PACIFIC SALMON COMMISSION

TRANSBOUNDARY TECHNICAL COMMITTEE REPORT

REPORT TCTR (90)-3

LONG-TERM RESEARCH PLANS FOR THE TRANSBOUNDARY RIVERS

A REPORT
TO THE STANDING COMMITTEE ON RESEARCH AND STATISTICS
FROM THE TRANSBOUNDARY TECHNICAL COMMITTEE

NOVEMBER 1990

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CHAPTER 1. INTRODUCTION

Long-term goals established by the Pacific Salmon Commission for the transboundary rivers include achieving optimum salmon production and providing each Party benefits equivalent to the salmon production originating in its own waters. If these goals are to be realized, careful planning of programs designed to address them must be undertaken. The special nature of the transboundary rivers is recognized by the Commission and the Parties are encouraged to cooperate in the development of harvest management strategies, research, and enhancement to the mutual benefit of both nations.

In the years leading up to the Treaty and then after the ratification of the Treaty, both parties directed considerable resources into investigating the fisheries and salmon stocks of the transboundary rivers. As a result, substantial progress has been made which has led to improved management approaches and a cooperative sockeye enhancement plan. In spite of this progress, large gaps remain in our understanding of the fisheries resources of the transboundary rivers.

The Transboundary Rivers Technical Committee (TBRTC) has identified seven Treaty-related activities which could benefit from acquiring additional or improved information from the transboundary rivers. These are:

1. in-season management,
2. management evaluation,
3. forecasting future returns,
4. development of spawning escapement goals,
5. enhancement planning,
6. enhancement evaluation, and
7. interception estimation.

The purpose of this report is to develop a long-term plan for addressing these needs. This is done by first identifying current research and monitoring programs and evaluating how well they are meeting our information needs (Chapter 2). Next, current programs that need further development or follow up in order to make best use of their information are identified (Chapter 3). Finally, new programs are identified, their importance determined, approaches for addressing them developed, and the specific programs are prioritized (Chapter 4). In some cases, to meet new data needs, entirely new programs will be required, while in others, further analysis of existing information may be sufficient. Findings are summarized in the last chapter (Chapter 5). This report will provide the Commission with a sense of direction for transboundary river programs. The report should also provide information to assist the various government agencies in funding allocation decisions. It is recognized that objectives sometimes change and this research plan must be considered flexible in order to respond to change.

CHAPTER 2. CURRENT RESEARCH AND MONITORING PROGRAMS

This chapter describes the research and monitoring programs being conducted by the U.S. and Canada on transboundary river salmon stocks in 1990. The programs are organized by river system and then by species. Programs are categorized into those that support management in determining and maintaining allowable catch levels and those that are used to develop escapement estimates and goals. In addition, for sockeye salmon from the Stikine and Taku Rivers, preseason forecasting is done based on statistical models and age-specific catch and escapement (run reconstruction) data. For other species, preseason forecasts may be done, but they are based more on impressions than rigorous analysis. Enhancement is a fourth program category for sockeye salmon on the Stikine and Taku Rivers, the only species and rivers currently being jointly enhanced.

Each program category ends with a conclusion statement about how well the current programs are meeting data needs.

Stikine River

Proposed field projects for all species on the Stikine River for 1990 are summarized in Table 1. A map of the Stikine River drainage, including principal Canadian and U.S. fishing areas can be found in Figure 1.

Sockeye Salmon

Management objectives for Stikine River sockeye salmon include sharing of the total allowable catch (TAC) in the manner specified by the Transboundary Annex and achievement of escapement goals for the Tahltan and non-Tahltan stocks. Attainment of these objectives requires development of preseason forecasts, in-season management, spawning enumeration, and postseason stock assessment (TBRTC 1987b, 1988b, 1989a, 1990b). Postseason stock assessment is also used to evaluate management effectiveness.

Management. The in-season management process for Stikine River sockeye salmon is well developed, having had the benefit of several years of research on stock identification techniques and on methods of evaluating run strength. The sharing arrangement under the Treaty also requires that the agencies develop a workable management scheme.

Table 1. Proposed Stikine River field projects, 1990.[a/]

Location	Function	Dates	Agency	Responsibility
District 106 & 108 Fishery	Generate in-season stock composition estimates via SPA.	06/18-08/10	ADF&G	All aspects
	Sample 20% of chinook, coho, chum, and sockeye catches per district for CWT; all species except pinks for age-sex-length (goals are 700 sockeye scales per week for 106-41, 106-30, and 108; 600 per district per season for chinook, coho, and chum); collect 200 otolith samples from sockeye caught in District 106 fishery.	06/18-09/20	ADF&G	All aspects
Lower Stikine	Conduct test fishery to assess size and timing of sockeye and coho runs. Collect age-sex-length and CWT's on all salmon species. Sample all sockeye for scales and all females for egg diameter (stock ID)	06/19-10/10	DFO	All aspects
	Sample commercial catches (up to 350 sockeye scales and 100 egg diameter samples per week).			
Tahltan Lake	Estimate age, size, and timing of sockeye smolt outmigration.	05/03-07/15	DFO	All aspects
	Enumerate adult sockeye and collect age-sex-length data on 800 fish.	07/16-09/01	DFO	All aspects
	Sample smolts for otoliths.	07/16-09/01	DFO ADF&G	Smolt Collection Otolith Analysis
Little Tahltan	Enumerate adult chinook and collect age-sex-length data.	06/23-08/21	DFO	All aspects
Tahltan River, Little Tahltan, Beatty Creek	Aerial survey estimates of spawning chinook salmon in index areas.	08/10-08/15	ADF&G	All aspects
Katete, Craig, Jekill, Verret, Porcupine, Scud, & Christina Rivers & Jones Lake	Aerial survey estimates of spawning sockeye in index areas.	09/06	DFO	All aspects
Lower Stikine	Aerial surveys of spawning coho salmon in mainstem tributaries from mouth to U.S./Canada border.	10/05-10/31	ADF&G	All aspects

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Doug Mecum (ADF&G) chinook aerial surveys
Brian Lynch (ADF&G) District 106 & 108 fishery sampling
Kathleen Jensen (ADF&G) District 106 and 108 sockeye stock ID

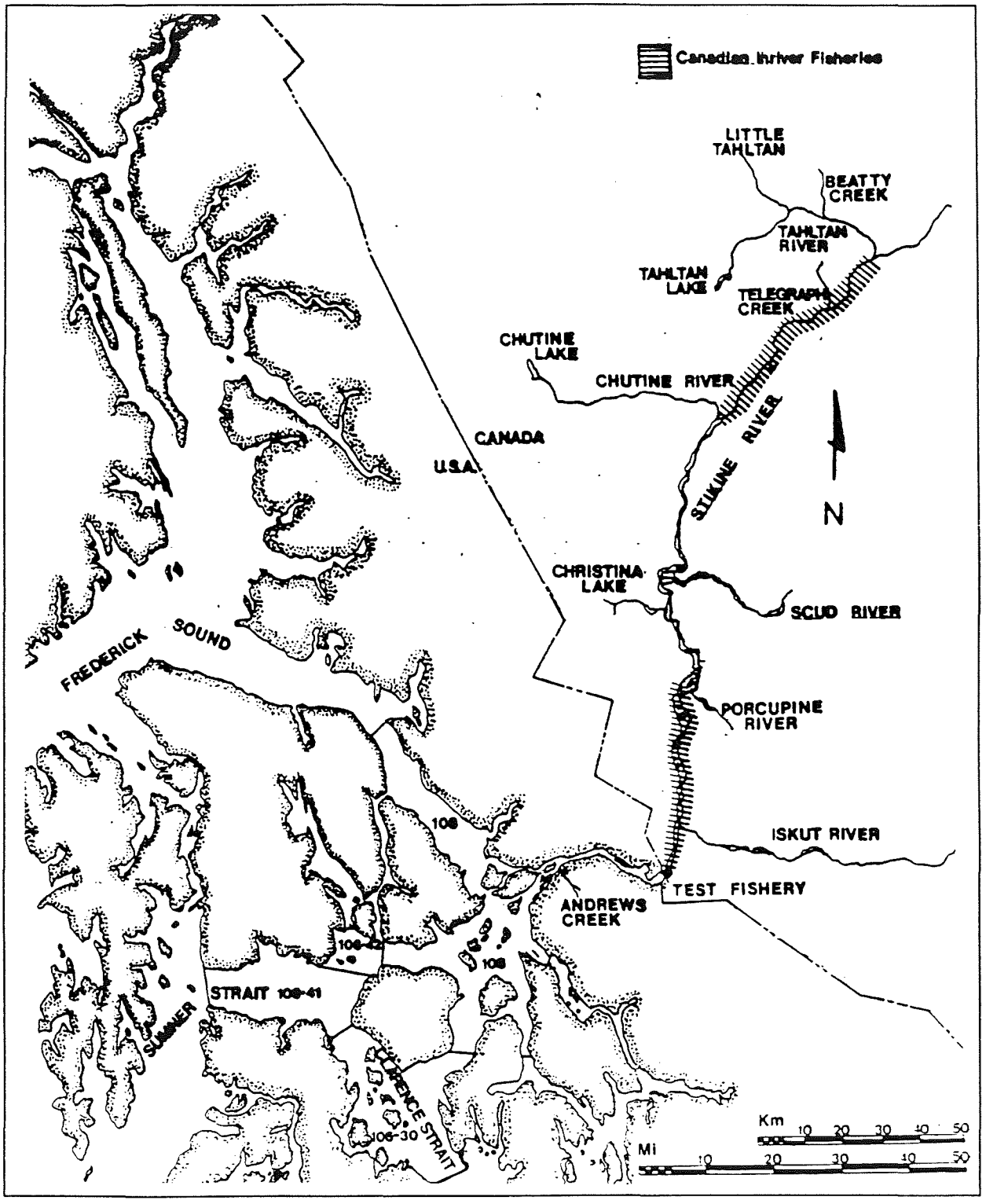

Figure 1. The Stikine River and principal Canadian and U.S. fishing area.

Stikine sockeye salmon are caught in significant numbers in U.S. commercial fisheries in Alaska's Districts 106 and 108 and Canadian commercial and Indian food fisheries within the river. Because the majority of sockeye salmon caught in District 106 are of non-Stikine origin (Jensen and Frank 1988 and 1989), a reliable in-season stock separation technique is required in order to manage the run to achieve the appropriate harvest shares. For management purposes, Tahltan and non-Tahltan Stikine sockeye stocks are treated separately. Catches of the two stock groups are estimated each week based on catch monitoring and stock composition analyses. Currently, scale pattern analysis is used for Districts 106 and 108 samples and egg-diameter analysis is used for inriver samples. Scale pattern analysis, genetic stock identification (GSI), and brain parasite prevalence have been used at various times for District 106 and inriver samples.

Escapement-to-date is estimated each week from data from the Canadian commercial fishery and from the Tahltan weir. However, because these estimates are significantly delayed with respect to the time of occurrence of individual stocks in the District 106 and 108 fisheries, they are of limited value to marine fisheries management.

In-season run reconstruction for Stikine River sockeye salmon is accomplished using the Stikine management model (TBRTC 1988b), which produces weekly updates of run strength based on catch-per-unit-effort (CPUE) from the various pertinent fisheries and on test fishery data. The model then determines the annual TAC for each Party based on the run strength estimate, the escapement goal, and Treaty harvest sharing stipulations. Weekly TAC guidelines are developed for each party based on catch-to-date and historical migratory timing data in each fishery. Weekly forecasts of TAC are imprecise early in the season but improve after a few weeks.

The Stikine management model also determines the amount of weekly fishing effort needed to catch the weekly TAC. This assumes constant fishing power within each fishery during the historical period incorporated in the model (1982 to present). However, it is recognized that increases in fishing efficiency have occurred, complicating comparison of recent and historical CPUE data.

> In conclusion, current management of Stikine sockeye stocks is working satisfactorily in terms of adhering to harvest sharing objectives. Improvement could be made in achieving stock specific escapement goals. Current management procedures require yearly in-season monitoring of the catch, effort, and stock composition in District 106 and the lower river commercial and test fisheries.

Escapement Estimation and Goals. Almost all of the sockeye salmon spawning in the Stikine River drainage takes place in Canada. A weir at the outlet of Tahltan Lake has been used to enumerate the sockeye escapement since 1959. The non-Tahltan Stikine sockeye escapement is estimated indirectly from data accrued from a test fishery conducted near the international border. Test fishery catches are apportioned into Tahltan and non-Tahltan fish. Migratory time-density functions are computed for each stock group. Since direct estimates of the inriver run size of the Tahltan stock can be made, the inriver run size of the non-Tahltan stock can be indirectly estimated by estimating the relative stock composition of the two stocks in the run (Jensen and Frank 1988; Jensen et al. 1989). Limited aerial and foot spawning ground survey data are available for some non-Tahltan Stikine sockeye stocks (TBRTC 1988c, 1989c, 1990a). Analysis of egg diameters is

currently the sole technique used to estimate inriver stock compositions and can be used to separate the Tahltan from the non-Tahltan females. However, analysis of scale, genetic, and parasite characters (Wood et al. 1987) indicates that these techniques might allow more stock-specific inriver run reconstruction should the need (and funding) arise.

The TBRTC (1987b, 1988b, 1989a, 1990b) has established interim management escapement goals for the Canadian portion of the Stikine River based on judgements of the quantity and quality of available spawning and rearing habitat, observed patterns in the distribution and abundance of spawners, and historical patterns of the near terminal area gill net harvest. The interim escapement goals for sockeye salmon are 30,000 to the Tahltan stock and 30,000 to all other stocks in the river. It is recognized that these goals are not based on rigorous data analysis and may not be optimal goals. Stock assessment programs now in place may permit development of better spawning goals based on stock recruit analysis in the future.

> In conclusion, escapement estimations for the two stocks are satisfactory, although we have no estimates of the precision or accuracy of the estimate for the non-Tahltan stock conglomerate. Escapement goals for both stock groups need improvement. While the need is not urgent, an evaluation could be done with analysis of existing data.

Preseason Forecasting. Annual preseason forecasts of Stikine River sockeye salmon are used to establish the fishing pattern in the initial weeks of the fishery. Several forecasting methods have been used. Most forecast the two stocks separately. One approach for forecasting the Tahltan run involves application of an assumed smolt-to-adult survival rate to the Tahltan Lake smolt count of the appropriate brood year. An alternate method is based on a sibling model which uses the return of age-1.2 Tahltan sockeye salmon in a given year to predict the entire Tahltan run during the following year.

For several years, the ratio of Tahltan to non-Tahltan stocks in the run varied around 1:1. Thus the Tahltan forecast was doubled to derive the forecast of the total Stikine River sockeye run. Another method for forecasting the non-Tahltan portion of the run uses a stock recruitment relationship derived from historical escapements and returns (excluding catch) to Tahltan Lake and the estimated non-Tahltan escapement in the principal brood year. The assumption is that Tahltan and non-Tahltan stocks have a similar stock-recruit relationship.

> In conclusion, a satisfactory method has not yet been determined for the annual preseason forecast. The preseason forecast only drives the management for two weeks; however, it is still important to develop a technique that could be relied on year after year.

Enhancement. Planting unfed sockeye salmon fry into barren or under-utilized lakes has been implemented on the Stikine River. The planted fish are expected to rear in the nursery area of the recipient lake and emigrate as smolts; the returning adults will contribute to traditional fisheries that harvest Stikine River stocks. Tahltan and Tuya Lakes were selected for sockeye enhancement projects on the Stikine River. Fry of Tahltan Lake origin are currently being backplanted into Tahltan Lake and Canada is attempting to obtain approval to outplant fry of this origin to Tuya Lake as well. Tuya Lake is barriered and contains no sockeye salmon.

Disease surveys of Tuya Lake have been conducted; however, the British Columbia Ministry of Environment is not satisfied that issues of disease transfer and interspecific competition have been addressed adequately and are withholding their approval.

The culture of sockeye salmon has historically been inhibited by the IHN virus. Stringent protocols have been developed in Alaska, however, that allow fish culturists to "farm around" this disease. Constant vigilance is needed during all cultural stages to minimize the risk of an IHN virus outbreak. Sockeye salmon broodstock are sampled during egg-takes for IHN virus and bacterial kidney disease (BKD), and a rigorous disinfection protocol is used during the egg-take and incubation activities. Stocks are isolated during incubation at the Snettisham central incubation facility (CIF), located near Juneau, Alaska; process water for the CIF comes from an INHV-free water source. The sockeye salmon fry are sampled for IHN virus before backplanting into the recipient lake. These fish disease protocols ensure the protection of wild stocks and increase the likelihood of success of the sockeye enhancement projects.

Post-stocking studies (net pen holding of fry) have been conducted at Tahltan Lake to determine if mortalities occur because of gas supersaturation during aerial transport. No such mortalities have been shown to occur.

Limnological studies have been conducted on Tahltan and Tuya Lakes to determine the carrying capacity of each lake system. Additional monitoring is needed to determine the freshwater survival of the planted sockeye salmon and what impact, if any, the planting had on the zooplankton biomass in the lakes.

Thermal marks have been successfully implanted into otoliths of sockeye salmon incubating at the Snettisham CIF. This mass mark is required to distinguish enhanced fish from wild fish when evaluating freshwater growth and survival and, most importantly, to identify enhanced fish in the near terminal mixed stock fisheries. Harvest rates will be based upon the abundance of wild stocks and harvest shares will follow international harvest sharing agreements. Additional research on developing rapid mass-processing technology for adult otoliths is necessary to fully develop this methodology of distinguishing enhanced and wild returns.

Proposed enhancement projects for sockeye salmon in the Stikine River are included in Table 2.

In conclusion, joint enhancement activities begun in 1989 will require continual monitoring of catches for marked enhanced fish in order to ensure that harvest sharing follows agreed proportions. In addition, monitoring and research will be needed into the behavior and survival of the enhanced fish and on possible effects enhancement may have on the environment and wild stocks. These research activities are of high importance if enhancement is to continue.

Table 2. Proposed enhancement projects for transboundary rivers, 1990.[a/]

Location	Function	Dates	Agency	Responsibility
Tahltan Lake	Backplant sockeye fry from Snettisham	06/01-07/01	ADF&G	All aspects
	Hold fry for four days unfed, to monitor gas bubble disease.	06/04-07/01	DFO ADF&G	Pens Disease sampling
	Take six million sockeye eggs	09/01-09/30	DFO ADF&G	Egg take & transport Incubation & otolith marking
	Hydroacoustic/limnological surveys to evaluate success of fry outplant.	06/01-09/30	DFO	All aspects
Tuya, Trapper, Tatsamenie L. Trapper, & L. Tatsamenie	Seasonal plankton sampling (one trip per month)	06/01-09/30	DFO	All aspects
Little Tatsamenie Lake	Take three million sockeye eggs	08/15-09/30	DFO ADF&G	Egg take & transport Incubation & otolith marking
Little Trapper Lake	Take three million sockeye eggs	09/01-09/30	DFO ADF&G	Egg take & transport Incubation & otolith marking
King Salmon & Nakina Lakes	Limnological studies to determine enhancement potential.	06/01-09/30	DFO	All aspects
Snettisham	Thermal marking of juvenile sockeye otoliths at Snettisham and pink fry at NMFS Auke Bay hatchery.	0101-03/30	ADF&G	All aspects

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Chinook Salmon

The primary management objective for Stikine River chinook salmon at present is to increase escapements to certain spawning areas to specified levels by 1995. This objective requires conservation measures by both nations. The focus of activities in recent years has, therefore, been to monitor escapements. However, once the stocks are rebuilt, depending upon the approach taken, a more active management scheme may be developed requiring additional information. Currently preseason forecasting is not done other than to predict whether the run may be above or below average.

Management. Stikine River chinook salmon are harvested in U.S. commercial troll, gill net, and seine fisheries and in recreational fisheries near the communities of Petersburg and Wrangell. There is currently no monitoring of chinook catches by stock in these fisheries. The available data indicate that Stikine River chinook salmon comprise only a small portion of the mixed stock catches in the District 106 gill net and seine fisheries. Conservation measures have been in place in the District 108 gill net fishery since the 1970's and in the troll fishery since 1981 in order to help rebuild the stocks. If catch restrictions are relaxed following rebuilding, monitoring of catches by stock will be desirable. Chinook salmon are also harvested in the Canadian commercial and test fisheries and Indian food fisheries. The Canadian commercial catch of chinook salmon occurs only incidentally to the sockeye fishery, as required by the Treaty. Catches in the Canadian fisheries are monitored during each fishery opening. Conservation measures in both U.S. and Canadian fisheries have resulted in larger spawning escapements in recent years.

Coded-wire-tagging studies conducted from 1978 to 1981 provided limited insight into the marine distribution and migratory timing of Stikine River chinook salmon, since only 34 tags were recovered. Most of the tags recovered were from chinook salmon caught in troll fisheries operating to the north of the river in late spring and early summer.

> In conclusion, there is very limited data on the distribution of Stikine chinook stocks in fisheries or on exploitation rates. When coastwide harvest restrictions are lifted, it will be difficult to estimate or control the harvest of Stikine stocks. It would be desirable to do the research necessary to determine exploitation rates of these stocks.

Escapement Estimation and Goals. The majority of the chinook salmon spawning areas in the Stikine River are located in Canada. Surveys to estimate the number of chinook salmon spawning in portions of the Stikine River are available since 1956 for Andrew Creek (U.S. tributary), since 1975 for the Tahltan and Little Tahltan Rivers, and since 1980 for Beatty Creek. In addition, an enumeration weir on the Little Tahltan River has provided chinook salmon counts since 1985. Estimates of the total number of chinook salmon spawning in the Stikine River drainage have been made by expanding either peak aerial survey counts or Little Tahltan weir counts by various factors. There is little or no scientific basis for any of the factors used; they are largely professional judgements of biologists familiar with the stocks.

The escapement goal range for chinook salmon to Canadian portions of the Stikine River is 19,800 (U.S. estimate) to 25,000 (Canadian estimate). These are only professional judgements based on limited information so there is a need to acquire the appropriate data on which to develop a more scientifically-based goal.

> In conclusion, escapement goals and information on actual escapement for Stikine River chinook salmon are subjective at best. This makes both management evaluation and run reconstruction difficult and impairs the assessment of stock rebuilding as required by the Pacific Salmon Treaty.

Coho Salmon

Specific management objectives for Stikine River coho salmon include achievement of spawning escapement goals and staying within the Canadian catch allocation (currently at 4,000 fish per year). Few projects to acquire information on Stikine coho salmon have been undertaken to date. Currently, preseason forecasting is not done other than to predict whether the run may be above or below average.

Management. Stikine River coho salmon are extensively harvested in U.S. commercial troll, gill net, and seine fisheries, as demonstrated by recoveries of coded-wire-tagged fish (Shaul et al. 1984). The troll fishery accounts for the greatest proportion of the U.S. harvest. Based on coded-wire-tag estimates for other nearby natural and enhanced production systems, the U.S. troll fishery probably harvests an average of between 35% and 50% of the total coho salmon run to the Stikine River. A recreational fishery near the communities of Petersburg and Wrangell harvests some Stikine River coho salmon. Coho salmon are also harvested in the lower river Canadian commercial fishery.

Stikine River coho salmon present a very difficult management problem in U.S. waters. Most are taken in the troll fishery and are mixed with (and not identified from) other stocks; further, these catches are distant in both time and space from the river mouth. Thus, no catch estimates of the Stikine stock are made for the troll fishery. Once the run enters the inside waters of S.E. Alaska, a limited assessment of run strength can be made from analysis of CPUE data in the District 108 gill net fishery (when open); however, this is also a mixed stock fishery with stock proportions unknown. Regulation of the District 108 fishery is based on the abundance indices of the mixed stock coho fishery in District 106 and the catches in the region-wide troll fishery.

Catch estimates in the Canadian lower river fishery are made weekly. Few coho salmon are caught in the upper river commercial or Indian food fisheries.

> In conclusion, coho salmon are not managed on an individual stock basis in U.S. fisheries. With existing knowledge and monitoring programs, this could not be done for Stikine coho stocks. Some type of tagging studies would probably be needed to estimate the abundance and timing of these stocks in the mixed stock fisheries.

Escapement Estimation and Goals. The majority of Stikine River coho stocks probably spawn in Canadian portions of the river. Data from limited aerial surveys of spawning grounds are available for coho salmon in some portions of the Stikine River. A test fishery is operated immediately above the U.S./Canada border throughout the coho migration; however, no data are available to develop a relationship between test fishery CPUE and actual escapement. An estimate of above-border coho escapement is made based on the assumption that the relationship between CPUE and run size for coho salmon is the same as for sockeye salmon (TBRTC 1988c, 1990a). This approach also assumes that the catchability of coho salmon is the same as for sockeye salmon. However, there is no existing method of assessing the reliability of the estimate.

The escapement goal range for coho salmon to Canadian portions of the Stikine River, based on professional judgement, is 38,000 (U.S. estimate) to 50,000 (Canadian estimate).

> In conclusion, both escapement estimates and goals are unreliable and need improvement. With increasing interest in coho management within the PSC process, improved escapement information will become more important.

Chum and Pink Salmon

The production of chum and pink salmon from the Stikine River is believed to be relatively small, consequently there are no projects directed at these two species.

Management. Stikine River chum and pink salmon runs are usually only managed indirectly through management strategies developed for sockeye and coho salmon. If chum or pink salmon CPUE is high in District 108, limited directed fisheries may occur on either of these species. No methods have been developed to permit identification of Stikine River stocks of these species in U.S. fisheries in Districts 106 and 108. Catches of chum and pink salmon in Canadian fisheries are numerically small and are taken incidental to the catches of other salmon species. Catches in the Canadian fishery are recorded weekly.

> In conclusion, there is currently not a pressing need to determine the production of Stikine River chum or pink salmon or to initiate any stock-specific management programs.

Escapement Estimation and Goals. As few pink or chum salmon spawn in the Canadian section of the Stikine River, there are no programs to monitor escapement annually. Several tributaries on the U.S. section of the river are monitored annually for spawning escapements. Escapement goal ranges for Canadian portions of the drainage are 3,000 (U.S. estimate) to 10,000 (Canadian estimate) for chum salmon and 5,000 (U.S. estimate) to 6,500 (Canadian estimate) for pink salmon.

> In conclusion, due to low production of these two species from the Stikine River, there is no pressing need to determine spawning escapement or evaluate escapement goals.

Taku River

Proposed field projects for all species on the Taku River for 1990 are summarized in Table 3. A map of the Taku River drainage, including principal Canadian and U.S. fishing areas can be found in Figure 2.

Table 3. Proposed Taku River field projects, 1990.[a/]

Location	Function	Dates	Agency	Responsibility
Nakina River	Chinook carcass weir; enumerate and sample for age-sex-length (1,000 samples) and adult tags.	7/25-8/25	DFO	All aspects
	Recovery of tagged adult chinook salmon.	8/10-15	DFO	2 personnel, transportation
Little Trapper Lake	Adult salmon weir (sockeye); enumerate and sample for age-sex-length (750 samples) and adult tags.	7/15-9/15	DFO	All aspects
Kowatua River	Chinook carcass weir. Sample adult chinook salmon below weir for age-sex-length (as many as possible) and adult tags. adult tags.	8/15-9/01	ADF&G DFO	2-3 week survey. ADF&G supplies personnel. Supplies assistance.
Little Tatsamenie Lake	Adult sockeye, chinook, and coho weir. Enumerate and sample for age-sex-length and coded-wire and adult tags (750 sockeye scale samples).	7/28-11/15	DFO	All aspects.
	Juvenile coho salmon tagging; sample for age-length.	7/25-8/15	DFO ADF&G	Two personnel as per availability, living facilities, two boats, one outboard motor, trap/tagging equipment. Two personnel, trapping and tagging equipment.
Tatsamenie River	Chinook carcass weir; enumerate and sample for age-sex-length and tagged adults (as many as possible).	8/25-9/15	DFO ADF&G	Living facility, assist in weir installation. 2 personnel, weir, transport from Juneau.
Nahlin River	Capture and coded-wire tag coho salmon smolt.	4/15-6/15	ADF&G	All Aspects
	Adult salmon weir; enumerate adult chinook, coho, & sockeye. Sample for age-sex-length (as many as possible). Coded-wire-tag coho salmon juveniles.	6/15-9/25	ADF&G NMFS	All aspects
	Foot surveys above and below weir to sample chinook salmon for age-sex-length (as many as possible) and adult tags.	7/30-8/10	ADF&G	All aspects
Canyon Island	Mark-recapture studies to estimate chinook, sockeye, coho, and chum escapement. Sample all fish caught for age-sex-length.	4/25-8/30	ADF&G	Three personnel, April 25-Aug. 30 including one biologist until 9/30; one boat & motor, camp supplies, food/tagging equip.
		5/1 -9/30	DFO	Biologist (5/1-9/30),1 Tech. (6/15-9/30), two boats,etc.
	Chinook Radio Tagging/Tracking	5/1-7/15	NMFS	All aspects

--Continued--

Table 3. (page 2 of 2.)

Location	Function	Dates	Agency	Responsibility
Esc. Sampling	Sample sockeye escapements at Kuthai Lake and mainstem areas for age-sex-length (400 samples per area) and adult tags.	9/5-25	ADFG/DFO	1-3 days of sampling/site
Canadian Fishery	Recover spaghetti tagged chinook, coho, sockeye, chum; Recover CWT'd coho. Sample all species except pinks for age-sex-length (200 samples per week for sockeye; as many as possible for other species).	6/20-9/30	DFO/ADF&G	Samp. by Canyon Is. crew. Tagged salmon collected Fisheries Officer
Canadian Test Fishery	Recapture of adult tags and sample total catch for coded-wire tagged coho. Sample age-sex-length compositions of sockeye (80/week) and coho catches (50% of coho catch).	6/20-10/10	DFO	All aspects
District 111 Fishery	Sample 20% of chinook, coho, chum catches for coded-wire tags; all species except pinks for age-sex-length (goals are 700 and 300 per week for sockeye and chum, and 600 per season for chinook and coho); generate in-season stock comp. estimates via SPA.	6/20-9/30	ADF&G	All aspects
Nakina, Nahlin, Dudidontu, Tatsamenie, Kowatua and Tseta	Aerial surveys of spawning chinook salmon in index tributaries.	7/25-8/25	ADF&G	All aspects
Dudidontu & upper Nahlin rivers; Flannigan Slough, Fish, Yehring, Moose, Johnson and Sockeye Creeks	Coho helicopter and foot surveys	9/15-10/31	ADF&G	All aspects
Yehring Creek	Adult coho salmon weir. Sample for age-sex-length (320 fish) and coded-wire tags.	8/15-10/31	ADF&G	All aspects
Nakina, Nahlin, Tatsamenie, Tseta Dudidontu, Kowatua	GSI, brain parasite, age-sex-size sampling and analysis for chinook salmon (100 per system), and	8/01-9/01	ADF&G/ NMFS/ CDFO	CDFO provides samples from Nakina; ADF&G all other; NMFS analyses all samples.

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Doug Mecum (ADF&G)	-	Aerial surveys, chinook carcass recovery, GSI sampling
Pat Milligan (DFO)	-	Contact for all Taku projects funded by DFO
Leon Shaul (ADF&G)	-	Coho aerial and foot surveys; Tatsamenie coho CWT
Kathleen Jensen (ADF&G)	-	Sockeye stock identification

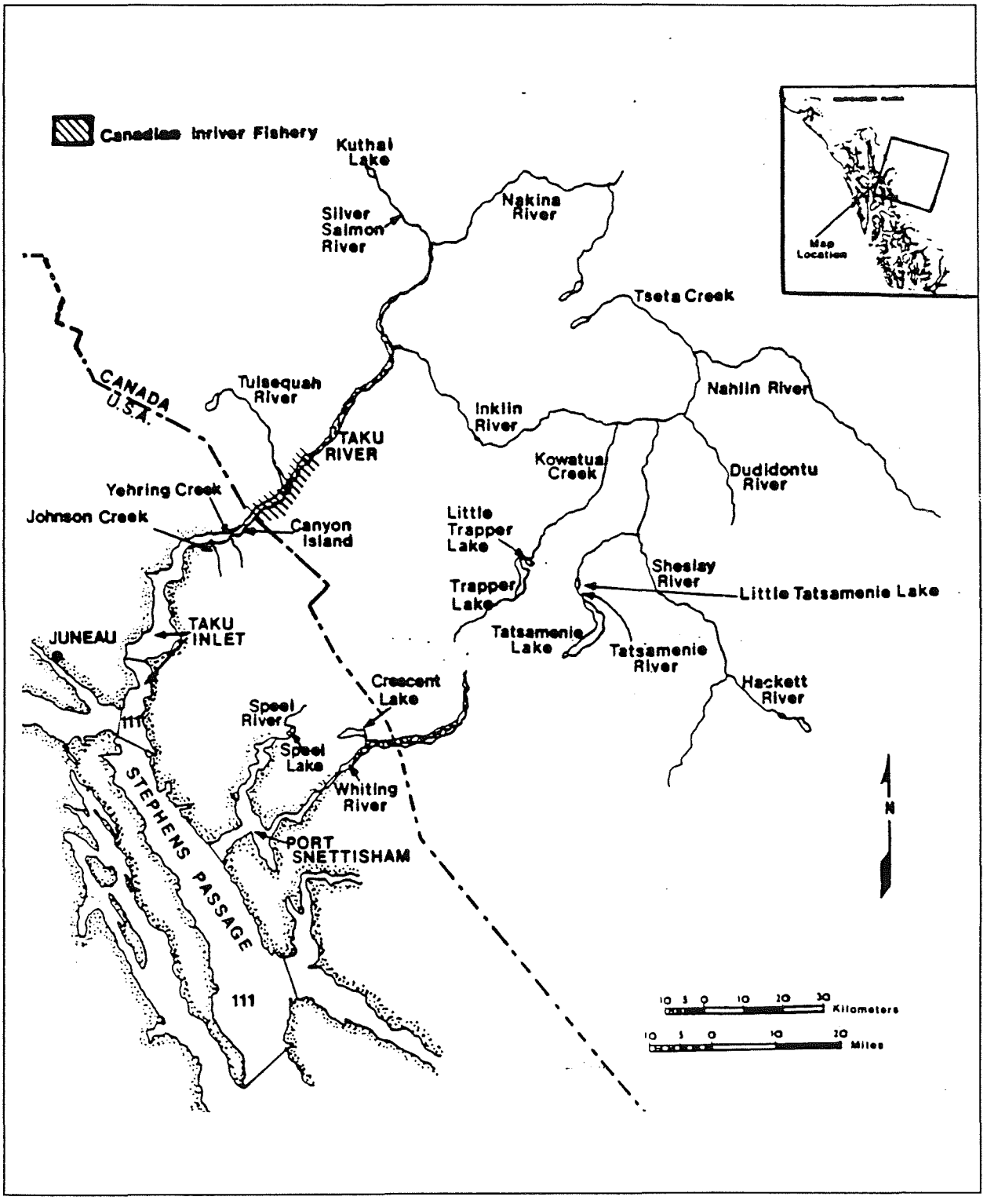

Figure 2. The Taku River and principal Canadian and U.S. fishing areas.

Sockeye Salmon

The management objectives for Taku River sockeye salmon include catch sharing as specified by the Treaty Annex and attainment of the spawning escapement goals. Meeting these objectives requires development of annual forecasts of abundance, a workable in-season management scheme, spawning enumeration, and postseason analysis (TBRTC 1987d, 1988b, 1989a, 1990b).

Management. Similar to Stikine management, the importance of the stocks and the need to manage them to meet escapement and catch sharing objectives has led to the development of an effective management approach for Taku sockeye stocks. Programs to determine in-season run strength and spawning escapements form an integral part of the management process.

Taku River sockeye stocks are the major contributor of sockeye salmon in the District 111 gill net fishery as indicated by scale pattern analysis (McGregor and Walls 1987) and the incidence of the brain parasite, *Myxobolus neurobius* (Moles et al. 1989). Some Taku sockeye salmon are also probably taken as an incidental catch during pink salmon fisheries in eastern Icy Strait and upper Chatham Strait. Sockeye salmon are the targeted species in the Canadian commercial fishery in the Taku River.

Estimates of the stock composition of sockeye salmon caught in District 111 are made weekly in-season, thus enabling the U.S. catch of Taku sockeye salmon to be estimated. In-season estimates are made for four Taku and two Port Snettisham stock groups, which potentially provide limited opportunity for managing individual stocks. Catch-by-stock data are combined with effort statistics in-season to obtain CPUE estimates which are then compared to historical information to assess run strength. However, no estimates of TAC are made by U.S. managers in-season. Stock composition estimates are revised after the fishing season.

Due to the large number of sockeye stocks present in the purse seine fisheries targeting on pink salmon in eastern Icy Strait and upper Chatham Strait, annual accounting of Taku River sockeye salmon in these fisheries has not been performed and may not be technically feasible using current methods for stock identification. Research to determine the feasibility of using genetic, parasite, and scale data concurrently to better differentiate Taku River sockeye stocks in mixed stock fishery catches is in progress (TBRTC and NBTC 1987).

Canadian managers develop weekly forecasts of TAC using in-season escapement estimates (from the Canyon Island mark-recapture program), District 111 and Canadian catches, and comparison of current year Canadian fishery CPUE with historical data. The weekly fishing pattern is then established to achieve the desired catch.

In conclusion, current management of Taku sockeye stocks is satisfactory. It requires yearly in-season monitoring of the catch and effort in District 111 and the inriver commercial fisheries and in-season escapement monitoring through the lower river.

Escapement Estimation and Goals. An annual estimate of the sockeye escapement to the entire Canadian portion of the Taku River drainage has been made since 1984 by subtracting the Canadian catch from the estimated border escapement derived from the Canyon Island tagging program. Escapements to the Little Trapper and Little Tatsamenie Lakes and the Hackett and Nahlin Rivers have been counted using weirs, thus providing some information on the distribution and abundance of spawners. Partial escapement counts to the Nakina River (Canadian tributary and Yehring Creek (U.S. tributary) are obtained from weirs. To determine run timing and the location and extent of utilization of spawning areas, radio transmitters have been affixed to some sockeye salmon to follow their movements (Eiler et al. 1988). Several sockeye spawning populations are regularly sampled for age, sex, and length composition.

Estimates of numbers of returning adults from known escapements are being made for the entire system and separately for the Little Trapper and Tatsamenie Lake stocks. The lower river is an important rearing and overwintering habitat for juvenile sockeye salmon (Murphy et al. 1988). Coupled with estimates of total rearing area, this information may be useful in determining the carrying capacity of the lower river and in establishing escapement goals.

The interim above-border spawning escapement goal range for Taku River sockeye salmon is 71,000 (U.S. estimate) to 80,000 (Canadian estimate). Goals for individual stocks have not yet been developed.

In conclusion, several methods are used to get escapement estimates for individual systems and for the entire system. Returns to the Taku River have been fairly consistent in recent years and current escapement estimates and goals appear satisfactory. It is unknown what returns would be realized from higher escapements. Escapement goals for individual stocks are needed.

Preseason Forecasting. We do not have sufficient years-worth of data to develop statistically valid relationships useful for forecasting run size. Less rigorous methods, such as using average return rates from other stocks applied to brood-year escapement estimates, are currently used instead. Forecasts are usually stated as being below, at, or above average.

In conclusion, as long as the runs remain stable, current forecasting methods appear satisfactory.

Enhancement. The sockeye enhancement program for the Taku River is similar to the one for the Stikine River. Project selection for the Taku River includes Tatsamenie and Trapper Lakes. Research and monitoring programs are almost identical with those described for the Stikine River. The only exception is that sockeye fry will be stocked back into the system of origin. This removes the need to sample resident species, other than the enhanced species, for the development of a disease history. Proposed enhancement projects for 1990 are included in Table 2.

In conclusion, joint enhancement activities, which began in 1990, will require continual monitoring of catches for marked enhanced fish in order to ensure that harvest sharing follows agreed proportions. In addition, monitoring and research will be needed into the behavior and survival of the enhanced fish

and possible effects enhancement may have on the environment and wild stocks. These research activities are of high importance if enhancement is to continue.

Chinook Salmon

As for the Stikine River, the main management priority at present is to rebuild escapements to specified levels by 1995. The lack of directed fisheries has minimized in-season data requirements.

Management. Recoveries of coded-wire tags have demonstrated that Taku River chinook salmon migrate to the north and west of Southeast Alaska during their ocean residence. They appear to be susceptible to harvest mainly in the spring and early summer during their maturation migration. Most fishery tag recoveries were made in northern Southeast Alaska in the approaches to and in Icy Strait and in areas near the river mouth. As the number of Taku chinook salmon caught in the U.S. is considered to be low at present, catch accounting procedures for this stock have not been a high priority and annual catch estimates are not made.

Weekly estimates of the incidental chinook salmon catch in the Canadian commercial fishery are made. Increased spawning escapements appear to be the result of restrictive measures on various fisheries. If additional harvests become possible in the future, depending on the approach taken, an active management program with specific data requirements may be required.

In conclusion, there is very limited data on the distribution of Taku chinook stocks in fisheries or on exploitation rates. When coastwide harvest restrictions are lifted, it will be difficult to estimate or control the harvest of Taku stocks. It would be desirable to do the research necessary to determine exploitation rates of these stocks.

Escapement Estimation and Goals. Virtually all known Taku River chinook spawning occurs in Canada. Surveys to estimate the number of chinook salmon spawning in tributaries of the Taku River began in 1951. By 1965, surveys were routinely conducted on six index tributaries; beginning in 1974 the methodology was standardized between tributaries (Kissner 1975). Annual estimates of the total number of chinook salmon spawning in the Taku River drainage have been made since 1974 by expanding peak aerial survey counts of index systems to account for that portion of the population not observed in these tributaries (Canada uses the survey counts of the Nakina, Nahlin, Kowatua, Tatsatua, Tseta, and Dudidontu Rivers expanded by a counting factor of two, while the U.S. uses a conversion that assumes that the combined Nakina and Nahlin escapements counts represent 45% of the total escapement).

An adult chinook salmon mark-recapture program was initiated in 1988 to determine the accuracy of these expansion factors. Chinook salmon tagged at Canyon Island are recaptured at weirs located on the Nakina, Kowatua, and Nahlin Rivers and Little Tatsamenie Lake and during carcass surveys at other locations. Marked-to-unmarked ratios of recovered fish will be used to obtain an estimate of the entire Taku River chinook escapement. Samples to estimate age, sex, and length composition of escapements are also obtained

at these sites. Since the sex ratio of the Taku River chinook escapement is variable (CDFO and ADF&G 1987), it is important to estimate this parameter in order to judge the potential production from given escapements. A program was undertaken in 1989 and 1990 using radio tags to estimate the fraction of the chinook population spawning in index tributaries and unsurveyed areas. The program may allow the accuracies of the mark-recapture estimates and the survey count expansions to be evaluated. Information is also being obtained in each principal tributary on migration timing, time of spawning, and the average time that females spent on redds.

The feasibility of using historical escapement data from spawning ground and aerial surveys to develop spawner-recruit relationships for individual spawning populations is being explored. This analysis depends on the assumption that exploitation rates are low and fairly constant between brood years. It is too soon to judge the success of this approach. However, if the stocks are rebuilt, increased harvests resulting from relaxation of time and area fishery restrictions would preclude this type of analysis unless stock identification programs are instituted for the marine fisheries.

The interim above-border spawning goal range for Taku River chinook salmon is 25,600 (U.S. estimate) to 30,000 (Canadian estimate).

In conclusion, while work is going on to improve escapement estimates and to evaluate expansion factors used to estimate total escapement from index escapement, more work in this field is needed. Escapement goals also need to be evaluated.

Coho Salmon

Management objectives for Taku River coho salmon include achievement of spawning escapement goals and the Canadian catch allocation (currently at 3,000 fish per year).

Management. Tagging studies (Gray et al. 1978, Shaul 1987, Elliott et al. 1989) indicate that Taku coho salmon contribute to U.S. commercial troll, seine, gill net and sport fisheries. The harvest occurs almost exclusively in northern Southeast Alaska. Of the U.S. catch, approximately 60% are caught by troll gear and 30% by gill nets. The average annual U.S. catch is thought to be in the order of 100,000 fish. The Canadian catch is restricted by the Treaty Annex so has averaged much less than the U.S. catch.

To monitor exploitation rates, coded-wire-tag programs have been established for indicator stocks in some areas (Yehring Creek in the lower river and Little Tatsamenie Lake and the Nahlin River in the upper river). Tagging at various mainstem locations will determine if migratory routes and timing of these indicator stocks are similar to other Taku coho stocks.

Because Taku River coho salmon are mixed with numerous other coho stocks in U.S. fisheries, no catch estimates are made. Once the run enters the inside waters of Southeast Alaska, assessment of run strength is made from analysis of CPUE data in the District 111 commercial and Juneau area recreational fisheries, both

of which are mixed stock fisheries for which no estimates of catch-to-date for Taku River stocks are made. Regulation of the near-terminal area gill net fishery is based on comparison of current year CPUE data with historical information.

Catches of coho salmon in the Canadian fishery are estimated weekly and are used to manage the fishery to meet catch allocations.

> In conclusion, catch accounting for Taku coho stocks in mixed stock fisheries is lacking. The Taku River is an important producer of coho salmon to fisheries in Southeast Alaska, yet there is little information on the impact of mixed stock fisheries on these stocks. There are currently large differences in guesstimates of interceptions by the two countries.

Escapement Estimation and Goals. For past years, only sporadic aerial and foot surveys of coho spawning in tributaries of the Taku River are available. Currently, index escapement counts are being provided at weirs at Little Tatsamenie Lake in Canada and Yehring Creek in Alaska. Estimates of escapement into the Canadian portion of the river are being developed using adult mark-recapture techniques, but problems exist in capturing fish for tagging and examining fish for tags during the last part of the run.

Run reconstruction data being obtained at Yehring Creek, below the border, and possibly above the border at the Nahlin River and the Tatsamenie Lake system may permit estimation of spawner-recruit relationships for these index systems. Analysis of the distribution and abundance of rearing coho salmon (Thedinga et al. 1988), when coupled with estimates of total available rearing habitat, may also prove useful in establishing escapement goals. The interim above-border escapement goal range is 27,500 (U.S. estimate) to 35,000 (Canadian estimate).

> In conclusion, estimates of total spawning escapement for coho salmon from the Taku River are lacking. Programs are needed to directly estimate total escapement, and to determine individual stock characteristics such as run timing and spawning distribution. Escapement goals need to be evaluated.

Chum Salmon

Management. Virtually all Taku River chum salmon are fall run fish. Most of the U.S. harvest is thought to occur in the District 111 fishery since this is the only fishery in the area which catches large numbers of fall chum salmon. However, the Whiting River, which empties into Port Snettisham, also produces fall run chum salmon, so fall chum catches in District 111 are not all of Taku River origin. There is currently no method of identifying Taku River chum salmon in these catches. Management is based on analysis of CPUE data, assuming that only late-season catches of chum salmon are of Taku River origin.

Canadian catches of chum salmon are small and no programs exist to actively manage the stocks. Catches are monitored weekly during the fishing season while relative abundance information is obtained from the test fishery.

In conclusion, in order to improve management of chum salmon in the mixed stock fisheries off the Taku River, information on the distribution, migratory timing, and magnitude of both Taku and non-Taku River stocks is needed.

Escapement Estimation and Goals. Only limited information is available on the location and importance of chum salmon spawning areas within the drainage. Sporadic aerial surveys have noted concentrations of chum salmon spawning in the King Salmon Flats area along the mainstem Taku River. Other spawning areas along the mainstem Taku River have also been identified above and below the border. Age, sex, and length composition of chum salmon in the escapement is estimated by sampling fish wheel catches.

The feasibility of estimating chum salmon escapements to Canadian portions of the drainage is being determined. Adults are tagged at Canyon Island and recoveries are made in Canadian commercial and test fisheries. The principal problem with this escapement estimation procedure has been that only small numbers of chum salmon have been taken in the fisheries, so the precision of the resulting escapement estimate is very poor. The above-border escapement goal range is from 50,000 (U.S. estimate) to 80,000 (Canadian estimate).

In conclusion, while runs have been low in recent years causing conservation actions in terminal fisheries, our ability to determine spawning escapement levels is very poor. Until our ability to estimate escapement levels improves, evaluation of escapement goals remains a low priority.

Pink Salmon

Management. Taku River pink salmon are harvested in the District 111 fishery along with other wild stocks and, in recent years, with pink salmon from large hatchery releases in the Juneau area. Taku pink salmon are also susceptible to harvest through their main migratory pathway through Icy Strait, around the north tip of Admiralty Island and down Stephens Passage and into Taku Inlet. There is presently no method for separating the catches in these areas into component stocks.

As with chum salmon, management of pink salmon in District 111 is based on CPUE analysis. Early-timed catches of pink salmon in this area are assumed to be of Taku River origin. The accuracy of this assumption is unknown.

Canadian catches of Taku pink salmon are relatively small and this species is not actively managed at present.

In conclusion, although information on catch accounting is poor, the low economic importance of Taku River pink salmon has made research on these stocks of lesser importance. However, lack of information has also resulted in large differences in guesstimates of interceptions of transboundary river pink salmon by the two countries.

Escapement Estimation and Goals. Data from sporadic aerial surveys exist to document escapements of pink salmon in the Taku River. The major pink salmon spawning area is in the Nakina River. Recovery of Canyon Island tags both above and below the Nakina weir now provides the data needed to make estimates of the escapement in odd-numbered years when pink salmon runs are relatively large. Because few fish are tagged and recovered in relation to population size, estimates produced have been imprecise. Returns of Taku River pink salmon in even-numbered years since 1984 have been so poor that mark-recapture estimates have not been attempted. The above-border escapement goal range is from 150,000 (U.S. estimate) to 250,000 (Canadian estimate).

In conclusion, although imprecise, current estimates of pink escapements in the Taku River are probably sufficient for current use of the information.

Alsek River

Proposed field projects for all species on the Alsek River for 1990 are summarized in Table 4. A map of the Alsek River drainage, including principal Canadian and U.S. fishing areas can be found in Figure 3.

Sockeye Salmon

Management. In Alaska, sockeye salmon are a target species by commercial inriver and surf set gill net fisheries occurring at the mouth of the Alsek River. Since 1983, the opening of the Dry Bay fishery has been delayed one to three weeks because of conservation concerns for Alsek River early run sockeye and chinook stocks. Annual monitoring of the catch-by-age is conducted in the Alsek River fishery. No estimates of the stock composition of harvests from this fishery are available.

Alsek River sockeye salmon are also taken in Alaskan set gill net fisheries at Manby Shore and Yakutat Bay, although the portion of Alsek stocks in these catches is unknown. Some Alsek River sockeye salmon may also be taken by the nearby surf fishery of the East Alsek River, but available run timing and age composition data suggest a low level of such interceptions.

Catch-to-date of Alsek River sockeye salmon is determined from on-the-grounds monitoring of catches in the Alsek River fishery. Comparison of current year CPUE with historical data is the basis for fishery regulations. A sockeye abundance model has been developed by the U.S. that provides in-season predictions of the total Alsek River catch and Klukshu escapement. The model incorporates effort, CPUE, and migratory timing data. Predictions have been accurate and are generated early enough in the season to allow managers to reduce fishing effort if the run appears weak. This has proved valuable to U.S. managers since Klukshu weir counts are not available during the fishing season due to the time necessary for fish to migrate from the fishery to the weir.

Catches of sockeye salmon also occur in the Canadian sport and Indian food fisheries. Restrictions have been in place for several years to rebuild the early-timed portion of the run. Catches are monitored in-season. A weir on the Klukshu River provides escapement data needed to help manage the Indian food fishery located upstream and the sport fishery in the area.

Table 4. Proposed Alsek River field projects, 1990.[a/]

Location	Function	Dates	Agency	Responsibility
Klukshu River	Enumerate chinook, sockeye, & coho at adult weir; estimate sport and food fishery catches; collect age-sex-length and CWT's on all salmon species (750 scale samples per species), 100 sockeye brain parasite samples.	5/23-10/20	DFO NMFS	All aspects Analyzes brain samples.
	Coded-wire tag and release approx. 30K juvenile chinook reared at Klukshu hatchery.	8/25	DFO	All aspects pending funding, but ADF&G may assist.
Blanchard, Takhanne, and Klukshu Rivers and Goat Creek	Aerial surveys of spawning chinook salmon in index areas.	8/10	ADF&G	All aspects
Tatshenshini	Coded-wire tag about 20K wild juvenile chinook salmon.	9/01-11/1	ADF&G	All aspects
Village Creek	Enumerate spawning sockeye using an electronic counter.	6/5-10/20	DFO	All aspects
Lower Alsek	Sample commercial catches of all salmon at lower Alsek and East River. Collect age-sex-length data (sockeye-600; chinook-600; coho-500), CWT chinook catches), and collect 200 sockeye brain parasite samples.	6/16-9/15	ADF&G NMFS	All aspects Analyzes brain samples.
Cabin, Tanis, Muddy, and Basin Creeks.	Aerial surveys of spawning sockeye salmon in index areas.	8/01-8/15 10/1-10/15	ADF&G	All aspects

[a] Contacts: Sandy Johnston (DFO) all DFO projects
Pete Etherton (DFO) all DFO projects
Doug Mecum (ADF&G) chinook aerial surveys & wild stock coded-wire tagging
Andy McGregor (ADF&G) Lower Alsek and East Rivers commercial catch sampling

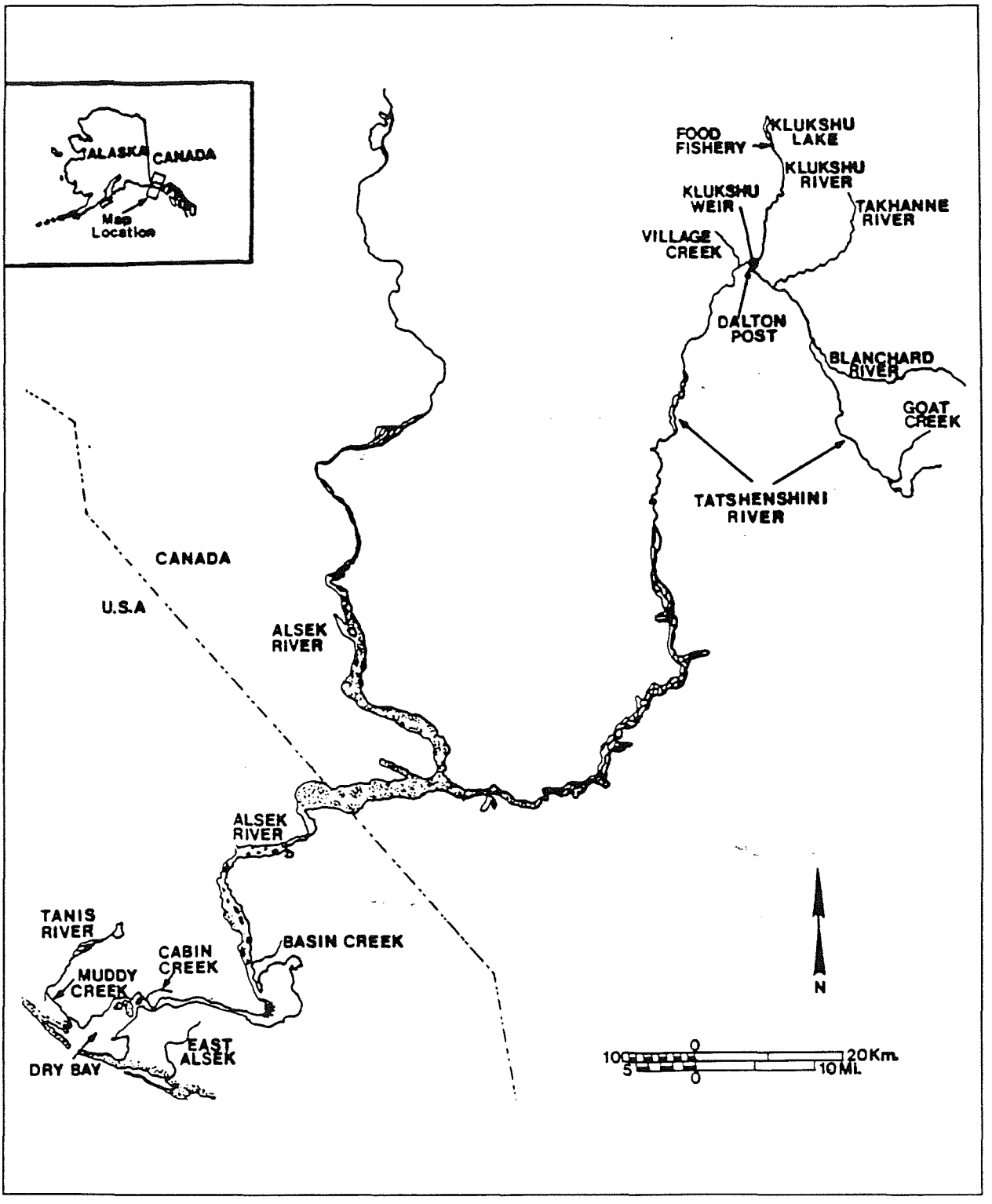

Figure 3. The Alsek River and principal Canadian and U.S. fishing areas.

In conclusion, while catch accounting for Alsek sockeye stocks in the U.S. Alsek fishery is sufficient to monitor returns to that fishery, stock-specific catch accounting in outer areas is non-existent. Information from outer marine catches may help explain the total returns to the Alsek River and provide ways to help conserve the early portion of the run.

Escapement Estimation and Goals. The interim above-border escapement goal range for the Alsek drainage, established by the TBRTC in 1984 (TBRTC 1984), is 33,000 (U.S. estimate) to 58,000 (Canadian estimate). To determine if the escapement goal has been achieved, escapement to the Klukshu Lake is multiplied by an expansion factor to estimate total escapement.

A weir has been operated on the Klukshu River annually since 1976 to provide counts of sockeye salmon migrating into Klukshu Lake. Age, sex, and length data are collected from fish sampled at the weir, so the escapement by age class can be determined. In 1983 an adult sockeye salmon tag and recovery project suggested that 37% of the sockeye escapement to the Alsek River drainage returned to Klukshu (McBride and Bernard 1984). This estimate is substantially lower than the 60% Klukshu contribution previously assumed (TBRTC 1986, 1987a). However, the tagging program did have sampling problems, which reduced confidence in the estimate. At present, both percentage estimates are used, resulting in a range estimate for total escapement.

Escapement monitoring programs on the Alsek River that are conducted annually but are not used to determine total spawning escapement include electronic counts of sockeye escapement into Village Creek (made annually since 1986) and the aerial surveys of several sockeye streams on the U.S. side of the border. Estimates of lake carrying capacity based on return-per-spawner, limnological, and fry-rearing density data are available for Klukshu Lake (TBRTC 1988a). This information suggests that the current escapement goal of about 20,000 sockeye salmon for this system may be higher than needed for optimal production; however, new estimates have not yet been made.

Two runs of Klukshu sockeye salmon (early and late) have been identified. Sockeye salmon passing through the Klukshu weir prior to August 15 are designated as the early run and are considered depressed and in need of conservation. It is not known if the spawning distribution, emergence timing, and potential productivity of the early and late runs differ from each other. Nor is it known whether it is necessary or even feasible to manage for separate escapement goals for the two runs.

In conclusion, information is needed on the proportion of Klukshu stocks to other stocks in the Alsek River in order to determine an expansion factor for estimating the total escapement to the drainage. Escapement goals need to be re-evaluated.

Chinook Salmon

Management. Chinook salmon are harvested in the U.S. Alsek River fishery and the inriver Canadian sport and Indian food fisheries. Unlike Stikine and Taku River chinook salmon, Alsek River stocks have not

responded positively to conservation measures taken in the 1980's to rebuild runs (CDFO and ADF&G 1987). Reasons for this failure are unknown. Migration patterns of Alsek River chinook salmon are unknown. It is not known if Alsek River chinook salmon contribute to the Alaskan troll fishery. A coded-wire-tag study is currently being conducted to determine the contribution of Alsek River chinook salmon to marine fisheries.

Catches in both U.S. and Canadian fisheries are monitored in-season. In the U.S., comparison of current year CPUE with historical data forms the basis for management.

In conclusion, catch accounting of Alsek chinook stocks in the mixed stock fisheries needs to be improved for the nearby fisheries and developed for other fisheries such as the Alaskan troll fisheries.

Escapement Monitoring and Goals. Counts of the chinook escapement into the Klukshu River have been made annually at the Klukshu weir. Age, sex, and length data are collected from fish sampled at the weir, so the escapement by age class can be determined. Estimates of the total number of chinook salmon spawning in the Alsek River drainage have been made by expanding the Klukshu weir count to account for the tributaries not surveyed. Canada and the U.S. use different expansion factors (Canada uses 2.0 and the U.S. uses 1.56); the accuracy of these factors is unknown and needs to be determined (CDFO and ADF&G 1987). Aerial surveys of spawning sites for other chinook stocks are used to augment the Klukshu weir count.

The above-border spawning escapement goal range is 7,200 (U.S. estimate) to 12,500 (Canadian estimate) fish.

In conclusion, escapement estimation for chinook salmon in the Alsek River needs improving, especially since changes in escapement levels need to be monitored in order to evaluate rebuilding efforts for these stocks. However, since rebuilding appears to be failing in the Alsek River despite conservation measures being taken, it is probably more important to re-evaluate escapement goals in light of possible changes in habitat and potential productivity of the system.

Coho Salmon

Management. Alsek River coho salmon are targeted by U.S. Dry Bay and surf fisheries late in the season. The contribution of Alsek River coho salmon to Alaskan troll fishery catches is unknown, thus no annual catch accounting is possible at present. Small numbers of coho salmon are taken in the Canadian sport fishery, while the species is generally not harvested in the Canadian Indian food fishery.

Catches are monitored during the season in both Canadian and U.S. fisheries. In the U.S. fishery, comparison of current year CPUE with historical values is used to help manage the fishery.

In conclusion, catch accounting for Alsek coho stocks in marine catches is lacking and needs to be developed. Exploitation rates on these stocks is unknown.

Escapement Estimation and Goals. Coho salmon are counted through the Klukshu weir; however, icing conditions late in the fall have precluded obtaining complete counts of this run. Aerial survey data are available for several coho salmon systems on the U.S. side of the border, but the data are incomplete. The interim above-border spawning goal range for the Alsek system is 5,400 (U.S. estimate) to 25,000 (Canadian estimate).

In conclusion, escapement data for coho salmon in the Alsek River are sketchy, but research on escapements is presently a low priority because of high costs and low fish abundance.

Other Transboundary Rivers

There are no harvest regimes specified within the Treaty for salmon stocks from transboundary rivers other than the Stikine, Taku, and Alsek Rivers. Information on the salmon resources from the Canadian portions of these rivers is very limited and few investigations on these systems have been undertaken. There is anecdotal information on the presence of sockeye and chum salmon in the Canadian portions of the Whiting River. Chinook salmon has been seen spawning in the Canadian portions of the Unuk and Chilkat Rivers, but there is no information as to distribution or abundance within the watersheds. All species of salmon spawn in Canadian portions of the Unuk River, but at unknown levels. There is very little information available on the contribution of salmon from these other transboundary rivers to U.S. fisheries.

As there are presently no Canadian fisheries on these systems, available research funding within Canada has been directed elsewhere. There is a U.S. program underway to determine exploitation rates, harvest distribution, and migratory patterns of chinook salmon that rear within the U.S. sections of the Chickamin and Unuk Rivers.

Because of the paucity of information on the presence and abundance of salmon species in these rivers and on the amount of available spawning habitat, development of spawning escapement goals has not been attempted for any species from these rivers.

In conclusion, the almost complete lack of information from these systems suggests that general spawning escapement surveys should be conducted first for each system.

CHAPTER 3. IMMEDIATE RESEARCH PLANS AND GOALS

In the preceding chapter, research and monitoring activities currently being carried out were described. Just about all of those programs need to be continued on an annual basis in order to carry out the harvest sharing arrangements and conservation concerns stipulated by the Treaty. Some of the work in escapement estimation and stock identification is more exploratory in nature with the aim of providing better information and methods in the future. In this chapter, research that has been started but needs additional years of work is discussed in terms of best use of time, effort, and money.

Radio telemetry has been used for several years now in the Taku River to monitor the movement of chinook and sockeye salmon and the potential of this technique for other species and rivers is obvious. For both economic and logistic reasons, it is probably best to finish studies in the Taku River before starting in another system. GSI techniques combined with other biological markers have the potential to improve the characterization of sockeye stocks. There also are potential applications for estimating mixtures of salmon stocks in mixed stock fisheries. Tissue samples have been taken from salmon from many spawning sites in order to build up a database of stock standards based on genetic stock identification techniques. There are still some representative stocks that need to be sampled and many tissues that remain to be analyzed before this stock composition technique may be used for analysis of mixed stock catches. Joint enhancement is a relatively new activity and research is in the stage of adapting and expanding to meet needs. Several studies have been done on carrying capacity and disease potentials in different lakes. Now that enhancement sites have been chosen and the first eggs incubated, studies must be directed to marking and identifying enhanced fish, survival of enhanced fish, and effects of enhanced fish on wild stocks in the area. Understandings between the U.S. and Canada have stipulated joint enhancement projects on the transboundary rivers and the enhanced fish must be marked and monitored in the returns such that harvest sharing regimes may be followed by both Parties and that wild stocks can be protected from negative impacts from enhancement.

Radio Telemetry

Radio telemetry has been an effective technique for studying salmon in large, turbid rivers where access and visibility are limited as it provides detailed information that can not be obtained using other methods. Work in 1990 will complete an intensive two-year telemetry study on Taku River chinook salmon and provide data on stock composition, run timing of the various stocks, movement patterns, and information needed to evaluate escapement estimates from aerial surveys of established index spawning areas.

Based on discussions by the TBRTC, other data needs exist that can best be addressed with radio telemetry. In particular, information is needed on Taku River coho salmon and Stikine River chinook salmon. Although Taku River coho salmon are commercially harvested by both the U.S. and Canada, limited information is available on escapement, inriver distribution, and stock timing. Conservation concerns over Stikine River chinook salmon prompted the elimination of terminal area commercial fisheries during the mid-1970's, but similar information on escapement, distribution, and timing is needed to assess the progress of rebuilding efforts and manage chinook stocks.

Due to the lead time needed for large-scale telemetry projects, it is desirable to establish research priorities in advance so that preparations can be made. Trends in escapement of chinook salmon to the Stikine River have been consistent with objectives of the chinook rebuilding program and fisheries and it is feasible that increased fishing on these stocks may be allowed through the Treaty process after 1998. It will be important for the wise development of any new fisheries to have additional information on spawning distributions and individual stock timing. Telemetry studies have been conducted on the Taku River since 1984, thus the support and equipment needed to conduct these types of chinook studies on the Taku River are in place. The costs of moving this program to a different river system are substantial. Completing telemetry work on the Taku River (e.g. studies on Taku River coho salmon) before moving to a new system is a more efficient use of funds.

Preliminary work is needed to prepare for projects on both Taku River coho salmon and Stikine River chinook salmon to avoid major logistical problems during the first year of a large-scale study. In particular, efficient means of capturing fish for tagging need to be developed. In addition, because telemetry studies are relatively short-term, research programs by NMFS, ADF&G, and CDFO should be designed to maximize the information obtained for the river and species being studied.

The following recommendation are made:

1. Telemetry studies be conducted on Taku River coho salmon during the 1991 and 1992 seasons; work on Stikine River chinook salmon would be planned for 1993 and 1994.

2. Methods for capturing and tagging Taku River coho salmon and Stikine River chinook salmon be developed in preparation for work on these species.

3. Research programs on the transboundary rivers be designed to maximize the information obtained in conjunction with telemetry studies.

Genetic Stock Identification

Cooperative stock identification studies by the United States and Canada on northern area salmon have been conducted since 1982 and now continue under the Pacific Salmon Treaty. In these coordinated studies, each country is establishing baseline data and evaluating biological markers provided by scale, parasite, and genetic characters for use in discerning proportions of stocks in mixture samples. Significant progress has been achieved in establishing baseline stock identification data for northern area sockeye, pink, chum, and chinook salmon.

For the transboundary rivers, stock identification methods are needed that tell us what the stock composition is in weekly fishery catches and escapements. The first step is to complete the baseline for each river by sampling adults on the spawning grounds. Analysis of the baseline data will tell us if we can identify stocks in fishery and escapement samples.

The TBRTC places highest priority on completing the baseline data for sockeye and chinook salmon in each river. Information on chum and pink salmon stocks is needed but presently has a lower priority for the transboundary rivers. Coho salmon stock identification is a priority also because we have less information for this species than the others. Preliminary results from GSI studies on southern coho stocks has shown promise for expanding the work to northern stocks.

Enhancement

Plans to carry out the sockeye enhancement projects on the Stikine and Taku Rivers are well established TBRTC (1987c, 1989b). Specific areas that must be addressed over the next two years include:

1. Completion of the permanent Snettisham CIF. Interim facilities are currently in use.

2. Obtaining approval from Canadian regulatory agencies for the planting of Tahltan Lake sockeye salmon fry into Tuya Lake.

3. Evaluation of the success and impact of the sockeye fry planting. Fry to smolt survivals will be determined. The carrying capacity of the respective lakes will be refined. Adult return forecasts will be generated.

4. Completion of plans for smolt sampling. Information will be collected to enumerate the smolt emigration and determine run timing, age class distribution, size, verification of the otolith mass mark, and marked to unmarked ratios when natural stocks are present.

5. Establishment of a laboratory for the analysis of the otolith mass mark. The associated personnel must be trained and a protocol established for the recovery and timely analysis of the mass mark.

6. Identification of additional enhancement opportunities in both the Stikine and Taku River systems. These studies should be expanded to include chinook and coho salmon.

CHAPTER 4. GOALS AND PRIORITIES FOR NEW RESEARCH PROJECTS

In this chapter we present the Transboundary Technical Committee's current evaluation of the long-term research goals for the transboundary rivers for projects not currently being addressed. The Committee identified and prioritized research needs for each river system and species during its February 27 to March 1, 1990, meeting. In addition to the four transboundary river systems (Stikine, Taku, Alsek, and "other rivers"), enhancement research needs were also identified. Results are presented in Table 5 and the rationale used to develop the rankings is provided in the text of this chapter.

Research Categories

Research needs for each species were organized into the following three categories: escapement estimation, catch accounting, and escapement goals. Enhancement research needs were identified separately for sockeye salmon and for other species. Categories for enhancement included enhancement potential, run forecasting, and catch accounting. Research programs were suggested for obtaining information related to each identified research need and rough estimates of annual costs, feasibility of success (ranked poor to good), and duration (years) of the proposed programs were developed. For each river system, research needs were prioritized numerically (one is highest, four is lowest) for each species and then across species using the above information. Next we provide a brief description of each research category, followed by the Committee's recommendations for long-term research.

Escapement Estimation

Escapement estimation is the process of determining the size of the spawning population for an individual stock or an entire river system. Knowledge of escapement magnitude provides a measure of the success of management for stock conservation. Research methods which are recommended to develop this information on the transboundary rivers include radio telemetry, mark-recapture, test fishery CPUE, test fishery CPUE combined with stock identification, fish wheel CPUE, and aerial escapement index surveys.

Catch Accounting

Catch accounting is a process of monitoring catches in fisheries by area and through time. Since most transboundary river salmon stocks are harvested in mixed stock fisheries some method of stock identification is usually required. The typical research methods used for catch accounting are coded-wire-tagging studies and stock identification. Coded-wire-tagging studies are used to determine exploitation rates, harvest distributions, and migratory patterns. Stock identification techniques include electrophoresis (GSI), scale pattern analysis, parasite prevalence, and nuclear and mitochondrial DNA analysis. Stock identification

Table 5. Long-term research needs on transboundary rivers. Species and research needs are listed in decreasing order of importance.

System	Species	Research Need	Suggested Method	Potential Cost (1,000's)	Feasibility	Duration (Years)	Priority Need Within Species	Priority Species by River
Stikine	Chinook	Escapement Estim.	Radio Tag	150-250	Good	2	1	1
			Mark/Recap.	50-100	Good	2		
			Test Fish/I.D.	25-50	Good[b/]	2		
		Escapement Goals	Data Analysis	10	Good	1	2	
			Habitat Survey	150-200[a/]	Fair	3		
		Catch Accounting	CWT	50-100	Good	5	3	
			Stock ID	20-50	Fair	3		
	Coho	Escapement Estim.	Radio Tag	150-250	Good	3	1	2
			Mark/Recap.	50	Fair	2		
			Test Fish CPUE	20	Fair	5		
		Catch Accounting	CWT	50-100	Fair	5	2	
			Stock ID	40	Poor	3		
			Test Fish CPUE	20	Fair	3		
Taku	Coho	Escapement Estim.	Radio Tag	150-250	Good	3	1	1
			Mark/Recap.[c/]	50	Poor	3		
			Test fish/CPUE	20-50	Fair	5		
		Catch Accounting	CWT (mainstem)	50-100	Fair	5	2	
			CWT (index)	150-200	Fair	5		
		Escapement Goals	Habitat surv.	50	Good	3	3	
	Chinook	Escapement Estim.	Fishwheel/CPUE	20	Good	3	1	2
		Escapement Goals	Habitat surv.	150	Fair	3	2	
		Catch Accounting	CWT	50-100	Good	5	3	
			Stock ID	40	Fair	3		
			Sport harvest	20	Good	5		
	Chum	Escapement Estim.	Mark/Recap.	15	Fair	2	1	3
			Test Fishery	10	Fair	5		
		Catch Accounting	Stock ID	50	Fair	3	2	
	Pink	Catch Accounting	CWT	100	Good	3	1	4
			Adult tagging	250	Good	3		
Alsek	Chinook	Escapement Goals	Habitat survey	150	Fair	2	1	1
			Data analysis	10	Fair	1		
		Catch Accounting	CWT	50	Good	5	2	
			Stock ID	25	Fair	3		
		Escapement Estim.	Test fish/I.D.	20	Good	3	3	
			Radio Tag	150	Good	2		

--Continued--

Table 5. (page 2 of 2.)

System	Species	Research Need	Suggested Method	Potential Cost (1,000's)	Feasibility	Duration (Years)	Priority Need Within Species	Priority Species by River
Alsek (Cont.)	Sockeye	Catch Accounting	CWT	40	Good	5	1	2
			Stock ID	30	Fair	1		
		Escapement Goals	Data analysis	5	Fair[d/]	1	2	
		Escapement Estim.	Mark/Recap.	60	Fair	2	3	
			Radio Tag	150-250	Good	3		
	Coho	Catch Accounting	CWT (Klukshu)	40	Fair	5	1	3
		Escapement Estim.	Radio Tag	150-250	Good	3	2	
			Aerial index	30	Fair	5		
			Mark/Recap.	30	Poor	2		
Other TBR's		All Spec.	Escapement Estim.	Various 100		Good	5	1
		Catch Accounting	Various	100-200	Good	5	2	
Enhancement		Sockeye	Enhance. Potential	Lake studies	50	Good	1	1
		Run Forecast	Data analysis	10	Fair	1	2	
		Catch Accounting	Otolith [e/]	100	Good	5	3	
	Other Sp.	Enhance. Potential	Various	50	Good	2	2	

[a/] Contingent on stock I.D. feasibility
[b/] Less cost per species if more than one included.
[c/] Escapement below border needed.
[d/] Klukshu River only.
[e/] Mixed stock sockeye fisheries (e.g., District 104).

techniques have been established for some transboundary river sockeye salmon stocks; however, application of stock identification methodologies to other salmon species in the transboundary rivers is in the developmental stage.

Escapement Goals

Interim escapement goals have been established by the Transboundary Technical Committee. The interim goals are preliminary in nature since they are based largely on professional judgement of the quantity and quality of available spawning and rearing habitat, observed patterns in the distribution and abundance of spawning fish, and historical patterns in near terminal marine gill net fisheries.

These goals need to be evaluated and refined if necessary to optimize production of transboundary river salmon stocks. Research methods which can be used to evaluate escapement goals include long-term catch and escapement monitoring, habitat surveys, and analysis of existing run reconstruction data sets.

Enhancement Research

Enhancement research needs for the transboundary rivers were identified separately for sockeye salmon and for other species. Studies of the physical and biological characteristics of lakes considered for sockeye enhancement are requisite to proper implementation of such enhancement programs. Improvement of run forecasting will become important when enhanced stocks return. Research into improved methods of catch accounting are imperative so that enhanced runs can be shared according to international harvest sharing agreements.

Stikine River

Chinook and coho salmon research needs were identified for the Stikine River. Research needs were limited to these two species. Stikine sockeye salmon research is considered to be well developed; therefore, research needs were not identified for this species, although reviewing sockeye escapement goals as more data becomes available will be done within the TBRTC. Since pink and chum salmon runs to the Stikine River are small and of limited economic importance, research needs were not identified for these species either.

Chinook research was ranked as most important for this river system. Conservation measures taken in marine fisheries in the 1980's appear to have been successful in permitting these stocks to rebuild. The total annual Stikine River chinook escapement remains unknown although indices of escapement have been developed, including operation of the Little Tahltan weir and aerial spawning ground surveys. The highest ranked need for Stikine chinook salmon was to improve escapement estimation procedures. The accuracy of expansion factors used for expanding escapement indices to estimate escapements needs to be determined and, when

fishery restrictions are relaxed, in-season estimates of escapement will become necessary. Examination of escapement goals was ranked second in importance. The Technical Committee recognized the importance of assessing the existing escapement goal to ensure optimal production from these stocks. Catch accounting was ranked lowest in importance. A limited historical coded-wire-tag data base exists for these stocks, providing some migratory timing and distribution information for marine fisheries. Until fishery restrictions are relaxed following stock rebuilding, catch accounting of Stikine River chinook salmon will remain a lower priority.

Very little is known about Stikine River coho salmon. Escapement estimation was ranked as the most important need. Spawning distribution, migratory timing, and escapement abundance are all poorly understood. Catch accounting was identified as the second most important research need for coho salmon. Historical coded-wire-tagging experiments have demonstrated marine harvest distributions but exploitation rates and harvest estimates remain unknown. Examination of interim escapement goals for Stikine River coho salmon was not considered important because of the lack of information available about escapements and catches of these stocks.

Taku River

For the Taku River research needs were identified for all salmon species except sockeye salmon. Since stock assessment programs for sockeye salmon are relatively well developed, the Committee did not identify research needs for this species, although reviewing sockeye escapement goals as more data becomes available will be done within the TBRTC. Coho research was rated as the top priority for the Taku River, followed by chinook, chum, and pink salmon.

The highest ranked research need for Taku River coho salmon was improving escapement estimates. Mark-recapture studies are currently used to estimate escapements into Canadian portions of the drainage. Escapements to U.S. portions of the drainage are largely unknown. A thorough study of spawner distribution and total escapement in the Taku River drainage is needed. Catch accounting was ranked as the second priority. The Taku River is among the largest contributors of coho salmon to fisheries in Southeast Alaska. Extensive coded-wire tagging of index stocks in the drainage has revealed migratory routes and allowed exploitation rates for these stocks to be determined. However, the estimated total contribution of Taku River stocks to marine fisheries is unknown. Differences in Canadian and U.S. estimates of the marine interceptions of Canadian Taku River coho salmon, reported by the Joint Interceptions Committee to the Pacific Salmon Commission, comprise 79% of the difference for U.S. interceptions of all transboundary river coho stocks. Escapement goals were ranked third in priority. Completion of habitat studies, together with improved escapement estimation and catch accounting, would allow the interim escapement goal to be evaluated.

The highest priority for chinook research was escapement estimation. Taku River chinook stocks are responding to conservation measures taken to rebuild runs and, when fishing restrictions are relaxed, in-season estimates of escapement will become necessary for effective management. Examination of escapement goals was ranked as the second most important research need. Studies of the utilization of spawning and rearing areas would be valuable in assessing escapement goals. Catch accounting of chinook salmon was ranked third in importance. Extensive coded-wire-tagging studies in the 1980's provided good migratory timing and

distribution information. If marine fishery restrictions are relaxed, development of marine catch accounting will be important.

The stock status of Taku River chum salmon is very poorly understood. Runs in recent years have been low causing restrictions in terminal marine fisheries and concern for the health of these stocks. Improvement in escapement estimation procedures for chum salmon was ranked as the highest priority for this species. Catch accounting was also identified as a need since marine harvests occur in mixed stock areas and have not been accurately estimated. Research on escapement goals was not considered important at this time due to the paucity of stock assessment data available and the comparably low economic value of chum salmon relative to runs of other Taku River salmon species.

Taku River pink salmon runs are of economic importance only in odd-numbered years. Catch accounting was the only research need specified for pink salmon. Several Southeast Alaska fisheries harvest Taku pink salmon, but programs to generate interception estimates have not been developed. Large differences exist in the Canadian and U.S. estimates of the U.S. marine harvest of Taku River pink salmon; these differences represent 88% of the total difference between the two nations' estimates of the U.S. catch of transboundary river pink salmon.

Alsek River

Research needs for the Alsek River were identified for chinook, sockeye, and coho salmon. Pink and chum salmon runs to the Alsek River are extremely small and did not warrant consideration for future research. Chinook salmon research was ranked as the highest priority, followed by sockeye and then coho research.

Unlike the Stikine and Taku River runs, Alsek River chinook salmon do not appear to have responded to rebuilding efforts. Reasons for the failure of the run to increase are unknown. It is possible that Alsek River chinook stocks have not rebuilt because of overfishing; high seas exploitation may be a factor. However, it also is possible that optimal escapements are currently being achieved or that productivity of the Alsek River has changed. With this in mind, examination of escapement goals was given the highest priority for Alsek River chinook research. Continuation and improvement of catch accounting was rated as the second priority. Escapement estimation was ranked as the lowest priority. Development of an inriver stock identification program could potentially provide estimates of the inriver catch by stock and, by combining results with Klukshu River weir counts, permit the total Alsek River escapement to be estimated.

Catch accounting was rated as the highest priority for sockeye salmon. Interception rates of Alsek River sockeye salmon in marine fisheries in the Yakutat area are unknown. Examination of the interim escapement goal was rated as the second priority and could be accomplished by continuing to collect spawner-recruit and lake productivity data for Klukshu Lake for future analysis. Escapement estimation was also identified as a research need. The Klukshu weir currently serves as an index of the Alsek River escapement, but the proportion of the total run comprised by this stock has not been rigorously examined and the spawner distribution within the drainage is not well documented.

Catch accounting was rated as the highest priority for Alsek River coho salmon. Marine exploitation rates for this species are not known. Escapement estimation was regarded as a lower priority because the run is thought to be fairly small and the costs of developing an effective escapement estimation program would be extremely high. Research into escapement goals was not considered important due to the lack of more basic stock assessment data.

Other Transboundary Rivers

Very little is known about returns of any salmon species to other transboundary rivers of Southeast Alaska and northwestern British Columbia. Research into escapement monitoring was given the highest priority for these systems. Catch accounting was listed as a secondary priority and would be necessary only for those systems and species documented to have escapements sufficient to produce substantial returns.

Enhancement

Enhancement research needs for the transboundary rivers were identified separately for sockeye salmon and for other species. Research needs related to enhancement of sockeye salmon were given the highest priority. Studies of the physical, chemical, and biological characteristics of lakes considered for sockeye salmon enhancement are prerequisites to proper implementation of such enhancement programs. Sampling of lakes in the Taku and Stikine River drainages may reveal new or revised lists of lakes for potential enhancement and would further assessment of the enhancement projects that are the best to implement; thus, studies of enhancement potential were given the highest priority. Monitoring the freshwater survival will determine the success of the freshwater portion of the program and provide important information on optimal stocking densities. It will also provide key information for generating adult return forecasts. Improvement of run forecasting was rated as the second most important need and will become extremely important when enhanced stocks return. Research into improved methods of catch accounting are imperative so that enhanced returns can be shared according to international harvest sharing arrangements. Continued development of thermal marking technology of otoliths offers promise for providing estimates of the contribution of enhanced stocks to non-terminal marine fishery harvests, data which are not currently available and is now extremely difficult and expensive to collect. Research on the enhancement potentials for other salmon species on the transboundary rivers was also identified as a priority, although specific programs to accomplish this work were not identified.

Long-term enhancement research goals on transboundary rivers should focus on three objectives. The first is to produce enough sockeye salmon through enhancement to increase benefits to the fisheries of both countries without adversely affecting habitat and wild stocks. The next step is to develop mechanisms that maximize the harvest of enhanced fish without overharvesting the wild stocks. Finally, additional enhancement opportunities need to be identified that benefit both Parties.

CHAPTER 5. SUMMARY

Current research and monitoring programs on transboundary river salmon stocks are primarily oriented towards sockeye salmon because of the existence of international harvest sharing agreements for returns of this species to the Taku and Stikine Rivers. Research on sockeye salmon has resulted in the development of escapement monitoring and stock identification programs, and in-season management systems. This research is necessary annually to fulfill international harvest sharing arrangements and conservation measures stipulated by the Pacific Salmon Treaty.

Substantial research and monitoring is also conducted on transboundary chinook and coho salmon stocks. Chinook salmon programs have generally involved monitoring of escapements to assess the success of the cooperative coastwide escapement rebuilding program. Most of the escapement estimation programs within the Alsek, Stikine, and Taku Rivers are conducted on index systems; relating the production of these index sites to that of the entire drainages is an area of research currently being highlighted. Research on coho salmon has been primarily focused on determining harvest rates and monitoring escapements of index stocks.

Little research on pink and chum salmon stocks has been conducted due to the reduced economic value of these runs particularly in the Stikine and Alsek Rivers. Escapement monitoring programs have been instituted for these species on the Taku River.

Current research on "other" transboundary rivers, including the Unuk, Chickamin, Whiting, and Chilkat Rivers is limited to U.S. programs designed to determine exploitation rates and harvest patterns of chinook salmon rearing in U.S. sections of the Unuk, Chickamin, and Chilkat Rivers. No commercial fisheries exist in these rivers and virtually no data exist on their salmon production; therefore, little research has been funded to examine the current or potential productivities of salmon stocks which they support.

Research programs are generally meeting our current management obligations for sockeye salmon, but additional assessment programs and management systems need to be developed for chinook and coho salmon to effectively manage these stocks. Many issues involved with new cooperative international sockeye salmon enhancement projects need to be addressed. Additionally, questions regarding estimates of the interceptions of transboundary river stocks exist which can realistically only be solved by new research.

Several transboundary river research programs begun in recent years promise to yield important results. Short-term plans and goals for these projects were reviewed by the TBRTC. Radio telemetry has been used to document run timing, spawner distribution, and to assess escapement estimation reliability of Taku River sockeye and chinook salmon stocks. Though radio telemetry is costly, it has proven to be an effective technique for acquiring such information from the large, turbid transboundary rivers where no other comparable techniques are available. For logistical and monetary considerations, the TBRTC recommends conducting telemetry studies in 1991 and 1992 on Taku River coho salmon before initiating telemetry studies on Stikine River chinook salmon in 1993 and 1994. Genetic stock identification combined with other biological markers offers promise in providing improved stock composition data. The TBRTC recommends completing the collection, processing, and analysis of the chinook and sockeye GSI baselines as the most important short-term goals for this research. Research related to enhancement activities on the Taku and Stikine Rivers is being

initiated in a wide variety of areas. The TBRTC recommends specific areas that need to be addressed over the next two years, including evaluating the success and impact of sockeye fry stocking, developing a laboratory for analysis of otolith mass marks, and identification of further enhancement opportunities in the Taku and Stikine Rivers.

The TBRTC prioritized long-term research needs not currently being addressed for the transboundary rivers. Chinook salmon research is rated as the highest priority for the Stikine and Alsek Rivers. Improving escapement estimates is the highest ranked priority for the Stikine River, while examination of escapement goals is ranked as most important for the Alsek River. Coho salmon research is ranked as the highest need for the Taku River, with improved escapement estimation identified as the highest priority. Long-term research needs for sockeye salmon are listed only for the Alsek River, where improved catch accounting, examination of escapement goals, and improved escapement estimation are ranked in order of decreasing importance. Research needs related to improving escapement estimates and catch accounting of Stikine and Alsek River coho salmon are identified, as are needs for Taku River chinook, chum, and pink salmon. For the "other" transboundary rivers, escapement monitoring is given the highest priority. Most enhancement-related research needs are for sockeye salmon, including studies on the enhancement potentials of new and current candidate lakes, improvement of run forecasting necessary for developing harvest management systems when enhanced returns come on-line, and further development of thermal mass-mark processing technology. Research into the enhancement potential of other species in the transboundary rivers is also identified as a need.

LITERATURE CITED

Canadian Department of Fisheries and Oceans and Alaska Department of Fish and Game (CDFO and ADF&G). 1987. Review of natural chinook salmon escapement trends in transboundary rivers of northern British Columbia and Southeast Alaska. Report prepared for the joint U.S./Canada Northern Panel of the Pacific Salmon Commission. February 12, 1987.

Eiler, J., B. Nelson, R. Bradshaw, J. Greiner, and J.Lorenz. 1988. Distribution, stock composition and location and habitat type of spawning areas used by sockeye salmon on the Taku River. N.W.A.F.C. Processed Report 88-24. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Auke Bay Laboratory. Auke Bay, Alaska.

Elliott, S., A. Schmidt, D. Sterritt, and P. Suchanek. 1989. A study of coho salmon in Southeast Alaska. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series No. 113. Juneau, Alaska.

Gray, P., K. Florey, J. Koerner, and R. Marriott. 1978. Coho salmon (*Oncorhynchus kisutch*) fluorescent pigment mark-recovery program for the Taku, Berners, and Chilkat Rivers in Southeast Alaska (1972-1974). Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 176. Juneau Alaska.

Jensen, K.A. and I.S. Frank. 1988. Stock compositions of sockeye salmon catches in southeast Alaska's Districts 106 and 108 and in the Stikine River, 1987, estimated with scale pattern analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 88-13. Juneau, Alaska.

Jensen, K.A. and I.S. Frank. 1989. Stock compositions of sockeye salmon catches in southeast Alaska's Districts 106 and 108 and in the Stikine River, 1988, estimated with scale pattern analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J89-44. Juneau, Alaska.

Jensen, K.A., I.S. Frank, and G.T. Oliver. 1989. Stock compositions of sockeye salmon catches in southeast Alaska's Districts 106 and 108 and the Stikine River, 1986, estimated with scale pattern analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical fishery Report 89-02. Juneau, Alaska.

Kissner, P. 1975. A study of chinook salmon in southeast Alaska. Alaska Department of Fish and Game, Division of Sport Fish, Annual Report 1974-1975, Project F-9-7, 16 (AFS-41). Juneau, Alaska.

McBride D. and D. Bernard. 1984. Estimation of the 1983 sockeye salmon (*Oncorhynchus nerka*) return to the Alsek River through analysis of tagging data. Alaska Department of Fish and Game, Technical Data Report No. 115. 24 pp. Juneau Alaska.

LITERATURE CITED (Cont.)

McGregor, A. and S. Walls. 1987. Separation of principal Taku River and Port Snettisham sockeye salmon (*Oncorhynchus nerka*) stocks in Southeast Alaska and Canadian fisheries based on scale pattern analysis. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 213. Juneau, Alaska.

Moles, A., P. Rounds, and C. Kondzela. 1989. Use of brain parasite *Myxobolus neurobius* in separating mixed stocks of sockeye salmon. Proceedings of the 1987 International Tagging Symposium. Special Publication of the American Fisheries Society.

Murphy, M., K. Koski, J. Lorenz, and J. Thedinga. 1988. Migrations of juvenile salmon in the Taku River, Southeast Alaska. N.W.A.F.C Processed Report 88-31. Northwest Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Auke Bay Laboratory. Auke Bay, Alaska.

Shaul, L. 1987. Taku and Stikine River coho salmon (*Oncorhynchus kisutch*) adult escapement and juvenile tagging investigations, 1986. Final Report, 1986. Salmon research conducted in Southeast Alaska by the Alaska Department of Fish and Game in conjunction with the National Marine Fisheries Service, Auke Bay Laboratory for joint U.S./Canada interception studies. Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau, Alaska.

Shaul, L.S., P.L. Gray, and J.F. Koerner. 1984. Migratory patterns and timing of Stikine River coho salmon (*Oncorhynchus kisutch*) based on coded-wire tagging studies, 1978-1982. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 232. Juneau, Alaska.

Thedinga, J., M. Murphy, and K. Koski. 1988. Seasonal habitat utilization by juvenile salmon in the lower Taku River, Southeast Alaska. N.W.A.F.C. Processed Report 88-32. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, Auke Bay Laboratory. Auke Bay, Alaska.

Transboundary Technical Committee (TBRTC). 1984. Report of the Canada/U.S. Transboundary Technical Committee. Prepared for the Advisors to the U.S./Canada Negotiations on the Limitations of Salmon Interceptions. December 3, 1984.

Transboundary Technical Committee (TBRTC). 1986. Report of the Canada/United States Transboundary Technical Committee. Final Report. February 5, 1986. Pacific Salmon Commission. Report TCTR (86). Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1987a. Report of the Transboundary Technical Committee. February 8, 1987. Pacific Salmon Commission. Report TCTR (87)-1. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1987b. Report of the Transboundary Technical Committee. Stikine River Sockeye Salmon Management Plan 1987. April 1987. Pacific Salmon Commission. Report TCTR (87)-2. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1987c. Report of the Transboundary Technical Committee. Enhancement Opportunities for the Transboundary Rivers. April 28-30, 1987. Report TCTR (87)-3. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1987d. Report of the Transboundary Technical Committee. Taku River Sockeye Salmon Management Plan 1987. April 27 - May 1, 1987. Pacific Salmon Commission. Report TCTR (87)-4. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1988a. Sockeye salmon enhancement feasibility studies in the transboundary rivers. Pacific Salmon Commission. February 1988. Report TCTR (88)-1. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1988b. Salmon management plan for the transboundary rivers, 1988. Pacific Salmon Commission. May 1988. Report TCTR (88)-2. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1988c. Salmon catches and escapements to the transboundary rivers in 1987. Pacific Salmon Commission. November 1988. Report TCTR (88)-3. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1989a. Salmon management plan for the Stikine, Taku, and Alsek Rivers, 1989. April 1989. Pacific Salmon Commission. Report TCTR (89)-1. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1989b. Progress report and recommendations for joint Canada/U.S. sockeye salmon enhancement projects in the Stikine and Taku River drainages. May 1989. Pacific Salmon Commission. Report TCTR (89)-2. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1989c. Preliminary salmon catches, escapements, and enhancement activities in the transboundary rivers in 1989. November 1989. Pacific Salmon Commission. Preliminary Report.

Transboundary Technical Committee (TBRTC). 1990a. Salmon catches and escapements in the transboundary rivers in 1988. Pacific Salmon Commission. March 1990. Pacific Salmon Commission. Report TCTR (90)-1. Vancouver, B.C., Canada.

Transboundary Technical Committee (TBRTC). 1990b. Salmon management plan for the Stikine, Taku, and Alsek Rivers, 1990. April 1990. Pacific Salmon Commission. Report TCTR (90)-2. Vancouver, B.C., Canada.

LITERATURE CITED (Cont.)

Transboundary Technical Committee and Northern Boundary Technical Committee (TBRTC and NBTC) 1987. Stock identification of sockeye salmon using biological markers. February 1987. Pacific Salmon Commission.. Report TCNB/TR (87)-1. Vancouver, B.C., Canada.

Wood, C.C., B.E. Riddell, and D.T. Rutherford. 1987. Alternative juvenile life histories of sockeye salmon (*Oncorhynchus nerka*) and their contribution to production to the Stikine River, Northern British Columbia, Canada. Canadian Special Publications in Fisheries and Aquatic Sciences 96:12-24.