RIVERS AND SMITH INLETS
SALMON ECOSYSTEM
RECOVERY PLAN

Prepared for
Pacific Salmon Endowment Fund Society

By
The Rivers and Smith Inlet
Salmon Ecosystem Renewal Society

January 2003

DRAFT (17 January 03) Only for Internal Discussion between the RSPG, the PSEF and their advisors

PLEASE DO NOT CIRCULATE OR CITE ELSEWHERE

This plan is to restore the salmon populations and their ecosystems to their full sustainable production – See Foreword for further discussion.
FOREWORD

This plan is aimed at setting a course for nothing less than the return of sockeye, other salmon and the ecosystems of which they are so key a part, to full health. It is a plan produced by a multi-party table of groups and communities2 (for convenience known as the RSPG). It is a plan funded by the Pacific Salmon Endowment Fund which has a mandate to support this kind of work. Other plans funded by PSEF have been called "Recovery Plans" and it is essential to be very clear on what the funder and what the RSPG as recipient mean by recovery. Other usages of the word and concept have had a restricted meaning: the attainment of population levels that are not in immediate danger of extirpation.

This is in no way the purpose of either the RSPG or the PSEF. Our vision is to get back to fit and healthy ecosystems throughout the life cycle range of the sockeye and other salmon originating in the freshwater systems in and around Rivers Inlet and Smith Inlet.

This and only this is what we mean in this plan when we speak of ‘recovery”

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2 The group was named the Rivers and Smith Planning Group (RSPG) from its inception in August 2000 to quite recently when it was officially registered as a society under the BC Societies Act, as the Rivers and Smith Salmon Ecosystem Renewal Society. For simplicity, its members continue to call it simply “the RSPG” and this will be followed in the present document.
EXECUTIVE SUMMARY

Since 1992, the salmon populations in Rivers and Smith Inlets have experienced dramatic declines. The major sockeye populations dropped to less than 5% of spawner targets, with many individual populations much lower. Despite closure of commercial fisheries, sockeye populations have yet to recover. Nothing definite is known about the causes of the declines. Only a few salmon populations and their freshwater habitat have been regularly monitored. The marine habitat had not been monitored until the last few years. Also, there is limited information on the impacts on other species populations in the salmon ecosystem, including bears, eagles and other salmon predator and prey species. The collapse of salmon production has also heavily impacted people and communities dependent on local fisheries resources and resulted in economic and socio-cultural hardship.

The situation is dire and requires a bold, new initiative to restore the salmon populations and their ecosystems to their full sustainable production. This plan is different from the federal Department of Fisheries and Oceans recovery plans that principally aim simply to rebuild to stock abundance levels where extirpation is not at hand. Here, the long-term objective is to re-establish numbers and production equivalent to best estimates of long term capacity and historic levels. In so doing we further aim to maximize the net sustainable biological, economic and social benefits from Rivers and Smith Inlet fish, ecosystem and people resources, by:

• protecting the diversity and productive potential of salmon and other fish, and their ecosystem;
• realizing as much of the sustainable amount of fish production and ecosystem potential as cost effective;
• realizing as much of the potential sustainable net value and other benefits as possible;
• realizing as much of the cost effective sustainable potential of local people and communities and others dependent on the resources, as possible;
• Organizing and strengthening collaboration among participating Nations, communities, agencies and groups for continued and improved stewardship

This plan sets the course for finding bold new ways to restore populations, manage fisheries, involve local and other interests, maximize catch benefits, and contribute to sustaining local communities and others with a long term interest in the resource.

Clearly, first priority is to protect fish and their ecosystem and to restore them to safe levels of abundance. This plan goes beyond that to rebuild populations to their full productive capacity in order to realize social and economic benefits, not just conservation benefits. Beyond that, the plan puts a priority on getting as much sustainable economic and social benefit from the salmon and their ecosystem as possible.

This plan has been developed by a multi-party team which has come to be known as the Rivers and Smith Planning Group (RSPG). The team comprises two First Nations, two senior public governments, local governments, forest companies, environmental non-
governmental organizations and members from key fishing sectors including the sports
and the commercial. We have been supported by the Pacific Salmon Endowment Fund
and the administering staff of the Pacific Salmon Foundation.

Our plan builds on the shared priority among all members for the goal of recovery and
future stewardship for the salmon and their ecosystems. It also is consistent with DFO
policy direction in “A New Direction For Canada’s Pacific Salmon Fisheries” and
“Canada’s Ocean Strategy”. An “integrated management through co-management”
approach is proposed. The plan is meant to give all concerned parties a clear indication
of where local fisheries policy should go in the future. The plan will serve as a
framework for developing detailed 5 and 10 year plans as well as annual work plans.
Rivers and Smith Inlet Ecosystem Recovery Plan 2003

Foreword

Restoration Plan ‘Public Executive Summary’

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1 INTRODUCTION

1.1 The Salmon Collapse

It has become almost a commonplace for public discussions of pacific salmon to begin with words like "crisis", "collapse" "chaos" and even "tragedy". As far back as the 1982 Commission on Pacific Fisheries policy or as recently as the 1997 "Fishermen's Forum" terse and depressing assessments of the state of fish populations and fisheries have predominated.

But for the famously productive salmon spawned in the waters of the Owikeno Lake/Rivers Inlet and the nearby Long Lake/Smith Inlet systems, the worst was yet to come even after 1997.

There had been dramatic declines in salmon populations in Rivers and Smith Inlets sockeye seen especially since 1992 and which by the late 1990s were at less than one percent of longer term average abundance. All other salmon species, except coho and steelhead\(^3\), had fallen to less than 10 percent of average abundance. Spawner populations also dropped to dangerously low levels. Many individual populations are considerably lower than those averages. All directed commercial fisheries on these stocks have been closed since 1996 in Rivers Inlet and 1997 in Smith Inlet. Known intercepting commercial fisheries have been closed or managed to avoid interceptions. Sport fishery interceptions have been minimized. The Native food fisheries have also been severely curtailed. Even with

\(^3\) The relative state of coho and steelhead stocks is unknown.
all of these actions, the salmon populations dropped to new, very dangerous lows.

As illustrated in Figures 1 to 6, the combined Rivers and Smith Inlet catch of each of 6 salmon species has decreased from levels that had been sustained for many years. In 1996, the stocks dropped so precipitously that all directed fisheries on them stocks were ended. The figures illustrate only part of the level of decrease in returns. Even without a commercial harvest spawner abundance decreased to new lows.

The decline was dramatic – the combined average total return (catch plus escapement) of sockeye from 1900 to 1974 was in the order of 2,000,000 fish. The recent total returns have been:

1996 = 121,697
1997 = 310,027
1998 = 130,161
1999 = 10,157
2000 = 22,530
2001 = 32,950
2002 = <200,000

The amount of decrease in abundance of other species is less certain because of very limited monitoring. However, the chinook spawning population in the Wannock River dropped to 500 in 1999. Down from a usual abundance of 3-5,000. In many streams, there were few if any salmon spawners of any species.

There are no counts of the steelhead populations in this area and no directed fishery to provide an indication of abundance. However, many other steelhead populations decreased to dangerously low

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Figure 4: Pink Commercial Catch

Figure 5: Sockeye Commercial Catch

Figure 6: Steelhead Commercial Catch

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4 Docee fence count was 91,939 sockeye. Owikeno spawner counts have not been finalized yet.
levels, as for example, in the Keogh River near Port Hardy. It seems likely that steelhead stocks in the Rivers and Smith Inlet area also had very poor survivals.

The figures also illustrate that the declines in salmon abundance, as reflected in the catch, started in the 1970s for chinook, coho, pink and sockeye. It is a major concern to understand what was causing these longer-term declines as well as the causes of the more recent collapse in the 1990s.

Some suggested causes of the decline in sockeye abundance since the 1970s are:

- Ocean regime shift and associated changes in ocean productivity are thought to have occurred in 1977 and 1989 (Beamish et al, 1999). Associated with the regime shifts, there may also have been changes in weather (Beamish, 1999) may also have affected freshwater survival. However, ocean regime shift related factors don't seem likely as Smith Inlet sockeye abundance increased during the period while Rivers Inlet sockeye decreased (see Figures 9 and 10).

- Commercial catching power increased dramatically from the 1960s to the 1980s with much better nets, electronics and mobility. This resulted in increased harvest rates that decreased the number of spawners and consequently the resultant population size. However, Rivers Inlet spawner counts show an increase from the 1970s to the 1990s. Smith Inlet sockeye were managed to fixed escapement by Docee fence counts and the population didn't decrease in abundance.

- Increasing spawner counting effectiveness also occurred from the 1960s to the 1980s with better access to spawning areas and increased use of jet boats, planes and helicopters. Shardlow et al (1987) found that stream counts of chinook by walking found 20% of chinook present, by rafting 43%, by swimming 63%, by fixed wing 85%, and by helicopter 100%. Brett (1952) found that walking counts of sockeye underestimated the fish present by two thirds. If the counting effectiveness changed during the period it could account for undetected decreases in spawner abundance and production. Smith Inlet sockeye were managed to 100,000 fixed escapement until 1981 when the target was increased to 200,000. The population increased in response to the increased number of spawners. A similar attempt made to increase Rivers Inlet production by increasing the number of spawners had little impact. However, the extent that the spawners were increased was uncertain.

- Decreasing nutrients from salmon carcasses might have reduced freshwater habitat carrying capacity. In Smith Inlet the nutrients from 200,000 sockeye carcasses were supplemented by lake enrichment. Consequently, nutrient levels in that watershed were increased and production increased. In Rivers Inlet, it is unclear how many salmon carcasses there actually were, there was no lake enrichment and the production decreased.

- Other factors such as disease or logging damage to freshwater habitat have been suggested as possible causes of the decline. However, based on juvenile sockeye abundance from the 1960s to the 1990s, McKinnell et al (2001) found that the long-term decline in Rivers Inlet catch cannot be attributed to a decline in freshwater survival.
There is no clear basis for determining the cause of the decline in Rivers Inlet sockeye abundance from the 1970s to the 1990s. However, the Smith Inlet experience would suggest that it might be related to reduced numbers of spawners.

The collapse of both Rivers and Smith Inlet sockeye (and other species) in the 1990s is thought to be the result of adverse ocean conditions that decreased food organisms available to juvenile salmon, which in turn prevented the salmon from reaching a large enough size to successfully survive their first ocean winter. However, the stock assessment/expectations process and fisheries management practices also may have been contributing factors. Predicted stock returns were based on past average survival without taking possible environmental factors into account. Fisheries were managed anticipating the general predicted level of returns. The lack of inseason indicators of population returns in Rivers Inlet and anticipatory fishing in Smith Inlet resulted in fishing when total returns were less than spawner targets in 1994, 1995 and 1996. That decreased the spawning populations and may have contributed to the exceptionally low returns in 1999, 2000 and 2001.

1.2 Impacts On The Salmon Ecosystem

“Quantitative associations in annual variations among salmon, large carnivores, nutrient loading rates and habitat productivity have been examined for over a decade in several British Columbia watersheds. Results indicate that reference points for salmon escapement objectives that satisfy classic stock recruitment needs are substantially lower than those that satisfy habitat nutrient loading requirements.”

- Hyatt 2002 (emphasis added)

The salmon ecosystem includes the web of interdependent and interacting species that salmon are dependent on and that are dependent on salmon as they relate to the abiotic environment. This includes the coastal and oceanic habitat as well as the forest / terrestrial habitat surrounding freshwater habitat. Watkinson (2001) identified beneficial effects of salmon carcasses up to 1 Km from the stream bank. More generally, the significance of salmon in “pumping” nutrients back from the ocean to freshwater and terrestrial communities has become well recognized (e.g. Reimchen 2001). The impacts of the collapse of the salmon stocks were felt quickly and dramatically by many species that rely on salmon as a food source. For example, bears appear to be especially dependent on the energy and nutrients (Reimchen 2000) with no salmon to feed on were forced into Oweekeno Village to look for food. The bear’s hunger and persistence eventually resulted in their being destroyed (Tizon, 2000 – in Appendix 4), an event that was extremely upsetting to the Oweekeno First Nation. Other animals died of malnutrition. Birth rate and survival of the young of animals that depend on salmon for food were likely heavily impacted for at least three years.

There has been no formal scientific assessment of bear, wolf, seals, orcas, eagle, gull and the many other bird, mammal and other salmon dependent populations in the area, either before or after the salmon collapse. Consequently, it is not yet possible to quantify the impacts on the ecosystem without reference to the local knowledge of First Nations and other area residents represented on Rivers and Smith Inlet Planning Group (RSPG).
Although not monitored, the species that salmon rely on probably were also affected by the decreased salmon returns. Low numbers of spawners may result in a phenomenon called "oligotrophication" (Stockner et al 2000–a vicious circle of decreased nutrient inputs to the freshwater ecosystem, reducing stock recruitment and, thereby, leading potentially to further impoverishment of nutrients. Shortreed (personal communication) estimated that the sockeye catch reduced the average nutrient contribution to Owikeno Lake by more than 6.9 tonnes of phosphorus and 37 tonnes of nitrogen. If the fishery reduced the nutrients by more than 6 percent per year, as reported by Shortreed (in preparation), then the recent severely reduced number of spawners would have had a much more significant impact. Such reduced nutrient inputs likely decrease the organisms that juvenile salmon feed on. Lower nutrient levels may also result in reduced nutrients for riparian vegetation that reduced growth and further negative impacts on the littoral and terrestrial fauna.

Salmon are also a significant component of pelagic offshore systems and while little is know with any precision of the effects of greatly diminished salmon numbers, it can be safely assumed that marine food chains are affected significantly by such collapses. In short a decrease in salmon abundance has potentially disruptive consequences for the diverse plethora of plants and animals that comprise the "salmon ecosystem" that stretches from high in the watersheds of coastal rivers to the depths of the ocean. Mindful of this possibility, the RSPG Recovery Plan includes measures to better understand such dynamics.

The mission of the RSPG is the restoration of all salmon species and their ecosystem in the Rivers Inlet and Smith Inlet watersheds. In agreeing to support RSPG restoration work, the Pacific Salmon Endowment Fund Society (PSEF), endorsed the perspective that an ecosystem approach that includes the coastal and ocean habitat of all salmon and dependent species is essential. The Owikeno and Long Lake watersheds, in Rivers and Smith Inlets respectively, have all species of salmon, including steelhead. The sockeye and some chinook populations are dangerously low spawner abundances. The BC government has designated parts of the watersheds as sensitive and proposed a number of protected areas in the watersheds. A Slaney (1997) review of salmon stock status identified 236 stocks in the Rivers and Smith Inlet area, of which 95 were rated at high risk of extinction. Thirty six percent of populations were rated as unknown because of lack of information. That study was based on data up to 1993. Since that time, the stocks and information about them have decreased.

The development of a comprehensive recovery plan is the first step in the recovery of sockeye and other species in the Rivers and Smith Inlet ecosystem.

An ecosystem approach to salmon restoration and management is proposed for the Rivers and Smith Inlet area. This approach would deal with the linkages between ecosystem components, land, water and people. The salmon ecosystem can be divided into 3 or 4 sections: the watershed ecosystem where spawning and early rearing take place; the estuarine / coastal ecosystem(s) where out-migrant smolts have their transition to salt water and get their initial "growth spurt"; and, the ocean ecosystem(s) where they get their final growth before returning to spawn.

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5 chinook, 2 chum, 3 coho, 1 pink, and 1 sockeye population
Figure 7 shows the ocean distribution of BC salmon (Margolis, 1990). This large area of the Pacific Ocean as well as coastal areas, are key parts of the salmon ecosystem. Rivers and Smith Inlet sockeye ocean distribution is known from high seas tagging done in the 1950s and 1960s (French et al, 1975).

1.3 Purpose of the Recovery Plan

The primary purpose of a recovery plan is to identify and set priorities for activities required to achieve the recovery goals for the specific area, its fish stocks and dependent ecosystem. Consequently, the recovery plan must focus on what is good for the fish and these plans must be permitted to evolve as new information is collected. Section 2, 3 and 4 of this recovery plan summarize the available information on the selected stocks, watersheds and ocean habitat. Sections 5 and 6 are a synthesis of this information and identify information gaps and the potential for recovery. Section 7 identifies realistic goals and priority activities required to achieve the recovery goals. Specific goals, strategies and recovery activities regarding habitat, stock use, land use and fresh and ocean water use will focus on what is good for the fish while taking into consideration competing uses within the watershed. Section 8 provides the framework for monitoring and assessing the effectiveness of the overall recovery plan, specific recovery projects/activities and the processes used to implement the recovery plan. Section 9 defines the priorities and implementation schedule for each set of activities. Section 10 contains a list of projects and approximate funding requirements.

1.4 Selection Criteria and Rationale for Species and Geographic Focus of This Plan

It has already been stated that our overall objective is ecosystem-wide in breadth – no species is disregarded, and no reach of the very extensive range of Rivers and Smith salmon is outside our concern. However, because this plan must be strategic, we must begin by identifying measures that are feasible. Thus while part of the plan is to be
constantly expanding knowledge of all components of the "salmon ecosystem", the activities to be undertaken are more narrowly concerned with the things that can be done in the next several years under quite optimistic funding assumptions.

The partners involved in the RSPG, including Department of Fisheries and Oceans (DFO) have identified the once highly productive salmon stocks in the Rivers and Smith Inlet area as at-risk and in immediate need of restoration. These are relatively large systems with many populations that appear to have been impacted by common factors. In the past, these watersheds supported the second largest sockeye catch in BC for many years. They also supported a world famous fishery for trophy sized chinook salmon, and a valuable sport fishery for coho. The other salmon species are lower profile but make an important biological, economic and social contribution to the area and are key parts of the ecosystem. The initial focus will be on restoring Owikeno and Long Lake sockeye.

Development in the area has been limited to forest harvesting. However, salmon and other aquaculture, and, if it proceeds, offshore oil and gas exploration and development are both expected to impact the coastal marine habitat of salmon from the Rivers and Smith Inlet area. The importance of the salmon in this area will hopefully attract the support and commitment required to initiate comprehensive recovery programs in other areas.

1.5 Guiding Principles for Recovery Planning

The Rivers and Smith Planning Group (RSPG) has reviewed the principles that guide other groups and organizations in recovery planning and, then, has adopted the its own specific approach and guidelines for its recovery planning. We drew on the National Marine Fisheries Service (NMFS 1996), Pacific Salmon Endowment Fund (PSEF 2001), DFO Wild Salmon Policy (DFO 2000a) and other direction on conservation and recovery planning to identify the following guidelines for recovery planning. Based on this review of other approaches, but, equally, based on the shared values and understandings of its membership, the RSPG has adopted the following principles for recovery planning:

1. **Conservation of fish stocks, their habitat and ecosystem integrity to sustain productivity will take precedence in managing the resource.**

2. **Recovery is to include the entire ecosystem and all its evolutionarily important components. All species, stocks and populations are valued.**

3. **Benefits and costs should be defined in the broadest sense, including social and ecological valuations that may not have an explicit dollar value.**

4. **Local people and interests must have a fair opportunity to benefit from local fisheries resources and make good use of local people resources.**

5. **Maximizing net benefits does not preclude management goals based upon social equity considerations (e.g. increased Native participation in the fisheries and in fisheries management and development) or sustainable resource use.**
6. In the context and spirit of conservation, allocation and use of public resources will be based on maximizing ecological, social, cultural and economic values to present and future generations. That is, resources (e.g. dollars, fish, etc.) will be directed towards the best opportunities for maximizing the potential overall sustainable net benefits.

7. The maintenance and further development of collaboration among the many parties concerned with Rivers and Smith, is essential to recovery and future stewardship.

1.6 Recovery Planning

The PSEF approach to recovery planning is similar to Stage II of the Watershed-based Fish Sustainability Planning Guidelines (WFSP; draft November 2000). In Stage II of the WFSP, a watershed profile is developed which describes the current conditions of the watershed and fish stocks. Objectives, targets and strategies are then developed to guide recovery. Finally, a monitoring and assessment framework is established. Throughout the process of developing the plan, public involvement is integrated into the planning. This recovery plan for the Rivers and Smith Inlet area includes each of these components, but extends beyond the watersheds to include the coastal and ocean range of all salmon species.

1.7 Community and Multi-Party Engagement in Recovery Planning

As noted, the RSPG arose from the consolidation and integration of the work of many parties. The First Nations in whose territories the salmon originate and who have used and managed the resources since time immemorial played a leading role in convening all of the parties in the midst of the precipitously low returns of the late 1990s. The Canada Department of Fisheries and Oceans, pursuing its mandate, strongly encouraged the concept of a table where all those with responsibilities, concerns and interests could cooperate. From an earlier and more limited Fisheries Renewal BC group, the RSPG evolved to comprise those First Nations, federal officials, local governments, forest tenure holders, environmental non-government organizations and sectorally based fisheries interests. Initially the Province of BC was represented and contributed very significantly to early RSPG development through the participation of and funding from the now-defunct Fisheries Renewal BC. Approximately 15 full group meetings have been held in the development of the background to and the contents of this plan.

This mechanism has worked well especially in light of the very dispersed location of the various parties. Appendix 1 details the evolving membership.

The engagement of the broader public beyond the RSPG table has been left, to date, primarily to the representatives of the various parties. The three communities of place involved in the RSPG (Oweekeno, Gwa’sala-Nakwaxda’w and the District of Port Hardy) have had varying degrees of internal and public discussion: more will occur as this plan is implemented. Engaging the broader BC public will continue to depend on

6 It is worth emphasizing the distinction between the challenges of convening RSPG membership compared to many other similar multi-party salmon recovery groups elsewhere in BC, especially in the south.
representatives of particular sectors but also on planned improvements to our communications including websites, magazine and newspaper articles and electronic newsletters (see Section).

2 PRODUCTION UNIT / STOCK PROFILES

Rivers and Smith Inlets are located in the Central Coast between the north end of Calvert Island and Cape Caution in the south, as illustrated in Figure 8. The watersheds of Owikeno Lake and Long Lake encompass an estimated 3,621 km² (Stockner & Shortreed 1979) and 408 km² (Sturhahn, pers. comm.) respectively. This area, the salmon that originate there, and salmon ecosystem are not well understood in terms of the factors affecting assessment, management, restoration and production.

For purposes of discussion in this recovery plan, the areas have been partitioned geographically into 14 zones containing 49 current or potential salmon production units (see Annex 2, Table 1). Each zone is a geographic area in which fish populations share common freshwater and early marine habitats. For example, the Upper Owikeno zone is the upper two basins of the lake and the salmon populations in the tributary streams.

Figure 8. Location of Salmon Streams In Rivers And Smith Inlets
2.1 Fish Population Status and Trends

The Rivers and Smith Inlet watersheds provide spawning and early juvenile rearing habitat for significant populations of salmon. Numerically, sockeye are the dominant species followed by pink, chum, coho, chinook and steelhead. Annex 2, Table 1 lists the streams and salmon populations in the Rivers and Smith Inlet area by geographic zone. Each stream is a habitat unit and each salmon species there a production unit. The table includes spawner targets to show where there has been consistent spawning of a species and the scale of that spawning. The DFO (2000) draft sockeye recovery plan describes the sockeye populations, life history and research findings. Information on chinook and coho in the area is in PFRCC (2001). The other species are described in the Rutherford (2000) and Pacific Region Salmon Stock Management Plan for Rivers and Smith Inlet DFO (1986). The time that spawners arrive, and spawning peaks and ends for each population are described in Thompson et al (1987).

Annex 2, Table 2 lists the 2001 spawner counts by stream and species. It gives an indication of current spawner abundance versus the target abundance, and shows how many populations were formally monitored:
- 8 of 15 sockeye populations;
- 1 of 29 coho populations;
- 3 of 21 pink populations;
- 4 of 20 chum populations;
- 9 of 13 chinook populations;
- 0 of 7 steelhead populations.

The spawner counts for each population in the area are available on the DFO website.

Catch records for the area started in 1882. Figures 1 to 6 illustrate both the catch and the general population trends.

2.1.1 Adult Abundance

There are two main components of adult abundance – catch and escapement. Historic catch records of sockeye in Rivers and Smith Inlet were pooled and averaged 1.2 million per year from 1900 to 1974. Figures 9 and 10 show sockeye catch and escapement for Rivers and Smith Inlets. From about 1975, Smith Inlet catch increased and Rivers Inlet
and total catch declined, then both collapsed in the 1990s. The Rivers Inlet commercial fishery has been closed since 1996 Smith Inlet since 1997.

Assessments of past production have been questioned because of unaccounted interceptions of stocks in previous years. For example, Wood (unpublished) found that as many as 100,000 Rivers Inlet sockeye were intercepted outside Smith Inlet; more than 250,000 Rivers Inlet sockeye were intercepted in Area 7 and 8. Also, more than 150,000 Rivers and Smith Inlet sockeye were intercepted in Area 27 in 1976. The interception rate in these areas depends on the sockeye migration route each year. The few past tagging studies have highlighted the variability of migration routes and interception of sockeye. Although this scale of interception would significantly affect stock assessments, it has not yet been included in them. However, recently, fisheries known to intercept local sockeye and coho stocks have been closed or managed to avoid interceptions. (see also PFRCC Background Paper No. 2000/4, State of Salmon Conservation in the Central Coast Area http://www.fish.bc.ca/html/fish2E20.htm)

The sockeye spawning streams and their spawner targets are listed in Annex 2, Table 1. There are 13 and 2 sockeye populations in Rivers and Smith Inlet respectively. The largest are Wannock, Sheemahant, Washwash, Dallery, and Amback systems in Rivers Inlet and Canoe and Smokehouse Creeks in Smith Inlet.

The old spawner counts were based on observed spawning habitat capacity and loosely on observed results of different sized spawning populations. The targets were probably closer to the spawner abundance at which digging up previously spawned eggs became apparent than to scientific maximum sustained yield spawner abundance. Originally, the spawner counts and targets were recorded as abundance ranges (e.g. 5-10k; 10-20k; 20-50k; 50-100k; and 100k+). These ranges were later averaged to convert them to a single number. However, there was no definite formula for converting a number of abundance estimates over a season into a single annual estimate of spawners. There was no allowance for the time individual spawners spent on the grounds, or for carcasses washed away by floods. Now an area-under-the-curve method is used to combine inseason estimates and average spawner turnover times are used. There is still no allowance for carcasses washed away by floods.

These spawner counts were visual, usually made from the stream bank. Such counts significantly underestimate the spawners actually present. Brett (1952) found that walking surveys underestimated the actual Babine sockeye population by two thirds. Shardlow (1987) found that stream walk counts only accounted for 20% of chinook present. Converting these old targets to actual numbers of spawner may significantly increase the targets.

The quality of Rivers Inlet sockeye escapement data is not consistent through time because of changing accessibility to spawning areas, and variable enumeration conditions and methods. For example, in the past, access was only on foot. Thompson et al (1988) describe 1987 spawner surveys on foot, by boat and by helicopter. Thompson et al also provide detailed daily records of sockeye escapement surveys and weather and water conditions. Since the early 1990s the number of spawner counts per stream has decreased from four to one or two and a number of streams are no longer counted. The early spawner data may underestimate spawner abundance by a factor of three or more. Recent data may also be an underestimate of the number of spawners.
Smith Inlet escapement data have been consistent and reliable since the Docees counting fence was installed in 1972 (Thompson et al., 1988).

The 1981 to 1999 catch of coho and chinook in various Rivers and Smith Inlet fisheries is shown in Figures 11 to 14. Chinook and coho caught in the Rivers and Smith Inlet area are a mix of local stocks and those from as far south of the area as the Columbia River. Information on where these stocks are harvested comes from the coastwide coded-wire tagging program. Information on local stocks is summarized in the PFRCC Advisory, March 2001, “Salmon Conservation in the Central Coast” http://www.fish.bc.ca/reports/background_2001/salmon_conservation2001.pdf. The complexity of many stocks being harvested together makes it difficult to estimate the production of chinook and coho from the Rivers and Smith Inlet area.

Chinook and coho feed primarily in coastal areas and become vulnerable to hook and line and net fishing gear within a year after migration to the ocean. In the marine environment, both species generally travel northward along the coast where they are fished by all types of gear. Consequently, chinook and coho originating in the Rivers and Smith Inlet area are harvested in fisheries from Alaska to their home area.

Figure 11: Rivers Inlet Coho Catch
Figure 12: Rivers Inlet Chinook Catch
Figure 13: Smith Inlet Coho Catch
Figure 14: Smith Inlet Chinook Catch

Figure 15: Locations Where Rivers Inlet Chinook are Caught
The northern distribution of chinook is determined from were chinook with coded wire tags were recovered. As Wannock River chinook migrate north, the different ages are harvested in the different areas they pass through.

The Wannock Recoveries, Chuckwalla Recoveries, and Kilbella Recoveries show the recoveries of all ages for these three chinook populations. A significant percent of all three stocks is taken in Alaskan fisheries. There are significant differences in the
percent of each population taken in the Central Coast area, with Wannock chinook having almost 50 percent taken there.
The sport fishery in the area takes an average of about 2,000 to 3,000 chinook and 10,000 coho. There has been a high profile sport fishery for trophy sized chinook in Rivers Inlet for many years. Catch statistics have been recorded since 1949. A special permit area for the chinook fishery was introduced in 1956 (Anon. 1956) and continued through the 1970s. A map of the permit is included in Schutz, 1975.

The First Nation fisheries in the area take very few chinook and coho.

Chinook and coho escapement or spawner counts are presented in Figures 16 and 17. They are not a complete count of spawners in any stream or of all spawning streams. For example, until 1998, coho were not counted through the Docee fence. Since then, that has been the only count of coho in the area and has been 3 to 5 times previous estimates, as shown in Figure 16. In Rivers Inlet, coho spawn in more than 23 streams, but few have been monitored in the last decade. The largest recorded coho populations have been in Johnston Cr., Sheemahant R., Wannock R., Chuckwalla R., and Kilbella R. There are seven coho systems in Smith Inlet, the largest of which are the Nekite R. and Smokehouse Cr.

As for coho, intensity and coverage of chinook spawner counts decreased in the 1990s but recently have been increased. There were 11 chinook spawning streams in Rivers Inlet and 2 in Smith Inlet. The largest spawning populations are in the Wannock, Chuckwalla and Kilbella rivers in Rivers Inlet and Docee and Nekite rivers in Smith Inlet. (See Table 1 in Annex 2 for a list of spawning streams for each species.)

Pink and chum salmon populations in the area tend to be relatively small with catches from 1984 to 1993 averaging about 150,000 pinks and 540,000 chums. Catch and escapement in each area are summarized in Figures 18 to 21. The total production is

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7 Year it was discontinued is uncertain.
8 The Docee River fence, near the Long Lake outlet, provides a reliable count of salmon migrating upstream to spawn. Management of the sockeye fishery is based on in-season fence counts.
difficult to determine because of unaccounted interceptions and limited escapement information. Recently, fewer spawner populations have been enumerated than from the 1950s to 1980s. There are 18 streams with pink spawner targets in Rivers Inlet, the large populations are in Chuckwalla, Clyak-Young-Neil, Johnston, and Kilbella systems. Of 16 chums streams in Rivers Inlet, the Wannock, Clyak-Young-Neil, Draney and Lockhart-Gordon systems are the largest. In Smith Inlet 3 streams have pink targets, but only the Nekite River has a significant population. The Nekite River is the largest of 3 chum streams in Smith Inlet.

2.1.2 Juvenile Abundance

McKinnell et al describe the two-boat trawl sampling program used in Owikeno Lake from 1960 to 1978, and 1995 to the present to monitor juvenile sockeye. Initially, sampling was conducted in spring, summer and fall. Since 1995 only the summer sampling has been conducted. This sampling provides a measure of juvenile abundance, size and distribution. Juvenile sockeye abundance has been indexed in Long Lake by hydroacoustic sampling since 1977 as part of the lake enrichment assessment program (Shortreed 2001).

Juvenile chinook abundance has been monitored sporadically in the Wannock and Chuckwalla-Kilbella Rivers using various traps, most recently a spiral screw trap. Instream sampling has also been conducted, but not on a continuing basis.
One time sampling of stream rearing species has been conducted in a number of the streams in the watersheds, especially those that are planned for logging. There has been no juvenile abundance sampling of chum and pink salmon. Also, redd sampling has been irregularly conducted in a number of areas.

2.1.3 Enhancement History

The following lists summarize the principal enhancement activities used for each species in the region.

Sockeye:

- A hatchery on Owikeno Lake operated from 1902 to 1937. It incubated mainly sockeye but also cultured several hundred thousand chinook annually. Also, large numbers of sockeye were transplanted into streams in the watershed that didn’t have any sockeye present, and further afield.
- Long Lake was enriched from 1977 to 1979, 1982 to 1985, and 1987 to 1997 (Shortreed 2001) to increase sockeye growth and survival. Enrichment was stopped in 1998 due to perceived high costs and reduced benefits as sockeye populations declined.
- The Washwash River channel was stabilized in 1973 (Hilland 2002) and 1986. Previously, flood driven changes to the channel reduced sockeye survival and spawning area.
- The Machmell River was diked to prevent sitation of the Genesee River sockeye spawning area.
- In 1982, 16,000 sockeye eggs were incubated as an experiment (Hilland 2002).
- In 2000, a semi-natural spawning and rearing channel was constructed on the Machmell River for sockeye and other species.
- In 2000, 2001, and 2002, sockeye eggs from most sockeye populations in tributaries to both Owikeno (> .55M) and Long Lake (>0.2 M?) were incubated in Snooti hatchery and replanted in their home streams. All enhanced sockeye were thermally marked (Hilland 2002, Hilland personal communication).

Chinook:

- There was limited hatchery production of chinook from the Wannock and Chuckwalla-Kilbella rivers in the period from 1983 to 2002. DFO, the Oweekeno Nation and the RIHPSFA operated small hatcheries during the period. A portion of this production was marked with coded wire tags. The RIHPSFA conducted a captive brood stock program, from 1994 to 2002, to rebuild chinook from the Chuckwalla and Kilbella Rivers from dangerously low levels (Hilland, 2002).

Chum:

- Chums were reared in seapens in 1984 and 1986 to assess enhancement potential (Hilland 2002).
- An unmanned spawning channel has operated since it was constructed in 1986 on the Nekite R. for chums. Other species also incubate and rear in the channel.
Coho:
• There has been very limited and short-term incubation of coho in the area (Hilland, 2002).

Pink:
• No enhancement

Steelhead:
• No enhancement

Hilland (2002) provides details on the specific enhancement methods and resultant production.

The enhancement potential in the area was identified in Lil et al (1985) and is summarized in Annex 2 Table 5. This gives an indication of potential methods to restore populations and rebuild their production. Some considerations likely have changed since then. An important consideration now, is how to take best advantage of the access provided by logging roads before they are decommissioned.

There are documented enhancement targets for sockeye rebuilding. However, RSPG is of the opinion that they are too low. Also, as a cost saving measure, DFO is considering terminating the sockeye restoration program before the targets have been met. There are no current enhancement targets for other species.

2.1.4 Survivals

Freshwater survival is estimated from the difference between egg deposition calculated from spawner counts and age / size, and pre-smolt abundance. Marine survival is estimated from pre-smolt abundance to adult returns (catch plus escapement). The parent (spawners) to progeny (catch plus escapement) ratio provides a general indication of total survival and production.

Ware (2000) proposed a marine survival index for Long Lake sockeye that incorporated June sea surface salinity at McInnes Island lighthouse. The predicted survivals for the 1994-97 brood years will be a test of this index. Based on the work of Tanasichuk, (2001), RSPG sponsored work by Routledge et al. (2002) to monitor the abundance of juvenile sockeye and their prey species in Rivers and Smith Inlet and outer coastal area. It is anticipated that this could also provide an index of early marine survival. As these indices relate to local marine productivity, they may also apply for pinks, chums, and possibly other species.

Sockeye:

Annual acoustic and trawl surveys have been carried out in Long Lake since 1977 (Shortreed et al 2001). Long Lake pre-smolt abundance hydroacoustic assessment tends to underestimate actual abundance and can't distinguish sockeye from sticklebacks that occupy the same area. Long Lake adult sockeye returns are counted as catch in the fishery and escapement through the Docee fence. This provides a
credible estimate of abundance. These statistics are also used to estimate overall survival or production from spawner to adult progeny. From 1980 to 1989 brood years the ratios of return range from 0.68 adult progeny per parent\(^9\) (0.68:1) to 5.86:1, with an average of 2.73:1. The 1990 to 1997 brood year average return was 0.4:1. This ratio is calculated by dividing the number of spawners in the parent year into the total number of adult progeny returning at all ages (this includes the 3, 4 and 5 year olds in the catch and spawning populations).

In Owikeno Lake, a reasonably consistent estimate of pre-smolt abundance, for most population sizes, is provided by a two-boat trawl index. Each population of sockeye enhanced in 2000, 2001 and 2002 broods have all been thermally marked, providing an opportunity to measure fry to pre-smolt and overall survivals. The lack of complete and credible escapement or spawner counts prevents measuring total and smolt to adult survival except in general terms. Owikeno spawner counts are incomplete, missing key large spawning rivers and lake spawning areas that are obscured by silt\(^{10}\). Instead, the spawner abundance is indexed to counts of spawners in clear streams that are assumed to have 1/3 of total spawners. The DFO (2000) Sockeye Recovery Plan describes weaknesses in both the spawner and the juvenile abundance indices.

The Rivers Inlet parent to progeny ratios for 1980 to 1989 brood years ranged from 0.5:1 to 2.18:1 for an average of 1.32:1. The 1990 to 1997 average was 0.28:1, clearly the population was shrinking.

Egg to pre-smolt survival rates in both Owikeno and Long lakes were within the range typical for coastal sockeye lakes and have been sustained (DFO, 2000). These measures indicate that the collapse of both stocks was a result of decreased marine survival. Sockeye marine survival and egg to pre-smolt survivals are in Figures B2 and B4 in DFO (2000).

**Chinook:**

The only estimates of chinook smolt to adult survival are from coded wire tagged enhanced production. This provides a measure of the number harvested. However, the lack of sampling for tagged spawning adults makes this a partial and weak indicator.

**Other species:**

There are no direct measures of freshwater or marine survival of other species in the area. However, Ward (2000) documented 70 percent declines in steelhead survival in the Keogh River near Port Hardy from 1992 to 1994. Marine survival decreased to less than 4 percent in the 1990s from 15 percent in the previous decade.

### 2.2 Salmon Resource Use

The salmon resources in the Rivers and Smith Inlet areas have been used for millennia. The Nations who have taken a leading role in the RSPG and in this recovery planning are like others of the “Northwest coast” in having relied on salmon and other aquatic

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\(^9\) At this rate of return, the population is decreasing, even without any harvest.

\(^{10}\) The old spawner targets for the Sheemahant, Machmell, Wannock and Owikeno Lake spawning areas totaled 480,000 sockeye.
resources as the underpinnings of unsurpassed cultural development (see Drucker 1965 for discussion). Until the 1880s, the salmon from Rivers and Smith were used exclusively by the Oweekeno and Gwa'Sala-Nakwaxda'xw peoples. Then commercial fisheries started and more recently, recreational fisheries have become significant.

2.2.1 First Nations Fisheries

It is now widely recognized that the richness of coastal First Nations in what is now British Columbia, arose significantly from the natural endowment of salmon runs and the unique cultural and managerial relationship First Nations established vis-à-vis these stocks. (Suttles 1990). Traditionally, the Oweekeno and Gwa'Sala-Nakwaxda'xw communities harvested enough – but only enough - salmon to sustain their entire local population. For the Oweekeno, with fewer people now living in the area than in the early contact and pre-smallpox period., harvests have averaged 2,000-3,000 sockeye per year recently. Catch has ranged from zero in the recent very low return years, to 4,156 in 1995. The Oweekeno now take very few chinook, coho and chums, depending on overall catch and availability. It is anticipated that Oweekeno catch will increase as the local sockeye stocks rebuild and as the population of the village at Rivers Inlet increases with the inception of new infrastructure and local economic opportunities.

Traditionally, the people also harvested enough salmon to sustain their entire local population. Since the population was relocated, access to their traditional resources has been very difficult and they have been taking very few salmon. The Gwa'sala Nakwaxda'xw people plan to increase their presence and harvesting in Smith Inlet.

The Constitution Act, 1982 recognizes and affirms existing Aboriginal and treaty rights. In 1990 in the historic Sparrow decision the Supreme Court of Canada upheld the application of Section 35(1) of the Constitution to Aboriginal rights in the fishery. By agreement, other First Nations may be allowed to harvest fish in a local Band’s traditional territory. Heiltsuk Nation fisheries along the outer coast and Fitzhugh Channel probably also take Rivers and Smith Inlet salmon when those stocks migrate through those areas.

2.2.2 Commercial Fisheries

Catch in commercial fisheries is summarized in Figures 1 to 6 in Section 1.1 and Figures 9 to 14 and 18 to 21, in Section 2.1 (see also Wood, 2000). The Rivers and Smith Inlet area had an important commercial fishery. In the past, the area has been the number 2 sockeye producer in BC with fairly consistent catches over 1.0 million and long-term average of 1.2 million (1900-1974). The loss of this sockeye fishery is costing stakeholders, communities, B.C. and Canada up to $20 million (in 2002 Cdn. dollars) per year, and many jobs. Catches of other species have averaged about: 150,000 pinks; 540,000 chums; 10,000 chinook; 30,000 coho; and 2,000 steelhead. It is important to note that much of the local catch of chinook and coho is of stocks from south of the area. Much of the catch of Rivers and Smith Inlet chinook and coho is taken north of the area.
2.2.3 Recreational Fisheries

The sport fishing is described in PFRCC 2001 and the CCLCRMP 1999. The sport fishing season generally lasts from early June to early September in this area. The Rivers Inlet chinook fishery has been a high profile fishery for trophy sized chinook for many years. Catch statistics have been recorded since 1948 as illustrated in Figure 22. In the 1980s, the Rivers Inlet sport fishery was mainly by private fishermen. Since then, the number of charter and lodge-based fishermen has increased to be the majority. Coho are now a very important part of the fishery. There are concerns that sport catch has been significantly underestimated because of limited monitoring and enforcement coverage of private (non-lodge) fishermen in many years.

The minor recreational fishery that occurs in Smith Inlet involves local and non-resident anglers. There are no lodges and no permanent guides operating in the area. The sport fishing effort is very low, most from local logging camps. Occasionally private boats fish the inlet. The non-tidal fishery is small and mainly by fly-in to the Nekite River for coho (>50) in the fall and steelhead in the spring.

2.2.4 Fisheries Management

Fisheries management in this area ranges from very effective for Smith Inlet sockeye, to high risk for Rivers Inlet sockeye, to passively manage for coho and unmanaged for steelhead. The strength of Smith Inlet management is the in-season Docee fence count that allows directly managing the fishery to achieve escapement goals. In contrast, Rivers Inlet sockeye management relies mainly on commercial catch related indices that are inconsistent, unreliable and very risky. Since 1990s, Rivers Inlet management has also been tied to Docee fence counts. There is a high correlation of stock strength between Rivers and Smith Inlet sockeye stock strength. If the Smith Inlet catch plus escapement to July 13th exceeded 50,000 sockeye then there was only a 16% probability that Rivers Inlet return would be less than 200,000. This level of return was used to trigger fisheries in Rivers Inlet. The RSPG expressed concern that treating both systems as a single unit in the past has not helped in managing Rivers Inlet sockeye. Consequently, it is recommended that the management of Rivers and Smith Inlet sockeye be decoupled.

Pink and chum salmon are managed to their observed abundance. Chinook and coho tend to be managed on an annual basis, except where there is an urgent conservation concern. Such a concern is building for the Wannock River chinook.
The biggest weakness in fisheries management in the area is the lack of information on returning stock abundance and stock specific catch and escapement.

2.3 Ecosystem Dependency On Salmon

From 1980-89, the average sockeye escapement was likely over 750,000. In addition, there were an average of about 175,000 pinks, 100,000 chum, 4,500 chinook, more than 10,000 coho and an unknown number of steelhead. Assuming average weights of each species that is more than 50 million pounds (25,000 tons) of protein and very substantial amounts of nutrient delivered to the Rivers and Smith Inlet watershed. A few of these fish are eaten by predators, but most spawn their eggs and leave their carcasses there. Some of the eggs hatch and eventually leave the watershed. The rest of the biomass are eaten by predators or decay and nutrify the watershed. Similarly, some of the spawner carcasses are eaten by various animals and the rest nutrify the watershed (Reimchen 2001, Watkinson 2001).

Loss or severe reduction of these inputs has heavy impacts on the species that eat the salmon, their carcasses, eggs or fry, as well as the species that benefit from the nutrient additions – including the next generation of salmon. The nutrient additions have an especially large impact\(^1\) in these coastal areas that are generally geologically young, with rocky, steep, high runoff watersheds. Consequently, these nutrient additions could have a major impact on productivity, enriching phytoplankton, then zooplankton and finally sockeye production.

There is limited information on the level of use and dependency of the various species that are dependent on the salmon. It is clear that black and grizzly bear, eagle and seal populations in the area have been heavily impacted by the salmon collapse. Many of the marine birds and mammals in the coastal area (CCLCRMP 1999) may also be impacted by the collapse. This is an issue that needs attention so that ecosystem needs can be incorporated into management. At the very least, ecosystem needs include sufficient salmon for major predators as well as an unknown amount to fertilize riparian area and sockeye lakes. Allowance must be made for increased ecosystem needs as the ecosystem recovers. For example, as salmon populations increase, bear population and their needs will increase from the current low levels.

3 Area Profile

Rivers and Smith Inlets are located in the Central Coast between the north end of Calvert Island and Cape Caution in the south, as illustrated in Figure 8. The watersheds of Owikeno and Long Lakes encompass about 4,029 km\(^2\). This area is typified by a lack of information about key factors for protection, assessment, management, restoration and production.

The Rivers and Smith Inlet watersheds have many similarities but also some important differences. They occupy the same basic area and geo-climatic zone and have similar proximity to coastal and ocean rearing areas. Outer coastal portions of both areas have low altitude, flat terrain, with tannic water and are reliant on seasonal water. Inland areas drain coastal mountains and are heavily influenced by coastal weather. Further

\(^1\) Stockner et al 1995, found that 36% of phosphorus in Great Central Lake came from spawners at high escapements.
inland, Owikeno Lake tributaries drain higher mountains and permanent ice fields. The Machmell River drains the Silverthrone Glacier and Sheemahant River drains the Monarch Icefield. Consequently, as the Owikeno Lake watershed is glacial fed, it is turbid and has a somewhat different runoff pattern than Long Lake.

Long Lake, in Smith Inlet, is more clear and therefore has higher primary production. Runoff from a number of large rivers provides a strong freshwater influence out to the mouth of Rivers Inlet. In contrast, Smith Inlet has limited freshwater influence throughout its length.

Overviews of the watersheds and coastal waters are provided in DFO (2000), BC Ministry of Sustainable Resource Management (2001) and Hilland (2002). More detailed information is available in a number of reports.

3.1 Freshwater Habitat Description and Condition

A basic summary overview of the freshwater habitat characteristics by stream is presented in Annex 2, Table 3. DFO (2000) and Hilland (2002) provide more details. Owikeno and Long Lake basins, under the CCLCRMP, protected areas are proposed for the: Ashlum and upper Inziana; the entire Long Lake watershed; lower Genesee and Walkus Lake in its headwaters; lower Machmell, Neechanz and floodplain; and Owikeno Lake second narrows - Sheemahant beach spawning areas. These areas would help to protect important salmon spawning and rearing areas.

3.1.1 Spawning Habitat

The area of accessible habitat and the percent gravel, and average spawner density for Owikeno and Long Lake tributaries are summarized in DFO (2000). Thompson et al, 1988 provide a general description of Owikeno Lake and its tributaries, including maps of lake beach spawning areas.

Spawning habitat has been disturbed and degraded in logged watersheds such as the Machmell and Sheemahant Rivers. However, at current spawner abundances, spawning habitat is not limiting survival enough to be apparent. Pendray (1988) found that the Sheemahant and Machmell rivers, with the most extensive anadromous habitat, had the lowest sockeye spawner densities. The highest spawner densities were in the Genesee, Amback and Washwash rivers that had the least available habitat.

There are lake shoreline and outlet areas where logging debris has covered areas where sockeye and chinook previously spawned. The increased runoff rate resulting from logged watersheds is also affecting some spawning areas. Instability of spawning areas results in loss of spawned eggs and alevins.

Some of the spawning habitat of other species is documented in a number of publications.

3.1.2 Rearing Habitat

Sockeye rearing habitat in Owikeno and Long Lakes is generally typical for coastal lakes. However, there are shoreline and outlet areas where logging debris has
accumulated in shallow areas that were thought to be where fry reared when they first entered the lake.

Chinook, coho and steelhead all rear in streams and have been variously impacted by logging and changes in runoff patterns. Chinook fry have been observed rearing in the estuary of the Chuckwalla and Kilbella rivers. Pinks and chums don’t rear in freshwater for a significant period. Generally, freshwater rearing habitat is not thought to be limiting at current population levels, but would become limiting as the populations increase.

3.1.3 Flow Regime

In this area, only the Wannock River discharge has been monitored for a significant time. Figure 23 shows following changes in the Wannock River discharge from 1961 to 1998:
- Annual discharge decreased about 15%;
- Spring (March-April-May average) discharge increased about 25%;
- Summer (June-July average) discharge decreased about 25%. There appears to have been a marked drop in summer discharge from 1977 to 1981 and onward.

It is not known how much of the change in discharge patterns is related to change in the amount of precipitation and change in temperature. The decreased summer runoff suggests earlier melting of snow. Also, the glaciers feeding Owikeno Lake have all receded significantly over the last 40 years. It is not known whether the increased spring discharge has affected salmon downstream migration timing or survival. Logging and global climate change may be causing or contributing to the change in runoff patterns.

3.1.4 Downstream Habitat

The salmon in this area have a very short downstream migration to the ocean, unlike the long trip that salmon in the Fraser, Skeena and other large watersheds must take. Most streams in this area do not pose difficult downstream passage. The short downstream trip is thought to be a major advantage to local stocks. It allows very small sockeye to get to coastal rearing areas. In Rivers Inlet, the longest migration between rearing areas is from freshwater to the coastal feeding areas.

3.1.5 Environmental Changes

There have been and are environmental changes going on in this area. However, few of the changes have been documented so can’t be properly assessed. Most observations are anecdotal. An exception is the change in Wannock River discharge. There may also be photographic records of the extent of ice fields feeding the Rivers Inlet drainage area, but they haven’t been assessed. Anecdotally, a number of small ice fields that

![Figure 23: WANNOCK RIVER DISCHARGE](image)
existed in the 1950s and 1960s no longer exist. This means that the streams that
drained those areas are probably clearer, with lower, warmer summer runoff. The
precipitation patterns also seem to have changed, possibly on a long-term cycle
(Beamish et al, 1999). Preliminary findings from Long Lake sediment cores suggest that
there may have been a significant decrease in zooplanton over the last 50 years
(Routledge, pers. comm.).

3.2 Spawner / Rearing Productive Capacity

The old spawner targets in Table 1 in Annex 2 provide an estimate of spawner capacity
based on observed spawners and returns. These targets were maxima, estimated from
observed habitat capacity and past parent to progeny survivals. They are based on the
number of spawners observed in a number of stream walks, not intensive surveys or
fence counts. Sockeye fence counts have been at least two times stream counts in
Smith Inlet. Coho targets and stream counts are likely considerably less than half of
what would be counted at a fence. Consequently, these targets are likely well below the
capacity in actual numbers of fish. As these targets tend to allow for at least a portion
of ecosystem use and needs, they more realistically reflect actual needs rather than strict
salmon productive capacity estimates.

3.2.1 Sockeye

Old sockeye spawner targets in Rivers Inlet were: 1,012,000 sockeye, 49,800 coho,
342,450 pink, 140,700 chum, and 22,700 chinook. In Smith Inlet the targets were:
200,000 sockeye, 10,700 coho, 65,600 pink, 95,500 chum, and 6,500 chinook.

Shortreed et al (2000), using photosynthetic rates, estimated juvenile sockeye rearing
capacity to be 43,000 kg in Owikeno Lake. In Long Lake, they estimated the capacity to
be 11,000 kg in the unfertilized lake and 29,000 kg if the lake was fertilized. In Owikeno
Lake, this is equivalent to 33,000,000 smolts. Using the biostandards13 for the Central
Coast, this would result in average returns of 1,485,000 adult sockeye. No allowance
was made for increased fertilization of Owikeno Lake by large numbers of spawners. In
Long Lake, using appropriate average smolt weights14, the capacity would be 3.7 and
5.9 million smolts respectively for the unfertilized and fertilized lake. Biostandards
estimates of average adult returns from these smolts would be at least15 166,500 and
265,500 sockeye. These estimates are based only on lake rearing capacity.
Depensatory impacts in the early marine life stage could contribute to increased average
survivals of large sockeye populations.

3.2.2 Chinook

There is limited information on chinook spawning populations or productive capacity.
The chinook in the Wannock and Chuckwalla-Kilbella Rivers have been monitored more
than other populations. Only in the last few years have there been attempts to assess
productive capacity. There are old hatchery egg-take records for Washwash River
chinook that give a general indication of a significantly larger population in the 1930s.

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12 Adjusted target to reflect fence counts and lake capacity studies. Smokehouse Cr. 150k,
Canoe Cr. 50k spawners.
13 The biostandard smolt to adult survival for Central Coast sockeye is 4.5%.
14 Shortreed et al, 2000, reported that smolts averaged 3.0 g (unfertilized lake) and 4.9 g
(fertilized lake.)
15 At least because Smith Inlet sockeye smolts are larger than average Central Coast smolts.
3.2.3 Coho
Coho spawn late in the season when access to spawning areas is very difficult and counting is almost impossible. Consequently, there are few estimates of coho spawner abundance and they are considered to be minimal, at best. Since 1998, Docee fence counts have been extended to cover the coho migration. These coho counts have often been more than previous total counts for both Rivers and Smith Inlets. The coho populations passing through the Docee fence are now being treated as an index-population for assessment.

3.2.4 Chum
Spawner and rearing productive capacity measures have been limited to spawner estimates and resultant returns. The main chum spawning populations have had a stream or aerial count most years since the 1950s. Age structure is not usually sampled so actual brood year production is not known.

3.2.5 Pink
Spawner and rearing productive capacity measures have been limited to spawner estimates and resultant returns. The main pink spawning populations have had a stream or aerial count most years since the 1950s.

3.2.6 Steelhead
Little is known about steelhead populations in the area.

3.3 Use of Land and Freshwater Resources
The primary land and freshwater resource use in both Rivers and Smith Inlet areas is forest harvesting.

3.3.1 Water Use
The only consumptive uses are for domestic water for logging camps, Oweekeno Village, sport fishing lodges and other settlements in the area. Non-tidal waters have also been used for booming and transportation of logs. The result has been deposition of bark and wood debris in a number of areas in Owikeno and Long Lakes. Both of these lakes and large rivers are also used for general transportation with little apparent impact.

A number of rivers and streams were developed as water and power supplies for now defunct canneries, including McTavish Creek, Sandell River, Hogan Creek, Margaret Creek, Boswell Creek. There was a salmon hatchery on Meadows Creek, tributary to Owikeno Lake. Oweekeno Village is considering developing a local stream for a small hydro project to meet their electric power needs.

3.3.2 Recreational Areas
There is very limited use of land and freshwater for recreation. The primary uses are hunting and sport fishing.
3.3.3 Forestry

Less than half of the Owikeno Basin is forested. The areas with merchantable timber tend to be in river valley bottoms or near the lakeshore. This means that much of the forest harvesting can have a direct impact on salmon habitat by affecting the rate and timing of snow-melt and runoff, riparian vegetation, stream bed stability and spawning gravel siltation. The logged areas and planned cuts in the Owikeno Lake watershed are described in DFO, 2000. The largest impacts have been in the Sheemahant and Machmell watersheds where logging has been extensive. Other logged watersheds include the Washwash, Tzeo, Inziana, Neechanz, Genesee, and Wannock (Hilland, 2002). Sloan (1972) found that turbidity, suspended wood and fibre concentrations, and benthic wood debris accumulation increased in the vicinity of log dumps and log load-out areas in Owikeno Lake. Hilland (2002) outlined the past logging related activities in the area, including sorting and booming in Owikeno Lake, log driving down the Wannock River, and sorting and booming in the Wannock estuary. Planned future logging in Owikeno drainage is about 5.6 million cubic meters of wood, mainly from the Doos, Dallery and Neechanz watersheds (Hilland, 2002).

In Rivers Inlet, the Chuckwalla and Kilbella Rivers have been extensively logged. Other logging activity in the Rivers Inlet area in the last few years includes:
- A-frame logging in Draney Inlet;
- handlogging at the head of Moses Inlet and some other shore areas;
- logging on the north shore of Hardy Inlet (McNair and Dorris Creeks) ended about 3-4 years ago;
- heli-logging on Walbran Island (no roads);
- conventional road based logging in Pearce Bay;
- conventional road based logging in Machmell, Neechanz, and Sheemahant river areas tributary to Owikeno Lake.

A number of other watersheds in the Rivers Inlet area are also slated for future harvesting.

There has been some A-frame logging along the Long Lake shore with limited impact. Logs were boomed in the lake, transported down the Docee River, and sorted in Wyclees Lagoon. These activities left wood debris in these waterways. The Wyclees Lagoon area is currently being logged and logs are boomed there. Other Smith Inlet areas that have been logged include Naysash Inlet.

3.3.4 Rural Residential

Residential development is limited to the Oweekeno Village area and Dawson’s Landing. There are also a number logging camps and sport fishing lodges in the area.

3.3.5 Industrial

Other than forestry, there is no land-based industry in the area yet. However, with the push for land based aquaculture this could change. This could involve hatcheries and land based grow-out facilities.
3.3.6 Habitat Mitigation and Compensation

The closest thing to mitigation of habitat impacts has been Fisheries Renewal BC (FsRBC) and Forest Renewal BC (FRBC) habitat restoration funding to mitigate forest harvesting and road building impacts. Also, Western Forest Products (WFP) constructed a spawning/rearing channel on the Machnell River by opening access to and restoring a side channel that had been blocked by earlier road construction.

The Rivers Inlet Hakai Pass Sport Fishing Association (RIHPSFA) has invested significant amounts in building and operating a hatchery to restore the chinook in the Chuckwalla-Kilbella systems. Initially, juvenile chinook were reared to smolts then released. The population was so low that it was difficult to get brood stock. Consequently, from 1994 to 2002, the focus has been a captive brood stock program to rebuild the population faster.

3.3.7 Habitat Management

Habitat management in this area ranges from cooperative to non-existent. The area is remote and expensive to access for DFO and BC government habitat staff. Planning and monitoring forest harvesting is done cooperatively with forest harvesting companies. There have been problems with developments approved without consultation with local interests. For example, current forest regulations don't take into account all other components of the ecosystem. Consequently, some forest harvesting locations and cutting rates are dictated without concern for impacts on other resources or sectors, such as tourism and sport fishing. Similarly, there is concern that salmon farming will be approved for the area without any consideration of ecosystem impacts or local input.

The biggest weaknesses in habitat management in the area are the lack of habitat capacity, fish utilization, and other baseline information, and of monitoring development and natural impacts. The initial focus will be on getting baseline information in anticipation of planned developments.

4 Marine Profile

It is commonly thought that the cause of the recent collapse of the Rivers and Smith Inlet sockeye and other salmon stocks is primarily a result of adverse ocean conditions in their first ocean year (Beamish and Mahnken, 2001). This might be a result of diminution of available food organisms in the area, increased predation rates by species normally resident in warmer southern waters, and/or from other factors associated with sea temperature increases and hydrodynamic changes. Rivers and Smith Inlet sockeye smolts are very small when they migrate seawards and so are especially susceptible to such factors.

For the purposes of this plan, the marine environment is divided into four basic components: estuary, inlet, coastal16 and ocean. Each has different, but important, characteristics and impacts on salmon survival and growth. The various estuary, inlet and coastal areas and their importance to salmon are described in Annex 2, Table 4.

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16 This usage has become common within and outside our group. More properly “coastal” here is the same as “neritic”, the shallower ocean waters over the continental shelf.
4.1 Estuary Habitat and Ecosystem Condition and Use

Compared to the mouths of larger BC river systems such as the Fraser and Skeena, there are no large estuary deltas in this area. But limited size does not mean limited importance. The dominant visible feature of Rivers Inlet estuaries is the large plume of turbid waters which has always made assessment of stocks and habitat challenging. This distinguishes these estuaries from those of Smith Inlet where no substantial amount of glacial fine materials is present.

There are indications that the Chuckwalla-Kilbella estuary is an important rearing area. Sockeye smolts do not appear to rear in the Wannock River estuary for much time (Routledge, 2002). The estuary of the Docee River is Wyclees Lagoon and Quascilla Bay area. These and other estuaries and their ecosystems have not been monitored, assessed or reported on.

There have been development impacts in some of the estuaries in the area. A portion of the Wannock estuary was diked and filled in 1973 for a log dump facility. The lost habitat included tidal grasslands that chum, chinook and coho were thought to rear in. There may also be metal contamination from old cannery waste in that estuary area. Many of the smaller estuaries also had old cannery developments in them that may have impacted them. Currently, some of those estuaries are being used by sport fishing lodges. Use of other estuaries is related to forest harvesting.

The current condition of most estuaries appears to be good, with limited impact of past or present development impacts. The Wannock estuary should be assessed for restoration need and potential. Wyclees Lagoon should also be assessed to better understand its importance to the Long Lake sockeye and its susceptibility to logging impacts. The anoxic water in the lower portion of Wyclees Lagoon should be assessed for its stability and potential risks for salmon.

4.2 Inlet Habitat and Ecosystem Condition and Use

The inlet habitat is a transition between estuary and coastal habitats. There is a range of types of inlet habitats in the area. For example, Rivers Inlet has a detectable freshwater surface layer throughout much of the inlet. In contrast, Smith Inlet has a very limited surface freshwater layer. The tributary inlets also differ, depending on freshwater inflow and tidal exchange and mixing. The changes in Wannock River discharge amount and timing likely have affected Rivers Inlet. Wind intensity and direction affects mixing and productivity in the inlets. Global climate change might be having local impacts.

The inlet ecosystems have not been monitored, reported on, or assessed. However, interview data on past abundance of eulachons and other species indicates that there were major eulachon runs to the Kilbella River and the presence of many species of fish, birds and mammals that were feeding on them there.

The inlets are used for transportation and sport and commercial fishing. The BC government has indicated that the inlets may be subject to aquaculture development, particularly salmon farming.
Generally, the inlet habitat is in natural condition. However, recreational use of the marine park on Penrose Island at the mouth of Rivers Inlet is growing and there are problems with sewage disposal.

### 4.3 Coastal Habitat and Ecosystem Condition and Use

Until recently, there has been limited monitoring or scientific work on marine habitats in Rivers and Smith Inlets and outer coastal areas. There are no stock, habitat and or ecosystem baseline measures for conservation and compensation.

Welch (personal communication) found that juvenile salmon from the Rivers and Smith Inlet area rear in the Central Coast – Queen Charlotte Sound – Hecate Strait area for an extended period before migrating north to the Gulf of Alaska. Consequently, they are highly subject to conditions in the area. Other stocks also feed in the area, but are thought to spend less time there before they migrate north.

The productivity in the coastal area has varied significantly over the 1951-1999 period. For example, in the following figures, at Egg Island, at the mouth of Smith Sound, both spring and summer sea surface salinity increased about 1.5‰ over the period 1970 to 1998. There was no appreciable change in salinity in March or April, but May showed an increasing trend and June and July showed a marked increase. At McInnes Island, at the mouth of Milbanke Sound, both spring and summer sea surface salinity decreased about 1.0‰ from 1956 to 1970-2, increased about 2‰ over the period 1970 to 1992 and then decreased 1.5‰ by 1998.

Figures 24-27 show the Egg Island and McInnes Island sea surface temperature and salinity from 1971 to the present, at the times of year when sockeye are passing through the area.

Beamish and Mahnken (2001) hypothesized that if salmon don’t reach a critical size before their first ocean winter they don’t survive. Recent studies suggest that the coastal habitat is a critical determinant of salmon growth and survival. Under productive upwelling conditions, juvenile salmon have a supply of rich marine food and there is little mortality in the area. In contrast, during years of low upwelling, juvenile salmon have a limited supply of rich marine food and there is high mortality in the area.

Figure 24: EGG IS. AVERAGE SEA SURFACE TEMPERATURE (SST)

Figure 25: EGG IS. AVERAGE SEA SURFACE SALINITY (SSS)
As coastal ecosystems have not yet been adequately monitored, assessed or reported, little is known about the relative importance of the various salmon food organisms, predators or competitors. In Barkley Sound, Tanasichuk (2001) found that sockeye growth and survival is highly dependent on the available supply of preferred sizes of euphausids.

Ware (2000), related ocean survival to McInnes Island ocean conditions and predicted survival rates. The quality of those predictions has not yet been assessed.

Juvenile salmon (mainly sockeye) and their habitat were sampled as they migrate from freshwater to the outer coastal area in 2002 (Routledge et al, 2002). Preliminary results of this study indicate that most sockeye don’t spend much time in the inlets, instead they migrate directly to more productive coastal areas. The only inlet areas with significant catches of juvenile sockeye were near Dawson’s Landing and in Kilbella Bay.

Changing abundance of predator species may also be a contributing factor to changing salmon survival. With the recent El Nino warm water, more mackerel, sardines and possibly hake have been present in the area. Since then there have been visible signs of increased productivity of the coastal area with many more whales, birds and fish feeding in the area (Personal communication, Sandi MacLaurin).

Development impacts in the coastal habitat are limited and related to transportation. However, petroleum transportation and handling requirements pose a risk to habitats in the area. Also, plans have been discussed for aquaculture development, including farming of salmon and other finfish and shellfish, and for offshore oil and gas exploration and development in the area. All planned marine activities would have to be considered in RSPG recovery plans.

4.4 Ocean Habitat and Ecosystem Condition and Use

Conditions in the ocean have apparently changed as a result of factors outside our knowledge and capability to address. Beamish and Bouillon (1993) identified the relationships between salmon production and the size, strength and location of the Aleutian Low pressure weather system in the ocean. In turn, changes in the Aleutian Low are associated with the Pacific Decadal Oscillation (PDO) and its interactions with the El Nino-Southern Oscillation (ENSO). This subject is summarized in the PFRCC Annual Report for 2000-1 (http://www.fish.bc.ca/html/fish2310.htm). Important new information on this area has been reported in the last few years.

High seas tagging in the 1950s and 1960s identified the ocean distribution of Pacific salmon stocks in the North Pacific. The Rivers and Smith Inlet results are summarized by French et al (1975). Figure 7, from Margolis (1990), shows the ocean distribution of all Canadian pacific salmon. The open ocean ecosystem is diverse, and the role of salmon in it is not understood.

Development impacts in the open ocean area are essentially unknown, but could include transportation and petroleum handling impacts. The habitat appears to be natural and not impacted by man, except possibly by global warming and low level pollution.
5 INFORMATION NEEDS

The current lack of key information to plan, implement and assess stock rebuilding makes meeting information needs a key basis for action. Soft data is a problem, especially for sockeye in Rivers Inlet and for other species in both areas. Soft data should be a reason for managing very cautiously and for getting better information as soon as possible.

5.1 Ecosystem Framework

A basic understanding of ecosystem interdependencies and interactions is important to restoring the salmon ecosystem. However, ecosystem information is generally lacking, and where available, has not been brought together into a usable form for management. An important unknown is whether there have been previous collapses of salmon production. It would also be important to know what salmon population levels were before commercial harvesting and before watershed logging. Information on the many species of land and marine mammals, birds, insects and other organisms dependent on salmon is essential to developing and understanding an ecosystem framework.

Traditional Ecological Knowledge is being assembled to help address this issue. Recent advances in trophodynamic modeling hold some hope of establishing ‘benchmarks’ in past production. These can also be linked to future oceanic regimes. There is good potential to use sediment cores to determine past production (Stockner and Shortreed, 1975). Tree ring data also throw light on past production levels (Reimchen, 2001).

5.2 Stock Condition

Quality and amount of information related to stock condition is a major limitation to recovery planning and implementation for Rivers Inlet sockeye. Spawner counts only include a portion of the actual spawners and that portion has likely been increasing through time as access and technology have improved. Estimates in the 1950s probably accounted for less than 1/3 of actual spawners (Brett, 1952). Recent counts include a higher percent, but still probably significantly less than 100 percent. In addition, there are major habitat related spawner and juvenile assessment problems due to silty water in the Sheemahant, Machmell and Wannock Rivers, and Owikeno Lake. The sockeye overall target for these areas is 480,000, but the target is based on visual estimates made under adverse conditions. The Sheemahant and Machmell are both large rivers with extensive potential habitat so the actual spawner capacity could be much larger or smaller than these targets. The lack of a direct or indirect measure of spawners to these areas is a major stock assessment and management problem. Without this information it is not possible to assess freshwater survival and production rates. There is no basis to set spawner targets or to manage the fisheries to meet spawner needs.

Figures 28 to 33 show the estimated number of sockeye spawners from 1950 to 2002. Some rivers were not monitored for the entire period, thereby affecting total Owikeno spawner numbers. For example, Machmell River spawners were not estimated until 1972 and Owikeno Lake spawner were first estimated in 1959. Over the period there were progressive changes, such as access to spawning areas increased with better boats, more use of airplanes and helicopters, and more road access. For example, the increasing spawner counts in the Sheemahant River coincide with boats that could make it up river and later with logging road access to much of the watershed. The habitat has
also changed as watersheds have had their forest progressively harvested. The lower basin watersheds have not been logged yet. Logging started in the early 1970s in the Washwash, Tzeo, and Inziana, in 1971 in the Sheemanhant, in 1978 in the Machnell, 1985 in the Neechanz.

There have been consistent differences between watersheds, with difficult viewing conditions associated with silty water in the Sheemanhant, Machnell, and Wannock Rivers and Owikeno Lake spawning areas. Variable differences such as fall flooding affected both access to spawning areas and viewing spawners to make estimates. In total, a lot of different and independent factors probably affected the spawner estimates for Owikeno sockeye.

Before the stock collapse in the 1990s, there was a major decrease in the Dallery spawners and a major increase in Sheemanhant counts. There were a number of
common spikes of spawner abundance: 1963 strike year\textsuperscript{17}; 1968 large return year; 1973; 1982. There were common lows also, as in 1965 when there was severe flooding in October. There are apparent differences between lake basins, with spawner populations in the upper and mid basins low in the 1950s and increasing in the 1960s. In contrast, the lower basin spawners were high in the 1950s and early 1960s and down in the mid to late 1960s. The common factor to all areas is the collapse in the 1990s (1994 on). Also in the 1990s, only “clear stream index” streams have had spawner estimates since 1998.

Some changes in spawner abundance can be related directly to the fisheries. For example, in 1969, Wood (1970) reported more than 100,000 troll caught sockeye not accounted for in inseason management. In 1969, the number of spawners to a number of populations was down. There were boundary changes in both Rivers and Smith Inlets that affected overall harvest rates. In 1964, the weather was exceptionally wet during the fishing season and sockeye were migrating deep and gillnets were not catching them.

Recently, most salmon populations have not been assessed (see Table 2 Annex 2 or (www.pac.dfo-mpo.gc.ca/ops/northfm/Areas/Area9/Default.htm). There have been summary or no spawner counts, and no juvenile abundance indexing. This makes it impossible to assess stock condition in detail. However, the decrease of salmon returns has been so large that it is readily apparent overall. In general, sockeye, chinook, pink and chum stocks decreased to dangerously low levels in the latter half of the 1990s. In 2001, pink salmon populations started to increase. In 2002, sockeye, chinook and pink returns and survivals increased. Little is known about past or current coho and steelhead populations.

With recently increased ocean survivals, the condition of stocks has generally improved (PFRCC, 2000). It is important to note that individual populations each recover in response to their specific capabilities and conditions. For example, Owikeno coho abundance hasn’t increased at the same rate as Chuckwalla-Kilbella populations. Also, available information indicates that sockeye spawning populations in the 1990s have been so low that it will likely take several generations to rebuild them. The continuing lack of basic stock information is a major risk and concern. Basic information on distribution of chinook and coho harvest is required to better protect and rebuild at risk stocks.

There is an opportunity to assess population specific survival, migration timing and route differences and to rationalize population conservation and production targets, using the marked incubated sockeye from the 2000, 2001, 2002 and subsequent broods.

5.3 **Freshwater and Marine Habitat Condition**

Two major information shortfalls on freshwater habitat capacity relate to the baseline conditions before forest harvesting and commercial fisheries. This information is important for the definition of habitat capacity and the factors that limit it. This includes measurement of the impacts of forest harvesting on salmon and ecosystem sustainability. Before intensive commercial harvesting, the number of salmon returning

\textsuperscript{17} There were other strikes in 1952, 1957 and 1959 but all were shorter with less impact on harvest rate than the 1963 strike.
to streams in the area was large. This was perceived as economic over-escapement – a waste of valuable resources. However, it was likely not ecological over-escapement as salmon provide the food and nutrients to support an extensive ecosystem. Stockner et al (1995) found that, at high adult escapements, at least 36% of phosphorus loading in Great Central Lake came from salmon carcasses. Without baseline information before forest harvesting, commercial fishing or other natural resources uses, it is not possible to quantify any impacts of that use.

Little is known about the salmon habitat in the river estuaries, inlets, coastal and open ocean areas. In the past, these areas supported significant salmon production. Recently, these habitats have been subject to global warming and ocean climate changes and estuaries have had some development impacts. Recent studies in the coastal marine area have shown generally low productivity in Rivers Inlet and higher productivity in coastal areas at the mouth of that inlet and in Smith Sound.

5.4 Marine Survival

Little is known about juvenile rearing areas, migration routes, rates and timing, and food dependencies. The physical and chemical characteristics of the various marine areas are poorly known. It is known that freshwater influence extends a long way out Rivers Inlet and that it is strongly influenced by wind and precipitation patterns. Recently, sampling of oceanographic conditions and juvenile salmon abundance and condition has been conducted in the Rivers and Smith Inlet areas. It will likely take a number of years of that sampling to better understand the dynamics that are affecting marine survival.

A better understanding of inlet and coastal ecosystem factors that affect salmon survival is needed to guide management and development in these areas. Ideally, an index of marine survival and production would be developed to guide management.

5.5 In-season Stock Abundance

There is no viable measure of in-season stock abundance of Rivers Inlet sockeye. When there was a fishery, management relied on catch rates and catch per effort for in-season management. The risks of this approach are discussed in PFRCC 2000. This approach, by itself, is not adequate for risk averse management. An attempt to develop an acoustic index at the head of Rivers Inlet was not successful (Walters et al, 1993). A fishwheel index in the Wannock River was also not successful, possibly because of very low sockeye abundance and/or river conditions in the years tested. In 2002, an acoustic counter was feasibility tested with positive results.

Smith Inlet sockeye in-season abundance is measured by escapement counts through the Docee fence and hailed catch. This has provided effective measures for in-season assessment and management.

Either there is no in-season measure of abundance of other species or it is from catch per effort. For these species, any over-harvesting must be compensated for in future years. For some populations, clean-up fisheries can be conducted near spawning rivers to harvest any apparent surplus abundance.
6 PROGNOSIS

This section attempts to take stock of the factors that will affect the recovery plan and its individual projects. Somewhat artificially these have been organized into biogeophysical (i.e. all non-human influences of the environment) and human factors. The distinction is because of the ever-increasing influence of human activity on even large global factors, notably the climate.

6.1 Bio-physical Factors Influencing Recovery

**Biological**

Key factors influencing population recovery are thought to be coastal and inlet survival and growth rates. The recent ocean regime shift has apparently resulted in increased productivity levels in coastal areas (PFRCC, 2000). It is anticipated that salmon survivals will also increase. However, as Figure 34 illustrates, the number of adult progeny produced per parent (spawner) apparently decreased from about 3 or 4 progeny per parent to almost zero. The high Rivers Inlet return rates in the 1950s and 1960s might, in part, be a result of underestimated escapement then. There are no Smith Inlet age data for the 1950s and 1960s to calculate brood returns. The points for 1995 to 1997 are approximations until age of returns has been analyzed. They suggest that production may have improved slightly from the low of almost zero, but it is likely a long way from 3 or 4 to 1. A real concern is the next four year’s of returns from abysmally low escapements. Age of returns each year will decide how fast the very low broods in 1999 in Rivers Inlet and 2000 in Smith Inlet will be restored.

As the population abundance rebuilds, it is expected that freshwater spawning and rearing limitations will come into effect. As the Long Lake sockeye population rebuilds the benefits of conducting lake enrichment again will have to be considered.

The rate of recovery may have been influenced by the sockeye incubation program (Hilland and Willis, 2002) to help increase freshwater survival to rebuild populations to at least the LRP level. The RSPG feels that the current temporary LRPs for sockeye in Rivers and Smith Inlets (30,000 and 8,000 spawners respectively) are too low. Consequently, the offsite incubation of the broods of the weakest returns, in the next few years, is essential to ensure population recovery.

There is concern that fishing of local stocks will begin and increase too soon, delaying restoration and increasing the risk of inadvertent over-harvest and population collapse.
**Ocean Conditions**

While the extent to which changes in climate impact on salmon populations is still wrought with uncertainty, increasingly compelling evidence from lake sediment records point to very considerable “natural” oscillations that long predate humanity’s ability to drastically reduce stocks (Finney et al 2000).

Currently it is thought that ocean conditions follow a long-term “decadal” scale cycle. Consequently, conditions could remain generally favourable for at sea growth and survival over the next 10 to 20 years, although concerns have been expressed that the number and intensity of El Nino events will increase in response to global warming and overwhelm the decadal cycle. Figure 34 shows that productivity of both Rivers and Smith Inlet sockeye stocks has been highly variable. Consequently, variability of returns and rebuilding should be expected. Rather than guessing about cycles, it is generally thought that indexing productivity and food organisms in the coastal and inlet areas will provide a real time predictor of productivity and survival.

### 6.2 Human Factors Influencing Recovery

While the RSPG represents the human groups closest to the issue of salmon and salmon ecosystem recovery for Rivers and Smith, there are other actions beyond our immediate control which will powerfully affect the course of any recovery plan. These include:

- Fisheries
- Land use activities
- Coastal and Ocean uses
- Availability of program funding

#### 6.2.1 Fisheries

There have been no commercial salmon fisheries in Rivers Inlet since 1995 and in Smith Inlet since 1996. All fisheries known to intercept sockeye have been limited and controlled to eliminate interceptions. The commercial fishing fleet has been decreased to less than half of what it was in 1995. The remaining fleet eligible to fish in the area has been halved again by area and gear licensing. However, this fleet is comprised of the most successful and best equipped fishermen. Consequently, it is difficult to assess the potential impact of the fleet on population abundances. The RSPG remains concerned and alert to the possibility that some of the recovering stocks from the area will be caught in mixed fisheries with stronger stocks elsewhere. This underscores the need for better and more precise stock identification.

The sport fishery generally has a low risk of over-harvesting stocks, but has a high potential catching power, where it targets a specific population, especially near or in a spawning stream. This is a concern with the low chinook spawner levels in Rivers Inlet. Even with limited enhancement, the Wannock chinook stock is not keeping up with the pressures on it. This is a concern because the Rivers Inlet sport fishery timing coincides with the early portion of the Wannock, Kilbella and Chuckwalla chinook runs and all have low numbers of spawners. The sport fishery in Rivers Inlet is primarily on local fish. The
fishery can be especially intensive because it uses the coho fishery to sustain local fishing effort and as a fallback for the chinook fishery.

An added concern is that the non-lodge portion of the sport fishery is heavily focused on catching chinook and has had very limited monitoring or enforcement re catch in the last decade. In 2001, there was a monitoring and enforcement program that covered this portion of fishery. The need for adequate monitoring of the sport fishery raises the issue of the sport fishing interests paying for, or at least contributing to, that monitoring. The lodges in the area monitor their clients catch and provide statistics to DFO. The shortfall is with the non-lodge fishermen.

The Native fisheries take a very small portion of an average return. They would only be a concern if a food fishery occurred when populations are very low, as they have been recently. However, the conservation values and concerns of Nations participating in RSPG have been amply demonstrated. Oweekeno voluntarily reduced their harvest to protect local populations. Gwa’Sala-Nak’wax’da’xw also didn’t harvest Smith Inlet stocks. It should be noted that the Heiltsuk Nation which is not in the RSPG may also harvest substantial but difficult-to-estimate numbers of salmon originating in Rivers and Smith systems.

6.2.2 Land Use

Forest harvesting is the highest impact land use in the area. There has been no “before and after” assessment to determine the extent of impacts in comparison to the effects other factors affecting salmon populations and habitat in Rivers and Smith areas. Lacking such information it is most prudent to assume that what has happened in the Rivers Inlet area broadly resembles more well-studied cases of other BC coastal watersheds.

The best known of these is the Carnation Creek system on western Vancouver Island. Tschaplinski et al (1998) concluded that while it was very difficult to separate the interacting and stock depressing effects of poor forestry practices from fishing and ocean climate effects, clear cause and effect mechanisms could be demonstrated for particular impacts of logging and related practices. The Oweekeno Nation by virtue of its location has had ample opportunity to observe and be concerned about former logging practices. The RSPG represents, in part, an effort to

More recently, the Central Coast Land and Coastal Resource Management Planning process for the area has identified a number of potential protected areas in the vicinity of both Rivers and Smith Inlets. The Oweekeno Nation has begun to develop its own more detailed land use plan supported in part through the “Turning point” process. Also, unharvested areas could be protected as Old Growth Management Areas (Hilland, 2002). DFO could also ask for higher levels of protection for key salmon spawning and rearing habitat areas – when they are identified.

6.2.3 Coastal and Oceanic Activities

In 2002 the BC Government lifted a longstanding ban on new fish farm leases in coastal waters. There are numerous and strong concerns about salmon farming in the area, especially until after the salmon stocks have rebuilt to safe sustainable levels. The concerns include local pollution, spread of disease and parasites, possible predation on
wild juveniles, and the specter of escaped farm fish competing with wild fish for spawning and rearing areas. The Oweekeno Nation is on record as opposing farming of fish in open net-cages in natural waters.

First Nations and other parties concerned with the future of salmon also are troubled by the recent increase in pressures for a possible lifting of moratoria on offshore oil and gas exploration and development. There remain unknown potential impacts of seismic exploration, oil spills and chronic effluents in highly productive nearshore areas. A major concern in both aquaculture and oil and gas is the lack of pre-development baseline information to measure impacts from.

6.2.4 Program Funding

A major limitation to stock recovery and realizing full sustainable production is inadequate funding to understand and act on many basic stock and ecosystem issues. Lack of basic information and funding shortfalls have contributed to the delays in acting on the sockeye collapse.

The development of remedial measures to deal with the decline of salmon stocks has depended significantly to date on special federal and provincial programming. It is estimated that Canada has invested several million annually in a variety of measures in the Rivers and Smith systems. This has led to significant leveraging of other funding sources. Also, the province of BC through its Forest Renewal and, later, Fisheries Renewal programs, funded a great deal of work on watersheds in the area. Fisheries renewal BC was instrumental in supporting the first two years of the RSPG, including a special grant that has paid for the coordination and logistics until recently. Both programs were entirely discontinued as of 2001. When making this decision, the BC provincial government assumed that the federal Department of Fisheries and Oceans would increase its financial commitments to habitat and enhancement. Instead, in 2002, clouds have gathered around the levels of funding for programs essential to the recovery of salmon and salmon-based ecosystems. Serious reduction has occurred in the 2003-4 budget for critical functions such as habitat protection and stock assessment (both key elements of any recovery planning).

Cutbacks in basic monitoring are making it impossible to determine the state of populations and assess their recovery. There are concerns that cutbacks may also result in the termination of the sockeye incubation program. For Wannock chinooks and possibly other populations, lack of information has resulted in continued targeted sport fisheries on them when they are already at dangerously low levels.

If governments will not pay the necessary conservation costs then clearly the users of the fisheries resources will have to pay to rebuild populations, if they are to be rebuilt. However, while there is demonstrated willingness by non-governmental sources to step up their support for salmon recovery – the Pacific Salmon Endowment Fund being an excellent example – potential growth in such philanthropic support will not be realized if it is seen as merely replacing budget cuts from DFO.

RSPG’s recovery plan includes much increased effort at private fundraising but we will also continue to meet with and press hard federal and provincial agencies whose mandate includes fisheries resource management and economic well being of coastal communities.
7 **RECOVERY GOALS, OBJECTIVES, TARGETS, STRATEGIES AND OPTIONS**

The following goals, objectives, guidelines and long-term goals provide the basic recovery direction. More detailed information on options, background data, and short-term plans is appended.

The RSPG’s overall goal is to restore the Rivers and Smith salmon and their ecosystems to their full capability and, then through cooperative stewardship to maximize the net sustainable ecological, economic and social benefits from Rivers and Smith Inlet fish, ecosystem and people resources.”

This goal is subject to the guidelines described in section 1.5 above, i.e.:

1. Conservation of fish stocks, their habitat and ecosystem integrity to sustain productivity will take precedence in managing the resource.

2. Recovery is to include the entire ecosystem and all its evolutionarily important components. All species, stocks and populations are valued.

3. Benefits and costs should be defined in the broadest sense, including social and ecological valuations that may not have an explicit dollar value.

4. Local people and interests must have a fair opportunity to benefit from local fisheries resources and make good use of local people resources.

5. Maximizing net benefits does not preclude management goals based upon social equity considerations (e.g. increased Native participation in the fisheries and in fisheries management and development) or sustainable resource use.

6. In the context and spirit of conservation, allocation and use of public resources will be based on maximizing ecological, social, cultural and economic values to present and future generations. That is, resources (e.g. dollars, fish, etc.) will be directed towards the best opportunities for maximizing the potential overall sustainable net benefits.

7. The maintenance and further development of collaboration among the many parties concerned with Rivers and Smith, is essential to recovery and future stewardship.

**Long-Term Objectives:**

1. **Conservation:** *To protect the diversity and productive potential of salmon and other fish, and their ecosystem; by:
   - maintaining habitat productivity and safe population abundances. [existence value]
   - To determine some measure of the current abundance of salmon populations in the area*
To develop a better collective understanding of the survival factors, life history and ecosystem of salmon originating in Rivers and Smith Inlets, past and present, in freshwater, estuaries and marine habitats.

To rebuild populations to above acceptable targets that RSPG has established in this recovery plan

To identify key habitat areas for protection and restoration

2. Production: To realize as much of the sustainable amount of fish production and ecosystem potential as cost effective by:

- rebuilding fish populations to optimum long-term sustainable production, recognizing ecosystem interactions and interdependencies.
- To increase spawning populations to target levels
- To restore and protect habitat to provide the capacity for rebuilding populations
- To enhance by manageable natural or reversible methods, such as groundwater side-channels or enrichment, and to clarify long-term potential
- To develop and implement effective stock assessment methods for sockeye, chinook, steelhead, coho, chum and pink salmon populations,
- To develop in-season fisheries management methods and population abundance measures for more population selective harvesting.

3. Economic: To realize as much of the potential sustainable net value and other benefits as possible, by:

- optimizing the net value of harvest and use of populations and ecosystems;

4. Social and Cultural: To realize as much of the cost effective sustainable potential of local people and communities and others dependent on the resources, as possible by:

- sharing the income and employment (net) benefits;
- sharing the responsibilities for local resource management activities, and:
- providing a meaningful role for local people in management decision making for resources in their area.

Goals 1 and 2 are dealt with together because they form a continuum – protecting and restoring to safe population abundances flows into increasing production and potential for catch. Also, the same basic tools are used for both. These goals are the ones which drive the present Recovery Plan. Goals 3 and 4 are outside the recovery plan at this time. However, it is the intent of the RSPG to also work on these goals in anticipation of the stocks rebuilding.

Much of the information available on salmon populations, habitats and ecosystems is lacking, out of date, or incomplete. Consequently, an early focus must be on assessing the current state of local resources as well as conservation problems and opportunities. For example, many populations have not been reported on over the last decade.

There is a need to get necessary economic and social information and to make some key changes before the stocks rebuild. Some of the possible changes in the commercial

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18 With conventional discounting, no enhancement or resource rebuilding is ‘cost effective’ in the conventional sense so RSPG proposes to adopt a wider definition of ‘cost-effective’ (Sumaila 2001; Sumaila et al. 2001)
fishery will take a number of years to prepare for. Consequently, some work on goals 3 and 4 should start as soon as possible.

The following framework of goals, objectives and strategies provides the basic recovery direction and the basis for assessment of the program and projects.

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**RSPG RECOVERY PLAN GOAL FRAMEWORK**

**Overall Goal:** To maximize the net sustainable ecological, economic and social benefits from Rivers and Smith Inlet fish, ecosystem and people resources.

**OBJECTIVES:**

**Strategies:**

1. **CONSERVATION:**
   1.1. Measure salmon abundance (see section 7.1)
   1.2. Understand life history and ecosystem
   1.3. Meet conservation targets
   1.4. Protect key habitat areas

2. **PRODUCTION:**
   2.1. Meet production targets
   2.2. Restore habitat productive capacity
   2.3. Enhance production
   2.4. Stock assessment methods
   2.5. Fisheries management methods

**7.1 Fish Abundance Targets**

DFO has not yet set its new science-based conservation minimum, and production target numbers of spawners for the 15 sockeye, 30 coho, 21 pink, 20 chum, 13 chinook and 7 steelhead populations in the area. Preliminary conservation targets for Owikeno and Long Lake sockeye were arbitrarily set by DFO at 30,000 and 8,000 respectively. The RSPG is concerned that these targets are too low for biological safety, as well as for rebuilding populations and production to harvestable and full capacity levels. Also, those interim targets make no allowance for ecosystem needs. In lieu of the DFO interim targets, RSPG is proposing the following more conservative targets. The RSPG is also proposing spawner numbers for production targets. These production targets are important because they provide a perspective on the relative health of populations and a measure for long-term direction and assessment of performance.

The RSPG interim targets for each Inlet are:

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<tr>
<th>Species</th>
<th>Conservation Targets</th>
<th>Production Targets</th>
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<tr>
<td></td>
<td>Smith Inlet</td>
<td>Rivers Inlet</td>
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<tr>
<td>Sockeye</td>
<td>20,000</td>
<td>100,000</td>
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<tr>
<td>Chinook</td>
<td>650</td>
<td>2,270</td>
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19 These are summary objectives and strategies. The complete wording is in section 7.
20 There have been various interim sockeye targets for the area including 100,000, and 200,000. The total old target is 820,000 sockeye
For Smith Inlet, setting production targets is relatively straightforward and low risk because of the reliable escapement counts through the Brooks River. The problem in setting targets is knowing what the actual number of spawners was through time. If early estimates were significantly less accurate than present, the apparent production and survival rate would have been lower. Instead of a Rivers Inlet production rate of about 4:1 in the 1950s and 1960s (Figure 34), it might be closer to 2:1. To take a conservative stance, RSPG proposes to set all targets high and safe until they can be demonstrated otherwise. This approach is supported by the experience for Long Lake when increasing the production target from 100,000 sockeye spawners to 200,000, in conjunction with lake enrichment, almost doubled the overall production. Although a similar attempt to increase production in Owikeno Lake apparently didn’t work, the number of spawners was uncertain, as was progenal production. Also, there was no allowance for the lag time for nutrients to build up in lieu of lake enrichment. Clearly, credible spawner estimates are key to setting realistic conservation and production targets.

Assuming progress is made toward credible spawner estimates, Figures 35 to 38 show the proposed red – yellow – green target approach. In Figure 35 the dashed black line is the DFO interim conservation target (LRP) for Owikeno sockeye stocks. At this LRP level, conservation actions weren’t taken until after 1998. If the target had been set at the proposed RSPG level, indicated in red with circles, it would have triggered conservation actions after 1994 instead of 1998. It would also have triggered a conservation response after the 1960 and 1970 low spawner years. It would have triggered a response of special conservation actions for the single affected brood year.

There is no magic minimum number of spawners below which a stock will go extinct or lose too much genetic diversity. It is a judgment call related to how much risk you are willing to take. It is agreed that low population abundances pose an undesirable risk of loss of genetic diversity, inadvertent extinction, high impact on ecosystem, and also high economic and social costs. To minimize those risks the RSPG has set the conservation target level

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<tr>
<td>Coho</td>
<td>2,200</td>
<td>10,000</td>
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<td></td>
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<td>Chum</td>
<td>10,000</td>
<td>15,000</td>
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<tr>
<td>Pink</td>
<td>6,600</td>
<td>35,000</td>
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<td>Steelhead</td>
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21 Numbers to be provided by BC Fisheries staff.
22 It would trigger limitation/closure of directed fisheries, limitation of intercepting fisheries, addressing habitat problems, enhancement to rebuild stocks, and, in the extreme, captive brood stock and gene banking.
higher than DFO. Conservation targets should trigger major intervention to prevent extinction of a population (“red light”). The proposed interim RSPG conservation targets were derived by taking 10 percent of the old production targets, rounded to the nearest thousand. Coho targets were increased based on the differences observed between old targets and recent counts for Long Lake populations.

The RSPG is proposing “yellow light” targets (the yellow line with triangles) to serve as a warning of possible impending conservation problems to help prevent populations dropping to dangerously low levels. This precautionary target would trigger conservation actions to prevent further declines, start restoration and address information issues. It would have triggered warnings 19 to 22 times since 1950. This usually would have got a response of more precautionary fisheries, a study to determine the cause of the shortfall and preparation for remedial action. When such a shortfall was predicted, it would be adjusted for before the fact instead of after. The proposed yellow light target wouldn’t have provided any early warning on the collapse in the 1990s.

In the past, DFO has used two spawner targets in the fisheries expectations\textsuperscript{23}, an overall long-term target, and a year specific target that reflected the expected sockeye returns. For example, in 1990, the overall target was 1 million sockeye to Owikeno Lake, but with an expected return that year of 1,357,000, the annual target was set at 643,500\textsuperscript{24}. The annual targets are shown as the solid black line and the long-term production target is shown as the green line in Figure 35. Theoretically, these two production targets provide a target range of spawner abundance to manage within. In 13 of the 21 years from 1973 to 1993, the number of spawners achieved was less than the production target range, even though in 9 of those years the total population would have allowed being within target range. This highlights the need for an inseason measure of population returns for management. The RSPG is proposing a low-side production target escapement of 500,000 spawners for Owikeno Lake until a better number can be demonstrated.

Figure 36, 37 and 38 show the Owikeno Lake clear stream index streams, Smokehouse Creek and Canoe Creek spawners respectively. They include the dashed DFO interim LRP, the RSPG conservation, yellow-light and high-side production target lines for reference.

\textsuperscript{23} Expectations include the predicted annual salmon returns for each species and the pre-season fisheries management plan, including escapement targets
\textsuperscript{24} This shows that having a fishery was more important than meeting the overall target.
In effect, the fishery was managed to about a 50 percent harvest rate rather than the spawner targets. An exception occurred in 1963 when there was a major strike that closed the Rivers and Smith Inlet fisheries for most of sockeye season. That resulted in an escapement that is recorded as 875,500, excluding Machmell spawners, which could have been more than 100,000. That large spawning population produced the largest return on record in 1968.

The old spawner targets were based on observed spawning habitat capacity and loosely on observed results of different sized spawning populations. The targets were probably closer to the spawner abundance at which digging up previously spawned eggs became apparent than to the scientific maximum sustained yield spawner abundance. However, these targets were based on visual counts, usually stream bank counts. Such counts significantly under-estimate the spawners actually present. Brett (1952) found that walking surveys underestimated the actual Babine sockeye population by two thirds. Shardlow (1987) found that stream walk counts only accounted for 20% of chinook present. These targets are interim only and will be adjusted by adaptive learning and experience. Converting these old targets to actual numbers of spawners may significantly increase the targets.

Originally, the spawner counts and targets were recorded as abundance ranges (e.g. 5-10k; 10-20k; 20-50k; 50-100k; and 100k+). These ranges were later averaged to convert them to a single number. Also, with the old spawner counts, there was no definite formula for converting a number of abundance estimates over a season into a single annual estimate of spawners. There was no allowance for the time individual spawners spent on the grounds, or for carcasses washed away by floods. Now an area-under-the-curve method is used to combine estimates in a season and average spawner turnover times are used. There is still no allowance for carcasses washed away by floods.

The old spawner production targets by species and population are tabled in Annex 2. Interim conservation targets by species and population will be developed over the next 6 months. The targets will change adaptively with learning and experience.

7.2 Habitat Protection Targets

A lot of habitat and stock damage was done by past logging and fishing. This is a “bygone” and now the focus must be on working together to prevent and resolve problems. The RSPG habitat protection objectives are to achieve no net loss of habitat capacity and to strive for a net gain. To achieve these objectives, credible pre and post-impact assessments are essential for protection and, if necessary, for restoration. In the case of potential large-scale impacts, contingency plans should be developed and agreed to, and funding and equipment provided before the potential impacts. These plans should be in the interest of protecting critical habitat and recovery of lost capacity. For example, there should be mutually agreed contingency plans and local capability to respond to oil spills that might result from offshore oil exploration and development or from salmon farming problems. The productive potential of foreshore and riparian areas should be protected. As important, habitat regulatory and enforcement agencies should be forced to do their jobs.
7.3 Habitat Rehabilitation Targets

Agreed habitat capacity targets and/or a process for defining those targets by adaptive management should be developed to provide direction and to measure and assess progress. Where the rehabilitation is a result of development, the developer should be responsible for full rehabilitation (DFO Policy, but not practice). User groups should be obligated to clean up all messes they make.

7.4 Knowledge Targets

It is important to develop a better collective understanding of the life history and ecosystem of salmon originating in Rivers and Smith Inlets, past and present.

It is essential to continue monitoring juvenile abundance of sockeye in Owikeno and Long Lakes and counting adults through the Doceo fence. A credible count of sockeye escapement to Owikeno Lake is also essential. Ideally it would be an in-season count that could also be used for fisheries management. Assessing inlet, coastal and ocean survival factors and developing an effective index is key to improving stock assessment and reducing the risk of over-harvesting.

A program to analyze lake sediment cores to determine marine derived Nitrogen15 levels in each time period could determine whether the Rivers and Smith Inlet sockeye stocks have collapsed before. This analysis could also provide an estimate of spawners in different time periods relative to now. That could indicate the impact of intensive commercial fisheries as well as of decreasing numbers of spawners. This project has been started under NSERC funding.

Knowledge for an assessment of chinook populations is also essential to prevent further declines in spawner populations. A general level of awareness of all salmon species in the area and of the rest of the ecosystem is necessary to better understand, manage for and rebuild them.

8 Monitoring and Evaluation Framework

The purpose of basic monitoring is to provide the information necessary to assess and manage salmon stocks, their habitats and ecosystem, and industrial development. Ultimately, the purpose is to facilitate conserving, sustaining and restoring stocks and managing the harvest of their production.

8.1 Stock Recovery Monitoring

Only a few salmon populations have been regularly monitored - only 24 of 98 in 2001. Monitoring priorities and schedule will be developed to ensure that high priority populations are monitored each year and others every few years to check that they are being sustained. Spawner abundance, age and condition would be monitored, and, if necessary, catch would be sampled for population identification to attribute catch to each population.
8.2 Physical Works / Activity Effectiveness Monitoring

Assessing the effectiveness of physical works and many types of projects requires clearly defined evaluation criteria at the start of the project and a long-term commitment to continuing the project and monitoring it. For example, the contribution a spawning channel makes ultimately takes a number of generations to assess — until the fish produced return, and populations build and the ecosystem stabilizes. Similarly, developing an index of ocean survival or measuring the escapement up the Wannock River may require many years to develop a reliable tool. The bottom line is that monitoring is a long-term commitment that requires long-term funding to realize.

8.3 Ecosystem Recovery Monitoring

Evaluation and accountability are key issues that will be fully addressed. It is desirable to learn from every activity and expenditure in the area. This requires:

• careful project design, evaluation criteria, adaptive implementation and detailed reporting;
• implementing projects on time so that parts of naturally timed events are not missed;
• following through to complete projects; and
• evaluation of program results.

There are two basic levels of evaluation:

1. Evaluation of program performance relative to criteria for each goal. e.g.:
   • Goal 1, stock preservation is relative to the conservation baseline;
   • Goal 2 could be the trend of number of fish in the TAC;

2. Evaluation of project or activity performance relative to pre-agreed criteria. Such criteria would include clear reporting requirements. For example, a project requirement could be that habitat related data had to be entered into a common database for continuing funding.

9 Recovery Implementation Plan

This plan lays out the objective and goals that will serve as long-term guidelines for activities in the Rivers and Smith Inlet area. It provides a basic framework and some details on the salmon portion of the plan. Strategies for other species have not yet been developed. This plan describes, for the area, the planning process, the policy development roles and responsibilities of various groups, and the implementation and evaluation procedures and criteria.

This plan builds on the DFO policy direction in “A New Direction For Canada’s Pacific Salmon Fisheries” and will form the cornerstone of local policy. It is meant to give all concerned parties a clear indication of where local fisheries policy should go in the future. It will also serve as the basis for the development of detailed 5 and 10 year plans as well as annual work plans.

The local Rivers and Smith Inlet groups would be responsible for implementation; either for doing or supervising projects. It is proposed to develop basic operating manuals for habitat, ecosystem and fisheries management, restoration and enhancement. This would provide basic certainty of what has to be done, how and when it has to be done.
and who has to do it. This would allow training people with an interest in these activities to take on more responsibility for them. This will be a continuing process to gain knowledge and experience.

Appendix 2 outlines the Plan Schedule Highlights

10 **Recommended Recovery Plan Projects**

This section begins with outlines of the detailed list of planned activities (projects) specific to each of the two areas first Smith Inlet (10.1) and then Rivers (10.2). The format of the following program tables is as follows:

The format of the following program tables is as follows:

**OBJECTIVES:**

**Strategies:**

<table>
<thead>
<tr>
<th>Life Stage</th>
<th>Projects</th>
</tr>
</thead>
</table>

We have included all objectives and strategies so that active or imminent projects (denoted by the italicized titles) can be understood in relation to our longer term plan. But it should be emphasized that only those with such projects are part of the current recovery plan.

Some detailed commentary has been included by way of footnotes. These footnotes are all attached to section 10 (Smith Inlet) but cross-refer to both systems (i.e. Rivers and Smith)

10.1 **Smith Inlet Program**

1. **Conservation:**

   1.1. Measure salmon abundance
      
      1.1.1. Catch
      
      1.1.2. Escapement
         
         1.1.2.1. Docee fence count – sockeye
         
         1.1.2.2. Docee fence age samples - sockeye

---

25 The Conservation related projects are structured to ensure that key information for conservation and restoration is collected and appropriate actions taken. The following is a general description of planned projects for Rivers and Smith Inlet areas.

26 Catch is monitored for number of salmon, their age, and possibly stock identification. Catch is a general inseason measure of population abundance. The Oweekeno First Nation reports its limited sockeye catch. Sport catch, mainly of chinook and coho, is monitored by creel census of lodge and non-lodge fisheries. Commercial catch will be monitored when the fishery reopens.

27 Escapement refers to fish that escape the fishery. Spawners are the fish that make to the spawning grounds. The difference between them is induced and natural mortality. Escapement is monitored for number of salmon and their age. The Docee fence provides a measure of escapement that is the basis for in-season fisheries management. The hope is that an acoustic counter on the Wannock River can provide both a similar measure of escapement for in-season management in Rivers Inlet, and the first overall count of sockeye escapement to Owikeno Lake.
1.1.2.3. Docee fence count – coho

1.1.3. **Spawners**
   1.1.3.1. Aerial surveys – sockeye
   1.1.3.2. Nekite R. spawner survey – chum
   1.1.3.3. Presence or absence surveys – all species

1.1.4. **Eggs**
   1.1.4.1. Fecundity (from sockeye egg-take)

1.1.5. **Smolts/Pre-smolts**
   1.1.5.1. Long L. juvenile assessment - sockeye
   1.1.5.2. Docee fence smolt index – sockeye

1.2. **Understand life history and ecosystem**

1.2.1. **Overall**
   1.2.1.1. Traditional ecological knowledge study
   1.2.1.3. Ecosystem modeling
   1.2.1.4. Ecosystem workshop/follow-up
   1.2.1.5. Sediment cores for N15, plankton

1.2.2. **Egg to smolt (freshwater)**
   1.2.2.1. Long L. limnology monitoring

1.2.3. **Smolt to adult (marine)**

---

**Spawners** are monitored for the number of salmon, their age and possibly marks. Spawner counts of sockeye, chinook, chum and pink are visual, either from the air or a stream walk. This is the weak link for Owikeno Lake sockeye data because of silty rivers. For Long Lake, the Docee fence counts are used in place of sockeye and coho spawner counts. Wannock River seining and dead pitch are used to assess chinook spawner abundance. Opportunistic surveys are proposed to determine the presence or absence of salmon species in streams that are not regularly surveyed.

The number of eggs deposited is estimated from the number of spawners and their age or size and fecundity. The size and age are sampled as part spawner surveys. Egg counts are made during egg takes or bio-standards are used. The number of eggs is the basis for measuring freshwater and total survival.

Smolts or pre-smolts are either sampled in their rearing lake (e.g. trawl sampling of pre-smolts in Owikeno L.) or as they leave the lake as smolts (e.g. Docee smolt index). There should be a consistent measure that, ideally, is non-lethal. The Wannock rotary screw trap is intended to develop a non-lethal sockeye index to replace the current lake trout index and possibly to provide a chinook index. A similar smolt trap index is proposed to replace the more expensive current acoustic sampling of pre-smolts in Long Lake. Surveys of juvenile coho are also proposed to get an initial indication of distribution and abundance.

With the recent collapse of salmon populations in the area it became clear that little was known about the marine life stage and factors affecting survival. Similarly, the low spawner numbers highlighted the importance of salmon to their ecosystem, especially in freshwater. To bring together life history and ecosystem information, a TEK study, and science and ecosystem workshops are planned. These processes will also address concerns that interim conservation targets for spawner numbers are too low to allow for natural risks and ecosystem needs. A sediment core analysis project will hopefully provide information on whether the salmon populations have collapsed previously and what the pre-commercial fishery number of spawners, lake nutrient levels and plankton populations were like.

Long-term programs indexing pre-smolt abundance, in conjunction with limnological studies in both Owikeno and Long Lakes show that low survival in freshwater was not the cause of the stock collapse. These programs also provide information on lake carrying capacity.
As the collapse of salmon production apparently resulted from reduced survival in the marine life stage, an early marine sockeye study was started in 2002. Oceanographic sampling in the inlets and outer coastal area and monitoring juvenile salmon in the Queen Charlotte Sound-Hecate Strait area were initiated. There is also considerable work being conducted on ocean climate regime shifts, juvenile salmon ocean migration routes and timing, and other factors relevant to understanding the ocean life history and ecosystem of salmon. To keep track of the diverse sources of new information on this life stage and keep the RSPG members informed, a coordination role is being proposed.

With low salmon stock returns and large seal populations, seal predation could be a significant conservation problem. The seal survey provides a continuing watch on this part of the ecosystem to determine if remedial action is necessary.

With the extremely low sockeye populations, restoration incubation has been used to increase egg to fry survival and fry output to safe conservation levels. This will be especially important from 2003 to 2006 when the sockeye from the years with extremely low spawner abundance will return. Similarly, Wannock R. chinook are at dangerously low levels of abundance and enhancement intervention is planned. The restoration production of sockeye and chinook are marked to identify them by stock and as being enhanced. A project is planned to sample for these marks in local fisheries and on the spawning grounds. These marks are also being sampled for in the various marine projects.

As information on key habitat areas is incomplete, a project to identify key sockeye spawning areas is planned. This will help to guide habitat protection and restoration work. For already logged areas, stream habitat restoration and road deactivation work will continue in both Rivers and Smith Inlet watersheds. Planning work on restoring the Wannock estuary will continue.

The focus at this point in recovery is on meeting conservation targets and restoring populations, habitat capacity and ecosystems to safe sustainable levels. As populations rebuild, more emphasis will be placed on rebuilding populations to meet production targets. For now, the focus will be on updating the enhancement potential list to prepare to take advantage of logging roads before they are deactivated.
2.4. Stock assessment methods
2.5. Fisheries management methods

3. ECONOMIC: (commercial and sport)\textsuperscript{38}
3.1. Consultation process re catch value
3.2. Develop options re catch value
3.3. Pilot program
3.4. Fleet changes
3.5. User pay arrangements

4. SOCIAL AND CULTURAL\textsuperscript{39}
4.1. Fair process
   4.1.1. Planning Group process and support
4.2. Improved group information
4.3. Strategic jobs strategy
4.4. Training and development strategy

10.2 RIVERS INLET PROGRAM

1. CONSERVATION\textsuperscript{40}
1.1. Measure salmon abundance\textsuperscript{41}
   1.1.1. Catch
      1.1.1.1. Lodge creel/charter patrol (chinook, coho)
      1.1.1.2. Non-lodge creel
   1.1.2. Escapement\textsuperscript{42}
      1.1.2.1. Wannock R. acoustic counter
   1.1.3. Spawners\textsuperscript{43}
      1.1.3.1. Aerial surveys – sockeye, pink, chum, chinook
      1.1.3.2. Spawner counts, age sampling – sockeye

To realize the full salmon production potential and value requires significant changes in the commercial and sport fisheries. A sectoral consultation and planning process is being considered to develop and prepare for these changes but is not part of the current adopted plan. It is anticipated that the planning process will be most effective if conducted before commercial fisheries are reopened.

To realize full salmon production potential and local economic and employment benefits requires changes in the fisheries, fisheries management, economic development and employment strategies. To that end, it is planned to work with local people and social and management agencies to define local needs and opportunities and develop a training and employment strategy. It is important that this work is done soon to take advantage of conservation work as well as later production and economic projects.

To coordinate the diverse groups involved in the Rivers and Smith Inlet process, group planning and technical processes and a coordinator/executive director are required. Communications with member groups and those that might be affected by plans are also essential for success. See section 10.3 for more details on plans.

\textsuperscript{38} To realize the full salmon production potential and value requires significant changes in the commercial and sport fisheries. A sectoral consultation and planning process is being considered to develop and prepare for these changes but is not part of the current adopted plan. It is anticipated that the planning process will be most effective if conducted before commercial fisheries are reopened.

\textsuperscript{39} To realize full salmon production potential and local economic and employment benefits requires changes in the fisheries, fisheries management, economic development and employment strategies. To that end, it is planned to work with local people and social and management agencies to define local needs and opportunities and develop a training and employment strategy. It is important that this work is done soon to take advantage of conservation work as well as later production and economic projects.

\textsuperscript{40} See note 25.
\textsuperscript{41} See note 26
\textsuperscript{42} See note 27
\textsuperscript{43} See note 28
1.1.3.3. Wannock R. dead pitch – chinook

1.1.3.4. Wannock R. seining/assessment - chinook

1.1.3.5. Kilbella/Chuckwalla R. aerial surveys – chinook

1.1.4. Eggs

1.1.4.1. Fecundity (from sockeye, chinook egg-takes)

1.1.5. Smolts/Pre-smolts

1.1.5.1. Owikeno L. juvenile sockeye assessment

1.1.5.2. Wannock R. rotary screw trap - sockeye

1.1.5.3. Early marine – sockeye

1.1.5.4. QC Sound-Hecate Strait sampling – all salmon

1.1.5.5. Juvenile surveys – coho

1.2. Understand life history and ecosystem

1.2.1. Overall

1.2.1.1. Traditional ecological knowledge study


1.2.1.3. Ecosystem modeling

1.2.1.4. Ecosystem workshop/follow-up

1.2.1.5. Sediment cores for N15, plankton

1.2.2. Egg to smolt (freshwater)

1.2.2.1. Terrestrial/lake environment study coordination

1.2.2.2. Owikeno L. limnology study

1.2.3. Smolt to adult (marine)

1.2.3.1. Marine environment coordination

1.2.3.2. QC Sound-Hecate Strait sampling – all salmon

1.2.3.3. Oceanographic sampling – all salmon

1.2.3.4. Early marine project - sockeye

1.2.4. Fishery to spawning

1.2.4.1. Seal survey – all species

1.3. Meet conservation targets

1.3.1. Sockeye restoration incubation

1.3.1.2. Wannock lakepen – sockeye

1.3.1.3. Wannock marking - sockeye

1.3.1.4. Adult sampling for marks – sockeye, chinook

1.3.1.5. Kilbella/Chuckwalla R. captive brood stock – chinook

1.3.1.6. Kilbella/Chuckwalla R. chinook restoration incubation, rearing

1.3.1.7. Wannock R. chinook restoration

1.3.1.8. Waukwash R. chinook restoration

1.4. Protect key habitat areas

1.4.1. Non-tidal habitat

1.4.1.1. Machmell R. side-channel

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44 See note 29
45 See note 30
46 See note 31
47 See note 32
48 See note 33
49 See note 34
50 See note 35
51 See note 36
1.4.1.2. Road deactivation
1.4.1.3. Stream habitat restoration
1.4.1.4. Log debris study
1.4.1.5. Identify key spawning areas
1.4.1.6. Re-open groundwater channels
1.4.2. Tidal habitat
1.4.2.1. Wannock estuary restoration and assessment

2. PRODUCTION
2.1. Meet production targets
   2.1.1.1. Long L. enrichment

2.2. Restore habitat productive capacity
2.3. Enhance production
   2.3.1.1. Update enhancement potential list

2.4. Stock assessment methods
2.5. Fisheries management methods
   2.5.1.1. Monitoring adult returns
   2.5.1.2. Monitoring fleet and catch
   2.5.1.3. Enforcement
   2.5.1.4. Fisheries management

3. Economic: (commercial and sport)
3.1. Consultation process re catch value
3.2. Develop options re catch value
3.3. Pilot program
3.4. Fleet changes
3.5. User pay arrangements

4. Social and Cultural
4.1. Fair process
   4.1.1.1. Planning Group process and support
4.2. Improved group information
4.3. Strategic jobs strategy
4.4. Training and development strategy

Table X contains a list of projects, objectives, timelines and approximate budget for each of the recommended recovery projects.

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52 See note 37
53 See note 38
54 See note 39
10.3 Program Management

The projects and activities under this heading are directed at especially at maintaining and increasing the current capacity for RSPG to act as the lead mechanism whereby recovery and stewardship are collaboratively managed. Earlier in this document, we articulated a key guiding principle, that “The maintenance and further development of collaboration among the many parties concerned with Rivers and Smith, is essential to recovery and future stewardship.”

To bring effect to this it is essential that the RSPG maintain and continually improve its organizational capacity, a particular challenge in a time of funding cutbacks. In November 2000 our immediate financial requirements for organizational maintenance and development were met with a one-time grant from the Province of British Columbia. Meeting and coordination costs were fully covered but, of course, this grant has now been fully expended. In fiscal 2002-3 we receive a smaller amount for coordination and information from the Pacific Salmon Endowment Fund, enough for our meetings and a part time coordinator. This has been leveraged upwards by the Oweekeno–Kitasoo–Nuxalk Tribal Council.

10.3.1 Professional Coordination

It is the collective belief of the membership of the RSPG that the salmon stocks and ecosystems of Rivers and Smith have (or soon could have) an international profile but that this will not happen without our being able to have a highly professional and, eventually, full time executive director. Accordingly, “project” 10.3.1 affirms this priority.

Activities: Activities to be undertaken will include seeking and securing funding at a level equal to that achieved in present fiscal year for professional coordination (approximately $25,000); fundraising in private sector to increase to a ¾ time equivalent in FY 2003-4 ($45-50,000).

10.3.2 RSPG Meetings

Unlike the situation for many other stewardship, multi-party watershed groups, the mere act of meeting – so essential in maintaining and advancing collective action – is a major expense and effort due to the remoteness of the plan area, and the dispersion of the membership. In order to maintain and increase participation of existing members in the RSPG a minimum of 4 face-to-face meetings and an equal number of full RSPG conference calls will be needed in FY 2003-4. Costs based on experience to date would be $15,000.

10.3.3 Restructuring – Working Groups and Executive

The RSPG will be considering options for more efficient internal organization including the creation of four working groups that can collaborate both on staying abreast of critical issues and developments in each field and on implementation of decisions taken by the full RSPG in regard to each area. These would be: .
• A Fish-Forest Working Group to harmonize forest harvesting and road building and deactivation activities with fisheries assessment, restoration and enhancement activities. This would help fisheries programs to take best advantage of forest harvesting activities and forest activities to tie into fisheries activities to minimize forestry impacts and costs.

• A Fisheries Working Group would bring together Native, sport and commercial fisheries interests to realize monitoring and data collection opportunities. This working group could also provide an interface with these three sectors with regard to project design and implementation. A key role would be serving as an information conduit to fisheries interests to inform them and get their feedback.

• A Terrestrial/Lake Environment Working Group that would facilitate a network of interests and knowledge for collection, understanding and use of ecosystem information. The working group would establish and maintain a network of contacts and promote agency and academic research and inputs. This group would work with funding groups to access diverse funding sources.

• A Marine Working Group to harmonize the various different groups responsible for, involved in, or with an interest in the marine environment. These interests would range from government agencies to academics to developers to local interests. Many diverse government agencies are mandated to deal with some aspect of protecting, managing or developing the marine environment. There are real and perceived overlaps and holes in jurisdictions. Although most agencies are under-funded to fulfill their mandate with regard to the marine environment, there is still some competition, secrecy and territoriality between agencies. The intent of this working group would be to take the initiative to pool observations, share monitoring, coordinate projects, cost share, and generally improve the understanding of the marine ecosystem and the salmon role in it.

RSPG sees these working groups working adaptively to harmonize the various interests and capitalize on opportunities.

In addition the RSPG will undergo an internal review of its overall structure and examine the possibility of creating an Executive Committee as part of developing a higher profile nationally and internationally.

10.3.4 Community Relations and Information

RSPG knows that no matter how capable and effective it becomes internally, there is a much larger array of communities “out there” whose support and participation in our recovery and stewardship planning is vital. Three activities are planned to insure that the work we do builds a broad base of support and understanding.

Community Outreach

Our highest priority under “Community Relations and Information” this year will be to get information out to the communities who are membership should be able to represent. This entails both development of an up to date presentation that comprehensively describes the situation and the recovery action plan, and taking that message out to the peoples in the nearby communities (First Nation and others) and to the most directly
involved "interests" who may not reside in the immediate area (e.g. various sectoral fisheries organizations, environmental groups etc.) . Opportunities will be assessed and, as determined to be effective, utilized for public presentations at conferences and events such as "rivers awareness days" and the like.

Membership Expansion

RSPG has identified several critically important groups who are not currently well represented on our organization:

- The very diverse commercial fishing sector which, to date has no formal involvement
- The Seafood industry which was at one time represented by the BC Seafood Sector Council but has not been since that Council became less active;
- The Government of BC which played a formative role for the RSPG through the Fisheries Renewal BC but has been unrepresented since the demise of that agency;

Consideration is also being given to other forms of membership including private individual subscriptions.

Website Development

The RSPG had a website developed in early 2002 (http://www.rspg.ca/) . It has not been updated in almost a year nor has its capabilities

Securing the funding and expertise needed to make the website an active tool for community relations and information dissemination will be an activity pursued outside the PSEF-funded Recovery Plan per se.

10.4 Ecosystem Concept and Model

Part of salmon population, watershed and ecosystem recovery is the development of a basic ecosystem framework/model for the area to help to guide planning, monitoring, management, and assessment within the context of ecosystem priorities and needs. This will require drawing on knowledgeable individuals from a number of different government agencies and universities. Cooperative workshops are proposed to develop the basic model and populate it with information. The findings would help to guide research and monitoring.

10.5 Juvenile Freshwater Survival

This program is to continue monitoring the freshwater abundance, rebuilding and survival as key inputs to assessing the stocks, production, and environmental and development impacts. Monitoring would include spawner and pre-smolt abundance and condition, as well as environmental factors that are most likely to affect growth and survival. The intent of the monitoring is to develop a core, continuing program covering the lakes, rivers and inlets to provide consistent information at minimum cost in dollars and fish. The current focus is on sockeye, chinook and coho, but in the longer term other species would be considered.
10.6 Marine Survival

The marine program is just being developed. Ultimately, it may include regular monitoring sea surface salinity and temperature as well as vertical and horizontal profiles of salinity, temperature, oxygen, nitrate and possibly other factors. To compliment this, seasonal sampling would be conducted for plankton and fish presence and characteristics. The intent is to develop a reliable, cost effective index of coastal marine survival for stock assessment.

Information on ocean survival and ecosystem factors is also key to restoring stocks and to sustainable management. This work would apply more broadly than to just Rivers and Smith Inlet salmon. The RSPG role is to promote and support such work and to bring together information from diverse sources.

10.7 Recovery and Adult Assessment

Some of the projects to directly increase survival of sockeye, chinook and coho to speed their recovery will continue, as required.

A number of projects are essential for assessing current stock condition and for ongoing monitoring of the recovery effort. The projects described in Section 8.1 of this plan will satisfy much of the requirement for recovery monitoring.

A key part of assessing stocks has to be mark and recapture programs. The sockeye incubated as part of the recovery plan have all been thermally marked. This provides an excellent opportunity to assess survival as well as timing and other factors. A coded-wire tagging program would be key to better understand chinook and coho dynamics. Nothing is known of the steelhead stocks in the area.

10.8 Habitat Assessment and Rehabilitation

Habitat assessment and rehabilitation is a critical component to the recovery of salmon populations in the Rivers and Smith Inlet watersheds. The initial focus is on “stock taking” to assess habitat conditions and develop a rehabilitation plan with specific measures to address watershed needs.

It is essential to collect pre and post-industrial impact data to assess and understand any possible impacts. This is an opportunity to work cooperatively with developers to collect information and develop minimal impact strategies. In many cases, the information collected could be applied more generally than the specific project. Findings in this area could also be applied in other areas.

10.9 General Operations and Monitoring

General operations in the area involve a core of DFO staff doing continuing enforcement, monitoring and management. These costs are included in the overall costs to provide as true a picture of spending as possible and to identify activities in the area that do resource related monitoring. This and other monitoring provide key information for almost all activities. Lack of a proper and adequate monitoring program would compromise watershed restoration and sustainable use.
Literature Cited


PFRCC. 2001. Salmon Conservation in the Central Coast. PFRCC Advisory


Watershed-based Fish Sustainability Planning Guidelines (WFSP; draft November 2000). See page 6


WFSP. 2000. Watershed-based Fish Sustainability Planning: Sustaining Fish Populations and their Habitat. Draft report prepared by the WFSP Coordinating Committee.


Annex 1: CURRENT SITUATION
See following tables:
  Where are we now?
  Progress to date and potential – sockeye
  Progress to date and potential – chinook
  Progress to date and potential – coho
  Progress to date and potential – pink
  Progress to date and potential – chum
  Progress to date and potential – steelhead
  Commercial Sockeye Fishery Changes
  Recreational Fishery Changes
  Fisheries and Oceans and Federal Changes
  BC Government Changes
  Environmental Changes

Note: these would be an updated version of the tables from the earlier draft plan.
Annex 2  
SALMON PRODUCTION UNITS

GOAL 1: CONSERVING DIVERSITY AND PRODUCTIVE POTENTIAL

Notes on Table 1: Rivers & Smith Inlet Streams, Populations and Spawner Targets

1. To protect the diversity and productive potential of salmon and other fish, and their ecosystem, by maintaining habitat productivity and safe population abundances. The following 4 tables describe the salmon production units (populations and their habitat), current state of populations and spawner abundance information, marine habitat, and enhancement potential. This is to provide a basis for a recovery plan as well as for shorter-term plans.

The preceding Figure 8 shows the location of streams in Rivers and Smith Inlets. The following Table 1 lists the streams and salmon populations in the Rivers and Smith Inlet area by geographic zone. Each stream is a habitat unit and each salmon species there, a production unit. This is the freshwater salmon production component. The streams provide habitat diversity for producing the various species. The populations provide the genetic diversity to utilize the various habitats and withstand natural variations.

Spawner targets are provided to show where there has been consistent spawning of a species and the scale of that spawning. These targets were maxima, estimated from observed habitat capacity and past performance. Going beyond targets may increase natural selection. These targets are based on stream walk estimates, not intensive surveys or fence counts. Fence counts have been at least two times stream counts in Smith Inlet. The targets are the best available now, so should be used until others are proven to be better. A “0” in the table means there is no target for that species in that stream. However, there could be fish of that species present in the stream.

Some streams don’t have spawner targets, but are included because there have been fish observed in them. Also, they might have enhancement potential as ex-hatchery sites, ex-cannery water sources, or with falls near their mouth. Owikeno and Long Lakes are included as spawning, rearing and migration areas. Large rivers often have a number of tributaries used by fish that are larger than other identified creeks.

In all probability, most populations of a species in an area are related. This means that as one population rebuilds, some fish will stray into adjacent streams, eventually increasing those populations. For example, it could be argued that all sockeye populations in Rivers Inlet are the same (genetically) so it isn’t necessary to worry about individual populations. However, Wannock fry migrate upstream, others only downstream, and Beaver Creek sockeye are stream type sockeye, others lake type.

The information in this table is subject to review and updating.

Little is known about the salmon habitat in the river estuaries, inlets, coastal and open ocean areas. In the past, these areas supported significant salmon production. Recently, these habitats have been subject to global warming and ocean climate changes and estuaries have had some development impacts. Recent studies in the coastal marine area have shown generally low productivity in Rivers Inlet and higher productivity in coastal areas at the mouth of that inlet and in Smith Sound. (Section 4 provides more information on marine habitat).
<table>
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<tr>
<th>ZONE</th>
<th>STREAM</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Chinook</th>
<th>Steelh'd</th>
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Notes on Table 2: Re Current Production Status and Spawner Counts

Table 2 shows how many spawning populations were formally monitored in 2001:

- 8 of 15 sockeye populations were counted. [Almost ½ of capacity in Rivers Inlet was not counted.] “Yes” in the Wannock row indicates that species was observed but no count was made. Docee fence counts are escapement to Long Lake, not Docee R. A total of 91,939 sockeye were counted through the Docee fence in 2002.
- 1 of 29 coho populations was counted. [Escapement to Long Lake is counted at the Docee fence.]. Counts may indicate the difference between a stream count based target [4,500] and a fence count [10,651]. Sockeye stream counts were less than ½ of fence counts. As coho hide, stream counts are probably considerably less than ½.
- 3 of 21 pink populations were counted. 2001 pinks had good ocean conditions for the 1.5 (2) years they spent in the ocean and some populations rebounded strongly (Chuckwalla-Kilibella), others didn’t (Nicknaqueet, Clyak). Pink returns were also strong in 2002.
- 4 of 20 chum populations were counted. As chums spend 3 or 4 years in the ocean, 2001 returns had mixed ocean conditions and only show limited increase in returns. 2002 and 2003 should have better returns.
- 9 of 13 chinook populations were counted. 2001 spawner estimates look good but were the result of an intensive search (not the overview that the targets are base on). Docee is a fence count, but most spawners are below the fence and not counted.
- Machmell and Nekite spawning channels were not formally monitored.

There are major habitat related spawner and juvenile assessment problems, due to silty water in the Sheemahant, Machmell and Wannock Rivers, and Owikeno Lake. The targets for these areas are 480,000, but based on visual estimates under adverse conditions. The Sheemahant and Machmell are both large rivers with extensive potential habitat so the actual spawner capacity could be much larger or smaller than these targets. The lack of a direct or indirect measure of spawners to these areas is a major stock assessment and management problem. Without this information it is not possible to assess freshwater survival and production rates. There is no basis to set spawner targets or to manage the fisheries to meet spawner needs.

The Docee River fence is located near the top of the Docee River and the outlet of Long Lake. The fence allows a reliable count of salmon passing upstream to spawn. It was originally constructed to make sockeye counts, but recently its operation has been extended to also count coho. The management of the sockeye fishery is tied to the in-season fence counts such that the harvest is controlled to ensure enough sockeye escape up the Docee into Long Lake. Predation in Long Lake and the spawning areas will make the actual number of spawners somewhat less than the escapement. When the escapement is small, as it has been for the past few years, this predation could account for a significant percent of escapement.

A similar in-season count of sockeye escapement is aspired for Owikeno Lake, both for in-season management and to indirectly estimate spawner abundance in the Sheemahant, Machmell, Wannock Rivers and Owikeno Lake.
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<td>Otstitial Creek</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Margaret Creek</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hagen Creek</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SMITH TOTAL</td>
<td>200,000</td>
<td>10,700</td>
<td>65,600</td>
<td>95,500</td>
<td>6,500</td>
<td></td>
</tr>
</tbody>
</table>
Notes On Table 3: Re Freshwater Salmon Habitat

Habitat and ecosystem capacity must be conserved as well as fish populations. Information on habitat and ecosystem capacity is needed as a baseline measure for conservation and compensation. Physical and chemical information required includes:

- Identification and documentation of all important spawning and freshwater rearing areas and their current characteristics such as:
  - Water type: clear, glacial, brown;
  - Whether the watershed is stable [landslides, erosion, siltation, channel changes], has been logged, or is subject to other development;
  - What the estimated spawning and rearing capacity is;
- Identification and documentation of all restoration needs and enhancement opportunities, including:
  - Presence of side channels that could be reopened for spawning and rearing
  - Blockages to migration to good areas upstream
  - Unproductive lakes and streams that could benefit from enrichment
  - Habitat clean-up and restoration needs, including road deactivation and improved access
  - Water "head," as a possible enhancement water source
  - Terrain potential for spawning channels
  - Logging road access to potential restoration or enhancement sites
- Plans for future development in the area, including:
  - In fresh water, primarily forest harvesting related development

This table is draft and summary. It needs input on all of the above items to update and improve it. It is planned to have more detailed habitat and ecosystem data accessible in an integrated geo-referenced data management system. Some additional information is available in a DFO Sensitive Watershed Database. See also DFO, 2000 and Hilland, 2002.

ECOSYSTEM

Plants and Animals in the salmon ecosystem fall into two basic categories, those: that salmon eat: sockeye feed on plankton in Owikeno and Long Lake. Chinook and coho feed on insects in streams and shallow areas. All species of salmon feed extensively on plankton or small fish in the estuary, coastal and ocean areas.

that eat salmon: It is necessary to get a better understanding of how many salmon and salmon carcasses are needed to support sustainable predator and other dependent populations in the ecosystem and how that need is distributed.

This subject needs the input of people knowledgeable about animals such as bears, wolves, eagles, seals, etc. Would the ecosystem be best sustained by a network of protected areas or just general protection and provision for sustaining predators?
<table>
<thead>
<tr>
<th>ZONE</th>
<th>STREAM</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RIVERS INLET</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owikeno Upper</td>
<td>Washwash Creek</td>
<td>Clear, logged, impassable falls at 4km, unstable, breakthrough to Tzo</td>
</tr>
<tr>
<td></td>
<td>Tzo River</td>
<td>Clear, logged, passable cascade at 6.5km</td>
</tr>
<tr>
<td></td>
<td>Inziana River</td>
<td>Clear, logged, impassable falls at 1.25km</td>
</tr>
<tr>
<td>Owikeno Mid</td>
<td>Sheelahart River</td>
<td>Glacial, logged, cascades at 20km, 24km accessible, beach spawning</td>
</tr>
<tr>
<td></td>
<td>Owikeno Lake Spawn.</td>
<td>Siltty</td>
</tr>
<tr>
<td></td>
<td>Genesee Creek</td>
<td>Clear, logged, impassable falls at 1.5km; flood channel from Machmell</td>
</tr>
<tr>
<td>Owikeno Lower</td>
<td>Machmell River</td>
<td>Glacial, logged, cascade at 20km, 32km accessible, shifts course</td>
</tr>
<tr>
<td></td>
<td>Machmell Channel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neechanz River</td>
<td>Clear(?), logged, passable cascades at 4.5km, accessible 6.5km</td>
</tr>
<tr>
<td></td>
<td>Ashlum Creek</td>
<td>Clear, unlogged, rapid at 5km</td>
</tr>
<tr>
<td></td>
<td>Armbank Creek</td>
<td>Clear, unlogged, 8km accessible, lake beach spawning near mouth</td>
</tr>
<tr>
<td></td>
<td>Dillery Creek</td>
<td>Clear, unlogged, 6.5km impassable cascade</td>
</tr>
<tr>
<td></td>
<td>Doos Creek</td>
<td>Clear, unlogged, falls at mouth, habitat above(?)</td>
</tr>
<tr>
<td></td>
<td>Meadows Creek</td>
<td>Clear, unlogged, falls at mouth, old hatchery water source</td>
</tr>
<tr>
<td></td>
<td>Owikeno Lake</td>
<td>Main basins glacial, 56km long</td>
</tr>
<tr>
<td>Owikeno Outlet</td>
<td>Wannock River &amp; Flats</td>
<td>Siltty, logged, 6.5km</td>
</tr>
<tr>
<td><strong>Upper Rivers In.</strong></td>
<td>Nicknauglet River</td>
<td>Clear, logged, Impassable falls at 2km</td>
</tr>
<tr>
<td></td>
<td>McTavish Creek</td>
<td>Clear, water for canny</td>
</tr>
<tr>
<td></td>
<td>Chuckwalla River</td>
<td>Clear, logged, cascades at 16km, limited spawning above</td>
</tr>
<tr>
<td></td>
<td>Kilbella River</td>
<td>Clear, logged, accessible to 48km, second growth forest, road removal</td>
</tr>
<tr>
<td></td>
<td>Shottbolt Creek</td>
<td>Clear, water for canny</td>
</tr>
<tr>
<td>Moses-Hardy In.</td>
<td>Clyak-Young-Neill River</td>
<td>Clear, logged, Clayak accessible to 3km, Y-N excellent area to 13km</td>
</tr>
<tr>
<td></td>
<td>Milton River</td>
<td>Clear, logged, passable falls at 5km, 11km accessible</td>
</tr>
<tr>
<td></td>
<td>MacNair Creek</td>
<td>Clear, passable cascades at 2km, accessible to 11km</td>
</tr>
<tr>
<td></td>
<td>Doris Creek</td>
<td>Clear,</td>
</tr>
<tr>
<td>Mid Rivers In.</td>
<td>Sandell River</td>
<td>Clear, 0.5km accessible, lakes above, water for canny</td>
</tr>
<tr>
<td></td>
<td>Newichy Creek</td>
<td>Clear, 0.5km accessible</td>
</tr>
<tr>
<td></td>
<td>Johnston Creek</td>
<td>Clear, unlogged, 10km accessible</td>
</tr>
<tr>
<td>Draney In.</td>
<td>Robert (West) Arm Cr.</td>
<td>Clear, spawning to 100m</td>
</tr>
<tr>
<td></td>
<td>Allard Creek</td>
<td>Clear, falls at 300m, spawning area excellent above Allard Lake</td>
</tr>
<tr>
<td></td>
<td>Lockhart-Gordon Cr.</td>
<td>Clear, logged? Impassable falls at 3km</td>
</tr>
<tr>
<td></td>
<td>Draney Creek</td>
<td>Clear, logged? 2km accessible</td>
</tr>
<tr>
<td>Outer Rivers In.</td>
<td>Hogan</td>
<td>Clear, canny water/ hydro source</td>
</tr>
<tr>
<td></td>
<td>Beaver Creek</td>
<td>Brown(?), water, 1.5km, sockeye above Elsie Lake, other species below</td>
</tr>
<tr>
<td></td>
<td>Oatsoalis Creek</td>
<td>Clear, 1km accessible</td>
</tr>
<tr>
<td></td>
<td>Chic Chic Creek</td>
<td>Brown water, unlogged</td>
</tr>
<tr>
<td>SMITH INLET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Lake</td>
<td>Canoe Creek</td>
<td>Clear water, unlogged, passable cascades from 1 to 2.5km</td>
</tr>
<tr>
<td></td>
<td>Triangle Creek/Lake</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smokehouse Creek</td>
<td>Clear water, unlogged, impassable cascades at 5km</td>
</tr>
<tr>
<td></td>
<td>Long Lake</td>
<td>Clear water</td>
</tr>
<tr>
<td>Long Lk. Outlet</td>
<td>Doece Creek</td>
<td>Clear water, logged, 1.5km, counting fence</td>
</tr>
<tr>
<td>Upper Smith In.</td>
<td>Nekite River</td>
<td>Clear water, logged, passable cascades at 4km, accessible to 11km</td>
</tr>
<tr>
<td></td>
<td>Nekite Spawn. Chan.</td>
<td>When due for cleanup?</td>
</tr>
<tr>
<td></td>
<td>Walkum Creek</td>
<td>Clear water, impassable falls at 2.5km, some logging</td>
</tr>
<tr>
<td>Boswell Inlet</td>
<td>Boswell (Coho) Creek</td>
<td>passable cascade at 1km, accessible to 2km, canny water source?</td>
</tr>
<tr>
<td>Outer Smith In.</td>
<td>Takush River</td>
<td>Brown (?) water, passable falls at 5km</td>
</tr>
<tr>
<td></td>
<td>Dsilish Creek</td>
<td>Brown (?) water, 3km accessible</td>
</tr>
<tr>
<td></td>
<td>Margaret Creek</td>
<td>Clear water, impassable falls at 1km, water for canny</td>
</tr>
<tr>
<td></td>
<td>Hagen Creek</td>
<td>Brown water</td>
</tr>
</tbody>
</table>

Total Kilometres of accessible stream habitat = 286+ [not all good or usable]
Notes on Table 4: Marine Salmon Habitat

The marine habitat and ecosystem capacity must be conserved as well as the non-tidal habitat and the fish populations. Information on habitat and ecosystem capacity is needed as a baseline measure for conservation and compensation. The needed information includes:

• Identification and documentation of current characteristics and impacts of all important marine rearing areas, such as:
  o In estuaries, inlets and coastal areas, information on: salmon migration routes and timing, abundance of predator and prey species, physical and chemical habitat conditions, and human impacts, such as from log sorting, diking, oil pollution, and sewage;
  o In the ocean, information on ocean productivity and likely salmon survival;

• Identification and documentation of all restoration needs and enhancement opportunities, including:
  o Habitat clean-up and restoration needs, including estuary cleanup and improved access

• Plans for future development in the area, including:
  o In estuaries, harbour development
  o In inlet and coastal areas, salmon and shellfish farming, offshore oil and gas exploration and development, increased transportation traffic.

This table is very draft and summary. It needs input on all of the above items to update and improve it. It is planned to have more detailed habitat and ecosystem data accessible in an integrated geo-referenced data management system.

Little is known about juvenile rearing areas, migration routes, rates and timing, and food dependencies. The physical and chemical characteristics of the various marine areas are poorly known. It is known that freshwater influence extends a long way out Rivers Inlet and that it is strongly influenced by wind and precipitation patterns.

Fish Egg Inlet area is between statistical areas and is largely unknown. The RSPG has indicated that as this inlet has the habitat characteristics for significant coho production, it should have at least basic reconnaissance for salmon and habitat.
<table>
<thead>
<tr>
<th>ZONE</th>
<th>LOCAL</th>
<th>HABITAT FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RIVERS INLET</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Rivers In.</td>
<td>Wannock Estuary</td>
<td>juvenile rearing area; diking, booming, debris</td>
</tr>
<tr>
<td></td>
<td>Head Rivers Inlet (9-6)</td>
<td>juvenile migration; adult holding area</td>
</tr>
<tr>
<td></td>
<td>Kilibella Bay (9-6)</td>
<td>juvenile rearing area</td>
</tr>
<tr>
<td></td>
<td>Rutherford Point (9-6)</td>
<td>juvenile/adult migration</td>
</tr>
<tr>
<td>Moses-Hardy In.</td>
<td>Upper Moses Inlet (9-8)</td>
<td>juvenile rearing area (?), migration, log handling?</td>
</tr>
<tr>
<td></td>
<td>Lower Moses Inlet (9-7)</td>
<td>migration</td>
</tr>
<tr>
<td></td>
<td>Hardy Inlet (9-9)</td>
<td>migration, log handling?</td>
</tr>
<tr>
<td>Mid Rivers In.</td>
<td>McAllister-Stone Pt. (9-5)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Stone Pt.-Good Hope (9-4)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Good Hope-Hemasila (9-3)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Darby Chanel (9-11)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td>Draney In.</td>
<td>Upper Draney Inlet (9-10)</td>
<td>juvenile migration, log handling?</td>
</tr>
<tr>
<td></td>
<td>Robert Arm (9-10)</td>
<td>juvenile migration, log handling?</td>
</tr>
<tr>
<td></td>
<td>Lower Draney (9-10)</td>
<td>juvenile migration</td>
</tr>
<tr>
<td>Outer Rivers In.</td>
<td>Hemasila-Dimsey (9-2)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Fish Egg Inlet (?)</td>
<td>juvenile migration, rearing (?)</td>
</tr>
<tr>
<td><strong>SMITH INLET</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Smith</td>
<td>Head Smith Inlet (10-10)</td>
<td>juvenile migration, log handling?</td>
</tr>
<tr>
<td></td>
<td>Mid Smith Inlet (10-9)</td>
<td>juvenile migration</td>
</tr>
<tr>
<td>Mid Smith</td>
<td>Wyclées Lagoon (10-11)</td>
<td>juvenile rearing (?), migration, adult fishing (?) logging</td>
</tr>
<tr>
<td></td>
<td>Quascilla Bay (10-8)</td>
<td>juvenile migration, adult holding, fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Naysash Inlet (10-7)</td>
<td>logging</td>
</tr>
<tr>
<td></td>
<td>Outer Smith Inlet (10-7)</td>
<td>juvenile migration, adult holding, fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Ahlakerho Channel (10-12)</td>
<td>juvenile migration, adult migration (?)</td>
</tr>
<tr>
<td></td>
<td>Boswell Inlet (10-6)</td>
<td>juvenile migration</td>
</tr>
<tr>
<td>Smith Sound</td>
<td>Inner Sound (10-5)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Mid Sound (10-4)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td></td>
<td>Outer Sound (10-3)</td>
<td>juvenile migration, adult fishing (?)</td>
</tr>
<tr>
<td><strong>COASTAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smith</td>
<td>Caution-Calvert (10-1, 10-2)</td>
<td>juvenile feeding &amp; migration, adult migration</td>
</tr>
<tr>
<td>Rivers</td>
<td>Calvert-Addenbroke Pt. (9-1)</td>
<td>juvenile feeding &amp; migration, adult migration</td>
</tr>
<tr>
<td>FFH</td>
<td>Addenbroke Pt-Island (9-12)</td>
<td>juvenile feeding &amp; migration, adult migration</td>
</tr>
<tr>
<td>FFH</td>
<td>Addenbroke-Whidbey (8-16)</td>
<td>juvenile feeding &amp; migration, adult migration</td>
</tr>
</tbody>
</table>
GOAL 2: INCREASING PRODUCTION AND ECOSYSTEM POTENTIAL
To realize as much of the sustainable amount of fish production and ecosystem potential as cost effective, by: rebuilding fish populations to optimum long-term sustainable production, recognizing ecosystem interactions and interdependencies.

The following table describes the potential enhancement methods and amounts of salmon production in the area. As this information is dated, there is an early priority to update it to account for changes. This information is to provide a general basis for strategic planning, as well as for shorter-term plans.

Table 5: Notes On Enhancement Potential
This information on enhancement potential is from a 1983 report, updated in 1985. Some considerations may have changed since then. For example: those plans don’t consider recent developments, such as:
- Potential for stream enrichment and restoration of habitat problems since 1983
- Using pinks, chums and sockeye to enrich for chinook and coho
- Compensating for development impacts
- Using semi-natural side channels and improved access to some areas
- Local knowledge
- Incubation in the Snootli hatchery, as was done with sockeye

In the “Enhancement” column the rating number after each project means:
1 = excellent, immediate;
2 = short or long-term, more information needed;
3 = long-term;
4 = non-viable;
5 = unmanageable;
6 = completed
? = the amount of production would be subject to type and scale of development

The enhancement potential totals are minimums because many of the potential projects didn’t have an amount of production identified (shown as ?) and because of new opportunities that were not identified earlier. However, it is likely that limiting enhancement to semi-natural, manageable projects would reduce the overall production, but also the capital, operating and maintenance costs. These same enhancement methods might also be used to help restore populations to safe abundances as well as to increase production for harvest.

It is important to note that any significant increased rate of production must be manageable in the fisheries before it can go ahead. This may require changes in fisheries to meet this requirement.

The attitude toward enhancement within DFO has changed to be very negative to most types of enhancement. This means that any future enhancement will likely be limited, reversible and thoroughly justified.

Pressing issues include:
- how to take best advantage of the access provided by logging roads before they are decommissioned, and to save useful roads?
### TABLE 5: Rivers And Smith Inlet Stream/Population Enhancement Potential, 1985 (in fish)

<table>
<thead>
<tr>
<th>ZONE</th>
<th>STREAM</th>
<th>Enhancement</th>
<th>Sockeye</th>
<th>Coho</th>
<th>Pink</th>
<th>Chum</th>
<th>Chinook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owikeno Upper</td>
<td>Washwash Creek</td>
<td>Control, Sp. Channel 3</td>
<td>75,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tzeo River</td>
<td>Sp. Channel 3</td>
<td>50,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inziana River</td>
<td>Control, Sp. Channel 3</td>
<td>90,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owikeno Mid</td>
<td>Sheermahant River</td>
<td>Sp. Channel 3</td>
<td>125,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Owikeno Lake Spawn.</td>
<td>Spawning Improvement 2</td>
<td>44,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Genesee Creek</td>
<td>Sp/Rear Channel, Incub 5</td>
<td>275,000</td>
<td>5,000</td>
<td>15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owikeno Lower</td>
<td>Machmell River</td>
<td>Satellite to Genesee 4</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neechanz River</td>
<td>Side Channel 3</td>
<td>33,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ashulim Creek</td>
<td>Satellite to Genesee 5</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amback Creek</td>
<td>Side Channel 4</td>
<td>33,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dallery Creek</td>
<td>Central Fac/Obst.Remov2</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Docs Creek</td>
<td>Hydro, Central Facility 2</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meadows Creek</td>
<td>(old hatchery site)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Owikeno Lake</td>
<td>Enrichment 4</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owikeno Outlet</td>
<td>Wannock River &amp; Flats</td>
<td>CEDP Hatchery 1</td>
<td>15,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chuckwalla River</td>
<td>Facility/Channel 5</td>
<td>45,000</td>
<td>250,000</td>
<td>25,000</td>
<td>50,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kilbella River</td>
<td>Satellite 5</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shottoff Creek</td>
<td>?</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moses-Hardy In.</td>
<td>Clyak-Young-Neil Rivers</td>
<td>Facility 3, Fishway 4</td>
<td>2,000</td>
<td>50,000</td>
<td>5,000</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MacNair Creek</td>
<td>?</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doris Creek</td>
<td>?</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid Rivers In.</td>
<td>Sandell River</td>
<td>Pilot Hatchery 1</td>
<td>15,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Newichy Creek</td>
<td>?</td>
<td>?</td>
<td></td>
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<td></td>
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<td>?</td>
<td>?</td>
<td></td>
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<tr>
<td>Draney In.</td>
<td>Robert Arm Cr.</td>
<td>Allard Creek</td>
<td>Fishway 4, Sp. Improve 4</td>
<td>1,100</td>
<td></td>
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<tr>
<td>Outer Rivers In.</td>
<td>Hogan</td>
<td>Beaver Creek</td>
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<td>3,500</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Oatsoalis Creek</td>
<td>?</td>
<td>?</td>
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<td></td>
<td>Chic Chic Creek</td>
<td>?</td>
<td>?</td>
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<tr>
<td>RIVERS TOTAL (Minimum)</td>
<td></td>
<td>728,500</td>
<td>83,100</td>
<td>315,000</td>
<td>30,000</td>
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<td>Canoe Creek</td>
<td>Doce Satellite 3, Fishway 4</td>
<td>?</td>
<td></td>
<td>?</td>
<td>?</td>
<td></td>
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<tr>
<td></td>
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<td>?</td>
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</tr>
<tr>
<td></td>
<td>Smokehouse Creek</td>
<td>Doce Satellite 3, Channel 4</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long Lake</td>
<td>Enrich 1, Gravel Addition 6</td>
<td>?</td>
<td></td>
<td>?</td>
<td>?</td>
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<tr>
<td>Long Lk. Outlet</td>
<td>Doce Creek</td>
<td>Central Facility 3</td>
<td>150,000</td>
<td></td>
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<td>Upper Smith In.</td>
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<td>10,000</td>
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<td></td>
<td>Walkum Creek</td>
<td>Satellite (Nekite) 3, other 4</td>
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<td>?</td>
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<td>Boswell Inlet</td>
<td>Boswell (Coho) Creek</td>
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<td>?</td>
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<td>Takush River</td>
<td>Satellite (Nekite) 3, other 4</td>
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<td></td>
<td>Dsutulich Creek</td>
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<td></td>
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<td>?</td>
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<td></td>
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<tr>
<td></td>
<td>Hagen Creek</td>
<td>?</td>
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<td>536,000</td>
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<td>93,100</td>
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<tr>
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<td>150,000</td>
<td>90,000</td>
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<td>425,000</td>
<td>107,000</td>
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Annex 3: STRATEGIES TO REACH CONSERVATION AND PRODUCTION GOALS

The preceding information summarizes the salmon streams, populations, habitat, and enhancement potential and value that are available to work with for both conserving the productive potential of the Rivers and Smith Inlet area and for realizing that potential production. Conservation and production can be addressed as a continuum – as the abundance of a population increases beyond conservation concerns the focus changes to production.

The joint conservation and production strategy is to identify and address the bottlenecks that have put some populations at risk and/or are limiting salmon production.

FIGURE 2: outlines the likely conservation and production bottlenecks by life stage and the general responses to those bottlenecks.

FIGURE 3: outlines how many of the same basic responses would be used for both salmon conservation and production.

FIGURES 4 and 5: outline the general strategies for sockeye and chinook to date, in 2002 and long-term.

The more detailed short-term strategies to protect and rebuild populations, production, and the ecosystem are as follows:

**Short-term goals for sustaining fish populations and ecosystem diversity** are:
- To rebuild populations to above an acceptable Limit Reference Point (LRP)\(^55\)
- To determine the current abundance of salmon populations in the area
- To identify key habitat areas for protection and restoration
- To get a basic understanding of marine and estuarine survival factors

**Short-term goals for achieving optimum sustained fish production** are:
- To increase spawning populations to target levels
- To restore and protect habitat to provide the capacity for rebuilding populations
- To enhance by manageable natural or reversible methods, such as enrichment, and clarify long-term potential
- To develop in-season fisheries management methods and population abundance measures

**DRAFT STRATEGIES**

**1.1. BASIC BIOLOGICAL KNOWLEDGE RE FISH AND ECOSYSTEM**

**Long-Term Strategy:**
As prescribed in the Wild Salmon Policy, Conservation units, Limit Reference Points (LRP) and Target Reference Points (TRP)\(^56\) will be defined and managed to.

a) Complete DNA and other stock identification work to define Conservation Units

\(^55\) LRP is the number of spawners below which the population is at-risk of extinction.

\(^56\) TRP is the number of spawners for optimum or maximum production.
b) Get credible information and analyses as a basis for setting the LRP and TRP for each Conservation Unit. The RSPG feels that current preliminary LRP and TRP for sockeye in Owikeno (30,000) and Long (8,000) Lakes are too low to provide adequate safety to the populations, especially given recent unexpected major decreased survivals. For Long Lake the 8,000 would be the Docee fence count that doesn't allow for predation and other losses before spawning. Also, the current TRP for Owikeno (200,000) is too low to realize production potential. Both LRP and TRP should include allowances to meet ecosystem needs.

Interim Strategy:
Until Conservation Units, LRPs and TRPs are defined:
• manage Rivers and Smith Inlets as separate areas;
• treat each population is a distinct stock;
• classify populations as either actively or passively managed, based on their traditional spawner target; [e.g. actively managed populations would be those above the following targets: sockeye >20,000; pink >10,000; chum >10,000; coho >3,000; chinook >1,000. Passively managed populations would be below those levels]
• passive populations would be managed to ensure that their spawner abundance stays above LRP – managed for conservation
• active populations would be managed to meet TRP – managed for production
• historic spawner targets would be used to define interim LRP and TRP
  - 10% (?) of spawner target is the interim LRP. This is to provide a safety buffer to protect the populations against unforeseen impacts and to trigger remedial actions sooner.
  - full spawner target is the interim TRP, (actual TRP based on hard counts could be 2-3 times old targets based on stream walks).

a) Ensure there are spawner counts of all actively managed populations every year, and at least a “presence or absence” survey for others every 3rd (?) year.

b) Sample carcasses of all actively managed populations of sockeye and chinook, every year, for age, size, sex ratio, spawning success, and condition assessment.

c) Monitor abundance and size of sockeye “smolts” in or leaving Owikeno and Long Lakes each year. This is now done by trawl that kills the fish, but indexing by live trapping in the Docee and Wannock rivers is being considered. Ideally, both methods should be conducted for a few years to provide continuity between the different methods.

d) Monitor chinook fry/smolt in or leaving selected rivers (e.g. Wannock, Chuckwalla / Kilbella, Docee)

e) Set up indicator streams for monitoring population abundance and survival, and habitat and ecosystem factors. (e.g. Chuckwalla / Kilbella could provide an index of chinook, coho, pink and chum)

f) Assess estuary survival factors (migration pattern, growth, residency, preferred food) for juvenile salmon to provide baseline information on survival and ecosystem interactions; sockeye first, then chinook)

g) Develop coastal survival indicators (extend previous work on ocean conditions vs survival; pilot test indexing juvenile salmon in coastal area)
h) Extend ocean productivity and regime shift work to provide an index of ocean survival
i) Operate the Docee fence to count escapement into Long Lake.
j) Develop an acceptable method to determine the total sockeye escapement into Owikeno Lake and/or the total number of spawners to the Machmell, Sheemahant, and Wannock rivers and to Owikeno Lake spawning areas.
k) Count chinook carcasses in the Wannock River.
l) Count chinook in the Docee River (above and below the fence).
m) Confirm presence or absence of sockeye in Beaver Creek, Nekite River and Chuckwalla-Kibella Rivers (4yrs).
n) Collect and analyze sediment core samples from Owikeno and Long Lakes for N15 to estimate historic spawner abundances and production cycles, and to determine if there have been previous sockeye production collapses.
o) Estimate ecosystem needs for salmon spawners to feed predators and nutrify watersheds.
p) Explore the benefits of ecosystem modeling as an approach to understanding and allowing for ecosystem interactions and interdependencies.
q) Put the Central Coast “Post Season Review and Planning Framework” information on the Central Coast web site.

1.2. HABITAT MANAGEMENT

Long-Term Strategy:
- Develop a detailed geo-referenced database of salmon habitat, including important tidal and non-tidal areas to protect and restore. It would also include baseline information for assessing impacts of development and natural changes.
- Conduct regular on-the-ground survey of habitat for problems and opportunities.
- Manage to a Habitat Management “instruction manual” (see below).

Interim Strategy:
- Ask DFO to report on progress made on addressing the issues and opportunities identified in the sockeye recovery plan. [e.g. logjam at Genesee Falls, wood debris at Machmell and Sheemahant deltas, Wannock estuary old log dump, Long Lake wood waste deposits, proposal for river and/or reach refugia, identification of locations to restore groundwater side-channel habitat]
- Ask DFO to work with RSPG members to do a review of each stream to develop the basis for a habitat management program – a Habitat Management Instruction Book for the watershed to include: [REGIONAL PRIORITY] • Identify key spawning areas and rearing areas as priorities for protection and restoration [atlas of stream maps (paper or electronic) with areas marked]
• Document (photo and data) baseline conditions for at least priority areas
• Identify current and anticipated habitat problems (natural and development related) affecting habitat productive capacity to sustain full production
• Identify road building and deactivation schedules by area
• Identify restoration needs, ASAP, well before road deactivation (start with areas to be deactivated next)
• Coordinate fish and forest work
  o look at future road building re opportunities as well as for problems
  o develop a comprehensive plan for developing and pilot testing ecosystem friendly logging, development and integrated management (see Annex 2).
• Assess all opportunities to restore or improve access to good habitat areas
• Confirm that chinook habitat in the Waukwash, Dallery and Clyak-Young-Neil is not limiting production

c) Continue ongoing monitoring of habitat development impacts, specifically in the Wannock estuary, in logging and logged areas, and log debris areas in Sheemanhant and Machmell deltas, and near the outlet of Owikeno and Long Lakes.

d) Restore habitat in logged areas, the Wannock estuary and others as required.

e) Monitor early marine environmental conditions such as water temperature, salinity, turbidity, type of habitat, and predator, competitor and prey species in the area.

f) Establish habitat baseline before aquaculture, logging and other developments in important areas.

1.3. ENHANCEMENT

Long-Term Strategy:
• Do manageable, cost effective enhancement in the area.

Interim Strategy:
• Continue offsite incubation until all “actively-managed” populations are clearly “out-of-risk” [and well on the way to full production?]. This should include Waukwash chinook and possibly those in the Nekite?
• Brood stock collection, disease sampling, incubation, transporting, and replanting into donor streams
• Continue marking production of each population to provide assessment and management information

b) Request that the Joint Technical Committee reassess and update the Enhancement Opportunities list and expand it to include: [REGIONAL PRIORITY]
• review of enhancement opportunities with regard to changes in access to sites and availability of heavy equipment (e.g. more cost effective opportunities) and the road building / deactivation schedule (starting with areas to be deactivated next)
• information on:
  o suggested production or species for previously identified projects that don’t have that information
  o habitat restoration and stream enrichment potential
o new technology and knowledge
  o Nekite and Machmell channels as operational facilities
• propose a new, comprehensive enhancement strategy with flexibility to meet diverse conservation and production needs
• identify opportunities to protect key habitat areas before, during and after forest harvesting, as by habitat improvement, side channel protection, channel stabilization and post-harvesting habitat restoration
• Lake enrichment:
  o Monitor lake productivity for decision making on when to enrich
  o Owikeno Lake: pilot test for learning, to help rebuild sockeye by supplementing nutrients
  o Long Lake: survey stickleback abundance with regard to when to restart enrichment for sockeye

1.4. ECOSYSTEM

Long-Term Strategy:
Manage fish and habitat resources specifically to meet ecosystem needs.

Interim Strategy:
interim_strategy
a) Work with wildlife managers, IOS, forest interests, universities, etc. to:
  • Continue seal predation and access monitoring
  • Provide special escapement allowances to meet the needs of the salmon ecosystem.
  • Pilot test structures to provide sanctuary areas for salmon from predators (to learn what can be done to protect remnant salmon populations)
  • Do N15 sampling and analysis to estimate carcass contribution to watersheds such as the Sheemahan and Machmell.
  • Study estuary and coastal ocean conditions, plankton abundance and mix, etc.
  • Study fish-forest-wildlife-tourism ecosystem relationships and pilot test various integrated development possibilities

1.5. FISHERIES MANAGEMENT

Long-Term Strategy: define conservation units and formal LRPs and TRPs and management to them.

Interim Strategy:
Interim_Strategy
a) Monitor and report all catch
  • Recreational lodge and non-lodge catch (creel survey)
  • Native food social and ceremonial catch
  • Commercial catch
    o Locally, when the fishery starts again
    o In potential interception times and areas

b) Manage fisheries to keep spawning populations above conservation risk levels.
  • Manage to avoid direct harvest, bycatch and induced mortality of at-risk\(^{57}\) populations – locally and in other areas, by
    o Having reliable in-season measures of returning populations
    o Knowing migration route, rate and timing of populations for management

\(^{57}\) “At-risk” has been defined in terms of genetic theory. An AFS study used 300 spawners as “at-risk”. Current DFO sockeye recovery plan uses about 3-4% of historic targets (30,000 Owikeno, 8,000 Long). Basic genetic needs of a population don’t meet ecosystem conservation needs or allow for natural variation or habitat problems.
o Adopting management methods that accurately control harvest rates

c) Manage fisheries to protect rebuilding populations until they reach spawner targets plus ecosystem needs for full production.
  • No commercial harvest until populations have rebuilt to at least 80% of spawner target, instead of starting fishing as soon as basic conservation needs (LRP) are met. Consider reaching full targets or limited “over-spawning” for while: to clean spawning gravel, nutrify habitat, meet ecosystem needs, and jump-start rebuilding.
  • Assess whether over-escaping smaller populations of pinks and chums is an effective way to nutrify habitat and enhance coho and chinook production.

d) Develop reliable abundance measures of populations returning to a fishing area
  • An in-season measure is needed to manage fisheries to.
  • A general measure for stock assessment, setting targets and planning fisheries.

e) Enforce fishing times, area, gear and catch limits.

1.6. CONSERVATION AND PRODUCTION COSTS
Limited funding currently impedes conserving populations, protecting ecosystem capacity, and realizing full productive capacity. Resource production is valuable, but currently there is no easy way to access and reinvest that value in management.

Long-Term Strategy:
It is proposed to seek “resource and user-pays” approaches to cover part of local management funding needs. This would involve taking a portion off the top of the commercial TAC to pay part of a share of management costs. This means that all commercial users would pay by forgoing catch. All sport fishermen would contribute by paying a user-fee. Commercial and sport fishermen would all get a share of the benefits of improved management and enhancement, in proportion to their use of the resource.

Interim Strategy:
a) Seek DFO funding to cover core conservation and production program costs.

b) Seek DIAND and other agency funding
  • to increase Native involvement in local fish resource management and enhancement
  • to increase fish production for Natives to meet food social and ceremonial needs, and for interim and Treaty settlements

c) Seek private funding and contributions in-kind for projects beyond the core program.

d) Seek policy approval to set aside a portion of the commercial TAC in the Rivers and Smith Inlet area to help pay for management costs there. This “resource-pays” funding approach would be applied only after the salmon resource has been rebuilt enough that a portion of the TAC can be safely harvested. This portion would be a second priority to Native Section 35 fish – it would come off the top before sport and commercial catch.

e) Seek policy approval to increase sport fishing fees, at least in the Rivers and Smith Inlet area, to help pay for management and enhancement costs.
Appendix 1: Rivers and Smith Inlet Planning Group (RSPG) Members

The Rivers-Smith Planning Group (RSPG) has had relatively informal procedures regarding membership since its inception in 2000. The following lists all sectors and representatives since August 2000, denoting those that remain current in **bold**.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oweekeno Nation</td>
<td>Jennifer Walkus</td>
</tr>
<tr>
<td>Gwa’Sal-Nakwaxda’wx Nation</td>
<td>Colleen Hemphill, Doug McCorquodale</td>
</tr>
<tr>
<td>Rivers Inlet/Hakai Pass Sport Fishing Association</td>
<td>George Ardley</td>
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<td>BC Seafood Sector Council</td>
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<tr>
<td>Western Forest Products Ltd.</td>
<td>Corby Lamb</td>
</tr>
<tr>
<td>International Forest Products Ltd.</td>
<td>Wayne Wall</td>
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<tr>
<td>Canada Department of Fisheries and Oceans</td>
<td>Russ Hilland, Greg Savard</td>
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<td>Fisheries Renewal BC</td>
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<tr>
<td>District of Port Hardy</td>
<td>Mayor Harry Mose</td>
</tr>
<tr>
<td>Coastal Ecosystems Research Foundation</td>
<td>William Megill</td>
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<tr>
<td>Sierra Club</td>
<td>Sharon Chow</td>
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<tr>
<td>Combined North Island Fisheries Center</td>
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<tr>
<td>UBC Fisheries Centre</td>
<td>Nigel Haggan</td>
</tr>
<tr>
<td>Commercial fishing sector</td>
<td>Lewis Bublé</td>
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The RSPG is currently coordinated by Norman Dale (Rapport Mediation, Prince George) assisted by Debbie Nelson, Administrator for the oweekeno~Kitasoo Nuxalk Tribal Council.

In addition and very significantly, there are a number of other technical experts who stay very close to and even regularly attend meetings, comprising, in essence a technical advisory team:

<table>
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<tr>
<td>SFU</td>
<td>Rick Routledge, Seana Buchanan</td>
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<tr>
<td>DFO</td>
<td>Sandie MacLaurin, Ron Tanasichuk</td>
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<tr>
<td>LGL and formerly with Rivers Inlet Restoration Society</td>
<td>Richard Bussanich</td>
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<tr>
<td>Consultant</td>
<td>Al Wood</td>
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Appendix 2 SCHEDULE HIGHLIGHTS

2001:
- 2nd year of sockeye strategic enhancement and 4th year of chinook captive broodstock and the 8th year of a chinook hatchery program
- Restoration of stream, lake and estuary habitat; Machmell side channel construction and first spawners
- Strategic planning framework developed cooperatively to address opportunities and needs of First Nations, sport, commercial, environmental and government groups.
- Basic assessment information on populations, habitat and ecosystem is lacking, out of date or incomplete.

2002:
- Develop direction and operational processes to guide strategic plan implementation
- Secure funding for 2002 and longer-term activities
- Start “stock taking” to determine available resources, problems and opportunities
- Expand stock and habitat assessment work, particularly in the early marine, coastal area (where the recent high mortality is thought to have occurred)
- Continue sockeye strategic enhancement; review LRP re precautionary increase
- Develop sectoral strategic plans, in the context of the overall plan

2003:
- Continue “stock taking”
- Direction process is operational and deals with results of resources “stock taking,” sectoral plans, assessment of progress, and performance to date
- Seek increased funding to expand programs; including user-pay, and new financial management arrangements
- Fine tuning assessment for effectiveness and return on investment; expand early marine, coastal sockeye monitoring and index of plankton availability
- Start implementing sectoral plans with emphasis on pilot testing to learn by doing
- Continue sockeye strategic enhancement;

2004
- Direction process assesses progress and performance to date, deals with further stock taking inputs and sectoral plans, and fine-tunes direction
- Seek increased funding to expand programs, including user-pay, and new financial management arrangements
- Rivers Inlet sockeye assessment fully operational; fine-tuning early marine, coastal sockeye monitoring and index of plankton availability
- First year of return of enhanced 4 year sockeye; decision whether sockeye strategic enhancement is required this year
- Continue to implement sectoral plans; emphasis on pilot testing

2005
- Direction process assesses progress and performance to date, results of continued resources stock taking and sectoral plans, and fine-tunes direction
- Seek increased funding and arrangements to expand programs
- Fine tuning assessment activities for return on investment; continue early marine, coastal monitoring and index of plankton availability
- First return of enhanced 4 and 5 year sockeye; decision re strategic enhancement
- Continue to implement sectoral plans
Appendix 3: GLOSSARY

**CCLCRMP:** Central Coast Land and Coastal Resources Management Plan

**Conservation:** wise use of a fish stock or population, its habitat or ecosystem to sustain it at a productive level

**Conservation Unit:** a group of one or more local populations that share a common genetic lineage, common productivity and common vulnerability to existing fisheries, and can be managed effectively as a unit

**Ecosystem:** the network of interacting physical and chemical habitat and living organisms [e.g. salmon ecosystem: the environmental factors that salmon interact with; that salmon live off or that live off salmon]

**Enhancement:** man-made improvements to natural habitats or the application of artificial fish culture technology intended to lead to the increase of abundance of salmon stocks.

**Escapement:** the number of fish escaping from a fishery; the escapement from all fisheries less any predation or other losses is the spawning population.

**Index stream:** a stream that is monitored as being representative of other streams in an area.

**Limit Reference Point (LRP):** the minimum spawning population required to ensure the long-term viability of a population; approaching that low abundance of spawners triggers conservation measures.

**PFRCC:** Pacific Fisheries Resources Conservation Council

**Population:** the salmon of a species that originate in an area, such as a stream. E.g. Wannock River sockeye are a population.

**Preservation:** managing to save a fish stock or population or its habitat or ecosystem, from extinction.

**Stock:** a group of genetically similar salmon. In some cases, it would be the salmon in a particular stream. In other cases, it might all the salmon of a species spawning in all streams in an area. E.g. Rivers and Smith Inlet coho.

**TAC:** Total Allowable Catch; the amount of the adult returns that can be safely harvested

**Target Reference Point (TRP):** the escapement that provides enough spawners for sustained maximum TAC and meets broader ecosystem needs

**TEK:** Traditional Ecological Knowledge; the knowledge acquired from the culture or experience of local peoples
APPENDIX 4:
The following article drew international attention to the ecosystemic nature and high cultural significance of the collapse of salmon stocks in the late 1990s. While not all of the views expressed express exactly how the RSPG sees the situation, the underlying theme of connectivity is central to our purpose and motivates our ecosystem-based way of thinking about recovery.

The killing of the bears by Alex Tizon
(Seattle Times November 1999)

RIVERS INLET, B.C. - The bones of grizzly bears litter the town dump in scattered piles. A skull here, a jawbone there. A rib cage picked clean by scavengers. Teeth as long as a grown man's fingers.

The first of the grizzlies were shot in September after they broke into trailers on the west end of the village. In October, six more were killed, and by mid-January, the tally had reached 14.

Nobody in this tiny native village of 80 souls wanted it to come to this. Something had gone terribly wrong. Natives and grizzly bears had coexisted peacefully for centuries in this lush, wild country on the central coast, 250 miles northwest of Vancouver.

Every fall, as far back as human memory reaches, the bears would pass through the village on the way to the Wanuk River to eat salmon. Villagers had no record or recollection of a bear ever harming a person. "There was respect," said tribe member Jeanette ChartrandSmith. "The bears left us alone and we left them alone."

But this year, virtually no salmon returned to the Wanuk or any other river in the region. The inlet's sockeye run, once the third-largest in the province and the main food source for natives and bears, had collapsed.

Scientists call it an ecological disaster, with the usual culprits suspected: overfishing, a warming ocean, and the destruction of salmon habitat. But the investigation is just beginning. Canadian fisheries officials began meetings this month in Vancouver to plot a study and Restoration plan, if Restoration is even possible. Meanwhile, villagers fear an important aspect of their ancient way of life may be coming to an end.

Even before the tribe could absorb the magnitude of the collapse, the bears began showing up. Instead of passing through as usual, the animals raided porches and back yards and trailers, clawed windows and doors and refused to be scared away. They showed an uncharacteristic boldness. At one point, nine grizzlies wandered the village, going from house to house.

After the first several bears were killed and skinned, the natives confirmed what was suspected. The animals were starving. Said villager Donovan LeBlond: None of the grizzlies "had enough fat to fill a coffee cup."

Long history of men and salmon

Rivers Inlet has been home to the Oweekeno (pronounced Oh-wuh-kee-no) First Nation for thousands of years. The tribe, which at its height numbered as many as 2,000, lived off the salmon that once returned to the inlet by the millions.

The heart of the region is a 38-mile-long lake, after which the tribe is named, located four miles east of the inlet. At least 17 rivers feed into the lake, many of them unnamed. The lake and inlet are connected by the Wanuk River, on whose north bank sits the last remaining Oweekeno village.

Wars and smallpox decimated the Oweekeno, who belong in the same linguistic group as the better-known Bella Bella nation to the north. What Oweekeno culture survived the 1800s was destroyed by a spectacular fire in 1935. All the traditional long houses burned along with the tribe's sacred objects and heirlooms.

Today, the village of Oweekeno, not found on most maps, is made up of 22 homes in varying degrees of disrepair, all connected by a single dirt road that runs roughshod along the Wanuk. Phone lines reached the village only five months ago. Until then, two radio phones served the entire village.

The only way in and out is by bush plane or boat. The nearest town of any size - Port Hardy, population 5,000 - is a 45-minute plane ride or three-hour boat ride across the Queen Charlotte Strait.

Logging and tribal administration provide what few jobs exist, which is why only 80 people continue to live here. Many receive government support. But most of the 220 registered Oweekeno have moved away for school or livelihood or
adventure in the big city, Vancouver.

One thing that hasn’t changed for the tribe members who remain is their dependence on salmon. Villagers consume up to 3,000 salmon a year, much of it smoked or canned for the winter. This year, the Oweekeno have no winter salmon supply. Instead they’ve relied more on store-bought foods, which are flown in from Port Hardy at 60 cents a pound or shipped by barge for 18 cents a pound. Transport can easily double the cost of groceries.

Like everywhere else in North America, salmon numbers have dramatically declined along the British Columbia coast. The days of 3.4 million salmon returning to Rivers Inlet have long gone. The inlet hasn't had a commercial fishery since 1994, and the village has only one commercial fisherman left.

But even in the past five years, as many as 35,000 to 60,000 sockeye have returned - enough to feed the people and bears of Oweekeno Lake.

This year, only 3,500 sockeye returned to the inlet. Tribal fishery manager Tom Gottselig said the number is "at extinction level." Brian Pearce, a member of the federal task force in Vancouver this month, described the situation as "pretty dire."

But it wasn't until a Vancouver environmental group, the David Suzuki Foundation, publicly decried the shooting of grizzly bears that federal officials began taking notice. The tribe had been trying to get the attention of the government since summer - with no response.

"The grizzly bear in North America is like the gorilla in Africa," said Jim Fulton, director of the Suzuki Foundation and a former four-term member of Parliament. "They're magnificent animals that evoke emotion in people, and they are, in many ways, under a sentence of death."

**Starving bears invade town**

Nobody wanted to shoot the bears. Grizzlies were prominent in the tribe's culture: in songs and stories, carvings and totems and names. According to oral histories, one of the most exalted traditional dances was called the Grizzly Bear Dance, although no one remembers now how to do it.

Before this year, wildlife biologists estimated between 150 and 220 grizzlies lived in the Oweekeno Lake region. While this is considered a healthy number, grizzlies as a whole are classified a vulnerable species in British Columbia.

Once every few years, the tribe would be forced to kill a nuisance bear, but the bears and humans of the region generally regarded one another with mutual respect. Villagers got used to seeing the animals lumber through town in the fall on the way to the Wanuk.

The bears would fatten up on sockeye - each must gain an average of 300 pounds - before returning to the mountains to hibernate in December.

Donovan LeBlond remembers the day in September when he realized something had changed.

"I was watching TV with my kids when I heard nails scratching on the window," LeBlond says. "I thought it was one of the dogs. I looked outside and saw a bear, a small one, standing on my porch. I panicked because I thought the mother might come up and try to get in."

Outside, a sow and her two cubs rooted around the yard. LeBlond shouted and slammed his front door to scare the bears away, but the animals didn't budge. He loaded a rifle and watched through the window.

He noticed right away something was wrong. A pack of dogs snapped and growled at the cubs, and the sow did nothing. A mother grizzly normally would not tolerate such affronts to her young.

The villagers, on the other hand, tolerated the bears for weeks. Finally, after the bears had broken into several trailers, the decision was made, reluctantly, to shoot them.

The only one in the village with experience in such matters was Frank Hanuse, a 60-year-old wisecracking, leathery-faced elder, nicknamed "Fugg," who unhappily agreed to do the job.

"They're coming to the village because they're hungry," said Hanuse, gloomily. "They're innocent. They haven't done anything wrong except be hungry. It's hard to put an animal down just for that."

Mature grizzlies can weigh anywhere from 500 to 1,500 pounds, but the bears that invaded the village were scrawny, weighing no more than 300 or 400 pounds - small for grizzlies but even the cubs, at 150 to 200 pounds, were big enough to be dangerous.

Hanuse used a 12-gauge shotgun with slug-loaded shells. He had to get within 15 feet of the animals before shooting them. In most instances, he was able to drop the animal with one shot.

**Bears' odd behavior sparks fear**
By the end of September, four bears had been killed, and the tribe hoped the episode was over. But October proved even worse. At one point in the middle of the month, nine grizzlies wandered the village looking for food.

Villagers, realizing that something extraordinary was taking place, began documenting the invasion with video cameras. School children drew pictures of the bears while watching them outside classroom windows.

The villagers tried in vain to scare or lure them away. They loosed their dogs on them, but the grizzlies barely acknowledged their undersized attackers. The bears didn't respond or retreat. They were passive, Hanuse speculates, because they were too weak.

Residents killed harbor seals and used them as bait to lure the bears out of town. Some emptied the contents of their freezers into the woods. Many decided simply to wait and hope the grizzlies would leave.

The bears remained, sleeping on porches and under houses, and rooting through gardens. After a while, the dogs got used to their presence and stopped barking at them. One resident recalls coming home to find two bears sleeping on one side of her porch and her dogs sleeping on the other.

The villagers had never seen such behavior in bears. It frightened them. It got so that people were afraid to walk the village. “We had to drive everywhere or run from house to house,” Hanuse said.

The tribe appealed to the province for help, hoping that game wardens could relocate the animals. The province responded on Oct. 21 by sending out several conservation officers who shot six of the bears and relocated three.

A spokesman for the Ministry of Environment said the six bears were killed because “they didn't have the fat reserves, and it wasn't likely they were going to survive.”

The Suzuki Foundation condemned the shootings, and blamed the federal government for allowing the salmon run to collapse. Fulton, the foundation director, said the government did not do enough to restrict logging and fishing in the area. The tribe decided on its own to forgo sustenance fishing this year, yet federal fisheries officials allowed a 75-day sport fishery in the inlet during the summer that took an estimated 2,000 salmon.

Fulton also condemned the provincial government for being ruthless in its dealings with the bears. He said all the animals should have been relocated and given the chance to survive. The tribe, Fulton said, did what it had to do in shooting the bears, and in some ways was as victimized as the starving animals.

‘It was getting dangerous’

The village, meanwhile, decided it could do the shooting on its own. There was no formal decision-making process; the village was small enough that if two or three households decided an animal was becoming too aggressive, a decision was made on the spot, and a call would be put out for “Fugg.”

The adults of the village were saddened by the situation. “I get choked up when I think about it,” said ChartrandSmith. But most traumatized were the children. Drawings of bears being shot or trapped began appearing in artwork. Some children wept over the killings.

“The kids were starting to think of them as pets, or as Yogi Bear, and they were trying to pet them,” Hanuse said. “It was getting dangerous. All it would have taken was one swipe from a bear and we'd have a tragedy.”

The last grizzly was shot in mid-November. After that, it was quiet for a while, presumably because the grizzlies of the region had gone into hibernation. Villagers, once again, hoped the ordeal was over, but then the black bears began showing up.

Grizzlies and black bears don't mix. The former is known to eat the latter. So it was only when the grizzlies faded from the scene that black bears, which also were starving, began wandering into town in search of food.

The last two bears killed in the village, in December and January, were black bears that normally would have been in hibernation. But like the grizzlies before them, they didn't have enough fat to survive the winter.

By mid-January, 14 grizzlies and two black bears had been killed in the village, and one more has recently been seen trudging from yard to yard. Villagers fear it may become victim No. 17.

Hanuse, who has lived in the region for more than 40 years, speculates that many other bears starved to death in the woods, and that more would die in late winter. Most vulnerable would be infant cubs, which are born in January or February while the mother is still hibernating.

Bears have one of the slowest reproduction rates of any land mammal in North America. Female grizzlies, for example, become sexually mature after their fifth year, and give birth to two or three cubs every three or four years. Of the 14 grizzlies killed, three were mothers and six were cubs under 2 years old.
"You won't find a bear biologist in the world who'd disagree that killing three sows and six cubs would have a destabilizing effect on the overall bear population in the area," said Fulton of the Suzuki Foundation. "What's going on there is a biological tragedy."

**Herbicide use adds to problem**

Among the causes of the salmon collapse are the familiar suspects: overfishing, overlogging, warming ocean temperatures, and toxins - from herbicides and pesticides - in rivers and streams.

The bears of the region, besides being deprived of their main protein source, may also have been deprived of their favorite plants. According to tree-planters and villagers, local logging companies used herbicides that destroyed vast stretches of salmonberries, elderberries and blackberries on which bears depend for sustenance before the salmon return.

With no plants or salmon to eat, the bears were desperate, and their desperation led to their demise, which, according to biologists, will affect the entire ecosystem. Bears bring salmon carcasses into the woods, which feed nutrients into the forest floor, and also feed insects and scavengers. The usual scavengers of the area this year have been noticeably absent.

Bald eagles, also a key figure in the tribe's culture, normally flock to Rivers Inlet by the hundreds when the salmon return. Hanuse said he once counted 80 eagles on a single tree by the river.

"It looked like a Christmas tree," he said. "The white heads were like ornaments."

But this year, few eagles returned, and those that showed up had nothing to eat but garbage. "It's a sad day," Hanuse said, "when the only eagles you see are at the dump."

The future seems full of foreboding for the Oweekeno. Great changes are upon them and many fear that little can be done. Five months ago, telephone lines reached the village in time to welcome the 21st century. But so far, the creeping of the outside world into this little patch of forest and sea has brought mixed blessings.

From the east, logging operations close in on the forests of the Coastal Mountain Range. From the west, resorts and boaters pour pollutants into the ocean. At Rivers Inlet, the skies are quiet, the great Wanuk River is empty, and the town dump is littered with the bones of grizzlies and black bears that were once the tribe's distant friends.

In response to questions about the future, Hanuse in slow, deliberate words evokes the past. "We've been here 10,000 years," he said simply and with no elaboration, as if sheer longevity by itself were a shield against things to come.