Yukon River Salmon Negotiation Studies
Completion Report
July1, 1997 – June 30, 2000

Prepared By

Alaska Department of Fish and Game

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PROJECT SPONSORSHIP

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OEO/ADA STATEMENT

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INTRODUCTION

The United States and Canada began negotiations on Yukon River salmon in March 1985. When in progress, negotiations are held about twice per year. The negotiations have relied heavily on information supplied by the Alaska Department of Fish and Game (ADF&G) about the salmon fisheries and stocks in the Yukon River drainage. Some of that information has been gained because of specific appropriations from Congress passed through the Department of Commerce to ADF&G. Federal FY 1997-1999 funds were passed through to ADF&G to provide support for negotiation meeting costs and field data collection for the period July 1, 1997 through June 30, 2000 through grant Award No. NA76FP0208.

The purpose of the program supported by Federal funds for Yukon River salmon negotiation studies is to help provide the technical support necessary to effectively manage the complex Yukon River salmon fisheries in the context of the U.S./Canada negotiation process, as well as to help provide support for the treaty negotiation process.

The Yukon River is the largest river in Alaska, and one of the largest in North America. It drains an area of approximately 330,000 square miles, nearly two-thirds of which is in Alaska. For perspective, the Yukon River drainage exceeds the combined areas of the U.S. Pacific coast states of Washington, Oregon, and California combined. The area is mostly remote, undeveloped, and in its natural pristine condition. The Yukon River supports one of the largest runs of chinook and chum salmon in the world.

Providing harvest opportunity among the many users along the river in both the United States and Canada, and conserving specific stocks in a fully developed fishery harvesting from a mixture of stocks, makes the Yukon River one of the most challenging salmon fisheries to manage for optimum sustainable yields. The Yukon River Joint Technical Committee (JTC) has determined that the technical program, for both countries, is inadequate to meet the requirements that might be expected with a treaty management regime.

This report serves as a completion report in summary form for six field data collection projects or activities funded with this grant for the period July 1, 1997 through June 30, 2000. Specifically, the projects or activities described in this report are as follows:

1) Chinook Salmon Stock Identification Using Scale Patterns Analysis (SPA);
2) Yukon River Salmon Stock Identification Using Genetic Stock Identification (GSI);
3) Spawning Escapement Surveys;
4) Subsistence and Personal Use Harvest Estimation;
5) Lower Yukon River Sonar at Pilot Station;
6) Yukon Program Support - Summer Season; and
7) Yukon Program Support – Fall Season.

Results from each of these projects or activities will be summarized in the subsequent individual sections of this completion report. Reference will be provided to specific reports in preparation or already completed. These reports provide a more comprehensive source of information on the background for these projects or activities, the methods used, the results and discussion, and literature references. A comprehensive review of the Yukon River salmon fisheries and overall field programs can be found in Bergstrom et al. 1999.

LITERATURE CITED

Bergstrom D.J., K.C. Schultz, V. Golembeski, B.M. Borba, D. Huttunen, L.H. Barton, T.L. Lingnau, R.R. Holder, K.R. Boeck, and W.H. Busher. 1999. Annual Mangement Report Yukon Area, 1998. RIR No. 3A99-26, Alaska Department of Fish and Game, Anchorage.

Chinook Salmon Stock Identification Studies Using Scale Pattern Analysis (SPA)
Completion Report
July 1, 1997 – June 30, 2000

I. Tracy Lingnau, Alaska Department of Fish and Game
NA76FP0208
October 25, 2000

I. Abstract:

Yukon River chinook salmon *Oncorhynchus tshawytscha* (Walbum) are harvested in subsistence and personal use fisheries in United States (Alaska), Aboriginal and domestic fisheries in Canada, and commercial and sport fisheries in both Alaska and Canada. Chinook salmon harvested in the Yukon River fisheries consist of a mixture of stocks destined for spawning areas throughout the Yukon River drainage. Evaluating stock productivities, spawning escapement goals, and management strategies requires information on the age and stock composition of the harvest. Scale Pattern Analysis (SPA) and age composition is used to evaluate stock composition of Yukon River chinook salmon harvests. Pooled separation criteria were characterized as three geographically based stock groups termed Lower, Middle and Upper River Runs. Maximum likelihood estimation models (MLE) were used to estimate stock composition for the most abundant age classes, typically age-1.3 and -1.4 fish. Observed age composition ratios among escapements, in combination with maximum likelihood estimates, were used to estimate stock composition of less abundant age classes. In 1997 and 1998 the upper river run was the largest component of the drainage-wide harvests, accounting for 57% in 1997 and 50% in 1998. Data from 1999 are currently being analyzed. Estimated age and stock composition of all harvests of chinook salmon within the Yukon River drainage in 1997 and 1998 and revised annual estimates of chinook salmon harvested within the Yukon River drainage, 1981-1996 were re-calculated. These results can be found in the reports listed in the evaluation section.

II. Executive Summary:

Aerial surveys of chinook salmon escapements indicate that the largest concentrations of spawners occur in three distinct geographic regions. Chinook salmon stocks within these three geographic regions are collectively termed the Lower, Middle, and Upper Yukon River stocks. The various stocks, or runs of origin, are sampled on or near the spawning grounds in the portions of the Yukon River drainage where they are assumed to be separate. Scales are taken from each fish sampled and the scale data are used to estimate the age composition at each sampling location. The scales of the more abundant age classes, typically age-1.3 and –1.4 fish, are digitized and a number of scale growth measurements are made on each scale. These data are assumed to characterize all salmon from each of the runs. Similar data are collected from subsistence, test fishing and commercial catch samples. These samples are classified to run-of-origin using maximum likelihood estimates, based on scale measurement data from each of the three runs, to determine the proportion for each run-of-origin of the various harvests of Yukon River chinook salmon. These proportions are then used to classify and apportion their associated harvests.

III. Purpose:

A. The Yukon River chinook salmon run consists of a mixture of different stocks which enter the mouth of the river each year. Without knowing age class composition and the timing of the stocks entry pattern into the river, managers are at risk of over harvesting weaker stocks. Evaluating stock production, spawning escapement goals and management strategies of Yukon River chinook salmon requires information on the age and stock composition of the various harvests. Stocks of the three distinct geographic regions enter the mouth of the Yukon River at varying times within a constricted run time period. Over-harvesting of an individual stock over several years could reduce the overall productivity of that individual stock. In addition, the U.S. and Canada have been engaged in treaty negotiations concerning management and conservation of stocks spawned in Canada. Biological information on these stocks provides the technical basis for the negotiation process.

B. The objective of this project is to provide area managers with the estimated age, sex and a historical pattern of the stock composition of chinook salmon entering the mouth of the Yukon River during the season. Post season, the estimated contribution of the two Alaskan-origin and the one Canadian-origin chinook salmon stocks to fishery harvests of the Yukon River drainage are provided. Additionally, the age, sex and length compositions are estimated for harvests and escapements of sampled chinook salmon throughout the Yukon River drainage.

IV. Approach:

A. Yukon River chinook salmon are identified based on their geographic origin as Lower, Middle, and Upper river runs. Chinook salmon scale samples were collected from spawning or post-spawning chinook salmon within the two regions of origin within the Alaska portion of the Yukon River drainage, identified as the Lower and Middle river runs. Additionally, scales were also collected by the Canada Department of Fisheries and Oceans (DFO) from test fish wheel catches in Canada, immediately upriver from the U.S.-Canada border. These samples provide the baseline for each run of origin. These baselines are used to apportion harvests by run of origin. Chinook salmon originating in the tributaries that drain the Andreafsky Hills and Kaltag Mountains comprise the Lower river run stocks. Fish that originate in the Upper Koyukuk River and Tanana River tributaries comprise the Middle river run stocks. The chinook salmon that originate in the tributaries in Canada draining the Pelly and Big Salmon Mountains, and the Canadian Yukon River mainstem comprise the Upper river run stocks. Scale samples were also collected from Yukon River chinook salmon caught in commercial and subsistence fisheries and test fishing projects throughout the drainage. Scales were mounted on gummed cards and impressions were made into cellulose acetate using heat and pressure. Scale impressions were then aged, using a microfiche reader with a 40x lens, and reported in European notation. After aging, each scale was enlarged by a factor of 100x and various scale characteristics were measured using a digitizing table.

From July 1, 1997 to June 30, 1998, subsistence, commercial harvest and test fishing samples were collected from Districts 1, 2, 4, 5 and 6. There was no commercial harvest of chinook salmon in District 3 in 1997. Escapement samples used for age and scale pattern analysis were collected from the East Fork Andreafsky, Anvik, Chena, and Salcha Rivers in Alaska, and from test fishing fish wheels in Canada. In 1997, 7,238 scale samples were taken from chinook salmon within the Alaska portion of the Yukon River drainage. DFO sampled over 1,638 chinook salmon from the White Rock and Sheep Rock tagging project fish wheels just upriver from the U.S.-Canada border. All of the samples collected were aged and results were tabulated. Digitizing of chinook salmon scale samples collected during the 1997 season was also completed.

In fall 1997, a dedicated effort began in developing a less cumbersome and more statistically valid means of processing and expressing SPA information. The first improvement involved the method of estimating the stock composition of major age classes. The linear discriminant model (LDM), used previously, was replaced with a maximum likelihood mixture model (MLE). The second improvement involved the adoption of robust estimators of sample means and variance-covariance matrices, which reduced the influence of extreme observations on estimates.

In 1998, chinook salmon age-sex-length (ASL) samples were collected from commercial, subsistence and test fishing catches, and escapement projects, providing age and sex composition, length data, and SPA information. Commercial catch samples were collected from Districts 1, 2, 5, 6 and subsistence catch samples were collected from District 4. There was no commercial harvest of chinook salmon in District 3 in 1998. Escapement samples used for scale pattern analysis were collected from the East Fork Andreafsky, Anvik, Chena and Salcha Rivers in Alaska, and from test fishing fish wheels in Canada. Approximately 6,900 useable samples were collected in 1998 from the Yukon River drainage. Commercial catch samples accounted for approximately 2,700; subsistence catch samples accounted for approximately 100 samples; and test fishing samples numbered approximately 1,400. Alaska escapement samples totaled approximately 1,500 chinook salmon. Canada's DFO tagging project sampled over 700 chinook salmon. The samples collected were aged and results were tabulated. Digitizing of chinook salmon scale samples collected during the 1998 season was completed in the spring of 1999. The newly written program to analyze scale measurements of chinook salmon was completed in the fall of 1998. Scale samples collected during the 1997 fishing season were also aged and digitized during this time. A report summarizing this information was drafted and finalized. During the summer of 1999, scale measurement data from 1997 and 1998 were initially analyzed. Results for these years were tabulated and summarized in separate reports listed below (VII.C.) Re-analyzing digitized data prior to 1997 continued as well.

From July 1, 1999 to June 30, 2000, the following activities were conducted. Chinook salmon scale samples collected from the 1999 commercial and test fishing fisheries and escapement projects were digitized. There were 3,929 chinook salmon commercial catch samples collected from Districts 1, 2, 4, 5 and 6. Test fishing samples collected from projects in Alaska numbered 1,665 while Canada's DFO collected 811 chinook salmon scale

samples. There were 356 samples collected from subsistence harvests occurring in Districts 4, 5 and 6. Tributaries sampled in the fall of 1999 were the Anvik, East Fork Andreafsky, Chatanika, Chena, Salcha and Gisasa Rivers. These tributaries provided 1,855 chinook salmon escapement samples. Preliminary investigations concerning a stock-allocation model for the 1999 fishing season was initiated. Age and sex composition tables for all data collected on the Yukon River in 1999 were tabulated and reported in memorandum format. Allocation of the 1999 harvests to run of origin is continuing.

During this time, scale pattern analysis data for the years 1981-1992 were compiled and analyzed using the new scale growth analysis program. The associated report, *Origins of Chinook Salmon in the Yukon River Fisheries, Revised Edition, 1981-96* was drafted and finalized. Sampling of test fishing and commercial catches of chinook salmon caught in Lower Yukon River test fisheries in the 2000 season were initiated. These commercial and test fishing samples were aged inseason and preliminary age-sex-length tables were generated on a daily basis.

B. Tracy Lingnau and Richard Price with the Alaska Department of Fish and Game process scale samples, tabulate and analyze associated data, and report findings. Baseline scale samples were collected by personnel from various State, Federal and Canadian departments. Several private organizations also collected scales for inclusion into the database.

V. Findings:

A. Of the 12 commercial fishing periods in the lower river during the summer season in 1997, nine were with unrestricted mesh size gillnets, which tend to harvest larger, older chinook salmon. Age-6 chinook salmon were dominant, contributing 82%, followed by 11% age-5 fish. Other contributing age classes in smaller quantities were age 4 (5%), age 7 (1%) and age 8 (less than 1%). Weighted upper river catch age composition was quite different, with 42% age 6, 36% age 4, 20% age 5 and 2% age 7. This difference is most likely attributed to the fact that roughly two-thirds of the upriver catch were from fish wheels. Fish wheels tend to catch smaller, younger age fish than do the large mesh gillnets used to target chinook salmon. Age 1.2 chinook salmon dominated the escapement in the Andreafsky (53%) and Chatanika (57%), rivers. Age-1.4 chinook salmon dominated samples from the Anvik River (44%), Chena River (48%), and Salcha River (69%). Chinook salmon samples from the Canadian tagging project fish wheels were composed of 55% age-1.4 at Sheep Rock and 43% age-1.4 at White Rock. It should be noted that fish wheels tend to select for smaller chinook, more of which are typically younger males. In 1997, of the 191,153 chinook salmon harvested, an estimated 26% were of Lower, 17% were of Middle and 57% were from Upper run-of-origin.

In 1998, chinook salmon commercial and subsistence catch samples indicated that the 5-year-old component was dominant in all but one of the fishing districts sampled, ranging from 54% to 90% of the sample. The second largest contributing age group was 6-year-old salmon, ranging from 8% to 35%. The one exception was a sample from unrestricted mesh size gillnets in District 5C, in which 6-year-olds were more abundant (57%), followed by 5-

year-olds (29%). Males were dominant in all of the commercial catch samples, ranging from 51% to 91% and averaging 63%. Escapement samples from the various projects had similar results concerning age composition, reflecting the results from commercial and test fishing samples. The primary contributing age group was age-5 fish. With two exceptions, the 6-year-old age group was next largest in abundance. These exceptions were the East Fork Andreafsky and Nulato Rivers, in which the 4-year-old age component was next in abundance. Male salmon dominated the escapement samples, ranging from 59% in the Chena River to 84% in the Gisasa River.

The total estimated Yukon River harvest in 1998 was 106,152 chinook salmon. Of those, 33% were estimated to be of Lower, 17% Middle and 50% Upper Yukon River stock group origin. Revised estimates for the 1995 Yukon River harvest of 198,550 chinook salmon were 18% Lower, 22% Middle and 60% Upper Yukon River run origin. Revised estimates for the 1994 Yukon River harvest of 193,533 chinook salmon were 18% Lower, 21% Middle and 60% Upper Yukon River origin. Revised estimates for the 1993 Yukon River harvest of 179,689 chinook salmon were 22% Lower, 25% Middle and 53% Upper Yukon River origin.

In 1999, the commercial catch was dominated by age-6 fish, which accounted for approximately 81.6% of the harvest. Age-5 fish followed, accounting for 14.2% of the harvest. Female salmon accounted for an estimated 43.3% of the harvest. Commercial catch samples from District 4 indicated that age-6 salmon dominated the catch. The age-6 component ranged from 52.2% to 81.1% in that district harvest. Female composition of the District 4B harvest was 49.7% whereas the District 4C female composition was 37.5%. Age-6 salmon dominated the District 5B and C combined commercial fish wheel and unrestricted mesh size catch samples, accounting for 54.3% of the total harvest. Age-5 salmon were next in abundance, accounting for 35.1% of that total harvest. District 6B commercial fish wheel catch samples were comprised of equal proportions of age-5 and age-6 fish, with 40% each. The increased contribution of age-5 fish in Districts 5 and 6 was thought to be related to the use of the fish wheel as primary capture gear. Fish wheels tend to select smaller and younger fish. Age composition of Lower Yukon River test fishing projects mirrored District's 1 and 2 commercial catch, with age-6 fish accounting for 87.1% and 87.8%, respectively, of the catch. However, the female component in the test net catch was larger than the commercial harvest sample, ranging from 53.9% to 63.3%. Escapement age composition was generally younger. Age-6 fish ranged from 33% in the East Fork Andreafsky River to 66% in the Salcha River. Age-5 fish ranged from 24% in the Salcha River to 43% in the Anvik River. The percent of females in escapement samples ranged from 26% in the Gisasa River to 59% in the Chena River.

Reanalyzed scale measurement data using MLE techniques resulted in the following: An average of 1.1% of the harvests that were previously apportioned to Lower River Run stocks using LDF methods, were re-apportioned to Middle River Run stocks. Similarly, an average 1.3% of the harvests originally apportioned to Upper River Run stocks were re-apportioned to Middle River Run stocks. The year with the least change in country of origin harvest was 1987 when 0.4% of the Canadian stocks were assigned to U.S. (Alaskan) stocks. The greatest change occurred in 1995 when 14.6% of the harvests assigned previously to Canadian stock,

were re-apportioned to U.S. (Alaskan) Stocks. An overall average of 1.3% of harvests previously assigned to Upper River Run (Canadian) stocks were re-apportioned to U.S. (Alaskan) stocks.

B. Additional work needs to be done in order to provide area managers tools for better inseason management. Yukon River Summer Season Area Managers have historically needed an inseason assessment of Yukon River chinook salmon stock composition. A project is needed to assess the feasibility of using historical data to estimate the stock structure of test fishing and commercial catches inseason. Inseason assessment of stocks entering the Yukon River would provide Alaskan and Canadian managers a much needed tool for inseason management.

VII. Evaluation:

1. In terms of the overall project success, goals and objectives during this evaluation period were met. Attainment of sample size objectives has been considered to be a reasonable measure of operational success. In 1997, samples sizes were judged to be adequate for age-1.4 chinook salmon but lacking for age-1.3 fish. This was due to the substantially higher portion of age-1.4 fish in the 1997 run. For 1998, sample sizes were judged to be adequate for age-1.3 fish but less than desired for age-1.4 fish in both the harvest and escapement samples. This was due to the substantial lack of age-1.4 fish in the poor run in 1998. In 1999, the same was true but opposite concerning the age groups. Sample sizes were judged to be adequate for age-1.4 fish but less than desired for age-1.3 fish. The reason was the same as mentioned above, a weak return of age-1.3 fish in 1999.

2. Poor sample quality in terms of scales continues to be of concern, especially with escapement samples. When the expected rejection rate of ageable scales is exceeded, the quantity of useable samples can become problematic. Sampling techniques must be optimized so that the sample size used in the analysis remains acceptable.

3. No modifications were made to the goals and objectives.

4. Project results were reported in the following Regional Information Reports (RIR):

Lingnau, T.R. and J.F. Bromaghin. 1999. Origins of Chinook Salmon in the Yukon River Fisheries, 1997, RIR No. 3A99-09, Alaska Department of Fish and Game, Anchorage.

Lingnau, T.R. 1999. Origins of Chinook Salmon in the Yukon River Fisheries, 1998, RIR No. 3A99-29, Alaska Department of Fish and Game, Anchorage

Lingnau, T. 2000. Origins of Chinook Salmon in the Yukon River Fisheries, Revised Edition, 1981-1996, RIR No. 3A00-25, Alaska Department of Fish and Game, Anchorage.

These reports were distributed to personnel with the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service and Canada Department of Fisheries and Oceans. Results have also been reported to the U.S./Canada Joint Technical committees and Yukon River delegate members.

Yukon River Salmon Stock Identification Studies Using Genetic Stock Identification (GSI)
Completion Report
July 1, 1997 - June 30, 2000

I. Penelope Crane and Lisa W. Seeb,
Gene Conservation Laboratory, Division of Commercial Fisheries, Alaska Department of Fish and Game,
NA76FP0208
October 25, 2000

I. Abstract

Alaska Department of Fish and Game (ADF&G) continued its work on the development and application of genetic baselines to evaluate diversity and population structure of chum and chinook salmon in the Yukon River. Projects initiated or completed during this period for chum salmon include: 1) evaluation of various marker classes for their ability to differentiate among stocks, 2) application of the allozyme data base to detect the presence of summer-run chum salmon in the Canadian portion of the Yukon River, and 3) description of the timing of entry of summer- and fall-run chum salmon into the Yukon River. Projects for chinook salmon include refining the allozyme baseline and standardizing the data for inclusion in the Pacific Rim database.

III. Executive Summary

Chum Salmon

- Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, and U. S. Geological Survey prepared a joint manuscript comparing mitochondrial DNA, nuclear DNA, and allozyme markers for their ability to identify the origin of chum salmon from the Yukon River in mixtures. Genetic variation for these marker classes were assayed in chum salmon from the Delta River, Chandalar River, Sheenjek River, Fishing Branch, Big Creek, Minto Slough, Tatchun Creek, and Kluane River. Results indicated that microsatellites and allozymes were similar in their ability to discriminate chum salmon, and that by combining both marker classes the precision of the estimates improved.
- Chum salmon (N=100) were sampled from commercial catches in the Yukon drainage near Fortymile in summer 1996; these chum salmon were unusually early. Muscle samples were collected to determine if summer-run chum salmon were present. The contribution estimate for fall-run was 83% and for summer run was 17%.
- ADF&G staff implemented a study to use genetic stock identification to estimate the migration timing of summer- and fall-run chum salmon entering the Yukon River. Muscle, liver, and heart tissues were collected from 1355 chum salmon sampled from species-apportionment gillnetting conducted at Pilot Station sonar from July 5 to August 5, 1999. Five weekly stock composition estimates (7/5-11, 7/12-18, 7/19-25, 7/26-8/1, and 8/2-5) were made on mixture samples of approximately 200 fish. The estimates indicated that

summer-run salmon were passing by Pilot Station sonar in large numbers through the week of 7/26-8/1. Fall-run chum salmon first appeared in large numbers in the third time stratum, 7/19-25, the time period when chum salmon entering the Yukon River are considered fall run (July 18 at Pilot Station). By the fifth time stratum, the contribution estimate of fall chum salmon exceeded 99%.

Chinook Salmon

- Allele frequency data for allozyme loci for 61 collections analyzed by ADF&G were standardized and incorporated into a coastwide database for chinook salmon. Inclusion of more data from the Yukon River into the coastwide baseline is critical to studies using genetic stock identification to determine migration patterns of juveniles and sub-adults on the high seas and the presence of Yukon River chinook salmon in interception fisheries.
- ADF&G collected allozyme data from the Andreafsky River (N=40) and Chena River (N=150). No frequency differences were observed between these samples and samples taken in 1988 and analyzed by USFWS, indicating temporal stability of allele frequencies.

IV. Purpose

Managing salmon populations requires knowledge of their genetic population structure to identify and protect local reproductive units. Genetics research to identify these reproductive units has been a major objective on the Yukon River (JTC 1997). In addition to identification of reproductive units, the described genetic diversity has been extremely useful for stock identification applications on the Yukon River (Wilmot et al. 1992; JTC 1997) and in marine areas throughout the migratory route of the Yukon River populations in the Pacific Ocean and Bering Sea (Seeb and Crane 1999a). Objectives of this project are:

1. Continue development of genetic databases for chum and chinook salmon from the Yukon River to describe genetic diversity and delineate distinct populations;
2. Develop stock identification applications for chum and chinook salmon within the Yukon River;
3. Contribute to Pacific Rim databases for stock identification of Yukon River salmon along their migratory pathways and on the high seas; and
4. Evaluate various classes of genetic markers for their ability to discriminate among populations and for their usefulness in stock identification applications.

V. Approach

Chum Salmon

Tissue collections

During the three years covered by this report chum salmon tissues were collected from both commercial and test fisheries in the Yukon River drainage (Table 1). Only 100 individuals were available for analysis from the Fortymile commercial fishery and only muscle tissues were available from these fish. A goal of 200 individuals per week was set for the Pilot Station test fishery collections. Muscle, liver, and heart tissues were subsampled from each fish, placed in labeled cryovials, and frozen at -20°C. All tissue

samples were shipped on dry ice to the ADF&G Gene Conservation Laboratory within one week of collection and stored at -80°C.

Laboratory Analysis

Tissue samples from the test fishery were assayed for genetic variation at the following loci: *sAAT-1,2**; *mAAT-1**; *mAH-3**; *ALAT**; *ESTD**; *G3PDH-2**; *GPIB-1,2**; *mIDHP-1**; *sIDHP-2**; *LDH-A1**; *LDH-B2**; *sMDH-A1**; *sMDH-B1,2**; *mMEP-2**; *MPI**; *PEPA**; *PEPB-1**; *PEPLT**; *PGDH**; and *TPI-1** using the laboratory protocols of Seeb and Crane (1999b). Because only muscle tissue was available from the Fortymile fishery, no more than the following 13 loci were able to be analyzed: *ALAT**; *mAAT-1**; *ESTD**; *GPI-B1,2**; *mIDHP-1**; *LDH-A1**; *LDH-B2**; *sMDH-B1,2**; *mMEP-2**; *MPI**; *PEPA**; *PEPB-1**, and *PGDH**.

Statistical Analysis

Maximum likelihood estimates for mixture samples were calculated using SPAM 3.0 (See Debevec et al. In press). Ninety percent confidence intervals were computed from 500 bootstrap resamples of the baseline and mixture genotypes. For each resample, contribution estimates were generated for all populations and summed into either summer-run or fall-run estimates. The 500 bootstrap estimates for a run were then sorted from lowest to highest with the 26th and 475th values in the sequence taken respectively as the lower and upper bounds of the 90% confidence interval for that run.

Chinook Salmon

Tissue collections

During the three years covered by this report, two collections of juvenile chinook salmon tissues were taken (Table 1). Sampling goals were set at 150 individuals and muscle, liver, eye and heart tissues were subsampled from each fish, placed in labeled cryovials, and frozen at -20C. Tissue samples were shipped on dry ice to the ADF&G Gene Conservation Laboratory and stored at -80C.

Laboratory Analysis

Collections of tissue samples from the baseline collections were analyzed for the full set of 55 loci identified as necessary for inclusion in the chinook salmon coastwide baseline described in Teel et al. (1999). Laboratory procedures followed those described in Crane et al. (2000).

Statistical Analysis

The relative frequency for each variant allozyme allele was calculated from the genotypes observed during laboratory analysis. Genetic variation between the collections sampled in 1998 and previous samples from these populations was assessed using the log likelihood ratio test. Allele frequency data for allozyme loci for 61 collections previously analyzed by ADF&G were standardized and incorporated into a coastwide database for chinook salmon (Teel et al.1999).

Project management:

Penelope Crane and Lisa W. Seeb – Alaska Department of Fish and Game, Division of Commercial Fisheries

Collaboration with U.S. Fish and Wildlife Service, U.S. Geological Service (Biological Research Division), National Marine Fisheries Service (Auke Bay Laboratory).

VI. Findings

Chum Salmon

Baseline Development

The allozyme baseline for chum salmon in the Yukon River includes data from 79 collections and 20 polymorphic loci. These data were assembled into a genetic baseline of 23 pooled stock groupings for mixture analyses (JTC 1997). Analysis of simulated mixtures using these loci shows that seven reporting regions can accurately be identified in mixtures: 1) Lower Summer (Andreafsky, Chulinak, Anvik, Rodo, Kaltag, Nulato, Lower Koyukuk-early, and Melozitna); 2) Middle Summer (Upper Koyukuk-late, South Fork Koyukuk-early, Tozitna, Chena and Salcha); 3) Toklat River; 4) Upper Fall Tanana (Delta, Bluff Cabin, Tanana Mainstem); 5) Border (Chandalar, Sheenjek, Fishing Branch, Canadian Mainstem, Pelly River); 6) White River (Kluane and Donjek); and 7) Teslin River. Potential uses for the baseline include in-season or post-season analyses of chum salmon mixtures in the Yukon River to address questions such as relative contribution to fisheries, relative abundance, and timing and migratory patterns.

Data from chum salmon from the Yukon River were contributed to the Pacific Rim allozyme database. Currently over 240 collections have been contributed to the database (described in Seeb et al. (1997)). At this scale, simulation studies reveal that ten regional stock groupings can be accurately identified in mixtures: 1) Japan, 2) Northern Russia, 3) China/Southern Russia, 4) Northwest Alaska summer, 5) Fall Yukon, 6) Alaska Peninsula/Kodiak, 7) Susitna River, 8) Prince William Sound, 9) Southeast Alaska/Northern British Columbia, and 10) Southern British Columbia/Washington. The database was used to identify the origins of chum salmon harvested in the South Peninsula June fishery (Seeb et al. 1997) and post-June fishery (Crane and Seeb 2000).

Marker Evaluation

Researchers from ADF&G, USFWS, and USGS compared mitochondrial DNA, nuclear DNA, and allozyme markers for their abilities to identify the origin of chum salmon from the Yukon River. Genetic variation for these marker classes were assayed in chum salmon from the Delta River, Chandalar River, Sheenjek River, Fishing Branch, Big Creek, Minto Slough, Tatchun Creek, and Kluane River. Significant genetic variation at all marker types was found among the five drainages. Results indicated that microsatellites and allozymes were similar in their ability to discriminate chum salmon, and that by combining both marker classes the precision of the estimates improved (Scribner et al 1998).

Fishery Analyses

Fortymile commercial fishery - Chum salmon returned unusually early to the Yukon drainage near Fortymile in summer 1996. Commercial catches were sampled (muscle tissue only) to determine if summer-run chum salmon were present. The contribution estimate for fall-run was 83% (90% confidence interval: 54%-90%) and for summer-run was 17% (90% confidence interval: 10%-46%). Zero or numbers approaching zero were in the 90% confidence intervals for all of the individual stock estimates (Lower Summer, Mid Summer, Toklat, Upper Fall Tanana, Border, White River, Teslin River); however, Teslin River and Border had the largest individual estimates. These results indicate that either the suite of 13 loci used in the analysis are not sufficient to identify the individual stock groups with certainty or that populations are missing from the baseline. The presence of summer-run chum salmon was interesting; their presence could simply be misallocation or could again indicate that upriver populations containing genotypes similar to the Lower- and Mid-River summer groups are missing from the baseline.

In the future, if mixed-stock chum salmon are sampled for allozyme analysis, muscle, liver, and heart tissue should be collected in order to assay all twenty allozyme markers in the chum salmon baseline. More definitive results may have been obtained using more loci. Alternatively, these samples will be archived and could be assayed for variation at DNA (microsatellite) loci. When an adequate DNA baseline is created, a second set of contribution estimates could be calculated, with the potential for finer resolution.

Pilot Station test fishery

ADF&G staff implemented a study to use genetic stock identification to estimate the migration timing of summer- and fall-run chum salmon entering the Yukon River. Muscle, liver, and heart tissues were collected from 1355 chum salmon sampled from species-apportionment gillnetting conducted at Pilot Station sonar from July 5 to August 5, 1999. Five weekly stock composition estimates (7/5-11, 7/12-18, 7/19-25, 7/26-8/1, and 8/2-5) were made on mixture samples of approximately 200 fish. The estimates indicated that summer-run salmon were passing by Pilot Station sonar in large numbers through the week of 7/26-8/1. Fall-run chum salmon first appeared in large numbers in the third time stratum, 7/19-25, the time period when chum salmon entering the Yukon River are considered by managers to be fall run (July 18 at Pilot Station). By the fifth time stratum, the contribution estimate of fall chum salmon exceeded 99% (Figure 1).

Chinook Salmon

Staff from USFWS and ADF&G made two baseline collections of chinook salmon: Andreafsky River, N = 40 and Chena River, N = 150. For both collections, juvenile chinook salmon were captured in minnow traps. These samples were assayed for allozyme variation at 55 loci. No allele frequency differences were observed between these population samples and corresponding samples analyzed previously by USFWS (Wilmot et al. 1992): Andreafsky River 1988, 1998: G-statistic=21.06, df=15, P=0.135; Chena River 1987 and 1988, 1998: G-statistic=24.34, df=18, P=0.144. This indicates that allele frequencies within the Andreafsky River and the Chena River are temporally stable. Also, the temporal stability and lack of deviation from Hardy-Weinberg expected

genotype frequencies indicates that it is unlikely that only a few families groups were sampled (Allendorf and Phelps 1981).

These collections were used to expand the allozyme baseline for chinook salmon from the Yukon River and were submitted to the coastwide baseline for chinook salmon maintained by National Marine Fisheries Service, Seattle. An updated baseline for chinook salmon, including populations from California to Russia, was prepared in fall of 1999 (Teel et al. 1999). This is the first baseline containing data from chinook populations in Alaska.

VII. Evaluation

Considerable progress was made on all four major goals. Goals 1, 2 and 3 are continuing into the next fiscal year for both species. Goal 4 has been completed for chum salmon, and the results were published in a peer-reviewed article. Goal 4 is continuing for chinook salmon.

An extensive review of stock identification (Goals 1 and 2) was completed in late 1997 by the Subcommittee on Stock Identification, Yukon River Joint Technical Committee (JTC 1997). Pacific Rim databases have been recently updated and compiled for both chum (Seeb et al. 1997) and chinook salmon (Teel 1999; Goal 3). Genetic markers were evaluated for their ability to identify the origin of chum salmon from the Yukon River (Goal 4). The study was documented in a joint manuscript by ADF&G, USFWS, and USGS scientists (Scribner et al. 1998).

Throughout this grant period, ADF&G has worked closely with other state, federal, and international agencies to compile and standardized allozyme and DNA databases. ADF&G participated in the Coastwide Salmonid Genetics Meeting held in Missoula, Montana in June 1999. This meeting occurs approximately every two years, and is an opportunity for researchers in salmonid genetics to meet to discuss data standardization and current and future research. At the meeting, ADF&G organized and lead a workshop on standardization of microsatellite loci. These efforts are continuing into 2000 and beyond.

In October 1999, ADF&G organized and hosted a comprehensive review and standardization of the allozyme database for chinook salmon. The standardization results were documented in Teel et al. (1999).

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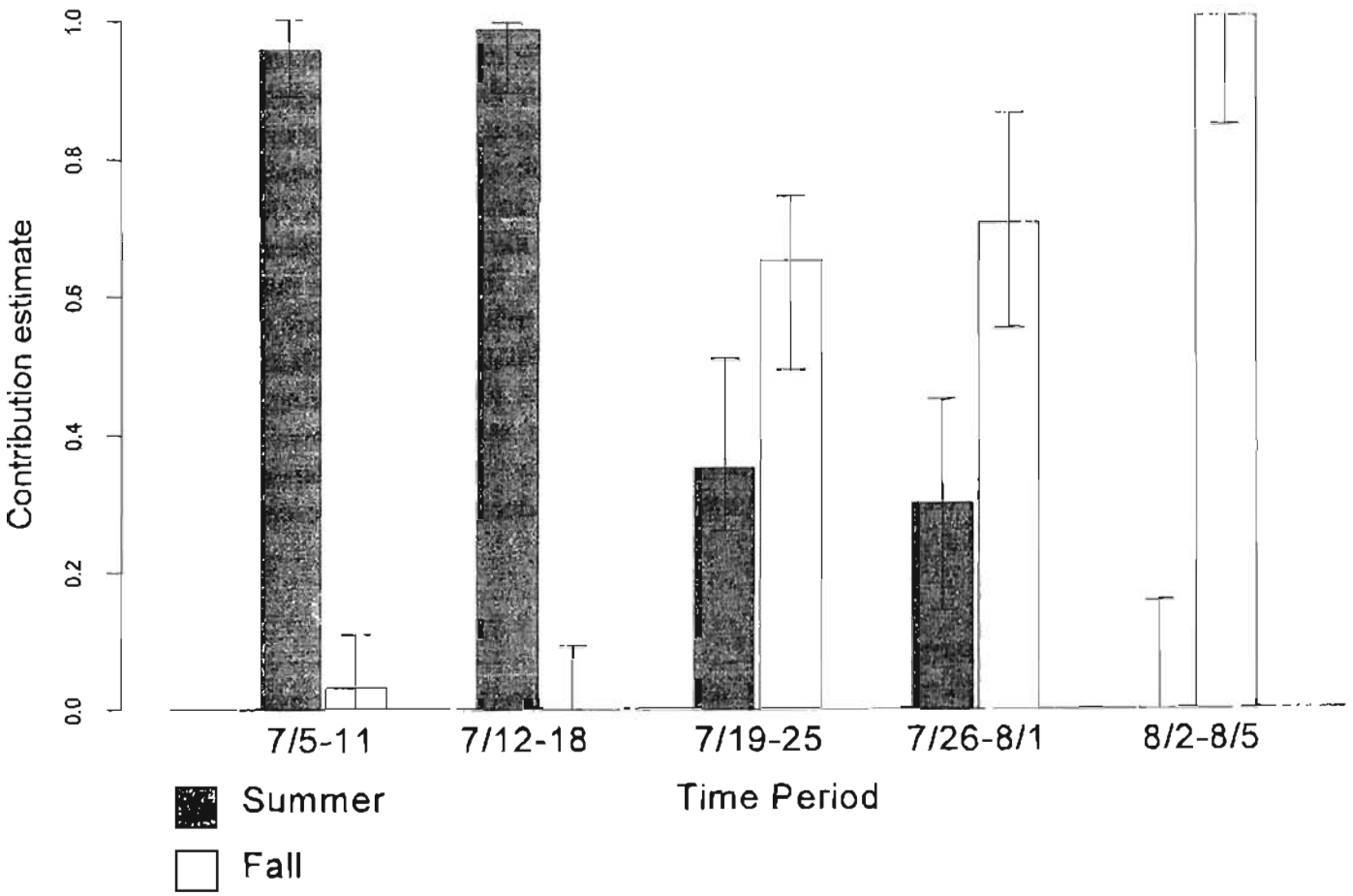
Table 1. Sample collections of chinook and chum salmon from the Yukon River, 1996 to 1999.

	Location	Sample size	Sample Date
Chum Salmon			
Test Fishery			
	Pilot Station	1355	Jul 5 – Aug 5, 1999
Commercial Fishery			
	Fortymile River	100	Summer 1996
Chinook Salmon			
Baseline			
	Andreafsky River	40	Aug 21 – Sept 10, 1998
	Chena River	150	Jul 23, 1998

Figure 1. Contribution estimates of summer and fall runs to chum salmon sampled at the Pilot Station sonar site, 1999.



Spawning Escapement Surveys
Completion Report
July 1, 1997 – June 30, 2000

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NA76FP0208
October 25, 2000

II. Abstract:

An essential requirement for management of the Yukon River salmon fisheries is the documentation of annual salmon spawning escapements. Such documentation provides for determination of appropriate escapement levels, or goals, for selected spawning areas or management units; evaluation of escapement trends; evaluation of the effectiveness of the management program, which in turn forms the basis for proposing regulatory changes and management strategies; and evaluation of stock status for use in projecting subsequent returns. The Yukon River drainage is too extensive for comprehensive escapement coverage of all individual salmon spawning streams during any given season. Consequently, low-level aerial surveys from single-engine fixed-wing aircraft or helicopters form an integral component of the escapement assessment program. Historical aerial surveys have found large spawning populations of salmon in numerous tributaries. There are also many smaller tributaries with lesser numbers of spawning salmon. Primary tributaries with larger spawning numbers are surveyed on an annual basis, weather permitting. Tributaries with smaller spawning populations are surveyed as time and weather allows. Some tributaries with comprehensive escapement projects may only assess the escapement of a single species. In these cases, aerial surveys may be conducted to assess escapement levels of other species.

III. Executive Summary:

Comprehensive salmon spawning assessment projects employing such techniques as intensified ground surveys, mark-recapture methods, counting towers, weirs, and hydroacoustics are conducted on tributaries that are important salmon producers. Some projects are also located on lesser salmon producing tributaries that are near a village, which monitors spawning salmon into that tributary. Other spawning tributaries, which are remote and not feasible to operate a comprehensive escapement project, are assessed by aerial surveys, which is a cost-effective method of obtaining escapement index information. Escapement projects provide research and management biologists spawning escapement estimates. Ground based comprehensive projects provide a total estimate of spawning salmon. Aerial surveys provide limited, but important indices of spawning salmon. These projects provide biologists run strength and run timing information of returning salmon. When paired with age and sex information, spawning salmon populations can be described in detail. With enough detailed information, biological escapement goals (BEG's), which produce an optimum number of salmon from a tributary stream can be determined.

IV. Purpose:

A. Documentation of salmon returning to spawn in tributaries of the Yukon River is an essential requirement for management of Yukon River fisheries. Documentation of spawning indices, among other information, provides data to determine appropriate escapement levels and evaluation of escapement trends. Without escapement information managers do not have a basis to document levels of returning salmon to spawn. Without knowledge of weak salmon species and stocks, other salmon species and stocks risk over-harvesting.

B. The objective of this project is to provide escapement level indices and escapement spawning estimates of salmon returning to tributaries of the Yukon River. Another goal is to use long term escapement information and indices to establish BEG's. These goals represent the approximate minimum number of spawners considered necessary to maintain historical yields. Age composition from escapement projects allows the department to build brood year tables. These brood year tables provide information for projecting future returns as well as lay the foundation for spawner-recruit analysis.

V. Approach:

A. Comprehensive escapement assessment projects funded and operated by ADF&G included monitoring chum salmon escapements to the Anvik and Sheenjek Rivers using hydroacoustic techniques. Intensive ground surveys and stream life data were used to estimate abundance of chum salmon spawners in the Toklat and Delta Rivers, and counting platforms were used by the Sport Fish Division to monitor timing and abundance of both chinook and chum spawners in the Chena and Salcha Rivers. Sport Fish Division also operated a counting tower on the Chatanika River to monitor summer chum and chinook salmon escapement, as well as conduct a boat survey of the Delta Clearwater River (DCR) during peak coho salmon spawning. The department operated the Yukon River sonar project at Pilot Station to provide daily estimates of salmon passage by species, as well as conduct a fourth-year, mark-recapture study in the upper Tanana River through cooperative agreement with BSFA. As a result of the disastrous salmon runs to Western Alaska in 1997 and 1998, the Tanana River tagging study was expanded in 1999 with federal disaster-relief funding to include the Kantishna River fall chum salmon run component. The major objective of this study was to estimate total abundance of fall chum salmon bound for the Kantishna and upper Tanana Rivers.

Some of the spawning escapement information presented here was collected from field projects that were not funded with this U.S. Department of Commerce grant. The information is presented here along with the escapement survey data funded by the grant in order to provide a more complete overview of the escapement information.

Projects funded and operated by USFWS to monitor salmon escapement included weir operations on the East Fork Andreafsky and Gisasa Rivers as well as a hydroacoustic project on the Chandalar River. While the East Fork Andreafsky weir was operated to monitor summer chum and chinook salmon escapements, duration of the project was extended a fifth

year with assistance from BSFA to provide information on timing and abundance of coho salmon. The Gisasa River weir provided comprehensive escapement information on summer chum and chinook salmon, while the 1999 Chandalar River operation consisted of using split-beam sonar techniques to monitor fall chum salmon escapements to that river.

Additional escapement assessment projects in the Alaskan portion of the Yukon River drainage, either jointly or entirely funded and operated by other organizations, included counting tower operations on the Nulato River, Kaltag and Clear Creeks, and weir operations on Henshaw and Beaver Creeks. The Nulato River tower project was cooperatively operated by ADF&G and the Nulato Tribal Council (NTC), with funding provided by BSFA. BSFA, in cooperation with TCC and BLM, also operated a counting tower on Clear Creek, a tributary of the Hogatza River in the Koyukuk River drainage, while TCC attempted a weir operation on Henshaw Creek with funding from USFWS. The Alaska Cooperative Extension 4-H program operated the Kaltag Creek project with partial funding from BSFA.

Projects conducted by the Canadian DFO included a mark-recapture project near Dawson to estimate the total number of mainstem Yukon River chinook and chum salmon passing the US/Canada border into Yukon Territory. Site-specific studies included manning an enumeration window and passage gate at Whitehorse to monitor chinook salmon escapement upstream of Whitehorse as well as installing weirs in Wolf Creek, Blind Creek (Ross River), and Tatchun Creek. Additionally, DFO operated a weir on the Fishing Branch River to count chum salmon escapement.

In addition to the above projects, an interagency chum salmon mark-recapture and radio-tracking study near Rampart to evaluate the distribution, abundance, and run characteristics of upper Yukon River fall chum salmon was conducted, with USFWS and NMFS as the lead agencies.

Remaining escapement information throughout the Yukon River drainage was obtained primarily by aerial surveillance, although occasional ground surveys were also conducted. This included aerial and ground surveys funded by BSFA and conducted by TCC in portions of the Nenana River drainage to increase knowledge on chum and coho salmon escapements to that area.

Chinook salmon spawning stocks are widely distributed throughout the Yukon River drainage. Chinook salmon escapement goals established by the Department for eight Alaskan streams, or index areas, are: East (>1,500) and West Fork (>1,400) Andreafsky, Anvik (>1,300 entire drainage or >500 Yellow River to McDonald Creek), North (>800) and South Fork (>500) Nulato, Gisasa (>600), Chena (>1,700), and Salcha (>2,500) Rivers. These escapement goals are based upon aerial survey index counts, which do not represent total escapement. It should be understood that caution must be used when comparing aerial survey results between years because of the variability inherent to this methodology. In addition, there is a rebuilding step escapement goal of 28,000 chinook for the Canadian mainstem Yukon River.

Summer chum salmon primarily spawn in tributaries from the mouth of the Yukon River to the Tanana River drainage. Escapement goals have been established for six major summer chum spawning streams as follows: East (>109,000) and West Fork (>116,000) Andreafsky, Anvik (>500,000), North Fork Nulato (>53,000), and in the Hogatza (Clear Creek at >8,000 and Caribou Creek at >9,000) Rivers. An additional escapement goal of >3,500 summer chum salmon exists for the Salcha River in the Tanana River drainage. With exception of the Anvik River objective, which is a total assessment based on sonar, all other escapement goals are based upon aerial survey indices of abundance during periods of peak spawning.

Major fall chum salmon spawning areas are located in the Chandalar River, Tanana River drainage, Porcupine River drainage and within the Canadian portion of the Yukon River drainage. The most complete database on Yukon River fall chum salmon escapements dates back to the early 1970s and exists for four streams: Delta, Toklat, Sheenjek, and Fishing Branch Rivers, the latter located in the Canadian Porcupine River drainage. Minimum escapement goals of total spawning abundance to these streams are 11,000, 33,000, 64,000, and 50,000 fall chum salmon, respectively. Additionally, annual estimates of border passage and subsequent spawning escapement also exist for Canadian fall chum stocks in the upper mainstem Yukon River. The minimum escapement goal for those stocks is 80,000 fall chum salmon (border passage).

Only one escapement goal has been established for coho salmon in the Yukon River drainage. The Delta Clearwater River (DCR) in the Tanana River drainage has a minimum goal of 9,000 coho salmon based upon a boat survey during peak spawning.

B. A substantial number of personnel from various agencies and organizations participated in the collection of salmon escapement and information. These agencies and organizations include the Alaska Department of Fish and Game (ADFG), U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Marine Fisheries Service (NMFS), Alaska Cooperative Extension 4-H program, Bering Sea Fishermen's Association (BSFA), Nulato Tribal Council (NTC) and Tanana Chiefs Conference (TCC). In Canada, participants include Canadian Department of Fisheries and Oceans (DFO), Yukon Fish and Game Association, Ross River Dena Council, Yukon First Nations and Quixote Consulting (Canada).

VI. Findings:

Chinook Salmon, 1997

Chinook salmon escapement to the Andreafsky River appeared to be near the escapement goal level. An aerial survey count of 1,510 chinook salmon in the West Fork Andreafsky was 8% above the minimum escapement goal of 1,400 salmon. The East Fork Andreafsky River aerial survey count of 1,140 chinook salmon was 24% below the minimum escapement goal of 1,500 salmon. The USFWS weir count of 3,186 chinook salmon for the East Fork Andreafsky River was 45% of the 1995 weir count.

An aerial survey of the Anvik River on July 23, conducted under good conditions, resulted in a record count of 2,690 chinook salmon within the escapement index area, which exceeded the minimum goal of 500 salmon by 500%. The entire Anvik River survey including the tributaries was 3,979 chinook salmon compared to the minimum escapement goal of 1,300.

Although an aerial survey was not conducted on the Nulato River due to poor weather conditions, an estimate of chinook salmon escapement was provided from a salmon counting-tower project. The tower count of 4,766 chinook salmon was the highest recorded since inception of the project in 1994.

No aerial survey was conducted on the Gisasa River, a tributary to the Koyukuk River, because of poor weather. There is a minimum aerial survey escapement goal of 600 chinook salmon for the Gisasa River. The USFWS counted 3,764 chinook salmon migrating through the Gisasa River weir, which was approximately 94% of the 1995 weir count and second highest on record since initiation of the project in 1994.

A weir was in operation by the USFWS on the South Fork of the Koyukuk River in 1997 beginning July 6. However, due to high water levels, after August 15 there were only four days, August 24-27, when the weir was operable. A total of 1,642 chinook salmon were counted for the season.

Although no chinook salmon escapement goals have been established for other streams in the Koyukuk River, results of aerial surveys made on a few other tributaries in 1997 indicated escapements were good. For example, counts were 593 chinook salmon in Henshaw Creek and 432 in Jim River.

High, turbid water hampered the operations on the Salcha River several times during the 1997 season. The preliminary tower count estimates for the Chena and Salcha Rivers were 13,390 and 18,396 chinook salmon, respectively. Based on commercial harvest and escapement data, the chinook salmon run to the Tanana River drainage was above average. An aerial survey of the Chena River conducted on July 18 under good conditions resulted in a count of 3,495 chinook salmon in the index area, which was double the minimum escapement goal for this index area. An aerial survey of the Salcha River index area on August 1 under poor conditions resulted in a count of 3,457 chinook salmon, which was 38% above the minimum escapement goal.

Observations on chinook spawning escapements in other tributaries of the Tanana River drainage indicated higher than average escapements in 1997. An aerial survey of Barton Creek in the Toklat River drainage on July 30, resulted in a count of 376 chinook salmon. On the same day a good survey of the mainstem Bearpaw River resulted in a count of 148 chinook salmon. A total of 97 chinook were observed on a fair survey of Seventeen Mile Slough on July 22. During 1997, Sport Fish Division conducted a mark-recapture study in the Chatanika River to estimate escapement of chinook salmon. The preliminary estimate

was 3,429 chinook salmon. No escapement goal exists for this stream, however aerial surveys have been conducted intermittently in past years.

The Beaver Creek weir was operated by BLM between June 14 and August 11 in 1997. The weir count of 315 chinook salmon was 54% higher than the 1996 count. Peak passage occurred between July 19 and July 26.

The DFO mark-recapture population estimate of chinook salmon entering the Canadian portion of the mainstem Yukon in 1997 was 53,400. Subtracting the estimated Canadian commercial and non-commercial harvest (excluding Old Crow) from this population estimate results in a spawning escapement estimate to the Canadian mainstem Yukon River of 37,683 chinook salmon. This is 35% above the rebuilding step goal of 28,000 chinook salmon. Yukon Territory chinook salmon spawning streams surveyed by DFO in 1997 included a ground survey of Tatchun Creek, and aerial surveys of Tincup Creek (Kluane River drainage), the Little Salmon, Big Salmon, Nisutlin and Wolf Rivers (Teslin River drainage). Results from these surveys revealed escapements ranged from between approximately 29% below (Nisutlin River) to 7% above (Wolf River) the 1991-1996 average escapements for these streams. The Ross River index area (Pelly River drainage) was not surveyed due to turbid water conditions.

The number of chinook salmon, which returned to the Whitehorse fishway in 1997 totaled 2,084 of which 201 (10%), possessed an adipose-clip from previous hatchery releases. Approximately 51% of the chinook salmon passing through the fishway were females. The total number of chinook salmon spawned for hatchery brood stock in 1997 was 75 females and 150 males. A total of 61 adult chinook salmon (34% female) were passed through Wolf Creek weir, a small tributary of the Yukon River located several kilometers upstream of the Whitehorse Rapids fishway.

The Blind Creek weir project operated by the Ross River Dena Council provided a count of 957 chinook salmon between July 25 and August 22, 1997. A weir project was also conducted for the first time on Tatchun Creek, from July 26 until September 3; 1,198 chinook salmon were counted. The Tatchun Creek foot survey result (266 chinook salmon) accounted for 40% of the weir count at the time the survey was conducted (August 19). The survey was hampered by unusually high water conditions and darkly stained water.

Additional aerial surveys were conducted on streams, which have not been subject to long term regular monitoring and consequently are not currently used as indices of abundance. Yukon First Nations through the DFO Aboriginal Fisheries Strategy conducted these surveys. All or parts of the following rivers were flown: Morley River, Little Kalzas River, Mica Creek, Jennings River and upper Teslin River. The highest count (230 chinook salmon) was observed on the Morley River.

Summer Chum Salmon, 1997

Escapements in the Anvik River, the largest single producer of summer chum salmon in the Yukon River drainage, have been above the escapement goal since 1991. However, spawning escapements to other Yukon River tributaries, based on limited aerial survey information, appeared to have been below desired levels in 1993. In general, escapement objectives appear to have been met in the majority of the drainage from 1994 through 1996. However, severe flooding in August 1994, particularly in the Koyukuk River drainage, and the lack of snowfall during the winter of 1995-1996 may affect the production from the 1994 and 1995 parent years.

Total summer chum salmon run abundance was estimated to be approximately 1,593,000 fish based on run reconstruction using Pilot Station sonar passage estimates and estimated harvest and escapement down river of the sonar. Spawning escapements to selected tributaries showed variable results. Those that met minimum goals or were considered adequate were Anvik, Nulato, Chena and Salcha Rivers and Kaltag and Clear Creeks. The East Fork Andreafsky, Gisasa and South Fork Koyukuk Rivers had poor escapements.

The 1997 Anvik River sonar-based escapement estimate of 609,118 summer chum salmon was approximately 22% above the minimum escapement goal of 500,000. However, the run was lower than expected based upon parent year escapements of 775,626 in 1992 and 517,409 in 1993.

Weir projects were operated by USFWS on the East Fork Andreafsky River, Gisasa River and the South Fork of the Koyukuk River. A total of 51,139 summer chum salmon were counted passing through the weir on the East Fork Andreafsky River. This count was 53% below the 1996 weir count and the second lowest escapement recorded from a tower, weir, or sonar project on the East Fork Andreafsky River. Aerial surveys were not conducted on the Andreafsky River for summer chum salmon in 1997.

A total of 31,802 summer chum salmon were counted passing through the Gisasa River weir. A summer chum salmon escapement goal has not been established for this river. However, the 1997 weir count was 20% of the 1996 weir count and the lowest on record since project inception in 1994.

The USFWS operated a weir project on the South Fork of the Koyukuk River for the second consecutive year. During the period July 6 through August 15, 11,237 chum salmon were counted. This was 70% less than the 1996 count of 37,450.

Counting-tower projects were operated on Kaltag Creek, Nulato River, Clear Creek, and the Chena and Salcha Rivers. The estimated summer chum salmon escapement into Kaltag Creek in 1997, 48,018 salmon, was 7% less than the 1996 estimate and 38% less than the 1995 escapement estimate. Although no escapement goal has been established for Kaltag Creek, this escapement was considered adequate. The estimated summer chum salmon escapement into the Nulato River (both forks combined) was 157,975 salmon. Based on this tower count, it is believed the escapement goal was met. An aerial survey of

the Nulato River was not conducted due to poor weather conditions. This was the third year the Clear Creek tower on the Hogatza River was operated. Summer chum salmon passage was estimated at 76,454 fish. Although the estimated escapement in 1997 was 24% and 35% lower than the escapement levels in 1996 and 1995, respectively, this escapement was considered adequate.

Observations on summer chum salmon escapements to other streams in the Koyukuk River in 1997 were made by aerial surveys. A total of 3,669 and 5,443 summer chum salmon were counted in Dakli River and Wheeler Creek, respectively. An aerial survey of Henshaw Creek and Jim River flown on July 29 under fair survey conditions resulted in estimates of 1,800 and 210 summer chum salmon, respectively.

The Chena River tower count was 9,439 summer chum salmon, which was 74% of the 1996 count of 12,810, but similar to the average count of 9,182 for the years 1993, 1994 and 1996. High, turbid water hampered operations on the Salcha River tower at times during the 1997 season. The Salcha River tower count of 35,741 summer chum salmon was 52% below the 1996 count of 74,827 fish, but similar to the average count of 37,718 for the period of 1993 to 1996. A survey of the Salcha River was flown on August 1 under poor survey conditions and 3,968 summer chum were observed. The Salcha River aerial survey was 13% above the minimum escapement goal of 3,500 summer chum salmon.

A weir operated on Beaver Creek by BLM recorded a passage of 34 summer chum salmon, which was only 5% of the 1996 count of 654 summer chum salmon. Most passage was between July 26 and August 4.

Fall Chum Salmon, 1997

Fall chum salmon runs in 1992 and 1993 were poor, with spawning escapements below goals in most systems. Fall chum abundance and subsequent escapements were much greater from 1994 through 1996, with all fall chum salmon spawning escapement goals achieved in 1994 and 1995. However, the lack of snowfall during the winter of 1995-1996 may affect production from the 1995 parent year.

The total run size of Yukon River fall chum salmon in 1997, estimated as the Pilot Station sonar passage estimate summed with the commercial and estimated subsistence harvest downstream of the sonar site, was below the preseason projection of 750,000 fish. The estimated number of fall chum salmon passing Pilot Station was 623,000 fish for the period July 19 though August 31. A preliminary estimate of 53,700 fish harvested below Pilot Station results in a total run size estimate of 676,700 fall chum salmon. This estimate is considered to be conservative as more fall chum salmon likely passed Pilot Station after August 31.

A review of upper river test fish data and escapement information indicates that the non-Tanana River run component, although not as strong as in 1995 and 1996, was comparatively much stronger than the Tanana River run component in 1997. Excluding the

Fishing Branch River, escapements upstream of the Tanana River were assessed as good and above minimum goals. The preliminary fall chum salmon escapement estimate for the Chandalar River was approximately 199,874 fish and similar in magnitude to the large escapement estimates for that stream in 1995 and 1996. Assessment of escapement to the Porcupine River drainage was based upon observations made in the Sheenjek and Fishing Branch Rivers. Although sonar operations were suspended in the Sheenjek River for five to six days due to high water which prevailed in late August and early September 1997, total escapement was conservatively estimated to have exceeded 80,000 fish, thus meeting the minimum escapement goal of 64,000 fish. By comparison, the escapement goal for the Fishing Branch River was not achieved in 1997. Only 26,959 chum salmon were counted through the DFO weir from August 28 through October 15; 46% below the minimum escapement goal of 50,000 fish.

The mark-recapture abundance estimate made by USFWS for Yukon River fall chum salmon passing Rampart Rapids was approximately 393,000 fish for the period July 21 through September 28. This estimate is approximately 40% lower than the abundance estimate made in 1996 of approximately 660,000 fish for the period August 1 through September 19. Similarly, the sum of escapements to the Chandalar, Sheenjek and Fishing Branch Rivers together with the mainstem Yukon River border passage estimate in 1997 was also on the order of 40% lower than that estimated to these areas in 1996.

The 1997 preliminary DFO mark-recapture estimate of spawning escapement for Canadian mainstem Yukon River fall chum salmon was 85,439 fish. This is 56% above the 1997 targeted level of 55,000 fall chum salmon, which was the goal established by the Yukon River Panel as a step in the rebuilding of the 1993 brood year. This was the fourth consecutive year that estimated spawning escapement was above the long-term rebuilding goal minimum of 80,000 fall chum salmon.

Tanana River fall chum salmon escapement in 1997 was evaluated to be extremely weak and comparatively much lower than that realized to other areas of the Yukon River. The preliminary population estimate for the Toklat River, based upon expanded ground surveys of Toklat Springs, was 14,511 fall chum salmon. This estimate is 56% below the minimum escapement goal of 33,000 chum salmon. The Toklat River sonar project was not operated in 1997. Although estimates of abundance using hydroacoustic techniques have been higher than those generated from subsequent ground surveys on the Toklat River during 1994 through 1996, preliminary results indicate the variation in disparity between the two estimates among years has been substantial. ADF&G conducted a fall chum salmon radio tagging feasibility study on the Toklat River in 1997 to begin to address the relationship of sonar passage estimates of abundance with estimates obtained from subsequent spawning ground surveys.

For the upper Tanana River (upstream of the Kantishna River), the preliminary mark-recapture total abundance estimate was 71,661 fall chum salmon. This indicates that total fall chum run size in the upper Tanana River in 1997 was approximately 50% of that

estimated in 1996 (approximately 135,000) and 25% of that estimated in 1995 (approximately 268,000).

The preliminary estimate of the total abundance of fall chum spawners in the Delta River in 1997 is 7,705 fish, approximately 30% below the minimum escapement goal of 11,000 chum salmon. While no escapement goals exist for other fall chum salmon spawning areas in the upper Tanana River, escapement during peak spawning was estimated at 3,145 in Bluff Cabin Slough (Big Delta region). This is well below the 1987-1996 ten-year average of 6,300 fish.

The USFWS operated a weir on the South Fork Koyukuk River for the second consecutive year in 1997 to monitor salmon escapements. After August 15, operations were suspended due to high water conditions for nearly the remainder of the season. The weir was in operation only three and one-half additional days in late August (24th-27th). A total of 2,685 chum and no coho salmon were passed during that period.

Coho Salmon, 1997

A coded wire tag recovery project for Toklat River fall chum salmon originating from and released into the Sushana River in the Toklat Springs area was continued for the second year in 1997. A relatively low number of tagged fish were recovered in 1997. Therefore, it was difficult to estimate survival and contribution rates. A final report summarizing the results of this study will be completed in the future.

While most escapement information on coho salmon is from the Tanana River drainage, cooperative efforts of USFWS and BSFA in 1997 allowed the East Fork Andreafsky River summer season weir operation to be extended into September for a third consecutive year. This provided comprehensive escapement information concerning timing and abundance of coho salmon to a tributary in the lower Yukon River. A total of 9,462 coho salmon were passed through September 13, the last day of weir operations in 1997. This compares to 8,037 coho salmon counted past the weir through September 16 in 1996 and 10,901 through September 12 in 1995.

In 1997, the Sport Fisheries Division conducted a boat survey of the Delta Clearwater River (DCR) index area on October 24 and estimated 11,525 coho salmon present, 28% above the minimum goal. An additional 2,375 coho salmon were observed in tributaries of the DCR by aerial survey on October 22. The Sport Fish Division also documented 2,775 coho salmon present in the outlet stream of Clearwater Lake from an aerial survey flown on October 22.

In the Toklat River drainage, only 274 coho salmon were counted by ground survey in Geiger Creek. Remaining escapement information on coho salmon in 1997 was obtained primarily by aerial surveys in portions of the Tanana River drainage, although limited ground surveys were also conducted at a few locations. A large part of this work was conducted by TCC, particularly in the Nenana River drainage. Estimated numbers of coho salmon spawners in the Nenana River drainage included 1,524 in Lost Slough, 1,996 in Seventeen Mile Slough, 1,446 in the mainstem Nenana River upstream of the

Teklanika River, and 3,688 in the Clear-Glacier-Wood Creek complex of the Julius Creek drainage.

Chinook Salmon, 1998

Yukon River chinook salmon abundance in 1998 was assessed as weak, based on commercial harvest data and escapement estimates from selected tributaries. Total chinook salmon run abundance was estimated to be approximately 176,000 fish based on run reconstruction using Pilot Station sonar passage estimates and estimated harvest and escapement down river of the sonar. This was well below the total run reconstruction estimates for 1995 and 1997 of 363,000 and 341,000 chinook salmon, respectively. Chinook salmon escapements in 1998 were below the recent 4- or 5-year averages throughout the drainage, with minimum escapement goals achieved in only three surveyed tributaries. The return of 5-year-old chinook salmon was less than expected given the large return of 4-year-olds in 1997. In addition, production from the 1992 parent year (age-6 fish) appears to have been poor given the escapement levels documented that year.

Chinook salmon escapement to the Andreafsky River appeared to be near escapement goal levels. An aerial survey count of 1,249 chinook salmon in the West Fork Andreafsky under poor survey conditions was 11% below the minimum escapement goal of 1,400 salmon. The East Fork Andreafsky River aerial survey count of 1,027 chinook salmon was 32% below the minimum escapement goal of 1,500 salmon. The USFWS weir count of 4,011 chinook salmon for the East Fork Andreafsky River was 19% below the recent 4-year average weir count of 4,946.

An aerial survey of the Anvik River on July 23, conducted under poor conditions, resulted in a count of 648 chinook salmon within the escapement index area, which exceeded the minimum goal of 500 salmon by 30%.

Minimum aerial survey index escapement goals are 800 chinook salmon for the North Fork and 500 for the South Fork Nulato River. Aerial surveys with fair ratings resulted in counts of 546 and 507 chinook salmon in the South Fork and North Fork (including mainstem below the forks), respectively. An estimate of chinook salmon escapement was provided from a salmon counting-tower project operated by the NTC, BSFA and ADF&G. The tower count of 1,536 chinook salmon was 30% below the recent 4-year average of 2,182 chinook salmon. However, mid-channel water clarity problems in the Nulato River vary within and between years, making it difficult to compare chinook escapements between years.

On July 31 an aerial survey was conducted on the Gisasa River, a tributary to the Koyukuk River. A total of 889 chinook salmon were observed on this survey under poor conditions. The minimum escapement goal is 600 chinook salmon. The USFWS counted 2,356 chinook salmon migrating through the Gisasa River weir, which was approximately 25% below the recent 4-year average of 3,157. The quality of the escapement was very poor as males predominated the escapement samples at 84% of the total.

Although no chinook salmon escapement goals have been established for other streams in the Koyukuk River, aerial surveys were flown on selected Koyukuk River tributaries. Aerial surveys flown under poor conditions observed 31 chinook salmon in the South Fork Koyukuk River on August 1 and 70 chinook salmon in the Kateel River on July 31. Aerial surveys flown under fair conditions observed 45 chinook salmon in the Jim River and 97 chinook salmon in Henshaw Creek on August 1. A weir was not operated by the USFWS on the South Fork of the Koyukuk River in 1998 due to flood conditions.

Since 1993, inseason assessment of chinook salmon escapement to the Tanana River drainage has been based on counts of chinook salmon passing the Chena and Salcha River tower sites operated by ADF&G, Division of Sport Fish. Mark-recapture escapement population estimates are available for both streams from 1987 through 1992. High, turbid water hampered operations on the Chena and Salcha Rivers several times during the 1998 season. The tower passage estimate for the Chena River was 4,745 chinook salmon, which was the lowest escapement since 1991. The tower estimate for Salcha River was 5,027 chinook salmon, which was the lowest escapement since 1989. High water resulted in poor aerial survey conditions on both rivers, although multiple attempts were made from July 16 through August 10. The highest count was 386 chinook salmon for the Chena River index area. The highest count of 1,923 chinook salmon for the Salcha River index area occurred on August 4 and was 23% below the minimum escapement goal.

Observations on chinook spawning escapements in other tributaries of the Tanana River drainage were made in the Chatanika and Goodpaster Rivers. Division of Sport Fish in 1998 operated a counting tower on the Chatanika River. The escapement estimate was 864 chinook salmon for the period of July 6 through July 31. A mark-recapture study conducted by Division of Sport Fish in the Chatanika River in 1997 resulted in an escapement estimate of 3,809 chinook salmon. No escapement goal exists for this stream, however aerial surveys have been conducted intermittently in past years. An aerial survey flown August 2 on the Goodpaster River with a survey rating of fair observed 591 chinook salmon.

In 1998, the BLM was not able to operate a weir on Beaver Creek due to flood conditions.

The DFO mark-recapture population estimated approximately 22,588 chinook salmon entering the Canadian portion of the mainstem Yukon in 1998. Subtracting the estimated Canadian commercial and non-commercial harvest (excluding Old Crow) of 5,838 fish from this population estimate results in a preliminary spawning escapement estimate to the Canadian mainstem Yukon River of 16,750 chinook salmon. This is 44% below the 1992-1997 average of 29,697 chinook salmon and well below the rebuilding step goal of 28,000 fish. In addition to poor run abundance, there was also concern about very low water levels that persisted throughout the chinook salmon season; most of the non-glacial watersheds were very low as a result of minimal precipitation. There were also reports of higher than normal water temperatures in some locations.

Aerial surveys were conducted by DFO of Yukon Territory chinook salmon spawning index areas on the Little Salmon River, Big Salmon River, Wolf River, Nisutlin River, and Tincup Creek, once per index in 1998. The Ross River index was not flown in 1998 due to budgetary and time constraints. Surveys with ratings other than poor are considered useful for inter-annual comparisons. However, it is likely low water conditions in 1998 improved visibility, contributing to high countability compared to most other years.

The Little Salmon aerial survey was flown on August 19. Countability was rated as good. A total of 361 chinook salmon were observed. This count is 53% below the recent 5-year average (1993 to 1997). The Big Salmon River, Nisutlin River, and Wolf River indices were flown on August 21. As in 1997, excellent viewing conditions were encountered due to favorable water levels and clear, calm weather. Consequently, countability on the Big Salmon River and the Wolf River surveys were rated as excellent, while that encountered on the Nisutlin River survey was rated as good. A total of 523 chinook salmon were enumerated on the Big Salmon River index, 65% below the recent 5-year average. The Nisutlin River index count of 146 chinook salmon was 64% below average. On the Wolf River index, only 66 chinook salmon were observed, which was 82% below average. The final chinook aerial survey conducted by DFO took place on August 22 on Tincup Creek. The visibility during this survey was excellent for the entire index area. Fifty-three chinook salmon were observed, which was 62% below average.

Timing of the aerial surveys appeared close to peak spawning, perhaps a couple of days early for indices other than the Little Salmon River. The contribution of dead fish to total counts ranged from 88% below the recent cycle average (on the Nisutlin River) to 9% below the recent cycle average (on the Wolf River). Many unoccupied redds were observed. However, the vast majority of them are believed to be associated with previous years' spawners.

The Whitehorse Rapids Fishway chinook salmon count of 777 fish, provided by the Yukon Fish and Game Association, was 59% below the recent 5-year average. The sex ratio observed at the fishway was 21% female, which was below the recent average of 39% female. Adipose-clipped fish accounted for 58% of the count, and numbered 433 males and 21 females. The adipose-clipped counts were expanded by the marked to unmarked release ratios using the age composition of adipose-clipped fish (sexes treated separately) observed in 1996. Preliminary calculations indicated a hatchery run contribution of 95%. There were at least 150 mortalities in the fishway, constituting a 24% mortality rate for females and 18% mortality rate for males. The 1998 and 1997 seasons have seen what are believed to be record numbers of mortalities in the fishway. However, the 1998 mortality rate was higher. The reason for the high mortality rates observed this year and last year has not been determined with certainty, however, many fish appeared to be reluctant or unable to move past the upper end of the fishway. It is possible that there has been some impediment to fish movement in the fishway itself, or that the fish simply lacked the energy to ascend the upper end of the fishway, which has a significant gradient. There were some anecdotal reports in 1998 that the overall fitness of Yukon River chinook salmon appeared poor, perhaps as a result of unfavorable marine conditions.

As has been observed each year since 1994, a number of chinook ascended the fishway more than once. In 1998, these fish comprised less than 1% of the run. Coded-wire tag data from 1994 through 1997 indicate that the fish exhibiting this behavior had been released into the fishway as fry, after rearing in the hatchery. The fishway was first used as a release site for adipose-clipped hatchery fry in 1989; hence, it is possible that the number of adipose-clipped fish may be exaggerated somewhat in annual counts beginning in 1991, when the first 3-year-olds would have returned. Adjustments have not been made to adipose-clip tallies for 1991 to 1994. Starting in 1995, all adipose-clipped chinook salmon ascending the fishway were marked with a caudal punch in order to eliminate the possibility of multiple counting.

The total number of chinook salmon spawned for hatchery brood stock in 1998 was 71 females and 104 males. An estimated 362,402 green eggs were taken between August 23 and September 7, 1998. The average fecundity for the females taken for brood stock was 5,100 eggs.

The Yukon Fish and Game Association also operated weirs on Wolf Creek and Michie Creek, both of which are upstream of the Whitehorse Fishway. The Wolf Creek weir provided a count of only 7 chinook salmon, 2 of which were female. A total of 131 chinook salmon were counted through the Michie Creek weir. The sex composition was only 21% female. Passage of chinook salmon through both these weirs, but particularly the Wolf Creek weir, appeared to be delayed, perhaps due to low water conditions.

The Blind Creek weir project, conducted by the Ross River Dena Council, provided a count of 373 chinook salmon between July 19 and August 19, 1998. Of the 220 fish sexed, 94 (43%) were identified as females. The Blind Creek weir count in 1998 was approximately 61% below the count obtained in 1997 of 957 chinook salmon.

For the second consecutive year, Quixote Consulting installed a weir on Tatchun Creek. Enumeration commenced on July 15 and terminated on September 5. A total of 405 chinook salmon were observed, 29% of which were identified as female. The total count was 66% below that obtained in 1997. At Tatchun Creek, the fish appeared to hold in the mainstem Yukon River for a significant period before ascending the creek. This delay is believed to have been caused by the extremely low water conditions observed at the mouth of Tatchun Creek in 1998.

Weirs were installed on two additional upper Yukon River tributaries for the first time in 1998. The Yukon Commercial Fishermen Association installed a weir on the Chandindu River, also known as the Twelvemile River, located downstream of Dawson City. Installation of the weir was originally scheduled for mid-June, but was delayed by flood conditions. A total of 132 chinook salmon were enumerated between July 4 and August 25, only 13% of which were female. Two Whitehorse residents installed a weir on MacIntyre Creek, a small tributary of the Yukon River downstream of Whitehorse. Only 8 chinook salmon were counted through this weir.

Additional aerial or ground surveys for chinook salmon adult enumeration were conducted on streams which have not been subject to long term, consistent monitoring. These surveys were conducted by Yukon First Nations through the DFO Aboriginal Fisheries Strategy or by consulting firms or private individuals funded by the R&E Fund. Streams surveyed included the Morley River, Gladys River, Mica Creek, Needle Rock Creek, Sidney Creek, Jennings River, upper Teslin River, and Nordenskiold River. The Morley River survey, flown on August 27, 1998, resulted in a count of 49 fish. This was 78% below the number observed on a survey conducted on the Morley River on August 23, 1997.

Summer Chum Salmon, 1998

Postseason analysis of comparative commercial harvest and escapement data indicates the summer chum salmon run was very weak in 1998. Total summer chum salmon run abundance was estimated to be approximately 979,000 fish based on run reconstruction using Pilot Station sonar passage estimates and estimated harvest and escapement down river of the sonar. This was well below the total run reconstruction estimates for 1995 and 1997 of 4,090,000 and 1,593,000 summer chum salmon, respectively. Spawning escapements to selected tributaries were below most other years for each project. No escapements in monitored tributaries met minimum goals or were considered adequate; results ranged from 27% to 81% below recent five-year averages. Aerial surveys were hampered by poor weather conditions in most of the drainage.

The Anvik River sonar-based estimated escapement of 471,865 summer chum salmon was approximately 6% below the minimum escapement goal of 500,000 and the sixth lowest since 1979. The run was lower than expected based on parent year escapements of 517,409 and 1,124,689 summer chum salmon in 1993 and 1994, respectively.

Weir projects were operated by USFWS on the East Fork Andreafsky and Gisasa Rivers. A total of 67,591 summer chum salmon were counted passing the East Fork Andreafsky River weir. This count was 49% below the recent 4-year-average of 133,180 fish. Aerial surveys were not conducted on the Andreafsky River for summer chum salmon in 1998 due to poor survey conditions. The weir count indicated the minimum escapement goal for the East Fork Andreafsky River was not met.

A total of 18,228 summer chum salmon were estimated to have passed through the Gisasa River weir. A summer chum salmon escapement goal has not been established for this river. However, the 1998 weir count was 43% below the 1997 weir count and the lowest on record since the project's inception in 1994.

The estimated summer chum salmon escapement into Kaltag Creek in 1998 of 8,113 fish was 85% below the recent 4-year-average escapement of 55,546 fish. While no escapement goal has been established for Kaltag Creek, this escapement level was considered poor.

The estimated summer chum salmon escapement into the Nulato River (both forks combined) was 49,140 salmon, which was 71% below the recent 4-year-average of 168,330 fish. Based on this tower count, the aerial escapement goal of 53,000 summer chum salmon was not met. An aerial survey of the Nulato River was not conducted in 1998 due to poor weather conditions.

This was the fourth consecutive year the Clear Creek tower on the Hogatza River was operated. No summer chum salmon were counted passing through the site prior to July 2. High water prevented counting operations on July 2. Partial counts obtained on July 9 and 13 totaled 212 summer chum salmon. The recent 3-year average is 98,034 summer chum salmon for the entire season. The aerial escapement goal is a minimum of 8,000 summer

chum salmon. An aerial survey flown on July 31 with a poor rating observed 120 summer chum salmon in Clear Creek.

Aerial surveys were flown on selected Koyukuk River tributaries and the Melozitna River. Aerial surveys flown with a survey rating of fair, resulted in the following counts: 395 salmon in the Melozitna River; 642 summer chum salmon in the Dakli River; 595 summer chum salmon in the Wheeler Creek; 24 summer chum salmon in the Jim River; and 151 summer chum salmon in Henshaw Creek. All these surveys were flown during peak summer chum salmon spawning during the period July 22 – August 1.

High, turbid water occasionally hampered tower-counting operations on the Chena and Salcha Rivers during the 1998 season. The 1998 Chena River tower count was 5,901 summer chum salmon, which was 37% below the 1993, 1994, 1996, and 1997 average count of 9,410 fish. The final Salcha River tower estimate of 17,289 summer chum salmon was 54% below the recent 5-year (1993 to 1997) average of 37,324 fish. Aerial surveys of both rivers were conducted either too early (prior to peak spawning) or under poor weather conditions. An aerial survey of the Salcha River flown on August 4 under poor survey conditions estimated 370 summer chum salmon within the index area. Summer chum salmon age and sex composition samples were not collected in 1998 from carcass surveys on either river due to high water conditions.

In addition to the Chena and Salcha River projects, Division of Sport Fish also operated a counting tower on the Chatanika River in 1998. The final estimate was 663 summer chum salmon for the period of July 7 through July 31.

Fall Chum Salmon, 1998

The 1998 Yukon River fall chum salmon run was approximately 10 days later than average (among the latest on record), and well below the preseason projected return of 880,000 fish. Total run size includes the Pilot Station sonar passage estimate and the harvest below the sonar site. The estimated number of fall chum salmon passing Pilot Station was 397,000 fish for the period July 19 through September 9. The corresponding total run size was the third lowest on record and only 45% of the preseason projection. Spawning escapements were below average throughout the entire drainage.

Assessment of escapement to the Porcupine River drainage was based upon observations made in the Sheenjek and Fishing Branch Rivers. Although sonar operations were suspended in the Sheenjek River for six to seven days due to prevailing high water conditions early in the season, total escapement was estimated to have approximated 33,000 fall chum salmon for the 45-day period August 17 through September 30. This is likely the poorest escapement observed to this river since inception of sonar counting operations in 1981, and is 49% below the Sheenjek River minimum escapement goat of 64,000 fall chum salmon. Similarly, the escapement goal for the Fishing Branch River was not achieved in 1998. Only 11,912 chum salmon were enumerated through the DFO weir during the 42-day period of August 26

through October 8, the lowest on record and 76% below the minimum escapement goal of 50,000 fish.

In the Chandalar River, the sonar-based estimated escapement was 75,800 chum salmon for the 48-day period from August 8 through September 25 by the USFWS. This escapaement was well below the 1995-1997 average of 228,000.

The preliminary fall chum salmon mark-recapture abundance estimate made by USFWS for fish passing the tagging site at "Rampart-Rapids", was 187,923 chum salmon for the period August 3 through September 19. This abundance estimate is approximately 52% lower than the 1997 estimate (393,000) and 72% lower than the 1996 estimate (660,000). By comparison, the sum of escapements to the Chandalar, Sheenjek and Fishing Branch Rivers, together with the mainstem Yukon River border passage estimate in 1998 was 58% and 75% lower than what was estimated to those areas in 1997 and 1996, respectively. The 1998 estimate of spawning escapement for Canadian Yukon River mainstem fall chum salmon was only 46,300 fish.

Tanana River fall chum salmon escapement in 1998 was evaluated to be extremely weak for the second consecutive year. The population estimate for the Toklat River, based upon expanded ground surveys of Toklat Springs, was 15,605 fall chum salmon. This is nearly 53% below the minimum escapement goal of 33,000 fish. For the upper Tanana River (upstream of the Kantishna River), the mark-recapture abundance estimate through October 5 was 62,400 ± 23,700 (95% C.I.) fall chum salmon, the lowest abundance estimate obtained in the four years the tagging study has operated. It was approximately 13% below the 1997 estimate (72,000 fish), 54% lower than the 1996 estimate (135,000 fish), and 77% lower than the 1995 estimate (268,000 chum salmon). Ten ground surveys were conducted in the spawning areas of the Delta River during the period of September 29 though December 2, 1998. The highest count was obtained on November 5 when 5,703 fall chum salmon were counted. A total spawner abundance estimate of 7,804 chum salmon was obtained using the area-under-the-curve method. This was 29% below the minimum escapement goal of 11,000 fall chum salmon for the Delta River. Although no escapement goals exist for other fall chum salmon spawning areas in the upper Tanana River drainage, a peak ground count of 2,110 fall chum salmon was obtained on November 5 by USGS personnel in Bluff Cabin Slough (Big Delta region). This is 66% below the 1988 through 1997 average of 5,666 fall chum salmon.

A coded wire tag recovery project for Toklat River fall chum salmon originating from and released into the Susanna River in the Toklat Springs area, after incubation at Clear Hatchery, was continued for the third year in 1998. Because a relatively low number of tagged fish were recovered in 1998, it was difficult to estimate survival and contribution rates. A final report summarizing results of that study will be completed in the future. A preliminary assessment of the low numbers of coded wired tags (CWT) recoveries in 1998 may indicate that poor ocean or early marine survival was the cause of the poor fall chum salmon returns and not fresh water survival.

Coho Salmon, 1998

Most coho salmon escapement information is from the Tanana River drainage. However, cooperative efforts of USFWS and BSFA allowed the East Fork Andreafsky River summer season weir operation to be extended into September for the fourth consecutive year in 1998. This provided additional information on the timing and abundance of coho salmon to a tributary in the lower Yukon River. A total of 5,417 coho salmon passed through the weir on September 13, the last day of operations in 1998. However, no fish passage estimates were possible for 11 days during the period August 17-28 due to high water conditions. The 1998 estimate compares to a 1995-1997 average passage of approximately 9,500 for the same approximate time period.

On October 20, 1998, the Division of Sport Fish conducted a boat survey of the DCR index area and estimated 11,100 coho salmon present, which exceeded the minimum escapement goal by 23%. An additional 2,775 coho salmon were counted in tributaries of the DCR by aerial survey on October 21. On October 20, 2,775 coho salmon were counted, by aerial survey, in the outlet stream of Clearwater Lake.

Remaining escapement information on coho salmon in 1998 was obtained primarily by aerial surveys flown in portions of the Tanana River drainage, although limited ground surveys were also conducted at a few locations. A large part of this work was conducted by TCC, particularly in the Nenana River drainage. Counts of coho salmon spawners in the Nenana River drainage were: 1,360 fish in Lost Slough, 1,413 fish in Seventeen Mile Slough, 2,771 fish in the mainstem Nenana River upstream of the Teklanika River, and 370 fish in the Clear-Glacier-Wood Creek complex of the Julius Creek drainage. In the Toklat River drainage, a mid-October ground survey of Geiger Creek documented only 157 coho salmon.

Chinook Salmon, 1999

Chinook salmon escapement to the Andreafsky River in 1999 appeared to be below desired escapement levels. No acceptable aerial surveys were conducted in either the East or West Fork Andreafsky Rivers, but the USFWS weir count of 3,347 chinook salmon for the East Fork Andreafsky River was 30% below the 5-year average weir count of 4,759. Age and sex composition samples were collected in 1999.

An aerial survey of the Anvik River on July 24, conducted under poor conditions, resulted in a count of 950 chinook salmon within the escapement index area, which exceeded the minimum goal of 500 salmon by 90%.

Minimum aerial survey index escapement goals are 800 chinook salmon for the North Fork and 500 for the South Fork Nulato River. No aerial surveys were possible in 1999 due to inclement weather. An estimate of chinook salmon escapement was provided from a salmon counting-tower project operated by the Nulato Tribal Council, Bering Sea Fishermen's Association (BSFA) and ADF&G. The tower count of 1,932 chinook salmon was 6% below the recent 5-year average of 2,053 fish. Age and sex composition samples were not collected in 1999.

The minimum aerial survey escapement goal for the Gisasa River is 600 chinook salmon. No aerial surveys were possible in 1999 due to inclement weather. The USFWS estimated a total 2,631 chinook salmon migrated through the Gisasa River weir, which was approximately 12% below the recent 5-year average of 2,997.

Although a weir was not operated on the South Fork of the Koyukuk River in 1999 by the USFWS due to flood conditions, aerial surveys were flown on selected Koyukuk River tributaries. Aerial surveys flown on August 5 under poor conditions resulted in; 34 chinook salmon observed in the South Fork Koyukuk River, 68 chinook salmon in the Jim River, and 119 chinook salmon in Henshaw Creek.

High, turbid water hampered operations on the Chena and Salcha Rivers for short intervals during the 1999 season. The preliminary tower estimate for the Chena River was 6,485 chinook salmon, 30% lower than the recent 5-year average of 9,307 fish. The preliminary tower estimate for the Salcha River was 9,198 chinook salmon, 27% below the recent five-year average of 12,685 fish. It should be noted, however, that recent escapements represent some of the largest ever recorded for both streams, so tower-based escapement goal evaluation may not yet be appropriate. Acceptable aerial survey conditions on both rivers resulted in estimates of 2,412 chinook salmon for the Chena River index area and 3,608 chinook salmon for the Salcha River index area. The minimum aerial survey escapement goals for the Chena River and Salcha River index areas are 1,700 and 2,500 chinook salmon, respectively.

The Bureau of Land Management (BLM) successfully operated a weir on Beaver Creek during the majority of the chinook and summer chum salmon migrations, though a wild fire prevented operations during part of the early portion of the counting season. The final count was 128 chinook salmon.

The preliminary mark-recapture estimate of the total spawning escapement for the Canadian portion of the upper Yukon drainage is 12,657 chinook salmon, 57% below the 1993-1998 average of 28,259 chinook salmon.

Aerial surveys were conducted by DFO of index areas on the Little Salmon River, Big Salmon River, Wolf River, Nisutlin River, and Tincup Creek. The Ross River index was not flown in 1999 due to budgetary constraints. Survey results relative to the previous cycle averages, or previous 6 years, are presented below. Index surveys are rated according to fish countability. Potential ratings include excellent, good, fair and poor. Surveys with ratings other than poor are considered useful for inter-annual comparisons.

The Little Salmon aerial survey was flown on August 18 under good conditions. A total of 495 chinook salmon were observed in this tributary. However, this count is 29% below the recent cycle average (1993-1998) of 702. The Tincup Creek aerial survey was conducted on 20 August and 2 chinook were observed; 98% below the historical average. The visibility during this survey was rated good for the entire index area. The Big Salmon River, Nisutlin

River, and Wolf River index areas were flown on August 23. As in 1998, good viewing conditions were encountered due to favorable water levels and clear, calm weather. Consequently, the countability on the Big Salmon River, Nisutlin River, and the Wolf River surveys was rated good to excellent. (The Nisutlin River index is somewhat wider than the other rivers; consequently, the countability is generally less.) A count of 372 chinook salmon was obtained on the Big Salmon River, 72% below the recent cycle average of 1341. The Nisutlin River count of 337 chinook salmon was only 6% below the recent cycle average. A count of 145 chinook salmon was observed in the Wolf River, 54% below the cycle average of 313.

Timing of aerial surveys appeared close to peak spawning for all systems other than Tincup Creek. There, an independent ground survey was conducted on August 24; a total of 16 chinook salmon were observed. Abandoned redds were noted on the Big Salmon River survey that indicates the survey may have been slightly late.

The Yukon Fish and Game Association counted a total of 1,118 chinook salmon past the Whitehorse Rapids Fishway, this was 34% below the recent cycle average. Sex composition was 16.7% female and 83.3% male.

A weir was operated on Michie Creek from August 10 to September 11 in 1999. A total of 395 chinook salmon were counted and sex composition was 10.9% female and 89.1% male. The Wolf Creek chinook enumeration program was not conducted in 1999 due to budgetary constraints.

The Blind Creek weir project, conducted by the Ross River Dena Council, provided a count of 892 chinook salmon for the period August 1-22, 1999. Of the 872 fish sexed, 386 (44.3%) were identified as females. Weir counts for the two previous years were 373 in 1998 and 957 in 1997.

Quixote Consulting installed a weir on Tatchun Creek for the third consecutive year. Enumeration commenced on August 15 and terminated on September 1 as a result of heavy flooding. A total of 250 chinook salmon were observed; 44.4% of these were identified as female. Previous weir counts were 405 in 1998 and 1,198 in 1997.

The Yukon Commercial Fishers Association installed a weir on the Chandindu River for the second consecutive year. The weir was operated from July 1 to August 31, 1999, and a total of 239 chinook salmon were counted (18 tagged: 221 untagged), with peak migration occurring in late July. A total of 92 chum salmon were counted (10 tagged: 82 untagged). For comparison, a total of 132 chinook salmon (17 females) and 23 chum salmon were counted in 1998.

Additional aerial or ground surveys for chinook salmon spawners were conducted on streams that have not been subject to long-term, consistent monitoring. These surveys were conducted by Yukon First Nations through the DFO Aboriginal Fisheries Strategy, or by consulting firms or private individuals funded by the Restoration and Enhancement Fund.

Streams surveyed included the Nisutlin River and tributaries, Pelly River and tributaries, White River and tributaries, Flat Creek, Crooked Creek, Tincup Creek, and Nordenskiold River.

Summer Chum Salmon, 1999

Preliminary post-season analysis of comparative commercial harvest and escapement data indicates the 1999 summer chum salmon run was very weak. No escapements in monitored tributaries met minimum goals or were considered adequate; results ranged from 27% to 81% below recent year averages. Aerial surveys targeting summer chum salmon were hampered by poor weather conditions throughout the drainage. It should be noted that severe flooding in August 1994 might have affected salmon returns in the Koyukuk River drainage in 1999.

The preliminary Anvik River sonar-based escapement count of 437,631 summer chum salmon was approximately 12% below the minimum goal of 500,000 and the fourth lowest since 1979. The run was weaker than expected based on parent year escapements of 1,124,689 and 1,339,418 in 1994 and 1995, respectively.

Weir projects were operated by USFWS on the East Fork Andreafsky and Gisasa Rivers. A total of 32,229 summer chum salmon were counted passing through the weir on the East Fork Andreafsky River. This count was 73% below the recent 5-year-average of 120,062 fish and 52% below the 1998 count of 67,591. The summer chum salmon minimum aerial survey escapement goals for the East and West Fork Andreafsky Rivers are 109,000 and 116,000 fish, respectively. However, aerial surveys were not conducted on the Andreafsky River for summer chum salmon in 1999 due to poor survey conditions. The weir count indicated the minimum aerial survey-based escapement goal for the East Fork Andreafsky River was not met.

A total of 9,920 summer chum salmon were tallied passing through the Gisasa River weir. A summer chum salmon escapement goal has not been established for this river. However, the 1999 weir count was 87% below the 5-year average weir count of 79,124 fish, and was the lowest on record since project inception in 1994.

A weir was not operated on the South Fork of the Koyukuk River in 1999 by the USFWS due to flood conditions.

Aerial surveys targeting chum salmon were not flown on any spawning tributaries in 1999 due to poor survey conditions.

The estimated summer chum salmon escapement into Kaltag River in 1999 was 5,339 fish, which was 89% below the recent 5-year average escapement of 46,378 fish and 35% less than the 1998 estimate of 8,113 fish. While no escapement goal has been established for Kaltag River, this escapement was considered poor.

The estimated summer chum salmon escapement into the Nulato River (both forks combined) was 30,076 fish, which was 79% below the recent 5-year average of 144,492 fish. An aerial survey of the Nulato River targeting summer chum salmon was not conducted due to poor weather conditions. However, based on the tower estimate, the aerial escapement goal of 53,000 summer chum salmon was not met.

This was the fourth year the Clear Creek tower project on the Hogatza River was operated for the entire counting period. This project was partially inoperable during 1998 because of high water. In all, 11,283 summer chum salmon were counted past the tower, which was 88% below the recent 3-year average escapement of 98,034 fish and 85% less than the previous lowest complete season estimate of 76,454 fish in 1997. No tower-based escapement goal has been established for Clear Creek, but this escapement was considered very poor. While no escapement goal exists for this project, the aerial escapement goal is a minimum of 8,000 summer chum salmon. Therefore, it is likely that the escapement goal was not met.

High, turbid water periodically hampered visibility in both the Chena and Salcha Rivers during the 1999 season and forced early cessation of tower counting operations for chum salmon on the Chena River. The Chena River tower count was 9,165 summer chum salmon, which was 5% above the 1993, 1994, and 1996 to 1998 average count of 8,707 fish. However, counting operations on the Chena River have historically been of highly variable duration, making direct comparison of counts between years difficult. The Salcha River tower project was operated through the end of August, which is three to four weeks longer than most previous years because of the late run timing. The resulting count of 23,221 summer chum salmon was 41% below the recent 5-year (1994-1998) average of 39,618 fish. In these years the tower project terminated approximately 3 to 4 weeks earlier than in 1999. Aerial surveys targeting chum salmon were not conducted on either river.

High water conditions forced an early cessation of summer chum salmon counting activities at the Beaver Creek weir in 1999. Final counts totaled 75 chum salmon.

Fall Chum Salmon, 1999

In general, the 1999 fall chum salmon run could be characterized as having strong components in the early and latter portions of the run, with weakness in the middle. Overall run timing was judged to be approximately one week earlier than average. This was anomalous to the late run timing observed in 1999 for chinook, summer chum, and coho salmon, and is largely a function of a strong early pulse of fall chum salmon that entered the river. The sonar passage estimate at Pilot Station was 510,900 ± 19,600 (90% C.I.) fall chum salmon for the 44-day period of July 19 through August 31. However, during the summer of 1999, ADF&G genetics began a study to determine the variation in timing of the summer-run and fall run chum salmon at Pilot Station. Post-season application of GSI sampling results from chum salmon collected at the sonar site on June 12 through August 31 1999, was used to apportion sonar counts attributed to chum salmon during that period to

summer- or fall-run fish. The estimated passage of fall chum salmon past Pilot Station was 442,731 fish.

Because the sonar project only provides an estimate of the number of salmon during its operational period, total run size must include an estimate for the number of fish that passed the sonar site subsequent to the end of August, in addition to the harvest that occurred below Pilot Station. Based upon comparisons between performance of the Mountain Village test fish (MVTF) and Pilot Station sonar projects when both were in operation, and the performance of MVTF subsequent to August 31, it was estimated that as many as 60,000 fall chum salmon may have passed Pilot Station subsequent to sonar operations. This estimate, together with the estimated commercial (17,500) and subsistence (10,400) harvest of fall chum salmon below the sonar site, suggests total run size to have been on the order of 530,631 chum salmon. This measure of total run size lies near the low end of the preseason projection (550,000) and is 56% below the upper bound (1,197,000). In other words, the 1999 fall chum salmon run materialized at only 44% of what would normally been expected. By comparison, the 1998 fall chum salmon run materialized at 46% of normal run size expectations.

An estimate of drainage-wide fall chum salmon escapement was taken as the reconstructed run size (530,630) less estimated total US/Canada in-river harvest (127,200). This measure of escapement totaled 403,400 chum salmon and compares to a *minimal* escapement estimate of approximately 305,700 fish as measured by the sum of estimated escapements among the various monitoring projects in place during 1999. With the exception of the upper Tanana River, spawning escapements were below average throughout the remainder of the drainage.

Escapement in the Chandalar River was estimated at 88,700 chum salmon for the 49-day period of August 8 through September 25. While that estimate is higher than estimated in 1998 (69,000), it is well below the 1995-1997 average of 229,700 fish. No fall chum salmon escapement goal has been established for the Chandalar River.

The preliminary escapement estimate for the Sheenjek River approximated only 14,000 chum salmon for the 46-day period of August 10 through September 23. This is the lowest escapement observed to this river since inception of sonar counting operations in 1981, and is considered a total run failure given the major parent year escapement levels. The 1999 estimated escapement in the Sheenjek River was 78% below the minimum escapement goal of 64,000 fall chum salmon. Similarly, in the Fishing Branch River only 12,900 chum salmon passed the DFO weir during the 41-day period of September 1 through October 11, 1999. This too, was the lowest escapement on record and 74% below the minimum escapement goal of 50,000 fish.

The preliminary mark-recapture abundance estimate for fish passing the USFWS tagging site at "Rampart Rapids" was approximately 190,600 chum salmon for the period August 2 through September 22, 1999, very similar to the 1998 estimate of 197,600 fish. However, the 1999 estimate is 48% lower than the 1997 estimate (369,500) and 71% lower than the 1996

estimate (654,300). For comparison, the sum of escapements to the Chandalar, Sheenjek and Fishing Branch Rivers, together with the mainstem Yukon River border passage estimate in 1999 (~195,300 fish), was similar to that observed to these areas in 1998 (170,200 fish). However, this measure of escapement in 1999 was also on the order of 51% and 71% lower than that estimated to the same areas in 1997 and 1996. The 1999 estimate of spawning escapement for Canadian upper Yukon River fall chum salmon was 65,900 fish.

The preliminary mark-recapture estimate for the Kantishna River run component was 27,700 ± 7,100 (95% C.I.) fall chum salmon. In the Toklat River the expanded population estimate was only 4,551 chum salmon based upon ground surveys conducted of the spawning areas at Toklat Springs during mid-October. This estimate was 86% below the minimum escapement goal of 33,000 chum salmon, and compares to the lowest escapement on record of 3,600 chum salmon in 1982. Returning age-4 and age-5 chum salmon to the Toklat River in 1999 were from two of the largest parent year escapements in recent years: 75,000 in 1994 and 58,000 in 1995. Like the Sheenjek River, results suggest a total failure in parent year production (1994 and 1995) for Toklat River chum salmon.

Fall chum salmon run strength to the upper Tanana River (upstream of the Kantishna River) in 1999 was estimated at 105,000 ± 41,500 (95% C.I.) fish. This preliminary mark-recapture abundance estimate was higher than estimates made in 1998 (69,000) and 1997 (72,000), but less than the 1996 (135,000) and 1995 (268,000) estimates. Based upon observations made in the Delta River and Bluff Cabin Slough, fall chum salmon spawning escapement appeared comparatively better in the upper Tanana River than to other areas throughout the Yukon River drainage.

Total spawning escapement for the Delta River was estimated at 16,500 chum salmon, based upon observations from ten ground surveys conducted of the spawning area during the period September 30 through December 7. This was 50% above the minimum escapement goal of 11,000 chum salmon and the only escapement goal achieved in 1999. In Bluff Cabin Slough, USGS personnel obtained a peak ground count of 5,078 chum salmon on November 15. This is 66% above the most recent three-year average peak count of 3,058 and very near the recent ten-year average (1989-1998) of 5,400 fish.

Coho Salmon, 1999

A total of 2,963 coho salmon passed through the East Fork Andreafsky Weir by September 11, the last day of weir operations in 1999. This estimate compares to a 1995-1998 average passage of approximately 8,500 for the same approximate time period.

Division of Sport Fish conducted a boat survey of the DCR index area on October 28 and estimated 10,975 coho salmon present indicting the escapement goal was achieved. An additional 2,799 coho salmon were estimated in tributaries of the DCR based upon an expansion factor derived from a comparison between the average proportion aerial survey escapement estimates in tributary streams to the mainstem DCR for the past 5 years.

Remaining escapement information on coho salmon in 1999 was obtained primarily by aerial surveys flown in portions of the Tanana River drainage, although limited ground surveys were also attempted at a few locations. A portion of this work was conducted by TCC, particularly in the Nenana River drainage. Estimated numbers of coho salmon spawners in the Nenana River drainage included 1,002 in Lost Slough, 662 in Seventeen Mile Slough, and 745 in the mainstem Nenana River upstream of the Teklanika River. In the Toklat River drainage, a mid-October ground survey of Geiger Creek documented only 29 coho salmon.

B. In 1997, the overall conditions for conducting aerial surveys throughout much of Interior Alaska during the chinook and summer chum salmon season were considered marginal because of rainy and windy conditions prevailing in much of the drainage and smoke from wild fires. In the Canadian portion of the drainage, DFO was successful in surveying most major chinook salmon index streams in Yukon Territory. While aerial and ground surveys made of fall chum and coho salmon spawning streams in the Alaskan portion of the Yukon River were confined to the Tanana River drainage in 1997, DFO was successful in flying surveys of most fall chum salmon index streams in Yukon Territory.

   For 1998, conditions for conducting aerial surveys throughout much of Interior Alaska during the chinook and summer chum salmon season were considered marginal because of cloudy and rainy conditions prevailing in much of the drainage. In the Canadian portion of the drainage, DFO was successful in surveying most major chinook salmon index streams in Yukon Territory. Aerial and ground surveys of fall chum and coho salmon spawning streams in the Alaskan portion of the drainage were confined to the Tanana River drainage in 1998, DFO flew surveys of most fall chum salmon index streams in Yukon Territory.

   Overall, survey conditions in 1999 were considered poor throughout most of the Alaskan portion of the drainage during the chinook and summer chum salmon survey season from mid-July though August (particularly downstream of the village of Tanana). This was due primarily to prevailing rainfall and high, turbid water conditions. Survey conditions during the fall chum and coho salmon survey period of late September through November were slightly improved from those of the earlier season. While acceptable aerial survey conditions were realized on selected fall chum and coho salmon spawning areas in the lower Nenana River, turbid water conditions in the upper Tanana River hindered aerial surveillance of that area. In the Canadian portion of the drainage, DFO was successful in surveying most major chinook and fall chum salmon index streams in Yukon Territory.

C. More ground-based escapements are needed to produce quality escapement information. Variability in aerial survey accuracy is dependent upon a number of factors such as weather, water conditions (turbidity), timing of the surveys with respect to peak spawning, type of aircraft used, availability of aircraft, experience of the pilot and the surveyor type and density of the salmon species being estimated. Further, peak spawning abundance measured by aerial survey measured is significantly lower than total season abundance due to die-off of early spawners and subsequent arrival of later fish. Given these sources of variability, aerial survey

estimates demonstrate a wide range in the proportion of the fish being estimated. Another concern is, of all the methods of determining abundance of fish, aerial surveys are the most dangerous due to the nature of slow flight at low altitudes.

VII. Evaluation:

A. In terms of the overall project success, most of the goals and objectives were met on an annual basis concerning ground based counting projects. A few ground-based projects did not accomplish their goals, such as the Beaver Creek Weir and South Fork Koyukuk. Other ground-based projects may have terminated earlier than normal, or were not able to count fish for portions of the season. These projects were hampered by natural elements, not a lack of resources. A portion of aerial surveys were not flown or hampered by weather conditions. Successful aerial surveys are highly dependent on good weather and water clarity.

B. Modifications were made to some of the ground based counting projects. These modifications were mostly extensions in the duration of the project, thereby allowing for a longer duration to assess escapement information.

Project results have reported in the following Regional Information Reports (RIR):

Bergstrom D.J., K.C. Schultz, B.M. Borba, V. Golembeski, R.D.Paulus, L.H. Barton, D.J. Schneiderhan, and J.S. Hayes. 1998. Annual Mangement Report Yukon Area, 1997. RIR No. 3A98-32, Alaska Department of Fish and Game, Anchorage.

Bergstrom D.J., K.C. Schultz, V. Golembeski, B.M. Borba, D. Huttunen, L.H. Barton, T.L. Lingnau, R.R. Holder, K.R. Boeck, and W.H. Busher. 1999. Annual Mangement Report Yukon Area, 1998. RIR No. 3A99-26, Alaska Department of Fish and Game, Anchorage.

Bergstrom D.J., K.C. Schultz, V. Golembeski, B.M. Borba, D. Huttunen, L.H. Barton, T.L. Lingnau, R.R. Holder, John S. Hayes, K.R. Boeck, and W.H. Busher. (In Prep), Annual Management Report, Yukon Area, 1999, Alaska Department of Fish and Game, Anchorage

These reports were distributed to personnel with the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service and Canada Department of Fisheries and Oceans. Results have also been reported to the U.S./Canada Joint Technical Committees and Yukon River delegate members.

Subsistence and Personal Use Salmon Harvests Estimation
Completion Report
July 1, 1997 – June 30, 2000

I. Bonnie M. Borba and Helen H. Hamner, Alaska Department of Fish and Game, Division of Commercial Fisheries
NA76FP0208
October 25, 2000

II. Abstract:

The Yukon Area includes all waters of Alaska within the Yukon River drainage and all coastal waters of Alaska from Point Romanof southward to the Naskonat Peninsula. Successful management of fishery resources is dependent upon obtaining accurate estimates of subsistence and personal use salmon harvests within the Yukon Area. The annual salmon harvest estimate program includes information from fishing permit harvests, estimates of fish provided by test fisheries for subsistence use, as well as stratified random sampling techniques for surveyed communities. Demographic information is collected to provide an estimate of number of households participating in the fishery, the number of people in the Yukon Area, the number of dogs, gear types utilized and areas fished. Combining survey, permit, and test fishery information an estimate of chinook, summer chum, pink, fall chum, and coho salmon harvested from the subsistence and personal use fisheries within the Yukon Area is generated annually.

III. Executive Summary:

The Yukon Area subsistence salmon harvests are the largest in the state. The subsistence program provides annual estimates of the subsistence and personal use salmon harvests within the Yukon Area. These estimates provide trend information by species in a dynamic and changing fishery. The estimates of salmon harvest are considered in Board of Fishery allocations as well as Canadian Negotiations. In seasonal prosecution of fisheries, especially during poor returns, the estimates provide valuable insight into the level of harvest taken by species throughout the Alaskan portion of the Yukon River drainage.

IV. Purpose:

A. The State of Alaska is mandated by the Board of Fisheries to provide adequate escapement of salmon to their spawning grounds and to provide for harvests in subsistence, sport, personal use, and commercial fisheries of which subsistence has the highest priority. Estimates of harvests are required in order to allocate and manage salmon. At this time, salmon returning to the Yukon River drainage are fully allocated between the various fisheries, including both the U.S. and Canadian fisheries. Additionally, families in the Yukon Area communities are dependent upon the return of salmon to provide a natural food source. When insufficient numbers of salmon return to the Yukon Area, they result in declarations of both economic and natural disasters.

B. Objectives:

1) Estimate the subsistence and personal use salmon harvests within the Yukon Area.
2) Estimate select demographics, which include the number of people in households and the number of fishing households in the Yukon Area.
3) Estimate the primary gear type utilized by fishermen participating in the Yukon Area fishery.
4) Estimate the number of dogs, number of households with dogs, number of households that feed fish to dogs and number of salmon fed to dogs.
5) Estimate the number of non-salmon harvests, consisting of primarily freshwater fish species utilized by the communities that participate in the Yukon Area subsistence and personal use fisheries.

V. Approach:

A. The household lists for surveyed communities are updated annually, based on the previous year's fieldwork and Permanent Fund Dividend listings. The households to be surveyed in 34 communities are selected as a stratified random sample. Survey methods include post-season door-to-door personal interviews, as well as incorporation of harvest information provided on calendars, and telephone interviews. Annually prior to the fishing season a mass mail out of salmon harvest calendars and a detailed letter providing the previous years results by community is distributed to approximately 2,500 households. The mail out list is generated from the household lists compiled after the previous year's survey.

Subsistence or personal use fishing permits are required in some areas of the Upper Yukon Area. Alaska Department of Fish and Game (ADF&G) staff annually travels to approximately eleven communities to issue the fishing permits and for contact with fishermen in these areas. The remainder of the permits are issued by mail or in person at the ADF&G office. On average, 480 permits are issued annually, primarily from the Fairbanks office. A summary letter containing the results from the previous years harvests and a summary of the regulations required for the particular permit area are provided with each permit issued. Information from the permits is entered inseason into a database. Harvests are entered by species and by date upon return of the permit. A current permit holder's household list is available inseason and is often used to provide data for mass mail outs, when management actions deem it necessary. Permit holders in a portion of the Tanana River near Fairbanks are required to telephone in their salmon harvests each week for use as a inseason management tool. Additionally, telephone requirements provide harvest numbers for the personal use area that has a harvest limit.

Post-season salmon surveys annually begin in the Lower Yukon Area in September and in the Upper Yukon Area in October. The surveys are first conducted in down river communities and move to up river communities. Due to the length of the migration routes, it takes a month for salmon to reach the upper areas. Survey data editing and entry into the database occurs during November and December. Additionally, ADF&G staff concentrates on retrieving fishing permits, most of which expire October 15.

Delinquent permit holders are notified by two separate mailings to return their harvest permits these may be followed up by a telephone call.

Once the survey data is entered into the database, additional edit checks are conducted prior to running the expansion, which usually occurs in January and February. The draft Regional Informational Report is produced in March, and comments are put together for the final report due out in April. In April the household database is once again updated and the new list of households is provided for preseason mail outs beginning in May.

B. Project management:
Fishery Biologist, Project Leader: responsible for project management, data analysis, and report writing.
Biometrician, Data Analysis: provides the expansion and random sample selection, and maintains the household list.
Fish and Wildlife Technician III, Survey Crew Leader: provides survey preparations, including radio announcements and posters sent to communities prior to conducting surveys, logistics, data editor, and data entry. Approximately four months salary annually is provided by grant.
Two Fish and Wildlife Technician II's, Yukon Surveyors: travel between communities conducting annual surveys. Approximately two months salary each is annually provided by grant.
Fishery Biologist I, Permit and Report Support: permit issuance and recovery as well as format of final report tables. Approximately four months salary is annually provided by grant.
Administrative Clerk, Calendar and Report Support: designs calendars in Corel Draw, report editing, as well as administrative support.
Tribal and City Office workers provide their time to go over maps of the communities and the household lists.
Council of Athabaskan Tribal Governments provide a high school intern (Joseph Thomas) to assist in locating individuals to be surveyed in the community of Fort Yukon.
Huslia Tribal Council, Cesa Sam, annually provides a student or staff to assist in locating individuals to be surveyed.

VI. Findings:

A. Produce a finalized annual report of estimated subsistence and personal use salmon harvests within the Yukon Area on schedule. Yukon Area subsistence and personal use harvest estimates of chinook salmon have remained steady even during poor returns (increased effort) approximately an average of 50,000 fish. The estimated subsistence and personal use harvest has been declining due to the lack of commercial fisheries (poor returns) in the middle Yukon, the area which normally contributes the highest levels of harvest. For example the 1999 subsistence harvest estimate of 84,166 summer chum salmon was 27 percent below the recent five-year average (1994 to 1998). The estimated subsistence and personal use harvest of fall chum salmon has been fluctuating

based on poor run sizes and in 1999 was approximately 37 percent below the five-year average harvest based on more typical years of 1989 to 1993. The estimated subsistence and personal use harvest of coho salmon has also fluctuated with the poor fall chum salmon harvests since management actions affects both species. For example the 1998 coho salmon harvest was 36 percent below the recent five-year (1994 to 1998) average due to subsistence restrictions on fall chum salmon. These harvest estimates include test fish given away to local communities.

B. No significant problems were evident. Tribal entities are beginning to show interest or have begun collecting their own salmon harvest information, although most lack the infrastructure or expertise to summarize the information in a useful format. This duplication of effort and questions of loyalties will become a problem in the future.

C. Additional work may be necessary to define and contact households that take harvested salmon out of the Yukon Area (i.e., commercial fishermen, residing out side the Yukon Area surveyed communities, remove in particular chinook salmon as home pack).

VII. Evaluation:

A. The goals of this project have been met. Since the project has become fairly standardized, the information collected over the years is becoming comparable and an effective source for a variety of issues. The Yukon Area fisheries are very unique because it provides the highest subsistence salmon harvests in the state per household. The fisheries contain highly controversial commercial roe fisheries which provide a by–product utilized in the subsistence fishery. Issues continue to raise concerns for the high utilization of chum salmon for dog teams, and most recently the issue of feeding chinook salmon to dogs. The recent poor returns of chinook and chum salmon have developed into declaration of disasters. This harvest assessment program provides a tool to explore issues of importance that affect harvesters. The results are provided when they apply to issues brought before to the Board of Fisheries and the U.S. Canadian negotiations. The most recent modification to the program was in 1999 and involved additional survey questions to gather information used to address a concern of the Board of Fisheries as to the use of feeding chinook salmon to dogs.

B. Dissemination of Project results:

Individual households and all recent permit holders are annually provided a summary table of the salmon harvest estimates from the entire Yukon River drainage preseason. Various agencies are mailed copies of a completed report annually upon request. Report recipients include ADF&G (Division's of Commercial Fisheries, Sport Fisheries, and Subsistence); U.S. Fish and Wildlife Service, including the Offices of Subsistence Management; National Park Service, Bureau of Land Management, and Refuge Managers. Tanana Chiefs Conference, Association of Village Council Presidents, Council of Athabascan Tribal Governments (Ft. Yukon and Stevens Village), Tribal Councils (Emmonak, Mt. Village, and Tanana), Alaska Outdoor Council, Yukon River Drainage Fisheries Association, Alaska Resources Library Information Services, Department of

Labor and Work Force, Department of Fisheries and Oceans (Canada), and select fishermen.

Lower Yukon River Sonar at Pilot Station
Completion Report
July 1, 1997 – June 30, 2000

I. Steve Parry, Alaska Department of Fish and Game, Division of Commercial Fisheries
NA76FP0208
October 25, 200

II. Abstract:

Salmon are harvested for commercial and subsistence purposes throughout the Yukon River drainage in Alaska and Canada. These salmon fisheries are critical to the river's people and economy, providing an important source of food and income. The lower Yukon sonar project at Pilot Station provides the most accurate, timely and comprehensive salmon passage estimates available on the river. The project design incorporates fish passage estimates from shore-based, single-beam sonar data and species composition estimates from drift gillnet data obtained by fishing a suite of gillnets. In the years of this grant, the project's yearly passage estimates were:

224,090 chinook, 1,411,233 summer chum and 623,367 fall chum in 1997.
122,046 chinook, 830,633 summer chum and 397,157 fall chum in 1998.
211,144 chinook, 945,881 summer chum and 510,891 fall chum in 1999.

III. Executive Summary:

Salmon are harvested for commercial and subsistence purposes throughout the Yukon River drainage in Alaska and Canada. These salmon fisheries are critical to the river's people and economy, providing an important source of food and income. Due to the unique need for these renewable resources, accurate and timely in-season estimates of salmon passage are critical. The lower Yukon sonar project at Pilot Station provides the most accurate, timely and comprehensive salmon passage estimates available on the river. Deployed at the historical location, river km 197 near Pilot Station, the project is far enough upriver to avoid the wide multiple channels of the Yukon River delta but far enough downstream to cover the majority of salmon stocks. This project was first operational in 1986 and has provided daily salmon passage estimates annually with the exception of 1992 and 1996. Data are obtained using shore-based, single-beam sonar for enumeration and drift gillnets for species apportionment. A relational database is used to store data and estimates are generated using statistical software on a daily basis during operations.

Sonar counts are generated in three, 3 hour sampling periods each day. These numbers are extrapolated to create a 24 hour fish passage estimate. Several times a year the accuracy of these estimates are verified by counting for an entire 24 hour period. A simulated estimate using the 9 hours of sampling time is compared to the actual 24 hour count for these days. On average, 24 hour counts are within 8% of the estimates.

Species apportionment data is taken during two, 3 hour drift gillnet periods each day. A suite of gillnets from 2.75 to 8.5 inch are used to sample all species counted by the sonar. Gillnet catches are adjusted to account for the differing probability of catch by species and length in each mesh. Adjusted catches are used to apportion sonar passage estimates by species in three zones; near shore on both banks and offshore on the left, (south), bank. In the years of this grant, the project's yearly passage estimates were:

224,090 chinook, 1,411,233 summer chum and 623,367 fall chum in 1997.
122,046 chinook, 830,633 summer chum and 397,157 fall chum in 1998.
211,144 chinook, 945,881 summer chum and 510,891 fall chum in 1999.

IV. Purpose:

Salmon are harvested for commercial and subsistence purposes throughout the Yukon River drainage in Alaska and Canada. These salmon fisheries are critical to the river's people and economy, providing an important source of food and income. Due to the broad geographic distribution of the Yukon's individual salmon stocks, management of the fisheries is complex, creating a need for accurate timely in-season estimates of salmon passage.

The lower Yukon sonar project at Pilot Station provides the most accurate, timely and comprehensive salmon passage estimates available on the river. The project design incorporates fish passage estimates from shore-based, single-beam sonar data and species composition estimates from drift gillnet data obtained by fishing a suite of gillnets. Deployed at the historical location, river km 197 near Pilot Station, the project is far enough upriver to avoid the wide multiple channels of the Yukon River delta but far enough downstream to cover the majority of salmon stocks, while providing timely information for inseason management of commercial and subsistence fisheries.

Project History

This project has produced estimates of daily fish passage annually since 1986, excluding 1992, when it was operated for experimental purposes, and 1996 when it was operated for training purposes. Project sonar equipment was reconfigured to operate at a frequency of 120 kHz prior to the 1993 season as compared to the former 420 kHz. This frequency change significantly extended the effective range of the sonar due to lower signal losses at the lower frequency. Project objectives during it's operational period, were to provide daily and cumulative passage estimates, with 90% confidence limits, for chinook and chum salmon. Estimates of the number of coho salmon and combined "other" species were also generated. Passage estimates are only comparable after 1994 because of changes in frequency and aiming criteria in 1995. A more comprehensive source of information on the background of this project can be found in the Regional Informational Reports, "Pilot Station Sonar Project Report" for 1997, 1998 and 1999.

V. Approach:

Bottom Mapping

Using bottom-mapping techniques developed during previous years, a bathymetric map of the river in the immediate vicinity of the sonar site was generated each year. Maps created

during the past three field seasons allow inter-annual monitoring of changes in the bottom topography, which could affect fish migratory behavior and subsequent detection. No significant change in the bathymetry of the river has been detected within the accuracy constraints of these maps. Bottom topography will continue to be closely monitored.

Sonar Deployment

In 1997 we deployed two transducers on the left (south) bank and a single transducer on the right bank at a point where the river was 1,030 m wide. The right bank has a stable, rocky bottom that drops off steeply to the thalweg. We positioned the right-bank transducer in 1.5 m of water roughly 8 m from shore and aimed along the bottom, sampling a single stratum to a range of 90-120 m. The left-bank river bottom drops off gradually, with a slightly steeper slope near shore than offshore. This bottom profile required the deployment of two transducers to ensonify the entire fish migration corridor. One transducer was deployed within 10 m of shore to sample both a near shore stratum (0-70 m) with a low aim and a midshore stratum (70-250 m) with a slightly higher aim. A second transducer was deployed 60-100 m offshore from the first transducer, creating a third stratum and extending the sampling range on the left bank to a maximum of 300-350 m. To avoid losing the offshore transducer in the silt river bottom, we raised it to the surface, carefully returned it to the river bottom, and reaimed it every other day. All transducers were repositioned frequently to compensate for the dynamic water level.

The right (north) bank sonar site has a stable, rocky bottom that drops off steeply to the thalweg. The transducer was deployed approximately 5-10 m from this shore at a depth of 1.5 m and aimed along the bottom, sampling three strata from 0-50 m, 50-100 m, and 100-150 m. The left bank river bottom drops off gradually, with a slightly steeper slope from 0 to roughly 50 m. A transducer was deployed nearshore, approximately 10 m from the shoreline, sampling three horizontal strata from 0-360 m. The range divisions of the individual strata varied dependent on river bottom linearity and degree of range-dependent signal loss. The transducer was aimed low along the river bottom for the nearshore strata, then tilted upward. In 1998 bottom profiles conducted along the left and right banks at the transducer locations revealed linearly sloping areas suitable for sonar deployment. No changes were noted in the steeply sloping, rocky bottom along the right bank during the field season. The sandy, gently sloping left-bank bottom remained largely unchanged throughout the field season. Weekly drifts conducted down the central portion of the river using a down-looking sonar revealed very few fish tracings outside the sampling area of the shore-based units throughout the course of data collection.

The left bank offshore transducer was deployed briefly during the early portion of the 1998 season. It's use was discontinued after it was determined that the range normally covered by this transducer was more easily ensonified using the nearshore transducer. Changing water levels required the periodic relocation of both transducers during the field season. The left and right bank sampling areas are approximately across the river from each other, at a point over 1,000 m wide. This width varies as water level fluctuates.

In 1999 we deployed a single transducer on the left (south) bank and right bank at a point where the river is approximately 1,000 m wide. The right bank has a stable, rocky bottom that drops off steeply to the thalweg with a vertical angle of 8.7°, calculated from a depth of 22.9 m at a range of 150 m. We positioned the right-bank transducer 5-10 m from shore, adjusting the aim between two strata (0-60 m) and (60-135 m) to position the beam as close to the river bottom as possible for each sample.

The left-bank river bottom drops off gradually with a vertical angle of 2.3°, calculated from a depth of 11.9 m at 300 m, with a slightly steeper slope near shore, 4.2° calculated from a depth of 3.7 m at 50 m (Figure 3). A single transducer was deployed near shore approximately 10 m from shore utilizing three aims to sample a near shore stratum (0-50 m), a midshore stratum (50-175 m), and an offshore stratum (175-350 m). Occasionally in 1999, during periods of high signal loss, the strata ranges were changed to (0-50 m), (50-150 m) and (150-350 m) in an effort to more accurately compensate for the loss at those ranges. The transducer was repositioned frequently to compensate for the dynamic water level.

Project planning and oversight was conducted by ADF&G staff. Work was accomplished by ADF&G staff in cooperation with technicians provided by AVCP, (The Association of Village Council Presidents).

VI. Findings:

Passage Estimates

Historical salmon passage estimates at Pilot Station have been based upon a sampling design in which acoustic data were typically collected on each bank for 9.0 hours daily divided amongst three periods with two gillnet sampling periods scheduled between the acoustic sampling periods. This schedule was adhered to all three years. During seasonal operational periods, passage estimates were reported daily to fishery managers in the Emmonak field office. These estimates included chinook salmon, summer and fall chum salmon, coho salmon and other fish. Other fish included pink salmon, whitefish spp., sheefish, burbot, sucker spp., Dolly Varden, sockeye salmon, and northern pike. It was not the intent of this project to document complete coho or pink salmon runs.

In 1997 an estimated 2,685,357 $\pm$ 28,458 (s.e.) fish passed through the sonar sampling area between June 6 and August 31, 1997, 30% along the right bank and 70% along the left bank. Included were an estimated 133,691 $\pm$ 13,439 large chinook salmon (>700 mm long), 90,399 $\pm$ 15,765 small chinook salmon (<700 mm), 1,411,233 $\pm$ 30,213 summer chum salmon, and 623,367 $\pm$ 15,471 fall chum salmon. Passage estimates were not obtained on the left bank from June 26 through July 3 nor on the right bank from June 29 and 30 because of a combination of factors including a heavy debris load, a strong reverberation band in the left bank near shore region, and increased signal loss. Passage estimates and standard errors do not account for this missed sampling time.

In 1998 the sonar project was operational from June 6 through September 9. An estimated 1,768,255 ± 16,379 (s.e.) fish passed through the sonar sampling area, 34% along the right bank and 66% along the left bank. Included were an estimated 83,175 ± 4,441 large chinook salmon (>700 mm long), 38,871 ± 3,122 small chinook salmon (<700 mm), 830,633 ± 15,058 summer chum salmon, and 397,157 ± 7,696 fall chum salmon. coho salmon monitored during the operational period totaled an estimated 176,792 ± 6,666. Other species totaled 241,627 ± 7,936.

In 1999 an estimated 2,024,366 ± 24,744 (s.e.) fish passed through the sonar sampling area between June 12 and August 31, 26% along the right bank and 74% along the left bank. Included were an estimated 183,104 ± 10,933 large chinook salmon (>655 mm long), 28,040 ± 2,483 small chinook salmon (<655 mm), 945,881 ± 21,893 summer chum salmon, and 510,891 ± 11,886 fall chum salmon. Occasional sonar periods were missed due to strong wave action. Passage estimates include estimated data from the missed periods. Routine system analyses did not reveal any problems that might interfere with sampling. Target species were not abundant in the region behind the transducer during test fishing drifts designed to sample this area.

24-Hour Sonar Periods

Several times during each season, 24-hour sonar periods were conducted to check the accuracy of standard 9 hour sampling estimates. For the most part these periods verified the assumption that fish passage rates are fairly uniform throughout the day. Uncertainties in fish behavior during the 24-hour sonar periods, induced by drift gillnetting activities in front of the sonar counters can account for some of the variability of these data.

In 1997, 24-hour continuous sampling sessions were scheduled four times (June 19, July14, July 29, and August 19) to estimate uncertainty associated with the normal sampling schedule. On the right bank, the single stratum was sampled continuously with counts recorded at 15-minute intervals. Left-bank sampling was divided among the three strata in proportions consistent with the regular sampling schedule. On average 24 hour counts agreed with standard 9 hour estimates within 12%.

In 1998 the five 24-hour and three 14-hour sampling periods conducted, estimated an average of 6% fewer targets than routine 9 hour sampling estimates from the same days. Half of the extended sampling periods produced estimates within the 90% confidence interval for that day.

In 1999 we sampled continuously for 24 hours on June 26, July 11 and 24, and August 8 and 21 for a total of five 24-hour sampling periods. On average the 24-hour periods agreed with standard 9-hour estimates within 5%.

Species Apportionment

Drift Gill netting was conducted to sample fish species counted by the sonar. Mesh size is systematically increased from 2.75" to 8.5" to insure all fish species detected by the sonar are sampled, resulting in an estimate of daily passage by species. Captured fish were

measured for length, the sex of each salmon was determined and scales were collected from each chinook salmon. Most captured fish were given to local residents for subsistence use.

In 1997 a total of 6,600 fish were captured during 1,988 drifts totaling 12,637 minutes. The catch included 3,350 summer chum salmon, 1,581 fall chum salmon, 242 Chinook (700 mm length or greater), 227 "jacks" (Chinook less than 700 mm in length), 488 Coho salmon, 10 pink salmon, 267 whitefish, 295 cisco, and 140 miscellaneous fish.

In 1998 total of 10,256 fish were captured during 2,256 drifts totaling 15,556 minutes for the purpose of estimating species composition of the acoustic passage estimates. The catch included 5,741 chum salmon, 598 Chinook salmon, 1,306 coho salmon, 980 pink salmon, 665 whitefish spp., 760 cisco spp., and 206 fish of miscellaneous species.

In 1999 a total of 6,818 fish were captured during 1,945 drifts totaling 13,309 minutes. The catch consisted of 2,897 summer chum salmon, 1,800 fall chum salmon, 459 large chinook salmon (655 mm length or greater), 80 "jack" chinook salmon, 584 coho salmon, 7 pink salmon, 398 whitefish, 442 cisco, and 151 fish of miscellaneous species.

VII. **Evaluation:**

Project objectives of providing daily and cumulative passage estimates with 90% confidence limits for chinook and chum salmon were attained. User configurable sonar was used to estimate the number of fish passing the sonar site by extrapolating the three daily sonar periods. This was checked several times each season against 24-hour counts. A suite of gillnets was used to apportion sonar passage estimates by species. Fishing occurred twice a day during the operational seasons.

Project results are disseminated through The following Regional Informational Reports and this report:

Maxwell, S.L.; Huttunen, D.C. Yukon River sonar project report, 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report. Anchorage.

Maxwell, S.L. Yukon River sonar project report, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report. Anchorage.

Pfisterer, C.T.; Maxwell, S.L. Yukon River sonar project report, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report. Anchorage.

Yukon Program Support –Summer Season
Completion Report
July 1, 1997 – June 30, 2000

I. Steve Hayes, Alaska Department of Fish and Game
NA76FP0208
October 25, 2000

II. Abstract:

The Yukon River supports significant commercial and subsistence salmon fisheries extending from its mouth on the Bering Sea to the Yukon Territory of Canada. The Alaskan Yukon River management area is divided into seven regulatory districts. In the Coastal District, only subsistence fishing is allowed. The lower three districts of the river, constituting approximately the first 300 miles, are collectively referred to as the Lower Yukon area. Set and drift gillnets are the legal gear for commercial salmon fishing. The Lower Yukon area accounts for approximately 75% of the limited entry salmon permits issued in the Yukon management area and is correspondingly the focus of the most intensive effort and harvests. Historically, approximately 97% of the catch and effort for the Lower Yukon area fishery occurs in Districts 1 and 2.

Although all five species of Pacific salmon *Oncorhynchus spp* occur in the Yukon River, only chinook or king *O. tshawytscha*, chum *O. keta*, and coho salmon *O. kisutch* are significant to the commercial and subsistence fisheries. The chum salmon run is divided into distinct early (summer chum) and late (fall chum) sub-populations.

Management of Yukon River salmon stocks is complicated by the difficulty in assessing relative run strength and timing within the season. The vast size of the drainage (330,000 square miles) makes it impossible to assess individual tributaries escapements. Other escapement estimates based on aerial surveys of index tributaries are not conducted for weeks and in some cases months after key management decisions have to be made in the lower river fishery. As a result, management decisions are currently based on commercial catch and test fishing data collected during the season in the lower river.

Comparative commercial catch and catch per fisherman hour (CPUE) data were traditionally used to indicate relative abundance of salmon stocks. Data are entered into a microcomputer-based system to improve the accuracy and speed with which basic catch and effort statistics can be generated from fish tickets collected during the fishing season. However, due to the increase in the efficiency of the commercial fishing fleet in recent years and the corresponding decrease in fishing time, commercial CPUE is of limited usefulness as a comparative statistic. As a result it has become increasingly necessary to place greater reliance on relative abundance information gathered form test fishing and/or Pilot Station sonar project data for inseason management.

Test fishing in the lower Yukon River was initiated in 1963 at Flat Island. Set nets were fished 7 days per week, 24 hours per day through the chinook and summer chum salmon runs (late May to mid-July). In 1977, test fishing was expanded to include the fall chum and coho salmon runs (mid-July to the first of September) in the Big Eddy area near Emmonak. Test fishing at Flat Island was discontinued in 1979 and test fishing in the south mouth (Kwikluak Pass) was conducted throughout the season in the Big Eddy area. Test fishing was initiated in the Middle Mouth area (Kawanak Pass) in 1979. During 1980 and 1981 the Middle Mouth project was extended in duration to cover the fall chum and coho salmon season, and geographically to cover the north mouth (Apoon Pass) of the delta.

III. **Executive Summary**:

Test fishing in the lower Yukon River was initiated in 1963 at Flat Island. Set nets were fished 7 days per week, 24 hours per day through the chinook and summer chum salmon runs (late May to mid-July). In 1977, test fishing was expanded to include the fall chum and coho salmon runs (mid-July to the first of September) in the Big Eddy area near Emmonak. Test fishing at Flat Island was discontinued in 1979 and test fishing in the south mouth (Kwikluak Pass) was conducted throughout the season in the Big Eddy area. Test fishing was initiated in the Middle Mouth area (Kawanak Pass) in 1979. During 1980 and 1981 the Middle Mouth project was extended in duration to cover the fall chum and coho salmon season, and geographically to cover the north mouth (Apoon Pass) of the delta.

The Lower Yukon Set Gillnet Testing project operates from end of May through July 15, each season. This project provides important information concerning the pattern of entry of the chinook and summer chum salmon into the Yukon River mouths. This project provides approximately 2,000 chinook and approximately 6,000 summer chum salmon annually for subsistence use in the local communities of Emmonak and Kotlik. Additionally, salmon harvested from the operation of the test fish program may be sold in years commercial fisheries were conducted in the area.

IV. **Purpose:**

The State of Alaska is mandated to provide adequate escapement of salmon to the spawning grounds as well as provide harvests in the Alaskan subsistence, sport, personal use, and commercial fisheries. Additionally, the United States and Canada have maintained goals established in the previous interim agreement for the purpose of seeking to ensure the effective conservation and management of Yukon River salmon and to provide for Canadian origin Chinook salmon escapement and harvests. The information gathered from the assessment project is used inseason during prosecution of Alaskan commercial and subsistence fisheries.

The vast size of the drainage (330,000 square miles) makes it impossible to assess individual tributaries escapements. Other escapement estimates based on aerial surveys of index tributaries are not conducted for weeks and in some cases months after key management decisions have to be made in the lower river fishery. As a result, management decisions are currently based on commercial catch and test fishing data collected during the season in the lower river.

However, due to the increase in the efficiency of the commercial fishing fleet in recent years and the corresponding decrease in fishing time, commercial CPUE is of limited usefulness as a comparative statistic. As a result it has become increasingly necessary to place greater reliance on relative abundance information gathered form test fishing and/or Pilot Station Sonar for inseason management.

V. Approach:

From July 1, 1997 through June 30, 2000, test fishing has been conducted from the Big Eddy and Middle Mouth camps located in District 1. The Big Eddy test fish project was conducted from the village of Emmonak. Two technicians fished set gillnets to monitor salmon passage through the south mouth of the delta. The Middle Mouth camp was located at the junction of the main Middle and North mouth passes. Two technicians fished set gillnets to monitor salmon passage through the Middle Mouth and north mouth of the delta.

Test fishing begins as soon after ice breakup as possible, usually late May or early June. Productive set net sites, leased from local commercial fishermen, were fished 24 hours per day, seven days per week throughout the duration of the projects. The contracted commercial fishermen typically operated the test nets during commercial fishing periods and either sold or retained the fish for their own use. The rest of the time Department personnel fished the nets. Gillnets were picked at least twice each day (just before 8:00 a.m. and 8:00 p.m.). When large catches occurred some nets were picked more often. Fish found in the test nets alive and in good condition were counted and released by the technicians. Dead fish were given away to subsistence users. Daily test net catch and effort data gathered at the Middle Mouth camp was transmitted by radio and Satellite telephone to the Fish and Game office in Emmonak.

Four set gillnet sites were fished at Big Eddy prior to July 16. Two 8.5 in mesh nets (stretch measure) were targeted on chinook salmon and two 5.5 inch mesh nets were targeted on summer chum salmon. The Middle Mouth camp operated two 8.5 inch mesh nets and two 5.5 inch mesh nets during the chinook salmon season. All nets were 25 fathoms in length. The 8.5 and 5.5 inch mesh gillnets were 28 and 45 meshes deep, respectively.

Typically, catch data for missed fishing time was linearly interpolated from preceding and following data by fishing site.

An attempt is made each year to maintain standardized set net site locations while maximizing the coverage of the passes and the productivity of each net. This becomes a difficult task when water levels, eddies and sand bar locations change between and within seasons. In order to quantify some of these factors, a bottom profile is made at each net site with a Fathometer.

In addition, scale samples are taken from each fish sampled and scale data used to estimate the age composition at each location. Throughout the season, daily catches of freshwater fishes and salmon species not taken commercially were tallied at both projects. Climatological

observations of cloud cover, precipitation, wind, and air and water temperatures were collected on a daily basis.

VI. Findings:

A. The information collected during the operation of the Lower Yukon River test fishery is utilized inseason as well as documented in the Yukon Area Summer Season Data Notebook. Test fishing in the various mouths assists in the decision making process when commercial fisheries are considered. The pulses of chinook and summer chum salmon that enter the mouths can be tracked upriver through other strategically located projects and verified. Typically four to five pulses of chinook and summer chum salmon enter the Yukon River drainage as detected by the Lower Yukon Set Gillnet Test Fishery. Over time the set gillnet sites have changed and the sites appear to becoming overly efficient when compared to other projects.

B. No significant problems to discuss. Set net sites appear to be changing to the extent that comparisons between years is becoming difficult. However, this method is still the best indicator available for assessing the run below the majority of the commercial or subsistence fishing districts within the Yukon River drainage by using the timing of pulses and mouth of entrance.

VII. Evaluation:

A. The goals of this project have been met. The long-standing historical database provides a starting point on which to begin to make assessments of salmon returns to the Yukon Area. Most of the commercial harvests are taken in the Lower Yukon Area however subsistence harvests are substantial and obligations to spawning escapement including the U.S./Canada border passage remain a priority. This supporting program provides a tool used in fisheries management for the benefit of all users.

B. Dissemination of Project results:
Various agencies are regularly e-mailed and faxed inseason project information along with written or oral interpretations of projects. The inseason information is disseminated by ADF&G Division of Commercial Fisheries to other department divisions (i.e. sport fisheries and subsistence), United States Fish and Wildlife Service, Tanana Chiefs Conference, Association of Village Council Presidents, Council of Athabascan Tribal Governments, Tribal Councils and city offices in Yukon Area communities, Alaska Outdoor Council, Yukon River Drainage Fisheries Association, Alaska Resources Library Information Services, Department of Fisheries and Oceans (Canada). These summaries are available to select fishermen in many areas throughout the Yukon River drainage through their tribal or city offices and inseason information is available upon request. Yukon Area annual management reports contain the finalized project information and are free to agencies and public.

Yukon Program Support –Fall Season
Completion Report
July 1, 1997 – June 30, 2000

I. Keith Schultz and Bonnie Borba, Alaska Department of Fish and Game, Division of Commercial Fisheries
NA76FP0208
October 25, 2000

II. Abstract:

Management of the Yukon River fall chum salmon involves utilization of various test fishing projects strategically located along the Yukon River to monitor inseason relative run abundance, timing, and escapement as well as harvests of salmon from subsistence, personal use, and commercial fisheries. The Lower Yukon Set Gillnet Test Fishing project provides the first standardized indication of the salmon return to the Yukon River drainage. Operating expenses for the fall season test fishermen as well as data organization for preparation preseason was provided through the Yukon Support Program.

III. Executive Summary:

The Lower Yukon Set Gillnet Testing project operates from July 16, through approximately August 31, each season. This project provides important information concerning the pattern of entry of the fall chum and coho salmon into the Yukon River mouths. This project provides approximately 2,500 fall chum and approximately 700 coho salmon annually for subsistence use in the local communities of Emmonak and Kotlik. Additionally, salmon harvested from the operation of the test fish program may be sold in years commercial fisheries were prosecuted in the area.

IV. Purpose:

A. The State of Alaska is mandated to provide adequate escapement of salmon to the spawning grounds as well as provide harvests in the Alaskan subsistence, sport, personal use, and commercial fisheries. Additionally, the United States and Canada have maintained goals established in the previous interim agreement for the purpose of seeking to ensure the effective conservation and management of Yukon River salmon. To provide for Canadian origin fall chum salmon escapement and harvests the U.S. obligations include the Procupine River and the mainstem Yukon River border passage. The information gathered from the assessment project is used inseason during prosecution of Alaskan commercial and subsistence fisheries.

B. Objectives:

To evaluate inseason the run abundance and timing of chinook, summer chum, fall chum and coho salmon returns in order to prosecute fisheries while sustaining populations by meeting established escapement goals within both Alaska and Canada.

V. Approach:

Operation of the Lower Yukon Set Gillnet Test Fishery program is used to evaluate the salmon returns upon entrance through the various mouths of the Yukon River. The South, Middle, and North mouths of the Yukon River were selected for operation of set gillnets in historic sites to monitor the salmon returns annually. Scale samples and other biological information are collected daily from salmon harvested in the test fishery. The information is used inseason for management of the commercial and subsistence salmon fisheries within Alaska. Data is analyzed and evaluated concerning the run strength and timing throughout the season. The project information is incorporated into the historical database. Season summaries are prepared and provided to the public, Board of Fisheries, U.S./Canadian negotiations, and to other interested agencies during numerous meetings.

A. Project management:

Fall Season Yukon Area Management Biologist

Three Fish and Wildlife Technician II's, Test Fishermen, Annual salaries for the fieldwork is provided by this grant.

One Fishery Biologist, Annual salary for data summarization and report writing is provided by this grant.

VI. Findings:

A. The information collected during the operation of the Lower Yukon River test fishery is utilized inseason as well as documented in the Yukon Area Fall Season Data Notebook. Test fishing in the various mouths assists in the decision making process when commercial fisheries are considered. The pulses of fall chum and coho salmon that enter the mouths can be tracked upriver through other strategically located projects and verified. Typically four to five pulses of fall chum salmon enter the Yukon River drainage as detected by the Lower Yukon Set Gillnet Test Fishery. Over time the set gillnet sites have changed and the sites appear to becoming overly efficient when compared to other projects.

B. No significant problems to discuss. Set net sites appear to be changing to the extent that comparisons between years is becoming difficult. However, this method is still the best indicator available for assessing the run below the majority of the commercial or subsistence fishing districts within the Yukon River drainage by using the timing of pulses and mouth of entrance.

C. The possibility may exist given the proper amount of funding to change the system from set gillnets to drift gillnets which could reduce the harvest taken by the department while maintaining an index of the salmon returns. However, for the first couple of years the two projects would need to be congruent for evaluation purposes. Typically, the project tries to pay for itself by generating funds through the test fish sales. However in recent years it still is unable to support it self.

VII. Evaluation:

A. The goals of this project have been met. The long-standing historical database provides a starting point on which to begin to make assessments of salmon returns to the Yukon Area. Most of the commercial harvests are taken in the Lower Yukon Area however subsistence harvests are substantial and obligations to spawning escapement including the U.S./Canada border passage remain a priority. This supporting program provides a tool used in fisheries management for the benefit of all users.

B. Dissemination of Project results:
Various agencies are regularly e-mailed and faxed inseason project information along with written or oral interpretations of projects. The inseason information is disseminated by ADF&G Division of Commercial Fisheries to other department divisions (i.e. sport fisheries and subsistence), United States Fish and Wildlife Service, Tanana Chiefs Conference, Association of Village Council Presidents, Council of Athabascan Tribal Governments, Tribal Councils and city offices in Yukon Area communities, Alaska Outdoor Council, Yukon River Drainage Fisheries Association, Alaska Resources Library Information Services, Department of Fisheries and Oceans (Canada). These summaries are available to select fishermen in many areas throughout the Yukon River drainage through their tribal or city offices and inseason information is available upon request. Yukon Area annual management reports contain the finalized project information and are free to agencies and public.