were small and samples of the less common age groups were insufficient to classify unless pooled with the adjacent week's sample.

The stock apportionment of the minor age groups not classified with LDF assumes that the proportion of the minor ages belonging to any given stock is equal to the combined proportion of all LDF classified age classes.

The variance of the weekly and seasonal stock composition estimates are approximated with the delta method (Seber 1982). Variance estimates are functions of: 1) accuracies of the models used to estimate stock compositions in the mixed stock catches, 2) sample size of known origin scales used to build models, 3) proportions of stocks in the initial and adjusted stock composition estimates, 4) total sample size of mixed stock catch samples, 5) number of samples of each major age class in the mixed stock catch, and 6) the number of fish caught. However, it is a minimum estimate of variance since it does not include any variance associated with the age classes not classified with LDF, variance for stocks contributing no fish during a given week, or any estimate of aging or digitizing errors.

Development of Standards

Stock identification analyses from 1982 through 1985 only distinguished between Alaskan and Canadian sockeye stocks in most districts. Additional stock groups, Tahltan and Stikine River non-Tahltan fish, were added in districts where Stikine River fish were relatively numerous, e.g. Districts 106 and 108. In 1986 stock groups were further refined in order to obtain

specific stock origin data. The Canadian group was split into Nass and Skeena River stocks. The Alaskan group was also split, one group consisting of McDonald Lake type fish, and the other the other Alaskan stocks. Nass and Skeena River standards remain combined for a single contribution estimate in District 106 due to misclassification between Tahltan Lake stocks (accurate estimation of which is a primary objective of the District 106 analysis) and Nass and Skeena River stocks when estimated individually.

While the standard for the Alaska II group is formed exclusively of McDonald Lake samples a significant amount of misclassification may occur with other Alaskan stocks currently included in the Alaska I group. Because we were unable to quantify the extent of this misclassification or the stocks involved we felt more comfortable referring to the groups as Alaska I and Alaska II rather than Alaska I and McDonald Lake. McDonald Lake is the single most productive sockeye salmon system in southern Southeast Alaska with an escapement greater than 100 thousand in recent years. Thus, contributions of Alaska II stocks should be viewed as an index of abundance of stocks primarily bound for McDonald Lake. Further analysis of similarities and differences of Alaskan stocks is planned and may result in further separability of component Alaskan stocks. Most of the misclassification in the 4-way models is within groups of the same national origin. The effect of modifying the discriminant models from 2-way Alaska vs. Nass/Skeena to 4-way Alaska I vs. Alaska II vs. Nass vs. Skeena was investigated using 1984 and 1986 data and changed national contribution rates by only a few hundred fish (Oliver et al. 1987).

RESULTS AND DISCUSSION

Fishery Dynamics

Gill net fishing in southern Southeast Alaska (Districts 101-11, 106, and 108) generally opens by regulation the third Sunday in

June. Some purse seine fisheries (generally Districts 104 and 101) open the first Sunday in July. Primary management objectives include meeting spawning escapement goals and compliance with provisions of the U.S.-Canada Pacific Salmon Treaty. Achievement of management objectives is accomplished through manipulation of fishing time and harvest areas. This manipulation of time and area openings affects stock composition of catches. The amount of fishing time allowed early in the season depends to some extent on the abundance of sockeye and to a lesser extent chum salmon. Later in the season length of openings depends on the abundance of pink salmon. Fishing time is also affected by the U.S.-Canada Pacific Salmon Treaty which limited purse seine sockeye harvest in District 104 prior to week 31 to a 4 year total (1985 - 1988) of 480 thousand fish, or an average of 120 thousand sockeye a year for that period. In the District 101-11 gill net fishery the treaty limits sockeye catch to a yearly average of 130 thousand. Seine fisheries Districts 103, 105, 106 and 107 are open only in years of localized pink salmon abundance, generally occur in late July and August, and are targeted on concentrations of pinks moving toward their spawning streams. Gear moves freely within Southeast Alaska and may concentrate rapidly in areas of real or perceived abundance. In years of high pink salmon abundance concentrations of gear and long openings may result in high incidental catches of sockeye salmon late in the season even though sockeye abundance is declining.

Fishery Performance

The 1987 southern Southeast Alaska net catch of 479 thousand sockeye represents the lowest area catch since stock composition analyses were begun in 1982. In comparison, approximately 773 thousand sockeye were taken in 1982, 905 thousand in 1983, 577 thousand in 1984, 1 million 50 thousand in 1985, and 840 thousand in 1986 (Table 1). Low catches were due, in part, to reduced fishing time as well as reduction in the number of boats participating. Fishing time reductions were primarily due to the weak return of pink salmon. The low catch of sockeye was more a reflection of the weak pink salmon runs rather than a lack of

Table 1. Estimated sockeye contribution by nation of origin to southeast Alaska District 101-108 gill net and purse seine fisheries, 1982-1987.

District Fishery	Group	1982		1983		1984		1985		1986		1987	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
101-11	Alaska	69,510	36.4	48,942	36.0	34,762	39.4	30,904	17.9	12,732	8.7	25,091	23.3
Gill Net	Canada	121,373	63.6	87,064	64.0	53,464	60.6	141,959	82.1	132,899	91.3	82,489	76.7
	Total	190,883		136,006		88,226		172,863		145,631		107,580	
101	Alaska	41,401	56.1	20,493	42.8	49,209	60.3	82,376	68.9	50,261	67.2	30,088	69.4
P. Seine	Canada	32,416	43.9	27,419	57.2	32,445	39.7	37,189	31.1	24,484	32.8	13,241	30.6
	Total	73,817		47,912		81,654		119,565		74,745		43,329	
102	Alaska	18,296	80.4	6,620	59.0	17,653	82.4	27,197	78.3	8,698	73.5	16,397	93.8
P. Seine	Canada	4,451	19.6	4,593	41.0	3,764	17.6	7,549	21.7	3,142	26.5	1,076	6.2
	Total	22,747		11,213		21,417		34,746		11,840		17,473	
103	Alaska			7,053	67.9			19,829	74.5	9,798	72.2	1,544	97.7
P. Seine	Canada			3,336	32.1			6,795	25.5	3,773	27.8	37	2.3
	Total			10,389				26,624		13,571		1,581	
104	Alaska	107,492	37.7	157,795	24.2	78,821	26.8	93,988	21.8	100,966	22.7	68,741	40.1
P. Seine	Canada	177,739	62.3	493,012[a]	75.8	214,847	73.2	337,587	78.2	343,024	77.3	102,473	59.9
	Total	285,231		650,807		293,668		431,575		443,990		171,214	
106	Alaska	94,187	48.7	32,670	66.7	60,367	65.8	126,952	47.9	100,334	68.8	112,893	82.7
Gill Net	Canada	61,976	32.0	10,610	21.7	24,661	26.9	111,051	41.9	42,784	29.3	21,190	15.5
	Stikine	37,365	19.3	5,693	11.6	6,761	7.4	27,064	10.2	2,687	1.8	2,344	1.7
	Total	193,528		48,973		91,789		265,067		145,805		136,427	
108	Alaska	1,632	25.0							930	22.2		
Gill Net	Canada	3,787	58.0							73	1.7		
	Stikine	1,110	17.0							3,184	76.0		
	Total	6,529								4,187			
	Alaska	332,518	43.0	273,573	30.2	240,812	41.8	381,246	36.3	283,719	33.8	254,754	53.3
Total	Canada	401,742	52.0	626,034[a]	69.2	329,181	57.1	642,130	61.1	550,179	65.5	220,506	46.2
	Stikine	38,475	5.0	5,693	0.6	6,761	1.2	27,064	2.6	5,871	0.7	2,344	0.5
	Total	772,735		905,300		576,754		1,050,440		839,769		477,604	

[a] District 104 Canadian estimates for 1983 include 'south migrating stocks' thought to be mostly of Canadian Fraser River origin.

availability of sockeye salmon. Declines in sockeye catches were most precipitous in District 104 where catches dropped by over 250 thousand sockeye from catches in 1985 and 1986.

National Origin of Southern Southeast Sockeye Catches

The proportion of Alaskan, Nass, Skeena, Tahltan and Stikine sockeye salmon harvested in the catch varied between gear types, districts, and time. Tahltan Lake and Stikine River sockeye salmon stocks were present in detectable levels in only Districts 106 and 108.

Approximately 478 thousand of the 479 thousand sockeye salmon harvested in 1987 net fisheries in southern Southeast Alaska (Districts 101-108) were allocated to nation and/or stock of origin. The 1 thousand unallocated sockeye salmon were taken in the District 108 gill net fishery and were often mixed with fish from other fisheries before delivery to port so that sufficient samples for analysis could usually not be obtained. Of the 478 thousand sockeye salmon allocated an estimated 255 thousand (53.3%) were bound for systems in Alaska, 221 thousand (46.2%) were bound for the Canadian Nass and Skeena Rivers and 2 thousand (0.5%) were of transboundary Stikine River origin (including Tahltan Lake stocks) (Table 2).

Although the estimated catch of 255 thousand Alaskan origin sockeye in southern Southeast net fisheries was the second lowest since 1982, the proportional Alaska contribution of 53% of the catch was the highest. Alaska stocks contributed 284 thousand (34%) of the allocated catch in 1986, 381 thousand (36%) in 1985, 241 thousand (42%) in 1984, 273 thousand (30%) in 1983, and 333 thousand (43%) in 1982 (Table 1). Alaskan stocks were a higher proportion of the catch in all southern Southeast net fisheries in 1987. Conversely, Canadian Nass and Skeena River contributions to area catches declined to 46.2%. Transboundary Stikine River contributions, typically less than 1% of the southern Southeast Alaska catch, showed little relative change contributing an estimated 0.5%.

Table 2. Estimated contribution by stock group of origin of sockeye salmon harvested in net fisheries in Alaska Districts 101-106, 1987.

District	Type	Group	Estimated Number	Percent	Standard[a] Error	90% C.I. Lower	90% C.I. Upper
101	Gillnet	Alaska I	14,341	13.3	2,052	10,966	17,716
		Alaska II	10,750	10.0	1,360	8,512	12,988
		Nass	66,989	62.3	2,282	63,234	70,744
		Skeena	15,500	14.4	1,758	12,609	18,391
		Total	107,580				
101	Seine	Alaska I	11,198	25.8	1,347	8,983	13,413
		Alaska II	18,890	43.6	1,203	16,912	20,868
		Nass	10,568	24.4	916	9,061	12,075
		Skeena	2,673	6.2	606	1,677	3,669
		Total	43,329				
102	Seine	Alaska I	5,483	31.4	598	4,500	6,466
		Alaska II	10,914	62.5	567	9,981	11,847
		Nass	486	2.8	144	250	722
		Skeena	590	3.4	171	308	872
		Total	17,473				
103	Seine	Alaska I	620	39.2	107	444	796
		Alaska II	924	58.4	100	760	1,088
		Nass	37	2.3	24	0	76
		Skeena	0	0.0	0	0	0
		Total	1,581				
104	Seine	Alaska I	36,996	21.6	3,803	30,740	43,252
		Alaska II	31,745	18.5	3,253	26,394	37,096
		Nass	39,620	23.1	4,080	32,909	46,331
		Skeena	62,853	36.8	3,921	56,403	69,303
		Total	171,214				
106-30	Gillnet	Alaska I	25,088	43.8	1,500	22,621	27,555
		Alaska II	23,223	40.6	1,275	21,126	25,320
		Nass/Skeena	8,020	14.0	848	6,625	9,415
		Tahltan	221	0.4	324	0	754
		Stikine	710	1.2	520	0	1,565
		Total	57,262				
106-41	Gillnet	Alaska I	41,416	52.3	1,712	38,600	44,232
		Alaska II	23,166	29.3	1,445	20,789	25,543
		Nass/Skeena	13,170	16.6	1,017	11,498	14,842
		Tahltan	1,155	1.5	568	220	2,090
		Stikine	258	0.3	695	0	1,400
		Total	79,165				
All Districts		Alaska I	135,142	28.3	5,102	126,749	143,535
		Alaska II	119,612	25.0	4,233	112,648	126,576
		Nass/Skeena	220,506	46.2	4,946	212,369	228,643
		Tahltan	1,376	0.3	654	300	2,452
		Stikine	968	0.2	868	0	2,395
		Total	477,604				

[a] The standard errors are minimum estimates since no estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in a like manner.

The change in relative Alaskan and Canadian contributions may, in part, be due to better than average Alaska sockeye returns and less than average Canadian Nass and Skeena returns. In 1987 over 170 thousand sockeye returned to McDonald Lake and 33 thousand to Hugh Smith Lake, typically the two most productive southern Southeast Alaska systems. In contrast, sockeye returns to the Canadian Nass and Skeena Rivers were considered to be less than average. Nass River sockeye escapements in 1987 were estimated at 180 thousand, below the goal of 220 thousand. The Skeena River is the second most productive sockeye system south of Bristol Bay. Skeena River escapements were estimated at 1.3 million, above the goal of 825 thousand. Much of the excess Skeena escapement was due to underestimation of escapements by the lower river test fishery during early season high water. Because of this underestimation fishing was restricted and, although the total return was less than normal, greater than desired numbers were allowed to escape. Relative contributions may also have been affected by the higher than usual proportion of the season's purse seine effort early in the season, when Alaska stocks are typically most abundant. Later in the season, when Skeena River sockeye are typically more abundant than other stock groups, fishing time was restricted. A third reason may be the decline in the number of sockeye taken in District 104, where large numbers of Canadian stocks are typically taken. The proportion of southern Southeast Alaska sockeye catch taken in District 104 declined in 1987 to 35%, down from the 1982-1986 average of 51%.

Stock Composition of the District 101-11 Gill Net Catch

The District 101-11 gill net fishery occurs in southeastern District 101 along the mainland coast just north of the Alaska-Canada border between Foggy Point and Akeku Point (Figure 3). Hours open, boats fishing, sockeye catch and CPUE are detailed in Table 3. The District 101-11 gill net fishery was open portions of week 26 through week 33 (June 21-Aug. 15), closed in week 34 (Aug. 16-22), then reopened portions of weeks 35 through 38 (Aug.

Table 3. Weekly hours open, boats fishing, sockeye catch, and sockeye catch per boat day (CPUE) in Southern Southeast Alaska gill net fisheries, 1987.

	District 101-11 Gill Net					District 106-30 Gill Net					District 106-41 Gill Net				
Stat. Week	Hours	Boats	Boat Days	Catch	CPUE	Hours	Boats	Boat Days	Catch	CPUE	Hours	Boats	Boat Days	Catch	CPUE
26	96	111	444	15663	35	48	29	58	1304	22	48	66	132	3845	29
27	72	142	426	17562	41	48	36	72	2918	41	48	72	144	7514	52
28	60	109	273	10136	37	48	32	64	5570	87	48	73	146	15175	104
29	48	87	174	9555	55	48	74	148	8525	58	48	82	164	13761	84
30	96	113	452	17217	38	48	41	82	10640	130	48	45	90	14031	156
31	48	91	182	7071	39	48	49	98	12766	130	48	48	96	10232	107
32	96	103	412	17219	42	48	64	128	11953	93	48	48	96	11075	115
33	96	112	448	11309	25	24	51	51	3316	65	12	39	20	3444	177
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	24	82	82	963	12	24	25	25	189	8	24	21	21	72	3
36	48	75	150	675	5	24	24	24	69	3	24	10	10	13	1
37	72	89	267	127	0	24	15	15	4	0	24	12	12	2	0
38	72	95	285	57	0	48	17	34	8	0	48	14	28	1	0

23-Sept. 19). Weekly hours open to fishing ranged from 48 to 96 and boats participating from 75 to 142.

The 1987 District 101-11 gill net harvest of 108 thousand sockeye salmon represents a slightly below average catch for this district where catches since 1982 have ranged from a low of 88 thousand to a high of 191 thousand (Table 1). Weekly catches ranged from 7 to 17 thousand sockeye a week until the closure in week 34. When the fishery reopened in week 35 catches of sockeye dropped to a few hundred a week for the remainder of the season. Sockeye abundance (CPUE) was 35 fish per boat day in the opening week rising to a maximum of 55 in week in week 29 (July 12-18) and then declining to 25 fish per boat day in week 33 (Aug 9-15). After the fishery reopened in week 35 (Aug. 23-29) sockeye CPUE dropped to only a few fish per boat day for the remainder of the season.

The 1987 District 101-11 gill net harvest of 108 thousand sockeye salmon was comprised of an estimated 25 thousand (23%) fish of Alaskan origin while 82 thousand (77%) were of Canadian Nass and Skeena River origin (Table 1).

Alaska I sockeye were the third most common of the 4 stock groups in the fishery contributing an estimated 14 thousand (13%) of the season's catch. Catch of Alaska I stocks was 3 thousand a week in the first week of the season (week 26, June 21-27). In week 27 (June 28-July 4) Alaska I catch rose to 4.5 thousand, then dropped to a thousand or less a week for the remainder of the season (Table 4, Figure 5). Abundance (CPUE) of Alaska I sockeye was 7 fish per boat day in the initial week of the season (week 26, June 21-27), reached a maximum of 11 in week 27 (June 28-July 4), then fell to a few fish a day for the remainder of the season (Table 5, Figure 6). The proximity and productivity of Hugh Smith Lake stocks may affect the magnitude of Alaska I contributions to the District 101-11 fishery. Hugh Smith Lake, which is included in the Alaska I standard, is located just north of the District 101-11 fishery and has been the second most productive sockeye system in southern Southeast Alaska in recent years (Figure 1). In 1987 Hugh Smith sockeye escapement was a relatively high 33 thousand sockeye, estimated Alaska I contribution was also relatively high at 14 thousand fish or 13%

Table 4. Estimated contribution of sockeye salmon stock groups originating in Alaska and Canada to Alaska's District 101-11 drift gill net fishery, 1987.

Dates	Group	Catch By Age Class					Total	Percent	Standard[a] Error	90% C.I.	
		1.2	1.3	2.2	2.3	Other				Lower	Upper
6/21-6/27	Ak. I	197	2,250	283	109	222	3,061	19.5	677.0	1,947	4,175
Week 26	Ak. II	0	21	0	60	6	87	0.6	411.4	0	764
	Nass	725	2,821	4,285	1,815	753	10,399	66.4	750.2	9,165	11,633
	Skeena	0	1,874	0	0	242	2,116	13.5	540.3	1,227	3,005
	Total	922	6,966	4,568	1,984	1,223	15,663				
6/28-7/04	Ak. I	339	3,767	494	0	88	4,688	26.7	1661.8	1,954	7,422
Week 27	Ak. II	0	1,388	0	109	29	1,526	8.7	784.3	236	2,816
	Nass	556	5,164	3,086	982	187	9,975	56.8	1141.0	8,098	11,852
	Skeena	0	1,341	0	0	32	1,373	7.8	761.0	121	2,625
	Total	895	11,660	3,580	1,091	336	17,562				
7/05-7/11	Ak. I	21	1,013	84	0	11	1,129	11.1	483.1	334	1,924
Week 28	Ak. II	35	564	0	239	8	846	8.3	360.6	253	1,439
	Nass	751	4,060	2,206	814	76	7,907	78.0	631.7	6,868	8,946
	Skeena	0	57	194	0	3	254	2.5	428.6	0	959
	Total	807	5,694	2,484	1,053	98	10,136				
7/12-7/18	Ak. I	325	123	175	119	8	750	7.8	440.4	26	1,474
Week 29	Ak. II	0	1,969	0	298	24	2,291	24.0	450.7	1,550	3,032
	Nass	524	3,419	1,088	344	57	5,432	56.8	644.1	4,372	6,492
	Skeena	0	965	105	0	12	1,082	11.3	468.0	312	1,852
	Total	849	6,476	1,368	761	101	9,555				
7/19-7/25	Ak. I	212	1,107	49	0	6	1,374	8.0	813.3	36	2,712
Week 30	Ak. II	170	2,100	0	446	12	2,728	15.8	719.2	1,545	3,911
	Nass	887	5,793	3,180	881	48	10,789	62.7	1157.1	8,886	12,692
	Skeena	0	2,292	23	0	11	2,326	13.5	881.1	877	3,775
	Total	1,269	11,292	3,252	1,327	77	17,217				
7/26-8/01	Ak. I	204	0	61	24	4	293	4.1	243.2	0	693
Week 31	Ak. II	0	983	0	50	16	1,049	14.8	222.9	682	1,416
	Nass	230	1,848	1,479	642	64	4,263	60.3	411.0	3,587	4,939
	Skeena	0	1,388	54	0	24	1,466	20.7	363.3	868	2,064
	Total	434	4,219	1,594	716	108	7,071				
8/02-8/08	Ak. I	578	76	0	0	6	660	3.8	307.8	154	1,166
Week 32	Ak. II	0	812	0	413	12	1,237	7.2	310.2	727	1,747
	Nass	1,066	1,507	7,648	1,225	109	11,555	67.1	864.5	10,133	12,977
	Skeena	129	3,445	156	0	37	3,767	21.9	819.5	2,419	5,115
	Total	1,773	5,840	7,804	1,638	164	17,219				
8/09-8/15	Ak. I	891	595	35	30	21	1,572	13.9	348.8	998	2,146
Week 33	Ak. II	0	627	0	233	12	872	7.7	259.8	445	1,299
	Nass	906	411	3,753	856	80	6,006	53.1	518.7	5,153	6,859
	Skeena	0	2,283	536	0	40	2,859	25.3	481.8	2,066	3,652
	Total	1,797	3,916	4,324	1,119	153	11,309				
8/16-8/22[b] Week 34											

-Continued-

Table 4. (page 2 of 2)

Dates	Group	Catch By Age Class 1.2	1.3	2.2	2.3	Other	Total	Percent	Standard[a] Error	90% C.I. Lower	Upper
8/23-8/29	Ak. I	83	164	69	78	8	402	40.9	47.2	324	480
Week 35	Ak. II	0	78	0	12	2	92	9.4	33.2	37	147
	Nass	67	32	211	60	8	378	38.5	42.2	309	447
	Skeena	0	45	63	0	3	111	11.3	31.9	59	163
	Total	150	319	343	150	21	983				
8/30-9/19	Ak. I	108	103	103	90	8	412	47.6	64.6	306	518
Wks 36-38	Ak. II	0	22	0	0	0	22	2.5	31.3	0	73
	Nass	3	51	183	42	6	285	32.9	69.0	171	399
	Skeena	21	104	18	0	3	146	16.9	46.5	70	222
	Total	132	280	304	132	17	865				
	Ak. I	2,958	9,198	1,353	450	382	14,341	13.3	2051.8	10,966	17,716
Fishery	Ak. II	205	8,564	0	1,860	121	10,750	10.0	1360.3	8,512	12,988
Total	Nass	5,715	25,106	27,119	7,661	1,388	66,989	62.3	2282.4	63,234	70,744
	Skeena	150	13,794	1,149	0	407	15,500	14.4	1757.6	12,609	18,391
	Total	9,028	56,662	29,621	9,971	2,298	107,580				

[a] The standard errors are minimum estimates since no estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in a like manner.

[b] No fishery occured in Week 34.

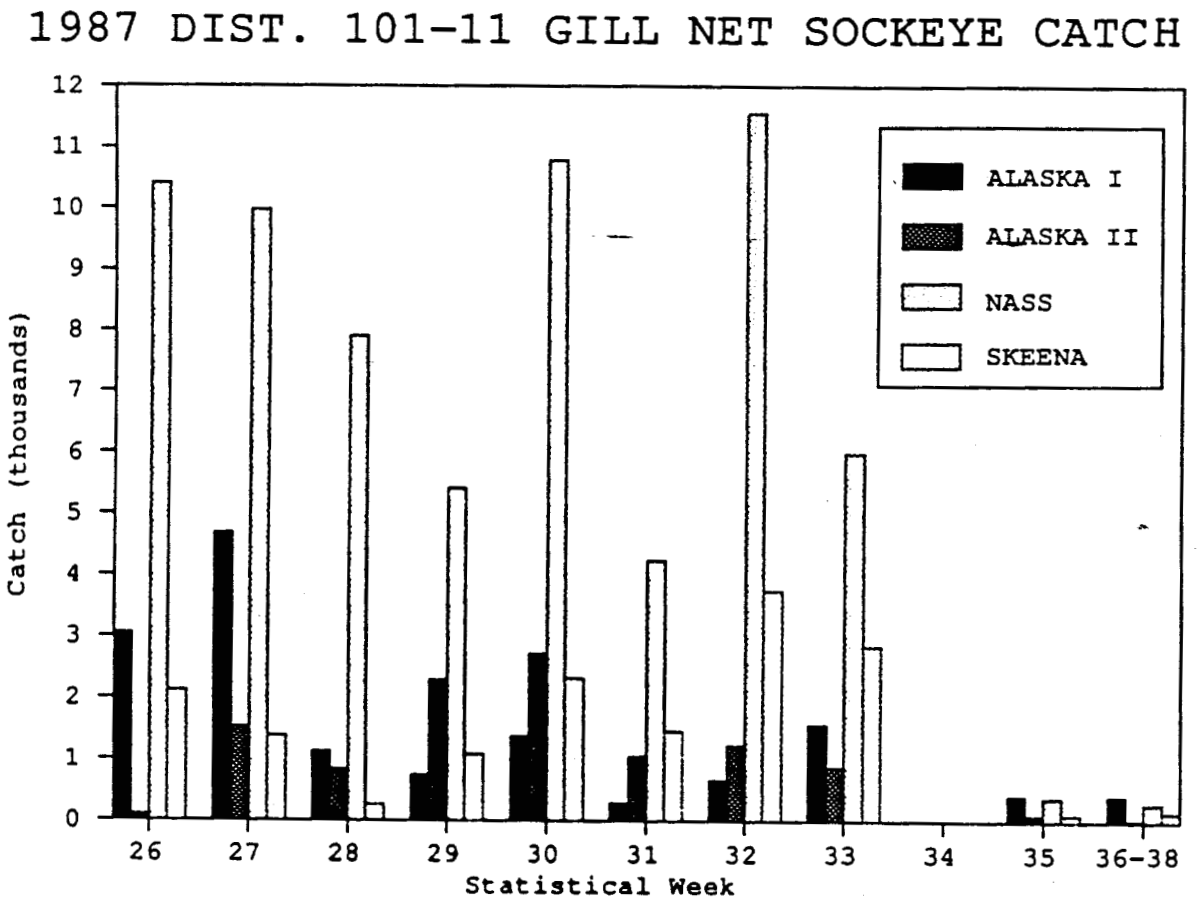

Figure 5. Weekly catch by stock group in Alaska's District 101-11 gill net fishery, 1987.

Table 5. Estimated weekly catch per boat day (CPUE) of sockeye salmon stock groups in Southeast Alaska purse seine and gill net fisheries, Districts 101-104, 1987.

Stat. Week	District 101-11 Gill Net				District 101 Purse Seine				District 102 Purse Seine				District 104 Purse Seine			
	Ak. I	Ak II	Nass	Skeena	Ak. I	Ak II	Nass	Skeena	Ak. I	Ak. II	Nass	Skeena	Ak. I	Ak. II	Nass	Skeena
26	7	0	23	5												
27	11	4	23	3												
28	4	3	29	1									23	23	40	19
29	4	13	31	6	18	7	35	6[a]					65	87	108	95
30	3	6	24	5	39	31	20	4					45	34	44	65
31	2	6	23	8	43	23	71	17	138	448	15	0	58	97	64	279
32	2	3	28	9	25	112	20	7	35	80	4	6	56	33	51	91
33	4	2	13	6	9	24	9	3	27	26	1	2	10	6	5	6
34	0	0	0	0									6	3	6	8
35	5	1	5	1												
36	3	0	2	1												

[a] Estimates for District 101 purse seine for weeks 28 and 29 are combined due to low catches in week 28.

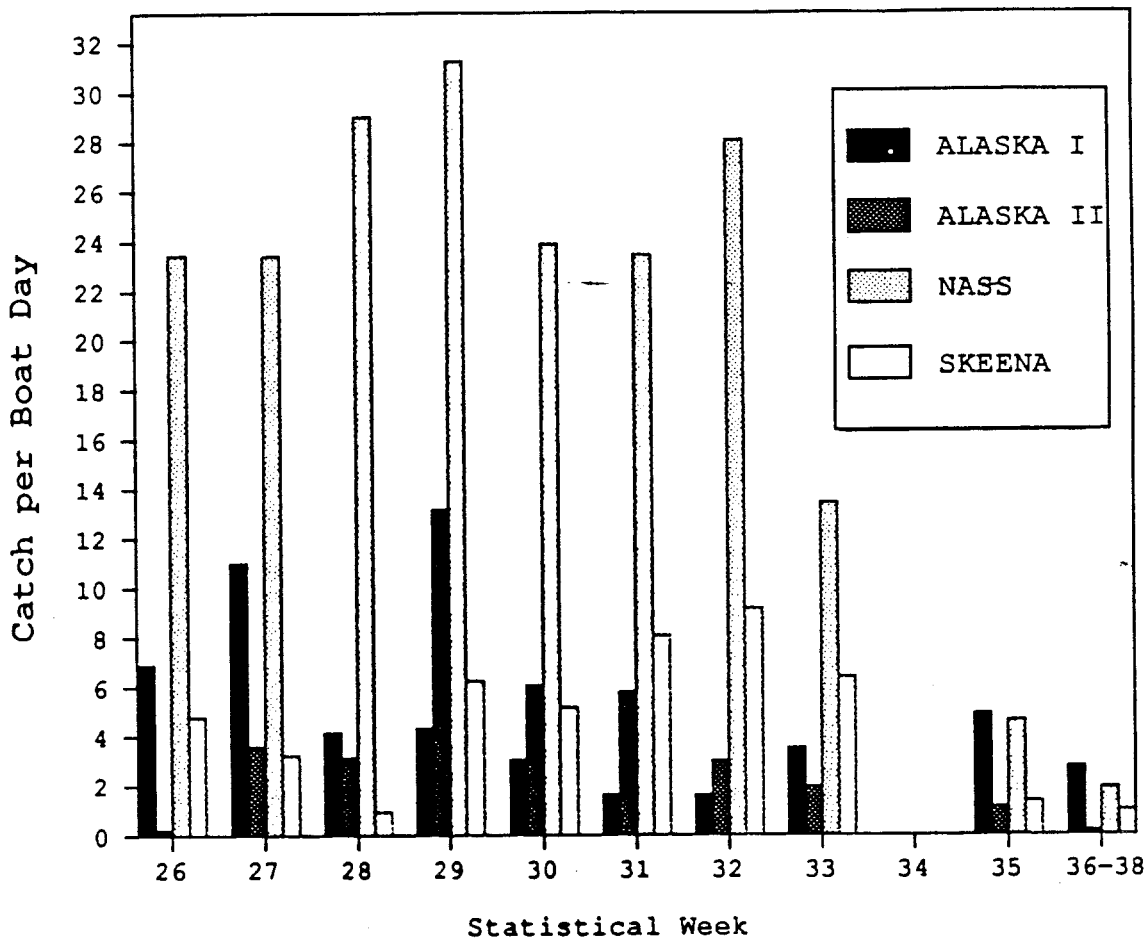

Figure 6. Weekly CPUE by stock group in Alaska's District 101-11 gill net fishery, 1987.

of the season's catch. In 1986, when Hugh Smith escapement was only 5 thousand fish, Alaska I stock contributions were estimated at only 8 thousand or 6% of the catch. Alaska I and Alaska II contributions were not estimated independently until 1986 complicating yearly comparisons. In 1982 both the catch of all Alaskan sockeye stocks in District 101-11 (69 thousand) and the Hugh Smith escapement (57 thousand) were the highest in recent years.

Alaskan II sockeye (mostly McDonald Lake stocks) were the least common of the 4 stock groups in the District 101-11 fishery contributing an estimated 11 thousand (10%) of the season's catch of 108 thousand. Only a few hundred Alaska II sockeye were taken weekly in the first 3 weeks of the season (week 26-28, June 21-July 11). Maximum catch of Alaska II sockeye occurred in weeks 29 and 30 (July 12 - July 25) with catches respectively of 2 and 3 thousand fish or 24% and 16% of the weekly catch (Table 4, Figure 5). Catches then dropped to about a thousand a week until the closure in week 34 after which catches declined further to a less than a hundred a week. Maximum abundance (CPUE) of Alaska II stocks occurred in week 29 (July 12 - 18) at 13 fish per boat day, over double the Alaska II CPUE in other weeks (Table 5, Figure 6). McDonald Lake sockeye salmon contributed the majority of fish allocated to the Alaska II group. McDonald Lake is relatively far away from the fishery in upper Behm Canal (Figure 1). Although Alaska II stocks accounted for about 40% of District 101 and 102 seine catches in 1986 and 1987 they do not seem to be as common in the District 101-11 gill net fishery. In 1986 Alaska II stocks contributed only 5 thousand, (3%) of the District 101-11 catch. However, Alaska II stocks have only been estimated independently since 1986.

Nass River sockeye salmon were the most common stock in the District 101-11 catch contributing an estimated 67 thousand (62%) of the season's catch. Nass River sockeye comprised at least 50% of the weekly catch until the last two weeks of the season when sockeye catches had fallen to a few hundred fish an week (Table 4, Figure 5). Catches of Nass River fish were greatest during week 30 (July 19 - 25) when they contributed 11 thousand (63%) of 17 thousand fish. Nass River sockeye were by far the most abundant stock group for the first 8 weeks of the season with a

weekly CPUE greater than the CPUE of the other three stock groups combined. Nass CPUE increased from 23 fish per boat day at the start of the season to a maximum of 31 in week 29 (July 12 - 18) and remained high until late in the season (Table 5, Figure 6). Since 1982 the majority of sockeye taken in the fishery have been of Canadian Nass and Skeena River origin (Table 1). In 1986 District 101-11 catch of Nass River stocks was estimated at 108 thousand or 74% of the season's total. The magnitude of the Nass River contribution is not surprising given the close proximity of the river to the fishery (Figure 3).

Skeena River sockeye were the second most common stock group in District 101-11 contributing 15 thousand fish or 14% of the season's catch (Table 4, Figure 5). An estimated 2 thousand Skeena sockeye were taken in the opening week of the season. Skeena catches then dropped to a low of 2 hundred in week 28 before rising to 1-2 thousand a week in weeks 29 through 31 (July 12-Aug. 1). Both catch and CPUE of Skeena stocks were highest in week 32 (Aug. 2-8) when they contributed 4 thousand (22%) of the catch at a rate of 9 fish per boat day (Table 5, Figure 6). The Skeena River is relatively close to the District 101-11 fishery (Figure 3). Catch of Skeena River sockeye in the district in 1987 declined slightly from 1986 when they contributed 25 thousand or 17% of the catch. Some of the reduction in Skeena catches may have been due to reduced fishing time later in the season when Skeena stocks typically are more abundant than other stock groups in Alaska fisheries. In addition to the proximity of the Canadian rivers to the Southeast fisheries the magnitude of Skeena contributions to the fishery can be explained by its productivity.

Stock Composition of the District 101 Purse Seine Catch

The extent of District 101 open to seine fishing typically varies weekly during the season depending primarily on the abundance and distribution of pink salmon in the district. Areas and duration of openings also vary for the same week from year to year. In 1987 only the southern portions of the district were open due to

poor pink salmon returns. Differences in the portions of the district that are open makes direct comparison of catch and stock composition estimates difficult unless the distribution of catch and effort within the district is known. The samples used to estimate stock contributions have been drawn at random from the district as a whole and the specific location within the district where particular fish were caught is often not known. Thus, stock composition estimates for specific portions of District 101 are not possible at this time. In the future, when disparate portions of the district are open, we will try to collect area specific samples to allow estimates of sockeye stock composition for specific portions of the district.

The southern portion District 101 purse seine fishery was open portions of week 28 through week 33 (July 5-Aug. 15). Hours open, boats fishing, sockeye catch and CPUE by week are listed in Table 6. Few boats fished in the initial weeks opening of 15 hours and only 24 sockeye were reported caught. Boats fishing rose to 93 in week 30 (July 19-25), then declined for the next two weeks before rising to a season's high of 126 in the final opening in week 33 (Aug. 9-15). Weekly hours open ranged from 15 in the initial week to 39 in the final two weeks. Less than a hundred sockeye were caught in the opening week (week 28, July 5-11). Maximum weekly catches occurred in weeks 30 and 32 (July 19-25, Aug 2-8) when 11 and 13 thousand sockeye respectively were taken. Although catch in week 31 dropped to 6 thousand sockeye the CPUE was the second highest of the season at 154 sockeye per boat day. The highest abundance (CPUE) of 164 sockeye per boat day was in week 32 (August 2 - 8).

The 1987 District 101 purse seine fishery harvested 43 thousand sockeye salmon, the lowest catch since stock analysis was begun in 1982. Alaska sockeye contributed an estimated 30 thousand (69%) of the seasons catch while 13 thousand (31%) were of Canadian Nass and Skeena River origin. The estimated Alaskan contribution of 30 thousand fish was lower than prior years although proportional Alaska contributions increased to a high of 69% of the catch (Table 1).

Alaska I stocks were the second most common of the four stock groups contributing an estimated 11 thousand fish or 26% of the

Table 6. Weekly hours open, boats fishing, sockeye catch, and sockeye catch per boat day (CPUE) in Southern Southeast Alaska purse seine fisheries, 1987.

	District 101 Purse Seine					District 102 Purse Seine					District 103 Purse Seine					District 104 Purse Seine				
Stat. Week	Hours	Boats	Boat Days	Catch	CPUE	Hours	Boats	Boat Days	Catch	CPUE	Hours	Boats	Boat Days	Catch	CPUE	Hours	Boats	Boat Days	Catch	CPUE
28	15	3	2	24	13	0	0	0	0	0	0	0	0	0	0	15	65	41	4258	105
29	15	45	28	3964	141	0	0	0	0	0	0	0	0	0	0	30	86	108	38214	355
30	30	93	116	11020	95	0	0	0	0	0	0	0	0	0	0	30	127	159	29913	188
31	15	60	38	5784	154	15	13	8	4879	600	0	0	0	0	0	15	74	46	23072	499
32	39	50	81	13319	164	39	40	65	8146	125	0	0	0	0	0	39	178	289	66894	231
33	39	126	205	9218	45	39	49	80	4448	56	0	0	0	0	0	39	160	260	7050	27
34	0	0	0	0	0	0	0	0	0	0	15	104	65	1182	18	15	125	78	1813	23
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	15	82	51	399	8	0	0	0	0	0

season's catch. With the exception of the opening week Alaska I stocks contributed at least 1-2 thousand fish to weekly catches. Maximum estimated catch of Alaska I stocks took place in week 30 (July 19 - 25) at 4.5 thousand (Table 7, Figure 7). CPUE of Alaska I stocks was relatively good except for the first and last weeks of the season (Table 5, Figure 8). Maximum abundance occurred in week 31 at 43 sockeye per boat day. Relative Alaska I contributions were about the same as 1986 although, as with the other stock groups, the numbers caught declined. Hugh Smith Lake, located directly adjacent to those portions of District 101 open to seine fishing, enjoyed a relatively good return in 1987 (Figure 1).

The most common stock group in the District 101 seine fishery was Alaska II (mostly McDonald Lake) contributing an estimated 19 thousand fish (44%) of the season's catch (Table 7, Figure 7). Both catch and CPUE of Alaska II stocks was greatest in week 32 (Aug. 2-8) when over 9 thousand were caught at a rate of 112 fish per boat day, up from a catch of 8 hundred at 23 per boat day in the prior week. Approximately 62% of season's total Alaska II CPUE occurred in week 32 (Aug 2-8)(Table 5, Figure 8). The proportional contribution of Alaska II stocks in 1987 was about the same as in 1986 (42%). This is somewhat surprising as northern portions of the district near McDonald lake where concentrations of Alaska II type sockeye would be expected were not open in 1987 as they were in 1986.

Nass River sockeye salmon were the third most common of the four stock groups in District 101 contributing 10.5 thousand fish or 24% of the catch. Catches of Nass River sockeye were relatively constant throughout the season contributing about 2 thousand fish to weekly catches (Table 7, Figure 7). There was a definite peak of abundance (CPUE) of Nass stocks in week 31 (July 26-Aug. 1) at 71 fish per boat day, up from 20 in the weeks 30 and 32 (Table 5, Figure 8). As in 1986 the proportion of Nass River sockeye in the catch was high during the first two weeks of the season. Later in the season at the catch of Alaska I and II stocks increased relative Nass sockeye contributions declined although the number of Nass fish caught remained constant.

Table 7. Estimated contribution of sockeye salmon stock groups originating in Alaska And Canada to Alaska's District 101 purse seine fishery, 1987.

Dates	Group	Catch By Age Class 1.2	1.3	2.2	2.3	Other	Total	Percent	Standard[a] Error	90% C.I. Lower	Upper
7/05-7/18	Ak. I	196	731	106	12	14	1,059	26.6	261.8	628	1,490
Wks 28-29	Ak. II	0	417	0	24	6	447	11.2	196.2	124	770
	Nass	147	1,448	366	117	28	2,106	52.8	296.3	1,619	2,593
	Skeena	0	364	6	0	6	376	9.4	205.0	39	713
	Total	343	2,960	478	153	54	3,988				
7/19-7/25	Ak. I	759	3,449	291	28	58	4,585	41.6	876.9	3,143	6,027
Week 30	Ak. II	203	2,840	0	495	45	3,583	32.5	733.8	2,376	4,790
	Nass	178	1,821	230	92	30	2,351	21.3	677.9	1,236	3,466
	Skeena	70	242	181	0	8	501	4.5	386.6	0	1,137
	Total	1,210	8,352	702	615	141	11,020				
7/26-8/01	Ak. I	333	905	192	136	65	1,631	28.2	329.9	1,088	2,174
Week 31	Ak. II	0	759	0	73	34	866	15.0	261.0	437	1,295
	Nass	474	1,231	794	60	106	2,665	46.1	348.9	2,091	3,239
	Skeena	16	572	0	0	34	622	10.8	250.8	209	1,035
	Total	823	3,467	986	269	239	5,784				
8/02-8/08	Ak. I	439	1,012	414	174	19	2,058	15.5	759.5	809	3,307
Week 32	Ak. II	94	7,180	0	1,716	82	9,072	68.1	735.6	7,862	10,282
	Nass	347	0	942	285	14	1,588	11.9	236.4	1,199	1,977
	Skeena	0	386	208	0	7	601	4.5	251.8	187	1,015
	Total	880	8,578	1,564	2,175	122	13,319				
8/09-8/15	Ak. I	440	907	188	255	75	1,865	20.2	538.9	979	2,751
Week 33	Ak. II	191	4,001	0	531	199	4,922	53.4	510.2	4,083	5,761
	Nass	282	103	1,184	214	75	1,858	20.2	338.8	1,301	2,415
	Skeena	116	418	0	0	39	573	6.2	221.5	209	937
	Total	1,029	5,429	1,372	1,000	388	9,218				
	Ak. I	2,167	7,004	1,191	605	231	11,198	25.8	1346.7	8,983	13,413
Fishery	Ak. II	488	15,197	0	2,839	366	18,890	43.6	1202.7	16,912	20,868
Total	Nass	1,428	4,603	3,516	768	253	10,568	24.4	916.4	9,061	12,075
	Skeena	202	1,982	395	0	94	2,673	6.2	605.7	1,677	3,669
	Total	4,285	28,786	5,102	4,212	944	43,329				

[a] The standard errors are minimum estimates since no other estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in a like manner.

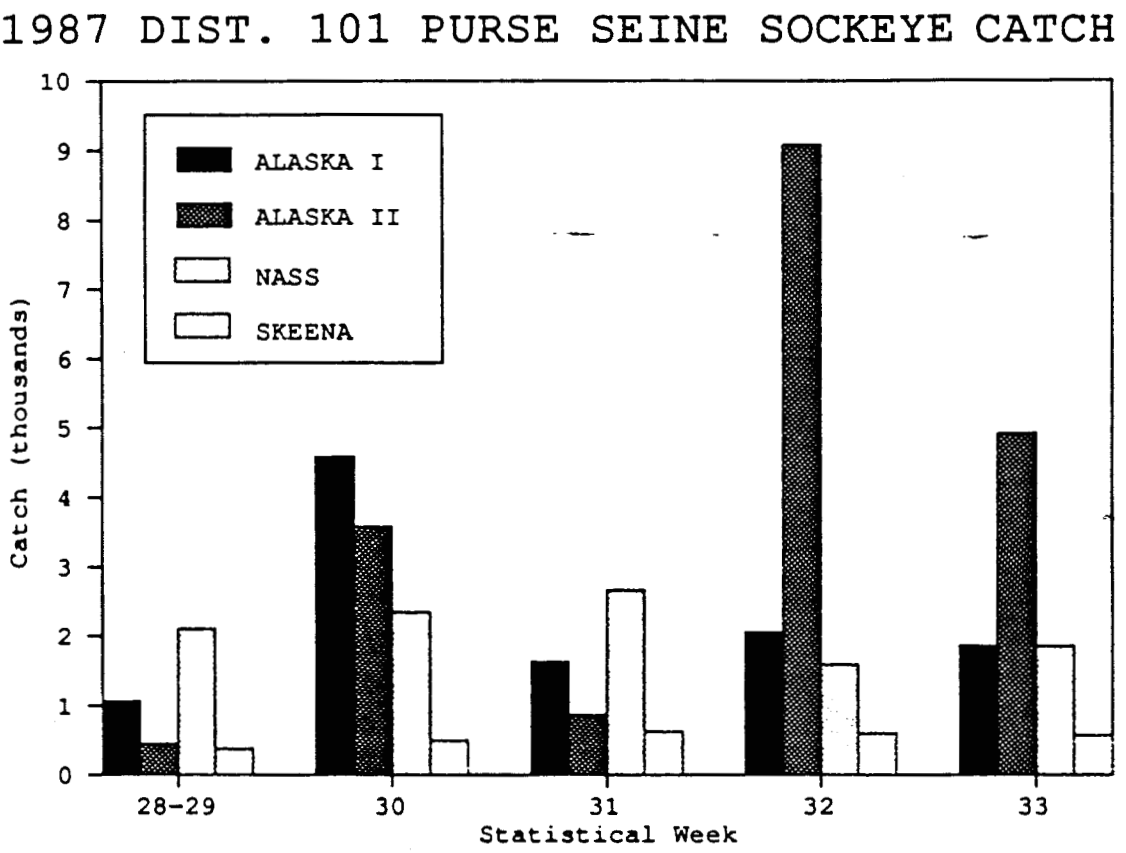

Figure 7. Weekly catch by stock group in Alaska's District 101 purse seine fishery, 1987.

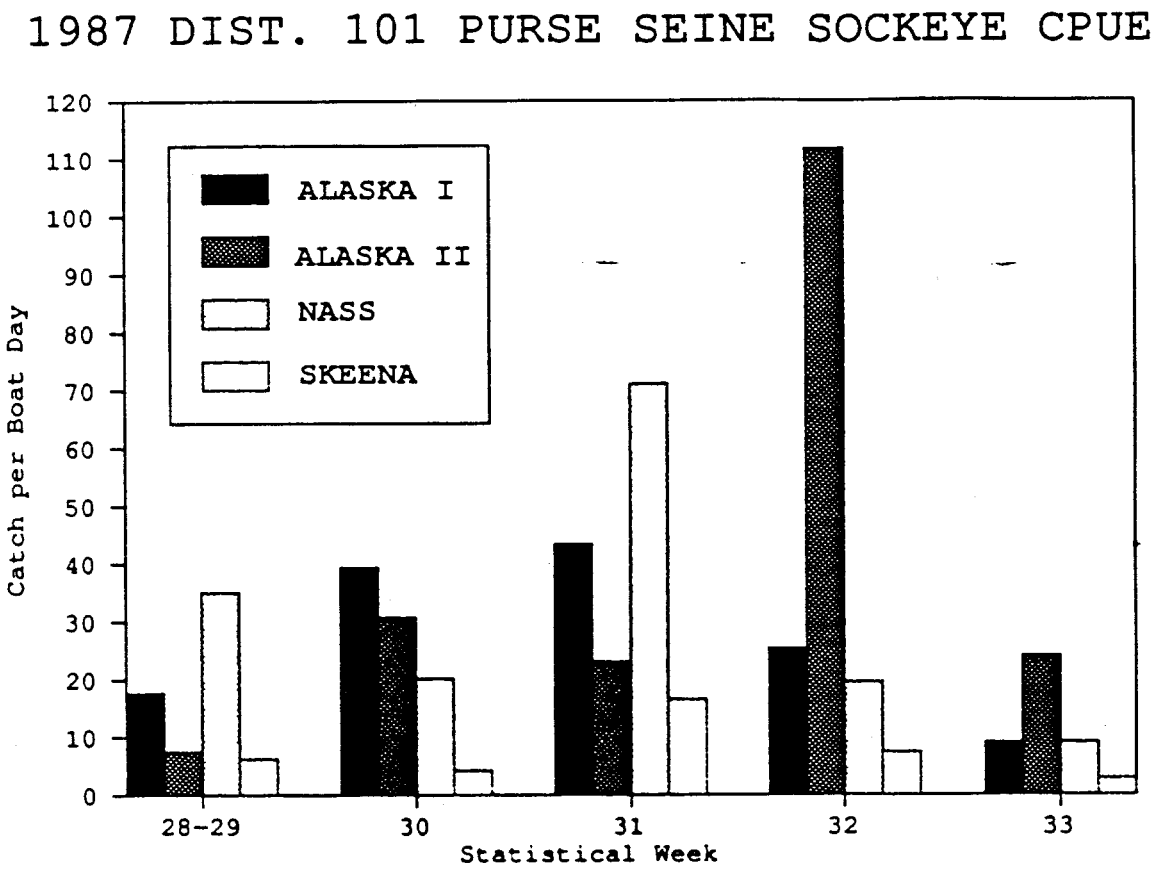

Figure 8. Weekly CPUE by stock group in Alaska's District 101 purse seine fishery, 1987.

Skeena River sockeye were the least common stock group contributing only a few hundred fish a week to the 1987 season in the District 101 seine fishery (Table 7, Figure 7). Slightly less than half the season's total Skeena River CPUE took place in week 31 (July 26-Aug. 1) at 17 fish per boat day (Table 5, Figure 8).

Stock Composition of the District 102 Purse Seine Catch

The District 102 purse seine fishery was open portions of weeks 31 through 33 (July 26-Aug. 15). Almost 50% of the season's catch in this district, 8 thousand of 17 thousand, occurred in the second week of the season (week 32, Aug. 2-8). As with the District 101 purse seine fishery low returns of pink salmon resulted in openings only in the southern portions of District 102 as well as reduced hours open to fishing. While the district catch was slightly lower than prior years the relative contribution of Alaska stocks increased to 94%. Canadian Nass and Skeena stocks contributed 6% of the district catch. Alaska sockeye have always been the major contributor in prior years analyses of District 102 never accounting for less than 59% of the catch (Table 1).

Alaska I stocks were the second most common stock in District 102 contributing an estimated 5 thousand fish (31%) of the catch. Alaska II type sockeye salmon (mostly McDonald Lake) were the most common stock in the catch in every week contributing 10 thousand (62%) of the season's catch. Nass and Skeena River stocks each contributed less than a thousand (3%) over the season (Table 8, Figure 9). Catch per unit effort (CPUE) for all but the Skeena River stock group was highest in the initial weeks opening (week 31, July 26 - August 1) when good numbers of sockeye were taken despite relatively low effort (Tables 5 and 6, Figure 10).

Table 8. Estimated contribution of sockeye salmon stock groups originating in Alaska and Canada to Alaska's District 102 purse seine fishery, 1987.

Dates	Group	Catch By Age Class						Percent	Standard[a] Error	90% C.I.	
		1.2	1.3	2.2	2.3	Other	Total			Lower	Upper
7/26-8/01	Ak. I	573	234	232	57	26	1,122	23.0	261.0	693	1,551
Week 31	Ak. II	0	2,803	0	753	86	3,642	74.6	255.4	3,222	4,062
	Nass	68	0	3	44	3	118	2.4	54.0	29	207
	Skeena	0	0	0	0	0	0	0.0	0.0	0	0
	Total	641	3,037	235	854	115	4,882				
8/02-8/08	Ak. I	1,136	476	540	39	54	2,245	27.6	475.2	1,463	3,027
Week 32	Ak. II	0	3,500	0	1,601	125	5,226	64.2	449.4	4,487	5,965
	Nass	185	0	21	42	6	254	3.1	116.6	62	446
	Skeena	0	393	13	0	15	421	5.2	149.4	175	667
	Total	1,321	4,369	574	1,682	200	8,146				
8/09-8/15	Ak. I	875	469	664	73	35	2,116	26.0	251.4	1,702	2,530
Week 33	Ak. II	73	1325	0	617	34	2,049	25.2	232.8	1,666	2,432
	Nass	0	0	9	103	2	114	1.4	63.9	9	219
	Skeena	25	114	26	0	4	169	2.1	84.0	31	307
	Total	973	1,908	699	793	75	4,448				
	Ak. I	2,584	1,179	1,436	169	115	5,483	31.4	597.6	4,500	6,466
Fishery	Ak. II	73	7,628	0	2,971	245	10,917	62.5	566.9	9,984	11,850
Total	Nass	253	0	33	189	11	486	2.8	143.5	250	722
	Skeena	25	507	39	0	19	590	3.4	171.4	308	872
	Total	2,935	9,314	1,508	3,329	390	17,476				

[a] The standard errors are minimum estimates since no other estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in a like manner.

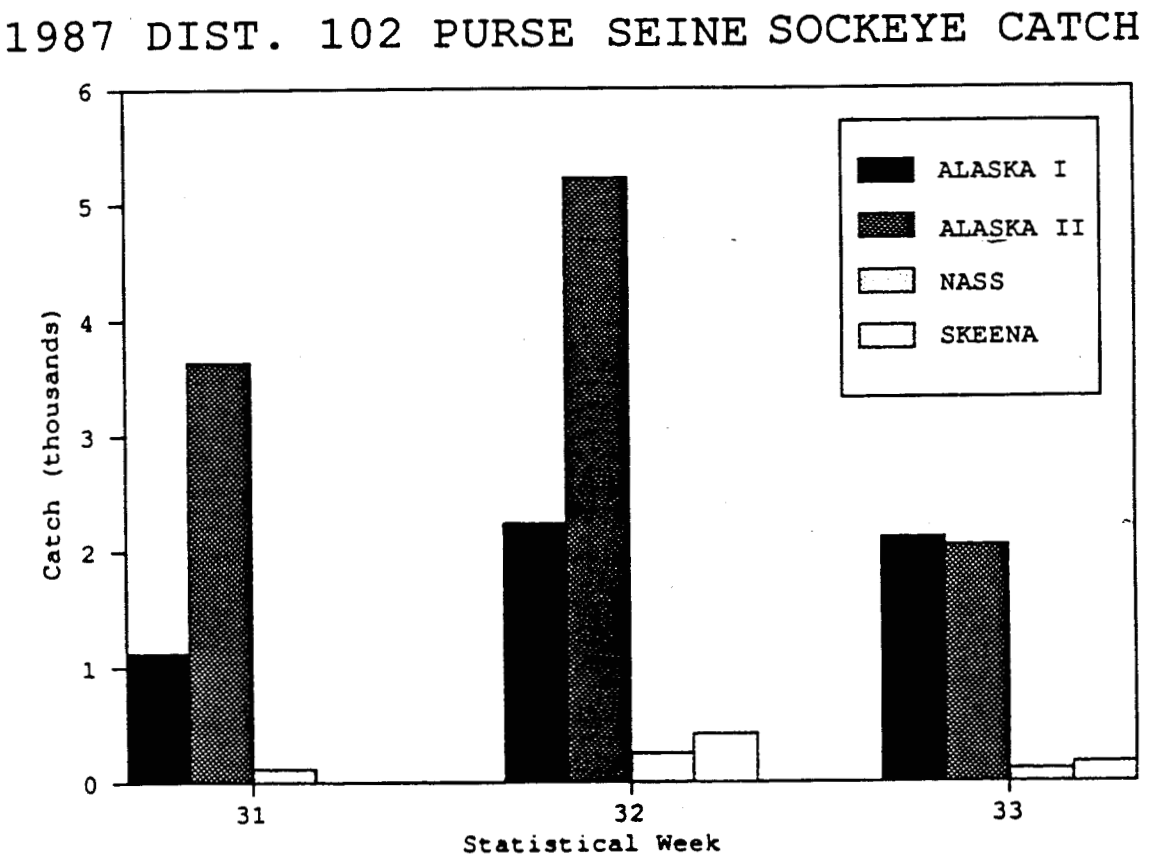

Figure 9. Weekly catch by stock group in Alaska's District 102 purse seine fishery, 1987.

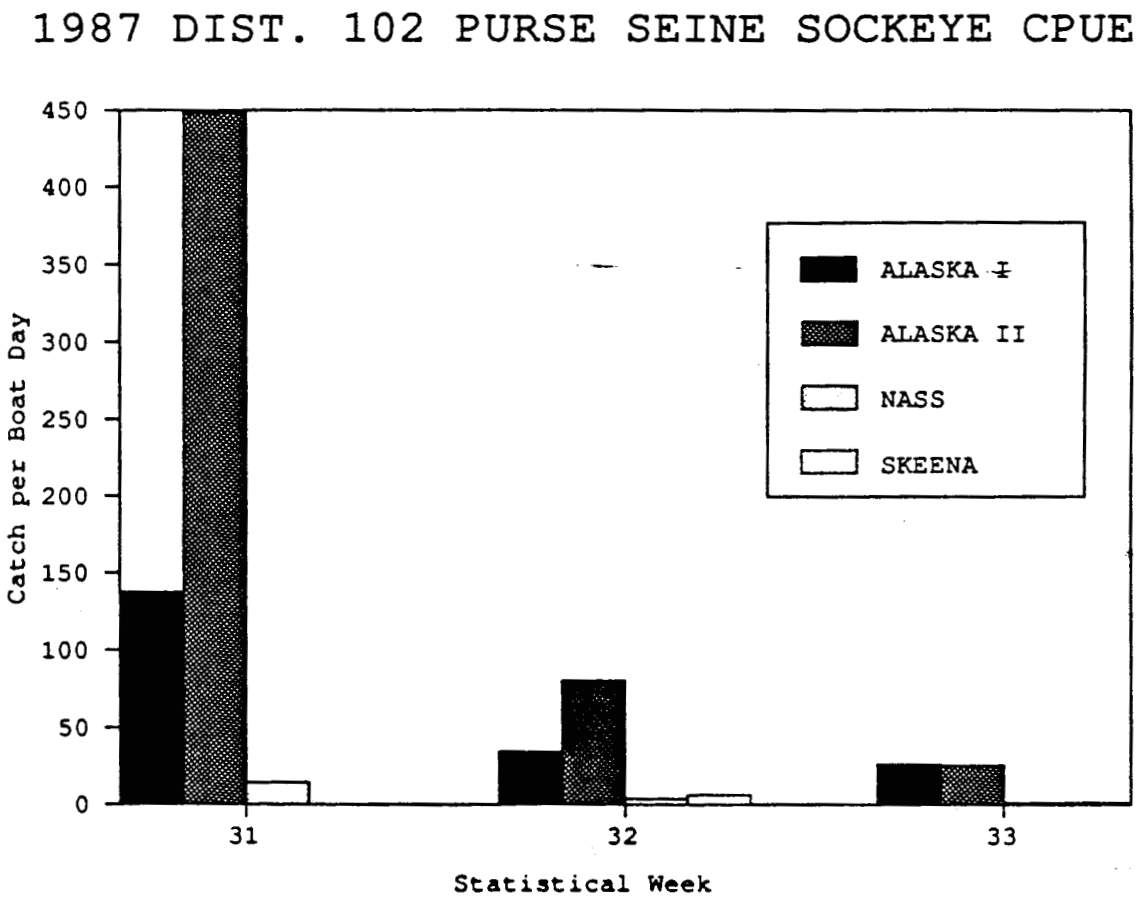

Figure 10. Weekly CPUE by stock group in Alaska's District 102 purse seine fishery, 1987.

Stock Composition of the District 103 Purse Seine Catch

The District 103 purse seine fishery was open portions of weeks 34 and week 36 (Aug. 16-22, Aug. 30-Sept. 5) (Table 6). Relatively low catches of sockeye salmon in the 1987 District 103 purse seine fishery resulted in small sample sizes necessitating pooling of the weekly samples for a single season's stock composition estimate. The catch of 1.5 thousand sockeye salmon in District 103 was estimated to be almost entirely of Alaskan origin (98%) with only 37 fish (2%) of Canadian Nass and Skeena origin. The Alaska component was comprised of 6 hundred Alaska I (39%) and 9 hundred Alaska II (58%) type sockeye (Table 9).

Sockeye catches in District 103 are typically not high. The fishery is primarily targeted on late run pink salmon stocks returning to the west coast of Prince of Wales Island. The fishery does not open until sufficient pink salmon move into the area from outer coastal waters, by which time most sockeye are in protected terminal areas or on the spawning grounds.

Stock Composition of the District 104 Purse Seine Catch

Unlike other southern Southeast purse seine fisheries all portions of the District 104 fishery are usually open throughout the season. However, in 1987 only the southern portion of the district was open in the final week of the season due to poor pink returns. Purse seine effort in District 104 is concentrated near capes and headlands along the outer coast from Noyes to Dall Islands. There are no sockeye producing systems of any note in the district itself, however, there are several moderate producers located just to the east along the western shore of Prince of Wales Island. Substantial numbers of sockeye from the Canadian Nass and Skeena Rivers located just south of the Alaska-Canada border are commonly harvested in this fishery. Enormous numbers of pink salmon, primarily bound for spawning areas along the Alaska mainland early in the season and Alaska island spawning systems later in the season, are often taken in this district (Hoffman 1983, 1984). In 1986 almost 8 million

Table 9. Estimated contribution of salmon stock groups originating in Alaska and Canada to Alaska's District 103 purse seine fishery, 1987.

Dates	Group	Catch By Age Class					Total	Percent	Standard[a] Error	90% C.I.	
		1.2	1.3	2.2	2.3	Other				Lower	Upper
8/16-8/22	Ak. I	125	256	156	44	39	620	39.2	106.9	444	796
8/30-9/5	Ak. II	9	511	0	346	58	924	58.4	99.5	760	1,088
Wk 34 and	Nass	12	0	0	23	2	37	2.3	23.9	0	76
Wk 36	Skeena	0	0	0	0	0	0	0.0	0.0	0	0
	Total	146	767	156	413	99	1,581				
	Ak. I	125	256	156	44	39	620	39.2	106.9	444	796
Fishery	Ak. II	9	511	0	346	58	924	58.4	99.5	760	1,088
Total	Nass	12	0	0	23	2	37	2.3	23.9	0	76
	Skeena	0	0	0	0	0	0	0.0	0.0	0	0
	Total	146	767	156	413	99	1,581				

[a] The standard errors are minimum estimates since no estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in a like manner.

pink salmon were taken in one week by the purse seine fleet at the peak of the season. In general the direction of sockeye migration through the district seems to be to the south (Hoffman 1983, 1984). Weather along this unprotected coast can significantly affect catches regardless of fishing effort or the abundance of fish. Fishing time since 1985 has been restricted from the beginning of the season until week 31 (late July) to maintain sockeye catches within the 4 year (1985-1988) ceiling of 480 thousand, or an average annual catch of 120 thousand for that period, as agreed under terms of the U.S.-Canada Pacific Salmon Treaty. Many boats in recent years have moved to northern Southeast Alaska early in the season to harvest early returns of chum salmon returning to the Hidden Falls Hatchery. The 1987 District 104 purse seine catch of 171 thousand sockeye is over 260 thousand less than were taken in 1985 or 1986 (Table 1). Rather than a lack of availability of sockeye salmon much of the decline in catch was due to the early season time and gear reductions, reduced fishing time in late July and the August, and the early closure of the fishery. The 1987 season's total sockeye catch per boat day of 175 was actually the highest in the past 5 years. Season's total sockeye catch per boat day was 91 in 1982, 168 in 1983, 104 in 1984, 150 in 1985, and 95 in 1986.

Even though sockeye catches of all stock groups declined from prior years the relative contribution of Alaska stocks increased (Table 1). Much of the difference in relative Alaska contributions in 1987 may be due to: 1) good to excellent returns of Alaska sockeye stocks, 2) less than average returns of Canadian Nass and Skeena River stocks, and 3) reduced fishing time later in the season when Canadian Skeena River stocks are typically most abundant.

District 104 was open to purse seining portions of weeks 28 through 34 (July 6 - Aug. 23). Hours open, boats fishing, sockeye catch and CPUE are listed in Table 6. Maximum catch of 69 thousand sockeye or 39% of the season's total occurred in week 32 (Aug. 2-8). Maximum CPUE was in week 31 (27 July - 2 August) at 499 fish per boat day although the catch in this week was a comparatively low 23 thousand. Catch and abundance were low at the start of the season (week 28, July 5-11) when only about 4 thousand sockeye were taken at a rate of 105 per boat day. Catch

and CPUE increased in week 29 (July 12-18) to 38 thousand and 355 fish per boat day, then declined in week 30 to a catch of 29 thousand at 188 fish per boat day. Maximum CPUE of 499 fish per boat day occurred in week 31 (July 26-Aug. 1) although catches were relatively low. Maximum catch occurred one week later in week 32 of 67 thousand fish at a rate of 231 fish per boat day. Both catch and CPUE then declined for the remainder of the season (Table 6).

The catch of 171 thousand sockeye salmon was comprised of 69 thousand (40%) Alaskan fish and 102 thousand (60%) Canadian Nass and Skeena River fish (Table 1). All 4 stock groups contributed significant portions of the catch, the least common stock never accounting for less than 10% of the weekly catch (Table 10). Both Alaska I and Alaska II stocks were a higher proportion of the season's catch in 1987 increasing, respectively, to 22% and 19%, versus 15% and 8% in 1986. Nass River contributions declined from to 23% from 27% in 1986. Skeena River contributions in 1987 declined to 38% from 50% of the catch in 1986.

Alaska I type sockeye stocks ranked third of the 4 stock groups contributing an estimated 37 thousand or 22% of the season's total. Catches of Alaska I sockeye increased from a few hundred fish at the beginning of the season to 7 thousand in both week 29 and 30 (July 12-25). In week 31 (July 26-Aug. 1) Alaska I catches fell to less than 3 thousand, then rose in week 32 (Aug. 2-8) to a season's high of 16 thousand or 24% of the catch (Table 10, Figure 11). As with the catch there were two modes of Alaska I stock abundance, the first occurred in week 29 at 65 fish per boat day and the second in week 31 of 58 fish per boat day. In week 32 (Aug. 2-8) when the maximum weekly catch of Alaska I sockeye occurred, the CPUE fell slightly to 56 fish per boat day (Table 5, Figure 12).

Alaska II type stocks (mostly McDonald Lake) were the least common of the stock groups contributing 32 thousand (18%) of the season's catch. Maximum catches of Alaska II sockeye took place in week 29 (July 12-18) when they contributed 9 thousand (25%), catches then declined to about 5 thousand a week in weeks 30 and 31 (July 19-Aug. 1) before rising again in week 32 (Aug. 2-8) to

Table 10. Estimated contribution of sockeye salmon stock groups originating in Alaska and Canada to Alaska's District 104 purse seine fishery, 1987.

Dates	Group	Catch By Age Class						Percent	Standard[a] Error	90% C.I. Lower	90% C.I. Upper
		1.2	1.3	2.2	2.3	Other	Total				
7/05-7/11	Ak. I	333	466	113	0	9	921	21.6	201.6	589	1,253
Week 28	Ak. II	0	747	0	195	9	951	22.3	174.0	665	1,237
	Nass	611	522	360	106	15	1,614	37.9	235.1	1,227	2,001
	Skeena	366	394	4	0	8	772	18.1	198.5	445	1,099
	Total	1310	2129	477	301	41	4,258				
7/12-7/18	Ak. I	2933	2074	719	1160	101	6,987	18.3	1834.1	3,970	10,004
Week 29	Ak. II	0	8133	0	1101	135	9,369	24.5	1739.8	6,507	12,231
	Nass	2614	7248	941	691	168	11,662	30.5	2236.1	7,984	15,340
	Skeena	3561	5850	630	0	155	10,196	26.7	1884.2	7,097	13,295
	Total	9108	23305	2290	2952	559	38,214				
7/19-7/25	Ak. I	2771	2832	1214	203	167	7,187	24.0	1381.9	4,914	9,460
Week 30	Ak. II	0	4198	0	1082	125	5,405	18.1	1156.7	3,502	7,308
	Nass	2156	3079	1418	135	161	6,949	23.2	1605.6	4,308	9,590
	Skeena	3732	6354	29	0	257	10,372	34.7	1512.1	7,885	12,859
	Total	8659	16463	2661	1420	710	29,913				
7/26-8/01	Ak. I	805	1377	255	207	31	2,675	11.6	974.3	1,072	4,278
Week 31	Ak. II	0	3479	0	975	52	4,506	19.5	945.6	2,951	6,061
	Nass	1848	0	800	284	34	2,966	12.9	653.5	1,891	4,041
	Skeena	2287	9639	846	0	153	12,925	56.0	1051.5	11,195	14,655
	Total	4940	14495	1901	1466	270	23,072				
8/02-8/08	Ak. I	4656	7932	769	1037	1697	16,091	24.1	2843.2	11,414	20,768
Week 32	Ak. II	0	6459	0	2172	1018	9,649	14.4	2283.2	5,893	13,405
	Nass	4429	1380	4433	2926	1553	14,721	22.0	2915.7	9,925	19,517
	Skeena	4255	15581	2977	0	3620	26,433	39.5	2884.4	21,688	31,178
	Total	13340	31352	8179	6135	7888	66,894				
8/09-8/15	Ak. I	836	751	399	415	240	2,641	37.5	329.1	2,100	3,182
Week 33	Ak. II	0	1322	0	163	149	1,634	23.2	275.4	1,181	2,087
	Nass	433	200	377	151	116	1,277	18.1	270.8	832	1,722
	Skeena	428	703	167	0	200	1,498	21.2	274.7	1,046	1,950
	Total	1697	2976	943	729	705	7,050				
8/16-8/22	Ak. I	211	72	160	40	11	494	27.2	79.1	364	624
Week 34	Ak. II	0	177	0	49	5	231	12.7	56.1	139	323
	Nass	261	67	49	44	10	431	23.8	98.6	269	593
	Skeena	379	204	58	0	16	657	36.2	102.1	489	825
	Total	851	520	267	133	42	1,813				
Fishery Total	Ak. I	12,545	15,504	3,629	3,062	2,256	36,996	21.6	3802.9	30,740	43,252
	Ak. II	0	24,515	0	5,737	1,493	31,745	18.5	3252.9	26,394	37,096
	Nass	12,352	12,496	8,378	4,337	2,057	39,620	23.1	4079.8	32,909	46,331
	Skeena	15,008	38,725	4,711	0	4,409	62,853	36.7	3920.8	56,403	69,303
	Total	39,905	91,240	16,718	13,136	10,215	171,214				

[a] The standard errors are minimum estimates since no estimates of the variance for stocks contributing 0 fish during a given week or for the 'other' age classes are available. The 90% confidence intervals are affected in like manner.

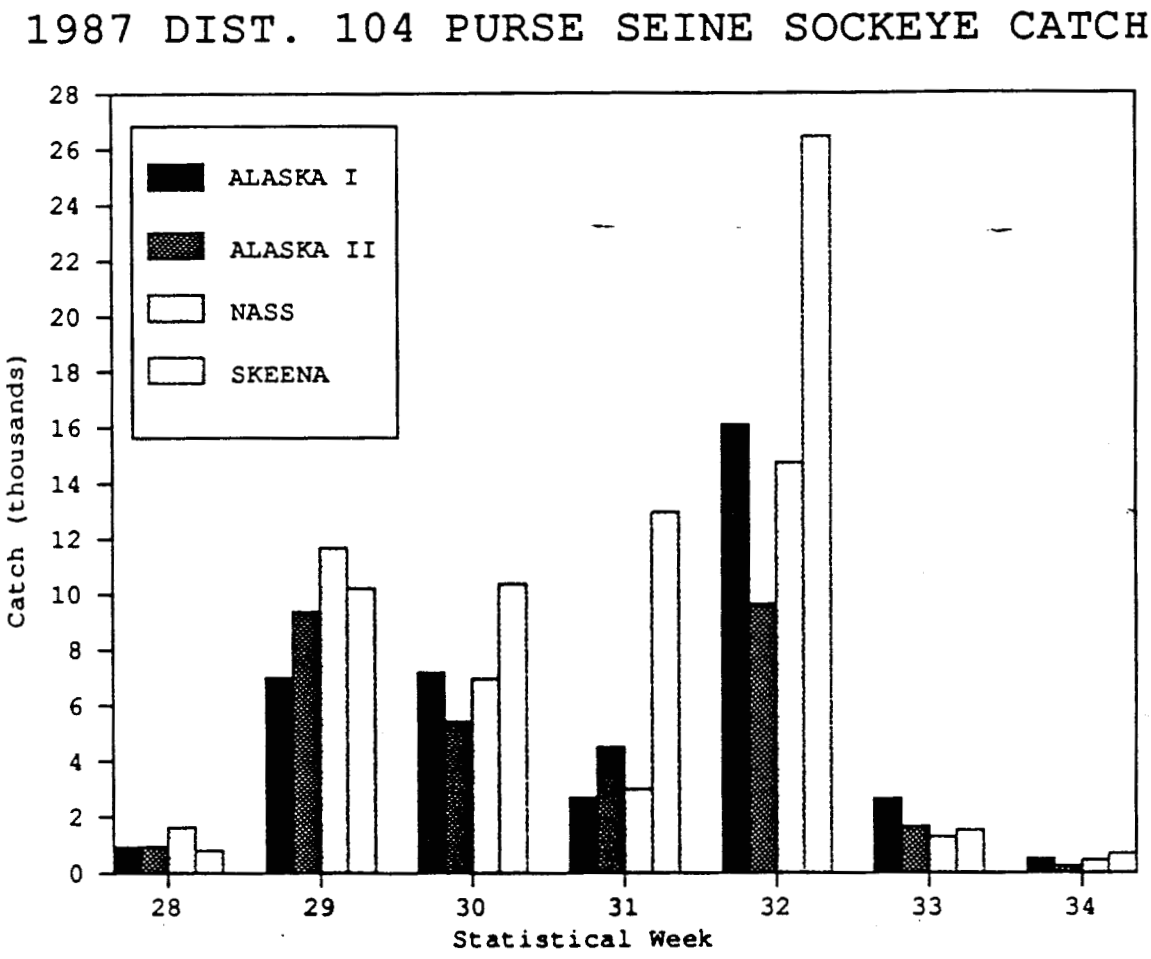

Figure 11. Weekly catch by stock group in Alaska's District 104 purse seine fishery, 1987.

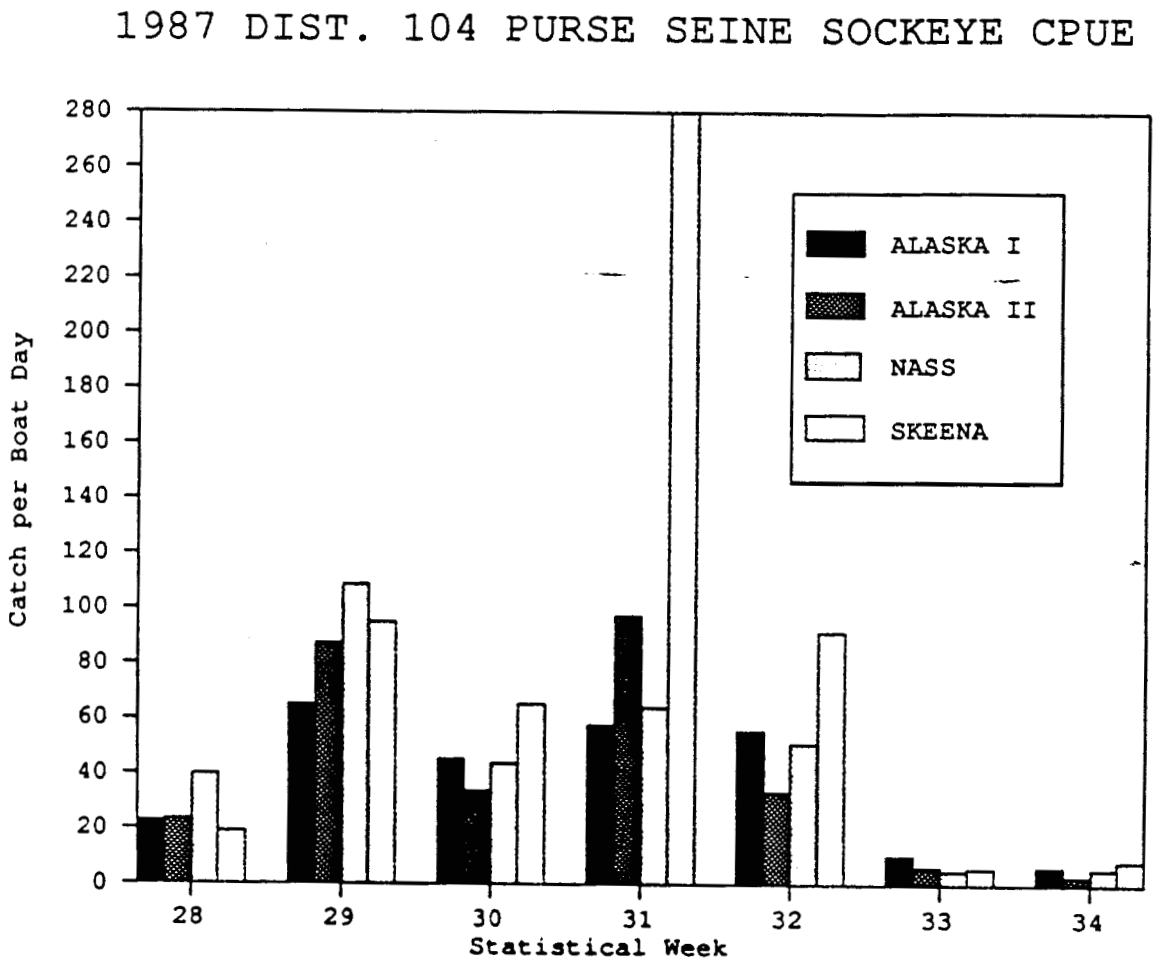

Figure 12. Weekly CPUE by stock group in Alaska's District 104 purse seine fishery, 1987.

10 thousand or 14% of the weekly catch. There were two distinct peaks of Alaska II sockeye CPUE of 87 and 97 fish per boat day respectively in week 29 (July 12 - 18) and week 31 (July 26 - Aug. 2) (Table 5, Figure 12) .

Nass River stocks were the second most common stock in the fishery contributing an estimated 39.5 thousand fish (23%) of the season's catch. Nass River sockeye salmon were the most numerous stock the first two weeks of the fishery contributing 1.6 thousand (38%) in week 28 (July 5-11) rising to 11 thousand (30%) in week 29 (July 12 -19) (Table 10, Figure 11). Nass River catches then declined to 7 thousand and 3 thousand respectively in weeks 30 and 31 (July 19-Aug. 1) before increasing to the season's maximum of 15 thousand in week 32 (Aug 2-8). Abundance of Nass River sockeye was higher than other stocks early in the season reaching a maximum in week 29 of 108 fish per boat day and remained high until the last two weeks of the season when catch and abundance dropped precipitously.

Skeena River sockeye were the most common stock in District 104 contributing 63 thousand (37%) of the season's catch. With the exception of the first two weeks of the season Skeena stocks were also the most common stock group in the weekly catches (Table 10, Figure 11). Catches of Skeena River sockeye rose from a few hundred in the first week of the season (week 28, July 5-11) to over 10 thousand in both weeks 29 and 30 (July 12-25). In week 31 (July 26-Aug.1), while catches of other stocks declined from the prior two weeks, catches of Skeena fish continued to increase to 13 thousand or 56% of the catch. Highest weekly catch of Skeena sockeye, 26 thousand fish or 40% of the catch, took place in week 32 (Aug. 2-8). Over 50% of the season's total Skeena River sockeye CPUE occurred in week 31 (July 26-Aug. 1) at a rate of 279 fish per boat day (Table 5, Figure 12).

Stock Composition of the District 106 Gill Net Catch

District 106 gill net fisheries were open portions of weeks 26 through 33 (June 21-Aug. 15), closed in week 34, then reopened from week 35 through 38 (Aug. 23-Sept. 19). Of 136 thousand

sockeye caught in the 1987 District 106 gill net fisheries, 79 thousand (58%) were taken in District 106-41 (Sumner Strait) and 57 thousand (42%) in 106-30 (Clarence Strait) (Table 2).

Of the 57 thousand sockeye salmon harvested in the District 106-30 gill net fishery an estimated 48 thousand (84%) were bound for Alaskan systems, 8 thousand (14%) were bound for the Canadian Nass and Skeena Rivers, and 9 hundred (2%) were bound for the transboundary Stikine River system (including Tahltan Lake) (Table 2).

Alaska I type sockeye salmon contributed 25 thousand fish (44%) to the 1987 District 106-30 catch of 57 thousand. Alaska II (McDonald Lake) fish contributed 23 thousand (41%). Nass and Skeena River sockeye salmon contributed 8 thousand fish (14%) to the District 106-30 catch. Stikine River sockeye salmon stocks (not including Tahltan Lake stocks) contributed an estimated 7 hundred (1.2%). Only about 2 hundred Tahltan Lake fish were caught in District 106-30 in 1987 (Table 2).

Of a catch of 79 thousand sockeye salmon in 1987 in District 106-41 an estimated 65 thousand (82%) were bound for systems in Alaska, 13 thousand (17%) were bound for the Nass and Skeena Rivers in Canada, and 1.5 thousand (2%) were bound for the transboundary Stikine River (including Tahltan Lake stocks).

Alaska I sockeye salmon contributed 41 thousand fish (52%) to a catch of 79 thousand in District 106-41 fishery while Alaska II stocks accounted for 23 thousand (29%) of the catch. Canadian Nass and Skeena River sockeye salmon contributed 13 thousand fish (17%) of the catch. Transboundary Tahltan Lake and Stikine River stocks respectively contributed 1 thousand (1.5%) and 2 hundred (<0.5%).

Stock Composition of the District 108 Gill Net Catch

Of 1.6 thousand sockeye salmon taken in the District 108 gill net fishery only a few hundred from week 29 could be allocated due to a lack of samples. The great majority (83%) of the fish in week

29 were of Stikine River and Tahltan Lake origin.

The primary objective of the District 106 and 108 scale pattern research is to estimate abundance of transboundary Stikine River and Tahltan Lake sockeye stocks. For a detailed examination of the fisheries in this district, as well as District 106 and Canadian fisheries in the Stikine River, the reader is referred to Jensen and Frank (1988).

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