YUKON RIVER JOINT TECHNICAL COMMITTEE REPORT

Prepared by

THE JOINT UNITED STATES/CANADA
YUKON RIVER TECHNICAL COMMITTEE

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1.0 INTRODUCTION

The chief negotiators for the United States and Canadian delegations to the Yukon River salmon treaty negotiations jointly directed the Joint Technical Committee (JTC) to meet and address the subject areas described in this report. The JTC met in Anchorage on 26-27 February 1992. A core group participated throughout the meeting, while other staff attended as agenda items pertaining to them were taken up. The meeting was attended at various times by the following persons:

Canadian Department of Fisheries and Oceans
- Ken Wilson (co-chair)
- George Cronkite

Alaska Department of Fish and Game
- Larry Buklis (co-chair)
- Louis Barton
- Chuck Blaney
- Jeff Bromaghin
- Rich Cannon
- Jill Follett
- Tom Kron
- Dave Mesiar
- Gene Sandone
- Jim Seeb
- Lisa Seeb
- Paul Skvorc

United States Fish and Wildlife Service
- Rebecca Everett
- Steve Klein
- Chuck Krueger
- Monty Millard
- Dick Wilmot

National Marine Fisheries Service
- Aven Andersen

Sections 2 through 4 of this report address specific assignments from the chief negotiators, while sections 5 and 6 document discussions on items that were put on the agenda by the JTC co-chairs under the heading of other business.

2.0 U.S. PROGRESS REPORT ON SALMON STOCK IDENTIFICATION RESEARCH

The U.S. Fish and Wildlife Service (USFWS) reviewed the progress of its genetic stock identification (GSI) study on Yukon River chum and chinook salmon for the years 1987-1990. Data for 1991 are still under analysis and results are not yet available. Earlier work had been conducted by the Canadian Department of Fisheries and Oceans (DFO), in cooperation with USFWS and the Alaska Department of Fish and Game (ADF&G). Purpose of the research is to determine the feasibility of using protein electrophoresis techniques for identifying U.S. and

Canadian origin salmon stocks in the U.S. Yukon River salmon fisheries. A comprehensive written progress report (entitled "Progress Report: Genetic Stock Identification of Yukon River Chum and Chinook Salmon, 1987 to 1990" by R.L. Wilmot, et al) was presented to the JTC and should be referenced for a detailed review of the results, which are only summarized here. The Canadian section of the JTC will review the progress report and provide peer review comments at a future JTC meeting.

Protein electrophoresis was used to examine the feasibility of estimating stock composition of chum and chinook salmon sampled from commercial and test fishery catches in Yukon River District 1 throughout the fishing seasons of 1987-1990. Populations of Yukon River chum and chinook salmon of Alaska and the Yukon Territory were sampled from tributary spawning stocks to provide baseline data describing the genetic characteristics of individual stocks.

Allelic data indicated that the genetic relationships among stocks generally followed a geographic pattern. Significant genetic differentiation was observed between the summer-run and fall-run chum salmon stocks. The level of differentiation within fall-run chum salmon stocks of Canadian and U.S. origin was less than that observed between summer and fall-run stocks, due to the close genetic relationship between fall chum salmon stocks near the U.S./Canada border. Thus, GSI estimates of stock composition were more precise for separating summer and fall stocks than for U.S. and Canadian origin stocks.

Using the results from this GSI study, the estimated origin of chum salmon in the District 1 commercial fishery ranged from 82.0 to 91.0% U.S. origin summer-run ($\bar{x}$ = 85.7 ± 5.8%), from 5.7 to 10.6% U.S. origin fall-run ($\bar{x}$ = 8.6 ± 5.8%), and from 3.4 to 8.2% Canadian origin fall-run chum salmon ($\bar{x}$ = 5.7 ± 4.7%). Of the fall-run fish, the proportion of chum salmon that were of U.S. origin ranged from 54.3 to 68.5% ($\bar{x}$ = 60.6 ± 44.7%). In numbers of fish, this equates to a four-year average harvest in the District 1 commercial fishery of 374,057 ± 25,102 U.S. origin summer-run, 33,200 ± 24,748 U.S. origin fall-run, and 22,208 ± 20,198 Canadian origin fall-run chum salmon.

The genetic relationships among chinook salmon stocks included a clear genetic separation which corresponded geographically to the boundary between the U.S. and Canada. Because of the correspondence of geographic and genetic stock groupings, the estimates of the proportion of U.S. and Canadian origin stocks in the District 1 commercial fishery, using this method, were both accurate and precise. The origin of chinook salmon harvested in the District 1 commercial fishery from 1987-1990 averaged 46.8 ± 5.1% United States origin, and ranged from 38.7 to 58.1%. In numbers of fish, this equates to an average District 1 harvest of 27,623 ± 3,012 U.S. origin and 31,419 ± 3,012 Canadian origin chinook salmon.

Based on the first four years of data, GSI is a feasible method for determining the relative magnitude of contribution to the fishery of chum and chinook salmon of the Yukon River drainage by country of origin and by major stock groups, although within the fall chum salmon run the degree of accuracy is substantially lower than desired due to the close genetic relationship between fall chum salmon stocks near the U.S./Canada border. Additional sampling and development of more genetic characters will be necessary to obtain accurate estimates of contributions by individual stocks.

Stock composition estimates for the District 1 chinook salmon catch have been made by ADF&G using scale patterns analysis since 1982 to the level of region of origin. Analyses of scale patterns by ADF&G to make stock composition estimates has been successful with chinook salmon in the Yukon River drainage, but not with chum salmon. Mean classification accuracies for lower, middle, and upper Yukon River chinook salmon using the SPA method have ranged from 0.657 to 0.862 for age 1.4 since 1982. The upper Yukon River stock group identified using this method corresponds to Canadian origin stocks. Estimates of the stock composition of chinook salmon samples from the District 1 catch from 1987 to 1990 made by ADF&G using analysis of scale patterns were within a 95% confidence interval of the estimates made by USFWS using genetic methods. Using scale patterns analysis, the estimated proportion of the catch in the District 1 commercial fishery of Canadian origin were: 56.4% in 1987; 48.8% in 1988; 47.0% in 1989; and 51.0% in 1990. The corresponding estimates, using genetic stock identification methods, were: 61.3% for 1987, 52.4% for 1988, 48.9% for 1989, and 50.3% for 1990.

The applicability of genetic methods to Yukon River chinook salmon stock identification in the lower river was supported by the accuracy and precision of U.S. and Canadian apportionments demonstrated by computer simulations, and by the correspondence of these genetic data with the estimates from analysis of scale patterns. Additional collections to represent unsampled populations should be analyzed, particularly from the Canadian Yukon River tributaries, for which mainstem collections were frequently used. Larger sample sizes from the District 1 catch would increase the precision of the estimates and therefore the utility of the data.

The GSI methodology has been extensively used and evaluated for the Lower Columbia River chinook salmon fishery, the coastal Washington chinook salmon fishery, and the Puget Sound chum salmon fishery. A large proportion of hatchery fish contribute to the harvest in all of the above fisheries, and because they are marked with coded wire tags, allow an alternative estimate of stock contribution to these fisheries. Acceptable levels of accuracy and precision for management of mixed-stock fisheries have been established for GSI estimates by blind tests and computer simulations.

Based on the results of this study, the usefulness of the GSI methodology for management of Yukon River chum and chinook salmon stocks was evaluated. The utility of the method is based to a large degree on the level of discrimination required for management purposes. If the question is "what is the relative magnitude of summer- and fall-run stocks, or U.S. and Canadian origin stocks in the mixed-stock fishery?" simulations demonstrate that the stock composition estimates are within ±15% (one standard deviation) for chum salmon and ±8% for chinook salmon. Stock composition estimates through the District 1 fishing season (June-August) show the proportional change from predominately summer-run to fall-run stocks. A small proportion of chum salmon caught in June were identified as fall-run stocks, and a statistically significant proportion of the chum salmon sampled in August were from summer-run stocks. Some problems exist in estimating the contribution of U.S. origin fall-run fish and Canadian origin fall-run fish to the District 1 fishery due to the relatively close genetic affinity between the Chandalar/Sheenjek, the Fishing Branch, and the Canadian mainstem stocks. On the other hand, the close agreement between the two independent estimates of stock contribution to the chinook salmon fishery by scale patterns analysis and by GSI helps establish considerable validity to these estimates for chinook salmon.

Estimates of mixed-stock composition below these levels of discrimination must be viewed with caution. The error on estimates of contribution of the six major stock groups in chum salmon can run as high as ±20% and up to ±10% in chinook salmon. At this time, the error terms on estimates of individual stocks for both species are too large and should not be used until the baseline data set is expanded.

The current baseline for both chum and chinook salmon is adequate for estimates of contributions of U.S. and Canadian origin stocks in the fishery. Additional genetic characters in the baseline data set would improve the accuracy and precision of the estimates and could eventually lead to the capability to make estimates of contributions by individual stocks. Other improvements would include larger sample sizes, making sure that samples are taken over the entire course of the run, and insuring that all major contributing stocks are included in the baseline data set. Estimates could also be improved by insuring the mixed-stock fishery sample is as large as feasible (300 fish per time period), and that the collection represents a random sample of the fishery. Future analyses will address questions regarding the pooling of data from different gear types, and the pooling of data from test and commercial fisheries. In the future, GSI methods should be applied to the fisheries that occur in the other fishing districts.

Adding more genetic characters to the baseline data mixture sample can potentially increase the resolution to acceptable levels for estimates for individual stocks. For example, using the current 19 loci baseline for chum salmon, we cannot discriminate between the early and late run South Fork Koyukuk River samples. Recently, we have been able to resolve a total of 33 variable loci for these two temporally different runs of Koyukuk River chum salmon, and the genetic differences between these runs were significant. Preliminary results with mtDNA analysis for both Yukon River chum and chinook salmon stocks also show promise as an additional discriminating character. Analysis of nuclear DNA may also provide additional characters, and already appears useful in Fraser River chinook salmon stock discrimination (Terry Beacham, DFO Vancouver, personal communication).

While there are limitations in the precision of the stock composition estimates, the strengths are the general agreement of the results with the known run-timing of Yukon River chum and chinook salmon stocks, and the close agreement between chinook salmon stock composition estimates derived from scale patterns analysis and the estimates using GSI. In addition, the stability of the genetic characters over time means the baseline does not need to be resampled every year, and timely estimates of stock contributions to the fishery are possible.

3.0 YUKON RIVER SALMON RESTORATION AND ENHANCEMENT

Discussion centered on a review of fish genetics and disease policies in Canada and Alaska; a review of the regional wild stock salmon restoration and enhancement planning process proposed by ADF&G for the Yukon River drainage in Alaska; and development of technical principles that would serve as guidelines for salmon restoration and enhancement planning on the Yukon River.

There was consensus agreement on several technical principles regarding salmon stock restoration on the Yukon River. The salmon fisheries of the Yukon River are, at present, supported almost entirely by wild stocks (with the minor exception of Whitehorse hatchery chinook salmon releases which are designed to mitigate the impacts of a hydro-electric dam). Given the productive status of salmon habitat in the system, and the depressed nature of many wild salmon runs, the JTC believes that the greatest benefits are to be derived by managing and rehabilitating wild salmon runs on the Yukon River. The JTC strongly believes that the natural abundance and diversity of the wild salmon runs of the Yukon River should not be compromised by the establishment of new enhanced stocks. Rather, our efforts should be directed towards increasing spawning escapements through fishery management and the protection and restoration of habitat and wild stocks.

Intervention in the life cycle of Yukon River salmon stocks, and in the extreme, the establishment of new hatchery stocks, can only be justified in the context of a comprehensive stock management plan. Priorities must be first to manage the impact of fisheries on stocks, second to restore damaged habitats, and third to intervene using fish culture technology to restore stock productivity to historic levels. The establishment of new hatchery stocks or increasing existing wild stock abundance beyond historical levels should only be permitted where no unacceptable wild stock impacts are likely to occur.

Identifying priority projects will require a detailed review of known opportunities, as well as surveys to evaluate and identify additional candidate projects. In order to select projects for implementation, the JTC recommends the development of a comprehensive basin-wide plan that addresses habitat and wild stock protection, habitat and wild stock restoration, and habitat extension. To protect wild stocks, the JTC recommends the development of agreed upon fish genetics and fish disease policies for the Yukon River basin. Until these policies are developed, it is recommended that restoration and enhancement activities comply with fish genetics and fish disease policies in place in both jurisdictions.

The JTC recommends that the priority of project implementation be first habitat and wild stock protection, second habitat and wild stock restoration, and third, fish habitat extension to provide access to presently unavailable spawning and rearing areas.

Based on these priorities, some projects may warrant immediate implementation. Other opportunities can be pursued as they are identified through the inventory and planning process. The JTC recommends that all restoration and enhancement projects undertaken be subsequently evaluated. This will involve, at a minimum, monitoring project performance and distribution of benefits, and may also involve specific studies to assess stock interactions and impacts.

The JTC proposes that the following guiding principles governing restoration and enhancement of Yukon River salmon stocks be incorporated into the treaty:

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1. Management and protection of wild stocks and the habitats upon which they depend is our first priority.

2. Careful planning is necessary before intervening in the natural life history of any salmon stock. Potential projects should be evaluated in the context of a Yukon River basin-wide stock rebuilding and restoration plan. A careful assessment and inventory of wild stocks and their health, habitat, and life history is an integral part of restoration and enhancement planning.

3. The more stringent of the fish genetics and fish disease policies in place in Alaska and the Yukon Territory will be applied if and when salmon restoration or enhancement work is conducted in the Yukon River basin.

4.0 YUKON RIVER CHINOOK AND CHUM SALMON RUN OUTLOOKS FOR 1992

4.1 Alaska

4.1.1 Chinook Salmon

Total inriver run size of Yukon River chinook salmon cannot be estimated at this time because total escapement within the Alaska portion of the drainage is not known. Consequently, inriver run projections are subjective, being based solely upon a qualitative review of brood year escapement data collected on selected key index streams and age composition data.

The majority of chinook salmon returning to the Yukon River are comprised of 6 year old fish, although age 5 and age 7 fish contribute significantly to annual returns. In general, chinook salmon spawning escapements were average to above average for the brood years 1985-1987, being especially strong in 1986, the return from which is expected to drive the 1992 run. Assuming average survival, it is anticipated that the 1992 return of chinook salmon to the Alaska portion of the Yukon River drainage will be average to slightly above average in magnitude. The 1992 Alaska commercial harvest is expected to total about 90,000 to 110,000 fish.

4.1.2 Summer Chum Salmon

Summer chum salmon return primarily as 4 year old fish, although substantial 5 year old returns often result from brood years with high survival rates. The return of 4 year old fish in 1992 will be dependent on production from the 1988 brood year and survival of the resulting cohort. In 1988, summer chum salmon escapements ranged from below average in non-Anvik River stocks to above average in the Anvik River. The Anvik River stock is expected to be the primary contributor to the 1992 return. In addition, the return of 5 year old fish in 1992 is expected to be below average in strength based upon the below average return of 4 year old fish in 1991. In summary, based upon evaluation of brood year run size data and assuming average survival, it is expected that the Yukon River summer chum salmon run in 1992 will be below average to average in magnitude. The commercial harvest is expected to be in the range of 600,000 to 800,000 fish. Because of the mixed stock nature of the fishery and the expected substantial contribution by the Anvik River stock, it will be difficult to optimize the harvest of the Anvik River stock. Therefore, the anticipated commercial harvest may not be achieved.

4.1.3 Fall Chum Salmon

Estimates of total run size for Yukon River fall chum salmon have been made annually for a significant historical period. Unlike the other salmon species, field projects on fall chums are implemented to estimate total spawning abundance to the majority of the major spawning areas. Thus, a more quantitative approach is feasible in making run projections, being based upon a review of brood year escapement levels, age composition data, and estimated return per spawner rates.

Assuming average survival, and using average maturity schedules together with predicted return per spawner rates which are likely to result from the various escapements observed from 1986-1989, the 1992 return projection for all Yukon River fall chum salmon stocks combined is approximately 600,000 fish. This below average outlook results in reduced opportunity for commercial harvest. The Alaska commercial harvest is anticipated to range from 0 to 85,000 fish, with the greatest prospect for commercial harvest being in the Tanana River (District 6). This is because escapements observed in 1988, the major contributing brood year to the 1992 return, were well below objective levels to all areas in that year, except for the Delta River.

4.2 Canada

4.2.1 Chinook Salmon

The 1992 expected total run size of Canadian Yukon mainstem chinook salmon is 116,500 fish, which is below average. This run outlook is based on escapement data for 1985 through 1987, calculated returns per spawner for the individual brood year escapements (from the spawner-recruitment relationship for the 1977 to 1984 brood years), and the average age composition.

Examining the relationship between escapement and production, returns were reconstructed for the 1977 to 1984 brood years. The year 1977 was chosen as the first data set since stock identification data from scale patterns analysis is only available for Yukon River chinook salmon since 1982; progeny from 1977 would have returned in significant numbers beginning in 1982. Escapements for 1977 and 1978 were estimated by expanding a cumulative four-area escapement index (Tatchun Creek, Big Salmon River, Nisutlin River, and the non-hatchery returns to the Whitehorse Fishway) by the average proportion the index represented of the total escapement estimates derived from DFO mark-recapture studies in 1982-83, 1985-89, (i.e. 0.111). Escapements for 1979-81 and 1984 were estimated in a similar manner except that a five-area index was used which included the four-area index streams plus the Wolf River index counts. Mark-recapture results were used to estimate the escapement in 1982 and 1983.

The total return for each brood year was estimated by apportioning the return in the principal return years (reconstructed from ADF&G scale pattern data and DFO tagging results) by the average age composition. On average, the majority of adult chinook return at six years of age (64%) with significant numbers returning at age seven (17%) and age five (15%).

The relationship between the natural logarithm of the return per spawner (R/S) and number of spawners (S) for the 1977 to 1984 brood years is:

$$Ln(R/S)=2.616-0.037(S); \quad [1]$$

where: S = # spawners (in thousands),
R = returns.

The correlation coefficient (r^2) of this regression is 0.80 and the relationship is significant ($p<0.025$).

Based on equation [1] and the average age composition, the estimated returns from the principal brood years for the 1992 return are as follows:

Brood Year	Esc.	Calc'd Ln(R/S)	Calc'd R/S	Est'd Prod'n	1992 Return
1985	10,730	2.220	9.203	98,751	16,689
1986	16,415	2.009	7.457	122,414	78,590
1987	13,210	2.128	8.396	110,916	16,527
sub-total (accounts for 96% of the return)					111,806
Total Expected Return					**116,464**

Compared to the 1985-1990 six-year cycle average total return of 128,700 chinook, the 1992 run is expected to be below average. The interim escapement objective range for Yukon mainstem chinook (excluding the Porcupine) is 33,000 to 43,000 chinook. Therefore, the escapements in all of the principle brood years of the 1992 return were well below the escapement objective.

The method used to forecast the 1992 return is significantly different from that used in past years, where a fixed rate of return of three to four adults per spawner was used. Using the former method, we would expect approximately 60,000 chinook using a constant rate of return of four adults/spawner. The expected returns per spawner for each brood year vary, and are greater than the previous estimates. This forecast method should be viewed with some caution until its accuracy is demonstrated.

4.2.2 Fall Chum Salmon

Seventy-three percent of the adult returns of Canadian Yukon mainstem chum salmon are four years old, and 24% are five years old. This suggests that the major portion of the 1992 return should originate from the 1988 escapement. Additional returns can be expected from the 1987 escapement. The spawning escapements in 1988 and 1987 were 36,786 and 80,776 respectively. The primary brood year escapement was well below the escapement objective of greater than 80,000.

There are insufficient stock identification data for Yukon River chum salmon to support run reconstruction. Assuming a productivity of 2.5 adults per spawner (as used in the chum rebuilding model), the brood year escapement estimates and average age composition data suggest a total return of 119,175 Yukon mainstem chum salmon (excluding Porcupine River production) in 1992. This is a below average return. The four-year cycle average (1987-90) total return from Yukon mainstem chum salmon is estimated to have been in the range of 159,500 to 210,300 chum. The estimates of total average run size are based on the following assumptions:

1) 30% to 50% of the U.S. catch of fall chum is composed of Canadian origin fish;

2) the U.S. harvests Canadian-origin stocks in the same ratio as: Yukon mainstem border escapement-to-Porcupine border escapement; and,

3) the Porcupine stock consists of the Old Crow catch plus the Fishing Branch River escapement.

It should be emphasized that chum salmon stocks in the Yukon mainstem appear to have been depressed in recent years, and therefore recent averages probably do not represent healthy stock levels.

The return of chum salmon to the Canadian portion of the Porcupine River drainage should originate primarily from the 1988 escapement. The escapement through the Fishing Branch River weir in 1988 was approximately 23,597 chum which is below the recent cycle average (1988 to 1991) of about 35,041, and below the lower end of the interim escapement objective range of 50,000 to 120,000 chum salmon for the Fishing Branch River. The total run in 1992 is expected to be 74,700 chum salmon based on an assumed productivity of 2.5 returns per spawner, and the average age composition. The stock size is estimated to have averaged 75,500 to 100,900 over the 1987 to 1990 four-year cycle. The 1992 forecast is below average. Recent escapements do not represent healthy stock levels as escapement objectives have not been met.

5.0 COOPERATIVE PROJECT PLANNING

5.1 Yukon River Border Sonar

The JTC reviewed the status of planning for the cooperative sonar project on the Yukon River near the U.S./Canada border. This is intended to be a cooperative project between the United States and Canada for estimating salmon passage across the border on the mainstem Yukon River. USFWS and ADF&G are in the process of drafting a project operational plan. To date each agency has prepared an independent first draft plan. These were circulated for the information of the JTC. Ultimately, a single project operational plan will be developed as a product of these initial drafts. For the 1992 season, project objectives will focus on establishment of a field camp on the Yukon River near Eagle, Alaska, and initial experimentation and field calibration of the sonar equipment. The level of participation by Canada in this project during 1992 is uncertain at this time due to uncertain funding levels for the fiscal year which begins in April.

Development of a sonar project of this type requires several years to determine feasibility. Salmon passage estimates should not be expected for at least three years.

5.2 Porcupine River Studies

The JTC has included potential Porcupine River studies in its cooperative project planning discussions in recent meetings. Initial discussions centered on sonar technology for salmon population estimation on the Porcupine River, similar to the direction of cooperative planning for the mainstem Yukon River. However, given the high funding level and technical demands a sonar project on the Porcupine River would require, and the lack of information on chum salmon distribution in the Porcupine River drainage, discussions have recently focused on learning more about chum salmon stock distribution prior to a decision on sonar project development. Specifically, it is not known to what extent the existing Fishing Branch River weir accounts for Porcupine River drainage chum salmon spawning escapement in Canada.

The USFWS informed the JTC that they may have a small amount of funding for a very limited field study in 1992. There was some discussion regarding feasibility of a small-scale chum salmon tag deployment effort on the Porcupine River near the U.S./Canada border by USFWS, with monitoring for tag recovery at the existing Fishing Branch River weir by DFO. However, unmeasured tag loss and mortality of tagged fish would confound interpretation of the results. Consensus was reached that the proposed study was not technically sound. It was recommended that if USFWS were to undertake small-scale field work in the Porcupine River drainage in Canada, it would be more usefull to work with DFO to initiate reconnaissance and inventory work on chum salmon spawning distribution.

There was further consensus that this work would be helpfull prior to planning for a more comprehensive stock distribution study in the Porcupine River drainage.

6.0 REVIEW OF JTC REPORT WRITING CONVENTIONS AND DATABASE

The JTC briefly discussed report writing conventions and the catch and escapement database used in JTC reports. It was agreed to allow the U.S. and Canadian sections of the JTC to maintain word usage and date formats that are standard for each country in those portions of the JTC reports drafted by each section. Agreement was also reached regarding some minor revisions in the historic catch and escapement database. The numerical changes were very small, but it was seen as necessary to make the JTC records as accurate and consistent with agency records as possible.