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Study Title:	**Pink Salmon Escapement In PWS**
Study Number:	9
Principal Investigator:	**Samuel Sharr, Commercial Fisheries Division**
Lead Agency:	**Alaska Department of Fish and Game**
Cost of Proposal:	**$230,000**
Inclusive Dates:	**July 1, 1991 - June 30, 1992**

DATE

Principal Investigator: _____ 28 May 91

Supervisor: Stephen M Fried 29 May 1991

OSIAR Division Director: Michael R. Dean 31 May 1991

PRINCE WILLIAM SOUND PINK SALMON

ESCAPEMENT ENUMERATION

Project Number:

Principal Investigator: Samuel Sharr

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Principal Investigator:_____

Organization Leader:_____

Finance Officer:_____

INTRODUCTION

Wild stock production of pink salmon in Prince William Sound (PWS) has ranged from 10 to 15 million fish in recent years. Chum salmon returns have ranged from .8 to 1.5 million fish. Much of the spawning for pink and chum salmon (up to 75% in some years) occurs in intertidal areas. Intertidal spawning areas are susceptible to marine contaminants and there is strong evidence the March 24, 1989, *Exxon Valdez Oil Spill* (EVOS) adversely affected spawning success and early marine survival in Prince William Sound. Salmon stocks impacted by the Exxon Valdez Oil Spill (EVOS) are also heavily exploited in commercial, sport, and subsistence fisheries. These stocks can most effectively be restored through stock specific management practices designed to reduce exploitation of impacted stocks. The stocks in areas heavily impacted by the EVOS are present in fisheries dominated by hatchery and wild stocks from unaffected areas of the Sound. The management of this mixed stock fishery has historically been based on maintaining good temporal and spatial distribution of spawning escapement for groups of stocks in eight major fishing districts. The success of this management strategy was predicated upon the effectiveness of the aerial survey program as an inseason escapement estimation tool. Restoration premised on stock specific management of the commercial fishery for reduced exploitation of impacted stocks will require even more accurate inseason escapement estimates for impacted and unimpacted wild stocks.

This project is designed to provide accurate, real time, escapement estimates for salmon stocks of Prince William Sound. Accurate inseason escapement estimates will enable fisheries managers to identify shortfalls in the number of spawning fish in impacted streams and impose fisheries restriction to reduce harvest rates on those stocks. The manager will also be able to identify any excesses in escapement and direct very localized fishing effort to harvest surplus fish. Post season analyses of the escapement enumeration project together with results from the proposed Coded-Wire Tagging project will provide stock specific estimates of total return and enable managers to assess the effectiveness of their stock specific management strategies.

In the absence of improved stock specific management capabilities afforded by this project, salmon stocks in western PWS which have already been stressed and depleted by the oil impacts could potentially be over-exploited in the commercial, sport and subsistence fisheries. Population levels of stocks may be reduced below that needed for rapid recovery and in some instances may result in virtual elimination of impacted stocks. Stocks not impacted by oil may also be adversely affected by management strategies designed to reduce effort on impacted stocks. Changes in fishing effort to areas of less oil impact could result in overexploitation of otherwise healthy unimpacted stocks if adequate stock monitoring programs are not in place.

The foundations for this project were firmly established during the damage assessment process in Natural Resources Damage Assessment (NRDA) Fish/Shellfish (F/S) Study #1. Extent of oiling in intertidal spawning areas was documented and escapement enumeration procedures were developed and perfected. In 1989 a total

of 411 streams were surveyed for the presence of oil in intertidal spawning areas and 138 streams from among the 218 in the historic aerial survey program were included in a ground census of pink and chum salmon escapements. In 1990 the oil survey was limited to the 138 streams in the escapement censusing portion of the project. Mussel samples for hydrocarbon analysis were collected in the intertidal mouths of the 138 streams in the ground censusing program in both 1989 and 1990. Total area of intertidal spawning habitat was estimated for each of the 138 streams and the area of upstream spawning habitat was estimated for 100 of the 138 streams. Total spawning escapement at four streams was estimated through weirs and stream residence time (stream life) estimates were made for pink salmon in 22 streams in 1990. Tissue samples for hydrocarbon analysis were collected from spawning adult pink salmon in 12 oiled and 10 unoiled streams in the ground survey program.

This program is designed for stock specific restoration and will emphasize more detailed and intensive data collection on fewer streams in the oil impacted areas of western PWS as well as streams respresentative of unimpacted areas in eastern PWS. Weirs will be installed on four streams weired in 1990 plus three or possibly four additional streams. Six of the weired streams will be wild stock coded wire tagging streams. Enumerated adult returns will also be sampled for coded wire tags applied during the 1990 field season for NRDA F/S Study #3. Ground surveys and stream life studies will be continued on all weired streams and approximately 21 additional streams. Oil surveys as well as mussel and adult salmon tissue sampling will continue on all surveyed streams for the duration of the project.

Results of this study will provide estimates of average stream life for pink and chum salmon in PWS, will calculate coefficients to adjust for bias in aerial survey counts based on comparisons with accurate counts through weirs, and will use the stream life estimates and calibration coefficients to make accurate escapement estimates for the current year and all prior years for streams included in the ADF&G aerial survey program. Historic aerial survey data will be used to build timing curves and develop escapement goals for major pink salmon stocks. Management strategies for oiled stocks as well as other stocks affected by altered fisheries management in 1991 and succeeding years will be based on comparisons of these timing curves and escapement goals with inseason escapement data.

This study will also provide important documentation of salmon stock recovery from oil damage and information which may help focus future restoration projects such as stream rehabilitation. The study will: provide estimates of post oil spill spawning distribution within stream zones and among streams; estimate total available intertidal and upstream spawning habitat for each stream; provide marine survival estimates for six wild stocks of pink salmon based on coded wire tagging and recovery; document physical presence or absence of oil in intertidal salmon spawning and rearing habitat and presence or absence of oil in the tissues of mussels and salmon which rear or live there; and provide an atlas of aerial photographs and detailed maps for important spawning sites.

OBJECTIVES

The objectives presented here and streams to be weired or surveyed are supplemental to those methods and objectives described in NRDA F/S Study #1. Restoration objectives require coverage of more streams than was necessary for damage assessment.

A. Enumerate the total intertidal and upstream pink and chum salmon escapement through weirs installed on three streams which are representative of streams in the aerial and ground escapement survey programs.

B. Estimate average stream life of pink salmon in at least 12 streams in PWS using a variety of techniques.

C. Estimate the number of spawning salmon, by species, within standardized intertidal and upstream zones for 12 streams in PWS from a systematic daily foot survey program.

D. Estimate the accuracy of aerial counts for the 218 aerial index streams by comparison of paired ground and aerial counts from the same streams on the same survey dates and by comparison of aerial, ground, and weir counts on three streams.

E. Develop escapement goals and timing curves for stocks in oiled streams in the ADF&G aerial survey program for inseason stock specific management of the commercial fisheries.

F. Assist in spawning ground sampling for tag recovery in streams where coded wire tags were applied to wild pink salmon stocks and in neighboring streams where foot surveys are conducted and where tagged fish which stray from natal streams are apt to appear.

METHODS

Personnel policy, purchasing practices, field camp operations, safety procedures, and project administration will comply with the ADF&G Division of Commercial Fisheries Manual of Standard Operating Procedures (SOP). Data collection procedures are similar to those used in NRDA F/S Study #1. These procedures have been thoroughly reviewed through the NRDA peer review process and approved by the Management Team.

The technology and methodology for escapement enumeration using systematic aerial and ground survey programs, as well as weir projects, are well established and have a long history of success in Alaska. The historic aerial and ground survey data base for Prince William Sound is one of the best in the world. This data base provides the principal inseason management tool for wild pink and chum salmon stocks and will be critical to stock specific restoration efforts. The

existing NRDA studies greatly enlarged the scope of the pre-spill escapement enumeration projects. The proposed salmon escapement enumeration restoration study will improve fisheries management and goes beyond the existing management programs and the NRDA process.

Aerial Surveys

Aerial survey estimates of 209 pink and chum salmon index streams will be flown by personnel from ADF&G Division of Commercial Fisheries employing methods used since 1961 (Figure 1).1Nine additional streams in oiled areas were incorporated into the program in 1989. Surveys are flown weekly from mid-June to mid-September each year. Counts of live salmon by species will be recorded for the bay at the terminus of each stream, the mouth of each stream, and within the stream (Pirtle, 1977). The stream counts for the 12 streams included in the weir and foot survey program will be further subdivided into intertidal and upstream areas. The mean high tide mark (3.7 m) at each of these streams will be delineated with a large orange float which will be clearly visable from the air. In 1990 the frequency of survey flights almost doubled and in most weeks there were at least two observations per stream. This increased survey frequency will continue in 1991.

Total Enumeration Studies

NRDA F/S Study #1 weirs are already in place on three oiled and three unoiled streams. Restoration weirs for total escapement enumeration will be installed on three addtional streams in 1991 (Figure 2). One of the restoration weirs in this study will be in eastern PWS and is typical of the streams in that area which are long and have extensive upstream spawning areas. The remaining two will be on oiled streams in western PWS. The weirs will be installed as near as possible to the 1.8 meter tide level or the lower level of intertidal spawning. Weir crews will record daily fish passage through the weir.

Ground Surveys of Escapements

The 12 streams (Figure 2) to be surveyed will be selected according to the following criteria:

1. stream is included in the ADF&G aerial survey program;
2. streams are representative of the variety of sizes and types where pink salmon spawning occurs in PWS.
3. salmon escapements to the streams are representative of range of run timing and magnitude for PWS stocks;
4. streams included will be from both oiled and unoiled areas;
5. stream has been included in stream life studies conducted by this project in 1989 and 1990;
6. stream was enumerated in prior spawning ground foot survey programs;

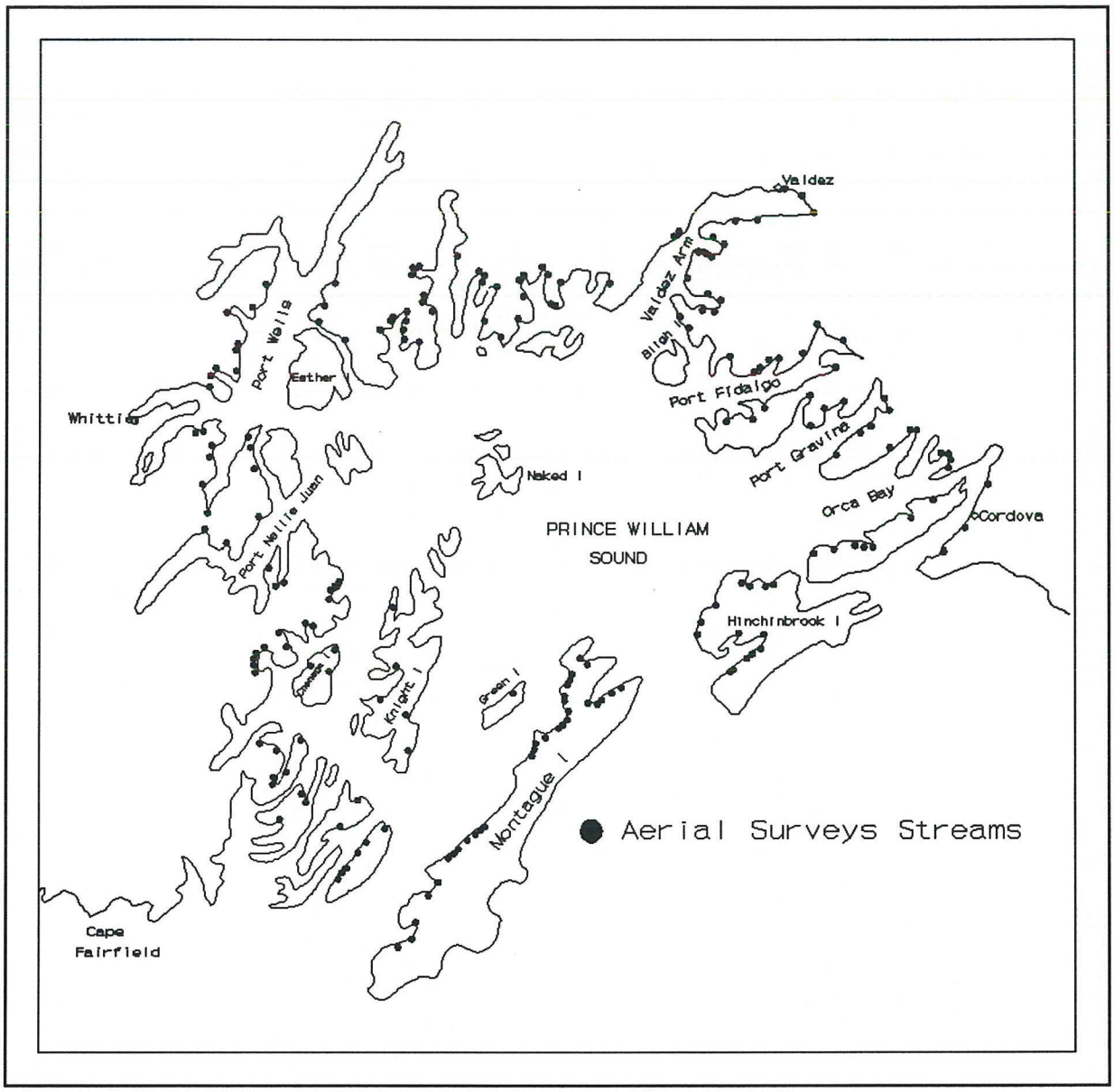

Figure 1. Streams included in the aerial survey program for estimating pink and chum salmon escapement to Prince William Sound.

7. stream is included in the CWT project for wild stocks of pink salmon (NRDA F/S Study 3); and
8. stream is included in the pink and chum salmon egg deposition and pre-emergent fry project (NRDA F/S Study 2).

A pre-season survey to mark tide zones will be conducted in June, prior to the return of the pink and chum salmon. The location of tide levels 1.8, 2.4, 3.0, and 3.7 m above mean low water will be measured from sea level using a surveyors's level and stadia rod. Sea level at each site will be referenced to mean low water with site specific, computer generated tide tables which predict tides at five minute intervals. Tide zone boundaries will be delineated with color coded steel stakes, and the 3.7 m boundary will be delineated with a large orange float which will be visible to aerial surveyors.

Weir camp crews will perform daily ground surveys of intertidal and upstream portions of the weired systems as well as 9 other pink and chum salmon spawning streams (Figure 2). Live and dead pink and chum salmon will be enumerated in standardized intertidal and upstream zones in each stream. During each stream survey the following data will be recorded:

1. anadromous stream number and name (if available);
2. latitude and longitude of the stream mouth;
3. date and time (24 hour military time);
4. tide stage;
5. observer names;
6. counts of live and dead salmon by species and tide zone (0.0-1.8m, 1.8-2.4 m, 2.4-3.0 m, and 3.0-3.7 m above mean low water and upstream) and;
7. weather and comments on visibility, lighting, and other survey conditions.

All data will be recorded on pre-printed data sheets. Maps will be improved and modified during the survey to show spawner distribution within each zone and the upstream limit of spawning.

Counts of live and dead salmon will be made for the five tide zones from the 1.8 m tide level to the limit of upstream spawning on all 12 streams during daily surveys. Tide stage will be monitored continuously and survey times and direction will be adjusted accordingly. If the tide stage at the time of the walk is at or below the 1.8 m level the stream walk will begin at the stream mouth and progress upstream. The mouth or downstream limit of the stream will be defined as the point where a clearly recognizable stream channel disappears or is submerged by salt water. Fish seen below the downstream limit will be included in an estimate of fish off the stream mouth and noted as a comment on the data form. If the intertidal portions of the stream above the 1.8 m level are submerged at the time the walk begins, the crew will go to the upstream limit of the walk, proceed downstream, and end the walk at the time the tide is predicted to be at or below the 1.8 m level. The upstream limit of a walk will be determined by the presence of natural barriers to fish passage (i.e. waterfalls), by the end of the stream, or by the upstream limit of spawning. The upstream limit of spawning will be marked on U.S. Geological Survey color aerial photos of each stream following each survey.

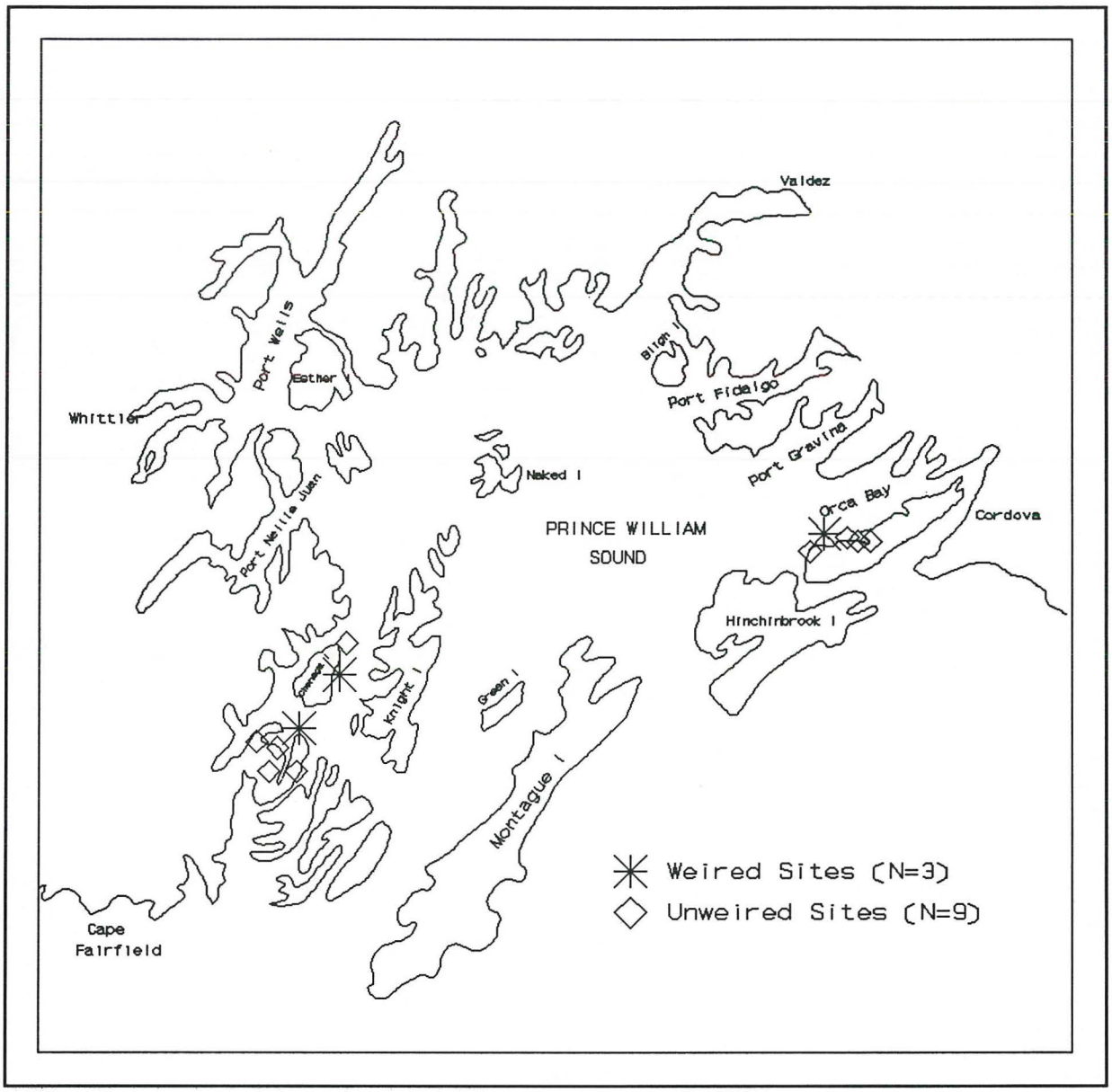

Figure 2. Streams proposed for the weir, ground survey, and stream life studies in 1991.

For counts of live and dead fish on moderate size streams with a single channel, crew members will walk together but independently count live fish in each intertidal zone. Crew members will individually enter their count on mechanical hand tallies. A maximum of three replicate counts may be made in each zone at the request of either observer. Upstream counts in a single channel will be similarly conducted at convenient stopping points (i.e., log jams or other clear counting delineators). For large braided or branched streams, each crew member will count separate channels or upstream forks. To avoid confusion with counts of live fish, counts of dead fish will be recorded on the return leg of the stream walk. Only fish that have died since the previous count will be tallied as dead in the daily surveys. To prevent duplicate counts between surveys, tails and tags of all dead pink and chum salmon observed will be removed. To avoid perpetuating counting biases within a crew, personnel will be rotated between crews daily. If possible, crew members will not be assigned to the same streams on succeeding days.

Restoration projects must also include continued assessment of the persistence of oil in environment which might affecting restoration efforts. Crews for this Project who mark, measure, and map tide zones will conduct foot surveys of the intertidal stream bed and adjacent beaches to document any remaining oil contamination. Composite samples of mussels will be collected at the mouth of each stream for hydrocarbon analyses. Results of the analyses will be used to document any persistent oil impact. Each sample will consist of enough mussels to provide 10 grams of tissue (approximately 30 mussels) for analysis. The mussels will be collected in the zone from 0-2 m above mean low water in the immediate vicinity of each stream mouth and will be collected above water to avoid contamination by hydrocarbons on the water surface. Samples from each stream will be stored in separate, properly cleaned, glass jars with teflon lined lids. Appropriate chain of custody forms will accompany each sample.

Stream-life Studies

All 12 streams in the ground survey program will be included in a study of pink salmon stream life (Figure 2). Average stream residence time on these streams will be estimated using data from daily ground surveys already described. An independent estimate of stream life will be made using tagging results similar to those described by McCurdy (1984) and Helle et al (1964). A third independent estimate of stream life will be made at the three weired systems using daily weir data and carcass counts from daily ground surveys.

For the tagging study, fish will be captured with beach seines at the stream mouths and tagged with Peterson disks. Tags will be uniquely colored to represent day of tagging and uniquely numbered for identification of individual fish and stream. Each week 120 fish will be tagged at 12 streams, except the largest in the study. At this stream, 200 tags will be applied weekly. If fewer than the desired number of fish are available, all fish captured will be tagged. Observations of tagged live and dead fish will be grouped by color within each tide zone during daily ground surveys. Where possible individual tag numbers will be recorded for tagged live fish.

DATA ANALYSIS

Data analysis procedures are similar to those used in NRDA F/S Study #1. These procedures have been scrutinized thoroughly by NRDA peer reviewers and approved by the Management Team. Report formats will be in accordance with those established by the Management Team. Reporting style and conventions will otherwise be in accordance with the ADF&G Division of Commercial Fisheries style manual (ADF&G 1987).

Total Escapement Enumeration Data

Total escapement for streams with weirs will be the sum of daily fish counts through the weir. Live fish present in the stream on any date will be the difference between the cumulative count of live fish to that date and the cumulative carcass count to that date. Estimates of fish present will be used to validate concurrent counts from aerial and ground surveys.

Adjustment of Aerial and Ground Counts

Stream types will be defined by the characteristics of the seven weired streams. Categorization will be based on stream size, extent of upstream and intertidal spawning, and other characteristics such as water clarity and extent of forest canopy. These same characteristics will be used to categorize all of the other streams in the aerial and ground survey programs. Daily aerial and ground counts at weired streams will be adjusted for bias using the regression of survey counts to the estimated numbers of live fish in the stream. The number of live fish (F_{ij}) above the weir will be estimated by:

$$F_{ij}=\Sigma W_{ji}-\Sigma D_{ji},$$

where
- i = serial day of weir operation,
- j = stream category,
- W_{ji} = live fish passed through weir j on day i,
- D_{ji} = count of dead fish in stream j on day i.

The bias adjustment function for each weired stream will be applied to aerial and ground counts from unweired streams which have similar stream characteristics.

Stream-life Data

Tagging data will be used to calculate stream life (S) values for individual fish as:

$$S = J_r - J_t$$

where J_t = julian date when the live tagged fish was first observed entering the stream channel from the milling area at the mouth.

J_r = julian date of tag recovery from the dead fish.

The stream life estimates for each stream and weekly strata will be the average for individual fish in the strata. The season-average stream life estimate will be the average of strata estimates. Stream life estimates within weekly time strata will also be averaged across all streams to examine time trends in stream life.

Another mean stream life estimate (S) for each stream will be calculated as the difference between the mean date of abundance of new arrivals of live fish in the stream and the mean date of abundance of daily dead counts as follows:

$$S = \frac{\Sigma D_i J_i}{\Sigma D_i} - \frac{\Sigma [((L_i - L_{(i-1)}) + D_i) J_i]}{\Sigma [(L_i - L_{(i-1)}) + D_i]}$$

where i = survey number,

L_i = number of live fish observed on survey i,

D_i = number of dead fish observed on survey i,

J_i = Julian date of survey i.

For weired streams a third estimate of mean stream life (S) based on daily counts of live fish through the weir and daily dead counts in the stream will be as follows:

$$S = \frac{\Sigma [(J_i - J_{(i-1)}) \Sigma (W_i - D_i)]}{\Sigma W_i},$$

Where i = serial day of weir operation,

J_i = Julian date,

W_i = live fish passed through the weir on day i,

D_i = count of dead fish in the stream on day i,

S = stream life (in days).

If observations for day i are missing, total live fish in the creek on day i ($\sum(W_i - D_i)$) will be linearly interpolated.

If significant differences occur in stream life estimates between streams or time strata, stream and week specific stream life estimates will be applied to similarly stratified aerial and ground observations when estimating escapements using the geometric method.

Escapement Estimates Based on Aerial Survey Data

Annual, spawning escapement estimates (E) for pink salmon within each surveyed stream will be made using a geometric approach similar to that described by Johnson and Barrett (1986):

$$E = \frac{\sum \left[(J_i - J_{(i-1)}) L_i - \frac{(J_i - J_{(i-1)})(L_{ji} - L_{(ji-1)})}{2} \right]}{S}$$

Where i = survey number,
j = stream category,
J_i = julian date,
L_{ji} = survey estimate of live fish in the stream adjusted for stream category j survey bias on survey i,
S = stream life (in days).

If the maximum daily survey of live fish in the stream exceeds the total escapement estimate based on the geometric method, the maximum daily survey count is treated as the total escapement.

Escapement estimates Based on Ground Survey Data

Ground survey counts will be summarized by species, stream, survey date, stream zone, and observer for all 12 streams in the study. Spawning escapement to streams surveyed from the ground will be estimated using the geometric method described for aerial survey data. Frequently survey counts (L_i) will be replicated as paired observations from two observers walking in tandem. The escapement estimate for a section walked in tandem will be the mean of the observations. The variance will be estimated using all replicates for the section. A one way analysis of variance will be used to test for differences between replicate observations from separate observers. In instances where the maximum daily sum of live and dead fish in a stream exceeds the total estimated escapement for the stream based on the geometric method, the maximum daily sum of live and dead will be the total escapement estimate.

SCHEDULES AND PLANNING

Data Collection, Analysis and, Reporting Schedule

Data collection, analyses and reporting of results for the 1991 field season will proceed as follows:

July 1 - 15 Sept. 1991 Weir installation and operation, ground surveys,

	and stream life studies. Inseason data entry of weir, ground survey, and aerial survey data. Analysis of inseason data and consultation with ADF&G Division of Commercial Fisheries management personnel concerning management decisions regarding oil impacted stocks.
Sept 15 - 30 Nov. 1991	Completion of post season computer data entry and editing.
Sept 15 - 30 Dec. 1991	Completion of preliminary post-season data analysis and progress report.
Dec. 15 - 28 Feb. 1992	Finalize post season data analyses and project completion report.

Sample and Data Archival

All project operational plans, data logs, field notebooks, as well as original copies of draft and final reports will be kept in locked file storage in the ADF&G Commercial Fisheries Division and OSIAR offices in Cordova.

Weir data, ground survey, tagging, and tag recovery forms will be labeled with a three part alpha-numeric code unique to each data type, stream and, date. At the end of each day, forms will be carefully edited and the code for each will be recorded in a data collection log maintained by each filed crew. As forms are logged they will be initialed by the crew member doing logging procedures for that day. Any biological samples collected will similarly be coded as to sample type, sampling site, and date. All data and samples collected will be remitted to the Cordova ADF&G office on a weekly schedule according to standard chain of custody procedures. Data collection log numbers, date sent and initials of the person sending these, will be recorded in a the field data camp data transmission log. Data received in Cordova will recorded in a data and sample transmission log which will show the codes assigned to each form and sample at each field camp as well as the date received and the initials of the receiver.

Original data forms for each data type and stream will be stored in separate, labeled three ring binders in the Oil Spill Impact, Assessment, and Recovery (OSIAR) office. Backup photocopies of the data will be stored in corresponding binders in the ADF&G Commercial Fisheries Division office in Cordova. All samples will be placed in locked storage and sent to the appropriate processing laboratories or centralized storage facilities when appropriate. Standard chain of custody procedures will be followed when any data or samples are remitted from the custody of project personnel in Cordova.

All data will be edited for errors immediately upon receipt in Cordova and then entered into a microcomputer data base in RBASE format. The RBASE data base will be accompanied by full documentation including a description of all columns, tables, and applications. Backup copies of the data base will be updated after every data edit or update and placed in locked, fireproof storage in the OSIAR and Commercial Fisheries Division offices. A complete log of data entries, edits,

and archives will be maintained by project personnel which will reflect the alpha numeric data form codes, the date of entry or editing, and the initials of the person performing these functions.

Management Plan

The Principal Investigator (PI) for the project is a Fisheries Biologist III with the Alaska Department of Fish and Game. The PI will be responsible for writing project operational plans, administering project budgets, quality control of data collection, supervising data analyses and, co-authoring final reports. The PI will be assisted by a Fisheries Biologist II Project Leader (PL) who will hire project personnel, supervise day to day project operations, maintain data quality, assist in data analyses, and coauthor final reports. The PL will be assisted by two Fisheries Biologist I's. One of these assistants will be in charge of installing weirs and camps, weir operations and, remote camp logistics. The other assistant will supervise data collection activities in the ground survey and stream life studies. Each weir camp will be manned by four people one of whom will be funded by NRDA Study F/S #3 for recovery of adult salmon bearing coded-wire tags. Each crew will have one Fisheries Technician III crew leader and three Fisheries Technician IIs. Each day, two persons on each crew will tend the weir and conduct the ground survey, stream life, and tag recovery activities on the weired stream. The other two crew members will conduct ground survey, stream life and, tag recovery activities on the unweired streams. Biometrics support for the project will be provided by a Biometrician II under the supervision of the ADF&G Region II Commercial Fisheries Division Biometrician III.

Project Logistics

Weir and camp materials will be purchased in the Spring of 1991 with funds from NRDA F/S Study #1. The ADF&G *R/V Montague* will transport materials to the weir sites in June 1991. Weirs and camps will be installed at seven sites (Figure 1) in the last week of June. Weir operations, ground surveys and, stream life studies will begin on July 1.

Weir camps will be supplied semi-weekly by the *R/V Montague* or as needed by fixed wing aircraft. The PL and the assistant project leaders will visit each camp on a weekly schedule to oversee weir and camp operations, collect completed data forms and heads from tagged fish, answer questions from field crews, and monitor the quality of data collected. The project leader or assistant project leaders will maintain twice daily radio schedules with weir camps. During radio schedules, crews will transmit weir and stream walk counts and any other information or requests essential to camp operations. Data collected each week will be edited and entered into an RBASE data base in Cordova by a Fisheries Technician III. The PI and the PL, in consultation with the Biometrician, will update escapement estimates based on aerial, ground survey, and weir data. These analyses will be completed daily and the results will be passed on to the ADF&G Division of Commercial Fisheries PWS Area Management Biologist. In consultation with the PI, the PL and, other ADF&G fisheries management and research staff, the Area Management Biologist will use these results to make inseason fisheries management decisions.

BUDGET

Salaries	$ 120.0
Travel	$ 2.0
Contractual	$ 43.0
Commodities	$ 25.0
Equipment	$ 40.0
Total	$ 230.0

PERSONNEL QUALIFICATIONS

Fisheries Biologist III Principal Investigator - Samuel Sharr

Mr. Sharr has been a research biologist for ADF&G since 1979 and has worked on PWS salmon and Herring since 1981. He assumed his present position as the ADF&G, Division of Commercial Fisheries, Biologist III, PWS Area Research Project Leader in 1986. In this capacity, Mr. Sharr oversees all salmon research conducted by the Division of Commercial Fisheries in PWS. His involvement with the PWS salmon escapement aerial survey program dates from the early 1980's. Mr.Sharr has supervised a total edit of the historic aerial and ground survey data and designed a new RBASE data base for inseason escapement analyses. Mr. Sharr wrote the original operational plans for NRDA F/S Studies 1,2 and, 3 and has been the Principal Investigator for those projects since their inception.

Fisheries Biologist II Project Leader - Dan Sharp

Mr. Sharp has been employed by ADF&G since 1982. As a biologist for the ADF&G Susitna Hydroelectric Project Mr. Sharp gained valuable experience in a wide variety of techniques to enumerate salmon escapements and estimate migratory timing. His experience included operation of weirs, sonar counters and fishwheels and tagging studies for of juvenile and adult salmon. Mr. Sharp has been the Fisheries Biologist II Project Leader for the tagging portion of NRDA F/S Study #3 since its inception.

Fisheries Biologist I Assistant Project Leader - Stephanie Carpenter

Ms. Carpenter was a Fisheries Biologist I for NRDA F/S Study #1 in 1990 and supervised the installation and operation of four adult pink salmon weirs in PWS.

Fisheries Biologist I Assistant Project Leader - Mary Hausler

Ms. Hausler was a Fisheries Technician in the escapement ground survey portion of NRDA F/S Study #1 in 1989 and as a Fisheries Biologist I in 1990, she supervised the all ground survey and stream life studies for that project.

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