Differences Between Inseason and Postseason Stock Composition Estimates for Sockeye Salmon in Gillnet Catches in 2 Districts in Southeast Alaska and in the Stikine River, 1986 to 1989

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ABSTRACT. Linear discriminant function analysis of sockeye scale patterns was used to estimate stock compositions of sockeye salmon *Oncorhynchus nerka* catches in U.S. and Canadian fisheries that harvest Stikine River stocks. Inseason and postseason estimates were made for U.S. gillnet fisheries in Southeast Alaska Districts 106 and 108 and Canadian gillnet fisheries in the Stikine River. Inseason analysis worked well in 1986, 1987, and 1988, but did not work well in 1989. Most differences between inseason and postseason estimates during 1986 to 1988 were not of practical significance; i.e., management actions based on inseason estimates would have been the same had they been based on postseason estimates. Differences were numerically small, generally <1,000 fish. The season total differences in stock-specific catch estimates ranged from 0.0% to 7.1% in District 106. In 1989 weekly differences were of practical significance and were numerically large, ranging from 12 to 7,882 fish. Season differences in District 106 ranged from 3.2% for transboundary Stikine fish to 28.7% for Nass/Skeena fish. In 1989 use of average historical proportions would have resulted in better stock composition estimates than the inseason analysis did. All practical differences were also statistically significant using log-likelihood ratio analysis with $\alpha = 0.05$.

INTRODUCTION

Sockeye salmon *Oncorhynchus nerka* are harvested in marine net fisheries throughout Southeast Alaska and northern British Columbia. Drift gillnet fisheries in Southeast Alaska Districts 106 and 108 harvest sockeye salmon of U.S., Canadian, and transboundary Stikine River origin (Figure 1). The Stikine River is called a transboundary river rather than a U.S. or Canadian river because its drainage includes both countries. The Canadian commercial fisheries in the Stikine River harvest 2 stock groups: Tahltan, or fish from Tahltan Lake, and non-Tahltan, or fish from the mainstem, sloughs, tributaries, and other small lakes within the Stikine drainage (Figure 2).

Initial knowledge of the stock compositions of sockeye catches in central and southern Southeast Alaska was gained from marine tagging studies (Hoffman et al. 1983, 1984). Tag recoveries indicated that Southeast Alaska lake systems, the transboundary Stikine River, and the Canadian Nass and Skeena Rivers were the major contributors of sockeye salmon to the District 106 fisheries.

In 1982 a study was undertaken that showed scale pattern analysis (SPA) to be a useful tool in estimating the origin of sockeye salmon harvested in mixed stock fisheries in southern Southeast Alaska (Marshall et al. 1984). Marshall et al. tested the classification potential of SPA using fish samples from the Nass, Skeena, and Stikine Rivers, as well as from 24 central and southern Southeast Alaska lake systems. The researchers found that few of the Canadian or transboundary fish were misclassified as U.S. fish, and only 2 of the U.S. stocks had significant portions that misclassified to Canadian stocks. Both parametric linear discriminant function (LDF) and non-parametric nearest-neighbor analysis were tested. LDF was chosen as the statistical method for estimating stock composition because it had a higher classification accuracy and was computationally

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less complex and less costly to run than nearest-neighbor analysis (Marshall et al. 1984).

Marshall et al. tested age-specific discriminant functions in addition to pooled-age discriminant functions. Ages 1.2, 1.3, 2.2, and 2.3 were pooled and tested in 2 ways: (1) freshwater ages were combined, and (2) all 4 age-groups were combined. Although the mean accuracies estimated from the pooled-age tests were less than those of the age-specific tests, differences were small. The relatively small magnitude of the differences indicated that intergroup differences were greater than interyear differences and that historical models could be used inseason to estimate stock compositions. The final component of the Marshall et al. study was to determine the best way to build the composite stock groups. The composite groups were composed of scales sampled from the Nass and Skeena Rivers (Canada), 24 lake systems in central and southern Southeast Alaska (Alaska), and the Canadian commercial catch in the Stikine River (transboundary). The samples used for each composite stock group were developed using different weighting methods: (1) equal for all stocks, (2) geographic proximity to the fishery, (3) estimated stock size, and (4) stock contribution to the fishery as estimated from marine tagging. There were no significant differences in the ability of each of the resulting discriminant functions to separate a test data set of scales of known origin.

The 3-group analysis has been refined since the Marshall et al. (1984) study. Scale patterns of some stocks have varied interannually, probably as a result

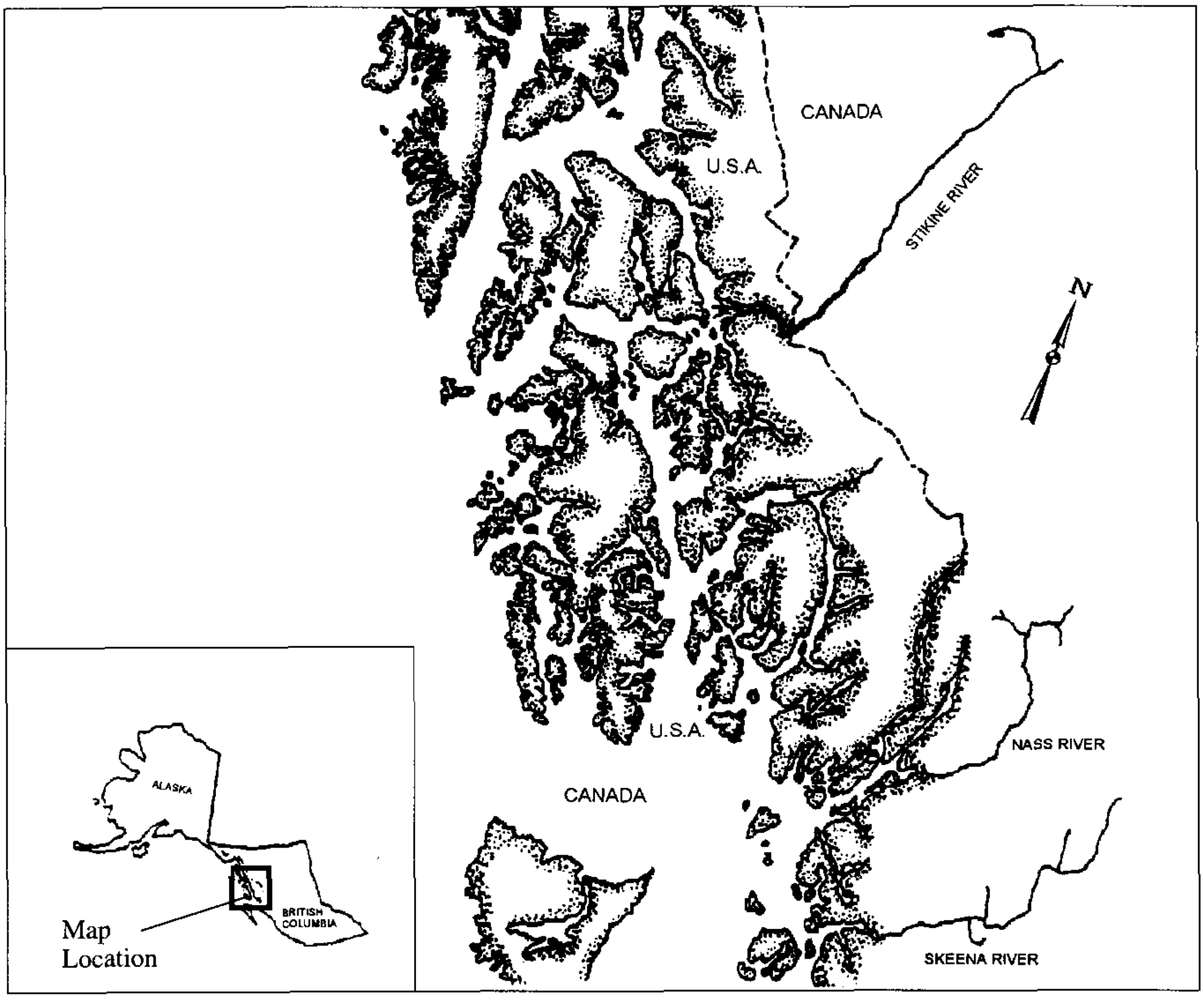

Figure 1. Southeast Alaska, northern British Columbia, and the transboundary Stikine River.

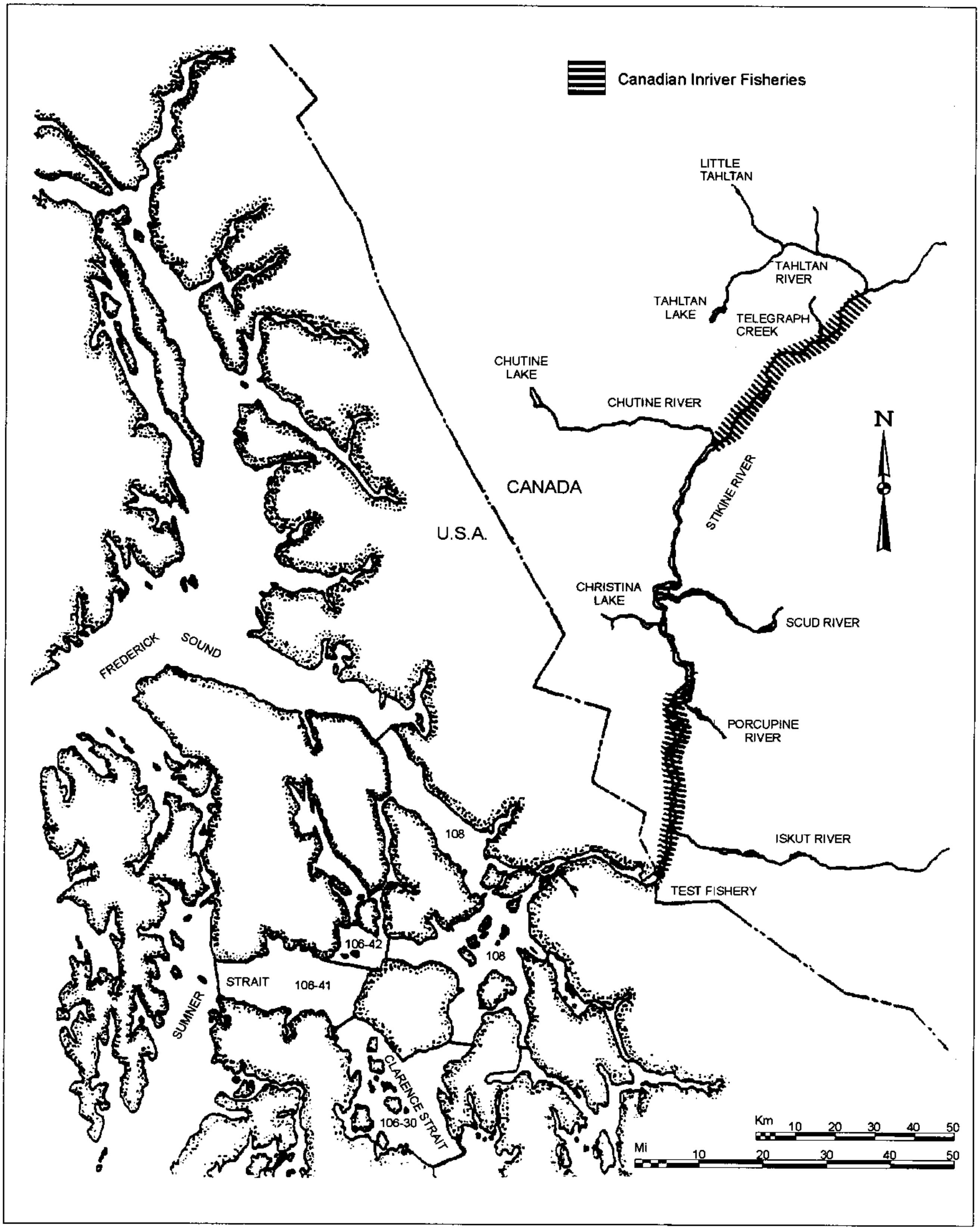

Figure 2. The transboundary Stikine River, major tributaries, and fishery areas.

of climatic changes, changes in juvenile rearing densities, introduction of lake fertilization or fry planting, or other mechanisms. Some of the stock groupings used in the original discriminant functions ceased to provide adequate discrimination; in other cases, more stock-specific estimates were needed. The Stikine composite was split into the Tahltan Lake group and the non-Tahltan Stikine group in 1983 (Oliver et al. 1985). Further stock-group refinements were required in 1986 when it became apparent that some Alaska fish were misclassifying to the non-Tahltan Stikine group (Jensen et al. 1989). Two separate Alaska composites were created, and a 5-group discriminant function was used to classify the District 106 and 108 catches. Although 5 stock groupings were needed to accurately classify catches, the Alaska, Canada, and transboundary composite groups remained the primary groups for fisheries management in Alaska Districts 106 and 108. The management groups are therefore Alaska (consisting of the combined Alaska I and Alaska II stock groups), Canada (composed of Nass and Skeena fish), and transboundary (composed of Tahltan and non-Tahltan Stikine) stocks. The Tahltan and non-Tahltan groups are considered separately in the Stikine River catches.

Postseason stock composition estimates have been generated from SPA for the years 1982 through 1989 and inseason estimates have been made since 1986 (Oliver et al. 1985; Oliver and Walls 1985; Oliver and Jensen 1986; Jensen and Frank 1988, 1993a, 1993b; Jensen et al. 1989). Postseason analysis is based on a comparison of scale patterns from fish sampled from mixed stock fishery catches to scale patterns from fish that have returned to spawning grounds (standards) during the same year. Because spawning-ground samples are not available inseason, another, less reliable source must be used for standards. Although it is known that annual variations occur in scale growth patterns, standards from the previous year have been used to provide inseason stock composition estimates. These variations cause imprecision in the inseason estimates; however, inseason estimates are needed to fulfill requirements of and assess compliance with harvest-sharing guidelines outlined in the U.S./Canada Pacific Salmon Treaty.

Interception of salmon bound for one country's rivers as they migrate through the territorial waters of the other country has become a research and management concern since the implementation of the U.S./Canada Pacific Salmon Treaty. Cooperative international management of transboundary Stikine River sockeye salmon is mandated by this treaty under Annex IV, Chapter 1, and requires inseason monitoring of Stikine sockeye salmon harvested in the District 106 and 108 gillnet fisheries. Postseason, stock-specific catch accounting is required to assess compliance with harvest-sharing agreements. The primary use of the inseason stock composition analysis is to estimate the catch of transboundary river sockeye salmon in U.S. marine fisheries and the ratio of Tahltan to non-Tahltan fish in the Canadian inriver fishery. During the commercial fishing season there may be questions about the accuracy of the inseason estimates. Ancillary data can increase or reduce confidence in the inseason estimates, but the accuracy of the inseason estimates is not really known prior to the postseason analysis.

The inseason estimates of the catches of transboundary Stikine sockeye stocks are used by fishery managers to adjust fishing effort and catch to comply with harvest guidelines outlined in the treaty. Fishery effort and catches of Tahltan and non-Tahltan Stikine stocks in the Stikine River fishery are used in an inseason management model that predicts run strength for Stikine sockeye salmon. The predicted run strength determines the allowable catches for the U.S. and Canada. An overestimated number of transboundary fish in the catches could result in unnecessary time and area restrictions in U.S. and Canadian fisheries, and an underestimate could result in non-compliance with treaty guidelines. Cumulative catch of transboundary sockeye salmon by each country is used to determine if directed fishing — i.e., the Alaska District 108 fishery for the U.S. and the lower river commercial fishery for Canada — will be allowed the following week. An extremely low Stikine run in conjunction with high catches of transboundary fish in U.S. fisheries could also trigger restrictions in Alaska Subdistricts 106-41/42 and 106-30, which are not directed on Stikine sockeye salmon. Because cumulative catch of transboundary stocks is a major factor in determining the following week's openings, an accurate estimate of stock composition is needed. Postseason stock composition estimates are used to determine compliance of both parties with treaty harvest goals. It is therefore critical that the inseason estimates not lead to a management action that would be inconsistent with the postseason results.

In this paper, I have (1) documented inseason and postseason stock composition estimates for sockeye catches in U.S. fisheries in Southeast Alaska Districts 106 and 108 and in the Canadian fishery in the Stikine River, (2) compared inseason and postseason estimates and evaluated the accuracy of the inseason estimates, and (3) evaluated the accuracy of the inseason estimates compared to average estimates from postseason stock composition analysis.

METHODS

Scale Collection

Mixed stock scale samples were collected from pertinent commercial catches in Southeast Alaska and the Stikine River (Figures 1, 2). Approximately 700 samples were collected from commercial catches in Alaska's Subdistricts 106-41/42 (note, Subdistricts 106-41 and 106-42 are separate subdistricts, but for purposes of sampling, stock composition, and management, they are treated as a single area) and 106-30 each week the fisheries were open. Although the goal was also 700 samples for District 108, it often was not met due to small catches and logistical difficulties with sampling. Weekly catches in the Canadian commercial fishery in the Stikine River were sampled with a goal of 350 scales per opening. Known-origin scale samples were collected from Alaskan, transboundary, and northern British Columbia escapements. Approximately 500 scales per lake were collected from up to 24 lake systems throughout Southeast Alaska; the escapements sampled varied among years. Annual transboundary escapement samples included 1,000 scales collected at Tahltan weir and 500 from the non-Tahltan Stikine spawning areas. Samples from Canadian systems included 1,000–1,500 scales from each test fishery operating in the lower reaches of the Nass and Skeena Rivers. Samples were collected, prepared, aged, and digitized in a standard manner each year (Jensen and Frank 1988; Jensen et al. 1989; Jensen and Frank 1993a, 1993b).

Variables and Discriminant Functions

Digitizing

From 1986 through 1988 age-1.3, -1.2, and -2.3 fish were classified inseason on a weekly basis (Jensen et al. 1989, Jensen and Frank 1988, 1993a). Age-2.2 fish were classified as time allowed. In 1989 only age-1.3 fish were classified inseason because of budget reductions (Jensen and Frank 1993b).

Age-specific discriminant functions were used to classify catches to (1) account for differences in age composition among stocks, (2) remove potential bias due to differences in migratory timing among fish of different ages, and (3) eliminate variable environmental influences on the scale patterns of different ages of fish within a stock.

In some situations, differences between the digitized data for a given stock group have been greater between digitizers than between years (Table 1). For this reason, the person assigned to perform the inseason digitizing for a given age group also digitized the escapement standards used to build the discriminant function for that age group, even if the standards had already been digitized by a different person. By doing this, I reduced potential sources of variance or bias in the inseason analysis. Several digitizers were involved during the study, and they processed different age classes in different years; therefore, the number of years that a given age class has been digitized by the same person is limited. In 1989 we unsuccessfully attempted to create discriminant rules based on combined years of historical data for age-1.3 fish digitized by a single digitizer. For these reasons, inseason analysis has been limited to using discriminant functions based on escapement samples collected and digitized the previous year rather than from multiple years.

Variable Selection and Classification Accuracies

LDF-based classification rules were used to assign sockeye salmon sampled from mixed stock fishery catches to stock group of origin (Marshall et al. 1987; Jensen and Frank 1988). The 2–10 scale variables used to create the discriminant function rules for each potential combination of stocks into groups were selected from among 108 variables using established methods detailed in Jensen and Frank (1993b). An almost unbiased estimate of classification accuracy for each function was determined using a leaving-one-out procedure (Lachenbruch 1967). Scale variables that separate groups which most often misclassified to each other were occasionally added to or substituted for other variables in the function to provide better balance to the classification matrix — i.e., to increase the classification accuracy for the least distinguishable stocks. The number of plus-growth circuli and the width of the plus-growth zone (the part of the scale formed during the last spring of freshwater rearing prior to migration to the ocean) were not included in the discriminant functions in 1986, 1987, and 1989. Within a stock, these 2 variables can differ greatly between years and are subject to more inter-reader variability than other variables (Table 1).

Because the discriminant functions developed one year were used for inseason catch classification the following year, plus growth was not a desired variable. In addition, plus-growth circuli counts usually range from 0 to 4 and therefore do not meet the normality assumptions of LDF. Although other circuli counts are used, they have a broader range of possible values and more closely approximate a normal distribution.

Because there are interyear differences in the scale patterns for given stock groups, the variables selected for use in LDF also differ among years. Thus, the variables used in the discriminant functions inseason were not the same as those used in the postseason discriminant functions. Informal tests indicated there generally were no major differences in results of classifying a set of mixed stock samples from variable sets that had similar classification matrices. For some stocks, the variables used in one year may result in a poor classification accuracy the following year. Classification accuracies are dependent on inherent separability of stock groups and on the stocks included in the discriminant functions.

Trends in Mean Values

Because the variables used in age-specific functions vary among years, it is difficult to detect temporal trends. Therefore, I tried to determine if temporal trends occurred for general categories of variables. Mean values of variables most frequently used in the discriminant functions were compared among stock groups and through time to determine if temporal changes were consistent among stocks.

Inseason Adjustments

Ancillary data, including migratory timing, age compositions, historical stock composition patterns, and independent assessments of run strength, have been used to support or adjust inseason stock composition estimates based on SPA.

Comparison with Inseason Estimates

The inseason and postseason weekly stock composition was estimated for Subdistricts 106-41/42 and 106-30, District 108, and Stikine River catches. Estimates for the marine fisheries were made for the Alaska, Nass/Skeena, and transboundary management groups, and estimates for the Stikine fisheries were made for 2 inriver stock groups: Tahltan and non-Tahltan.

Inseason and postseason estimates were compared to determine if differences were of practical significance. A difference of practical significance refers to an inseason estimate that was sufficiently different from the postseason estimate to have altered fishery management. A difference between inseason and postseason estimates may have statistical significance but not practical significance, and vice versa, or both may be significant or not significant.

Inseason overestimates were considered of practical significance if (1) the perceived catch of fish in a particular management group limited the fishery, but the actual catch of that group was low enough that additional fishing time would have been allowed; (2) the actual catch would have resulted in a change in the total allowable catch (TAC) of transboundary fish; (3) the error in the inseason estimate resulted in an actual catch of transboundary fish less than the TAC allowed under U.S./Canada harvest sharing agreements; or (4) the error in inseason estimates resulted in overescapements of some management group. Inseason underestimates were considered of practical significance if (1) the actual catch of fish in a particular management group was large enough that fishing time would have been restricted, (2) the actual catch would have resulted in a change in the TAC of transboundary fish, (3) the actual catch of transboundary fish was above the harvest guideline in the Pacific Salmon Treaty, or (4) the error in inseason estimates resulted in underescapement of some management group.

The differences between average postseason (1986–1990, excluding the year being compared) and current-year postseason estimates were also calculated. The inseason and average estimates were compared to look for trends in errors and to determine if inseason analysis was better than assuming average stock-specific catches.

The inseason and postseason weekly stock composition estimates for Subdistricts 106-41/42 and 106-30, District 108, and Stikine River catches were compared to test whether the inseason estimates were statistically different from the postseason estimates. The actual numbers of fish in the sample that were classified to each management group in the inseason analysis were compared to those in each group in the postseason analysis. Chi-square analysis was deemed an inappropriate test because the data did not conform to the general rule that none of the expected frequencies should be <1.0 and no more than 20% of expected frequencies should be <5.0 (Zar 1984). Log-likelihood ratio analysis is not as sensitive to small frequencies and was therefore the more appropriate analysis to use. One was added to each cell count to avoid calculating the logarithm of zero. Yates' correction for continuity (Zar 1984) was used for the stock composition comparisons of the Canadian catches in the Stikine River where df = 1.

In addition to comparing the weekly inseason estimates with the weekly postseason estimates, the set of weekly differences was also tested for heterogeneity (Sokal and Rohlf 1981). Significant heterogeneity would indicate either differences in sign or magnitude among the weekly differences. A lack of heterogeneity would mean that the sum of the weekly G statistics could be used to test for an overall seasonal difference.

Because the scales used for the inseason estimates are also used, along with additional scales, for the postseason analysis, the G-test described above was not entirely appropriate. This test assumes independent samples, i.e., a different set of scales for the inseason and postseason analyses. Because the samples are not independent, the G-test will tend to be conservative; i.e., the probability will be less than the test result indicates, and tests may be found insignificant when they really are significant. Unfortunately, methods that correctly take into account the dependencies among samples (Agresti 1990) would have required each scale be assigned to a specific stock. Although discriminant analysis makes such an assignment, the subsequent adjustments to estimate the mixing proportions deal with proportions rather than with individual fish, and the individual assignments are lost.

In light of the above, test results were used to flag differences needing further examination because they may not correspond to practical significant difference.

RESULTS

Most of the basic data used to prepare these results are available in Jensen (1994).

Variables and Discriminant Functions

Variable Selection and Classification Accuracies

Although the variables selected for the discriminant functions varied among age classes and years, there were several variables or related variables that were common to many functions. Common variables included a measure of the first freshwater zone (variables 1 or 2), the distance from the focus to the fourth circuli (variable 4), the average distance between circuli in the first annular zone (variable 27), total freshwater growth including plus growth (variables 63 through 67), and the distance across the first marine zone (variable 71). Interyear differences (Table 1) were difficult to measure because the variables were also dependent on the stock groups included in the functions. However, some generalities were apparent. In 1987 the age-1.2 functions included very few marine variables. In 1989 none of the age-1.3 functions included variable 4, but nearly every function included the average width of first annular circuli.

Classification accuracies were usually highest for the Nass/Skeena stock group and lowest for the Alaska or transboundary Stikine groups. Interannual comparison of accuracies is difficult for fish other than age-1.3 because the stock groups with other ages sufficiently abundant to form standards varied from year to year. In general, mean accuracies were similar among years for a given age class, but stock-specific accuracies varied. In 1989, however, the mean accuracies for age-1.3 functions were consistently lower than in 1986 through 1988, as were accuracies for individual stock groups in many of the discriminant functions.

Trends In Mean Values

I found no consistent trends in growth patterns within or among stocks, but there were apparent correlations among returns for a given brood year. A stock that had greater-than-average growth of age-1.2 fish one year often exhibited greater-than-average growth of age-1.3 fish the following year. Similarly, the same age classes and years for a different stock might have smaller-than-average growth. For example, the number of freshwater circuli decreased for Alaska I, Alaska II, and Stikine fish and increased for Nass/Skeena and Tahltan fish between 1987 and 1988 (age 1.2) and between 1988 and 1989 (age 1.3). However, the magnitude of change varied among stocks and among years. The stock with the largest measurement for a particular variable in a given year did not always have the largest measurement the following year.

Inseason Adjustments

In 1986 the first weeks of the inseason analysis for District 106 indicated that the non-Tahltan Stikine group was contributing more than 25% to the commercial catch. Because historical postseason stock composition

Table 1. Interdigitizer and interyear differences (proportion of change) in select scale variables. Averages are for absolute values for scales from age-1.3 sockeye salmon.

	Interdigitizer					Interyear (Digitizer 1)				
Year	Alaska I	Alaska II	Nass/Ske	Tahltan	Stikine	Alaska I	Alaska II	Nass/Ske	Tahltan	Stikine
1: First freshwater count										
1986	0.03	0.18	0.04	0.07	0.09	0.01	0.00	0.08	0.00	0.06
1987	0.17	0.08	0.07	0.06	0.07	-0.09	0.08	-0.02	0.00	-0.01
1988	0.15	0.11	0.04	0.06	0.14	0.00	-0.13	0.04	-0.07	-0.06
Ave.	0.12	0.12	0.05	0.06	0.10	0.03	0.07	0.05	0.02	0.04
2: First freshwater distance										
1986	-0.02	0.04	0.00	0.04	0.00	0.05	-0.09	0.05	-0.05	0.05
1987	0.16	0.07	0.06	0.06	0.03	-0.09	0.02	0.01	0.00	-0.08
1988	0.08	0.01	-0.00	-0.02	0.08	0.04	-0.16	0.02	-0.02	0.04
Ave.	0.09	0.04	0.02	0.04	0.04	0.06	0.09	0.03	0.02	0.06
61: Plus growth count										
1986	-0.08	-0.18	0.06	0.09	-0.02	-0.17	-0.03	-0.08	-0.01	0.05
1987	-0.24	-0.17	0.14	-0.17	-0.09	-0.07	-0.08	-0.14	-0.45	-0.33
1988	-0.22	-0.32	-0.14	0.12	-0.22	0.12	0.05	0.26	0.97	0.38
Ave.	0.18	0.22	0.11	0.13	0.11	0.12	0.05	0.16	0.47	0.25
62: Plus growth distance										
1986	-0.08	-0.17	0.05	0.19	0.01	-0.17	-0.03	-0.03	-0.05	0.05
1987	-0.30	-0.14	0.23	-0.14	-0.07	-0.05	-0.11	-0.22	-0.48	-0.37
1988	-0.31	-0.53	-0.24	0.00	-0.17	0.16	0.10	0.40	1.43	0.37
Ave.	0.23	0.28	0.17	0.11	0.08	0.13	0.08	0.22	0.65	0.26
65: Total freshwater count										
1986	0.01	0.14	0.04	0.07	0.07	-0.02	-0.00	0.06	0.00	0.06
1987	0.11	0.05	0.08	0.02	0.04	-0.08	0.06	-0.04	-0.08	-0.08
1988	0.10	0.06	0.02	0.07	0.08	0.02	-0.11	0.07	0.04	0.01
Ave.	0.08	0.08	0.05	0.05	0.06	0.04	0.06	0.06	0.04	0.05
66: Total freshwater distance										
1986	-0.03	0.02	0.01	0.05	0.00	0.02	-0.09	0.04	-0.05	0.05
1987	0.10	0.04	0.08	0.03	0.01	-0.08	0.00	-0.01	-0.08	-0.13
1988	0.03	-0.04	-0.02	-0.02	0.05	0.05	-0.14	0.05	0.09	0.08
Ave.	0.05	0.04	0.04	0.03	0.02	0.05	0.08	0.03	0.07	0.09
70: First marine count										
1986	0.02	-0.00	0.01	0.01	0.02	-0.05	-0.01	-0.05	0.04	-0.03
1987	0.02	-0.00	-0.03	-0.01	-0.02	0.04	0.04	0.08	0.01	0.07
1988	0.02	-0.03	0.02	0.00	-0.03	0.00	0.08	-0.03	-0.00	0.01
Ave.	0.02	0.01	0.02	0.01	0.02	0.03	0.05	0.05	0.02	0.04
71: First marine distance										
1986	0.00	-0.02	0.01	-0.01	0.03	-0.02	0.01	0.01	0.06	-0.00
1987	-0.00	-0.00	-0.01	-0.01	-0.01	0.04	0.00	0.04	-0.01	0.04
1988	0.00	-0.05	-0.00	-0.03	-0.04	-0.04	0.06	-0.04	-0.01	0.01
Ave.	0.00	0.02	0.01	0.02	0.03	0.03	0.02	0.03	0.03	0.02

estimates showed that this group has a relatively late migratory timing and in years prior to our analysis had never been more than a minor catch component (Jensen et al. 1989), it was plausible there was a problem with the inseason analysis. In prior years, even when the non-Tahltan stocks were more abundant than the Tahltan stocks in the inriver commercial catch, non-Tahltan stocks were less abundant than the Tahltan stocks in the District 106 catches in weeks when both stocks were present. In 1985 the ratio of Tahltan sockeye salmon to all Stikine River sockeye salmon in District 106 commercial catches was mirrored in the inriver catch 1 week later; generally there was <10% difference in estimates through mid July (Jensen et al. 1989). Therefore, an adjusted inseason stock composition estimate was made by applying a ratio of the Tahltan to non-Tahltan stocks in the inriver catch to the estimated proportion of Tahltan fish in the District 106 catch:

$$N_{dt} = \frac{N_{r(t+1)}}{T_{r(t+1)}}(T_{dt}),$$

where:

N_{dt} = adjusted estimated proportion of non-Tahltan Stikine fish in Alaska's district d catch in week t;

$N_{r(t+1)}$ = proportion of non-Tahltan Stikine fish in the inriver commercial catch in week t+1;

$T_{r(t+1)}$ = proportion of Tahltan fish in the inriver commercial catch in week t+1; and

T_{dt} = proportion of Tahltan fish in Alaska's district d catch in week t.

In 1987 the inseason catch estimates for the transboundary stocks appeared low when compared to historical postseason data (1983–1986). The low catches were unexpected in light of the moderated escapements in the 1982 parent year. However, the low inseason estimate of abundance was corroborated by the low catch and catch per unit effort in the Canadian commercial fishery in the Stikine River, and no adjustments were made to the inseason analysis.

In 1988 the weekly inseason stock composition estimates of District 106 catches indicated that the Nass/Skeena group was relatively and numerically less abundant than during 1982 to 1987. However, the Nass/Skeena fish composed an estimated 32.5% of the opening week's catch in District 108 in 1988 compared to 0.0% in 1986. It seemed reasonable, based on limited knowledge of migratory routes, that Nass/Skeena fish would compose a much smaller fraction of the sockeye salmon catch in District 108 than in District 106. Because Tahltan stocks were present in District 108 early in the season and the Tahltan and Nass/Skeena stock groups tended to misclassify as each other, it seemed likely that the fish that classified to the Nass/Skeena group were really of Tahltan origin. A second analysis was run omitting the Nass/Skeena group. The samples were classified, and results indicated that fish formerly assigned to the Nass/Skeena group were classified as Tahltan fish. A further test was made by classifying the Canadian commercial catch in the Stikine River with the 5-stock discriminant functions. A substantial portion of the catch was classified to the Nass/Skeena group. I tentatively concluded that the week 26 catch component classified as Nass/Skeena fish were actually of Tahltan origin. This large, apparent misclassification did not occur again during the inseason analysis; therefore, no steps were taken to adjust the remaining inseason estimates. The postseason analysis verified there had been misclassification between Nass/Skeena and Tahltan stock groups during the first weeks of the District 108 fishery but that, otherwise the inseason estimates were fairly accurate.

In 1989 the very low numbers of Nass/Skeena fish estimated in the inseason analysis indicated that it was not performing well. The inseason analysis indicated the Alaska group composed 70–90% of the catch, whereas only trace numbers of Nass/Skeena fish were caught. The age composition of the catches indicated that average (1982–1988) numbers of fish of ages other than 1.3 were caught. Because the Alaska stocks are predominated by age-1.3 fish and the Nass/Skeena stocks typically have high abundances of age-1.2, -2.2, and -2.3 fish, it seemed likely that inseason analysis was overestimating the contribution of Alaska stocks and underestimating the contribution of Nass/Skeena stocks. Fishery managers were notified of the potential misclassifications and were provided with ancillary age composition data. There did not appear to be any statistically defensible method of adjusting the inseason analysis; therefore, no changes were made.

Comparisons with Inseason Estimates

The differences between inseason and postseason analyses have varied among years and among fisheries (Tables 2–7). From 1986 through 1988 the magnitude of the differences in stock-specific catch estimates were numerically small, generally <1,000 fish, and were usually not of practical significance (Tables 2–5). The differences between inseason and postseason analyses in 1989 were large, 2,000 to 8,000 fish, and were of practical significance. All differences of practical significance were also statistically significant.

Subdistricts 106-41/42

In 1986 an overestimate of 1,181 transboundary sockeye salmon in week 27 for Subdistricts 106-41/42 (Table 2) was of practical significance. There were no other weekly or total season significant differences. However, the inseason analysis overestimated the transboundary contributions in all weeks except week 30 and underestimated the Alaska contributions in all weeks except week 32 (Table 2). The greatest differences were an underestimate of 929 Alaska fish in week 31, an underestimate of 1,017 Nass/Skeena fish in week 32, and an overestimate of 1,181 transboundary fish in week 27. The differences between inseason and postseason estimates for the total season were -1.3% for the Alaska group, -2.3% for the Nass/Skeena group, and +3.6% for the transboundary group. The inseason analysis worked better than the average postseason estimates in week 25, but there were no practical differences between the 2 methods for the remainder of the season (Table 3).

In 1987, there were no practical differences among inseason and postseason estimates for either weekly or total season estimates in Subdistricts 106-41/42 (Table 2). The greatest differences were an overestimate of 794 Alaska fish in week 32, an underestimate of 977 Nass/Skeena fish in week 28, and an overestimate of 494 transboundary fish in week 28. The inseason analysis tended to overestimate the Alaska and transboundary contributions and underestimate the Nass/Skeena contributions (Table 2). The differences between inseason and postseason estimates for the total season were +2.5% for the Alaska group, -3.3% for the Nass/Skeena group, and +0.8% for the transboundary group. The inseason

Table 2. Differences between inseason and postseason stock composition estimates for Alaska Subdistricts 106-41/42 sockeye salmon catches, 1986–1989.

		Stock Composition Differences			
Stat.		1986	1987	1988	1989
Week	Management Group	6/15	6/14	6/12	6/18
25	U.S.: Alaska	-93			2,040[a]
	Canada: Nass/Skeena	17			-2,028[a]
	Transboundary Stikine	76			-12
26	U.S.: Alaska	-140	-67	40	2,886[a]
	Canada: Nass/Skeena	-127	-156	85	-1,959[a]
	Transboundary Stikine	267	223	-125	-927[b]
27	U.S.: Alaska	-231	230	142	1,979[a]
	Canada: Nass/Skeena	-950	-298	-200	-1,952[a]
	Transboundary Stikine	1,181[b]	68	58	-27
28	U.S.: Alaska		483	-720	3,367[a]
	Canada: Nass/Skeena		-977	169	-7,882[a]
	Transboundary Stikine		494	551	4,515[ab]
29	U.S.: Alaska		-43	-388	4,063[a]
	Canada: Nass/Skeena		-32	386	-3,958[a]
	Transboundary Stikine		75	2	-105
30	U.S.: Alaska	-169	177	-596	3,422[a]
	Canada: Nass/Skeena	233	55	33	-3,361[a]
	Transboundary Stikine	-64	-232	563	-61
31	U.S.: Alaska	-929	329	-612	5,097[a]
	Canada: Nass/Skeena	348	-329	571	-4,825[a]
	Transboundary Stikine	581	0	41	-272
32	U.S.: Alaska	737	794	-676	
	Canada: Nass/Skeena	-1,017	-794	740	
	Transboundary Stikine	280	0	-64	
	U.S.: Alaska	-825	1,903	-2,810	22,854[a]
	Canada: Nass/Skeena	-1,496	-2,531	1,784	-25,965[a]
	Transboundary Stikine	2,321	628	1,026	3,111

[a] Practical significance, differences being large enough to have altered general fisheries management.
[b] Practical significance, differences being large enough to have altered fishery management to conform to U.S./Canada harvest sharing agreements.

Table 3. Postseason catch estimate for sockeye salmon in Subdistricts 106-41/42 and differences between postseason stock proportions and average historical and inseason stock proportions, 1986–1989.

Week and Year	U.S.: Alaska			Canada: Nass/Skeena			Transboundary Stikine		
	Catch	Average	Inseason	Catch	Average	Inseason	Catch	Average	Inseason
1986									
25	1,659	-0.221	-0.048	287	0.124	0.009	0	0.098	0.039
26	2,541	-0.065	-0.046	444	-0.010	-0.042	62	0.074	0.088
27	9,121	-0.037	-0.018	2,377	0.001	-0.073	1,595	0.036	0.090
28									
29									
30	9,861	-0.016	-0.013	2,744	0.006	0.018	64	0.010	-0.005
31	13,958	-0.040	-0.048	4,560	0.072	0.018	728	-0.032	0.030
32	10,093	0.031	0.050	4,681	-0.036	-0.069	0	0.005	0.019
Total	47,233	-0.028	-0.013	15,093	0.011	-0.023	2,449	0.017	0.036
1987									
25									
26	3,505	-0.168	-0.017	289	0.084	-0.041	51	0.084	0.058
27	6,418	-0.234	0.031	996	0.062	-0.040	100	0.172	0.009
28	9,396	-0.006	0.032	4,962	-0.054	-0.064	817	0.060	0.033
29	12,016	-0.168	-0.003	1,629	0.115	-0.002	116	0.053	0.005
30	12,659	-0.171	0.013	1,043	0.184	0.004	329	-0.013	-0.017
31	8,986	-0.231	0.032	1,246	0.216	-0.032	0	0.015	0.000
32	8,800	-0.109	0.072	2,275	0.104	-0.072	0	0.005	0.000
Total	61,780	-0.138	0.025	12,440	0.096	-0.033	1,413	0.041	0.008
1988									
25									
26	1,496	-0.131	0.024	53	0.143	0.050	144	-0.012	-0.074
27	4,822	-0.213	0.025	523	0.114	-0.035	411	0.099	0.010
28	4,806	-0.270	-0.122	777	0.206	0.029	296	0.065	0.094
29	13,381	-0.199	-0.026	1,378	0.150	0.026	163	0.049	0.000
30	8,880	-0.117	-0.058	1,403	0.107	0.003	57	0.010	0.054
31	8,475	-0.325	-0.069	415	0.310	0.064	0	0.015	0.005
32	6,317	-0.243	-0.097	623	0.249	0.106	64	-0.006	-0.009
Total	48,177	-0.222	-0.052	5,172	0.183	0.033	1,135	0.039	0.019
1989									
25	2,469	0.324	0.404	2,114	-0.283	-0.402	466	-0.041	-0.002
26	3,566	0.364	0.415	2,098	-0.218	-0.282	1,289	-0.146	-0.133
27	3,661	0.216	0.267	2,352	-0.170	-0.264	1,389	-0.046	-0.004
28	13,668	0.055	0.141	9,073	-0.126	-0.331	1,084	0.071	0.190
29	16,612	-0.075	0.197	3,958	0.018	-0.191	105	0.057	-0.005
30	12,397	-0.023	0.216	3,361	0.011	-0.212	61	0.012	-0.004
31	6,146	0.222	0.284	5,507	-0.209	-0.269	272	-0.013	-0.015
32	2,647	0.061	0.000	1,326	-0.052	0.000	45	-0.009	0.000
Total	61,166	0.084	0.234	29,789	-0.087	-0.266	4,711	0.003	0.032
Average Absolute Error									
25		0.273	0.226		0.203	0.205		0.069	0.021
26		0.182	0.126		0.114	0.104		0.079	0.088
27		0.175	0.085		0.086	0.103		0.088	0.028
28		0.110	0.099		0.129	0.141		0.065	0.105
29		0.147	0.075		0.094	0.073		0.053	0.004
30		0.082	0.075		0.077	0.059		0.011	0.020
31		0.205	0.108		0.202	0.096		0.019	0.012
32		0.111	0.055		0.110	0.062		0.006	0.007
Total		0.118	0.081		0.094	0.089		0.025	0.024

analysis worked better than the average postseason estimate for all stocks during most weeks and was substantially better for the season totals (Table 3).

In 1988 there were no practical differences among inseason and postseason estimates for either weekly or total season estimates in Subdistricts 106-41/42 (Table 2). The greatest differences were an underestimate of 720 Alaska fish in week 28, an overestimate of 740 Nass/Skeena fish in week 32, and an overestimate of 563 transboundary fish in week 30. The inseason analysis underestimated the Alaska stocks and overestimated the Nass/Skeena and transboundary stocks in most weeks (Table 2). Differences between inseason and postseason estimates for the entire season were -5.1% for the Alaska group, +3.3% for the Nass/Skeena group, and +1.9% for the transboundary group. The inseason analysis worked better than the average postseason analysis for the Alaska and Nass/Skeena groups during all weeks; however, there was little difference between the methods for the transboundary stocks (Table 3).

Differences between inseason and postseason estimates in 1989 were of practical significance for transboundary stocks in weeks 26 and 28 and for Alaska and Nass/Skeena stocks in all weeks of the Subdistricts 106-41/42 fishery (Table 2). All practical differences were statistically significant. Differences ranged from overestimates of 1,979 to 4,063 Alaska fish, underestimates of 1,952 to 7,882 Nass/Skeena fish, and underestimates of 927 to overestimates of 4,515 transboundary fish. Season total differences were an overestimate of 22,854 Alaska and 3,111 transboundary fish and an underestimate of 25,965 Nass/Skeena fish (Table 2). Differences were +23.4% for Alaska stocks, -26.5% for Nass/Skeena fish, and +3.2% for transboundary fish. Neither the inseason nor average postseason estimates worked well for weekly estimates (Table 3). However, the average postseason estimate for total season catches was substantially better than the inseason estimate for all stock groups.

Differences were statistically significant in weeks 25–27 in 1986, week 26 in 1987, weeks 26, 28, and 30–32 in 1988, and all weeks in 1989. Heterogeneity was not significant in 1986, 1987, or 1989, but overall season differences were significant. Heterogeneity was significant in 1988.

Subdistrict 106-30

In 1986 there were no practical differences between inseason and postseason estimates in Subdistrict 106-30 (Table 4). However, the inseason analysis underestimated the Alaska contributions and overestimated the transboundary contributions in all weeks. The greatest differences were an underestimate of 932 Alaska fish in week 29, an overestimate of 621 Nass/Skeena fish in week 29, and an overestimate of 666 transboundary fish in week 27 (Table 4). The differences between inseason and postseason estimates for the total season were -5.9% for the Alaska group, +1.4% for the Nass/Skeena group, and +4.4% for the transboundary group. For most weeks the inseason analysis worked better than the average postseason estimates for the Alaska and Nass/Skeena stocks but was slightly worse than the average postseason estimates for the transboundary group (Table 5).

In Subdistrict 106-30 in 1987 there were no differences of practical significance between inseason and postseason estimates (Table 4). The inseason analysis overestimated the Alaska stocks and underestimated the Nass/Skeena stocks in most weeks. The greatest differences in estimates were an overestimate of 1,112 Alaska fish, an underestimate of 1,112 Nass/Skeena fish in week 32, and an overestimate of 654 transboundary fish in week 30 (Table 4). The differences between inseason and postseason estimates for the total season were +5.8% for the Alaska group and -5.8% for the Nass/Skeena group. There was no difference in the inseason and postseason total estimates of transboundary fish (Table 4). The inseason analysis worked better than the average postseason estimates for most weeks for the Alaska and Nass/Skeena fish and was marginally better for the transboundary fish (Table 5).

In 1988 there were no practical differences between inseason and postseason estimates in Subdistrict 106-30 (Table 4). The inseason analysis tended to underestimate Alaska and transboundary contributions and overestimate Nass/Skeena contributions. The greatest differences were an underestimate of 698 Alaska and an overestimate of 698 Nass/Skeena fish in week 32 and an underestimate of 445 transboundary fish in week 29 (Table 4). The differences between inseason and postseason estimates for the total season were -5.8% for the Alaska stocks, +7.1% for the Nass/Skeena stocks, and -1.3% for the transboundary stocks (Table 4). For all weeks the inseason analysis worked better than the average postseason estimates for the Alaska and Nass/Skeena groups; however, there was little difference in the 2 methods for the transboundary group (Table 5).

In 1989 there were differences of practical significance between inseason and postseason estimates in weeks 28, 29, and 30 in Subdistrict

Table 4. Differences between inseason and postseason stock composition estimates for Alaska Subdistrict 106-30 sockeye salmon catches, 1986–1989.

		Stock Composition Differences			
Stat. Week	Management Group	1986 6/15	1987 6/14	1988 6/12	1989 6/18
25	U.S.: Alaska	-47			410
	Canada: Nass/Skeena	27			-344
	Transboundary Stikine	20			-66
26	U.S.: Alaska	-167	148	-69	633
	Canada: Nass/Skeena	167	-2	-17	-546
	Transboundary Stikine	0	-146	86	-87
27	U.S.: Alaska	-491	196	-56	333
	Canada: Nass/Skeena	-175	-290	77	-765
	Transboundary Stikine	666	94	-21	432
28	U.S.: Alaska		474	-43	4,717[a]
	Canada: Nass/Skeena		-454	-13	-6,300[a]
	Transboundary Stikine		-20	56	1,583[b]
29	U.S.: Alaska	-932	501	-23	860
	Canada: Nass/Skeena	621	109	468	-4,173[a]
	Transboundary Stikine	311	-610	-445	3,313[b]
30	U.S.: Alaska	-515	-183	-545	5,710[a]
	Canada: Nass/Skeena	-197	-471	653	-5,559[a]
	Transboundary Stikine	712	654	-108	-151
31	U.S.: Alaska	-405	843	-437	
	Canada: Nass/Skeena	190	-843	437	
	Transboundary Stikine	215	0	0	
32	U.S.: Alaska	-168	1,112	-698	
	Canada: Nass/Skeena	12	-1,112	698	
	Transboundary Stikine	156	0	0	
	U.S.: Alaska	-2,725	3,091	-1,871	12,663[a]
	Canada: Nass/Skeena	645	-3,063	2,303	-17,687[a]
	Transboundary Stikine	2,080	-28	-432	5,024

[a] Differences were large enough to have altered general fisheries management.
[b] Differences were large enough to have altered fishery management to conform to U.S./Canada harvest sharing agreements.

106-30 (Table 4). All practical differences were statistically significant. The Alaska group was overestimated and the Nass/Skeena group was underestimated in all weeks. Differences ranged from overestimates of 333 to 5,710 Alaska fish, underestimates of 344 to 6,300 Nass/Skeena fish, and overestimates of 3,313 to underestimates of 151 transboundary fish (Table 4). The differences between inseason and postseason total season estimates were +20.5% for the Alaska group, -28.7% for the Nass/Skeena group, and +8.1% for the transboundary group. The average postseason estimates worked better than the inseason analysis during all weeks for the Nass/Skeena and transboundary stocks and during most weeks for the Alaska stocks (Table 5). The total season estimates of the average postseason estimates were substantially better than the inseason analysis for all stock groups.

Differences were statistically significant in weeks 26–30 in 1986, weeks 27–30 and 32 in 1987, weeks 26 and 29–32 in 1988, and all weeks in 1989. Heterogeneity was significant in all years.

District 108

In 1988 there were no practical differences between inseason and postseason estimates in District 108 (Table 6); however, the total sockeye

Table 5. Postseason catch estimate for sockeye salmon in Subdistrict 106-30 and differences between postseason stock proportions and average historical and inseason stock proportions, 1986–1989.

Week and Year	U.S.: Alaska			Canada: Nass/Skeena			Transboundary Stikine		
	Catch	Average	Inseason	Catch	Average	Inseason	Catch	Average	Inseason
1986									
25	580	-0.218	-0.073	64	0.109	0.260	0	0.116	0.031
26	583	-0.123	-0.260	59	-0.020	-0.041	0	0.079	0.000
27	3,613	-0.068	-0.114	673	0.184	0.000	9	0.041	0.155
28									
29	7,201	-0.257	-0.122	424	0.065	-0.022	2	0.100	0.041
30	7,492	-0.134	-0.059	1,295	0.058	0.013	0	0.015	0.081
31	11,346	-0.093	-0.028	2,993	0.007	0.001	0	0.003	0.015
32	7,009	0.094	-0.017	2,931	0.204	0.000	105	-0.006	0.016
Total	37,824	-0.092	-0.059	8,439	0.243	0.000	116	0.031	0.045
1987									
25									
26	1,121	-0.064	0.114	33	0.128	-0.002	149	-0.064	-0.112
27	2,557	-0.111	0.067	358	0.070	-0.099	4	0.042	0.032
28	4,745	-0.182	0.085	805	0.164	-0.082	20	0.018	-0.004
29	6,834	-0.079	0.059	1,035	0.074	0.013	656	0.005	-0.072
30	9,493	-0.184	-0.017	1,147	0.169	-0.044	0	0.015	0.061
31	10,283	-0.110	0.066	2,483	0.107	-0.066	0	0.003	0.000
32	10,270	-0.108	0.093	1,683	0.101	-0.093	0	0.007	0.000
Total	45,303	-0.127	0.058	7,544	0.113	-0.057	829	0.014	-0.001
1988									
25									
26	538	-0.189	-0.123	21	0.112	-0.030	1	0.077	0.154
27	2,605	-0.196	-0.020	78	0.188	0.028	77	0.009	-0.008
28	2,697	-0.283	-0.015	212	0.260	-0.004	0	0.023	0.019
29	8,020	-0.100	-0.002	1,309	0.059	0.048	467	0.041	-0.045
30	7,044	-0.186	-0.069	634	0.203	0.083	197	-0.016	-0.014
31	3,119	-0.340	-0.139	33	0.338	0.139	0	0.003	0.000
32	5,029	-0.197	-0.129	375	0.190	0.129	0	0.007	0.000
Total	29,052	-0.191	-0.058	2,662	0.186	0.071	742	0.005	-0.013
1989									
25	778	0.151	0.345	344	-0.184	-0.290	66	0.033	-0.056
26	1,141	0.208	0.357	546	-0.225	-0.308	87	0.017	-0.049
27	1,564	0.202	0.133	765	-0.159	-0.306	171	-0.042	0.173
28	9,903	0.203	0.268	7,127	-0.183	-0.358	563	-0.020	0.090
29	15,597	-0.057	0.043	4,173	-0.036	-0.210	130	0.093	0.166
30	13,042	0.062	0.305	5,559	-0.067	-0.296	151	0.005	-0.008
31	6,869	0.114		3,980	-0.103		125	-0.011	
32	4,420	0.125		2,098	-0.123		49	-0.002	
Total	53,314	0.087	0.205	24,592	-0.099	-0.287	1,342	0.012	0.081
Average Absolute Error									
25		0.184	0.209		0.146	0.275		0.075	0.043
26		0.146	0.213		0.121	0.095		0.059	0.079
27		0.144	0.084		0.150	0.108		0.033	0.092
28		0.223	0.123		0.202	0.148		0.020	0.038
29		0.123	0.057		0.059	0.073		0.060	0.081
30		0.142	0.112		0.124	0.109		0.013	0.041
31		0.164	0.078		0.139	0.069		0.005	0.005
32		0.131	0.080		0.154	0.074		0.006	0.005
Total		0.124	0.095		0.160	0.104		0.016	0.035

Table 6. Differences between inseason and postseason stock composition estimates for Alaska District 108 sockeye salmon catches, 1988–1989.

Stat. Week	Management Group	Stock Composition Differences 1988 6/12	1989 6/18
25	U.S.: Alaska		[a]
	Canada: Nass/Skeena		
	Transboundary Stikine		
26	U.S.: Alaska	[a]	235
	Canada: Nass/Skeena		-25
	Transboundary Stikine		-210
27	U.S.: Alaska	67	
	Canada: Nass/Skeena	61	
	Transboundary Stikine	-128	
28	U.S.: Alaska	[a]	1,175
	Canada: Nass/Skeena		-244
	Transboundary Stikine		-931[b]
29	U.S.: Alaska	49	1,304
	Canada: Nass/Skeena	18	-105
	Transboundary Stikine	-67	-1,199[b]
30	U.S.: Alaska		612
	Canada: Nass/Skeena		-99
	Transboundary Stikine		-513
	U.S.: Alaska	116	3,326
	Canada: Nass/Skeena	79	-473
	Transboundary Stikine	-195	-2,853

[a] Samples were combined with those from the following week for the analysis.
[b] Differences were large enough to have altered fishery management to conform to U.S./Canada harvest sharing agreements.

catch driving the inseason analysis was only 1,246 fish. Total season differences between inseason and postseason estimates were +9.3% for Alaska stocks, +6.3% for Nass/Skeena stocks, and -15.7% for transboundary stocks (Table 6).

In 1989 in District 108 there were practical differences between the inseason and postseason estimates for the transboundary group in weeks 28 and 29 (Table 6). All practical differences between inseason and postseason estimates were also statistically significant. The inseason analysis overestimated the Alaska contributions and underestimated the Nass/Skeena and transboundary contributions in all weeks. The greatest differences were an overestimate of 1,304 Alaska fish in week 29 and underestimates of 244 Nass/Skeena fish in week 28 and 1,199 transboundary fish in week 29 (Table 6). Differences between inseason and postseason estimates for the total season were +33.0% for Alaska fish, -4.7% for Nass/Skeena fish, and -28.3% for transboundary fish.

In 1988 differences in week 27 estimates were of statistical significance but week 29 differences were not. All differences in 1989 were statistically significant. Heterogeneity was not significant in 1988 but was significant in 1989. Differences in total season estimates were statistically significant in 1988.

Table 7. Differences between inseason and postseason stock composition estimates for Canada's sockeye salmon catches in the Stikine River, 1986–1988.

Stat. Week	Stock Group	Stock Composition Differences[a] 1986 6/15	1987 6/14	1988 6/12
27	Tahltan	16	22	-23
	Non-Tahltan	-16	-22	23
28	Tahltan	11	6	-88
	Non-Tahltan	-11	-6	88
29	Tahltan	128	9	-57
	Non-Tahltan	-128	-9	57
30	Tahltan	145	73	-289
	Non-Tahltan	-145	-73	289
31	Tahltan	243		-192
	Non-Tahltan	-243		192
	Tahltan	543	110	-649
	Non-Tahltan	-543	-110	649

[a] There were no differences large enough to have altered fishery management.

Stikine River

The sockeye stocks in the Stikine River are either of Tahltan origin or a component of the non-Tahltan Stikine composite. Because the analysis is confined to 2 groups, errors in estimation are interdependent; i.e., an overestimate in one group means an underestimate of the same magnitude in the other group.

In 1986 there were no practical differences between inseason and postseason estimates in the Stikine River (Table 7). However, the inseason analysis consistently overestimated the contributions of Tahltan fish. The greatest overestimate, 243 fish, occurred during week 31 (Table 7). The difference between inseason and postseason estimates for the total season was +5.2% Tahltan fish.

There were no practical differences between inseason and postseason estimates in the Stikine River in 1987 (Table 7). However, the inseason analysis consistently overestimated the contributions of Tahltan fish. The greatest overestimate, 73 fish, occurred during week 30 (Table 7). The difference between inseason and postseason estimates for the total season was +4.7% Tahltan fish.

In 1988 there were no practical differences between inseason and postseason estimates in the Stikine River (Table 7). However, the inseason analysis consistently underestimated the Tahltan stock group. The greatest underestimate, 289 fish, occurred during week 30 (Table 7). The total season difference in estimates was 10.2% Tahltan fish.

Although there were no differences of practical significance in any year, statistical significance occurred during weeks 28–31 in 1988. Heterogeneity was not significant in 1986 or 1987 but was significant in 1989. Overall seasonal differences were not significant in 1986 or 1987.

DISCUSSION

Although the inseason analyses worked well in 3 of 4 years, there was a large degree of uncertainty surrounding the estimates during the fishing season in all years, and stock compositions were viewed with caution.

Interannual differences in growth rates and scale patterns of the different stock groups may be caused by many factors, including climate, competition for resources, and food supply, and are reflected by differences in average values for scale variables for a given stock. Because different age classes and stocks experience different rearing environments, the difference between inseason and postseason estimates varies among age classes and stocks. Trends in growth in scale zones within a stock are not consistent in all years. Some growth zones may increase between years, while other growth zones may remain the same or decrease. In addition, the rank of the stocks in order of decreasing size or frequency of a scale measurement may change between years. The magnitude of these types of interannual variations within and between groups determines how well the inseason stock composition estimates predict the postseason estimates.

From 1986 through 1988, 3 and sometimes 4 age classes were digitized inseason. The use of multiple age classes may have smoothed the age-specific differences between years. The catch of a stock group that was overestimated for one age class was often underestimated for a different age class. Although the age-1.3 fish generally compose approximately 60% of the District 106 catch, the age-specific classification differences of age-1.2, -2.2, and -2.3 fish may have helped to lower the weekly and total season differences between inseason and postseason estimates. The magnitude of difference from the prior year in most scale variables for age-1.3 fish was greater in 1989 than in 1986–1988 and was often twice the average for that period. In addition, the classification rank order changed for both freshwater and marine growth. This was not true for age-1.2 or age-2.3 fish. In 1989, when only age-1.3 fish were analyzed inseason, there was no age-difference buffering mechanism. This was also the least successful inseason analysis (1986–1989) for differences, both practical and statistical, from postseason estimates. In addition, the stock composition estimates for fish other than age 1.3 might have enabled us to adjust the inseason analysis to be consistent with ancillary data, such as age-composition of catches and escapements, historical stock composition patterns, and relative run strengths of major contributing stocks.

It may be reasonable to generate weekly inseason stock composition estimates based on average postseason estimates if the inseason analysis does not appear to be supported by ancillary data. In 1989 this would have worked better than the inseason SPA estimate, but it still would have had large errors.

An unknown but hopefully small component of interannual variation may also be contributed by changes in perception of growth by the digitizer through time. We attempted to minimize this source of variation by following a rigid set of digitizing criteria, including measurements along a consistent axis, standard methodology for definition of scale zones, and informal testing of digitizer consistency. In informal testing, a digitizer redigitizes a small sample of scales to determine consistency of measurements. If persistent differences occur, digitizing perception and criteria are reevaluated.

The accuracy of the classification matrices and the use of the matrix correction procedure theoretically ensured validity of the estimates, provided we had the appropriate discriminant functions and met the assumptions of LDF. Unfortunately, there is no independent verification of postseason scale pattern analysis results. There have been, however, limited studies using other stock identification techniques that have yielded results consistent with the postseason scale pattern analysis, although direct comparisons are difficult because of differences in stock groupings among the analyses.

In 1986 a genetic stock identification (GSI) program was conducted on test-fishery catches in Subdistricts 106-41 (Wood 1987). The only stock group common to both the SPA and GSI analysis was the Tahltan group, for which the GSI indicated a 1.69% contribution while the SPA indicated a 0.81% contribution. The Tahltan stock group has separated well from other stock groups in both GSI and SPA analysis. Estimates of the 1986 contribution of Alaska stocks generated from analysis of the prevalence of brain parasite *Myxobolus arcticus* in Subdistricts 106-41 and 106-30 were generally 5–15% lower than estimates based on SPA (Moles et al. 1989). Stock compositions of the commercial and test-fishery catches in the Stikine River have been similar for SPA and egg-diameter analysis (TTC 1988, 1990). In addition, the postseason stock composition estimates have been consistent with auxiliary information, including age composition of catches and estimates of major stock groups, migratory timing information, relative stock escapement abundances, and migratory pathway information from marine tagging studies.

The inseason analysis of scale patterns was sufficiently accurate for fisheries management in 3 of 4 years. Management actions would not have been altered had the actual, rather than the inseason, estimates been available in 1986 through 1988. However, in 1989, differences between the inseason and postseason stock composition estimates were of practical significance. Had fishery managers relied solely on the inseason stock composition estimates for management decisions, non-compliance with Pacific Salmon Treaty harvest-sharing guidelines might have occurred. Research is being conducted to try to improve the accuracy of inseason stock composition estimates using methods less susceptible to interannual variability than the method currently used.

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