YUKON RIVER JOINT TECHNICAL COMMITTEE REPORT

prepared by

THE JOINT UNITED STATES/CANADA
YUKON RIVER TECHNICAL COMMITTEE

April 13-14, 1994

Anchorage, Alaska

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1.0 INTRODUCTION

The Yukon River Joint Technical Committee (JTC) met in Anchorage on 13-14 April, 1994. A core group attended throughout the meeting, while attendance of other staff was subject to their availability and pertinence of subject matter discussed. The meeting was attended by the following persons:

Canadian Department of Fisheries and Oceans
- Ken Wilson (co-chair)
- Sandy Johnston
- Ian Boyce
- Tim Mulligan

Alaska Department of Fish and Game
- Larry Buklis (co-chair)
- Jeff Bromaghin
- Rich Cannon
- Penny Crane
- Dan Huttunen
- Tom Kron
- Gene Sandone
- Lisa Seeb
- Paul Skvorc

United States Fish and Wildlife Service
- Dave Daum
- Steve Klein
- Monty Millard
- Mitch Osborne
- Larry Peterson
- Bill Spearman

National Marine Fisheries Service
- Aven Andersen

2.0 CHINOOK AND CHUM SALMON RUN OUTLOOKS FOR 1994

2.1 Alaska

2.1.1 Chinook Salmon

The majority of chinook salmon returning to the Yukon River are 6-year-old fish; however, 5- and 7-year-old fish make a significant contribution to the run. In general, spawning ground escapements in 1988, the primary brood year (age-6 in 1994), were assessed to be average in magnitude in the Yukon River drainage in Alaska. Status of the parent year escapements in the Canadian portion of the drainage are discussed in a subsequent section. Survival and production of the 1988 brood year appears to be average based on observations of a normal contribution of 5-year-old fish to the

1993 commercial catch. It is expected that the return of 5-year-old fish in 1994 will be average in magnitude based on parent year escapements in 1989 and the average proportion of 4-year-old fish observed in the 1993 run. The return of 7-year-old fish in 1994 (1987 year class) is expected to be average, as the return of the 1987 year class in 1993 as 6-year-old fish was average. The overall 1994 chinook salmon run is anticipated to be near average in strength. However, it should be noted that if a very poor summer chum salmon run occurs, the chinook salmon harvest may be lower than would otherwise be expected due to management actions taken to conserve summer chum salmon.

2.1.2 Summer Chum Salmon

Summer chum salmon return primarily as 4-year-old fish, although substantial numbers of 5-year-old fish can occur in some years. The return of 4-year-old fish in 1994 will be dependent on production from the 1990 brood year and survival of the resulting cohort. Summer chum salmon spawning escapement to the Anvik River in 1990 was 403,600, which was below the minimum escapement goal of 500,000. Aerial survey conditions were poor for assessing escapements to other spawning areas in 1990, but the available information indicates that escapements were likely below the goals. The return of 5-year-old fish in 1994 is expected to be very poor based upon the poor return of 4-year-old fish in 1993. In summary, based on evaluation of parent year escapements in 1990 and assuming a poor return of age-5 fish, the outlook for Yukon River summer chum would normally be for a below average run in 1994. However, if the production failure apparent for Yukon River summer chum salmon from the 1989 brood year occurs for the 1990 brood year, the outlook for 1994 would change from below average to critically low. There will likely not be any directed commercial fishing allowed for summer chum salmon in 1994. Additional conservative management actions may be necessary to assure adequate escapements, including additional restrictions to commercial, sport, personal use, and subsistence fisheries.

2.1.3 Fall Chum Salmon

The estimated average annual age composition of returning Yukon River fall chum salmon is approximately 70% age 4 fish, followed by 20% age 5 fish. Escapement abundance in 1990, the brood year for returning age 4 fish in 1994, varied throughout the drainage. In that year only escapement goals in the Toklat River and Sheenjek River were achieved. Elsewhere, estimated escapements were below objective levels. The contribution of age 3 fall chum salmon in the 1993 run was estimated to be the lowest on record which, when combined with escapement data for 1990, suggests a below average return of age 4 fish in 1994. Further, the return of age 5 fall chum salmon (1989 brood year) is expected to be well below average in 1994 based upon the widespread failure of that year class as age 4 fish in 1993. Based upon estimated parent year total spawning escapements, spawner-return relationships, and age composition data, the total run of fall chum salmon to the Yukon River in 1994 is projected to be 605,000 fish. This projection includes an estimated age-5 shortfall from the 1989 brood year. Taking into account spawning escapement requirements and other uses, no commercial fishing opportunities are anticipated for fall chum salmon in the Alaska portion of the Yukon River drainage in 1994. Furthermore, if the production failure apparent for the 1989 brood year occurs for the 1990 brood year, the outlook for 1994 would change to critically low. In such a case, even more conservative management actions may be necessary to assure adequate escapements, including additional restrictions to sport, personal use, and subsistence fisheries.

2.2 Canada

2.2.1 Chinook Salmon

The 1994 expected total run size of Canadian origin upper Yukon chinook salmon is 132,000 fish, which constitutes an average run size. For comparison, the upper Yukon chinook run size averaged approximately 129,000 fish during the six year cycle from 1987 to 1992. The 1994 run outlook is based on escapement data for 1987 through 1989, calculated returns per spawner for the individual brood year escapements based on the spawner-recruitment relationship for the 1977 to 1985 brood years, and the average age composition. The interim escapement goal range for upper Yukon chinook (excluding the Porcupine) is 33,000 to 43,000 chinook. As indicated below, the escapement in the principal brood year of the 1994 run was well below this escapement goal range.

In order to examine the relationship between escapement and production, returns were reconstructed for the 1977 to 1985 brood years. The data set begins in 1977 since stock identification data from scale pattern analyses of Alaskan catches 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 R., Nisutlin R., 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, 1983 and 1985 through 1993.

The total return from each brood year escapement was estimated by apportioning the total annual run sizes in the principal return years 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%). Annual run sizes were reconstructed from ADF&G scale pattern data and DFO tagging results.

The relationship between the natural logarithm of the return per spawner (R/S) and number of spawners (S) for the 1977 to 1985 brood years is described as follows:

$$Ln(R/S)=2.637-0.0375(S); \quad [1]$$

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

The correlation coefficient (r^2) of this regression is 0.83 and the relationship is significant ($p<0.005$).

Based on equation [1] and the average age composition, the estimated returns from the principal brood years in 1994 are as follows:

Brood Year	**Esc.**	**Calc'd Ln(R/S)**	**Calc'd R/S**	**Est'd prod'n**	**1994 Return**
1987	13,260	2.140	8.501	112,727	19,051
1988	23,118	1.771	5.874	135,794	87,180
1989	25,201	1.692	5.433	136,906	20,399
sub-total (accounts for 96% of the return)					126,629
Total Expected Run Size in 1994					**131,906**

The method used to forecast the 1994 return is significantly different from that used prior to 1991, when a fixed rate of return of three to four adults per spawner was used. Using the former method, a run size of approximately 87,000 chinook would be expected in 1994 using a constant rate of return of four adults/spawner. In the approach used since 1991, the expected returns per spawner vary for each brood year, and are significantly greater than the previously used constants. This new forecast method should be viewed with some caution until its accuracy is demonstrated.

2.2.2 Fall Chum Salmon

On average, 73% percent of upper Yukon adult chum salmon are four years old and 24% are five years old. This suggests that the major portion of the 1994 fall chum run should originate from the 1990 escapement of 51,735 chum salmon which was approximately 35% below the escapement goal of >80,000 chum salmon. Additional returns can be expected from the 1989 escapement of 35,750 chum. The 1989 escapement was approximately 55% below the escapement goal of >80,000.

Assuming an average productivity of 2.5 adults per spawner, which is used in the JTC upper Yukon chum salmon rebuilding model, the brood year escapement estimates and average age composition data suggest a total run of approximately 119,500 upper Yukon chum in 1994 (excluding Porcupine River production).

Although there are insufficient stock identification data for Yukon chum salmon from which to estimate annual run sizes, estimates based on the following assumptions have been made to qualify the 1994 outlook, in terms of the average estimated run size:

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

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

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

Using these assumptions, the recent four-year cycle average (1990-1993) total return of upper Yukon Canadian-origin chum salmon is estimated to have been in the range of 125,000 to 158,000 fish. The forecast of 119,500 upper Yukon chum salmon for 1994 is therefore below average. The assumed productivity rate of 2.5 returns per spawner is considered optimistic; thus, this forecast may be an over-estimate. It should also be emphasized that chum stocks in the upper Yukon drainage appear to have been depressed in recent years, and therefore recent averages probably do not represent healthy stock levels.

For management purposes in 1994, the JTC recommends a target escapement for Canadian origin, upper Yukon fall chum salmon of 65,900 fish. This is consistent with the proposed three cycle rebuilding plan for upper Yukon chum salmon agreed to in the Canada/U.S. Yukon salmon negotiations. With a run size of 119,500 chum and an escapement goal for 1994 of 65,900 fish, the total allowable catch is expected to be 53,600 chum. The overall exploitation rate therefore should not exceed 45%. Under terms agreed to in the Yukon Salmon negotiations, the U.S. will endeavour to manage its fisheries to allow 84,600 - 112,600 chum to reach the border. This implies a maximum U.S. harvest rate of 29%. Because of the below average return, the Canadian fishery is expected to be managed towards the lower end of the 23,600 - 32,600 guideline harvest range, which implies a maximum Canadian harvest rate of 28%.

The chum salmon run to the Canadian portions of the Porcupine drainage in 1994 should originate primarily from the 1990 escapement. The escapement to the Fishing Branch in 1990 was estimated by aerial survey expansion (using historic aerial:weir count ratios) to be 35,000 chum which is above the 1990-1993 cycle average of about 31,000 but below the lower part of the interim escapement goal range of 50,000 to 120,000 chum for the Fishing Branch River. The total run size in 1994 is expected to be approximately 93,000 chum based on an assumed productivity of 2.5 returns per spawner, and an average age composition of 73% age four and 24% age five. The stock size is estimated to have averaged 53,000 to 66,000 fish over the 1990 to 1993 four-year cycle (based on the assumptions previously described). The 1994 forecast is therefore above average. However, as with upper Yukon chum salmon, the assumed productivity rate of 2.5 returns per spawner is considered optimistic; thus, this forecast may also be an over-estimate. Again, it is unlikely recent escapements represent healthy stock levels since the escapement goal range has not been met.

3.0 PROJECT UPDATES AND PLANS FOR 1994

3.1 Yukon River Border Sonar

A project overview was presented by ADF&G including operations and detailed hydroacoustic results obtained during the 1993 field season. Following that presentation, the USFWS presented a review of their data analysis. The overall progress made from initial site surveys in 1991 through the present was reviewed in the context of the original project objectives established by the JTC during the initial planning phase of the program. Finally, recommendations were made for 1994 Border Sonar research activities given available funding levels and potential competing management requirements for research staff resources.

Specific tasks outlined as objectives in the 1993 Project Operational Plan which were achieved during the 1993 field season included: 1) simultaneous ensonification of both banks of the river continuously from 15 July through 23 September; 2) establishment and implementation of inseason electronic and chart recording data management protocol; 3) systematic acquisition of background noise level data on both banks on Digital Audio Tape recording media and by direct calibration procedures; and, 4) successfully conducting repeated calibrations using standard acoustic targets.

Some research tasks identified in the Project Operational Plan were not completely accomplished during 1993 operations. These included collecting acoustic and non-acoustic data to describe the 1) complete cross-sectional spatial distribution of fish targets and 2) target strength and mean length of migrating adult chinook salmon and chum salmon at the sonar site. An additional question not resolved in 1993 included the type, relative abundance, and size distributions of all fish species present in the study area during the acoustic sampling period. It was not possible to ensonify a complete cross-section of the river in 1993 because existing project hardware (rotator assemblies) allowed simultaneous deployment of only two transducers. Based on the bottom profile, this task will require a suite of at least three transducers deployed in the river simultaneously.

Most tasks not fully accomplished in 1993 resulted from an inability to collect non-acoustic data in a systematic fashion. Drift gillnet test fishing activities were interrupted by mechanical problems with the test fishing boat during the chinook salmon migration. The inability to catch sufficient numbers of fish prevented relative abundance and body length/target size analyses from being conducted. Later, test fishing activities were terminated to avoid additional mortalities in a catastrophically weak chum salmon run.

During the presentation, a discussion centred on the capability and relative importance of using on site target strength analysis to apportion counts to species. Special attention was drawn to the matter of on site calibration procedures using standard targets in mid-water, and the appropriateness of applying system performance knowledge from this procedure to acoustic data acquisition on free swimming fish at the sonar site. Mainly the discussion clarified the effects of decreased signal-to-noise ratio on the bias induced to standard target and fish target strength values. This discussion clarified further that this bias diminishes confidence in estimating target strength (and therefore, fish size) far more than the ability to detect fish targets.

An additional discussion dealt with comparisons between the 1993 daily chart recording tallies and DFO daily fishwheel catches. Chinook salmon dominated DFO test fishwheel catches through 16 August, and chum salmon dominated catches after that date. The patterns of daily abundance from both data sources were similar when chinook salmon tallies were lagged seven days and chum salmon tallies were lagged three days. These comparisons indicate that both independent sampling techniques were responding similarly to changes in fish abundance. In addition, the number of sonar targets tallied through 16 August was similar to the total number of chinook salmon estimated to have passed the fishwheels during the corresponding time frame, and the number of targets tallied after 16 August was close to the number of chum salmon estimated to have passed the fishwheels during the remaining sonar sampling time. While the fit of the sonar daily counts to wheel daily catches is statistically best using these lag times, seven and three days travel time are inconsistent with observations from the tagging data collected at the wheels, and inconsistent with travel times observed elsewhere on the Yukon River for these same species. This should be examined further in future years.

An assessment of the project's progress to date included a review of the original JTC annual objectives and the degree to which they had been achieved. Subsequent discussion centred on the primary objective for the third field season, which had previously been identified as "operate the project in a 'dry run' mode as if it were fully operational". Concerns about funding, hardware availability, Canadian support, and technical and supervisory staffing availability led to the consensus that planned project operation would be limited to only the fall chum salmon migration, from approximately mid-August to late September. It was agreed that no gillnet test fishing will be conducted in support of the sonar data if the fall chum salmon run is as weak as anticipated.

Final discussions revolved around the issue of which criteria should be used to evaluate the performance of the border sonar project and whether sonar would eventually be capable of estimating salmon passage into Canada. The results of the project to date compared well with the original goals.

The JTC generally agreed that the sonar project had achieved many of its goals and much success in its first two field seasons. A site had been selected in 1991 and in the two subsequent field seasons, a two-transducer deployment was demonstrated, the sonar successfully detected passing fish, and the preliminary sonar abundance estimates and timing of the salmon runs resembled information obtained from the upriver Canadian fishwheel project. Thus, the project showed much promise. Where the project fell short in meeting the original goals, the JTC debated whether the goals might have been too optimistic, and noted that they were written in 1991 before the project started.

The project managers apprised the JTC that, although they had encountered a number of problems at the border sonar project (e.g., a decrease in target strength with range), only two significant problems remain unresolved. The first was ensonifying the entire cross-section of the river; they felt this problem will likely be overcome by adding a third transducer. The second problem was the inability, at this time, to distinguish the size (and therefore species) of fish from sonar target strengths. There was a general consensus, however, that the ability to distinguish fish size and species from acoustic data is less important that the ability to provide reliable estimates of the number of salmon passing upriver. If necessary, species composition can be estimated from gillnet samples or other means, although it may eventually be possible to make those determinations based on acoustic data.

On the basis of knowledge gained during the first two field seasons, the plan for 1994 is for ADF&G staff to set up the border sonar project in mid-August to monitor the fall chum salmon migration, and further fine tune the ability of the sonar to detect passing salmon. These plans may be modified as hardware availability and staff commitments are clarified. The USFWS will not participate in border sonar project data collection activities during 1994, but will provide all of the split-beam sonar equipment for the project. DFO intends to have one staff member assigned to the project for at least part of the field season, pending availability of funding.

3.2 Yukon River Salmon Genetic Stock Identification

3.2.1 ADF&G

ADF&G presented results of the 1993 field season, laboratory and statistical analysis of baseline samples collected to date, and a 1994 operational plan.

During 1993, the following summer chum salmon stocks were sampled: West and East Fork Andreafsky River; Innoko River; Beaver Creek (Anvik River); Swift River (Anvik River); Otter Creek (Anvik River); Canyon Creek (Anvik River); and Huslia River. Fall run stocks sampled in 1993 included Toklat River, the Tanana River mainstream, and Sheenjek River. All chum salmon baseline stocks have been processed in the laboratory, though Toklat River 1993 samples were not included in the analyses presented at the JTC meeting.

The results of preliminary statistical analyses on allozyme data collected in the ADF&G Genetics laboratory were presented. Hierarchical analyses using likelihood ratios were performed to determine at what level allele frequency differences were detectable (α=0.05). Significant allele frequency differences existed between summer and fall run stocks. Among summer run stocks, significant allele frequency differences occurred among drainages, and within the Anvik River and Tanana River drainages. No allele frequency heterogeneity occurred among Andreafsky River stocks, or between multiple year samples from Beaver Creek and Swift River within the Anvik River drainage. Among fall run stocks, significant allele frequency differences occurred among drainage and within the Tanana River. No overall allele frequency differences were detected between multiple year samples from the Toklat River, Delta River, Tanana River mainstem, or the Sheenjek River.

Two UPGMA phenograms using Nei's unbiased genetic distance (Nei 1978) were presented. Fifteen of 19 polymorphic loci used in Wilmot et al. (1992) were used for one tree. The second tree was constructed using 26 of 31 polymorphic loci detected by ADF&G. The tree constructed from 15 loci was similar to the tree in Wilmot et al. (1992). There was a genetic distinction between summer and fall run stocks, and also a distinction between upper and lower Yukon River summer run stocks. The tree derived from 26 polymorphic loci showed subdivision along geographic lines; the major split was not between summer and fall run groups but between upper and lower Yukon River stocks. However, the genetic relationships among fall run populations and the genetic difference between Tanana River summer run stocks and lower Yukon River summer run stocks was conserved in both phenograms.

Finally, preliminary mixture analyses with ADF&G data were presented. For stocks sampled over multiple years, first-year data were used as the baseline and second-year data as the mixture to determine how these artificial mixtures allocate to five geographical stock groupings. Most stocks did extremely well with at least 85% of an artificial mixture allocating to the correct stock grouping.

Goals for 1994 are to: 1) continue refining the baseline; 2) merge the USFWS and ADF&G genetic data sets into one comprehensive baseline; and 3) to evaluate the baseline using proof tests and simulations. By early 1995, ADF&G expects to present a finalized baseline and define the identifiable genetic units of chum salmon in the Yukon River drainage.

The JTC recommended the following stocks be resampled in the 1994 field season: Toklat River, Chena River, Salcha River, Chandalar River, Delta River, Gisasa River, Nulato River, Kaltag River, and Fishing Branch River. These stocks were identified based on the necessity of refining allele frequency estimates and the logistics of sample collection. The JTC also recommended sampling spawning populations of chum salmon in the Black River, Melozitna River, and Upper Koyukuk River. However, GSI samples probably will not be collected in these rivers in 1994; they all require special sampling effort and may be prohibitively expensive.

In order to meet the goal of combining the USFWS and ADF&G data sets, staff from ADF&G and USFWS will meet to finalize data standardization and merge the two databases. After merging, the baseline will be tested with proof tests. Proof tests evaluate the baseline by determining the accuracy with which artificial mixtures of known origin, not included in the baseline, allocate. Mixture analyses will be used to test the effects of adding or deleting loci and pooling populations. These analyses will be coordinated with USFWS to avoid duplicated effort and also to standardize analytical procedures and software.

More research effort was placed on augmenting the chum salmon rather than the chinook salmon baseline because of the success of scale pattern analysis in identifying Canadian and Alaskan chinook salmon stocks. However, DFO collected genetic samples from the

Whitehorse Fish Hatchery and North Klondike River. These samples have not been analyzed to date.

ADF&G provided the JTC with a brief review of other chum and chinook salmon GSI projects in which it is currently involved. ADF&G has an ongoing research project on Alaska chum salmon genetics. The goal of this project is to collect a comprehensive baseline for Alaska and apply the data to determine continent of origin of chum salmon bycatch in the Area M South Peninsula June fishery. To date, over 75 spawning populations of chum salmon ranging from Kotzebue Sound to Prince William Sound have been sampled by ADF&G. In addition, other participating laboratories in the Coastwide Genetic Stock Identification Consortium have contributed genetic data for chum salmon stocks from Japan, Russia, Southeast Alaska, Canada, and Washington. This data will provide the baseline data for the mixed fishery analysis. In June 1993, a pilot study was begun, sampling the Area M fishery. Over 2,700 chum salmon were sampled from the bycatch of the Southwest Unimak and Cape Lutke fisheries across six commercial fishery openings. A proportion of these mixed fishery samples will be analyzed in the laboratory, and continent of origin estimated using the chum salmon baseline database. Preliminary results from this pilot study will be presented at the Alaska Board of Fisheries meeting in February 1995. Plans are underway to sample the Cape Lutke and Shumagin Fishery in June 1994.

Additionally, ADF&G has a research project underway on Alaska chinook salmon GSI. The goal of this project is to determine origin of chinook salmon bycatch in groundfish fisheries in the Bering Sea and Gulf of Alaska. In conjunction with this project, ADF&G has collected genetic data on chinook salmon populations from Norton Sound, Kuskokwim River, Bristol Bay, Cook Inlet, Copper River, and three hatchery stocks from Southeast Alaska. The Yukon River chinook salmon baseline has been established in conjunction with the Yukon River salmon GSI research previously described.

3.2.2 USFWS

Staff from the National Biological Survey (NBS) Alaska Science Center and the USFWS briefed the JTC on three topics: 1) status of analyses for 1991 chum and chinook salmon mixed stock samples from the District 1 commercial and test fisheries; 2) 1992 baseline collections of chum salmon; and 3) status of the 1992 District 5 chum salmon mixed stock subsistence fishery samples.

Analyses of 1991 District 1 mixed stock samples of chum and chinook are complete. The methods used followed those of Wilmot et al (1992). The 1991 results will be incorporated with 1987-1990 results and a completion report will be finalized prior to the JTC meeting in the spring of 1995. The pattern of stock composition in the 1991 chum salmon harvest did not deviate from patterns seen in

1987-1990. For chinook salmon, the 1991 harvest differed from the patterns seen in 1987-1990. Unlike previous years, a higher proportion of U.S. stocks were caught early in the season, while a higher proportion of Canadian stocks was caught later in the season.

Laboratory processing for proteins is complete for chum baseline samples collected in 1992 from Kaltag, Dakli, Tozitna, Fishing Branch, Kluane, Teslin, mainstem Yukon (Minto area), and Tatchun Creeks/Rivers. Protein scores from these collections were given to ADF&G for inclusion in the west coast chum salmon data base.

The mixed stock chum salmon subsistence fishery in District 5 near the village of Tanana was sampled in 1992. A total sample of 2,353 chum salmon was collected, which should permit testing hypotheses concerning bank orientation, fish wheel sampling bias, stock composition over time, and accuracy and precision of stock composition estimates of mid-river samples. A subsample of 533 chum salmon was processed and analyzed as a preliminary test of the hypotheses of bank orientation and run timing. The subsample was partitioned into early north bank (4-7 August), late north bank (10-14 September), and late south bank (8-13 September) groups. Stock composition was similar between early and late north bank groups, being composed primarily of Chandalar, Sheenjek, Fishing Branch, and Canadian Yukon mainstem stocks. The south bank group was composed primarily of Tanana River stocks. The preliminary results suggest evidence of stock related bank orientation, however accuracy and precision of the estimates must be improved for greater confidence. The remaining 1,820 samples will be processed to support more comprehensive analyses and test assumptions of the GSI model.

Federal efforts (USFWS and NBS) in 1994 will focus on: 1) completion of a draft report for the District 1 mixed stock fishery sampling; 2) continuation of the District 5 mixed stock fishery analyses; 3) collection of additional baselines (see section 3.2.1); 4) continuing application of emerging molecular DNA methodologies for stock differentiation; 5) conducting research and development of nuclear and mitochondrial DNA genetic markers for stock differentiation; and 6) coordination with ADF&G to consolidate USFWS and ADF&G baseline data.

3.3 Restoration and Enhancement (R&E) Fund List

The list of potential R&E projects presented by Canada at the December 1993 negotiation session (Appendix 1) was reviewed briefly by the JTC. The list met with general approval, partly due to the strong emphasis on basin-wide planning prior to program implementation.

Some general comments made are as follows: 1) the costs of some of the bio-reconnaissance and feasibility projects may have been over estimated while costs of some of the R&E and assessment projects may have been underestimated; 2) with regard to R&E projects involving artificial propagation, there should be more funds directed towards impact assessments, the marking of juveniles and the monitoring of returns; and 3) more funds could be directed towards community-based in-stream incubators in order to shift their emphasis from demonstration to production.

Other suggestions included increasing the proposed expenditure for product development to enhance the value of Yukon River salmon to fishers and industry; changing the title of the proposed project "Expanded Aerial Surveys" to "Escapement Assessment"; and indicating that implementation of a Porcupine River sonar project would be dependant upon results of a Porcupine River chum salmon radio-tagging program.

A joint list was not developed by the JTC.

3.4 Fishing Branch River Coded-Wire Tagging

The concept of coded-wire tagging Fishing Branch River juvenile fall chum salmon was discussed. Coded-wire tagging could provide a means of assessing the productivities and patterns of exploitation of Fishing Branch chum salmon in relation to those of mainstem Yukon River chum salmon. This information was identified in the October 1992 JTC report as being necessary for predicting the capacity of Fishing Branch River chum salmon to rebuild by benefit of the mainstem Yukon River chum salmon rebuilding program.

Several points were raised which need further consideration. These included the availability of suitable incubation sites or facilities; the scale of marking and recovery effort; and the cost of such a program in proportion to the information gained.

The JTC concluded that investigations regarding Fishing Branch River chum salmon productivity, stock identification and harvest patterns could be addressed under the Restoration and Enhancement Fund.

3.5 New Projects

The 1993 chum salmon run failures elevated concerns about the status of stocks on the USFWS refuge system. Although relatively extensive aerial surveys are conducted by ADF&G, only one refuge river, the Sheenjek, is monitored by an escapement project, in this case a sonar project by ADF&G. A rapid expansion of monitoring programs is anticipated by the USFWS. In 1994, after a three year absence, the USFWS will return to the Chandalar River, which supports a run of fall chum salmon. This river will be monitored by split-beam sonar. A floating weir will be placed in the East Fork Andreafsky River, a tributary in the lower Yukon, and in the Gisasa River, a tributary of the Koyukuk River. These systems support runs of summer chum and chinook salmon. Two additional weirs are being considered for 1995 and 1996. Counting tower sites are also being evaluated.

Several other new projects are anticipated for the 1994 season. The Bering Sea Fishermen's Association will operate, in cooperation with ADF&G, a counting tower on the Nulato River for chinook and summer chum salmon escapement assessment. ADF&G will operate a sonar project on the Toklat River for fall chum salmon escapement assessment. In addition, ADF&G is planning a habitat study of the Toklat River spawning grounds, and a third consecutive year of a small scale egg take for restoration research purposes.

4.0 LITERATURE CITED:

Nei, M. 1978. The estimation of average heterozygosity and genetic distance from a small number of individuals. Genetics 89: 583-590.

Wilmot, R. L., R. Everett, W. J. Spearman, and R. Baccus. 1992. Genetic stock identification of Yukon River chum and chinook salmon 1987 to 1990. Progress report, U.S. Fish and Wildlife Service, Anchorage, AK, 132 pp.

APPENDIX I.
EXAMPLES OF TYPES OF PROJECTS THAT COULD BE FUNDED BY THE PROPOSED RESTORATION AND ENHANCEMENT FUND AS PRESENTED BY CANADA AT THE CANADA/U.S. YUKON RIVER NEGOTIATION SESSION DECEMBER 1993.

Propos penditures under the Restoration and Enhancement Fund.

a) BIO–RECONNAISSANCE & FEASIBILITY PROJECTS:

PROJECT NAME	CATEGORY	DURATION (YEARS)	ONGOING COSTS	TERM COST/YR	TOTAL TERM COSTS	OBJECTIVES	ASSUMPTIONS/ RATIONALE/ CONSIDERATIONS
Traditional Knowledge Documentation	inventory	1		$280,000	$280,000	– document local knowledge regarding distribution and relative abundance of salmon stocks in traditional areas	– assumes $20K/FN, 14 FN's. – may highlight areas requiring restoration.
		annual	$42,000			– annual updates	– maintain updated database with annual program
Sub–basin Inventories	inventory	8		$200,000	$1,600,000	– to inventory salmon habitat, adult and juvenile distribution within sub–Basins and identify opportunities for restoration and enhancement.	– data would be collected to add to knowledge of restoration and enhancement potential of sub–Basins.
GIS Development	research	1		$30,000	$30,000	– to develop a comprehensive geographical information system to compile fisheries data in a consistent and organized manner.	– there are a number of GIS programs in existence in the Yukon – none have been developed for DFO purposes. The approach would be to review existing GIS programs and determine which approach best suits needs of DFO, develop the approach and provide for annual updating of the data files.
	development	2		$100,000	$200,000		
	inventory	annual	$25,000				
Literature Review – northern interior stocks.	research/ planning	1		$50,000	$50,000	– compile information on life history requirements of northern, interior salmon stocks.	– development of a restoration and enhancement strategy from a biological perspective will require compiling available information to better understand biological limitations to production in northern climes.
Sub–basin Planning	planning	1		$70,000	$70,000	– compile existing information (biological, physical, chemical, sociological, etc.) and recommend plan for implementing projects.	– once existing information has been compiled along with results of new studies (inventory) a plan for restoration and enhancement will be formulated including methodologies, time frames, production targets, assessment needs, and economic factors.
		4		$100,000	$400,000		
Yukon Salmon Range Plan	planning	2		$300,000	$600,000	– develop a comprehensive R&E plan which would address the rebuilding, restoration and enhancement of Yukon salmon throughout their range.	– final planning process should include provisions/understandings for all areas affecting the viability of Yukon salmon stocks to ensure effective delivery of R&E programs so that benefits accrue to fishers with primary interest in the stocks.
Survey of Existing Potential Man–made Barriers	inventory	1		$30,000	$30,000	– to identify existing problems with culverts and fish passage and recommend corrective actions.	– the Yukon has a well developed road network with numerous stream crossings, many of which may pose migration barriers to salmon. Habitat extension might be quite easily accomplished in these systems through corrective actions.

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Propos. ,enditures under the Restoration and Enhancement Fund.

a) BIO–RECONNAISSANCE & FEASIBILITY PROJECTS (continued):

PROJECT NAME	CATEGORY	DURATION (YEARS)	ONGOING COSTS	TERM COST/YR	TOTAL TERM COSTS	OBJECTIVES	ASSUMPTIONS/ RATIONALE/ CONSIDERATIONS
Fox/Richtofen Case Study	demonstration	1		$10,000	$10,000	– to test the restoration and enhancement strategy planning, research, development.	– work in a small system following protocols for R&E strategies could proceed at a rapid rate and ground truth the approach suggested/being developed for larger sub–Basins.
Parasite/Disease Screening	research/ inventory	annual	$20,000			– screen potential broodstocks for disease and parasite profiles.	– health characteristics/hazards of broodstock should be fully researched prior to using for R&E.
Life History Studies	research	annual	$150,000			– research juvenile production and associated habitat characteristics. – fill in data gaps identified in literature search	– improvement in ability to identify/classify critical habitats essential to long term restoration and enhancement planning.
SUBTOTALS							
cost of annual ongoing projects			$237,000				
cost of term projects					$3,270,000		

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Propos[illegible] ,enditures under the Restoration and Enhancement Fund.

b) FISH PRODUCTION; RESTORATION AND ENHANCEMENT PROJECTS:

PROJECT NAME	CATEGORY	DURATION (YEARS)	ONGOING COSTS	TERM COST/YR	TOTAL TERM COSTS	OBJECTIVES	ASSUMPTIONS/ RATIONALE/ CONSIDERATIONS
Fisher Compensation Plan	restoration		$211,169			– compensate fishers for not fishing in years of low returns – estimated cost of compensation for one chinook season is $545,000. – estimated cost of compensation for one chum season is $481,000.	– assumes 1 chinook season per 6 year cycle and 1 chum season per 4 year cycle. – costs are to compensate for commercial catches of 9,100 chinook and 20,900 chum; Domestic catches of 300 chinook and 25 chum; District 5 commercial catches of 2,700 chinook, 6,000 chum; Cdn fish procesors and plant workers (2X's landed commercial value). – compensation for District 5 subsistence is not yet included but could be. – assumed for CK: 18# avg, $1/lb; for chum: 7# avg, $1/lb. – rationale: stock rebuilding will require curtailment of catches in some years: this approach maximizes the rebuilding of escapements by closing the fisheries partially/completely on an as needed basis.
Stream Maintenance & Improvement	restoration	annual	$280,000			– to promote small scale stream improvement projects such as beaver dam removal/modifications, logjam clearing, etc.	– allows community based stream monitoring capability.
Barrier Removal Engineering	feasibilty/ planning inventory	annual	$50,000			– to identify candidate projects for barrier removal and develop plans for such.	– prior to embarking on barrier removal/modifications engineering data will be compiled and plans developed for site alteration.
Fishway Construction/ Barrier Removal	habitat extension/ restoration/ enhancement	annual	$100,000			– to construct fishways around barriers to enable adult salmon to reach new potential spawning areas/ former spawning areas.	– fishways will be another option considered for enhancing stocks. This provides for 1 major project per decade (eg. Fraser Falls, Lapie Falls).
Fishway Maintenance	O&M	annual	$50,000			– to maintain fishways	
Community Projects	demonstration/	1		$80,000	$80,000	– continue existing projects in Mayo, Dawson and Whitehorse and expand to 3 more locations.	– data re. survival needed for restoration/enhancement planning.
	research/ restoration	annual	$340,000			– release cwt groups to obtain data re. survival.	– cwt data will provide productivity data and harvest distribution data.

b) FISH PRODUCTION; RESTORATION AND ENHANCEMENT PROJECTS (continued):

PROJECT NAME	CATEGORY	DURATION (YEARS)	ONGOING COSTS	TERM COST/YR	TOTAL TERM COSTS	OBJECTIVES	ASSUMPTIONS/ RATIONALE/ CONSIDERATIONS
Central Incubation Facility Development	research/ planning	1		$75,000	$75,000	– to determine locations for hatchery facilities including expansion of existing facilities.	– one option for R&E would be to take eggs from specific watersheds, incubate them in isolation from other populations in a centralized facility, and outplant the resultant fry back into the systems of origin. This approach maximizes the flexibility of hatchery facilities in that a number of different stocks could be restored in the one facility.
CIF Design	planning	1		$100,000	$100,000	– to design a central incubation facility for use in the upper Yukon watershed with isolated incubation capabilities.	
CIF Construction	restoration/ enhancement	2		$700,000	$1,400,000	– to constuct CIF	
CIF O&M	restoration/ enhancement	annual	$125,000			– to provide for annual operation of CIF.	
Eggtakes & Fry Plants	restoration/ enhancement	annual	$150,000			– to conduct eggtakes and fry plants assoc. with CIF.	
	assessment	annual	$100,000			– to assess the juvenile productivity of enhanced vs wild fry	– monitor potential impacts of enhanced fry on wild fry production. Includes development of mass marking program.
Chum Spawning Channel Experimentation	research/ planning	3		$40,000	$120,000	– to examine hydrological, physical and biological regimes suitable for spawning channels in northern climes.	– one of the obvious options for chum and perhaps chinook enhancement is the use of spawning channels. Unique hydrological characteristics (warm upwelling water) may be a prerequisite for success in northern areas. This would begin to improve understanding of the potential for spawning channel use in the Yukon drainage.
Spawning Channel Design	planning	1		$30,000	$30,000	– to design an experimental chum spawning channel.	
Spawning Channel Construction	restoration/ enhancement	2		$300,000	$600,000	– to construct an experimental chum spawning channel.	
Spawning Channel O&M	restoration/ enhancement	annual	$50,000			– to maintain the spawning channel	
Product Development	value enhancement	annual	$25,000			– to enhance the value of Yukon salmon to fishers and industry.	– research options for value-added products and promote Yukon salmon in the world market.
SUBTOTALS							
cost of annual ongoing projects			$1,481,169				
cost of term projects					$2,405,000		

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Propos. enditures under the Restoration and Enhancement Fund.

c) STOCK ASSESSMENT PROJECTS:

PROJECT NAME	CATEGORY	DURATION (YEARS)	ONGOING COSTS	TERM COST/YR	TOTAL TERM COSTS	OBJECTIVES	ASSUMPTIONS/ RATIONALE/ CONSIDERATIONS
Mainstem Upper Yukon Sonar	stock assessment	annual	$75,000			– to particpate in the development of the upper Yukon sonar program.	– combined with stock ID, this program will allow the early assessment of restored/enhanced returns.
Porcupine Sonar	stock assessment	annual	$75,000			– to particpate in the development of Porcupine sonar program.	– combined with stock ID, this program will allow the early assessment of restored/enhanced returns.
Radio Tagging	research/ stock assessment	1 10		$700,000 $500,000	$700,000 $5,000,000	– detail spawning distribution of chinook and chum, identify major contributing stocks and stock timing; – use data in conjunction with inventory data re. spawning and/or rearing potential to indicate status of individual stocks/stock groupings vs potential and thereby establish enhancement/restoration production targets.	– assumes 1 year startup including equipment purchase and deployment followed by 6 years study in upper Yukon and 4 yrs in Porcupine. – considerations: intensive followup within tributaries – several years.
Stock ID Development	research/ stock assessment	2 3 annual	 $75,000	$100,000 $50,000	$200,000 $150,000	– to develop techniques to identify stocks that may be subject to enhancement/restoration so that efforts can be properly assessed.	– restoration and enhancement projects will require intensive monitoring to determine success of projects and to ensure well–being of wild stocks; therefore, stocks should be identifiable.
Expanded Aerial Surveys	research/ stock assessment	6 4 annual	 $50,000	$420,000 $180,000	$2,520,000 $720,000	– increase monitoring of spawning stocks; – refinement of existing indexing system to improve data quality.	– current survey data requires improvement – provides for several surveys of existing index areas and new surveys of additional areas.
Fishing Branch Weir	stock assessment	annual	$55,000			– to enumerate annual return of chum salmon to the Fishing Branch River.	– this project provides the only escapement data of chum salmon in the Porcupine drainage in Canada and requires a secure funding committment.
Whitehorse Fishway	stock restoration/ enhancement/ assessment	annual	$15,000			– to enumerate annual returns of chinook through the Whitehorse fishway.	– expand sampling effort and monitor hatchery vs wild returns.
SUBTOTALS							
cost of annual ongoing projects			$345,000				
cost of term projects					$9,290,000		

Propos… …enditures under the Restoration and Enhancement Fund.

SUMMARY OF COSTS:

	ANNUAL COSTS OF ONGOING PROJECTS	TOTAL COST OF TERM PROJECTS
a) BIO–RECONNAISSANCE & FEASIBILITY PROJECTS:	$237,000	$3,270,000
b) FISH PRODUCTION; RESTORATION AND ENHANCEMENT PROJECTS:	$1,481,169	$2,405,000
c) STOCK ASSESSMENT PROJECTS:	$345,000	$9,290,000
GRAND TOTAL	**$2,063,169**	**$14,965,000**