



To: Distribution
A

From: F.E.A. Wood
De: Director
Program Planning & Economics Branch

Security Classification - Classification de sécurité	
Our File - Notre référence	
Your File - Votre référence	
Date	94/6/21

Subject: **Terminal Fisheries Quality and Financial Viability Study**
Objet:

Please find attached a report written by my staff, Elisabeth Wipfli and Kaarina McGivney. The report describes the results of a study aimed at determining whether fish harvested at selected in-river locations are of an acceptable quality to be marketable and if so, whether such fisheries would be financially viable. Factors influencing the decisions on in-river fisheries include:

- Mixed and stock specific management requires limiting harvest rates in mixed stock fisheries to the sustainable levels of the weaker stocks and/or selectively harvesting the more productive stocks, often in freshwater.
- Native claims and interim settlements suggest that most of the native groups living in interior areas will seek increases in and the right to sell their catch.
- Since tourism and sport fisheries have seen a dramatic increase in their contribution to the B.C. economy, recreational harvesters will be seeking more salmon in the interior.

While the topic of in-river salmon fisheries is controversial, I believe that it is important to gather relevant information (e.g. quality and value of fish at various locations) and make it generally available to facilitate an informed debate. Given the nature of our salmon fisheries and the aspirations of stakeholders, it is likely that the debate amongst all interests will intensify over the coming years.

The quality and value information is essential for evaluating the options for inland "harvests" of salmon each of which has different benefits, costs and risks. Possible options include:

- Inland Native commercial fisheries produce a lower value product than ocean fisheries, but harvesting costs may also be significantly less resulting in net benefits of similar or even larger size;
- Exclusive guided sport harvest for some species and areas;
- Ocean harvest by or for interior groups to get high quality fish;
- Ocean commercial harvest with a royalty on the catch to provide interior communities with revenues from forgone catch and/or for fish production activities;

- Non-consumptive tourism events, such as Adams River "Salute to the Sockeye", are already a valuable economic input to the interior and could be expanded to other areas.

This study focuses on the potential for commercial inland fisheries to provide stock specific harvest. Since this pressure is mainly economically motivated, the conclusions of the study are significant - salmon harvested in interior areas are safe for human consumption and the fisheries can be financially viable. The products tested in this study could be sold commercially, although at lower values than typical commercial products.

Although the 1993 terminal fisheries quality study provided important commercial information on a few stocks, the results can not be used to reach general conclusions. Further sampling of other cycles, stocks and species is necessary. A pilot terminal harvest of a likely surplus of Chilko River sockeye in 1994 is a suggestion being considered by the Fraser River Action Plan. Not only would such a fishery provide further information on the feasibility of conducting terminal harvests in the future, it would also provide a possible economic opportunity to a B.C. interior community group.

Since terminal fisheries are sensitive, the issues addressed in this memo need to be discussed with all the stakeholder groups involved to gather input to future studies and policy development. A first step towards this would be for this study report to be distributed to all stakeholder groups for discussion.

Distribution:

P.S. Chamut
A. Lill
P. Sutherland
S. Law
P. Kariya



Attachment

TERMINAL FISHERIES
for Late Stuart and Horsefly Sockeye -

QUALITY AND FINANCIAL VIABILITY

Elisabeth Wipfli
Kaarina McGivney

PROGRAM PLANNING AND ECONOMICS BRANCH

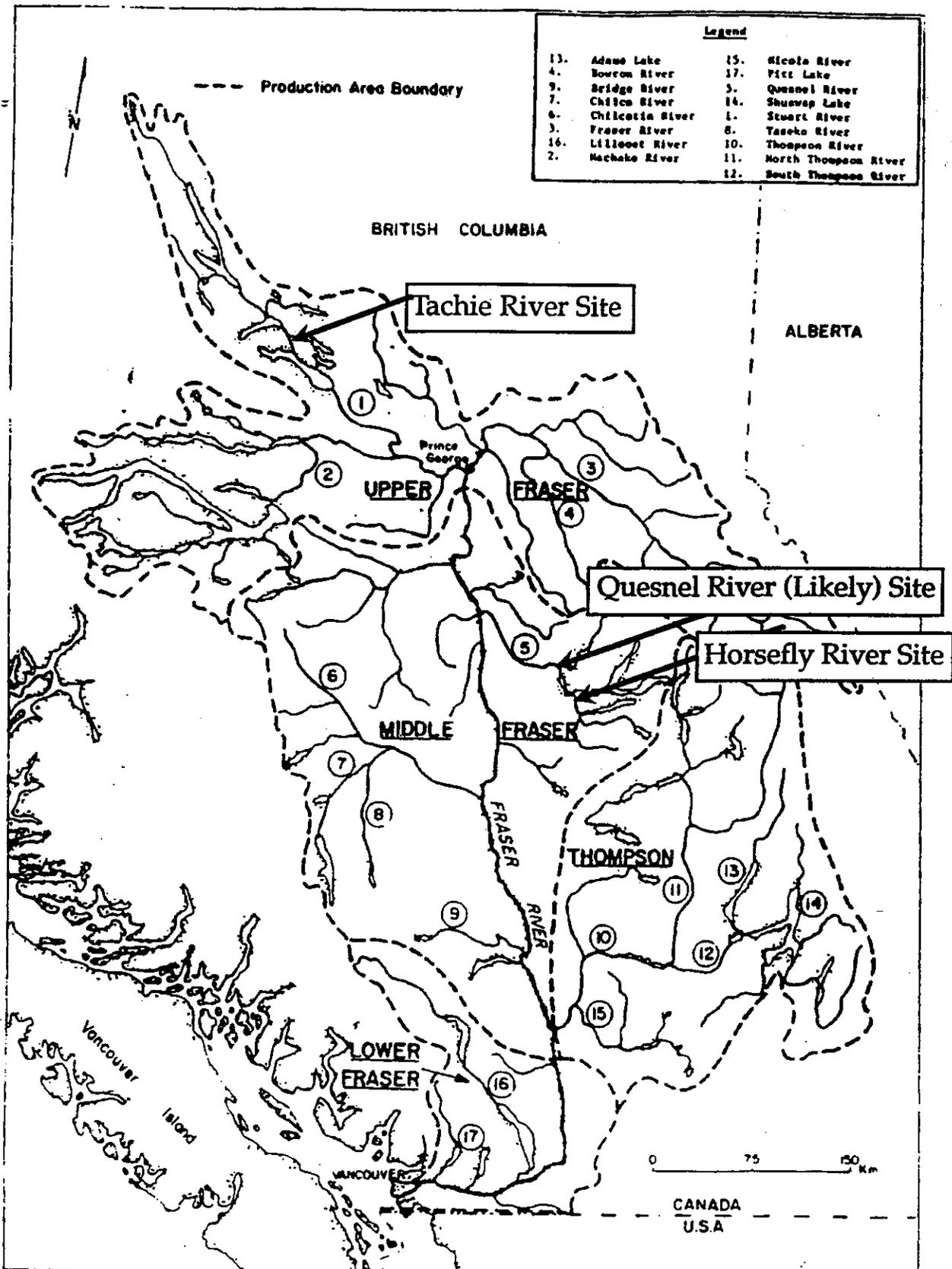
DRAFT: May 10, 1994

TABLE OF CONTENTS

EXECUTIVE SUMMARY

I.	INTRODUCTION	1
II.	BACKGROUND	2
	The Mixed-Stock Problem	2
	Aboriginal Issues	3
	Previous Studies	3
III.	METHODS	4
	Harvesting & Transport	4
	Processing	4
	Inspection Assessment Procedures	5
IV.	RESULTS	6
	Stock Timing and Abundance	6
	Inspection Branch Quality Assessment	6
	i) Fresh/Frozen	7
	ii) Smoked	7
	iii) Canned	8
	9
	9
	iv) Roe	9
V.	DISCUSSION	10
	Capture, Handling and Transport	10
	Market Considerations	10
	Financial viability	13
V.	CONCLUSIONS	14
VI.	RECOMMENDATIONS	14
	ACKNOWLEDGEMENTS	16
	APPENDIX I - Basic Assumptions for Financial viability scenario:	17
	APPENDIX II - Inspection Branch Grading Methods & Criteria	18
	APPENDIX III - Mixed Stock Problem and Genetic Diversity	20

Study Harvesting Locations



EXECUTIVE SUMMARY

STUDY OBJECTIVES

- In 1993 DFO conducted a study to examine the quality of Late Stuart and Horsefly sockeye stocks harvested near their spawning grounds. The study was intended to determine:
 - whether fish harvested from selected locations produced products of an acceptable quality to be marketable and, if so
 - whether the fisheries in these locations would be financially viable.

BACKGROUND

- Management of Fraser River sockeye salmon is a complex issue due in large part to what is known as the mixed stock problem. Under current management regimes in mixed stock fisheries, some of the more productive stocks may have an escapement surplus to spawning targets. This escapement surplus gives managers two choices:
 - i) Allow surplus escapement on the spawning grounds, or
 - ii) Conduct a terminal fishery to harvest the surplus.
- Controversy exists over the quality and value of in-river caught salmon. Fishing interests who catch salmon in tidal fisheries see the possibility of in-river fisheries as a threat to their share. They have typically opposed such fisheries citing poor quality of all in-river fish. There is also concern that lower quality products could affect Canada's reputation for exporting high quality products.
- Although DFO has undertaken quality studies on Fraser and Skeena stocks in the past, little detailed information has been available about the quality or marketability of various products from any Fraser River sockeye stocks harvested in terminal area fisheries. This study differs from past ones in both its scope (harvesting locations and product forms) and detailed results on both the quality of products and financial viability.
- The controversy over the Fraser River sockeye quality becomes especially important in the context of the Aboriginal Fisheries Strategy (AFS) and Native Land Claims which could involve increased allocations to Native fisheries in terminal areas. Some basic measures of value and marketability of possible products produced from terminal catches of various stocks will assist in the evaluation of the viability of terminal fisheries.

METHODOLOGY

- Sockeye were harvested at three in-river locations: on the Tachie River north of Ft. St. James, on the Horsefly River southeast of Williams Lake and on the Quesnel River

close to Likely (Refer to Map). Samples of 100 fish at each location were harvested with beach seines, gillnets and dip nets once each week over a four week period in September of 1993.

- The iced round sockeye were trucked to Vancouver and processed into three types of canned products, two smoked products and the roe was processed and assessed.
- Inspection Branch staff evaluated the quality of the fresh and processed products through sensory and chemical analysis.

PRODUCT QUALITY RESULTS

PRODUCT TYPE:	GRADES:			
	Grade A	Standard	Utility	Reject
Fresh/Frozen			100%	
Canned:	Acceptable ¹	Marginally Acceptable ²	Grade B	Unacceptable
	Regular Pack	55%	27%	18%
	Skinless/ Boneless	57%	26%	17%
		Acceptable		Reject
Smoked	100%			
Smoked:	Acceptable		Reject	
	Barbecue Style	100%		
	Hard Cure (jerky)	100%		
Roe ³ :	Grade #1	Grade #2	Off Grade	
	Sujiko (in skeins)		100%	
	Ikura (caviar)	Sockeye roe isn't normally processed into ikura, therefore there are no grades for sockeye ikura.		

- Fisheries conducted on Late Stuart and Horsefly sockeye stocks on and near their

¹Acceptable, Marginally Acceptable and Grade B grades of canned product are all allowed to be sold commercially but Grade B must be labelled as such.

²Marginally Acceptable is defined as those cans with (paler) colour characteristics very close to Grade B.

³Roe products are graded only by industry. All the roe grades shown here are acceptable for sale but vary in price.

spawning grounds under very good harvest, handling and transport conditions resulted in products that meet current minimum standards for commercial products set by DFO Inspection Branch. Although the quality of all products met DFO standards for sale, it was below that of comparable commercial products. The smoked products most closely resembled current commercial products

- The fresh fish evaluated were designated as Utility grade. All fish exhibited quality attributes typical of late run or sexually mature fish in that the fish skin was heavily watermarked and covered with slime. The colour of the flesh ranged from red to white, losing colour as the weeks progressed.
- Of the 44 canned product lots evaluated, 57% of the skinless/ boneless packs qualified as Acceptable, another 26% as Marginally Acceptable (due to pale colour) and the rest (17%) were designated as Grade B. Quality attributes included some late odours and flavours, heavily watermarked skin and soft texture. There was considerable variation in fish flesh colours, from pink to white/grey, within each treatment group and in some cases within the same can of fish.
- Those fish processed into barbecue style and hard cure cold smoked styles were also found Acceptable. As a result of low fat content the texture was grainy and chewy in many cases and the products were very thin.
- The roe evaluated by a roe processor was acceptable for commercial sale but of very low quality. An industry representative indicated that with a fishery of sufficient volume, it might be worthwhile setting up a small processing facility near the capture site that could remove and process the roe quickly to minimize quality deterioration due to transport time.

MARKET OPPORTUNITIES

- The quality of the products from this study indicates that they would not meet the requirements of many of the commercial markets they are traditionally sold into. The Canadian market for canned sockeye demands the highest quality product of any of the canned sockeye markets. The Japanese market for sockeye roe is mainly for sujiko (roe in skeins) and is presently in a supply glut situation. Ikura (caviar) is made mostly from chum roe. However, most of the barbecue-style smoked salmon produced in B.C. is sold domestically and uses mainly salmon of below premium quality.
- Marketing opportunities for products of lower quality from in-river fisheries will likely be in smoked-style and roe products. A new sockeye caviar product marketed in Japan or Germany at a discount to traditional products is a possibility. Smoked products from in-river fisheries could be sold at a discount into the domestic market.

- Concern over Canada's reputation for exporting high quality products is not likely to be affected by products from terminal fisheries since the most likely product forms will be sold into the domestic market (smoked) and non-traditional export markets (German or Japanese caviar).
- Simple financial viability scenarios for two different surplus harvesting strategies reveals that with a landed price of \$0.20 per pound and a volume of 50,000 fish, profits could result. At larger volumes and higher landed prices, profits to such operations could be significant.
- Anecdotal information reveals that landed prices for sockeye from 1993 in-river fisheries in the Lower Fraser River ranged from \$0.60-\$1.20/lb, with an average price of about \$0.90/lb. It is difficult to predict what the price would be for fish of the quality seen in this study. The price is likely to be lower than that seen in the Lower Fraser since the fish would have lower flesh value but could potentially have some roe value. Of course the quality results would be very dependent on harvest, handling and transport conditions as well as run timing.
- The results of this study cannot be applied to other sockeye stocks harvested at other locations throughout the Fraser watershed or elsewhere in B.C. They do, however, provide a benchmark of information that may be indicative of the possible outcomes in some other fisheries for stocks with similar timing.

RECOMMENDATIONS

- The potential for financial profits from harvesting surplus sockeye from the Fraser River system and the potential for large surpluses to occur suggests that further work should be done to develop a strategy for dealing with them on this system.
- ESSR fisheries are a contentious issue. This report covers only one of the factors that needs to be considered in the process of developing guidelines for implementing ESSR fisheries in the Fraser River system. The question of whether these fisheries can provide marketable quality products and profitability has been addressed. The next steps in developing an overall ESSR strategy for the Fraser River system are to address the issues of: identifying surpluses, developing feasible strategies for harvesting them, considering the effects of harvesting surpluses on co-migrating species and determining the actual size of economic benefits from such fisheries.
- Some aspects of these issues could best be addressed by holding a pilot-scale fishery and documenting the outcome.

I. INTRODUCTION

The purpose of this paper is to report the findings of a 1993 study conducted by the Department of Fisheries and Oceans (DFO)⁴ which examined the quality of Late Stuart and Horsefly sockeye stocks harvested on and near their spawning grounds. The study was intended to determine:

- whether fish harvested from selected terminal locations produced products of an acceptable quality to be marketable and
- if so, whether fisheries in these locations would be financially viable.

The results of this study provide useful information on the quality, marketability and potential commercial viability associated with harvests at three specific locations in 1993. Since the quality of salmon varies considerably, depending on the stock, location of harvest and time of harvest, results of this study can not be used to reach general conclusions about "terminal fisheries".

Over the last several years, the Department has developed a policy to harvest fish in terminal areas when the escapement is surplus to spawning requirements (ESSR). There are a number of factors that are considered in implementing an ESSR fishery. These include:

i) Quality and financial viability - Minimum standards of product quality must be met for consumer safety reasons and to produce a commercial product that would make a fishery financially viable. Viability also requires revenues to exceed costs.

ii) Biological assessment - In most river systems we do not have a clear understanding of optimum spawning levels. Our management strategy includes probing the systems by allowing escapements beyond levels previously experienced. In addition, spawning estimates are currently not available until after the fish have spawned. A target escapement level has to be set and some in-season assessment has to be done to be able to declare a surplus.

iii) Harvest Strategy - The ESSR policy identifies that first priority is to use surpluses to meet outstanding Aboriginal food fish requirements. The details of the fishery and conditions of the licence need to be worked out given the stock and site specific limitations.

This study deals only with the first of these factors, the quality and financial viability. Before any ESSR fishery could be held, the others must be addressed as well.

⁴ The study was conducted by the Program Planning and Economics Branch and Inspection Branch and funded by the Fraser River Action Plan.

II. BACKGROUND

The Mixed-Stock Problem

Management of salmon stocks is a complex issue. Fraser sockeye stocks are managed as timing groups because stocks that overlap in their migration timing stay mixed from marine into fresh water river environments. Separation of the timing group is realized only as stocks split off in-river to their streams. If we have a fishery directed at one dominant stock within the timing group, several other smaller co-migrating stocks may be intercepted and overharvested. Alternatively, escapement to the more productive stocks may exceed targets when harvest rates are set at low levels more appropriate for the total stock group. This is known as the mixed stock problem.

Under the current management regime, mixed stock fisheries occur resulting in some of the more productive stocks having an escapement surplus to spawning targets. This escapement surplus gives managers two choices:

- i) Allow the escapement to surpass the target, or
- ii) Conduct a terminal fishery to harvest the surplus.

Terminal ESSR fisheries are not a new idea. They have taken place in a number of locations across B.C. for many years. For example, in 1993 marine and in-river ESSR fisheries were conducted by the Sliammon and Kitasoo bands. An ESSR fishery was conducted on the Nass river targeted at Meziadin sockeye and a fishery was conducted on surplus jack and adult enhanced sockeye stocks at the Babine Fence. Products from these fisheries were marketed in various forms: fresh and frozen (Nass sockeye), canned (Babine Fence) and as nuggets and breaded pieces (Sliammon chum). Roe was also sold from the chum fisheries. ESSR harvests, mostly conducted by Aboriginal groups, also occurred at many enhancement facilities.

Although ESSR fisheries provide a possible solution to the mixed stock dilemma, they have some practical problems.

1. Firstly, the quantity available for harvest is not consistent from year to year. The harvester must have the ability to deal with very large fluctuations in available catch.
2. The time that fish are available for harvesting is limited. Although pre-season forecasts are useful for anticipating where surpluses are likely to occur, there is very short notice as to the actual abundance of fish available for harvest. Also, harvest may be concentrated over the latter part of the run after availability of the surplus has been confirmed.
3. Depending on the location, fish quality can be marginal. Fish harvested during the latter part of the run tend to be poorer quality due to their advanced sexual maturity. Therefore, handling procedures must be efficient and meet DFO Inspection standards.

There is a controversy over the quality and value of terminally caught salmon, especially Fraser River sockeye stocks. Commercial interests generally contend that in-river quality is so low that sockeye have low or no value and that trying to market such low value catch would affect Canada's reputation for high quality products. Other, mainly Native, interests contend that in-river salmon quality is not necessarily bad. Natives have been eating fish caught from in-river areas for many hundreds of years and for some time they have been selling these fish locally. So far, the positions of both groups are based on anecdotal information.

Aboriginal Issues

The controversy over the quality of in-river caught Fraser River sockeye and of in-river caught salmon in general becomes especially important in the context of the Aboriginal Fisheries Strategy (AFS) and Native Claims which could involve increased allocations to Native fisheries in terminal areas in their home territories. The AFS aims to increase economic opportunities for Aboriginal people while maintaining stability and profitability in the commercial and recreational fisheries. Some basic measures of value and marketability of possible products produced from terminal catches of various stocks would be useful.

Previous Studies

Although DFO has undertaken quality studies on Fraser and Skeena stocks in the past, little detailed information has been available about the quality or marketability of various products from any Fraser River sockeye stocks harvested in terminal area fisheries. This study differs from past ones in both its scope (harvesting locations and product forms) and detailed results.

Past studies include one done by Wayne Holmes in 1982 on many of the stocks throughout B.C. It is entitled *Salmon Quality Considerations for Fisheries Management*. Although a few of the fish samples were canned, no other processing was done. There were also no samples taken from the sites used in this study. The sockeye samples taken in the Lower Fraser River at various times during July and August, 1981 revealed fresh fish quality ranging from Standard to Utility Grade. Canned sockeye quality from the Babine Fence ranged from Acceptable to Grade B.

Another study by Slaney and Birch of Aquatic Resources assessed the *Commercial Quality of Sockeye Salmon Collected from the Skeena River in 1982*. Samples of fish were taken at various times at four locations along the Skeena including at the Babine Fence. The product quality attained from the sockeye caught at the Babine Fence was Standard grade fresh and an Acceptable canned product when processed without the skin. Some Acceptable skin-on canned product was produced but a large proportion was Grade B canned. All samples produced Acceptable smoked products.

III. METHODS

a) Harvesting & Transport

Large escapements were predicted for the Horsefly and Late Stuart sockeye stocks in 1993, so these were the stocks selected for this study.

Fish were harvested at three locations on:

- 1) the Tachie River testing the Late Stuart sockeye
- 2) the Quesnel River at Likely testing both Quesnel Lake tributaries including the Horsefly and Mitchell River stocks and
- 3) the Horsefly River testing Horsefly sockeye

The harvesting for this study was done over a 4 week period in September (5th-27th) with one lot of 100 fish taken at each site once each week. There were a total of 11 lots of fish harvested. (Fish weren't harvest from the Horsefly site in week 4 due to sampling difficulties.)

Sampling at the Tachie and Horsefly River sites was coordinated with on-site DFO crews. Other sites were considered but were not practical for this study. The fish were harvested with beach seines at Tachie and Horsefly and with a gillnet and dip net at the Likely site. The fish were individually taken out of the nets, clubbed, put in fish boxes and then transferred into totes and layered with ice.

The iced fish were trucked to Vancouver in totes. The contractor ensured that the amount of time between harvesting and processing the fish was minimized to maximize the quality of the fish.

Fish harvested at the Tachie site were taken in the morning of day 1; at Horsefly in the morning of day 2; and Likely the morning of day 3. Following the final capture of the fish at the Likely site, the truck immediately left for Vancouver and reached the processing plant in the lower mainland on day 4.

b) Processing

Upon arrival at the processing plant, each lot of fish was initially assessed by DFO's Inspection Branch. Once the lots were deemed fit for human consumption, the roe was extracted and the fish was processed into canned (skinless/boneless, regular pack and smoked) and smoked (cold smoked hard cure and hot smoked barbecue) products. The first processor extracted the roe and produced headed and gutted fish and skinless/boneless fillets for canning and sides for smoking. A second processor did the custom canning and the third did the smoking. Processing and evaluation of the roe products, sujiko and ikura, (eggs in skeins and caviar or single eggs) was done by a fourth processor on samples from the first two weeks. After the second

week, the roe was so mature that it was not recoverable for processing.

c) Inspection Assessment Procedures

Inspection Branch staff evaluated the quality of the fresh and processed products through sensory and chemical analysis. All sensory analyses were done at the Inspection Laboratories in Burnaby while the chemical analyses were done by The National Centre for Quality Indicators in Halifax, Nova Scotia. Each product form has a standard against which it is evaluated. Only the roe products were not evaluated by Inspection Branch as industry sets the standards for these products.

(More details on Inspection assessment procedures and standards are available in Appendix II).

IV. RESULTS

Stock Timing and Abundance

The Horsefly stock arrived at the spawning grounds between August 22 and October 5. There were two peaks of arrival, the first on August 27 and the majority between September 13 and 17. The run timing was abnormally late compared to historical peak late arrival averaging September 3 (Gilhousen, 1990⁵). Spawning occurs 10-14 days after arrival. Preliminary estimates of the spawning population are 1,879,000 for the Horsefly stock and 2,592,000 for the Quesnel system.

The Late Stuart stock arrived at the Tachie River between August 29 and September 30 with the peak between September 7 and 13. This corresponds with a historical average peak arrival of September 9. The preliminary estimate of the Late Stuart escapement is 1,780,000 spawners.

Inspection Branch Quality Assessment

A brief description of the quality assessment of the various products follows. Inspection Branch has written a separate, more detailed report of their assessment of the products from this study entitled Report on the Quality of Sockeye Salmon caught from Terminal Sites on the Fraser River System, March 1994.

The products assessed were all fit for human consumption but of lower quality than comparable commercial products. The smoked products most closely resembled current commercial products and therefore show the most market potential.

PRODUCT TYPE:	GRADES:			
	Grade A	Standard	Utility	Reject
Fresh/Frozen			100%	
Canned:	Acceptable ⁶	Marginally ⁷ Acceptable	Grade B	Unacceptable
Regular Pack	55%	27%	18%	
Skinless/ Boneless	57%	26%	17%	

⁵Gilhousen, P. 1990. Prespawning mortalities of sockeye salmon in the Fraser River system and possible causal factors. International Pacific Salmon Fisheries Commission. Bull. XXVI. Vancouver, B.C.

⁶Acceptable, Marginally Acceptable and Grade B grades of canned product are all allowed to be sold commercially but Grade B must be labelled as such. Industry sells sub-grades of Acceptable canned under different labels.

⁷Marginally Acceptable is defined as those cans with (paler) colour characteristics very close to Grade B.

		Acceptable	Reject
	Smoked	100%	
Smoked:		Acceptable	Reject
	Barbecue Style	100%	
	Hard Cure (jerky)	100%	
Roe ⁸ :		Grade #1	Grade #2
	Sujiko (in skeins)		100%
	Ikura (caviar)	Sockeye roe isn't normally processed into ikura, therefore there are no grades for sockeye ikura.	

i) Fresh/Frozen

All fresh fish were of Utility grade. The quality of the fish varied from week to week. The colour of the flesh ranged from red to white and although it generally began to pale as the weeks progressed, it showed no distinct colour pattern from week to week or site to site. Colour variations were evident within the same sample group.

The fish skin was very slimy. The texture was soft and became softer as the weeks progressed. The skin in all cases was heavily watermarked and covered with slime. The quality of the fish began to deteriorate in week three from all sites.

Less physical damage was experienced at the Horsefly River. More damage was seen at the Likely site, probably due to the gillnet capture method.

Although no off-odours of decomposition were detected from any samples, the slight sour odour detected in some of the fish from week four could show up in a "late" (unpleasantly musty) odour in the finished products.

Fats generally decreased as the weeks progressed, although variations between fish were apparent. Fat values were significantly less than that found in the commercial pack.⁹

ii) Smoked

All smoked samples were found Acceptable to DFO minimum requirements.

⁸Roe products are graded only by industry, not by Inspection Branch. All the roe grades shown here are commercially acceptable but vary in price.

⁹Fat values were 6-11% in our samples compared to ocean caught with 33-43%.

a) *Hot-smoked Barbecue Salmon* - portions of salmon mildly cured and cooked were evaluated. There was no significant difference found in quality between the sites and weeks. Colour was masked by the red dye used in the processing of the product. There was a slight late odour in the flesh. Texture was non-characteristic of the commercial barbecued salmon. It was rubbery when chewed.

b) *Cold-Smoked Hard Cure* - The hard cure products were Acceptable but very thin and chewy. The smoking process masked any late odours or flavours found in the barbecue style products. There was no significant difference in quality between the samples over sites and weeks. The overall yield for this product was very low.¹⁰

iii) Canned

Twenty nine out of the total 44 (regular, skinless/boneless and smoked) canned product lots (66%) were identified as Acceptable, 9 lots (20%) were Marginally Acceptable (due to pale colour) with the remaining six (14%) as Grade B¹¹. No quality attributes characteristic of decomposition were noted in any samples examined. Commercial packs will generally produce 0.5% Grade B product. Grade B is the lowest quality permissible under the acceptable definition.

It was noted that the absence of skin in skinless/boneless packs was probably a contributing factor to that product form having the least measured level of decomposition¹². This level was highest in the canned smoked packs perhaps due to the form of processing.

a) *Regular* - The regular canned pack exhibited typical quality characteristics of late run fish: heavy watermarking on the external skin and neutral to late odours and flavours. Flesh colours in the regular pack ranged from red to pink to grey/white. A wide range of colour within the same lots was evident. The flesh colours became extremely pale and more prominent as the weeks progressed. Commercial packed canned sockeye is normally red in colour.

b) *Skinless/boneless* - The skinless/boneless canned salmon packs exhibited neutral to late odours and flavours. There was a range of flesh colours within all the weeks and even within single cans the colour ranged from pink to grey/white. The pale colour is atypical of canned "red" sockeye.

¹⁰The thickness varied from less than 0.5 cm to 1.7 cm.

¹¹The percentages given here are for all the canned lots combined. The table provided breakdowns by canned product type.

¹² Testing for putrescine and cadaverine - 2 substances which increase in concentrations through the decomposition of animal tissues - was done on all canned lots as a quality indicator. An acceptable level of these 2 substances is being developed by Inspection Branch as part of a revised canned salmon standard.

c) *Smoked* - The canned smoked packs exhibited many of the same quality characteristics as the other canned treatment groups, in that watermarked skin was evident throughout all presentations. Mixed colours were seen between weeks and sites, and within single cans. Very intense flavours were noted in the smoked packs. The colour of the canned smoked samples examined was atypical of current commercial packs.

iv) Roe

Roe extracted from the first two weeks of the study was of "off grade" but acceptable commercial quality. In later weeks the roe was not retrievable. The roe from weeks 3 and 4 was so mature that it was loose in the belly cavity and spilled out as soon as the belly was cut open for evisceration. Many of the fish were partially spawned and some were completely spawned out.

The roe from the week two fishery was considerably more mature than from week one. Most of the eggs came out of the skeins quite easily. It was processed as a single egg (ikura) product. Sockeye roe is not normally processed into this type of product as the eggs are smaller than those used typically for ikura. Chinook and chum roe, which has a milder flavour as well as larger egg size, is normally used to produce ikura.

Some of the comments from the Japanese buyers as to the quality of the sockeye roe from this study follow:

- The eggs presented were larger than those from European trout but were much smaller than the usual single egg roe used to produce "ikura". The colour was judged to be similar to that of the European trout roe.
- The membrane on the eggs was judged to be of "ordinary" (ie. low) quality. The eggs weren't perfectly round and had a slightly puckered appearance. The drip loss was quite high at about 5%.
- The flavour and odour of the eggs were stronger than ideal and they were saltier. It was speculated that this type of product would have to be marketed differently because of its dissimilarity from traditional salmon roe products. It would thus receive a lower price.
- The roe from this study was not as fresh as it should have been because of the time required to transport the fish to the lower mainland for processing. This lack of freshness contributed to the stronger odours and flavours, the saltiness and the puckered membrane and drip loss.

V. DISCUSSION

Capture, Handling and Transport

Before deciding when to harvest a surplus, several significant factors must be considered. Obtaining a reasonable assessment of escapement in-season is difficult until the peak of the run has reached the spawning grounds. Therefore, the majority of harvest of fish surplus to escapement goals would normally occur only later in the run when the actual size of a surplus was reasonably assured.

The handling of the fish caught and processed for this study was very good. However, lower standards of sanitation, icing, handling and transport in a larger scale terminal fishery could affect the quality of fish delivered to the processing plants.

The harvesting sites used in this study are not necessarily the sites that would be chosen for a commercial operation. However, comments on the logistics of using these sites as harvesting locations follow:

A large scale fishery at the Tachie River for the Late Stuart sockeye could encounter numerous fishing and transport difficulties. Heavy precipitation would make both the capture and transport of fish from this site very difficult. Quality could decrease if there were additional handling and delays caused by bad weather conditions.

The Horsefly River capture site is easier to access than the Tachie site, but excessively wet conditions could make it difficult for large, heavily loaded trucks to manoeuvre across the grassy meadow adjacent to the site.

Access to the capture site on the Quesnel River at Likely is very steep and requires a vehicle with four wheel drive. Only a limited number of fishers could operate here if an ESSR fishery were established. The river also has a very strong current which would affect the harvesting gear used at this location. The team capturing the fish in 1993 found that numerous attempts were required to capture the 100 fish each week.

Market Considerations

The quality of the products from this study indicates that they would probably not meet the requirements of some of the traditional commercial markets.

Fresh/Frozen

The main market for B.C. frozen sockeye is Japan. Total export volumes to Japan were up in 1993, but competition from high quality Chilean coho on the high end of

the market and Russian sockeye on the low end as well as the smaller size of B.C. sockeye all contributed to keeping prices down.

There is now a limited Japanese market for cheaper sockeye that still has red flesh colour. Since the Japanese are now becoming bargain hunters, most of these later run fish are presently being purchased from Alaska. Fish from this study would not likely compete in this market because of their flesh and skin colour.

Canned

About 50 per cent of canned sockeye is sold into the Canadian market which demands the highest quality of any canned sockeye markets. The rest of our canned sockeye is sold into the U.K., Australia and other overseas markets. It is unlikely that any of this study's canned products could be sold into these traditional markets. Canadians are used to higher quality and competition in the overseas markets is becoming stiffer.

The U.K is B.C.'s main export customer for canned salmon. After the record Alaskan and B.C. sockeye runs in 1993, there is quite a glut of canned sockeye on the world market. Canned salmon prices in general are lower than the previous year. It is believed that some U.K. supermarkets are using canned salmon as a loss leader in a price war, so they are buying cheaper Alaskan canned salmon. U.S. processors are known to have lower raw fish and labour costs than B.C. processors.

Canned smoked product is sold almost exclusively into the B.C. tourist market. Retail prices for canned smoked sockeye are double that of regular canned. However processing costs for canned smoked products are also much higher (close to double).

Sockeye landed prices from the Babine Fence and Fulton River surplus fisheries on the Skeena ranged from \$0.60-\$0.85/lb. These surplus fisheries produced canned Marginally Acceptable products.

Smoked

Smoked products are sold both domestically and for export. The cold-smoked lox style products exported use almost exclusively premium quality fish. Hot-smoked - barbecue style products normally use lower quality fish, not necessarily sockeye, and are only sold domestically. The hot-smoked products from this study would be sold into this market.

Roe

The Japanese salmon roe market traditionally buys sockeye roe only in sujiko form (in skeins). Nearly all the ikura or caviar product consumed in Japan is from Japanese chum salmon. Because of large 1993 Japanese fall chum runs, a weak economy and supply from Russia, the market for sujiko and ikura products is presently quite weak.

Quality deteriorates rapidly the greater the time between harvesting the fish and processing it. The margin on #2 sujiko is minimal so that processors may not bother to extract the roe from several day old fish. Roe not processed will last up to 6 hours from the time it is removed from the fish. The best option for making a viable product from in-river sockeye fisheries may be to set up a small processing facility as close as possible to the harvesting sites so the delay in removal and processing of the roe is minimized.

There may be an opportunity to market a caviar-style product in Germany since the sockeye roe was similar in colour but larger in size to European trout roe. Germany bought about 3% of the value of B.C.'s export of roe and caviar products in 1992.

Salmon Market Outlook

Alaska and B.C. both predict record sockeye runs in 1994. Both Chile and Norway also plan to increase their farmed production of Atlantic and coho salmon. Combining a glut of salmon in the world market with still weak Japanese and European economic recoveries means the best market for B.C. to be selling into in the near future may be our domestic market. Increasing the demand for salmon products domestically may be the salmon industry's best option.

Financial viability

The following assumptions are based on information from a variety of industry and DFO sources. They should not be considered the only possible assumptions. They do, however, provide some basis upon which to make realistic conclusions as to the financial viability of harvesting surplus sockeye in terminal areas.

The financial viability of terminal harvests depends on a few key elements. The harvesting strategy or technique chosen will define what the total (capital, operating and labour) costs of a harvesting operation will be. The landed price and quantity of surplus fish available will determine the revenues. The possible combinations of these key elements are numerous. Therefore, only a few harvesting strategies, surplus quantities and prices will be looked at in the scenarios.

Possible harvesting strategies considered here are: a) broomstick fence and fish trap, b) beach seine operation, c) permanent fence with a trap.

The strategy chosen depends on the harvesting location available, the likelihood of long-term harvesting opportunities, who will be doing the harvesting and advance notice of a harvesting opportunity. On some river systems a beach-seine operation may be the easiest to implement on short notice, but a permanent fence would be built if a surplus was predicted as an annual occurrence. There may even be an existing fence used for counting, harvesting and/or diversion eg. Babine fence.

The two lower cost alternatives (a temporary fence and trap or a beach seine operation) are considered the more likely options for a fishery on the Horsefly and Tachie River sites used in this study. A permanent fence structure does exist on the Horsefly which could be used with some modification. However, constructing a permanent fence structure could cost up to one million dollars, depending on the site.

Basic Harvesting Strategy Assumptions for Financial viability scenarios:

Using a broomstick fence and trap to harvest requires a total capital and equipment outlay of about \$21,000. This capital is assumed to last two seasons. A seven person crew with one crew chief can harvest a maximum of 7,000 fish per day during the peak of the spawning period.

A beach seine operation requires a capital and equipment outlay of about \$17,000 per site. This capital is also assumed to last two seasons. A five person harvesting crew with one crew chief can harvest up to 4,000 fish per day per site.

The number of days needed to harvest the available surplus will depend on the total abundance available at the time of harvest as well as the harvest strategy and the total surplus.

Financial Viability

Broomstick Fence and Trap Operation

	SCENARIO 1	SCENARIO 2	SCENARIO 3
TOTAL REVENUES:	\$150,000	\$50,000	\$10,000
TOTAL COSTS	<u>\$33,450</u>	<u>\$25,800</u>	<u>\$18,150</u>
GROSS INCOME/LOSS:	<u>\$116,550</u>	<u>\$24,200</u>	<u>(\$8,150)</u>

Beach Seining Operations

TOTAL REVENUES:	\$150,000	\$50,000	\$10,000
TOTAL COSTS	<u>\$50,020</u>	<u>\$39,860</u>	<u>\$29,700</u>
GROSS INCOME/LOSS:	<u>\$99,980</u>	<u>\$10,140</u>	<u>(\$19,700)</u>

- The above tables show that gross profits would occur for either harvesting operation under SCENARIO 2 of \$0.20/lb and an available surplus of 50,000 fish.

- It should be remembered that these are gross profits (before taxes) to the harvesters. Overall economic benefits to Canada would require that these profits exceed other additional costs.

- These other costs could include additional inspection and conservation and protection costs.

Basic Assumptions

	Scenario 1	Scenario 2	Scenario 3
One sockeye = 5 lb.			
Landed Prices (\$/round lb)	\$0.30	\$0.20	\$0.10
Surplus fish available (pieces of sockeye)	100,000	50,000	20,000

REVENUES:	\$150,000	\$50,000	\$10,000
------------------	-----------	----------	----------

Catch: Pieces/day:	Trap	7,000	5,500	4,000
	Seine (2 crews)	8,000	6,000	4,000
Number of days needed to catch surplus	Trap	15	10	5
	Seine (2 crews)	13	9	5

COSTS:		Trap Operation	Beach Seine
Annual Capital & Equipment Costs		\$10,500	\$17,000
Daily	Harvesting Labour	\$680	\$1,040
	Operating Expenses	\$650	\$1,300
	Stock Assessment Labour	\$200	\$200
	Total Daily costs	\$1,530	\$2,540

Under the above assumptions, the total costs will be:

	Scenario 1	Scenario 2	Scenario 3
TOTAL COSTS:			
Trap	\$33,450	\$25,800	\$18,150
Seine (2 crews)	\$50,020	\$39,860	\$29,700

V. CONCLUSIONS

Fisheries conducted on Late Stuart and Horsefly sockeye stocks on and near their spawning grounds under very good harvest, handling and transport conditions resulted in products that meet current minimum standards for commercial products set by DFO Inspection Branch.

The quality of products from a commercial ESSR fishery would be very dependent on harvest, handling and transport conditions as well as run timing. Therefore, these results cannot necessarily be transferred to other sockeye stocks harvested at other locations throughout the Fraser watershed or elsewhere in B.C. They do, however, provide a benchmark of information that may be indicative of the possible outcomes in some other fisheries for stocks with similar timing.

Under certain assumptions, a landed price of only \$0.20/lb could make a terminal location harvesting operation financially viable. Profits could be significant since landed prices for sockeye from 1993 in-river fisheries in the Lower Fraser River ranged from \$0.60-\$1.20/lb, with an average price of about \$0.90/lb. Although \$0.20/lb is a breakeven price, it does give a lower bound to what price is necessary for a financially viable fishery.

There may be marketing opportunities for products of lower quality from in-river fisheries in smoked-style and roe products. One possibility is a new sockeye caviar product marketed in Japan or Germany at a lower price. Smoked products from in-river fisheries could also be sold at a discount, probably into the domestic market.

The most feasible processing option may be smoked products. Inspection Branch concluded that the smoked products were the closest to current commercial grade. This fact combined with the fact that current ESSR policy puts Aboriginal groups as the first priority in receiving ESSR licences, makes traditional style smoked products a likely product form. Aboriginal groups could see economic gains from ESSR fisheries conducted in their home territories that produce traditional style products.

VI. RECOMMENDATIONS

The potential for financial profits from harvesting surplus sockeye from the Fraser River system and the potential for large surpluses to occur suggests that further work should be done to develop a strategy for dealing with them on this system.

ESSR fisheries are a contentious issue. This report covers only one of the factors that needs to be considered in the process of developing guidelines for implementing ESSR fisheries in the Fraser River system. The question of whether these fisheries can provide marketable quality products and profitability has been addressed. The next steps in developing an overall ESSR strategy for the Fraser River system are to

address the issues of: identifying surpluses, developing feasible strategies for harvesting them, considering the effects of harvesting surpluses on co-migrating species and determining the actual size of economic benefits from such fisheries.

Some aspects of these issues could best be addressed by holding a pilot-scale fishery and documenting the outcome.

ACKNOWLEDGEMENTS

There are many people that advised us in planning and executing this study as well as reviewing the report. These people include:

Susan Schenkeveld, Klaus Schallie, Preston Chan, Deborah Koo and David McLachlin of the Inspection Branch;

Judy Gwin, Al Wood, Alan Greer, Sheila Fagnan, Paul Macgillivray, Colin MacKinnon and Ken Wilson of the Program Planning and Economics Branch;

Timber Whitehouse and Wayne Saito from Fraser River Division
Robin Dixon from SEP

Robin Kent and Gerry Buxton from Ardacy Consulting
Sherry and Terry Babcock from Coastwise Fisheries,
Rob Gordon from Orca
Grant Johncox from Billingsgate Fish
Mr. Fukuyama and Barney Sugiyama from Fukuyama/Sugiyama

APPENDIX I - Basic Assumptions for Financial viability scenario:

- Average weight of a sockeye is 5 lbs

Broomstick fence and trap used to harvest has a capital cost of about \$20,000 and lasts about two seasons (includes labour to construct & set up)

- A 7 person harvesting crew with one crew chief operates fish trap & loads totes
- The Harvesting Crew works for 8 hrs/day at \$10/hr for crew and \$15/hr. for chief
- The maximum number of fish the crew can harvest per day during peak spawning period is about 7,000

Beach seine operation requires a capital outlay of about \$15,000 for a boat and jet motor and \$1000 for a seine net - assume capital lasts 2 seasons

- A 5 person harvesting crew with one crew chief can harvest up to 4,000 fish per day working an 8 hr/day
- to harvest maximum amount of fish possible at peak we assume 2 crews with capital and equipment are working at 2 separate sites

Other equipment costs for either operation:

- small totes, dip nets, hip waders etc. - \$1000

Daily Operating Costs/Site

- Flat bed truck to bring in forklift, boat & other equipment - \$100
- 2 rental vehicles with fuel to transport crew - \$200
- Forklift to get totes in reefer truck - rental cost \$100
- Meals for crews - \$250
- Stock Assessment crew - 2 people at \$12/hr x 8 hrs/day - \$200

- Assume harvesters sell to truck buyers so price per pound reflects transport costs
- One reefer truck used to transport can handle up to 38,000 lbs of fish/trip
- Assume truck buyer provides ice and large totes

Quantities of surplus fish available for harvest:

Low - 20,000 fish

Moderate - 50,000 fish

High - 100,000 fish

APPENDIX II - Inspection Branch Grading Methods & Criteria

Extended Holding Study:

During week 2, samples representing the three sites were forwarded to the Fresh/Frozen laboratory for a further 5-day storage study of terminal fish products. The salmon were kept round and allowed to "age" in ice. Temperature of the fish was maintained at 0-4 degree C throughout. Ten fish from each tote (each from a different site) were withdrawn at random, inspected, dressed and photographed every day for 5 consecutive days. If the quality of the salmon was found to be acceptable, 4 of the 10 fish were frozen and canned. The remaining 6 fish were also frozen and sent for subsequent chemical analysis. This study was completed to collect more information on potential quality changes resulting from delay in transport of fish caught at terminal sites and processed in the lower mainland.

Results of this holding study indicated that fish held on ice for 4 or more days would remain Utility grade fresh. Some Reject samples were identified at day 4 and it is speculated that had the fish been held for any additional length of time, the number of reject samples would increase to unacceptable levels.

Sensory Evaluation:

Fresh/Frozen Samples -sensory procedures were used to evaluate samples for the presence of fish that was tainted or decomposed. The sensory analysis follows the Fresh/Frozen Finfish Standard. The trained inspectors graded the fish according to their eyes, gills, flesh texture, skin, belly cavity, odour and physical damage. A grade (A/S/U/R or Grade A/Standard/Utility/Reject) was assigned for each of these characteristics and the final grade was determined. Any fish that was found to be tainted or decomposed would not be used for further processing.

Canned Samples - Samples for this study were evaluated using the same procedures and standards currently being utilized by the Inspection Branch's Pacific Region Canned Fish Laboratory in the evaluation of domestic and imported canned Pacific salmon. Regular and skinless/boneless packs were evaluated according to the Inspection Branch's Canned Pacific Salmon Grade Standard. Assessment of colour, appearance, and odour characteristics were used in the grading to define the product quality as either "Acceptable Grade", "Grade B" or "Below Grade B". Below Grade B is considered unacceptable or reject.

Smoked canned pack was evaluated to a minimum quality standard (Accept/Reject) for taint, decomposition and unwholesomeness. The Canned Pacific Salmon Grade Standard is not applicable to this product presentation as the smoking process affects both colour and odour.

Smoked fish is also evaluated to a minimum quality standard of Accept/Reject. The fresh/frozen fish used for smoking must be deemed acceptable (wholesome) to minimum standards before being processed. The final product was evaluated according to texture, flavour and odour.

Chemical Analysis:

Fresh/Frozen and Smoked Samples - Following completion of the sensory evaluation, the fresh fish were glazed and frozen in preparation for transport. The National Centre for Quality Indicators in Halifax, Nova Scotia completed all chemical testing for this study. The chemical tests included testing fat and moisture content as well as total volatile base (TVB - an indicator of fish spoilage for fresh and frozen fish).

Canned Samples - Testing for levels of putrescine and cadaverine was conducted on all canned salmon treatment groups. Testing for the presence of these two substances is a quality indicator since they increase in concentration through the decomposition of animal tissues. Although there is presently no standard for what is an acceptable amount of these substances in canned salmon, a revised canned salmon standard is being developed by Inspection Branch which will incorporate acceptable levels.

APPENDIX III - Mixed Stock Problem and Genetic Diversity

If high harvest rates are maintained in mixed stock fisheries so that the problem of overharvesting of weaker stocks is not addressed, there is the risk of losing genetic diversity in the many salmon stocks. Diversity has economic, social and biological benefits.

Economic returns from fishing and tourism provide benefits from maintaining diversity of fish stocks. Allocations between user groups have made it increasingly necessary to maintain diverse salmon populations. Recreational fishing expansion and the necessity of allowing certain species and stocks of salmon to escape to sport and Native fisheries that occur close to their natal streams have required limiting harvests in mixed stock fisheries. There is also less risk of a fishery collapse with a broader base of stocks and thus there is more economic stability in the commercial fishing industry.

However, it may be possible to maintain the economic benefits of commercial and sport fisheries through a smaller number of productive stocks than we have now. There is some debate as to what the optimal number of stocks to manage for is.

The social value of having a wide base of salmon stocks is difficult to quantify. Pacific salmon has played a significant role in the cultural development of both Native and non-Native communities throughout the West Coast and North America.

From a biological point of view, the value of preserving diversity comes from genetic theory. This theory predicts that inbreeding within small populations will reduce a population's ability to respond to future environmental change and therefore reduce the opportunities for evolution or even increase the probability of extinction.

Given that genetic diversity of Pacific salmon is important, there are a variety of stock selective fishing methods that can aid in reducing the harvest of weaker stocks and species. These include using different fishing gears, timing and/or location.