ORIGINS OF CHINOOK SALMON *(Oncorhynchus tshawytscha* Walbaum*)* IN THE YUKON RIVER FISHERIES 1982

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ABSTRACT

Nearest neighbor analysis of scale patterns and age composition data of chinook salmon *(Oncorhynchus tshawytscha* Walbaum) obtained from the spawning escapements and catches in the Yukon River provided the basis for apportioning the District 1 and 2 commercial harvests to geographic region (run) of origin. Estimates of run contribution to the remaining mixed stock commercial and subsistence fisheries were based on age specific trends in run composition of the District 1 and 2 commercial catches. The total 1982 Yukon River harvest of chinook salmon was comprised of 100,692 (62.1%) upper Yukon, 37,682 (23.3%) middle Yukon, and 23,653 (14.6%) lower Yukon fish.

INTRODUCTION

The Yukon River chinook salmon *(Oncorhynchus tshawytscha* Walbaum*)* commercial fishery is one of the largest in Alaska. The average combined Alaskan and Canadian annual harvest during the period 1961 to 1981 was 104,576 fish; ranging from a low of 77,224 to an all time high of 157,509 in 1981. While chinook salmon are commercially harvested throughout virtually the entire length of the Yukon River, an average of 70% of the catch is taken in the District 1 gillnet fishery which operates in the lower 101 km of the river (Figures 1 and 2). Another 20% of the annual harvest is regularly taken in the District 2 commercial fishery. Most of the chinook salmon harvested in these two Districts are taken in a directed fishery that commences in early June where mostly gill nets of 203 to 229 mm (8 to 9 in) stretched mesh are operated[1]. This June fishery is commonly referred to as the "early" or "chinook" season. The remaining harvest is taken incidentally to the chum *(O. keta)* and coho *(O. kisutch)* salmon fishery. This fishery, in which gill nets of up to 152 mm (6 in) stretched mesh are allowed, is commonly referred to as the "chum" or "fall" season and commences in late June to early July. Subsistence fisheries along the Yukon River harvested an additional 25,060 chinook salmon annually between 1961 and 1981. Most of the subsistence harvest is taken with fishwheels and gill nets in Districts 3, 4, and 5. The Yukon River chinook salmon fisheries generally harvest mixed stocks of fish destined for spawning streams throughout the Yukon River drainage.

Estimation of the numbers of fish harvested by run is essential for sound management by the Alaska Department of Fish and Game (ADF&G). Catch apportionment to stock or stock grouping is critical to development of a long-term data base of stock-specific production. These data are necessary to develop an understanding of the population dynamics of the various spawning stocks. Stock production information can subsequently be incorporated into regulation of the fishery so that harvest patterns are adjusted to optimize yield.

The feasibility of identifying major component stocks of chinook salmon in the lower Yukon River commercial fishery was investigated for the 1980 and 1981 returns (McBride and Marshall 1983). Scale pattern measurements were used to identify major component stocks of age 5_2 and 6_2[2] chinook salmon in the District 1 commercial catch (Appendix Table 1). Scale patterns methodology was considered adequate to allocate catches to three broad geographic regions of origin; the lower, middle, and upper Yukon. These regional classifications of major component

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[1] During this fishery, there are no gill net mesh size restrictions and most fishermen operated large mesh nets for chinook salmon. However, some nets of 140 to 152 mm (5-1/2 - 6 in) stretched mesh are also operated.

[2] Gilbert-Rich formula: the first numeral refers to the total age of the fish. The second numeral, usually subscripted, refers to the number of years of freshwater residence. Marine age is the arithmetic difference between these two numbers.

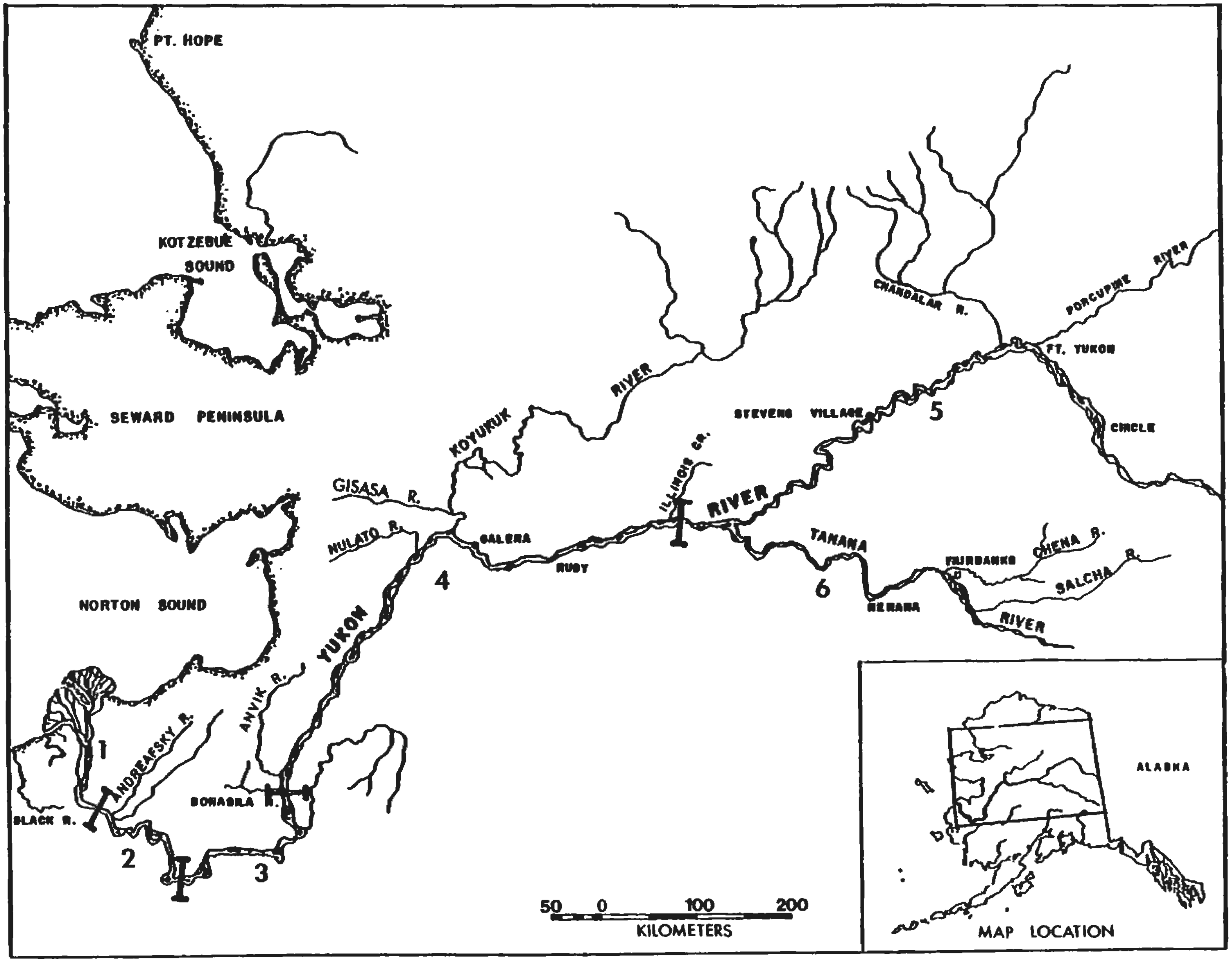

Figure 1. Alaskan portion of the Yukon River showing the Alaska regulatory districts.

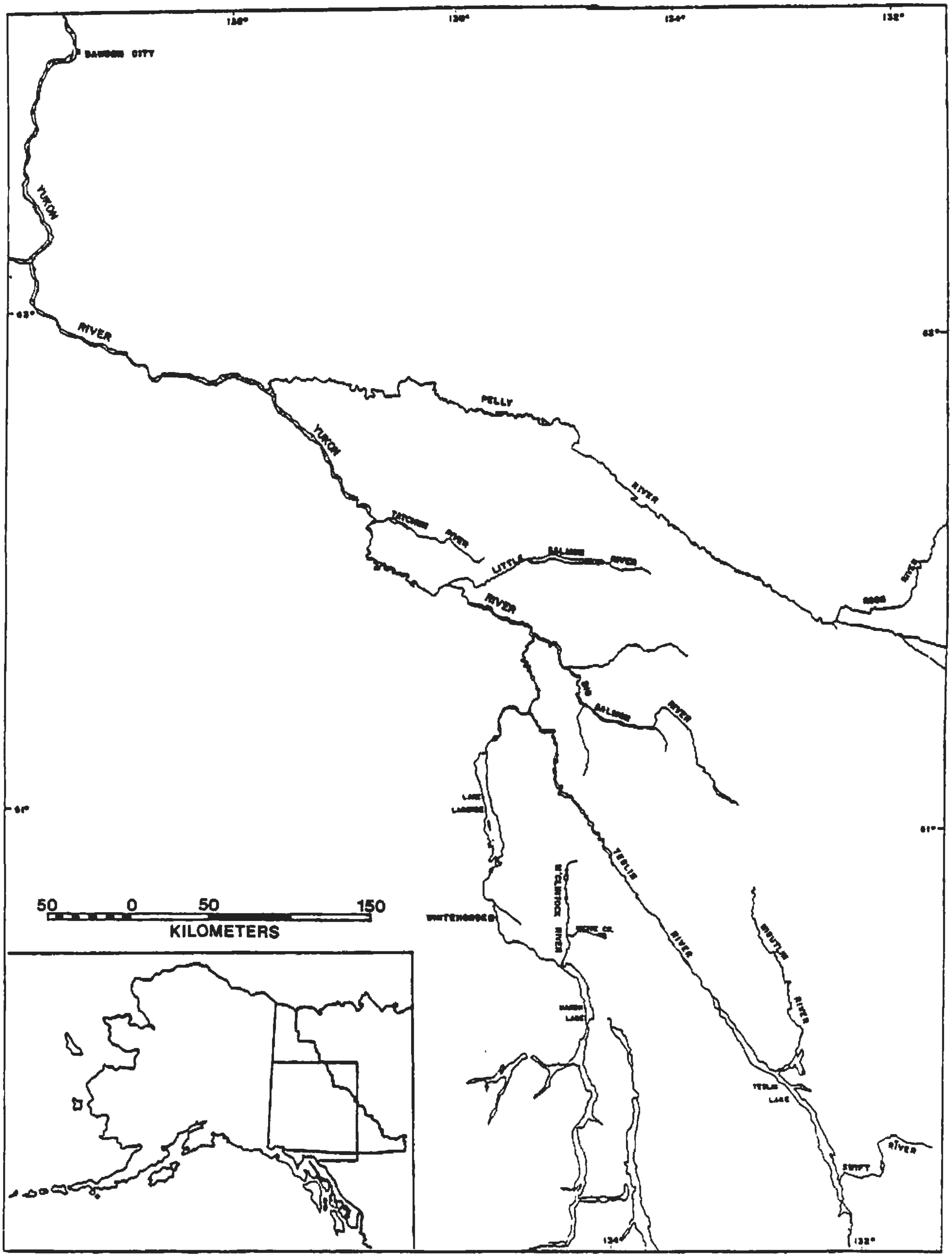

Figure 2. Canadian portion of the Yukon River.

stocks, termed runs by McBride and Marshall (1983), were defined as follows:

1) The lower Yukon classification is comprised of samples from the Andreafsky, Anvik, and Gisasa Rivers (Figure 1, Appendix Table 2).

2) The middle Yukon classification is comprised of samples from the Salcha and Chena Rivers (i.e., Tanana River drainage).

3) The upper Yukon classification (Figure 2) is comprised of samples from the Big Salmon, Little Salmon, Tachun, Pelly, Wolf, Nisutlin, Takhini, Ross, and Michie Rivers (i.e., spawning tributaries in Canada's Yukon Territory).

Because of the promise shown by the pilot study, this work was continued during 1982. Since significant commercial and subsistence catches occur throughout much of the length of the Yukon, the feasibility of allocating the entire Yukon River harvest to run of origin was also investigated.

The purpose of this report is to provide estimates of the 1982 Yukon River commercial and subsistence harvest of chinook salmon by run of origin. To this end, we continue to evaluate the use of scale pattern analysis to identify origins of chinook salmon harvested in lower Yukon River fisheries. Run contribution is estimated using nearest neighbor analysis of scale patterns for age 5_2 and age 6_2 chinook salmon from District 1 and District 2 commercial gillnet catches. Additionally, stock composition of the early season portion of the run that precedes the commercial season is estimated from analysis of test fishing and subsistence catch samples.

Age composition data are used to allocate the remaining age classes in the District 1 and 2 commercial catches to run of origin. We estimated stock composition for the remaining mixed stock fisheries in Districts 3, 4, 5, and 6 by applying the results obtained in Districts 1 and 2 commercial fisheries.

METHODS

In this report, we build upon the catch, escapement, and age composition data base compiled by McBride et al. (1983) for the 1982 return of salmon to the Yukon River.

Age Composition

Examination of scale samples provided age information of fish in the catch and escapement. Samples were collected on the left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (INPFC 1963). Scales were mounted on gum cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). Ages were recorded in Gilbert-Rich notation.

Catch:

An age composition was computed for each Yukon River commercial and subsistence fishery (McBride et al. 1983).

Samples from the District 1 commercial catch were collected for each fishing period during the chinook salmon season and most of the chum salmon season. In addition, test fish catches[1] were sampled throughout the chinook salmon migration. Subsistence catches were sampled prior to the first commercial opening. District 2 commercial catch samples were collected for each fishing period during the chinook salmon season and the first two fishing periods during the chum salmon season. Samples from individual fishing periods were pooled into sample periods as described by McBride et al. (1983) for the purpose of computing age composition. Sample periods for each district were defined as follows: (1) sample period 1 consisted of the first three fishing periods, (2) sample period 2 consisted of the remaining fishing periods during the chinook salmon season, and (3) sample period 3 consisted of all fishing periods during the chum salmon season.

Sampling of most upriver catches (above District 2) was either minimal or non-existent. An age composition was computed directly for each sampled fishery and included the District 4 and Dawson commercial fisheries. No scale samples were collected from the District 3 catches. However, examination of the timing of peak catches in District 3 compared to that of downriver catches indicated that most fish harvested in the District 3 fishery probably migrated through District 2 during sample period 1. Therefore, age composition data from the District 2 fishery (sample period 1) were applied to the District 3 fishery. The District 5 fishery was also not sampled and an age composition was estimated from samples collected in the Canadian Dawson fishery. Samples collected from the subsistence fishery in District 6 were used to assign the age composition for the commercial fishery.

Subsistence catches were generally not sampled. However, subsistence fishing occurs concurrently with commercial effort and age composition for subsistence catches in each district was assumed to be directly analogous to commercial catch composition.

Escapement:

Scale samples were collected during peak spawner die off from the major spawning tributaries (as determined by aerial survey). Virtually all samples were collected from carcasses.

We pooled samples from individual spawning tributaries in the middle and upper Yukon areas to form a composite proportional to the contribution of individual stocks as measured by aerial survey data. There were no aerial survey data for the Anvik River in 1982, and a pooled sample was selected for the lower Yukon run without weighting for abundance of individual stocks.

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[1] ADF&G conducts test fishing projects in the Yukon River delta to index the timing and magnitude of the salmon migration entering the Yukon River. Test fishing is conducted concurrently with the commercial fishery and samples collected from these projects also represent fish of unknown origin in District 1.

Run Identification

We used scale pattern analysis to classify age 5_2 and 6_2 commercial catches in District 1 and 2 to lower, middle, or upper Yukon run of origin. The remaining age groups in the District 1 and 2 catches were allocated based on differences in age composition of the three runs. Results of the Districts 1 and 2 analysis were extrapolated to allocate adjacent mixed stock fisheries.

Scale Pattern Analysis:

Measurements of scale features were made as described by McBride and Marshall (1983). Scale impressions were magnified to 100 power and projected onto a digitizing tablet using equipment similar to that described by Ryan and Christie (1976). Data recording onto computer diskettes from the digitizer tablet was under the control of a FORTRAN program executing on a microcomputer. Measurements were taken along an axis approximately perpendicular to the sculptured field. The distance was measured between each circulus in each of three scale pattern zones. The zones were as follows: (1) scale focus to the outside edge of the freshwater annulus, (2) outside edge of the freshwater annulus to the last circulus of the freshwater growth, and (3) the last circulus of the freshwater growth zone to the outer edge of the first ocean annulus (Figure 3). In addition, the incremental distance of successive scale pattern zones was also measured as follows: (1) the last circulus of the first ocean annulus to the last circulus of the second ocean annulus (age 5_2 and age 6_2), and (2) the last circulus of the second ocean annulus to the last circulus of the third ocean annulus (age 6_2 only). A set of 15 variables was then computed for each of the first three zones while only one variable was computed for each of the last two zones (Table 1). We then obtained descriptive statistics and frequency histograms for all scale variables and calculated a set of data transformation from combinations of these variables, similar to combinations described by Van Alen (1982) and Meyers and Rogers (1982). The purpose of creating these transformations was to combine variables with some discriminatory powers in such a way as to increase their utility in this respect.

Examination of frequency histograms indicated that many variables were not normally distributed (example: Appendix Figures 1-3). We therefore selected nearest neighbor analysis (Clover and Hart 1967) as the technique for classifying Yukon River chinook salmon to run of origin because the test is nonparametric and requires no underlying assumptions of normality concerning population paremaeters. We used the computation routines of the FORTRAN program ARTHUR (Duewer et al. 1975) for the nearest neighbor analysis in this study.

Selection of a subset of scale variables for inclusion in the nearest neighbor model was made by offering all variables to the selection procedures available in ARTHUR. These procedures removed correlations, evaluated the usefulness of each variable (by Fisher weighting), and ranked them in order of their utility. The Fisher weights of these ranked variables were then subjectively examined to determine those variables for inclusion in the model to obtain the highest possible classification accuracy. McBride and Marshall (1983) evaluated this procedure using age 5_2 fish from the 1981 escapement sample and concluded that this method provided an acceptable subset of variables. Subsequent analysis was then limited to these top selected variables.

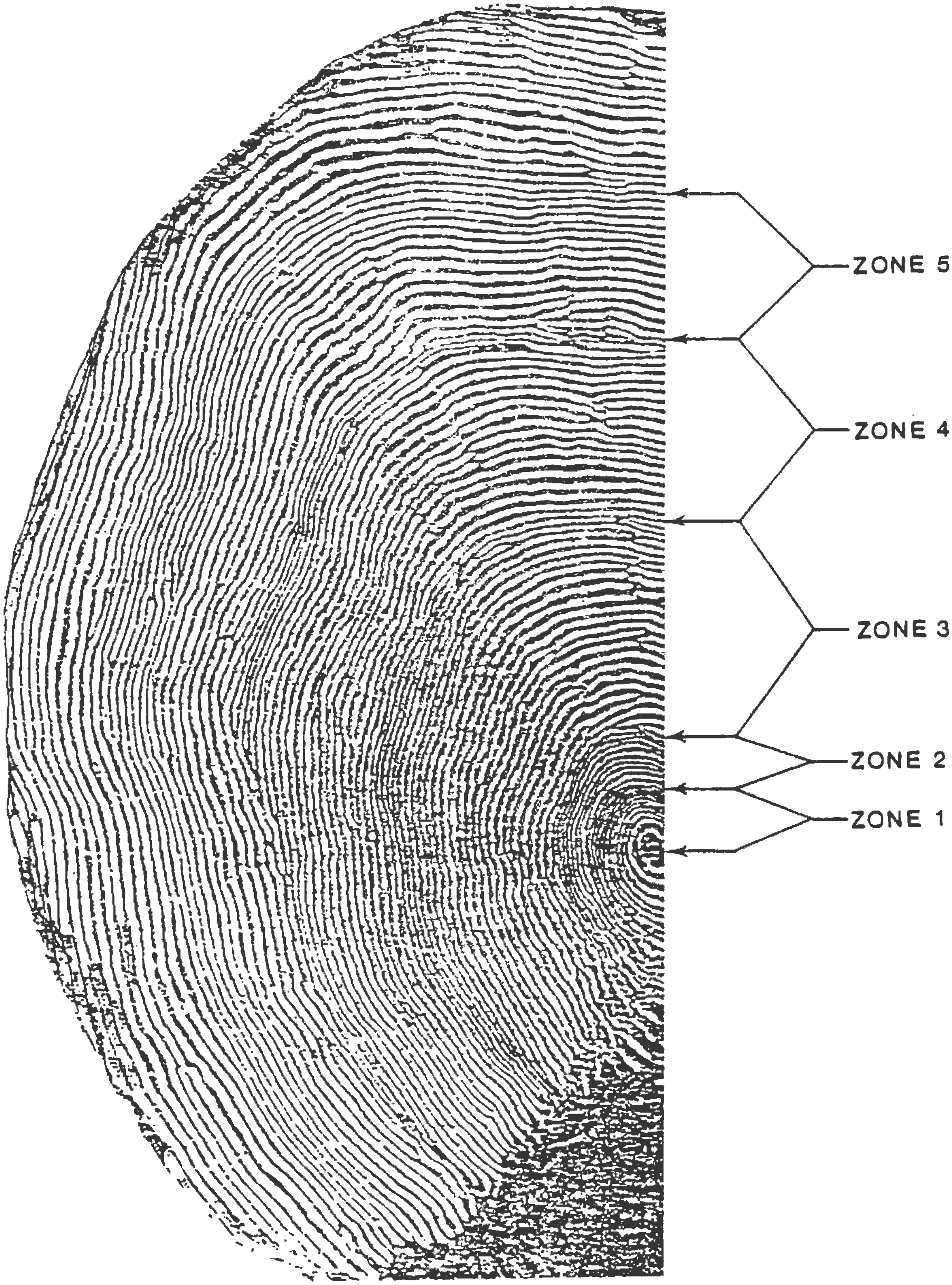

Figure 3. Age 6_2 chinook salmon scale showing the zones measured for nearest neighbor analysis.

Table 1. Variables computed for scale pattern zones 1, 2,and 3 for inclusion in the nearest neighbor analysis.

Variable Name[1]	Description
NC(i)[1]	Number of circuli in zone (i).
ID(i)[2]	Measured size of zone (i).
TWO(i)	Distance from the beginning of zone i to the second circulus of zone (i).
FOUR(i)	Distance from the beginning of zone i to the fourth circulus of zone (i).
SIX(i)	Distance from the beginning of zone i to the sixth circulus of zone (i).
EIGHT(i)	Distance from the beginning of zone i to the eighth circulus of zone (i).
MIN(i)	Distance between the two closest circuli in zone (i).
MAX(i)	The maximum distance between two contigious circuli in zone (i).
LMIN(i)	The distance from the beginning of the zone (i) to the first circulus of variable MIN(i) in zone (i).
LMAX(i)	The distance from the beginning of zone (i) to the first circulus of variable MAX(i) in zone (i).
NCH(i)	The number of circuli in the first half of zone (i).
NSIX(i)	The distance from the sixth-from-last circulus of of zone (i) to the last circulus of zone (i).
NFOUR(i)	The distance from the forth-from-last circulus of zone (i) to the last circulus of zone (i).
NTHREE(i)	The distance from the third-from-last circulus of of zone (i) to the last circulus of zone (i).
NTWO(i)	The distance from the second-from-last circulus of zone (i) to the last circulus of zone (i).

[1] Where i = 1, 2, 3.

[2] Also computed for zone 4 (age 5_2 and 6_2) and zone 5 (age 6_2).

Three-way stock identification models were constructed from both age 6_2 and 5_2 scale measurements representing the lower, middle, and upper Yukon runs. The nearest neighbor method requires equal sample sizes for data sets of known origin and, ideally, the number of samples from individual rivers is determined by the relative contribution of each escapement to the run.

The small number of age 6_2 escapement samples from the lower Yukon run limited test pattern data sets to 77 samples from each run. Upper Yukon standards were chosen at random from Dawson commercial catch sample. We felt that the Dawson sample was a more representative composite of the overall upper Yukon escapement than samples from individual spawning streams.

The availability of age 5_2 fish from the upper Yukon limited sample sizes to 108 fish for each run. Because of limited samples and escapement data, the lower Yukon standards included all available scales from the Gisasa (N=12) and Anvik (N=22) rivers; and randomly selected scales from the Andreafsky River (N=74). Middle Yukon standards included all available Chena River scales (N=35) and randomly selected Salcha Rivr scales (N=73).

For Districts 1 and 2, we computed estimates of the proportions of age 6_2 and 5_2 fish originating from the lower, middle, and upper Yukon runs by classifying scale pattern data from samples of the commercial catches. For District 1, test samples were included for those periods where the availability of samples was limited (i.e., less than 100 samples). Contribution rates for age 6_2 fish were computed for each fishing period during the chinook salmon season and a pooled sample of the chum salmon season. Because of limited samples, contribution rates of age 5_2 fish were computed only for each sample period (i.e., sample periods used to compute age composition). Point estimates were corrected for misclassification error rates using the procedure of Cook and Lord (1978). The variance and 90% confidence intervals for these estimates were computed using the procedures of Pella and Robertson (1979).

A catch sample was reclassified with a model representing only two runs if the final proportion estimate was less than or equal to zero for the run in question. A two-way model was constructed using only standards from the two runs with positive classification estimates. Data were then resubmitted to the ARTHUR variable selection routines and a new subset of variables was chosen for inclusion in the two-way model.

Differential Age Composition Analysis:

Allocation of the remaining age classes in the District 1 and 2 commercial catches was based on differences in escapement age composition in each of the three runs. We felt that escapement abundance data (peak aerial survey data) were to imprecise to allow direct comparisons among runs. To directly compare escapement age composition, we computed ratios for each run whereby the proportion in the escapement of the age class in question was divided by the proportion in the escapement of an age class of known composition (estimated from nearest neighbor analysis) in the commercial harvest (either age 5_2 or 6_2):

E_{ci} = Proportion of fish of age class i in run c escapement samples where i is an age class of unknown run composition in the catch.

E_{ca} = Proportion of fish of age class a in run c where a is an age class of known run composition in the catch (either 5_2 or 6_2).

$R_{ci} = E_{ci}/E_{ca}$

Because the relative contributions of age 3_2 and 4_2 fish decreased in escapements moving progressively upriver, these age classes were compared to age 5_2. All other age groups (5_3, 6_3, 7_2, and 8_3) were compared to age 6_2 fish since the relative contributions of all of these age classes increased in escapements moving progressively upriver.

These ratios of proportional abundance were then multiplied by the allocated catch of either age 5_2 or 6_2 fish. These computations were summed over all runs to calculated age-specific contribution rates. Multiplication by total catch by age class yields age-specific run contribution estimates:

N_i = Total catch of age group i.

N_{ca} = Catch of age group a (where a is either age 6_2 or 5_2) in run c.

F_{ci} = Proportion of fish of run c in N_i.

$$F_{ci} = \frac{R_{ci} \cdot N_{ca}}{\sum_{j=1}^{3} R_{ji} \cdot N_{ja}}$$

(where j is run number: either 1, 2, or 3 for lower, middle, or upper run)

N_{ci} = Catch of age group i in run c.

$N_{ci} = F_{ci} \cdot N_i$

Allocation of Remaining Fisheries:

We used estimates of age-class specific run composition from nearest neighbor analysis and differential age composition analysis in the lower Yukon River fisheries to allocate the catches of adjacent commercial and subsistence fisheries to run of origin. Subsistence fishing in Districts 1, 2, and 3 is open between commercial fishing period openings and we assume that gear and fishing patterns are similar to the commercial fishery. Therefore, we assumed that run composition for the commercial catches was directly applicable to the subsistence catches.

Run composition estimates from the District 2, sample period 1 commercial catch were applied to the District 3 commercial and subsistence catches. We assumed that all chinook salmon in the District 4 harvests were destined for either the middle or upper Yukon River as most of the catches occur upstream from the major lower Yukon River spawning streams. Age-class specific run contribution rates for District 4 were calculated from the ratio of middle to upper Yukon River fish allocated in the District 2, sample period 1 catch. We assumed that virtually all chinook harvested in District 5 were destined for upper Yukon River spawning sites. We feel that this hypothesis is valid as most of the District 5 catch occurs above the confluence of the Tanana River and there are few documented spawning concentrations between the Tanana River confluence and Dawson. The entire District 6 harvest was allocated to the middle Yukon run.

RESULTS AND DISCUSSION

Age Composition

We computed age composition for the lower, middle, and upper Yukon River escapements (Table 2). Consistent with previous years' data (McBride and Marshall 1983) the proportion of older fish increased in spawning populations moving progressively upriver. The lower Yukon run was comprised mainly of age 5_2 and 4_2 fish (45.5% and 32.9%, respectively). The middle Yukon fish were mostly age 6_2 (39.2%), followed closely by age 5_2 and 4_2 fish (28.7% and 27.3%, respectively). The upper Yukon River escapements were dominated by age 6_2 fish (61.6%) followed by age 5_2 and age 7_2 fish (17.0% and 12.8%, respectively).

No age 3_2 fish were observed in the upper Yukon River escapements and no fish with two freshwater annuli were found in the lower Yukon. Virtually all 2-freshwater age fish were found in the upper Yukon escapement with only two 2-freshwater chinook salmon (one each age 6_3 and 7_3 fish) observed from the middle Yukon River escapement. Age 4_2 fish were in very low abundance (0.4%) in the upper Yukon, while age 7_2 fish were relatively minor components of the lower (1.2%) and middle (4.5%) Yukon River escapements.

The generally large differences between runs and relatively small differences within runs observed in the 1982 analysis were consistent with findings in 1980 and 1981. The Anvik River age composition, however, was generally intermediate between the Andreafsky River and the Chena and Salcha Rivers. Sample sizes in 1982 were small, however, and confidence intervals for age structure estimates were large.

Run Identification

We continued to observe the persistent and significant differences in scale patterns of Yukon River chinook salmon reported by McBride and Marshall (1982). Using these scale pattern differences, and differences in age compositions observed among runs, we allocated the entire 1982 Yukon River chinook salmon harvest to run of origin.

Scale Pattern Analysis:

The number of circuli (NC) and the incremental distance (ID) of zone 2 increased markedly from the lower to upper Yukon runs (Tables 3-4). Conversely, NC and ID for zones 1 and 3 generally decreased from the lower to upper runs. These trends were also observed in both the 1980 and 1981 data. Variables with the largest F values and lowest probabilities for equality of means were consistently those associated with zone 2 for both age groups.

Variable Selection. Variables selected for inclusion in the nearest neighbor model were chosen by a subjective method of plotting the ranked Fisher weights to judge the relative value of each in contributing to the discriminatory power of the model (Figures 4-6). Two data transformations, T_1 (T_1=NSIX2/ID2) and T_{15}

Table 2. Age composition summary of chinook salmon escapements, Yukon River, 1982.

			Percent Compostion								
Location	N	Escapement [1] Estimates	3_2	4_2	5_2	5_3	6_2	6_3	7_2	7_3	8_3
Lower											
Andreafsky R.	237	1,973	1.2	33.2	50.4		13.2		2.0		
Anvik R.	138			34.9	37.6		27.5				
Gisasa R.	32	421 [2]		21.8	43.8		34.4				
Total	407		0.7	32.9	45.5		19.7		1.2		
Middle											
Chena R.	182	2,073		33.1	27.3		38.1		1.5		
Salcha R.	527	2,534	0.5	22.5	29.8		40.1	0.1	6.9	0.1	
Total [3]	709	4,607	0.3	27.3	28.7		39.2	0.1	4.5	0.1	
Upper											
Tatchun Cr.	12	73 [4]			33.3	16.8	33.3		16.8		
Little Salmon R.	51	305			27.5		51.1		17.6	1.9	1.9
Big Salmon R.	162	1,168			15.3	0.6	60.2		20.9	1.8	1.2
Nisutlin R.	117	843			15.4	0.8	77.0		3.4	3.4	
Morley R.	5	176		20.0	20.0		60.0				
Wolf R.	20	225			5.0		50.0	5.0	15.0	25.0	
Takhini R.	11	14 [4]					54.5			45.5	
Teslin R.	14	51					85.8		14.2		
Michie Cr.	40	150 [5]		7.5	32.5	15.0	32.5	5.0	2.5	5.0	
Total [3]	432	3,005		0.4	17.0	0.7	61.6	0.6	12.8	4.2	0.7

[1] Aerial survey except as noted.

[2] No survey.

[3] Weighted by escapement estimate.

[4] Foot survey.

[5] Estimate is from aerial survey, actual fishway count at Whitehorse = 473.

Table 3. Group means, standard deviations, one-way analysis of variance F-test, and probability for equality of group means, for scale variables measured from age 6_2 chinook salmon sampled at selected lower, middle, and upper Yukon River sites, 1982.

Variable	Lower		Middle		Upper		F	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	Value	Probability
TWO1	47.6	7.6	49.3	5.9	48.2	5.8	2.72	.0670
FOUR1	68.5	10.3	71.1	8.2	69.1	8.2	4.01	.0186
SIX1	85.0	12.4	88.2	10.5	85.6	10.0	4.31	.0138
EIGHT1	94.4	26.4	97.0	27.7	95.4	23.7	0.35	.7057
MAX1	33.4	6.3	33.8	4.9	33.7	4.8	0.17	.8477
MIN1	5.3	1.4	5.8	1.3	5.4	1.1	7.16	.0008
LMIN1	7.8	2.6	7.1	1.9	7.7	2.1	4.39	.0128
NC1	10.4	1.9	9.4	1.4	9.9	1.6	12.06	.0000
ID1	117.9	24.6	113.7	16.8	113.1	17.9	2.14	.1190
NCH1	2.5	.9	2.2	.6	2.2	.8	7.03	.0010
NSIX1	46.4	7.4	49.6	8.1	45.8	8.2	13.01	.0000
NFOUR1	29.3	5.2	30.5	4.8	28.2	4.7	13.00	.0000
NTHREE1	21.6	4.2	22.4	3.9	20.7	3.6	10.57	.0000
NTWO1	14.5	3.6	15.0	3.2	13.8	2.8	10.34	.0000
TWO2	15.6	6.7	20.5	4.2	20.4	4.3	35.77	.0000
FOUR2	8.2	15.2	43.2	7.6	43.1	7.1	525.29	.0000
SIX2	1.5	9.3	40.3	32.4	57.0	23.2	148.17	.0000
EIGHT2	0.0	0.0	3.4	16.4	40.0	43.6	182.09	.0000
MAX2	10.9	2.7	14.0	2.5	14.3	2.4	58.63	.0000
MIN2	7.6	2.0	7.9	1.5	7.5	1.6	3.13	.0433
LMAX2	2.1	1.1	3.2	1.5	3.8	2.1	27.80	.0000
LMIN2	1.6	.7	2.5	1.8	3.0	2.6	14.78	.0000
NC2	2.9	1.2	5.9	1.1	7.4	1.7	309.65	.0000
ID2	26.2	12.3	63.3	14.1	79.7	20.3	292.85	.0000
NCH2	1.0	.7	2.5	.7	3.2	1.0	211.92	.0000
NSIX2	1.5	9.3	40.8	32.8	57.6	23.6	146.68	.0000
NFOUR2	8.3	15.5	44.1	7.5	43.2	7.1	529.14	.0000
NTHREE2	17.2	14.6	32.9	5.2	31.7	5.5	140.29	.0000
NTWO2	17.0	7.2	21.2	4.0	20.6	4.3	23.22	.0000
TWO3	25.5	5.0	27.3	4.9	27.5	5.3	4.92	.0076
FOUR3	53.2	9.5	58.1	8.8	59.1	9.5	12.39	.0000
SIX3	83.0	13.1	91.0	11.4	93.2	14.1	18.30	.0000
EIGHT3	113.5	16.0	125.3	14.5	128.7	18.5	24.83	.0000
MAX3	25.7	3.3	26.3	3.5	25.9	3.8	.87	.4205
MIN3	9.5	1.8	10.3	2.1	10.4	2.1	7.14	.0009
LMAX3	18.6	5.4	16.4	5.7	14.6	5.3	18.48	.6238
NC3	27.6	3.1	26.8	2.5	24.7	3.4	44.45	.0000
ID3	462.7	73.1	473.8	46.4	436.5	61.9	24.61	.0000
NCH3	14.5	1.7	13.5	1.5	12.5	2.9	28.35	.0000
ID4	375.5	69.8	405.6	59.9	402.1	68.6	6.14	.0023
ID5	385.0	70.2	413.4	61.0	391.9	66.9	8.06	.0004
Sample Size	77		189		300			

Table 4. Group means, standard deviations, one-way analysis of variance T-test, and probability for equality of group means, for scale variables measured from age 5_2 chinook salmon sampled at selected lower, middle, and upper Yukon River sites, 1982.

	Lower		Middle		Upper			
Variable	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	F Value	Probability
TWO1	46.6	5.4	47.9	5.6	47.1	5.3	1.59	.2052
FOUR1	71.1	7.9	71.2	8.3	69.5	8.2	1.46	.2341
SIX1	89.8	9.2	89.0	10.3	86.5	13.4	2.67	.0705
EIGHT1	103.7	17.7	100.0	22.9	96.7	26.3	2.63	.0737
MIN1	5.3	1.0	5.5	1.3	5.5	1.1	.88	.4148
LMIN1	9.3	2.1	8.1	1.9	7.9	2.1	14.35	.0000
NC1	11.2	1.8	10.4	1.4	10.1	1.9	12.20	.0000
ID1	127.9	18.2	120.0	16.4	116.3	19.0	11.72	.0000
NCH1	2.9	.9	2.5	.7	2.4	.8	8.29	.0003
NSIX1	46.1	7.4	46.3	8.4	47.3	9.3	.67	.5129
NFOUR1	28.3	4.3	28.2	4.5	28.8	4.7	.53	.5912
NTHREE1	20.6	3.6	20.7	3.8	21.0	3.6	.39	.6794
NTWO1	13.7	2.7	13.9	2.8	13.8	2.8	.14	.8732
TWO2	15.3	5.5	17.7	3.7	19.9	4.5	26.73	.0000
FOUR2	15.7	17.3	37.7	5.6	41.2	7.5	159.85	.0000
EIGHT2	0.0	0.0	4.6	17.5	21.6	36.0	52.38	.0000
MAX2	10.1	2.2	12.3	2.0	13.7	2.4	70.27	.0000
MIN2	6.7	1.6	7.0	1.5	7.1	1.5	2.05	.1306
LMAX2	2.2	1.1	3.4	1.6	3.2	1.8	21.07	.0000
LMIN2	1.7	1.1	2.3	1.6	3.0	2.3	16.04	.0000
NC2	3.3	1.3	5.7	1.2	6.5	1.5	157.59	.0000
ID2	27.9	12.1	54.2	11.9	65.4	16.8	211.36	.0000
NCH2	1.3	.7	2.5	.7	2.6	.9	92.06	.0000
NSIX2	2.2	10.3	31.4	29.1	41.0	29.1	73.35	.0000
NFOUR2	15.8	17.5	39.8	5.4	40.2	6.8	168.58	.0000
NTHREE2	17.9	12.3	29.8	4.4	29.4	4.7	76.85	.0000
NTWO2	15.8	5.8	20.0	3.3	19.0	3.6	26.57	.0000
TWO3	25.6	4.3	27.9	5.2	26.2	5.2	6.34	.0020
FOUR3	55.0	7.2	61.2	8.1	59.2	9.0	16.73	.0000
SIX3	85.5	10.4	94.7	10.4	93.3	13.1	20.62	.0000
EIGHT3	116.4	13.3	129.8	13.2	129.7	16.8	30.12	.0000
MAX3	26.7	2.9	25.8	3.0	26.7	3.9	2.76	.0650
MIN3	10.1	1.7	10.5	1.8	10.2	2.0	1.94	.1451
LMAX3	16.8	4.4	13.7	4.9	13.4	4.8	17.77	.0000
NC3	27.8	2.5	26.0	2.6	24.5	2.7	43.38	.0000
ID3	484.9	50.4	467.5	55.9	437.3	51.8	21.74	.0000
NCH3	14.5	1.5	12.8	1.5	12.0	1.6	74.92	.0000
ID4	402.7	65.9	422.0	67.3	409.9	62.3	2.43	.0896
T1	.045	.206	.513	.474	.577	.413	62.53	.0000
T15	.043	.018	.085	.020	.106	.028	215.48	.0000
Sample Size	108		108		108			

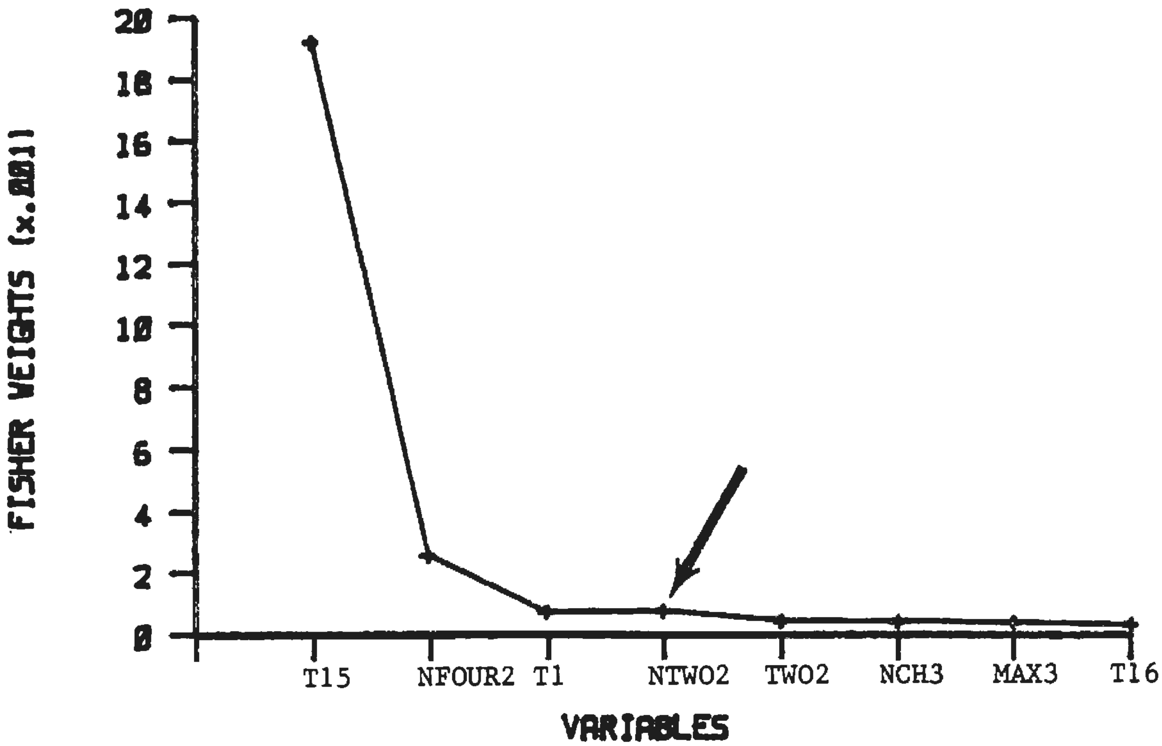

Figure 4. Fisher weights of the top ranked variables, and those variables included in the final classification model (arrow) as determined from nearest neighbor analysis of age 5_2 lower, middle, and upper Yukon fish, 1982.

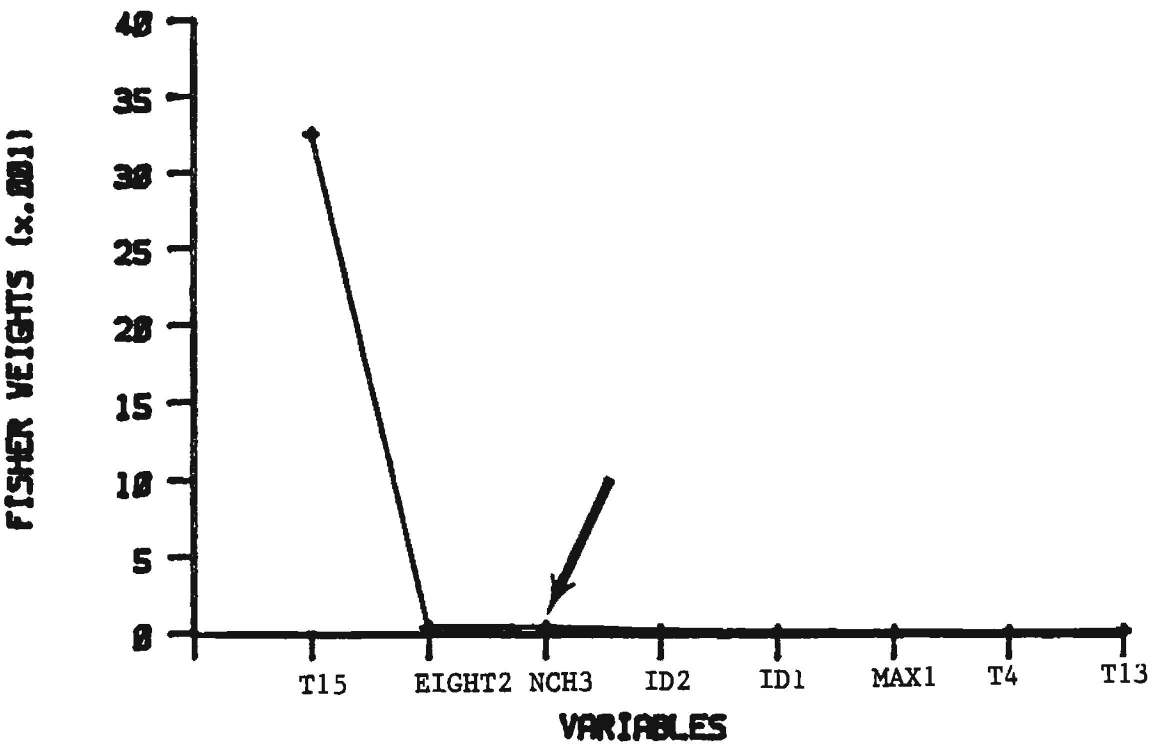

Figure 5. Fisher weights of the top ranked variables, and those variables included in the final classification model (arrow) as determined from nearest neighbor analysis of age 5_2 lower and upper Yukon fish, 1982.

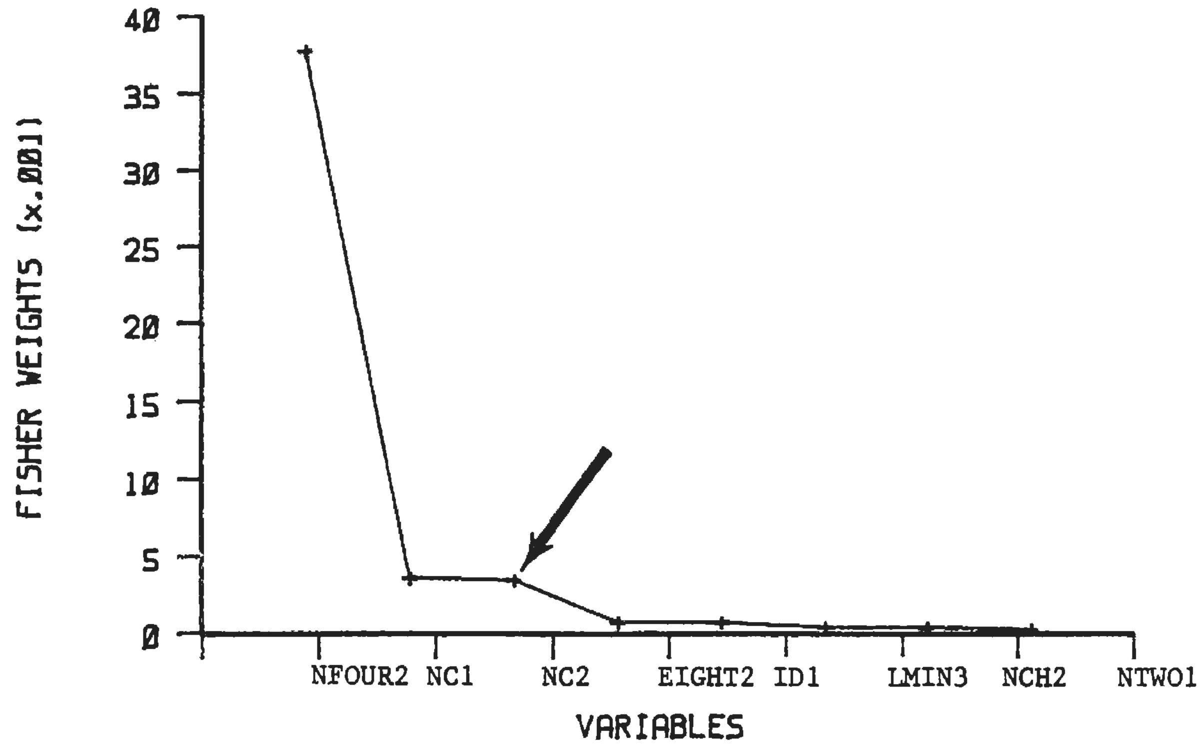

Figure 6. Fisher weights of the top ranked variables, and those variables included in the final classification model (arrow) as determined from nearest neighbor analysis of age 6_2 lower, middle, and upper Yukon fish, 1982.

[T_{15}=ID2/(ID1+ID2+ID3)], were selected as significant variables. The most commonly chosen variables were NFOUR2 and T_{15}, both derived from measurements of zone 2 features.

Classification Accuracies. Average classification accuracy of the age 6_2 3-way model was 77.9% (Table 5). Lower Yukon fish had the highest classification accuracy (85.7%). Poorest discrimination was between the middle and upper runs with upper Yukon fish more commonly being misclassified as middle Yukon fish (31.2%) than vice-versa. Lower and upper Yukon fish were seldom mistaken for one another (6.5% and 1.3%, respectively).

Average classification accuracy of the age 5_2 3-way model was 66.7% (Table 6). Similar to the age 6_2 model, lower Yukon fish exhibited the highest classification accuracy (76.9%). Misclassification rates between the middle and upper Yukon runs were large (30.6% and 32.4%, respectively). The upper and lower runs had the same low frequency (4.6%) of misclassification. Classification accuracy of the age 5_2 2-way model for lower and upper runs was high (91.7%).

Overall classification accuracies for both age 5_2 and 6_2 3-way models were greater in 1982 than in 1981. Classification accuracies during the 1982 analysis were sufficiently high so that virtually all point estimates of run specific contribution rates were greater than zero. A major weakness of the 1981 analysis was that no age 6_2 fish were allocated to the lower Yukon run as all point estimates of lower Yukon contribution rate were less than zero. However, it is difficult to determine whether the observed increases in accuracy were due to the addition of new variables or to other factors, since we did not attempt to perform the analysis without including the modifications.

Run Composition Estimates. We used the calculated 3-way and 2-way classification models to estimate contribution rates by run for the age 5_2 and age 6_2 chinook salmon harvest in the District 1 and 2 commercial gillnet fisheries (Tables 7 and 8).

Several temporal trends were apparent in the run compositions of age 6_2 fish from Districts 1 and 2. The proportions for all runs observed in the pre-season sample closely resembled those of the first commercial period in District 1. The proportion of upper Yukon fish in both District 1 and 2 catches dramatically declined over time (from 70.4% to 29.9% in District 1, and from 77.6% to 38.0% in District 2). The proportion of lower Yukon fish was consistently low through period 5 in both districts and ranged from 2.6-13.0%. However, the proportion of lower Yukon fish dramatically increased during the chum salmon season in both Districts 1 and 2 (48.7% and 30.9%, respectively). Contributions of middle Yukon fish remained fairly constant through period 4 in both Districts, ranging from 19.8-30.2%, but varied widely thereafter. However, confidence intervals for these estimates were generally large and frequently overlapped.

Similar temporal trends were evident in the run composition of age 5_2 fish. Lower Yukon fish increased from 17.0% to 75.3% in District 1, and from 29.4% to 78.2% in District 2. Contribution rates of upper Yukon fish in District 1 displayed the same pattern of decline over time (52.6% to 6.4%) as age 6_2 fish. However, the estimated proportions of middle and upper Yukon fish in District 2 were variable. The widths of confidence intervals for this age class were also large.

Table 5. Test classification matrices for nearest neighbor analysis of age 6_2 Yukon River chinook salmon, 1982.

Actual Group of Origin	Sample Size	Classification Group of Origin (Variables = NFOUR2, NC1, NC2) Lower	Middle	Upper
Lower	77	.857	.078	.065
Middle	77	.039	.805	.156
Upper	77	.013	.312	.675

Average Correctly Classified = .779

Table 6. Test classification matrices for nearest neighbor analysis of age 5_2 Yukon River chinook salmon, 1982.

Actual Group of Origin	Sample Size	Classification Group of Origin (Variables = T15, NFOUR2, T1, NTWO2) Lower	Middle	Upper
Lower	108	.769	.185	.046
Middle	108	.093	.602	.306
Upper	108	.046	.324	.630

Average Correctly Classified = .667

Actual Group of Origin	Sample Size	Classification Group of Origin (Variables = T15, EIGHT2, NCH3) Lower	Upper
Lower	108	.935	.065
Upper	108	.102	.898

Average Correctly Classified = .917

Table 7. Sample sizes of unknown fish, age class specific run composition estimates, and 90% confidence intervals calculated from scale pattern analysis of age 6_2 chinook salmon, Districts 1 and 2, Yukon River, 1982.

District	Period	Dates	N	TF[1]	Lower	Middle	Upper
1	Pre-season[2]	6/06-6/13	100	66	.048 ± .067	.248 ± .266	.704 ± .261
	1	6/14-6/16	100	4	.036 ± .063	.262 ± .267	.702 ± .262
	2	6/17-6/20	100	6	.072 ± .075	.259 ± .260	.670 ± .257
	3	6/21-6/23	100	2	.059 ± .072	.293 ± .260	.649 ± .255
	4	6/24-6/27	93	8	.118 ± .091	.215 ± .261	.667 ± .260
	5	6/28-6/29	100		.129 ± .091	.305 ± .246	.566 ± .243
	6	7/01-7/05	89	34	.448 ± .141	.042 ± .213	.509 ± .235
	7-13[3]	7/05-7/14	86	26	.487 ± .147	.214 ± .206	.299 ± .208
2	1	6/16-6/17	100		.026 ± .058	.198 ± .275	.776 ± .270
	2	6/20-6/21	100		.130 ± .091	.266 ± .249	.604 ± .247
	3	6/23-6/24	100		.035 ± .063	.302 ± .264	.664 ± .258
	4	6/27-6/28	45		.083 ± .113	.224 ± .345	.693 ± .343
	5	6/30-7/01	90		.060 ± .081	.545 ± .245	.394 ± .243
	6-7[3]	7/21-7/09	46		.309 ± .176	.310 ± .298	.380 ± .294

[1] Number of samples from test fishing catches included in *N*.

[2] Samples from subsistence and test fishing catches.

[3] Chum salmon season.

[4] 2-way model.

Table 8. Sample sizes of unknown fish, age class specific run composition estimates, and 90% confidence intervals calculated from scale pattern analysis of age 5_2 chinook salmon, Districts 1 and 2, Yukon River, 1982.

District	Period	Dates	N	TF[1]	Lower	Middle	Upper
1	1-3	6/14-6/23	60	5	.170 ± .165	.304 ± .494	.526 ± .435
	4-6	6/24-7/02	100		.705 ± .183	.059 ± .334	.236 ± .264
	7-13[2]	7/05-7/14	100	6	.753 ± .188	.184 ± .339	.064 ± .241
2	1-3	6/16-6/24	49		.294 ± .218	.586 ± .531	.120 ± .450
	4-5	6/27-7/01	37		.299 ± .235	.161 ± .577	.540 ± .529
	6-7[2]	7/04-7/09	73		.782 ± .107	[3]	.218 ± .107

[1] Number of test fishing catch samples included in *N*.

[2] Chum salmon season.

[3] Original 3-way test classification yielded negative estimate of -.055 + .374.

The temporal differences in run composition evident in point estimates of the 1982 District 1 and 2 harvests were generally not detected in the 1980 and 1981 analyses. However, the generally low classification accuracies, small fishing period sample sizes, and persistent necessity to resort to 2-way models make interpretation of temporal trends more difficult for 1980 and 1981.

Commercial Catch Apportionment to Run of Origin. We used the contribution rates presented in Tables 7-8 to allocate the District 1 and 2 commercial catches of age 5_2 and 6_2 fish to run of origin. Most of the age 6_2 District 1 catches were allocated to the upper Yukon run, 27,412 fish or 62.1% (Table 9). Fish of upper Yukon origin were the most abundant for every period except the chum salmon season. Catches of lower Yukon fish were low (5,547 fish or 12.6%) and ranged from 135 fish during commercial period 1 to 1,857 fish during period 6. Middle Yukon fish (11,217 fish or 25.3%) were generally intermediate.

Age 5_2 catches were comprised primarily of lower Yukon fish. The District 1 harvest of age 5_2 fish was comprised of 53.4% (8,040 fish) lower Yukon, 15.3% (2,300 fish) middle Yukon, and 31.3% (4,717 fish) upper Yukon chinook salmon (Table 10).

Fish of upper Yukon origin also dominated the age 6_2 District 2 catch and totaled 14,684 fish (59.8%). Again upper Yukon fish were the most abundant for every period, and lower Yukon fish (totaling only 1,836 fish for the entire season or 7.4%) were least abundant.

Lower Yukon fish dominated the catch of age 5_2 fish in District 2 (2,416 fish or 40.0%). Middle and upper Yukon fish were roughly equal and comprised 32.1% (1,939 fish) and 28.0% (1,690 fish), respectively.

Differential Age Composition Analysis:

We allocated the remaining age classes of the District 1 and District 2 commercial catches to run of origin using age composition differences observed between various escapements (Table 11). Because of the predominance of age 4_2 fish in the lower Yukon escapements, we allocated most of the age 4_2 commercial harvests of District 1 (3,107 fish or 71.7%) and District 2 (1,033 fish or 48.1%) to the lower Yukon run. Virtually no District 1 and 2 age 4_2 fish were allocated to the upper Yukon (79 fish total). Conversely, we allocated a total of only 546 (3.9%) age 7_2 fish from both Districts to the lower Yukon run and 10,725 fish (76.5%) to the upper Yukon River. Virtually all 2 annuli freshwater fish (age 5_3, 6_3, 7_3, 8_3) in the District 1 and 2 catches were allocated to the upper Yukon run (3,048 fish).

Allocation of Remaining Fisheries:

Based on the findings of the scale pattern analysis of age 6_2 and 5_2 fish, and the differential age composition allocation of the remaining age classes, the commercial and subsistence fishery catches of chinook salmon from all districts of the Yukon River drainage were allocated to age-class specific run or origin (Tables 11-13). The largest proportion of chinook salmon caught in both the commercial (Table 11) and subsistence (Table 12) fisheries were allocated to the upper Yukon River run (78,262 fish or 59.2% and 22,074 or 75.1%, respectively). The total estimated harvest of upper Yukon stocks was 100,336 fish or 62.1% for both fisheries (Table 13). Middle Yukon stocks were second in abundance at 37,387 fish,

Table 9. Run composition estimates by fishing period for age 6_2 and 5_2 chinook salmon, Districts 1 and 2, Yukon River, 1982.

Sample Period	Commercial Period	Run	District 1 Dates	District 1 No. of Fish	District 2 Dates	District 2 No. of Fish
1	1	Lower	6/14-6/15	135	6/16-6/17	71
		Middle		984		543
		Alaska Subtotal		1,119		614
		Upper		2,636		2,127
		Total		3,755		2,741
	2	Lower	6/17-6/18	577	6/20-6/21	698
		Middle		2,145		1,429
		Alaska Subtotal		2,722		2,127
		Upper		5,527		3,244
		Total		8,249		5,371
	3	Lower	6/21-6/22	795	6/23-6/24	328
		Middle		3,845		2,457
		Alaska Subtotal		4,640		2,785
		Upper		8,618		5,404
		Total		13,258		8,189
Sample Period Subtotal		Lower		1,507		1,097
		Middle		6,974		4,429
		Alaska Subtotal		8,481		5,526
		Upper		16,781		10,775
		Total		25,262		16.301
2	4	Lower	6/24-6/25	461	6/27-6/28	180
		Middle		839		487
		Alaska Subtotal		1,300		667
		Upper		2,605		1,505
		Total		3,905		2,172
	5	Lower	6/28-6/29	1,289	6/30-7/01	326
		Middle		3,048		2,986
		Alaska Subtotal		4,337		3,312
		Upper		5,655		2,117
		Total		9,992		5,429
	6	Lower	7/01-7/02	1,857		
		Middle		165		
		Alaska Subtotal		2,022		
		Upper		2,105		
		Total		4,127		
Sample Period Subtotal		Lower		3,607		506
		Middle		4,052		3,473
		Alaska Subtotal		7,659		3,979
		Upper		10,365		3,622
		Total		18,024		7,601
3	1/	Lower	7/05-7/14	433	7/04-7/09	233
		Middle		191		235
		Alaska Subtotal		624		468
		Upper		266		287
		Total		890		755
Total		Lower		5,547		1,836
		Middle		11,217		8,137
		Alaska Subtotal		16,764		9,973
		Upper		27,412		14,684
		Total		44,176		24,657

1/ Chum salmon season subtotal. Scales sampled during periods 7-13 for District 1, and periods 6-7 for District 2.

Table 10. Estimated run composition of age 5_2 chinook salmon commercial catches, Districts 1 and 2, Yukon River, 1982.

Sample Period	Run	District 1 Commercial Periods	District 1 Dates	District 1 No. of Fish	District 2 Commercial Periods	District 2 Dates	District 2 No. of Fish
1	Lower	1-3	6/14-6/22	842	1-3	6/16-6/24	811
	Middle			1,506			1,617
	Alaska Subtotal			2,348			2,428
	Upper			2,606			331
	Total			4,955			2,760
2	Lower	4-6	6/24-7/02	6,004	4-5	6/27-7/01	597
	Middle			502			322
	Alaska Subtotal			6,506			919
	Upper			2,010			1,078
	Total			8,516			1,997
Chinook Season Subtotal	Lower			6,846			1,408
	Middle			2,008			1,939
	Alaska Subtotal			8,854			3,347
	Upper			4,616			1,409
	Total			13,471			4,756
3 [1]	Lower	7-13	7/05-7/14	1,194	6-7	7/04-7/09	1,008
	Middle			292			[2]
	Alaska Subtotal			1,486			1,008
	Upper			101			281
	Total			1,585			1,289
Total	Lower			8,040			2,416
	Middle			2,300			1,939
	Alaska Subtotal			10,340			4,355
	Upper			4,717			1,690
	Total			15,056			6,046

[1] Chum salmon season.

[2] 2-way model. Original value negative.

Table 11. Estimated run composition by age class of chinook salmon commercial catches, Yukon River, 1982.

District	Gear Type	Dates	Run	Numbers of Fish 3 2	4 2	5 2	5 3	6 2	6 3	7 2	7 3	8 3	Total
1	Gillnet	6/14-7/14	Lower		3,107	8,040		5,547		406			17,100
			Middle		1,170	2,300		11,217	50	1,562	13		16,312
			Alaska Subtotal		4,277	10,340		16,764	50	1,968	13		33,412
			Upper		56	4,716	69	27,412	346	6,858	1,302	279	41,038
			Total		4,333	15,056	69	44,176	396	8,826	1,315	279	74,450
2	Gillnet	6/01-7/09	Lower		1,033	2,416		1,836		140			5,425
			Middle		1,091	1,939		8,137	38	1,177	8		12,390
			Alaska Subtotal		2,124	4,355		9,973	38	1,317	8		17,815
			Upper		23	1,691	26	14,684	263	3,867	624	139	21,317
			Total		2,147	6,046	26	24,657	301	5,184	632	139	39,132
3 1/	Gillnet	6/28-8/18	Lower		16	90		72		11			189
			Middle		17	179		540		91			827
			Alaska Subtotal		33	269		612		102			1,016
			Upper			36		1,189	4	298	58	8	1,593
			Total		33	305		1,801	4	400	58	8	2,609
4 2/	Gillnet	7/12-7/19	Middle	46	91	77		68		9			291
			Upper		2	16		166		37			221
			Total	46	93	93		234		46			512
4 2/	Fishwheel	7/08-8/20	Middle	39	317	151		15					522
			Upper		7	30		37					74
			Total	39	324	181		52					596
5 3/	Gillnet	6/25-8/1	Upper		251	887	19	2,679	155	1,233	155		5,379
6 4/	Gillnet	7/06-8/07	Middle		279	150	7	214					650
6 4/	Fishwheel	7/20	Middle		49	146		98		16			309
Dawson	Gillnet	7/28-8/07	Upper		403	1,425	31	4,303	248	1,982	248		8,640
Total			Lower		4,156	10,546		7,455		557			22,714
			Middle	85	3,014	4,942	7	20,289	88	2,855	21		31,301
			Alaska Subtotal	85	7,170	15,488	7	27,744	88	3,412	21		54,015
			Upper		742	8,801	145	50,470	1,016	14,275	2,387	426	78,262
			Total	85	7,912	24,289	152	78,214	1,104	17,687	2,408	426	132,277

[1] Based on District 2, period 1 samples.

[2] Age composition based on District 4 commercial catch samples. Run composition based on District 2, period 1 samples.

[3] Based on Dawson commercial gillnet catch samples.

Table 12. Estimated run composition of chinook salmon subsistence catches by District, Yukon River, 1982.

				Numbers of Fish									
District	Gear Type	Dates	Run	3 2	4 2	5 2	5 3	6 2	6 3	7 2	7 3	8 3	Total
1	Gillnet	6/14-8/13	Lower		173	307		152		11			643
			Middle		65	88		307	2	41			503
			Alaska Subtotal		238	395		459	2	52			1,146
			Upper		4	179	4	750	8	181	32	7	1,165
			Total		242	574	4	1,209	10	233	32	7	2,311
2	Gillnet	6/16-8/16	Lower		100	156		90		6			352
			Middle		105	125		399	3	56			688
			Alaska Subtotal		205	281		489	3	62			1,040
			Upper		2	108	3	721	15	183	30	7	1,069
			Total		207	389	3	1,210	18	245	30	7	2,109
3 [1]	Gillnet	6/28-8/18	Lower		20	115		93		12			240
			Middle		22	230		695		94	2		1,043
			Alaska Subtotal		42	345		788		106	2		1,283
			Upper			48		1,531	5	409	72	11	2,076
			Total		42	393		2,319	5	515	74	11	3,359
4 [2]	Gillnet	7/12-7/19	Middle	163	320	273		238		31			1,025
			Upper		7	56		579		133			775
			Total	163	327	327		817		164			1,798
4 [2]	Fishwheel	7/08-8/20	Middle	137	1,114	530		53					1,834
			Upper		24	108		131					263
			Total	137	1,138	638		183					2,096
5 [3]	Gillnet	6/25-8/01	Upper		394	1,393	30	4,207	243	1,939	243		8,449
6	Gillnet	7/06-8/07	Middle		292	157	7	225					681
6	Fishwheel	7/20	Middle		49	148		99					312
Dawson [3]	Gillnet	7/28-8/07	Upper		386	1,364	30	4,125	237	1,898	237		8,277
			Lower		293	578		335		29			1,235
Total			Middle	300	1,967	1,551	7	2,016	5	238	2		6,086
			Alaska Subtotal	300	2,260	2,129	7	2,351	5	267	2		7,321
			Upper		817	3,256	67	12,044	508	4,743	614	25	22,074
			Total	300	3,077	5,385	74	14,395	513	5,010	616	25	29,395

[1] Based on samples from District 2, commercial period 1.

[2] Age composition based on District 4 commercial samples. Run composition based on samples from District 2 commercial catch.

Table 13. Total estimated run composition of chinook salmon commercial and subsistence catches, Yukon River, 1982.

		Numbers of Fish									
Fishery	Run	3_2	4_2	5_2	5_3	6_2	6_3	7_2	7_3	8_3	Total
Commercial	Lower		4,156	10,546		7,455		557			22,714
	Middle	85	3,014	4,942	7	20,289	88	2,855	21		31,301
	Alaska Subtotal	85	7,170	15,488	7	27,744	88	3,417	21		54,015
	Upper		742	8,801	145	50,470	1,016	14,275	2,387	426	78,262
	Total	85	7,912	24,289	152	78,214	1,104	17,687	2,408	426	132,277
Subsistence	Lower		293	578		335		29			1,235
	Middle	300	1,967	1,551	7	2,016	5	238	2		6,086
	Alaska Subtotal	300	2,260	2,129	7	2,351	5	267	2		7,321
	Upper		817	3,256	67	12,044	508	4,743	614	25	22,074
	Total	300	3,077	5,385	74	14,395	513	5,010	616	25	29,395
Total	Lower		4,449	11,124		7,790		586			23,949
	Middle	385	4,981	6,493	14	22,305	93	3,093	23		37,387
	Alaska Subtotal	385	9,430	17,617	14	30,095	93	3,679	23		61,336
	Upper		1,559	12,057	212	62,514	1,524	19,018	3,001	451	100,336
	Total	385	10,989	29,674	226	92,609	1,617	22,697	3,024	451	161,672

comprising 23.1% of the total 1982 harvest. The total catch of 23,949 fish from the lower Yukon comprised only 14.8% of the total harvest. Total harvest values include catches documented in Canada.

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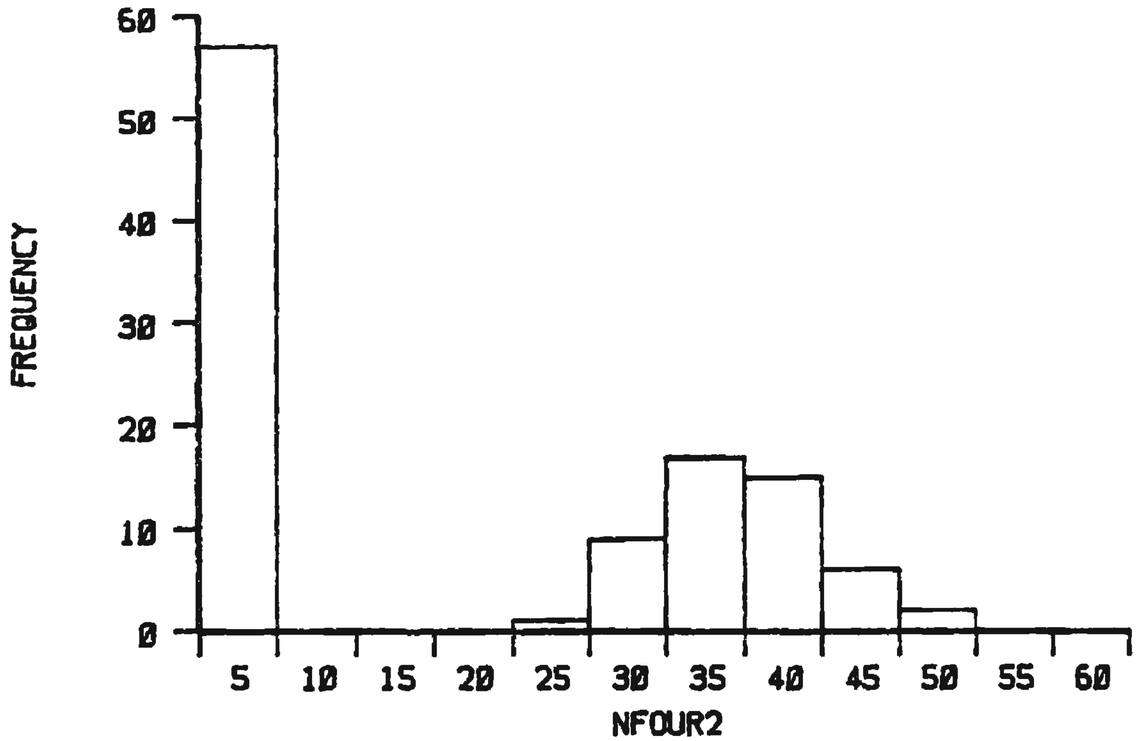
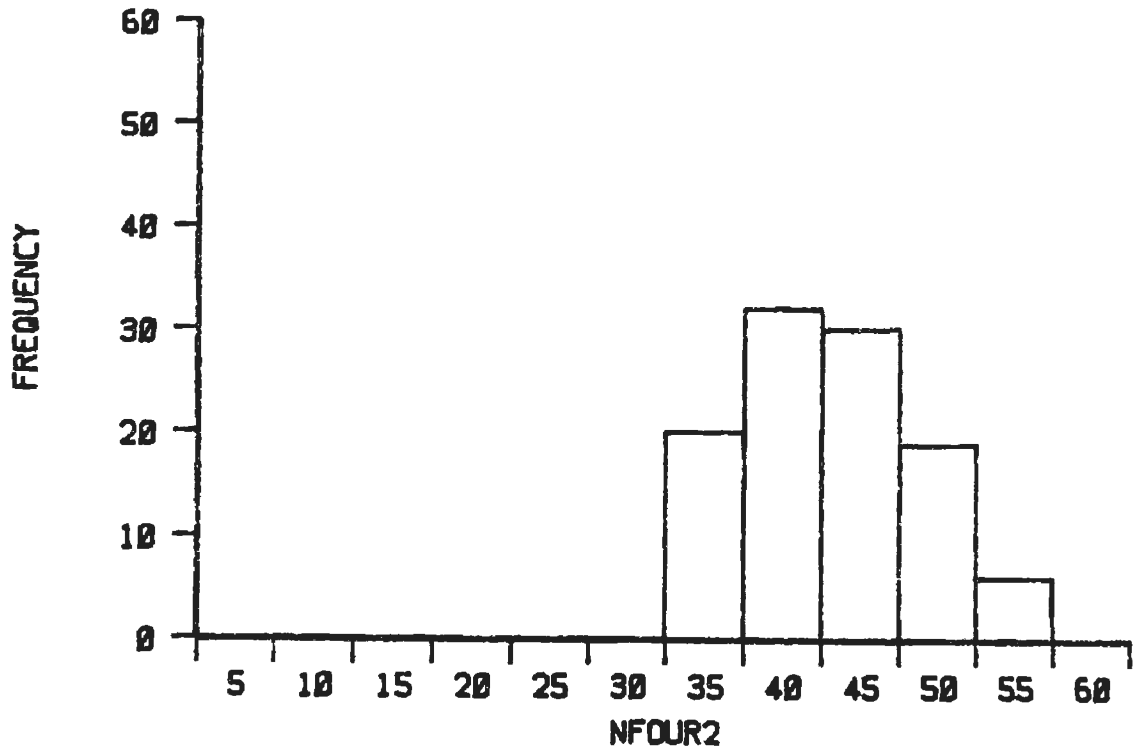
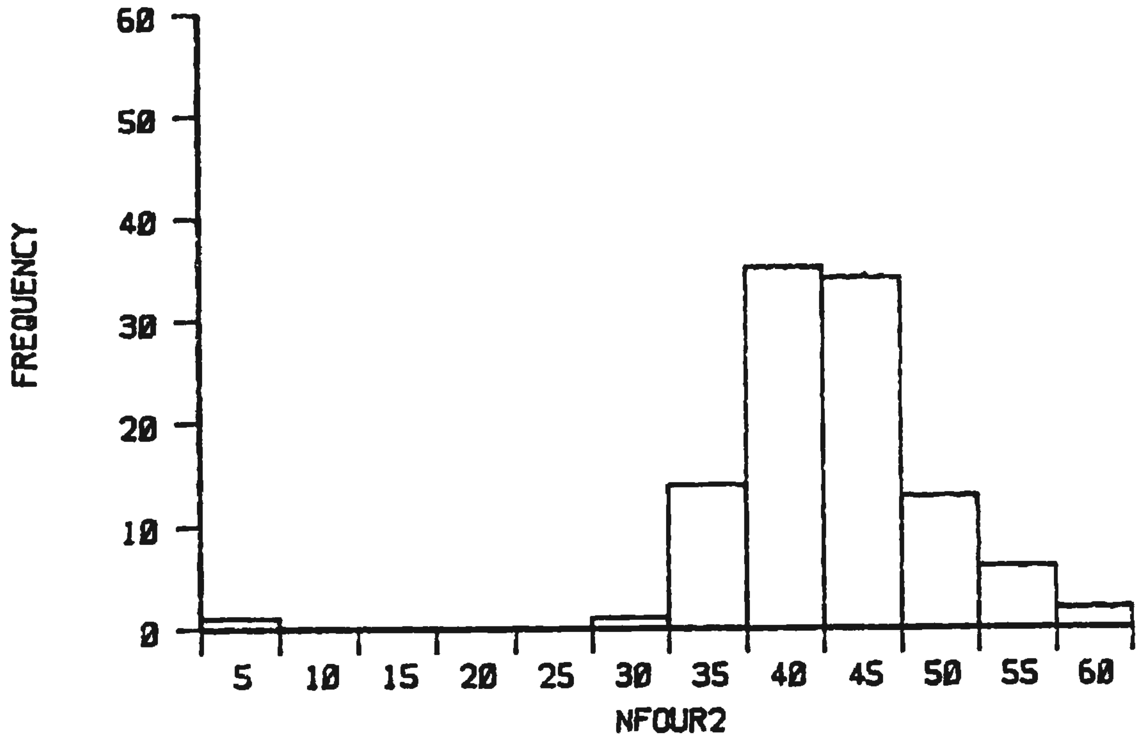
APPENDICES



Appendix Figure 1. Frequency distribution of scale variable NFOUR2 for age 5_2 chinook salmon from the lower Yukon River run, 1982.



Appendix Figure 2. Frequency distribution of scale variable NFOUR2 for age 5_2 chinook salmon from the middle Yukon River run, 1982.



Appendix Figure 3. Frequency distribution of scale variable NFOUR2 for age 5_2 chinook salmon from the upper Yukon River run, 1982.

Appendix Table 1. Run composition estimates of age 5_2 and 6_2 chinook salmon commercial catches, Districts 1 and 2, Yukon River, 1980-1982.

		Age 5_2				Age 6_2				Total			
			Percent Composition				Percent Composition				Percent Composition		
District	Year	Total Catch	Lower	Middle	Upper	Total Catch	Lower	Middle	Upper	Total Catch	Lower	Middle	Upper
1	1980	41,689	17.5	24.9	57.6	41,693	[1]	70.6	29.4	83,382	[1]	56.5	43.5
	1981	17,958	32.3	8.7	59.0	75,730	[2]	77.7	22.3	93,688	[2]	70.7	29.3
	1982	15,056	53.4	15.3	31.3	44,176	12.6	25.4	62.1	59,232	23.0	22.8	54.2
2	1982	6,046	40.0	32.1	28.0	24,657	7.4	33.0	59.6	30,703	13.8	32.8	53.4

[1] Limited by sample sizes to two-way model: Alaska vs Upper.

[2] All point estimates less than zero.

Appendix Table 2. Comparison of mean values for scale variables NC2 and ID2 for age 5_2 chinook salmon from the lower Yukon run, the middle Yukon run, and the Gisasa River.

Variable	Location	n	$\bar{x}$	S.E.
NC2	Lower	96	3.3	1.3
	Gisasa	12	3.5	1.7
	Middle	108	5.7	1.2
ID2	Lower	96	27.9	11.9
	Gisasa	12	28.0	13.3
	Middle	108	54.2	11.9