# Habitat Status Report for the Sarita River Watershed, Vancouver Island, BC

**Prepared for:**
Margaret Wright, Habitat Restoration Biologist
South Coast Area
Fisheries and Oceans Canada
Nanaimo, BC

**June 2010**

**Prepared by:**
Karen Barry, M.Sc., R.P. Bio.
Nanaimo, BC
KLBarry@yahoo.com

# Table of Contents

# 1.0 Introduction

The goals of Canada's Wild Salmon Policy (DFO, 2005) are to restore and maintain healthy and diverse salmon populations and their habitats by safeguarding the genetic diversity of wild salmon populations, maintaining habitat and ecosystem integrity, and managing fisheries for sustainable benefits. The Policy will be implemented through 6 strategies which aim to integrate information on wild salmon and their habitat with other biological, social and economic information to produce strategic plans, followed by the development of operational plans and ongoing review.

Implementation of the Wild Salmon Policy (WSP) is based on identified Conservation Units (CU's) for all species of Pacific Salmon. A CU can be defined as a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable timeframe, e.g., a human lifetime or a specified number of salmon generations (Stahlberg et al., 2009). In the Sarita River watershed area, the 5 CUs that have been identified include: South West Vancouver Island Chinook, West Vancouver Island Chum, Juan de Fuca – Pachena Coho, West Vancouver Island Pink and West Vancouver Island Sockeye.

In Strategy 2 of the WSP, the Assessment of Habitat Status, the following 4 steps have been identified:

1) Document habitat characteristics within Conservation Units
2) Select indicators and develop benchmarks for habitat assessment
3) Monitor and assess habitat status
4) Establish linkages to develop an integrated data system for watershed management.

In Step 1, factors that are limiting production and high value habitats that require protection are to be identified in order to identify options and priorities for habitat protection and restoration. The habitat status reports should also identify appropriate indicators and benchmarks (Step 2) which can be monitored to assess changes in habitat condition over time. (Step 3).

The goal of this project is to complete a Habitat Status Report for the Sarita River Watershed. A watershed scale was selected over an entire CU to expedite and explore the pilot nature of the project, and for the practicality of acquiring information on multiple CU species through single interviews with local watershed–based personnel. The scope of work for the present project included the following general objectives:

- Obtain and synthesize habitat information for the systems of interest in the Sarita River watershed;
- Complete Habitat Status Template Tables provided by DFO for 5 species of Pacific salmon;
- Identify appropriate indicators and benchmarks (or thresholds), where possible, in conjunction with DFO, and
- Prepare a report documenting the data sources and results obtained (this report) outlining the methodology used.

## 2.0 Background

The Sarita River watershed is located 12km northeast of Bamfield. It is approximately 18,972 ha in area, and drains into Trevor Channel on the west side of Vancouver Island (Figure 1). The geographic scope of this contract work is the Sarita River Watershed, Vancouver Island which includes the South Sarita River, Frederick Creek, Sabrina Creek, and the smaller tributaries to the Sarita, namely the Central, Hunter, Thompson and Miller Creeks.

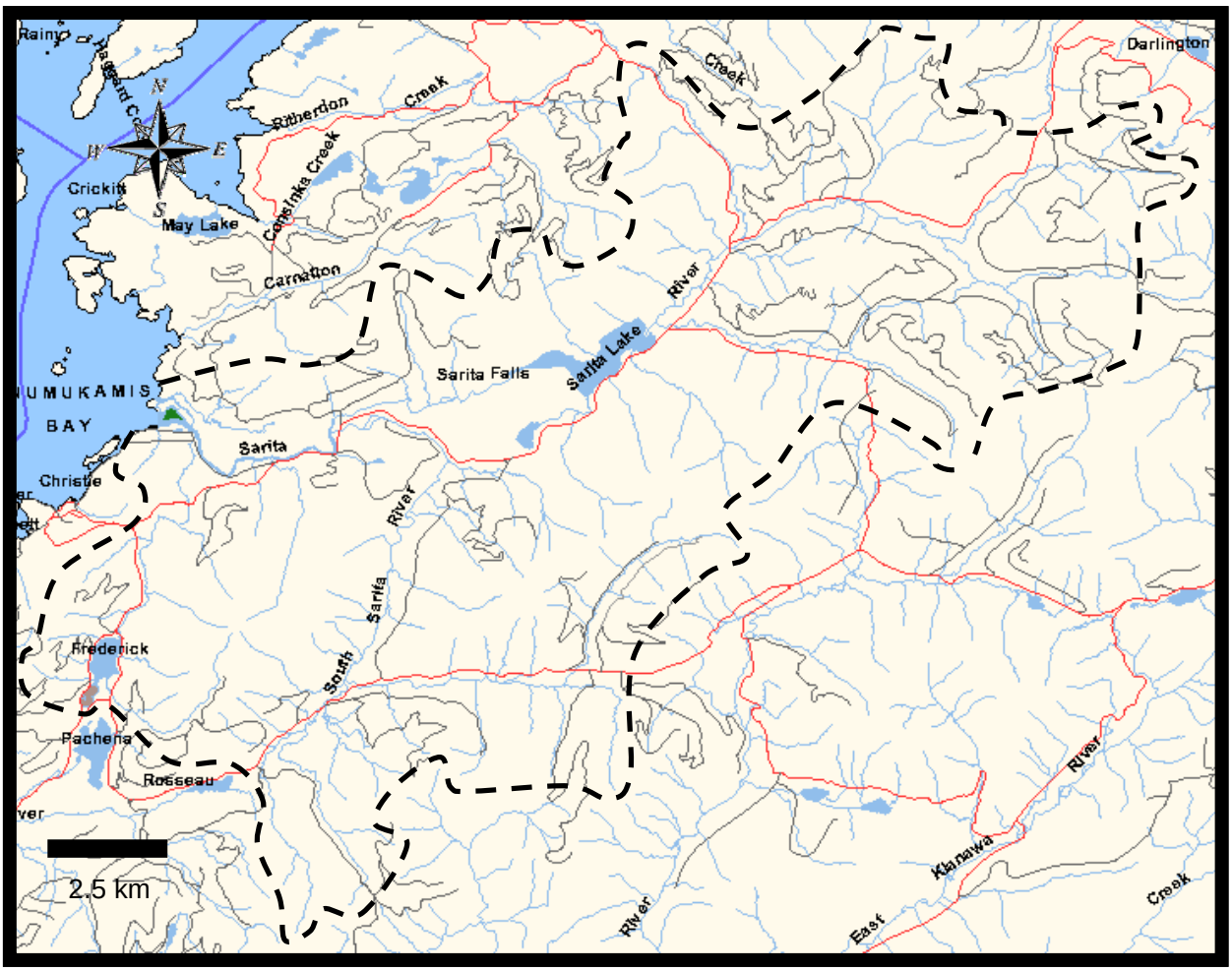


Figure 1. Location of Sarita River watershed. Approximate boundaries of watershed shown in dashed line.

Land ownership in the Sarita River watershed includes lands owned by First Nations (Huu-ay-aht First Nation), Crown land and other parcels of private land owned by Island Timberlands (Figure 2). The majority of the land is under tenure held by Western Forest Products (WFP). The Arrowsmith Timber Supply area is located further north. Huu-ay-aht First Nation (HFN) Treaty Lands are part of Timber Forest License (TFL) 44 and are presently managed by Western Forest Products (M. Davies, Western Forest Products, pers. comm.). These lands are part of the Treaty Settlement Lands that will become private land owned by HFN in

future as part of the Maanulth Treaty or other land agreement. Huu-ay-aht Community Forest #1 and #2 are part of TFL 44 and managed by WFP. These lands will be removed from TFL 44 in future to be managed by HFN as part of the Maanulth Treaty and/or other land agreement. The land will remain Crown Land.

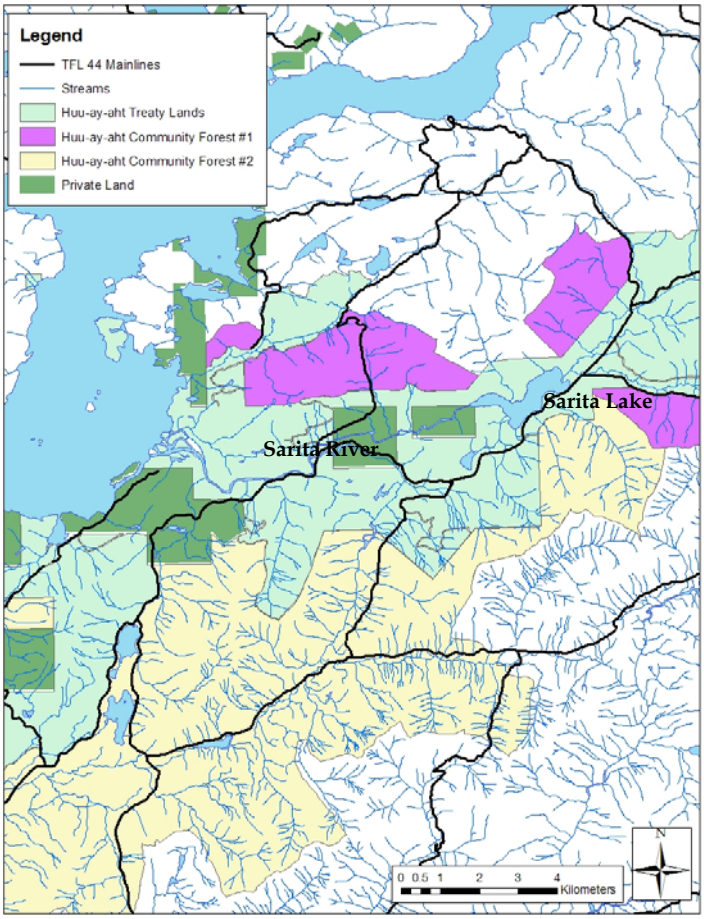


Figure 2. Land ownership as of February 2010 (Courtesy Western Forest Products).

Historically, the Sarita River supported many salmonids including coho, pink, chinook, chum, sockeye, steelhead and resident trout (cutthroat, rainbow and Dolly Varden). In recent years, the most abundant species has been chum salmon, with smaller numbers of coho, and variable but increasing numbers of chinook. Pink and sockeye occur in low numbers sporadically (S. Ochman, 1998; J. Lane, pers. comm.). The most abundant trout species in the Sarita River watershed are cutthroat and steelhead (S. Ochman, pers. comm.), although the watershed also supports Dolly Varden, rainbow trout and kokanee (LGL, 1997; J. Lane, pers. comm.). The smaller tributaries flowing into the upper Sarita River, upstream of Sarita Lake, support trout and sculpins in all accessible habitat, i.e. where gradient is less than 20% (J. Lane, pers. comm.).

There are several lakes in the watershed. The largest is Sarita Lake (147 ha) located near the center of the watershed; Frederick Lake (41 ha) is in the lower part of the watershed and Bewlay Lake (11 ha) drains into Sarita Lake. Several smaller tributaries drain into Sarita Lake, including Thompson Creek, Miller Creek and Central Creek. As part of the Sarita Watershed Restoration Project conducted in the mid 1990's, several watershed assessments (eg. geomorphological channel assessment, hydrological overview, fish habitat assessment) were completed in the Sarita River watershed. The information in these reports has been included in this assessment. A map of the approximate locations of pre-established reach breaks is provided in Appendix A.

Overall land use activities in the Sarita River watershed are primarily related to forestry and include logging, road building, bridge construction and culvert installations. Early logging along the mainstems in the 1950's and 1960's left little or no riparian buffers along most fish bearing streams throughout the watershed, except where access was impossible. As a result, upslope instability has occurred and almost all of the systems in this watershed have experienced channel widening, channel and bank instability, infilling of pools, reduced surface flows in summer, higher peak flows in winter and reduced woody debris and nutrients due to the loss of riparian vegetation (LGL, 1997). In 1996, 62% of the watershed had been harvested, 27% of streams within the watershed had been logged, and 97% of the total floodplain area had been logged (Horel, 1996). In 1996, there were 499 km of roads in the watershed and about 556 stream crossings (Horel, 1996). Reviews of air photos conducted by Horel (1996) and Graham (1997) indicated that major channel shifts occurred during the 1950's and 1960's when the floodplain of the Lower Sarita River and South Sarita River was logged, and numerous slide events had occurred. Further details on these events and locations can be found in the reports by Horel (1996) and Graham (1997).

Graham's hydrological overview (1997) found that the flow pattern tends to be "flashy". Summer flows in the Sarita River can be extremely low, rarely exceeding 1 $m^3/s$. Prior to 1985, the annual 7 day mean flow ranged from 2.03-0.37 $m^3/s$. Since 1985, it has not exceeded 0.79 $m^3/s$ and is often lower. The lowest annual flows generally occured during August – September and highest flows occurred during November - February (Graham, 1997). The river responds predominately to rainfall events and surface run-off as storage is limited and winter snowpack contributes very little to the accumulated annual precipitation yield. It's possible that removal of the trees has exacerbated low flow problems since infiltration is likely lower and fog condensation on trees is reduced (Graham, 1997). Graham also found that mean annual discharge (MAD) appeared variable over 1950-1995, with a period of 6-8 years between extreme lows flow events, and none of the low flow periods were sustained for more than 1-2 years. Overall, Graham (1997) concluded that MAD appears to have declined slightly from 1950-1995 but no significant and marked decrease was evident. Further details regarding this hydrological assessment can be found in Graham's report.

## 3.0 Methods

In order to describe the current habitat condition of the rivers and creeks within the Sarita River watershed, information regarding instream and riparian habitat conditions was collected from multiple sources, including both published reports and personal communication

with knowledgeable persons (see Table 1). General information on trout species was also included where available.

Table 1. Existing databases that were accessed.

| Name | Type of Information | Web Address |
|---|---|---|
| Fisheries Information Summary System (FISS) | Spatially represented summary level fish and fish habitat data for waterbodies throughout British Columbia and the Yukon. | http://www.env.gov.bc.ca/fish/fiss/index.html |
| Fish Habitat Wizard | Fish Wizard to create maps, view reports and find the most recent information about British Columbia's lakes, rivers and streams. | http://www.fishwizard.com/default.htm |
| Community Mapping Network (CMN):<br>- Sensitive Habitat Inventory & mapping (SHIM)<br>- Pacific Coastal Resources Atlas<br>- BC Wetlands | The CMN provides access to maps of sensitive habitats and species, and provides access to various fish and land use datasets such as FISS, historic mines, watershed statistics. Information is integrated from many sources and is available in various online atlases. The Sensitive Habitat Inventory and Mapping (SHIM) Atlas is a land-planning, computer-generated interactive GIS tool that identifies sensitive aquatic and terrestrial habitats. | http://cmnbc.ca/ |
| Hectares BC | Hectares BC is a collaborative pilot project created under the Biodiversity BC partnership to provide access to summarized, integrated, geospatial data about British Columbia's natural resources. This database included information on sensitive terrestrial ecosystems, amphibians, wetlands, etc but no new fish habitat information. | www. hectaresbc.org |
| Compass | Information database developed by DFO that includes information on watershed size, stream length, and expert opinions from DFO staff on riparian conditions, flow, water quality, instream habitat, impacts and future land uses. | Provided by DFO |

Personal interviews were conducted to obtain first hand knowledge that may be unpublished and to add to the published information that may be outdated (i.e. more than 15 years old). Interviews were conducted with Fisheries and Oceans staff, First Nations biologists and other organizations. Table 2 lists the individuals that were contacted. Interview questions and responses are provided in Appendix B.

Table 2. Persons who were contacted for information requests (those marked with an asterisk did not have fish habitat information to provide).

| Name | Agency | Interview Date |
|---|---|---|
| Rob Brouwer | Manager, Nitinat Hatchery, Fisheries & Oceans Canada | January 21, 2010 |
| Kevin Head* | West Coast Aquatic Management Board | - |
| Jim Lane | Biologist, Uu-a-thluk/ Nuu-Chah-Nulth Tribal Council | February 4, 2010 |
| Stefan Ochman | Fisheries Manager, Huu-ay-aht First Nation | January 27, 2010 |
| Brad Rushton | Habitat Management Technician, Fisheries & Oceans Canada | January 26, 2010 |
| Randy Stennes | Conservation and Protection Officer, Fisheries & Oceans Canada | January 15, 2010 |
| Jeff Till* | Stock Assessment, Fisheries & Oceans Canada | - |
| Lori Wilson* | Mapping & Computer Technician, Clayoquot Alberni Regional District | - |
| Erin Badesso* (declined interview, referred to HFN; provided literature/maps) | Western Forest Products | - |

Habitat information was synthesized and summarized in a Tabular format for each species and each life-stage using a slightly modified version of the Habitat Status report template that was provided. Key types of information included:

- Known limiting factors
- High value habitats
- Information Gaps
- Possible measures to address limiting factors
- Possible measures to maintain productivity
- Habitat protection and restoration measures undertaken

From this information, relevant habitat pressure and state indicators for the Sarita watershed were identified. They were selected from those identified in the report " Canada's' Policy for Conservation of Wild Pacific Salmon; Stream, Lake and Estuarine Habitat Indicators" (Table 4.1, Stahlberg et al., 2009) and are intended to guide monitoring or evaluation of trends and changes in habitat condition over time. Gaps in knowledge were identified where no existing data was found and when no one had recent information based on their personal knowledge.

This report is intended to provide background information and context for the life stage-specific information presented in the Habitat Status Tables in Appendix D. This report describes limiting habitats that have been identified either from previous habitat assessment reports or from interviews conducted for this project. It is important to note that many habitat assessment reports did not identify which salmon life stage or species the existing habitat would be used by. Rather, these assessments focused on documenting the amount and types of physical habitat features present.

Within the current scope of work, it was not possible to determine a causal linkage between identified limiting habitat conditions in streams and production of salmon species since other factors, such as ocean survival, could also be a contributing factor. Therefore, this report identifies limiting freshwater habitat conditions that could be contributing to reduced production. Further study will be required in order to conclusively identify those stream habitat conditions that are causing reduced salmon production for a given species.

## 4.0 Results

The Sarita River watershed is in a state of natural regeneration after extensive logging occurred in the mid 1900's and continued through the 1990's. Presently, Western Forest Products is not conducting new logging in the area, only silvicultural activities are taking place (Mike Davies, Western Forest Products, pers. comm.).

In terms of fish distribution in the watershed, chum and coho occur in the smaller tributaries of the lower Sarita River, while chinook are restricted to the Sarita River mainstem and lower reaches of the South Sarita River. Pink and sockeye occur in very low numbers. Most interviewees stated that the habitat for pink salmon in the Sarita River watershed was reasonably good, however west coast pink stocks have undergone a severe decline and only a few strays can be found in the area (B. Rushton, pers. comm.; S. Ochman, pers. comm.; J. Lane, pers. comm.).

In the case of sockeye, low numbers of fish have been observed returning every year for the last 10-15 years. In 2007, adult sockeye were observed throughout the mainstem of Sarita River all the way up to the Sarita Falls in late summer (S. Ochman, pers. comm.). In the fall of 2009, there was a good return of about 500 adults to the Sarita River (S. Ochman, pers. comm.). Since access to Sarita Lake is blocked by an impassable rock waterfall, the Sarita River could support a small population of a stream/estuary rearing sockeye, although little study has been done to investigate this. It is possible that these sockeye may have a different life history strategy than lake sockeye in that the spawning cycle is completed much quicker (J. Lane, pers. comm.). That is, stream rearing sockeye may return to the spawning stream as fresh silver coloured fish, and complete the entire spawning cycle in as little as a few weeks (J. Lane, pers. comm.). Both Rob Brouwer and Stefan Ochman commented that the sockeye could be strays from another system. No studies or reports on the life history of Sarita sockeye were found, thus the sockeye information presented here is based on information supplied from interviews. Most of the life history requirements of Sarita sockeye remain unknown at this time.

During interviews, many people identified similar habitat factors that are likely to affect salmon productivity in the Sarita River watershed. The table below provides a general summary of the limiting habitat features and high value habitat for each conservation unit in the Sarita River watershed (Table 3).

Table 3. Notable habitat conditions for each Conservation Unit (CU) in the Sarita Watershed based on interviews conducted during January-February 2010.

| CU | Most Limiting Habitats | Highest Value Habitats |
|---|---|---|
| Chinook | • Sufficient number of deep pools for adult holding in Sarita River<br>• Summer rearing habitat for juveniles (estuary and in-river)<br>• Lack of stable spawning habitat in Sarita River<br>• Lack of stable spawning habitat in South Sarita River | • Sarita River has abundant gravel as potential spawning substrate but stability is a problem and it is compacted in many areas<br>• Lower Sarita River has some good habitat (pools and spawning)<br>• Several deep pools in Sarita River for adult holding ("Deep Hole", "Cable Car", Corner Pool", Blenheim bridge, base of Sarita Falls) |
| Chum | • Stable spawning habitat in South Sarita and Sarita River<br>• Estuary rearing habitat | • Lower Sarita River has some good habitat (pools and spawning)<br>• Marshy off-channel juvenile rearing habitat off Frederick Creek<br>• Spawning habitat in the lower section of Hunter creek<br>• Frederick Creek has high quality spawning and rearing habitat |
| Coho | • Juvenile overwintering habitat<br>• Off-channel rearing areas during summer low flow conditions<br>• Access to off channel refuge areas, especially in lower South Sarita River | • Side channel rearing areas off Sarita and South Sarita<br>• Most of Frederick Creek provides high quality habitat for rearing & spawning<br>• Off-channel beaver pond/swamp overwintering habitat on Sarita River near of confluence with South Sarita<br>• Marshy off channel habitat at Frederick Creek for rearing<br>• Sabrina Creek has several areas of good rearing habitat. |
| Pink | • Little information available<br>• Spawning habitat | • Lower Sarita River has suitable habitats in tidally influenced reaches for spawning |
| Sockeye | • Little information available<br>• Stable spawning habitat | • None identified (no information available) |

The following sections of the report provide information about the data sources accessed and a habitat summary for each system. Appendix C contains a map of locations of the known limiting habitat features and high value habitats. Habitat Summary Tables for each species and life stage can be found in Appendix D.

## *4.1 Sarita River*

DATA SOURCES:

Personal Interviews:

- Rob Brouwer
- Jim Lane
- Stefan Ochman
- Brad Rushton
- Randy Stennes

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- LGL Ltd. April 1997. Watershed Level Assessment of Stream and Riparian habitat of the Sarita River, Vancouver Island, BC. Prepared for Huu-ay-aht First Nation and MacMillan Bloedel Limited.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat
DFO Mapster: Escapement records for chinook, chum, coho, pink, sockeye, steelhead
Compass BC: Information from an interview with Rob Brouwer.

No fish habitat data for Sarita River was available from BC Wetlands, Pacific Coastal resources or Hectares BC.

WATERSHED CODE: 930-110800

LOCATION & GENERAL DESCRIPTION

The Sarita River flows west from the westernmost end of Sarita Lake for 9 km where it flows into Numukamis Bay and Trevor Channel in Barkley Sound. The gradient of the lower Sarita is generally low, less than 0.5%, until Sarita falls (LGL, 1997).

## *Sarita River (cont.)*

FISH PRESENCE

In the mainstem of Sarita River, coho, chinook, chum, sockeye and occasional pink salmon can be found. Cutthroat (anadromous and resident), Dolly Varden, rainbow, and steelhead trout also occupy the Sarita River. Other species include prickly sculpin, lamprey and sticklebacks.

At 1 km downstream from the lake, there is a series of impassable falls (8-15 m high) which prevents upstream fish access in the Sarita River (FISS; LGL, 1997; Ochman, 1998.). FISS indicates that pink salmon have been observed in the lower part of Sarita River previously, and occasional strays are seen (S. Ochman, pers. comm.). Sockeye salmon have occurred in this system (FISS) and adults have been observed all the way to the falls (S. Ochman, pers. comm.), but no information is available on sockeye habitat use in this system. In the fall of 2009, about 500 adult sockeye returned to the system (S. Ochman, pers. comm.).

POSSIBLE LIMITING HABITAT CONDITIONS

The lower reaches of the Sarita River have undergone channel disturbance as evidenced by several areas of elevated, unvegetated bars and eroding banks (LGL, 1997). Some lateral channel movement has also occurred (Graham, 1997). Because of high peak flows, spawning gravels are subject to scour and/or burial by transported sediment which can cause destruction of eggs (R. Stennes, pers. comm.; S. Ochman, pers. comm.), particularly in Reach 1 (Ochman , 1998). Please refer to the map provided in Appendix A for locations of reach breaks.

Overall, juvenile rearing and adult holding habitat is limited in the Sarita River (LGL, 1997). Pool frequency is low in the mainstem. Large woody debris (LWD) is limited and generally clumped and parallel to the bank so does not provide functional cover (LGL, 1997). Boulder-riffle type habitat used by juvenile chinook is limited (R. Brouwer, pers. comm.). Based on a Habitat assessment conducted in 1998 (Ochman, 1998) of the Sarita River:

- Reach 1 had signs of scour. Also, cover was limited in that few undercut banks and little woody debris or instream vegetation present. Pools were not deep enough nor did they have sufficient wood cover for holding.
- Reach 2 had inadequate LWD and only 1 pool had sufficient depth and cover for holding. Off channel habitat in Reach 2 consisted of 2 short side channels.
- Reach 3 had inadequate LWD and the number of pools and amount of wood was inadequate for cover.
- Reach 4 had insufficient LWD and the number of pools was inadequate to accommodate the coho fry.

Upstream of the South Sarita confluence, a portion of the Sarita River (Reach 4) is composed of a wide channel with large cobble and boulder substrate with very low habitat complexity, and limited suitability for spawning, rearing or cover (S. Ochman, pers. comm.).

The upper Sarita River (above Sarita Lake) has undergone extensive channel disturbance with significant bar formation from aggradation and channel widening which has caused increased bank erosion (LGL, 1997).

## *Sarita River (cont.)*

HIGH VALUE HABITATS

A shallow beaver pond/swampy area just upstream of the confluence with the South Sarita River, on the north side of the Sarita River, provides high quality juvenile rearing habitat for coho (S. Ochman, pers. comm.; B. Rushton, pers. comm.). Reach 1 and 2 have suitable spawning substrate for chum.

A few deep pools in the mainstem are suitable for chinook adult holding. One such pool is located near the confluence of Frederick Creek ("Deep Hole"), another pool is near the mouth of Hunter Creek ("Cable Car"), and there is a pool downstream of the confluence of the South Sarita at a bend in the Sarita River ("Corner Pool"). There is also a deep pool at Blenheim Bridge and a very deep pool at the base of Sarita falls (S. Ochman, pers. comm.). Based on a Habitat assessment conducted in 1998 (Ochman, 1998) of the Sarita River:

- Reach 1 had good off channel habitat present in the form of two long side channels that are accessible at most flow levels
- Reach 2 had 1 pool with sufficient depth & cover for holding.
- Reach 3 had good substrate for spawning, incubation and winter refuge. Off channel habitat included 1 slough and 1 side channel accessible at all flows.
- Reach 4 had the best substrate for chinook and chum spawning, incubation and winter refuge. Boulder substrate provided good cover for rearing steelhead and chinook, but marginal rearing habitat for coho fry due to low number pools and low wood cover in pools. This reach also had the best amount of overhead cover for rearing fry. Off channel habitat was good with 3 side channels, including 1 pond and 1 slough accessible at most flows.

COMPLETED HABITAT RESTORATION PROJECTS

- To increase habitat complexity and create pools for coho fry, log cover structures were installed in 1998 at 2 sites on the Sarita River and at 1 site at the confluence of the Sarita & South Sarita (Huu-ay-aht First Nation. February 2000).
- To increase off channel rearing habitat for coho fry in low flow conditions, a fishway was installed in 1999 to provide access to the beaver pond in Reach 3. Log structures were installed at 6 sites in Reach 3, and at 4 sites in Reach 4 to enhance habitat complexity and pools for rearing coho fry (Huu-ay-aht First Nation. February 2000).

In 2003, Murray and Gaboury conducted effectiveness monitoring of previous restoration projects involving the installation of instream structures in the Sarita River, South Sarita River, Sabrina and Hunter creeks, as well as a side channel in the South Sarita River. They found that most instream structures were stable and were meeting or exceeding physical objectives at that time, although a small number needed repair and some were lost due to floods. Generally they found that single log structures were out performed by lateral jams, deflectors and revetments.

## *4.2 South Sarita River*

DATA SOURCES:

Personal Interviews:

- Rob Brouwer
- Jim Lane
- Stefan Ochman
- Brad Rushton
- Randy Stennes

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- LGL Ltd. April 1997. Watershed Level Assessment of Stream and Riparian habitat of the Sarita River, Vancouver Island, BC. Prepared for Huu-ay-aht First Nation and MacMillan Bloedel Limited.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for South Sarita River was available from DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-17900

LOCATION AND GENERAL DESCRIPTION:

This is the major tributary that flows north and enters the Sarita River, about 4.7 km below Sarita Lake, and 5.5 km from the river mouth. The headwaters to the South Sarita River are located in the southern most part of the Sarita watershed. There are 3 main sub-basins: the Lower Sarita, the Upper South Sarita which includes Evans Creek, and Sabrina Creek. The lower section of the South Sarita is very wide, with low to moderate gradient (1-3%).

## *South Sarita River (cont.)*

FISH PRESENCE

The South Sarita River supports coho, chinook in the lower reaches only, chum in the lower reaches, and occasional sockeye and pink salmon. Coho are present in the upper reaches. Cutthroat, rainbow and steelhead trout can be found (FISS; S. Ochman, pers. comm.). A barrier in Reach 24-25 (log jam or slide) seems to be preventing adult coho from accessing the uppermost reaches leading to Sabrina Creek (Ochman, pers. comm.)

POSSIBLE LIMITING HABITAT CONDITIONS

Severe channel aggradation has occurred in the lower reaches (Reach 20-21), "the flats" of the South Sarita River as a result of increased flood flows, depositing coarse material from numerous small upstream failures and bank erosion from destabilized banks and degraded riparian areas (B. Rushton, pers. comm.; LGL, 1997).

Historically, this area was likely composed of a network of side channels and swampy areas (J. Lane, pers. comm.). Following clearing of the riparian vegetation and upslope forests, large amounts of material were deposited in this area which filled in the small channels, and/or cut off fish access to them. Consequently, there is a considerable lack of refuge areas for fish, particularly in low summer flow conditions (J. Lane, pers. comm.; S. Ochman, pers. comm.). This would be a limiting factor for coho and stream rearing chinook juveniles.

During the dry summer period, water levels drop considerably in the South Sarita River. Because of the large amount of sedimentation which has infilled the side channels as well as mainstem pools, low flow conditions result in many pools becoming cut-off in the mainstem and reduced access to off channels areas (J. Lane, pers. comm.). Although pools may have been cut off historically, the recent impacts within the watershed (i.e., clear-cut logging and significant sedimentation) likely contributed to an increase in the frequency and extent of pools being cut-off (J. Lane, pers. comm.).

In addition to channel disturbance, there is generally very little woody debris in the South Sarita River (LGL, 1997; Ochman, 1998). The riparian zone has been severely impacted or removed entirely such that wood available for recruitment to the system is very low (LGL, 1997). High impacts to bank stability and LWD have been observed in Reaches 20, 21, 30, 31 (Ochman, 1998). Please refer to the map provided in Appendix A for locations of reach breaks.

Based on a Habitat assessment conducted in 1998 (Ochman, 1998) of the South Sarita River:

- Reach 20 had inadequate cover for juveniles (LWD or instream cover). No pools with adequate cover for coho fry were present. Off channel habitat was poor as there were no side channels with good access, however several relict side channels were found.
- Reach 21 had inadequate LWD and no overhanging vegetation for cover. Side channels were poor; 4 were present but they were inaccessible at low flows and not useful for coho rearing.
- Reach 27 had inadequate cover from LWD and cover from pools was limited. Off channel habitat was present but cover from LWD in side channels was lacking.

## *South Sarita River (cont.)*

- Reach 28 – 29 consisted of canyon type channel morphology with very steep banks. Reach 29 had glide-riffle habitat and no pools, while Reach 28 was a series of cascades and pools on bedrock.
- Reach 30 had inadequate LWD. Overhanging vegetation was absent since the banks were recently clearcut. Only 1 deep pool was present and no off channel habitat existed.
- Reach 31 had inadequate LWD. There was little overhanging vegetation, few pools, and no off channel habitat for coho rearing.

HIGH VALUE HABITATS

Reach 30 has suitable spawning substrate and high quality rearing habitat for steelhead. There are pockets of suitable habitats, with deep pools (J. Lane, pers. comm.). Based on a Habitat assessment conducted in 1998 (Ochman, 1998) of the South Sarita River:

- Reach 21 had good substrate for spawning & incubation (chinook, coho and chum). Good deep pools for adults. Boulders in riffles provide some cover for chinook juveniles.
- Reach 27 had good substrate for coho spawning, incubation and winter refuge. 3 pools for adult holding. Good offchannel habitat but adequate cover is not provided for coho fry.
- Reach 30 had good coho spawning and incubation habitat. Good summer and winter rearing areas, especially for coho and steelhead. Some undercut banks present.
- Reach 31 had good spawning substrate for coho.

COMPLETED HABITAT RESTORATION PROJECTS:

The restoration projects conducted in the South Sarita River were aimed at improving holding and rearing habitat for juvenile coho and steelhead by improving habitat complexity and access to off channel areas. LWD structures were installed to promote pool scour, provide cover, provide refuge for juvenile coho during high flows, as well as increasing bank stability. Fertilizer additions were conducted on a trial basis in an attempt to increase overall productivity of the streams.

- In 1998, log cover structures were installed at 1 site on the South Sarita and at 1 site at the confluence of the Sarita & South Sarita (Huu-ay-aht First Nation. February 2000)
- In 1998, a 150m long side channel along the South Sarita was built in Reach 20 and was used by coho fry in 1999 (Huu-ay-aht First Nation. February 2000).
- In 1999, large woody debris structures were installed at 2 sites in reach 20 (Huu-ay-aht First Nation. February 2000).
- In 2000, the side channel previously built in Reach 20 was extended by 115m to provide summer and winter off channel habitat for coho fry and large woody debris was added. In 2001, rip-rap armouring was added to the upstream corner of the berm (Ochman, January 2002).
- In 2000, 5 structures were constructed to protect an eroding bank in Reach 20, and 3 structures previously built were repositioned and recabled (Ochman January 2002).
- In 2000, large woody debris was added to 9 sites in Reaches 30-31 (Ochman, January 2002).

*South Sarita River (cont.)*

- In 2001, large woody debris was added to 10 sites in Reaches 30-31 (Ochman, January 2002).
- In 2006, Pollack bone meal was added as a slow release fertilizer in 5 areas, including the mainstem South Sarita and Sabrina Creek (Pellet and Wright, 2007).
- In 2006, 7500 $m^2$ of new off- channel rearing habitat was created in Reach 20. In 2009, this side channel and the protection berm were rehabilitated due to flooding damage.

In 2003, Murray and Gaboury conducted effectiveness monitoring of previous restoration projects involving the installation of instream structures in the Sarita River, South Sarita River, Sabrina and Hunter creeks, as well as a side channel in the South Sarita River. They found that most instream structures were stable and were meeting or exceeding physical objectives at that time, although a small number needed repair and some were lost due to floods. Generally they found that single log structures were out performed by lateral jams, deflectors and revetments.

## *4.3 Sabrina Creek*

DATA SOURCES:

Personal Interviews:

- Stefan Ochman

Reports containing fish habitat assessment information:

- LGL Ltd. April 1997. Watershed Level Assessment of Stream and Riparian habitat of the Sarita River, Vancouver Island, BC. Prepared for Huu-ay-aht First Nation and MacMillan Bloedel Limited.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.

DATA COMPILED:
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Sabrina Creek was available from FISS, DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-17900-62100

## *Sabrina Creek (cont.)*

LOCATION & GENERAL DESCRIPTION

Sabrina Creek flows into the South Sarita River at the southern end of the Sarita River watershed. It consists of 2 branches, both flow northeast before joining together and flowing for 1.5 km into the South Sarita River. It has low to moderate gradients (1-3%) and is fish bearing up to a series of log jams 2-3 km upstream from the confluence with the South Sarita.

FISH PRESENCE

Sabrina Creek supports coho and steelhead trout. There are 2 impassable log jams, located in Reach 35 and Reach 37 (S. Ochman, pers. comm.) which likely prevent access by adult coho. However juvenile coho can access Sabrina creek for rearing. In 1997, a few small coho juveniles were caught so it is possible that coho might spawn in Sabrina Creek (Ochman, pers. comm.), but that has not been confirmed.

Adult coho have not been seen in Sabrina Creek but it is possible that historically they could access this area and spawn (Ochman, pers. comm.). Now there may be a barrier in the form of a log jam or a slide in the canyon (Reaches 24-25) preventing adult access to the top of the Sarita watershed. In 1997, some juvenile coho were captured in Sabrina Creek which would indicate that there was probably spawning in this area (Ochman, pers. comm.).

POSSIBLE LIMITING HABITAT CONDITIONS

Sabrina Creek was logged to the bank which has reduced the riparian vegetation thereby decreasing available sources of instream woody debris. Consequently, there is an overall lack of functioning LWD in this system which has resulted in a general lack of pool habitat. Lower Sabrina Creek showed signs of channel aggradation in the form of extensive unvegetated bars, channel widening and eroding banks (LGL, 1997). Upper Sabrina Creek showed evidence of scour and a lack of LWD and pools (LGL, 1997).

Based on a Habitat Assessment of the Sabrina River conducted in 1998 (Ochman, 1998), Reaches 34-37 have been impacted by bank erosion and have few good pools and low amounts of LWD (instream and in pools). Please refer to the map provided in Appendix A for locations of reach breaks. Specific habitat limitations identified included:

- Reach 34 had inadequate LWD overall. There was little overhanging vegetation, and a general lack of pools due to poor functioning LWD and channel aggradation.
- Reach 35 (West branch) had inadequate LWD and 2 log jams at 1500m which impede upstream fish migration.
- Reach 36 (West branch) had inadequate cover from LWD, no overhanging vegetation and few pools.
- Reach 37 (East branch) had inadequate LWD for cover. There was a major logjam at 650m which blocks upstream fish movement. Rearing habitat for coho fry was marginal due to a lack of pools.

## *Sabrina Creek (cont.)*

HIGH VALUE HABITATS

Reach 34, at the Central Creek Mainline crossing, had good habitat diversity in the form of gravels and near bank cover (LGL, May 1997). A Habitat assessment conducted in 1998 (Ochman, 1998) found that:

- Reach 34 had fair substrate for spawning (steelhead). Boulders & deep pools provided some cover for juvenile coho and steelhead. There were some good deep holding pools with cover for adult steelhead and 1 side channel for coho rearing.
- Reach 35 (West branch) had good spawning substrate (steelhead). Boulders & deep pools provided cover and there were some deep pools for adult steelhead holding. One side channel provided suitable rearing habitat for coho fry.
- Reach 36 West Branch had little gravel present but it was good quality for steelhead spawning.
- Reach 37 East Branch had little gravel present but it was good quality for steelhead spawning. Boulders and deep pools provided some cover. Good off channel habitat for coho and steelhead rearing with 3 accessible side channels, 2 side channels accessible only at high flows.

COMPLETED HABITAT RESTORATION PROJECTS:

Restoration projects conducted in Sabrina Creek were designed to improve holding and rearing habitat for juvenile coho and steelhead by enhancing habitat complexity and access to off channel areas. LWD structures were installed to promote pool scour, provide cover, provide refuge for juvenile coho during high flows, as well as increasing bank stability. Fertilizer additions were conducted on a trial basis in an attempt to increase overall productivity of the streams.

- In 1999, four riffle structures and 8 large woody debris structures were installed in Reach 34 (Huu-ay-aht, 2000).
- In 1999, two log jams were lowered and large woody debris structures were installed at 25 sites in Reach 35 (Huu-ay-aht, 2000).

In 2003, Murray and Gaboury conducted effectiveness monitoring of previous restoration projects involving the installation of instream structures in the Sarita River, South Sarita River, Sabrina and Hunter creeks, as well as a side channel in the South Sarita River. They found that most instream structures were stable and were meeting or exceeding physical objectives at that time, although a small number needed repair and some were lost due to floods. Generally they found that single log structures were out performed by lateral jams, deflectors and revetments.

- In 2000 and 2001, small woody debris was removed from a logjam in Reach 35 (Ochman, January 2002).
- In 2000, 20 new large woody debris structures were installed in Reach 37 (Ochman, January 2002).
- In 2001, 18 new large woody debris structures were placed in Reach 34 (Ochman, January 2002).

*Sabrina Creek (cont.)*

- In 2001, 4 new large woody debris structures were installed in Reach 35 (Ochman, January 2002).
- In 2001, 6 new large woody debris structures were installed in Reach 37 (Ochman, January 2002)
- In 2006, Pollack bone meal was added as a slow release fertilizer in 5 areas, including the mainstem South Sarita and Sabrina Creek (Pellet and Wright, 2007).

## *4.4 Frederick Creek*

DATA SOURCES:

Personal Interviews:

- Jim Lane
- Stefan Ochman
- Brad Rushton

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.
- LGL Ltd. April 1997. Watershed Level Assessment of Stream and Riparian habitat of the Sarita River, Vancouver Island, BC. Prepared for Huu-ay-aht First Nation and MacMillan Bloedel Limited.

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat
DFO Mapster: Escapement records for chum and coho

No fish habitat data for Frederick Creek was available from BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-03000

## *Frederick Creek (cont.)*

LOCATION AND GENERAL DESCRIPTION:

Frederick creek flows into the lower Sarita River mainstem from the south side, about 700 km upstream from the river's mouth. Its headwaters are located in Frederick Lake, which is 5.5 km upstream of the confluence with Sarita River. The lower reach is an alluvial channel with very gentle gradients. The lower reaches were logged in the 1930's and 1940's, and now support advanced second growth forest.

FISH PRESENCE

Frederick Creek is fish bearing throughout. Coho and chum salmon, as well as cutthroat and steelhead trout, occupy Frederick Creek (FISS; S. Ochman, pers.comm.). Fish Wizard reports that Dolly Varden and sockeye salmon are also present. Frederick Creek does not support chinook because of its small size. From Frederick Lake downstream to 1 km, there is a small but passable falls (LGL, 1997).

POSSIBLE LIMITING HABITAT CONDITIONS

Some channel aggradation has occurred in the lower reaches of Frederick Creek, with unvegetated gravel bars present. This has led to infilling of some pools. At the Sarita mainline crossing, Frederick Creek lacks LWD and rearing pools (LGL, May 1997). During summer low flows, there is reduced access to some off channel habitat in Reaches 13-14 for rearing coho (Ochman, 1998). LWD for cover is limited in Reaches 16-17. Please refer to the map provided in Appendix A for locations of reach breaks.

HIGH VALUE HABITATS

Overall, Frederick Creek has high quality habitat for coho and chum throughout, with abundant off-channel habitat, pools, refuge areas, and good gravel substrate for coho spawning in Reaches 13-17 (LGL, 1997; Ochman, 1998; B. Rushton, pers. comm.). Compared to other systems in the Sarita River watershed, Frederick Creek has the best developed riparian zone. Some large mature trees have been left, primarily because the swampy conditions made logging difficult (S. Ochman, pers. comm.). There is abundant large woody debris and good cover for adult and juvenile coho (S. Ochman, pers. comm.).

The creek flows through an extensive swampy area in Reaches 13-16, located about 500m upstream from the confluence with Sarita River. This may provide some of the best rearing habitat for juvenile coho salmon in the entire watershed (LGL, 1997). Reach 17 has the highest amount of deep pools for adult holding and juvenile cover (Ochman, 1998).

Despite seasonal low flow conditions in other streams in this watershed, Frederick Creek generally maintains good flow in summer (B. Rushton, pers. comm.; S. Ochman, pers. comm.).

Three historical First Nations fish weirs exist on Frederick Creek which further suggest it was a highly productive system (J. Lane, pers. comm.).

*Frederick Creek (cont.)*

COMPLETED HABITAT RESTORATION PROJECTS

No habitat restoration projects have been completed on Frederick Creek since the habitat is relatively high quality compared to other nearby systems. A preliminary restoration project was proposed to build a small dam on Frederick Lake to release water gradually during summer months to augment the flow to the side channel. It was determined that flows would only increase marginally, therefore this plan was not pursued (S. Ochman, pers. comm.).

## *4.5 Frederick Lake*

DATA SOURCES:

Personal Interviews:

- Stefan Ochman
- Randy Stennes

Reports containing fish habitat assessment information:
None

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Frederick Lake was available from DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-03000

LOCATION & GENERAL DESCRIPTION

Frederick Lake flows north and is the headwaters of Frederick Creek. There are 2 small waterfalls just downstream of the lake.

FISH PRESENCE

Fish Wizard reports that coastal cutthroat trout, resident cutthroat, Dolly Varden, prickly sculpin, rainbow trout and threespine stickleback are found in the lake.

POSSIBLE LIMITING HABITAT CONDITIONS

No information was found.

HIGH VALUE HABITATS

No information was found.

*Frederick Lake (cont.)*

COMPLETED HABITAT RESTORATION PROJECTS

None identified

## *4.6 Hunter Creek*

DATA SOURCES:

Personal Interviews:

- Stefan Ochman
- Brad Rushton

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.

DATA COMPILED:
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Hunter Creek was available from FISS, DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-11200

LOCATION & GENERAL DESCRIPTION

Hunter Creek flows into the south side of Sarita River mainstem, about 4 km upstream from the mouth of the Sarita River. Hunter Creek is relatively low gradient from its mouth to 1km upstream (<5%), and then becomes confined and steeper with 10-20% gradients (LGL, 1997).

FISH PRESENCE

Hunter Creek is approximately 3km in length but only the lower 700-800 m is fish bearing (LGL, 1997; Ochman, 1998). Above this, there is a 5m high waterfall which is a barrier to upstream fish movement (Ochman, 1998). Coho and chum salmon are found in the lower reach of Hunter Creek, as well as cutthroat and steelhead trout (S. Ochman, pers. comm.)

*Hunter Creek (cont.)*

POSSIBLE LIMITING HABITAT CONDITIONS

Previous erosion and small torrents have occurred on the gullied slopes in the past, both natural and many exacerbated by forestry activities (Horel, 1996). The lower reach is mostly riffle habitat with few pools (Ochman, 1998). Large woody debris for juvenile cover is somewhat lacking in the lower reaches and in side channels (LGL, March 1997; Ochman, 1998). Some evidence of bank erosion and scour has been observed (Ochman, 1998) which would reduce spawning success of chum and coho. Please refer to the map provided in Appendix A for locations of reach breaks.

HIGH VALUE HABITAT

The accessible portion of the lower reach has suitable substrate for coho and chum spawning and incubation. The habitat also has high potential to support summer rearing and provide winter refuge for overwintering juveniles, especially coho (Ochman, 1998) Some side channel habitat is present at the upper end of the lower reach which would support coho winter rearing (Ochman, 1998).

COMPLETED HABITAT RESTORATION PROJECTS

- In 2000, large woody debris was placed at 9 sites in Reach 50 to increase habitat complexity and provide cover for rearing juvenile coho (Ochman, January 2002).

In 2003, Murray and Gaboury conducted effectiveness monitoring of previous restoration projects involving the installation of instream structures in the Sarita River, South Sarita River, Sabrina and Hunter creeks, as well as a side channel in the South Sarita River. They found that most instream structures were stable and were meeting or exceeding physical objectives at that time, although a small number needed repair and some were lost due to floods. Generally they found that single log structures were out performed by lateral jams, deflectors and revetments.

## *4.7 Sarita Lake*

DATA SOURCES:

Personal Interviews:

- Jim Lane
- Stefan Ochman
- Randy Stennes

## *Sarita Lake (cont.)*

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- Ostapowich, 1997. Overview Assessment Summary including Access management Summary & Sediment Source Summary. Prepared for MacMillan Bloedel Ltd. and Huu-ay-aht First Nations.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Sarita Lake was available from DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800

LOCATION & GENERAL DESCRIPTION

Sarita Lake drains the Upper Sarita River and flows west into the Sarita River.

FISH PRESENCE:

No anadromous salmon are present in the lake due to a series of 3 natural rock waterfalls downstream from the lake, approximately 8-15 m high (Fish Wizard; LGL, 1997; Ochman, 1998; B. Rushton, pers. comm.). Resident trout are present in the lake (cutthroat, rainbow, Dolly Varden) and provide good sport fishing (R. Stennes, pers. comm.). Kokanee is also present (Fish Wizard; J. Lane, pers. comm.). Other species include sculpins and sticklebacks (Fish Wizard).

POSSIBLE LIMITING HABITAT CONDITIONS

Water quality is often turbid due to upslope slides and sedimentation. Typically after the first fall rain, the lake becomes murky and stays that way for the rainy season. This occurs every year (Ochman, pers. comm.). No studies have been conducted on the potential effect of turbidity on trout in the lake. The lake is thought to act as a buffer for sediments to settle before flowing downstream into the lower Sarita River (Ostapowich, 1997).

HIGH VALUE HABITATS

There are likely trout spawning grounds in the lake or lower reaches of the feeder streams. No detailed information was available.

*Sarita Lake (cont.)*

COMPLETED HABITAT RESTORATION PROJECTS

None identified

## *4.8 Miller Creek*

DATA SOURCES:

Personal Interviews:

- Jim Lane
- Stefan Ochman
- Brad Rushton

Reports containing fish habitat assessment information:

- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.
- Rigets, D.G (D.G. Rigets and Associates). 2000. Stream assessment conducted for Weyerhaeuser Co. Ltd. Franklin River Operation: Miller Creek stream and fish habitat assessment.

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Miller Creek was available from DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-46200

LOCATION & GENERAL DESCRIPTION

Miller Creek flows north from two headwater tributaries and drains into the south side of Sarita Lake, about 2 km from the south end of the lake. This stream flows through an incised V-shaped valley.

FISH PRESENCE

Miller Creek supports cutthroat trout for about 1.7km upstream of the lake with gradients of 3-8% (J. Lane, pers. comm.; LGL, 1997). Above this point, the creek becomes very steep and is not fish bearing.

No anadromous fish can access this creek which is upstream of Sarita Lake and the impassable barrier at Sarita Falls. Trout could access the lower portions of this creek for only short periods of time when there is sufficient water.

*Miller Creek (cont.)*

POSSIBLE LIMITING HABITAT CONDITIONS

Slide activity in the upper part of the basin has caused heavy sediment transport to the lower reaches, which has created an alluvial fan at the shoreline of Sarita Lake - the recreation site is located on this fan (Horel, 1996). Miller Creek experiences huge flows and large amounts of sediment have been deposited into the channel from upslope slides and bank erosion (J. Lane, pers. comm.).

Miller Creek is usually completely dry in summer and often dry for protracted periods in winter. Even in winter, the creek only flows for a few days after a rainfall event (S. Ochman, pers. comm.; B. Rushton, pers. comm.). Steep gradients prevent access by trout to the upper reaches.

Cover from large woody debris is lacking. Deep pools are also lacking and no off channel habitats are present (Ochman, 1998). It is very likely that the large amounts of sediment deposited in this system have infilled any pools and side channels that may have existed at one time.

HIGH VALUE HABITATS

None identified although suitable trout spawning substrate is present (Ochman, 1998).

COMPLETED HABITAT RESTORATION PROJECTS:

None identified.

## *4.9 Thompson Creek*

DATA SOURCES:

Personal Interviews:

- Jim Lane
- Stefan Ochman
- Brad Rushton

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- Rigets, D.G. (D.G. Rigets and Associates). 2000. Thompson Creek stream and fish habitat assessment - habitat assessment conducted for Weyerhaeuser Co. Ltd. Franklin River Operation.

DATA COMPILED:

Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

## *Thompson Creek (cont.)*

No fish habitat data for Thompson Creek was available from FISS, DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-42000

LOCATION & GENERAL DESCRIPTION

Thompson Creek is a 3rd order stream that flows north and drains into the south side of Sarita Lake. It is composed of a low gradient alluvial fan in the lower reaches and then becomes steeper. A tributary from Bewlay Lake flows northeast and enters Thompson Creek about 500m upstream from the confluence with Sarita Lake.

FISH PRESENCE

No anadromous fish can access Thompson Creek which is upstream of Sarita Lake and the impassable barrier at Sarita Falls. Thompson Creek supports cutthroat trout (Fish Wizard) up to the 1.6 km mark and then gradients becomes too steep for fish access (LGL, 1997). Electrofishing done in 2000 found that fish were only present in the lower reaches (Rigets, 2000).

POSSIBLE LIMITING HABITAT CONDITIONS

Previous slide activity and steep gradients of the upper reaches have resulted in heavy sediment loads transported to the lower reaches (Horel, 1996; J. Lane, pers. comm.). The ongoing deposit of material from upstream areas has been exacerbated by forestry activities (J. Lane, pers. comm.). The substrate is mainly gravel and cobble. Large woody debris is limited and new wood recruitment to the stream is low since the riparian vegetation is young second growth.

Thompson Creek becomes completely dry in summer and for protected periods in winter. Even in the winter season, the creek only flows for a few days after a rainfall event (S. Ochman, pers. comm.; B. Rushton, pers. comm.). Steep gradients prevent trout access to upstream areas.

Upstream of the Sarita mainline crossing, flow becomes subsurface and the channel is more unstable due to numerous large wood debris jams. Cobble and boulder wedges have formed behind the debris jams, deflecting flow and causing considerable scouring of many side channels and undercut banks. Further upstream, an abandoned road crossing has collapsed into the stream (Rigets, 2000).

HIGH VALUE HABITATS

The lower reaches have some pools, riffles and undercut banks with some large woody debris present which is likely used by trout (Rigets, 2000).

COMPLETED HABITAT RESTORATION PROJECTS

Some remedial flood protection works have occurred, however these focused more on flood prevention than on restoring functional fish habitat (J. Lane, pers. comm.). At the Sarita mainline crossing, material from the stream channel was excavated and placed along the stream banks to form a berm to restore the stream channel and direct high flows into the culvert rather than flooding over the road (Rigets, 2000).

## *4.10 Bewlay Lake*

DATA SOURCES:

Personal Interviews:
- Stefan Ochman
- Randy Stennes

Reports containing fish habitat assessment information:
None

DATA COMPILED:
FISS: Fish Distribution report
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Bewlay Lake was available from DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-42000

LOCATION & GENERAL DESCRIPTION

Bewlay Lake forms the headwaters to Thompson Creek which flows into the south side of Sarita lake.

FISH PRESENCE:

No anadromous salmon are present in the Lake due to a series of high natural rock waterfalls downstream in Sarita River. Fish Wizard reports that Cutthroat trout and unidentified species are present.

POSSIBLE LIMITING HABITAT CONDITIONS

No information available.

HIGH VALUE HABITATS

No information available.

COMPLETED HABITAT RESTORATION PROJECTS

None identified

## *4.11 Central Creek*

DATA SOURCES:

Personal Interviews:

- Jim Lane
- Stefan Ochman

Reports containing fish habitat assessment information:

- Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.
- Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.

DATA COMPILED:
Fish Wizard: Watershed Code
Fish Habitat Wizard: Locations and types of Obstructions
SHIM: Fish presence, location of spawning habitat

No fish habitat data for Central Creek was available from FISS, DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: 930-110800-48700

LOCATION & GENERAL DESCRIPTION

Central Creek drains into Sarita River about 400 m upstream of Sarita Lake. The upper portion of the main creek valley is a V-shaped valley with mainly steep gullied slopes rising to narrow rock ridges. Slides have occurred in unlogged areas in the headwater portion of the Central Creek mainstem, in gullies and clearcuts, and from the road system (e.g., Branches 167 and 168).

FISH PRESENCE

Central Creek is about 7 km in length and supports cutthroat trout only (Fish Wizard). This creek does not support anadromous salmon because it is upstream of the impassable barrier at Sarita falls.

Harrison creek, which feeds into the upper reaches of Central Creek, supports abundant, large cutthroat trout (J. Lane, pers. comm.). Harrison Creek is a bedrock controlled system and is more stable.

POSSIBLE LIMITING HABITAT CONDITIONS

Channel disturbance was observed in 1997 (LGL) in terms of extensive bar formation from aggradation and channel widening from bank erosion. Pool frequency and LWD were limited (LGL, 1997).

*Central Creek (cont.)*

In 2006, a major debris torrent occurred in Central Creek and huge amounts of sediment and wood were transported from upslope areas (S. Ochman, pers. comm.; J. Lane, pers. comm.). The lower reaches of the creek were completely covered by sediment and wood debris and the channel has migrated (S. Ochman, pers. comm.).

HIGH VALUE HABITATS

None identified.

COMPLETED HABITAT RESTORATION PROJECTS

None identified.

## *4.12 Sarita River estuary*

DATA SOURCES:

Personal Interviews:

- Rob Brouwer
- Randy Stennes
- Brad Rushton
- Jim Lane
- Stefan Ochman

Reports containing fish habitat assessment information:
None

DATA COMPILED:

No fish habitat data for Sarita River estuary was available from FISS, Fish Wizard, Fish Habitat Wizard, SHIM, DFO Mapster, BC Wetlands, Pacific Coastal resources, Compass BC or Hectares BC.

WATERSHED CODE: Not Applicable

LOCATION & GENERAL DESCRIPTION

The Sarita River estuary is located at the mouth of the Sarita River and includes a fairly wide salt marsh area, with tidal channels and some small islands.

FISH PRESENCE

Anadromous salmon, as well as marine fish and invertebrates use the estuary.

## *Sarita River Estuary (cont.)*

POSSIBLE LIMITING HABITAT CONDITIONS

Based on information from 1930's marine navigation charts, the composition of the estuary habitat has changed considerably. Considerable amounts of coarse material have been deposited from upstream sources such that the estuary has shifted from a mud-sand substrate to a gravel-cobble substrate with abundant fines which is less stable than the historic mudflat environment (J. Lane, pers. comm.). In addition, the elevation has increased due to accretion (S. Ochman, pers. comm.; J. Lane, pers. comm.) and historic small islands are not longer evident. It is estimated that as much as 1 m of sediment has accumulated from riverine inputs , (Lane, pers. comm.) but this has not been confirmed with sediment core studies. Because of the accumulated "sediment wedge" in the estuary, there is now a steep drop-off which limits eelgrass growth to a narrow fringe (S. Ochman, pers. comm.) compared to historic eelgrass beds which were probably much wider and extended further offshore (J. Lane, pers. comm.). Prevailing winds and/or wave action are thought to be pushing some of this material northwards.

Overall, productivity of the estuary has likely decreased because more substrate is exposed at low tide and/or vegetation and shellfish have been smothered by the deposition of gravel and fines from upstream (S. Ochman, pers. comm.). The amount of suitable clam habitat has been reduced.

In terms of fish production, the rearing capacity of the Sarita River estuary may have reached maximum capacity for chinook (J. Lane, pers. comm.). That is, because the same number of chinook adults return each year (300-400 naturally produced fish) regardless of the number of juveniles outmigrating, there may be a bottleneck at the estuarine rearing stage (J. Lane, pers. comm.). However no studies have been conducted to assess this issue, or identify other factors that could be involved such as ocean survival and harvest rates.

Invasive species in the estuary include Varnish clam and Green crab (S. Ochman, pers. comm.). The Varnish clam has colonized almost all of the upper intertidal zone (S. Ochman, pers. comm.).

No other anthropogenic impacts have affected the estuary. The only log dump in the area is sufficiently distant that it does not impact the estuary (R. Brouwer, pers. comm.; B. Rushton, pers. comm.).

HIGH VALUE HABITATS

There is a narrow fringing eelgrass bed, approximately 20-50m wide, with abundant crabs (S. Ochman, pers. comm.). Numerous tidal channels and woody debris provide estuarine habitat complexity (R. Stennes, pers. comm.).

COMPLETED HABITAT RESTORATION PROJECTS

None identified.

## 5.0 Habitat Status Tables

Detailed Habitat Status Tables were completed for each of the five Pacific Salmon species (chinook, chum, coho, pink and sockeye salmon). Information specific to the various life stages of each species was included wherever available. This includes known limiting factors, known high value habitats, performance indicators for habitat limiting factors, performance indicator(s) status, information gaps, performance indicator thresholds, possible measures to address limiting factors, possible measures to maintain productivity and habitat protection & restoration measures undertaken. Tables can be found in Appendix D.

## 6.0 Pressure-State Indicators

The major habitat pressures facing the Sarita River watershed are generally a result of the extensive logging that has taken place over the entire landscape. The resulting changes that have occurred in almost all of the systems include:

- loss of riparian function: reduced shade, nutrient inputs, bank stability and recruitment of large woody debris;
- increased sedimentation;
- loss of habitat complexity due to channel aggradation, bank erosion, removal of the riparian zone (see above); and
- increased migration obstacles from log jams.

Pressure and state indicators were chosen based on the above. The indicators that were most relevant to the Sarita system were those with linkages to the above factors (Table 4). Thresholds for Indicators (i.e., Benchmarks) were identified from Appendix 14 in the Stahlberg et al. report (2009).

Table 4. Summary of Indicators that were most applicable to the Sarita River watershed.

| **Type** | **Indicator** |
|---|---|
| Stream: pressure | Riparian disturbance |
| Stream: pressure | Watershed road development |
| Stream: pressure | Total land cover alteration (forestry) |
| | |
| Stream: state | Stream discharge |
| Stream: state | Water temperature (Migration/spawning or Juvenile rearing) |
| Stream: state | Suspended sediment |
| | |
| Estuary: quantity | Estuarine habitat area (eelgrass and mudflat) |

# 7.0 Restoration Recommendations

Numerous restoration projects have been conducted in the Sarita River watershed, mostly focused on increasing habitat complexity through installation of woody debris and constructing new side channels or restoring access and habitat in off channel areas for juvenile coho rearing. Some of the instream structure projects had limited success as they did not withstand the flow conditions and washed out of the system during high flows (B. Rushton, pers. comm.; S. Ochman, pers. comm.). Effectiveness monitoring of previous restoration projects (Murray and Gaboury, 2003) suggest that most instream structures were stable although a small number needed repair and some were lost due to floods. Generally single log structures were out performed by lateral jams, deflectors and revetments.

Based on interviews conducted for this assessment, the following restoration activities were recommended:

<u>Overall:</u>

- Many interviewees noted that the highest priority to restore functional fish habitat in this watershed is to address the instability in upslope areas. Specifically, ongoing slides and instability causing repeated sedimentation in streams. To address this ongoing problem, it was suggested that culverts and roads should be re-assessed and that sediment sources associated with roads and bridges be remediated. Catch basins should be constructed in areas prone to natural slides. Installation of sediment traps or debris catchers instream is recommended to allow for natural complexity.
- More overwintering habitat is needed. Not only U-shaped side channels, but shallow flooded areas should be created that resemble wetlands and swamps. These types of habitats are well suited for coho & trout overwintering. Wetlands with abundant instream vegetation are highly productive and can provide high levels of leaf litter and other nutrients.
- Increased stable large woody debris is needed almost everywhere in the watershed.
- More pools would be beneficial for juvenile rearing and for adult holding.
- Riparian zones should be improved by planting to increase diversity.

<u>Sarita River:</u>

- Stabilization of spawning gravels and creation of additional off channel gravel areas that could be used for spawning but would be protected from high flows.
- Installation of catch basins for sediments in slide prone areas.
- Creation of more refuge areas and add debris catchers to create natural complexity for juveniles.
- In the Lower Sarita River, more large woody debris structures and off channel rearing areas are needed.
- Revegetation and stabilization of gravel bars and stream banks.
- More boulder-riffle habitat is needed for juvenile chinook.

South Sarita River:

- Installation of a side channel with an intake at Reach 22 at kilometre 15.
- Revegetation and stabilization of gravel bars.
- Riparian vegetation should be re-established.
- Stabilization of flats by planting in Reach 20-21.
- Investigate the feasibility of conducting additional fertilization applications in the upper headwaters of South Sarita to replace lost nutrients and increase overall productivity, using methods developed in a previous small scale project (Pellet and Wright, 2007).

Frederick Creek:

- Constructing another shallow side channel downstream of the existing marsh on the flats may be beneficial.

Sarita River estuary:

- Increase the habitat complexity with more woody debris, rock, and excavated tidal channels.
- Planting additional eelgrass and kelps in deeper areas.
- Deposited gravels should be removed by recontouring the estuary and replanting the area with eelgrass.

## 8.0 Measures to Maintain Productivity

To maintain productivity of the identified high value habitats, the following general measures are recommended:

- Protect existing riparian vegetation. Ensure no new roads or harvesting occurs within 30m of the streambank.
- Forestry harvesting practices should implement low impact methods. Clear cutting should be avoided and the number of new roads should be minimized.
- Develop and implement a road deactivation plan such that old roads are revegetated and vehicle access is blocked to allow natural regeneration to occur.
- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.

## 9.0 Information Gaps

Previous habitat assessment work conducted on the Sarita River, Frederick Creek, Hunter Creek, South Sarita River and Sabrina Creek was fairly detailed. However, these assessments are over 10 years old. To identify measures to address limiting habitat conditions and protect valuable habitats, the systems in this watershed must be re-assessed to determine if conditions have changed.

In general, previous habitat assessments in the Sarita River watershed focused on chinook and coho salmon, with less information available on habitat use by chum, pink and

sockeye. As well, little habitat information was available for the estuary, the lakes and the upper Sarita watershed (Miller, Central and Thompson creeks). The main information gaps are:

- Current information on habitat quality of the estuary is lacking. It would be useful to understand the extent of habitat disturbance from sedimentation in the estuary. Since the estuary has been identified as a possible limiting factor in the rearing of chinook salmon, an assessment of estuarine habitat capacity and potential is recommended as a priority.
- Mapping and monitoring changes in area of the eelgrass beds would be useful. Stefan Ochman has advised that Ramona DeGraaf has conducted eelgrass mapping in this area, but this baseline information was not available for this report.
- An assessment of changes over time in the morphology of the estuary (formation and disappearance of eelgrass beds, channels and islands) through air photo analysis or other method is also recommended.
- Little information was available on the historical and current habitat use by resident trout in Sarita Lake, Bewlay Lake and the smaller tributaries into Sarita Lake (Miller, Central, Thompson). Jim Lane advised that they had conducted extensive fish sampling and habitat work for Ministry of Environment in the upper watershed but the report was never finalized.
- Stream conditions and structures required to maintain deep holding pools for adults are not well documented and this information would be useful to create similar features in other areas.
- Limited water quality information exists.

## 9.0 Summary

Overall, the Sarita River watershed has been significantly impacted by forestry activities. Future forestry activities must be conducted to minimize any further impacts to this recovering watershed. In particular, efforts should focus on identifying possible means of reducing the upslope instability issues that are contributing to chronic sedimentation in the watershed.

There is potential to improve salmon habitat in this watershed. Many west coast salmon rely on estuaries as rearing habitat for some duration (chinook, chum, pink and stream/estuary sockeye), therefore the Sarita River estuary warrants more attention. A habitat assessment of the estuary should be conducted to assess the level of impact and change that has occurred, followed by the development of a well-researched restoration plan (if appropriate).

Based on the information provided for this habitat status report, Frederick Creek has the least impacted habitat compared to the other systems in this watershed. Therefore, efforts must be focused on ensuring intact habitats in this system are conserved to maintain the existing high quality coho and chum habitat. Similarly, Sabrina Creek offers some areas of high quality habitat for coho salmon and it should be a priority for restoration and protection.

Other systems in which to target restoration and habitat protection measures to conserve the chum CU are the Sarita and South Sarita Rivers, and Hunter Creek. For the coho CU, attention should focus on re-establishing shallow off-channel areas along the Sarita River and

South Sarita River. Efforts to conserve the chinook salmon CU should focus on the Sarita and lower South Sarita Rivers and include measures to improve adult spawning habitat, create suitable adult holding pools and increase the amount of boulder riffle habitat used by rearing juveniles.

Sockeye and pink CUs have not been a primary focus in this watershed because of their low numbers. Pink numbers are likely to remain low, however suitable habitat in the lower reaches of the Sarita River should be maintained. Although sockeye may not be numerous in this system, there seems to be a small population that persists and restoration plans should consider this for the Sarita River. However, information regarding habitat requirements of both pink and sockeye in this watershed is limited and additional habitat use studies would be worthwhile.

The Upper Sarita River watershed, which is located upstream of impassable waterfalls at Sarita Lake, does not support anadromous salmonids (i.e. Miller, Central and Thompson creeks) therefore these systems may not be a high priority for restoration at this time.

The next step in the Habitat Status assessment process will be to select the appropriate Indicators from those identified here, identify suitable benchmarks and monitor trends in habitat status in the Sarita watershed over time.

## 10.0 References

Crawford, W.R. and J. R. Irvine. (2009). State of physical, biological, and selected fishery resources of Pacific Canadian marine ecosystems. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/022. vi + 121 p.

Graham Engineering Ltd. 1997. Sarita Watershed Restoration: Hydrology Overview. Prepared for MacMillan Bloedel Ltd.

Horel, G. (Ostapowich Engineering Ltd). 1997. Coastal watershed assessment (CWAP) of Sarita Watershed. Report available from Ministry of Environment Records, Nanaimo, BC.

Horel, G. (Ostapowich Engineering Services Ltd). 1996. Coastal watershed assessment (CWAP) of Sarita watershed (Draft). Report Available from Ministry of Environment Records, Nanaimo, BC.

Huu-ay-aht First Nation. February 2000. Sarita River Watershed Restoration Program As-Built Report. Submitted to: BC Ministry of Environment, Lands & Parks, and Weyerhaeuser Ltd.

LGL Ltd. April 1997. Watershed Level Assessment of Stream and Riparian habitat of the Sarita River, Vancouver Island, BC. Prepared for Huu-ay-aht First Nation and MacMillan Bloedel Limited.

LGL Ltd. May 1997. Sarita River Site Reconnaissance, 14 March 1997. Letter to Ostapowich Engineering Ltd.

Murray, R. B and M. Gaboury (LGL Limited). 2003. Routine effectiveness monitoring of past side channels and instream projects in Port Alberni District. Prepared for Renewal Investment Corp.

Northwest Hydraulic Consultants Ltd. 1998. Sarita River watershed 1998 watershed restoration program further level 2 prescriptions. Prepared for Huu-Ay-Aht First Nations for Forest Renewal British Columbia c/o Ministry of Environment, Lands and Parks.

Ochman, S. (Huu-ay-aht First Nation Fisheries). 1998. Sarita River Watershed Level 1 Fish Habitat Assessment and Rehabilitation Opportunities. Prepared for MacMillan Bloedel Ltd and Ministry of Environment, Lands and Parks.

Ochman, S. January 2002*. Sarita River Watershed: Fish Habitat Restoration As-Built and Monitoring Report for 2000-2001. Submitted to: BC Ministry of Water, Land and Air protection and Weyerhaeuser Ltd. (* Note the paper copy of this report is incorrectly dated as January 2001).

Ochman, S. (Huu-Ay-Aht First Nation) and M. Gaboury (LGL Ltd). 2001. Sarita River watershed: fish habitat instream restoration designs and maintenance of existing structure. FRBC Workplan : PAM 01407 FRBC Activity: 717295DAS. Submitted to BC Ministry of Environment, Lands and Parks Nanaimo, BC and Weyerhaeuser Limited West Island Woodlands Division Port Alberni, BC.

Ostapowich, 1997. Overview Assessment Summary including Access management Summary & Sediment Source Summary. Prepared for MacMillan Bloedel Ltd. and Huu-ay-aht First Nations.

Pellet, K and H. Wright. 2007. Vancouver island Stream Enrichment Feasibility, Application and Monitoring 2006. Prepared for Habitat Conservation Trust Fund and Pacific Salmon Foundation and Georgia Basin Living Rivers.

Pestal, G. (editor). October 2009. Sustainable Management of Wild Salmon in Barkley Sound and Alberni Inlet: Challenges, Resources, and Priorities. Discussion Paper.

Rigets, D.G (D.G. Rigets and Associates). 2000. Stream assessment conducted for Weyerhaeuser Co. Ltd. Franklin River Operation: Miller Creek stream and fish habitat assessment.

Rigets, D.G. (D.G. Rigets and Associates). 2000. Thompson Creek stream and fish habitat assessment - habitat assessment conducted for Weyerhaeuser Co. Ltd. Franklin River Operation.

Stalberg, H. C., R. B. Lauzier, E. A. MacIsaac, M. Porter and C. Murray. 2009. Canada's Policy for Conservation of Wild Pacific Salmon: Stream, Lake, and Estuarine Habitat Indicators. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2859.

## Appendix A. Reach Break Map

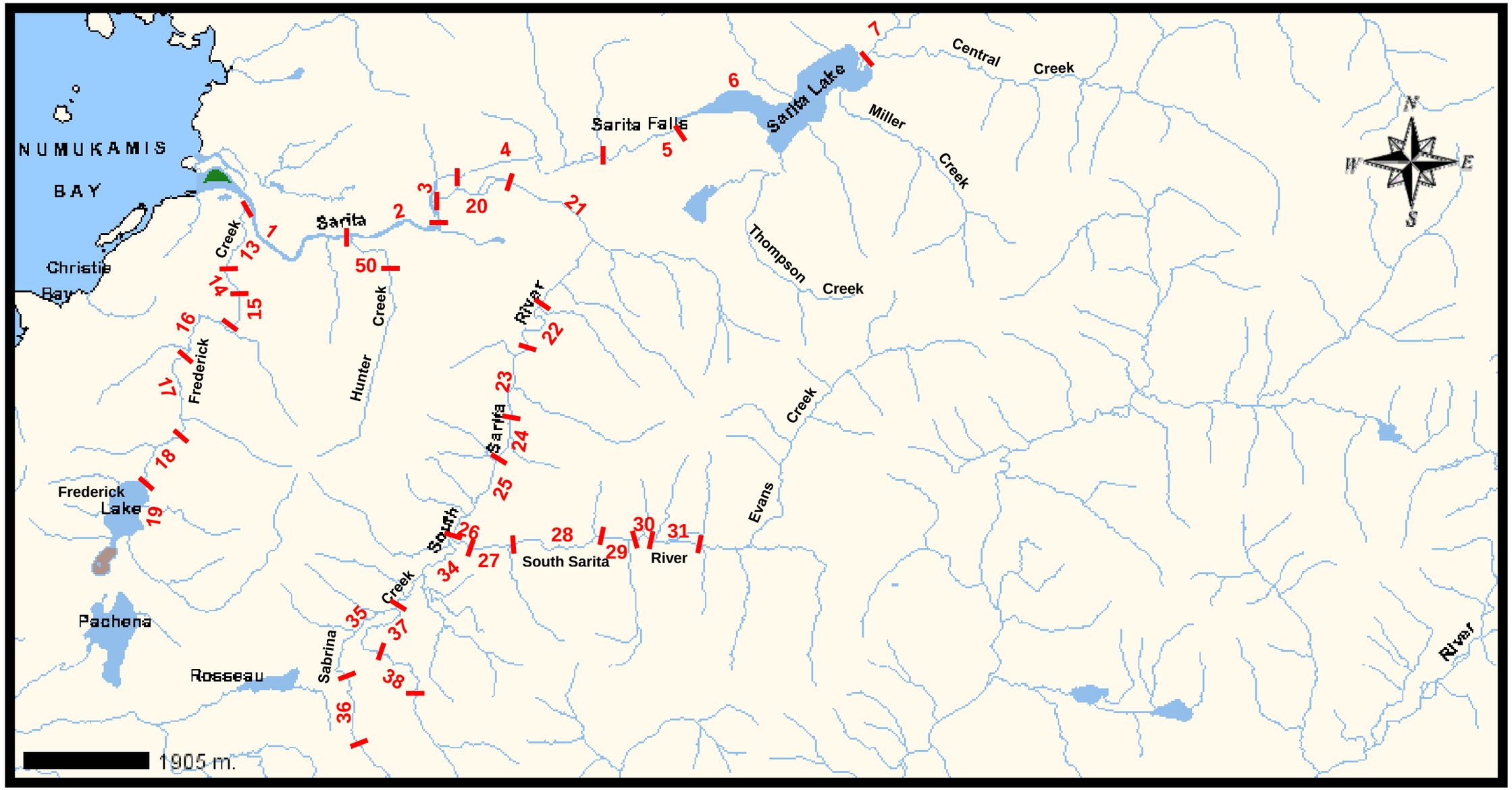


Figure 3. Locations of established reach breaks in the lower Sarita watershed.

## Appendix B. Notes from Personal Interviews

1) Randy Stennes, DFO.
2) Rob Brouwer, DFO.
3) Brad Rushton, DFO.
4) Stefan Ochman, Huu-ay-aht First Nation.
5) Jim Lane, Nuu-chah-nulth Tribal Council.

**1) Randy Stennes, Conservation & Protection Officer, DFO January 14-15, 2010**

**1) Which streams or lakes are you most familiar with in terms of habitat condition (physical and/or water quality)?**

- I don't have a lot of specific information. I used to go to Sarita regularly to check fishing violations, esp. lower Sarita river. Poaching occurred. I have personal experience fishing the area

**2) Over the entire watershed, what is the most limiting habitat type for specific life stages (adult spawner, egg, fry, alevin, fry etc) of each species?**

- Chinook – need deep holes
- Chum
- Coho – need overwinter
- Pink
- Sockeye

- Nice Cutthroat in Bewlay lake
- Frederick Lake has nice cutthroat
- Sarita Lake also has nice Cutthroat, possibly other trout or kokanee.
- Not much chum in the system, very few pinks here and in Barkly Sound overall.
- Sockeye – would be surprised if any there.
- Mainly coho and chinook found here and are species of interest. Very few chinook left.
- There is a very large falls 8km up from mouth of Sarita lake → fish obstruction to lake
- System is very flashy, high flows in winter, landslides and debris torrents. Spawning gravels are very mobile.

**3) Which streams have the most limited habitat for salmon?**

- At Sarita lake, many huge debris torrents have occurred at both ends. The last debris torrent caused major damage to the Forestry Recreation site and now it's almost impossible to get in there. This influx of material may have caused water quality issues in lake
- The system is very mobile, so spawning gravels are always shifting. It's a very active system, very flashy. Every time you go there it looks different

**4) Are there seasonal limitations in habitat quality in any of these streams (e.g., overwintering habitat, low summer flows)?**

- Logging activity has greatly destabilized landscape, plus the area receives huge amounts of rain in winter. Many landslides have occurred, naturally and facilitated by logging
- Low summer flows are an issue in the system. There is limited snowpack, so flows originate from groundwater and seepage. Flow may go subsurface in summer.

**5) Within these streams and rivers, where are the highly productive habitats located and for which species/life stages?**

- There are some side channel rearing areas that are not bad, as long as they are protected from huge flows

**6) How have adjacent upland activities in the watershed negatively affected salmon habitat and their survival, growth or reproduction?**

- Logging: destabilized area, loss of riparian
- Fishing pressure in the area – fishing closure issued every fall at mouth of Sarita.
- Some poaching in lower Sarita River
- There is a log dump outside estuary near Bamfield but unlikely to have any negative effects on estuary. Other land use in the area includes docks and cabins in Poets Nook.

**7) What restoration projects would you recommend to improve habitat quality, especially to address limiting factors in which stream/river?**

- Some previous restoration projects involving installation of wood debris have failed because huge flows in winter blew them out
- One suggestion for a restoration project would be to stabilize spawning gravels and create some off channel gravel areas that would be more stable.

**8) What habitat limitations exist in the estuarine environment at the mouth of Sarita River.**

- Estuary is probably one of the nicest in the area. Very broad with many channels, like a delta. Good vegetation, eelgrass bed. Open to ocean and exposed to wave action – may help keep water quality good as this prevents fines from accumulating/smothering. Many logs have washed up creating good structure. Relatively undeveloped nearby, just some small roads.

**9) Are there any specific habitats in the estuary that should be noted as valuable/highly productive?**

- Nice eelgrass bed with lots of crabs.
- Water quality is good, lots of habitat complexity with logs and vegetation

**10) What is the area of land cover alteration in the watershed? i.e. logging/road development ?**

- There are several large and active logging roads, not maintained but in use.
- Some smaller overgrown roads are cleared and a cat is used

**11) Are there any invasive species in the estuary? Area of impact?**

- Possibly green crab, varnish clam and tunicates but not confirmed.
- In Somass there is a New Zealand mudsnail, and Didimo (algae)
- Possibly a SARA listed plant (some name like "wort"), has been found in Nitnat.

## 2) Rob Brouwer, Manager, Nitinat Hatchery, DFO January 21, 2010

**1) Which streams or lakes are you most familiar with in terms of habitat condition (physical and/or water quality)?**

-Mainstem Sarita, estuary
-South fork
-Chinook 20% wild in system, Fall run, rear in estuary. Hatchery produces Chinook only

**2) Over the entire watershed, what is the most limiting habitat type for specific life stages (adult spawner, egg, fry, alevin, fry etc) of each species?**

- Chinook: estuary/rearing in river, second most limiting habitat is spawning areas
- Chum: poor spawning habitat, silt, mobile gravels. Most abundant species (20-50K)
- Coho: no major limitation, overwinter habitat is there, more being built. Could use more.
- Pink: extinct about 30 years ago. Main limitation spawning habitat
- Sockeye : only some strays in system

**3) Which streams have the most limited habitat for salmon?**

-A lot of work has been done to restore side channels, but it this isn't good for steelhead and chinook. Fingerling chinook need more boulder riffle type habitats

**4) Are there seasonal limitations in habitat quality in any of these streams (e.g., overwintering habitat, low summer flows)? Which ones/where?**

-In winter, peak flows blow out habitat and fish. Flush out gravels. Rain driven.
-In summer, low flows and high temperatures occur. Aggraded river channel. Very little good substrate, poor habitat complexity. Just gravel and very compacted.

**5) Where are the highly productive habitats located and for which species/life stages?**

-Some natural side channels are good – coho rearing.

-Mainstem has lots of gravel potentially for spawning substrate but needs to be stable

**6) How have adjacent upland activities in the watershed negatively affected salmon habitat and their survival, growth or reproduction?**

- Logging & road development. Area is unstable, steep sided, many slides. Many road failures. Sedimentation from roads is an historical and ongoing problem

**7) What restoration projects would you recommend to improve habitat quality, especially to address limiting factors in which stream/river?**

-Upslope: need to address siltation issues. If failures continue, sedimentation will continue to be a problem. Must re-evaluate culverts and roads. Install catch basins for sediments in slide areas.

-In estuary, increase complexity with woody debris, rock, create tidal channels. Plant kelp, eelgrass.

-Instream: need more refuge areas, add debris catchers to create natural complexity. Steelhead need refuge from predation

**8) What habitat limitations exist in the estuarine environment at the mouth of Sarita River.**

-Could use more habitat complexity.

-Sedimentation.

-More tidal channels needed as refuge

-Historically kelp used to live all along the coastal zone in this area, but was shaded out by sedimentation..

**9) Are there any specific habitats in the estuary that should be noted as valuable/highly productive?**

Habitat is reasonably good, but could use more of it for rearing. More eelgrass.

**10) What is the area of land cover alteration in the watershed? i.e. logging/road development ?**

-A lot of clearing took place near rivers & streams. Logging & road development continues but not as active as years before. Possibly heli-logging could take place in upper elevations.

-Other development: proposed IPP downstream of Sarita Lake, below falls. Potentially a new hatchery.

**11) Are there any invasive species in the estuary? Area of impact?**

- Not sure. Possibly Japanese hogweed plant. In freshwater, rock snot?

**Brad Rushton, Habitat Management Technician, DFO January 26, 2010**

**1) Which streams or lakes are you most familiar with in terms of habitat condition (physical and/or water quality)?**

-Sarita, S. Sarita, Frederick, Hunter, Thompson & Miller, Upper Sarita. Not as familiar with Central.

- Thompson & Miller: no fish, dry in summer. Only flows when it rains. Even dry in winter when there's little rain.

- Central creek likely has resident trout only

**2) Over the entire watershed, what is the most limiting habitat type for specific life stages (adult spawner, egg, fry, alevin, fry etc) of each species?**

- Chinook: Good spawning habitat, adult holding pools limited
- Chum: not much is limiting, habitat OK
- Coho: need more overwinter rearing, side channels
- Pink: habitat is OK in lower river, just disappeared suddenly, not sure why
- Sockeye: no lake access, only remnant few dozen occur

**3) Which streams have the most limited habitat for salmon?**

- South Fork is like a canyon, very restricted, no floodplain areas. Morphology is limiting.
- Thompson and Miller:, dry and no access

**4) Are there seasonal limitations in habitat quality in any of these streams (e.g., overwintering habitat, low summer flows)? Which ones/where?**

- Winter: lack of overwinter habitat, refuge in high flows throughout
- Summer: Hunter Creek mouth is good, South Sarita has low flows, Mainstem of Sarita is OK, Frederick is OK in summer

**5) Where are the highly productive habitats located and for which species/life stages?**

- Frederick Creek is nice, good spawning habitat for coho, good summer flows. Frederick Creek is good all year. Nice pools and refuge. Good riparian, large wood, good gravel for coho all the way through.
- Lower Sarita throughout is good for chinook & chum
- Nice overwinter swamp for fry off Sarita (see map)
- Hunter is good for the first few 100m near mouth, has some spawning habitat

**6) How have adjacent upland activities in the watershed negatively affected salmon habitat and their survival, growth or reproduction?**

Forestry:
-Pool infilling
-Loss of riparian veg
-Widening of channels
-Slides – high sediment loading
-High peak flows – scour
- South Sarita – aggraded channel (see map)

**7) What restoration projects would you recommend to improve habitat quality, especially to address limiting factors in which stream/river?**

- Need more overwinter habitat – not just channels but more shallow flooded areas, wetlands & swamps for coho & trout, with instream veg for lots of litter. Not many beavers here so few flooded areas.
- LWD needed almost everywhere
- More pools for rearing and adult holding
- riparian zone OK, regenerating but could use more diversity

**8) What habitat limitations exist in the estuarine environment at the mouth of Sarita River.**

-Estuary is quite healthy, no issues, Geese are not a problem

**9) Are there any specific habitats in the estuary that should be noted as valuable/highly productive?**

-The whole thing is quite good, it was never impacted. Log dump is far away, no other development.
-It's getting bigger as sediments are moved from upstream areas. Material does not seem to cause an issue re shading, a large area to deposit. Estuary has gravelly/muddy substrate.

**10) What is the area of land cover alteration in the watershed? i.e. logging/road development ?**
- The whole watershed has been stripped. Progressive clear-cut.
- Any areas where a road could be built, a road has been built.
- Road crossing over mainstems have big bridges so these are OK
- Original culverts likely installed improperly, may be some left over
- Road along Sarita near Hunter Creek floods regularly

**11) Are there any invasive species in the estuary? Area of impact?**
Not sure. Probably Scotch broom, Himalayan blackberry, Japanese Little neck clam?

**Stefan Ochman, Fisheries Manager, Huu-ay-aht First Nation January 27, 2010**

**1) Which streams or lakes are you most familiar with in terms of habitat condition (physical and/or water quality)?**
- All of them, have walked the entire area.
- South Sarita, generally low productivity, very little nutrients, very little periphyton, substrate bare. Possibly due to lack of carcasses not replenishing the nutrients. Did a fertilization addition for a few years, but never measured effect over long term (stopped).

**2) Over the entire watershed, what is the most limiting habitat type for specific life stages (adult spawner, egg, fry, alevin, fry etc) of each species?**
- Chinook: spawning habitat, very mobile sediments. Estuary rearing. Before clear-cut was a series of islands & channels. After clear-cut, huge amounts of sediments have been flushed down river and infilling now, smothering, rising, not as deep.
- Chum: spawning habitat
- Coho: spawning OK, over-summer off channel habitat for low flow conditions
- Pink: spawning OK
- Sockeye: no lake access, most are strays.

**3) Which streams have the most limited habitat for salmon?**
- S. Sarita has a canyon boulder stretch (may have some pools), clear-cut to the streambanks
- S. Sarita has had massive gravel movement in the lower reaches (Reach 20).
- Sabrina Creek: I've never seen adult coho in Sabrina Creek, but I do believe that historically they used to make it up to this area and spawn. Now there may be a barrier in the form of a log jam or something else like a slide in the canyon (Reaches 24-25) preventing them from getting to the top of the Sarita watershed. Back in 1997, we did catch some juvenile coho in Sabrina Creek which would indicate that there was probably spawning in this area.

**4) Are there seasonal limitations in habitat quality in any of these streams (e.g., overwintering habitat, low summer flows)? Which ones/where?**
-Winter → high peak flows. Lower reach of S. Sarita and Sarita join together at Corner Pool
-Summer → dry in Upper Sarita (above lake). Sarita downstream of lake is wetted. No flow in S. Sarita in summer. Hunter is OK, Frederick is OK

**5) Where are the highly productive habitats located and for which species/life stages?**
- Built some beaver ponds at Obstacle #2, very productive for coho. Beavers coming in to make dams.
-Frederick marsh – chum, coho, cutts. Large trees remain because logging was not possible in marsh
-Adults holding, Deep Hole Sarita
-Cable car pool - Hunter creek
-Corner pool Sarita
-Blenheim bridge – good pool

-Good pool at base of Sarita falls.
-Lower reaches of South Sarita have good pools
-Sabrina creek has good habitats for coho, good riparian zone.

**6) How have adjacent upland activities in the watershed negatively affected salmon habitat and their survival, growth or reproduction?**
-Massive gravel movements and debris flows
-After fall rains, Sarita lake goes murky and stay turbid all winter (occurs every year)
-Logging continues, leave riparian buffers now
* Need more protection for small feeder streams

**7) What restoration projects would you recommend to improve habitat quality, especially to address limiting factors in which stream/river?**

- Lower Sarita: LWD, side channels, reach 1 & 2 need to be re-assessed
- Reach 22 S. Sarita km 15: side channel with intake
- Frederick Cr: marsh → construct side channel downstream on flats
- More planting to stabilize gravel bars
- Fertilization in upper headwaters to replace nutrients
- Estuary: push gravel over bank (drop-off), replant with eelgrass

**8) What habitat limitations exist in the estuarine environment at the mouth of Sarita River.**
- Infilling with gravel from debris washing downstream
- At low tide, many areas exposed and dry out, only a few deeper areas stay wetted

**9) Are there any specific habitats in the estuary that should be noted as valuable/highly productive?**
-Eelgrass beds: fringing bed before drop-off 20-50m wide, linear
- Tidal channels
* Ramona de Graaf has mapped eelgrass beds

**10) What is the area of land cover alteration in the watershed? i.e. logging/road development ?**
- All lower elevations and accessible areas have been cleared., about 90% of watershed has been altered
- Roads have been built almost everywhere
- Many improperly installed culverts
- Huge wash-outs have occurred

**11) Are there any invasive species in the estuary? Area of impact?**
- Varnish clams in upper intertidal everywhere. Came in suddenly a few years ago and now cover the entire zone. No one eats them because they are exotic
- Green crab
- Scotch broom in open upland areas
- Himalayan blackberry upland
- Some Hogweed in Reserve

## Jim Lane, Biologist, Uu-a-thluk/ Nuu-Chah-Nulth Tribal Council February 4, 2010

**1) Which streams or lakes are you most familiar with in terms of habitat condition (physical and/or water quality)?**
Very familiar with Upper Sarita, lake and tributaries. Familiar with Frederick, Sarita & South Sarita near confluence. Not as familiar with Hunter & Sabrina.

In 1997, did assessment work in Upper Sarita, above Lake, on Miller, Thompson, Sarita, Central.

All trout habitat. 2 types of streams: boulder/bedrock embedded and other cobble/gravel type more disturbed (gravel/cobble). Only the boulder/bedrock ones support abundant large-sized trout. Fewer & smaller fish in others. Large abundant trout found in Harrison Creek which flows from canyon. Sarita lake acts as buffer, rearing for trout.

Upper Sarita & lake supports Dolly Varden, kokanee, Rainbow & Cutthroat, also sculpins. Trout found in any useable habitat, i.e. <20% gradient.

No fish above canyon in Upper Sarita. Thompson & Miller creeks have had huge flows and deposition. Central Creek has trout all the way until flats, highly aggraded. In 2006-07 there was a huge debris torrent over the road in Central Creek. At upper Sarita where confluence of Central Creek joins, there has been huge amount of material deposited and unstable banks.

**2) Over the entire watershed, what is the most limiting habitat type for specific life stages (adult spawner, egg, fry, alevin, fry etc.) of each species?**

- Chinook: there may have been 2 populations. Water in mainsten Sarita is warm from lake, water from South Sarita from snowmelt is cooler. Spawning seems ok in the main stem. At confluence of South Sarita there is lots of material deposited. Chinook are all ocean rearing now. Rearing habitat (estuary) has become less functional.
- Chum: spawning & rearing in estuary. Frederick seems OK. 3 ancient FN weirs in Frederick.
- Coho: Historically, South Sarita flats were complex with many channels. This has all been filled in with deposited material from upstream. Access to off channel habitat in South Sarita is limited. Low water in South Sarita in summer, less complex habitat now.
- Pink: spawning habitat
- Sockeye: River sockeye on West coast, not just strays. They are different than lake rearing type, have a very rapid reproductive cycle, return to natal stream, change colour, spawn & die in about 3 weeks. Don't migrate too far upstream. Spawning habitat limited.

**3) Which streams have the most limited habitat for salmon?**

- South Sarita: need to stabilize flats and re-vegetate.
- Estuary: must assess amount of infilling, cores

Before these 2 can be done, must address upslope stability issues.

There have always been problems with Thompson & Miller, caused by logging. Some remedial action has been done but it seems to be focused on preventing road flooding rather than restoring functional fish habitat.

**4) Are there seasonal limitations in habitat quality in any of these streams (e.g., overwintering habitat, low summer flows)? Which ones/where?**

-Summer: South Sarita has low flow, intermittent flows probably always occurred. Pools become cut-off. But now the frequency & extent is greater since disturbance.
-Winter: sediments move around because so much material has washed down, access issues to off channel habitat in South Sarita leads, therefore lack of refuge areas.

**5) Where are the highly productive habitats located and for which species/life stages?**

-Frederick Creek is nice for chum & coho
-Mainstem Sarita is good
-Pockets of South Sarita are good
-Estuary fringes are good – eelgrass, clams, crabs & prawns
-There is lots of potential but it needs improvement

**6) How have adjacent upland activities in the watershed negatively affected salmon habitat and their survival, growth or reproduction?**
Forest & Road building are main activity
- Destabilized slopes, large amount of material released, channel aggradation
- Logging of flats reduced complexity
- South Sarita – no riparian zone, some young trees are returning, bank erosion has occurred, sediment wedges making their way downstream into estuary

**7) What restoration projects would you recommend to improve habitat quality, especially to address limiting factors in which stream/river?**

- Must stabilize upslope areas a priority
- Re-assess slope stability and sediment sources, done 15 years ago
- Re-establish riparian zones, esp South Sarita, Cottonwoods

**8) What habitat limitations exist in the estuarine environment at the mouth of Sarita River.**
Based on early information (1930's charts), the estuary has changed considerably. It's changed from a mud-sand substrate to gravel, fines & cobble, which is much less stable. There has been infilling from all the material washed downstream. The amount of wetted area has been reduced. Lost productive clam habitat. Tidal height has changed so more of the estuary is dry at low tide now. Lower productivity overall. As much as 1m of material has accumulated, need to confirm exact amount. Wind is pushing some material northwards.

There is a steep drop-off which limits eelgrass growth to a narrow fringe, historically may have been a very wide bed that extended far out from shore.

Rearing capacity of estuary seems to be maxed out. No matter how many juveniles are put in, the same number of chinook adult returns, usu 300-400 naturally produced.

**9) Are there any specific habitats in the estuary that should be noted as valuable/highly productive?**
Estuary on the north side up inlet is OK, but starting to lose productivity due to movement of sediments. Tom Joe lives there and has seen changes - Huu-ay-aht Administration (250)728-3414

**10) What is the area of land cover alteration in the watershed? i.e. logging/road development ?**
-Almost all of it has been logged, even upper elevations. Now heli-logging occurring.
-Mainstem roads are OK, but smaller culverts can be poor. Smaller roads not maintained.
-Frederick Creek has a bridge so that is good.
-Roads often located right beside creek, eg, in South Sarita the riparian zone is a road. Rip rap has been used to armour alongside road due to erosion issues at South Sarita.

**11) Are there any invasive species in the estuary? Area of impact?**
Varnish clam appeared in 1990's. Haven't seen any Green crab.
Hogweed nearby, past Poets Nook
Nothing new & unusual along streambanks.

## Appendix C. Habitat Features Map

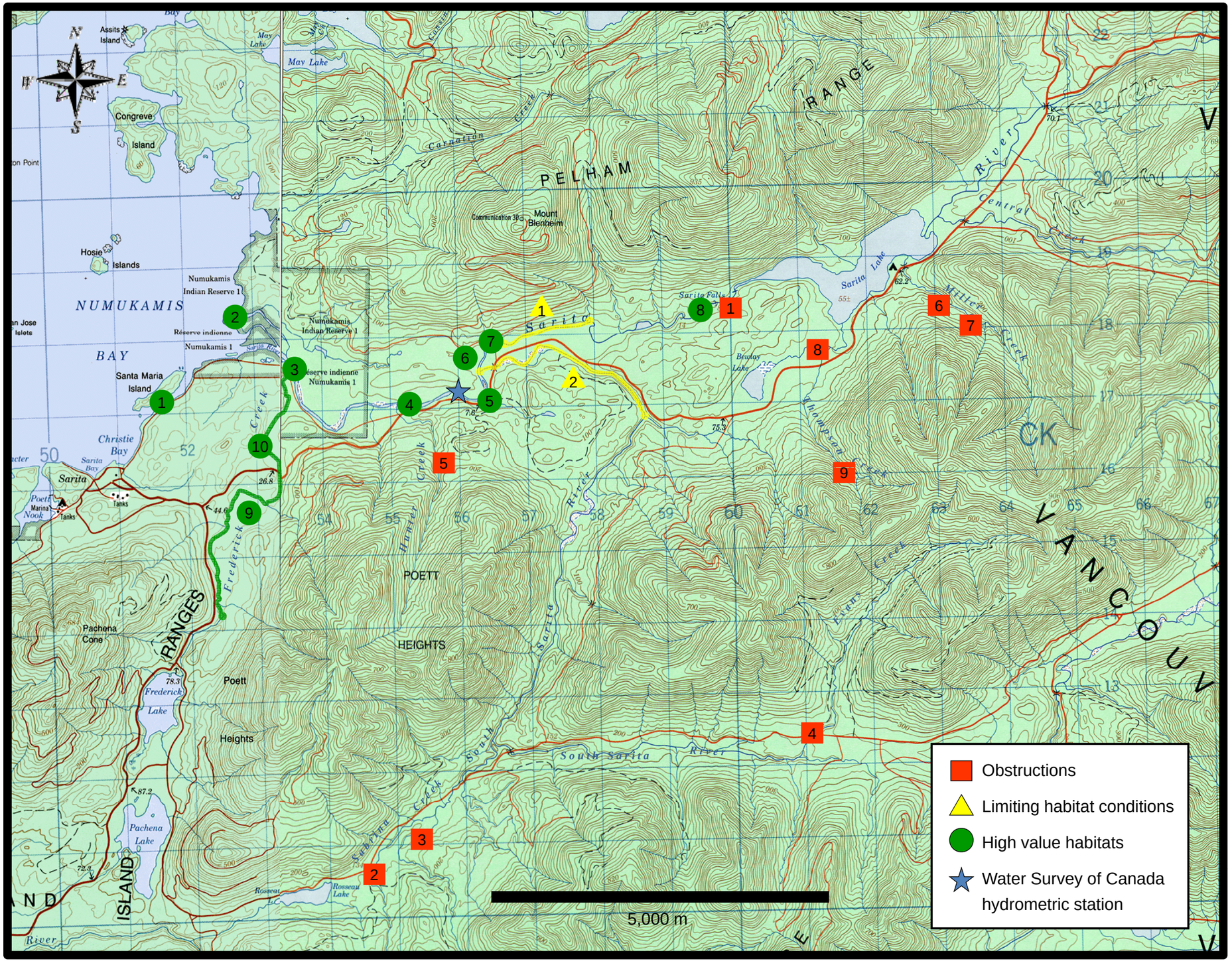


Figure 4. General locations of possible limiting habitat features, obstructions and high value habitats in the Sarita River watershed. See legend on following page.

Map Legend

| SYMBOL | TYPE | LOCATION | SOURCE |
|---|---|---|---|
| **Obstructions** | | | |
| 1 | Impassable barrier: Waterfalls | Sarita River, Sarita Falls | Fish Habitat Wizard; S. Ochman, pers. comm.; LGL 1997 |
| 2 | Impassable barrier: Log Jam | Sabrina Creek, Reach 35 | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 3 | Impassable barrier: Log Jam | Sabrina Creek, Reach 37 | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 4 | Impassable barrier: Waterfalls | Evans Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 5 | Impassable barrier: Waterfalls | Hunter Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 6 | Impassable barrier: Waterfalls | Miller Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 7 | Impassable barrier: Log Jam | Miller Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 8 | Impassable barrier: Log Jam | Thompson Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| 9 | Impassable barrier: Waterfalls | Thompson Creek | Fish Habitat Wizard; S. Ochman, pers. comm. |
| **Limiting Habitat Conditions** | | | |
| 1 | Low habitat complexity: cobble / boulder channel | Sarita River | S. Ochman, pers. comm. |
| 2 | Severely aggraded channel | Upper South Sarita River | S. Ochman, pers. comm.; B. Rushton, pers. comm. |

Map Legend (cont'd)

| SYMBOL | TYPE | LOCATION | SOURCE |
|---|---|---|---|
| **High Value Habitats** | | | |
| 1 | Marine coastal habitat | Channel inshore of Santa Maria Island | S. Ochman, pers. comm. |
| 2 | Estuarine habitat | Northern portion of Sarita River estuary | S. Ochman, pers. comm. |
| 3 | Pool | Sarita River, near confluence of Frederick Creek ("Deep Pool") | S. Ochman, pers. comm. |
| 4 | Pool | Sarita River, near confluence with Hunter Creek ("Cable Car Pool") | S. Ochman, pers. comm. |
| 5 | Pool | Sarita River, downstream of confluence with South Sarita River ("Corner Pool") | S. Ochman, pers. comm. |
| 6 | Pool | At Blenheim bridge over Sarita River | S. Ochman, pers. comm. |
| 7 | Off channel habitat | Swamp/beaver pond off Sarita River near confluence of South Sarita River | S. Ochman, pers. comm.; B. Rushton, pers. comm. |
| 8 | Pool | Sarita River, at base of Sarita River Falls | S. Ochman, pers. comm. |
| 9 | Off channel habitat (coho) | Marshy area on west bank of Frederick Creek | S. Ochman, pers. comm. |
| 10 | High quality spawning habitat (chum & coho) | Reaches 13-17 Frederick Creek | LGL, 1997; Ochman, 1998 |

## Appendix D. Habitat Status Tables

1) Chinook
2) Chum
3) Coho
4) Pink
5) Sockeye

**Table 1 - Chinook Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Spawner/Egg/ Alevin** | - Severe channel aggradation in lower South Sarita River has occurred[1,3].<br>- Spawning gravels are very mobile in Sarita and South Sarita Rivers due to high peak flows in winter[2, 5].<br>- Egg destruction can occur in winter from scour in Sarita and South Sarita during high flows [2].<br>- Sedimentation is an ongoing problem from bank erosion and roads[4].<br>- Fragmented spawning areas in Sarita and South Sarita River[2].<br>- Upstream of the South Sarita confluence, there is a portion of the Sarita River which is a wide channel with large cobble and boulder susbrate which provides limited spawning or rearing habitat[2].<br>- Loss of riparian vegetation due to logging has led to bank erosion, loss of LWD, reduced nutrients and higher temperatures throughout the watershed[7]. | - Chinook spawn in the mainstem of Sarita River and possibly in the lower South Sarita River.[2, 8]<br>- Good spawning substrate in Reach 4 Sarita River[13] | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Spawning and incubation 10ºC | -Identify spawning locations | - Address upslope instability issues and ongoing sedimentation issues.<br>- Re-establish riparian function, especially along flats of South Sarita River.<br>- Conduct logging road upgrades or deactivation and repair improperly installed culverts.<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads.<br>- Clearcutting large blocks should be avoided<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled | In 2000, 5 structures were constructed to protect an eroding bank in the South Sarita[10]. |
| **Fry/Juvenile Summer** (N/A for immediate ocean migrants, ie. pink, chum, some chinook & sockeye poplns) | - Fry spend a short time in the stream and then migrate to rear in the Sarita River estuary.<br>- In summer, pools are often cut-off in the South Sarita River due to low flows[3].<br>- There is limited woody debris for cover in the Sarita and South Sarita Rivers[6].<br>`Boulder-riffle type rearing habitat is limited[4]. | - Not Applicable. Fry do not spend much time in the Rivers and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2, 3]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Juvenile rearing 15ºC | | - Create more boulder riiffle habitat for cover and rearing<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads.<br>- Clearcutting large blocks should be avoided<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |
| **Fry/Juvenile Winter** (N/A for immediate ocean migrants as above) | Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary. | - Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2,3]. | Not Applicable. By winter, fry have moved into the estuary. | Not Applicable | Not Applicable | | | | |
| **Smolt** | - Rearing capacity of estuary degraded by deposition of sediment (gravels, fines, cobble) from Sarita River[2,3].<br>- Reduced habitat complexity from infilling of tidal channels and burial of small islands[2,3].<br>- More estuarine areas become dry at low tide due to higher elevation of the seafloor from sedimentation[2]. | - Fringing eelgrass bed provides high quality feeding and refuge habitat[2,3]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | - Enhance eelgrass habitat with plantings.<br>- Develop restoration prescriptions for intertidal habitat restoration. | -Control sedimentation from upstream sources | None in estuary |
| **Marine Coastal** | - Eelgrass bed has been reduced to a narrow fringe[2]<br>- Nearshore kelp bed seems less abundant[4]. | - Good quality habitat with high complexity is located in the channel between Santa Maria Island having deeper areas and small islands[2]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | | -Control sedimentation from upstream sources | |

**Table 1 - Chinook Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Marine Offshore** | - Ocean conditions can affect marine survival of salmon with high degree of variation among years[9].<br>- Many species and populations of wild salmon from Barkley Sound rear in offshore waters of the Gulf of Alaska, thus any climate change impacts there (eg. salmon distribution, thermal stratification, nutrient delivery, primary production, ocean acidification) could have a signifcant effect on Barkley Sound and West Coast Vancouver Island salmon. The ultimate consequences of these changes are unknown but southern salmon populations, such as those of the Barkley Sound area, could be at greater risk of future losses from climate change compared to northern | | | | TBD | Studies of causes of low ocean survival are underway | | | |
| **Returning Adult Migration** | - In low flow years, upstream migration may be delayed.<br>- Poaching has been a problem[5].<br>- Limited deep pools for adult holding[2]. | - 4 main pools are known in Sarita River: Deep Hole near Frederick Creek, Cable Car pool near Hunter Creek, Corner pool near the South Sarita River, pool at Blenheim bridge, and a deep pool at the base of Sarita River falls[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration and spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Adult migration 16ºC | - Identify structures required for creation and maintenance of deep pools | - Install structures to create more deep holding pools in the mainstem of Sarita and lower South Sarita rivers<br>- Remediate any impassable culverts.<br>- Improve habitat complexity with pools and woody debris in Sarita and South Sarita rivers.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers. | - Protect existing riparian zone<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.<br>- Enforcement to reduce poaching. | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |

**REFERENCES:**


1) Brad Rushton, personal communication
2) Stefan Ochman, personal communication
3) Jim Lane, personal communication
4) Rob Brouwer, personal communication
5) Randy Stennes, personal communication
6) LGL, 1997
7) Horel, 1996
8) SHIM
9) Crawford & Irvine, 2009
10) Ochman, 2002
11) Huu-ay-aht, 2000
12) Pestal, G. 2009
13) Ochman, 1998

**Table 2 - Chum Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Spawner/Egg/ Alevin** | - Severe channel aggradation in lower South Sarita River has occurred[1,3].<br>- Spawning gravels are very mobile in Sarita and South Sarita Rivers due to high peak flows in winter[2, 5].<br>- Egg destruction can occur in winter from scour in Sarita and South Sarita during high flows [2].<br>- Sedimentation is an ongoing problem from bank erosion and roads[4].<br>- Fragmented spawning areas in Sarita and South Sarita River[2].<br>- Upstream of the South Sarita confluence, there is a portion of the Sarita River which is a wide channel with large cobble and boulder susbrate which provides limited spawning or rearing habitat[2].<br>- Loss of riparian vegetation due to logging has led to bank erosion, loss of LWD, reduced nutrients and higher temperatures throughout the watershed[7]. | Chum salmon spawn in Sarita River, South Sarita River, Frederick Creek and lower Hunter Creek[2, 8]. Frederick Creek provides high quality spawning habitat for chum[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Spawning and incubation 10ºC | | - Address upslope instability issues and ongoing sedimentation issues.<br>- Re-establish riparian function, especially along flats of South Sarita River.<br>- Conduct logging road upgrades or deactivation and repair improperly installed culverts.<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads. | In 2000, 5 structures were constructed to protect an eroding bank in the South Sarita [10]. |
| **Fry/Juvenile Summer** (N/A for immediate ocean migrants, ie. pink, chum, some chinook & sockeye poplns) | - Fry spend a short time in the stream and then migrate to rear in the Sarita River estuary.<br>- In summer, pools are often cut-off in the South Sarita River due to low flows[3].<br>- There is limited woody debris for cover in the Sarita and South Sarita Rivers[6]. | - Not Applicable. Fry do not spend much time in the Rivers and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2, 3]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Juvenile rearing 15ºC | | - Fry spend a very short amount of time in the Sarita River, then migrate quickly to the estuary.<br>- Add more LWD structures for cover and pool formation | | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |
| **Fry/Juvenile Winter** (N/A for immediate ocean migrants as above) | Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary. | - Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2,3]. | Not Applicable. By winter, fry have moved into the estuary. | Not Applicable | Not Applicable | | | | |
| **Smolt** | - Rearing capacity of estuary degraded by deposition of sediment (gravels, fines, cobble) from Sarita River[2,3].<br>- Reduced habitat complexity from infilling of tidal channels and burial of small islands [2,3].<br>- More estuarine areas become dry at low tide due to higher elevation of the seafloor from sedimentation[2]. | - Fringing eelgrass bed provides high quality feeding and refuge habitat[2,3]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | - Enhance eelgrass habitat with plantings.<br>- Develop restoration prescriptions for intertidal habitat restoration. | -Control sedimentation from upstream sources | None in estuary |

**Table 2 - Chum Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Marine Coastal** | - Eelgrass bed has been reduced to a narrow fringe[2]<br>- Nearshore kelp bed seems less abundant[4]. | - Good quality habitat with high complexity is located in the channel between Santa Maria Island having deeper areas and small islands[2]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | | -Control sedimentation from upstream sources | |
| **Marine Offshore** | - Ocean conditions can affect marine survival of salmon with high degree of variation among years[9].<br>- Many species and populations of wild salmon from Barkley Sound rear in offshore waters of the Gulf of Alaska, thus any climate change impacts there (eg. salmon distribution, thermal stratification, nutrient delivery, primary production, ocean acidification) could have a signifcant effect on Barkley Sound and West Coast Vancouver Island salmon. The ultimate consequences of these changes are unknown but southern salmon populations, such as those of the Barkley Sound area, could be at greater risk of future losses from climate change compared to northern populations[12]. | | | | TBD | Studies of causes of low ocean survival are underway | | | |
| **Returning Adult Migration** | - In low flow years, upstream migration may be delayed.<br>- Limited deep pools for adult holding. | - 4 main pools are known in Sarita River: Deep Hole near Frederick Creek, Cable Car pool near Hunter Creek, Corner pool near the South Sarita River, pool at Blenheim bridge, and a deep pool at the base of Sarita River falls[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration and spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Adult migration 16ºC | | - Install structures to create more deep holding pools in the mainstem of Sarita and lower South Sarita rivers<br>- Remediate any impassable culverts.<br>- Improve habitat complexity with pools and woody debris in Sarita and South Sarita rivers.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers, and Hunter Creek. | - Protect existing riparian zone<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.<br>- Enforcement to reduce poaching. | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |


**REFERENCES:**

1) Brad Rushton, personal communication
2) Stefan Ochman, personal communication
3) Jim Lane, personal communication
4) Rob Brouwer, personal communication
5) Randy Stennes, personal communication
6) LGL, 1997
7) Horel, 1996
8) SHIM
9) Crawford & Irvine, 2009
10) Ochman, 2002
11) Huu-ay-aht, 2000
12) Pestal, G. 2009

**Table 3 - Coho Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Spawner/Egg/ Alevin** | - Severe channel aggradation in lower South Sarita River has occurred[1,3].<br>- Spawning gravels are very mobile in Sarita and South Sarita Rivers due to high peak flows in winter[2, 5].<br>- Egg destruction can occur in winter from scour in Sarita and South Sarita during high flows[2].<br>- Sedimentation is an ongoing problem from bank erosion and roads[4].<br>- Fragmented spawning areas in Sarita and South Sarita River[2].<br>- Upstream of the South Sarita confluence, there is a portion of the Sarita River which is a wide channel with large cobble and boulder susbrate which provides limited spawning or rearing habitat[2].<br>- Loss of riparian vegetation due to logging has led to bank erosion, loss of LWD, reduced nutrients and higher temperatures throughout the watershed[7]. | - Coho spawn in the Sarita River, South Sarita River, Frederick Creek and lower Hunter Creek[2,8].<br>- Frederick Creek provides high quality coho spawning habitat in Reaches 13-17 [1,2,6]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Spawning and incubation 10ºC | | - Address upslope instability issues and ongoing sedimentation issues.<br>- Re-establish riparian function, especially along flats of South Sarita River.<br>- Conduct logging road upgrades or deactivation and repair improperly installed culverts.<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads. | In 2000, 5 structures were constructed to protect an eroding bank in the South Sarita[10]. |
| **Fry/Juvenile Summer** (N/A for immediate ocean migrants, ie. pink, chum, some chinook & sockeye popins) | - Low flows in summer especially in the South Sarita River and many pools become cut-off in South Sarita during summer[3].<br>- Access to off channel habitat during low flow conditions is limited[2].<br>- Increased water temperature and reduced nutrient input due to loss of riparian vegegation[2].<br>- Lack of large woody debris instream and reduced habitat cover in the Sarita and South Sarita River[6].<br>- Lack of off channel refuge areas in the South Sarita River.[3] | - Marsh off Frederick Creek provides very good off channel rearing habitat [2,6].<br>- A shallow beaver pond on the Sarita River near the South Sarita confluence provides high quality rearing habitat[1,2] | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Juvenile rearing 15ºC | | - Increase habitat complexity by adding large woody debris to create cover and pools.<br>- Create more shallow off channel areas in South Sarita and Sarita rivers for rearing during low flows<br>- Restore riparian vegegation along banks and gravel bars in Sarita and South Sarita rivers.<br>- Improve access to existing off channel areas overall and in South Sarita.<br>- Increase access to pools during low flows in South Sarita River | | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, a fishway was installed to provide juveniles access to the rearing habitat in a beaver pond in the Sarita River and several log structures were installed in reaches 3 and 4[11].<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek to increase habitat complexity, cover and promote pool formation and stabilize banks [10,11].<br>- From 1998-2000, off channel habitat was created to increase rearing areas for juveniles during low flow periods in the South Sarita River [10,11].<br>- In 2006, 7500m$^2$ of off channel rearing habitat was created in South Sarita River. In 2009, the side channel and berm were repaired due to flood damage [13].<br>- In 2011, a proposed restoration project will take place involving the construction of side channel habitat in the South Sarita River to increase juvenile rearing habitat [13] |
| **Fry/Juvenile Winter** (N/A for immediate ocean migrants as above) | - High peak flows in winter in most systems and inadequate instream cover[1].<br>- Limited off channel habitat and reduced access to some off channel areas especially in the South Sarita River[2,3].<br>- Lack of large woody debris instream and reduced habitat cover in many streams[6].<br>- Impassable log jams in Reach 35 & 37 Sabrina Creek [14] | - Frederick Creek and Sabrina Creek offer good cover for coho rearing[2,6].<br>- Frederick Creek has suitable flows in summer and provides high quality overwinter rearing habitat in the marsh on the east side of the creek2.<br>- A pond on the north side of Sarita River, near the confluence of South Sarita River, provides high quality overwinter rearing habitat1,2. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | TBD | | - Increase the amount of shallow, vegetated off channel habitat that resembles flooded/swamps.<br>- Add woody debris structures to increase habitat complexity in terms of cover and creation of pools in Sarita, South Sarita and Hunter creek.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers.<br>- Remove log jams in Sabrina Creek | | - To increase habitat complexity, in 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita Rivers.<br>- In 1999, a fishway was installed to provide access to the rearing habitat in a beaver pond in the Sarita River and several log structures were installed in reaches 3 and 4[11].<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek to increase habitat complexity, cover and promote pool formation and stabilize banks [10,11].<br>- From 1998-2000, off channel habitat was created to increaase rearing habitat for juveniles in the South Sarita River during low flow conditions [10,11].<br>- In Sabrina Creek during 1999, riffle structures were added to Reach 34 and a log jam was lowered in Reach 35 to improve cover and access for juveniles. LWD was also added to Reaches 34 & 35 to increase habitat complexity and stabilize banks[11].<br>- In 2000-2001, LWD was added in Reaches 34, 35 and 37 of Sabrina Creek to increase habitat complexity for juveniles .<br>- A log jam was removed in Reach 35 to improve juvenile access[10]. |

**Table 3 - Coho Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Smolt** | - Rearing capacity of estuary degraded by deposition of sediment (gravels, fines, cobble) from Sarita River[2,3].<br>- Reduced habitat complexity from infilling of tidal channels and burial of small islands[2,3].<br>- More estuarine areas become dry at low tide due to higher elevation of the seafloor from sedimentation[2]. | - Fringing eelgrass bed provides high quality feeding and refuge habitat[2,3]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | - Enhance eelgrass habitat with plantings.<br>- Develop restoration prescriptions for intertidal habitat restoration. | -Control sedimentation from upstream sources | None in estuary |
| **Marine Coastal** | - Eelgrass bed has been reduced to a narrow fringe[2]<br>- Nearshore kelp bed seems less abundant[4]. | - Good quality habitat with high complexity is located in the channel between Santa Maria Island having deeper areas and small islands[2]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | | -Control sedimentation from upstream sources | |
| **Marine Offshore** | - Ocean conditions can affect marine survival of salmon with high degree of variation among years[9].<br>- Many species and populations of wild salmon from Barkley Sound rear in offshore waters of the Gulf of Alaska, thus any climate change impacts there (eg. salmon distribution, thermal stratification, nutrient delivery, primary production, ocean acidification) could have a signifcant effect on Barkley Sound and West Coast Vancouver Island salmon. The ultimate consequences of these changes are unknown but southern salmon populations, such as those of the Barkley Sound area, could be at greater risk of future losses from climate change compared to northern populations[12]. | | | | TBD | Studies of causes of low ocean survival are underway | | | |
| **Returning Adult Migration** | - In low flow years, upstream migration may be delayed.<br>- Impassable log jams in Reach 35 & 37 Sabrina Creek.<br>- Limited deep pools for adult holding. | - 4 main pools are known in Sarita River: Deep Hole near Frederick Creek, Cable Car pool near Hunter Creek, Corner pool near the South Sarita River, pool at Blenheim bridge, and a deep pool at the base of Sarita River falls[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration and spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Adult migration 16ºC | | - Install structures to create more deep holding pools in the mainstem of Sarita and lower South Sarita rivers<br>- Remediate any impassable culverts.<br>- Improve habitat complexity with pools and woody debris in Sarita and South Sarita rivers.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers. | - Protect existing riparian zone<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.<br>- Enforcement to reduce poaching. | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |

**REFERENCES:**


1) Brad Rushton, personal communication
2) Stefan Ochman, personal communication
3) Jim Lane, personal communication
4) Rob Brouwer, personal communication
5) Randy Stennes, personal communication
6) LGL, 1997
7) Horel, 1996
8) SHIM
9) Crawford & Irvine, 2009
10) Ochman, 2002
11) Huu-ay-aht, 2000
12) Pestal, G. 2009
13) Margaret Wright, personal communication
14) Ochman, 1998

**Table 4 - Pink Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Spawner/Egg/ Alevin** | - Severe channel aggradation in lower South Sarita River has occurred[1,3].<br>- Spawning gravels are very mobile in Sarita and South Sarita Rivers due to high peak flows in winter[2, 5].<br>- Egg destruction can occur in winter from scour in Sarita and South Sarita during high flows[2].<br>- Sedimentation is an ongoing problem from bank erosion and roads[4].<br>- Fragmented spawning areas in Sarita and South Sarita River[2].<br>- Upstream of the South Sarita confluence, there is a portion of the Sarita River which is a wide channel with large cobble and boulder susbrate which provides limited spawning or rearing habitat[2].<br>- Loss of riparian vegetation due to logging has led to bank erosion, loss of LWD, reduced nutrients and higher temperatures throughout the watershed[7]. | Spawning sites likely in the lower mainstem of Sarita River, although exact locations are unknown[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Spawning and incubation 10ºC | Identify spawning sites and habitat requirements | - Address upslope instability issues and ongoing sedimentation issues.<br>- Re-establish riparian function, especially along flats of South Sarita River.<br>- Conduct logging road upgrades or deactivation and repair improperly installed culverts.<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads. | In 2000, 5 structures were constructed to protect an eroding bank in the South Sarita[10]. |
| **Fry/Juvenile Summer** (N/A for immediate ocean migrants, ie. pink, chum, some chinook & sockeye poplns) | - Fry spend a very short amount of time in the Sarita River, then migrate quickly to the estuary.<br>- There is limited woody debris for cover in the Sarita and South Sarita Rivers[6] | - Not Applicable. Fry do not spend much time in the Rivers and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2, 3]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Juvenile rearing 15ºC | | - Fry spend a very short amount of time in the Sarita River, then migrate quickly to the estuary.<br>- Add more LWD structures for cover and pool formation | | - None focused on pink<br>- In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |
| **Fry/Juvenile Winter** (N/A for immediate ocean migrants as above) | Not Applicable. Fry have left the streams in winter and are found in coastal areas. | - Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2,3]. | Not Applicable. Fry spend a very short amount of time in the Sarita River, then migrate quickly to the estuary. | Not Applicable | Not Applicable | | | | |
| **Smolt** | - Rearing capacity of estuary degraded by deposition of sediment (gravels, fines, cobble) from Sarita River[2,3].<br>- Reduced habitat complexity from infilling of tidal channels and burial of small islands[2,3].<br>- More estuarine areas become dry at low tide due to higher elevation of the seafloor from sedimentation[2]. | - Fringing eelgrass bed provides high quality feeding and refuge habitat[2,3]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | - Enhance eelgrass habitat with plantings.<br>- Develop restoration prescriptions for intertidal habitat restoration. | -Control sedimentation from upstream sources | None in estuary |
| **Marine Coastal** | - Eelgrass bed has been reduced to a narrow fringe[2]<br>- Nearshore kelp bed seems less abundant[4]. | - Good quality habitat with high complexity is located in the channel between Santa Maria Island having deeper areas and small islands[2]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | | -Control sedimentation from upstream sources | |

**Table 4 - Pink Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Marine Offshore** | - Ocean conditions can affect marine survival of salmon with high degree of variation among years[9].<br>- Many species and populations of wild salmon from Barkley Sound rear in offshore waters of the Gulf of Alaska, thus any climate change impacts there (eg. salmon distribution, thermal stratification, nutrient delivery, primary production, ocean acidification) could have a signifcant effect on Barkley Sound and West Coast Vancouver Island salmon. The ultimate consequences of these changes are unknown but southern salmon populations, such as those of the Barkley Sound area, could be at greater risk of future losses from climate change compared to northern populations[12]. | | | | TBD | Studies of causes of low ocean survival are underway | | | |
| **Returning Adult Migration** | In low flow years, upstream migration may be delayed. Limited deep pools for adult holding. | - 4 main pools are known in Sarita River: Deep Hole near Frederick Creek, Cable Car pool near Hunter Creek, Corner pool near the South Sarita River, pool at Blenheim bridge, and a deep pool at the base of Sarita River falls[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Adult migration 16ºC | | - Install structures to create more deep holding pools in the mainstem of Sarita and lower South Sarita rivers<br>- Remediate any impassable culverts.<br>- Improve habitat complexity with pools and woody debris in Sarita and South Sarita rivers.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers. | - Protect existing riparian zone<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.<br>- Enforcement to reduce poaching. | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |


**REFERENCES:**

1) Brad Rushton, personal communication
2) Stefan Ochman, personal communication
3) Jim Lane, personal communication
4) Rob Brouwer, personal communication
5) Randy Stennes, personal communication
6) LGL, 1997
7) Horel, 1996
8) SHIM
9) Crawford & Irvine, 2009
10) Ochman, 2002
11) Huu-ay-aht, 2000
12) Pestal, G. 2009

**Table 5 - Sockeye Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Spawner/Egg/ Alevin** | - Severe channel aggradation in lower South Sarita River has occurred[1,3].<br>- Spawning gravels are very mobile in Sarita and South Sarita Rivers due to high peak flows in winter[2, 5].<br>- Egg destruction can occur in winter from scour in Sarita and South Sarita during high flows[2].<br>- Sedimentation is an ongoing problem from bank erosion and roads[4].<br>- Fragmented spawning areas in Sarita and South Sarita River[2].<br>- Upstream of the South Sarita confluence, there is a portion of the Sarita River which is a wide channel with large cobble and boulder susbrate which provides limited spawning or rearing habitat[2].<br>- Loss of riparian vegetation due to logging has led to bank erosion, loss of LWD, reduced nutrients and higher temperatures throughout the watershed[7]. | Spawning sites likely in the mainstem of Sarita River, although exact locations are unknown[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration & spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Spawning and incubation 10ºC | Identify spawning sites and habitat requirements | - Address upslope instability issues and ongoing sedimentation issues.<br>- Re-establish riparian function, especially along flats of South Sarita River.<br>- Conduct logging road upgrades or deactivation and repair improperly installed culverts.<br>- Add more LWD structures for cover and pool formation | - Ensure protection of existing intact riparian zone.<br>- Limit construction of new roads and re-activation of old roads. | In 2000, 5 structures were constructed to protect an eroding bank in the South Sarita[10]. |
| **Fry/Juvenile Summer** (N/A for immediate ocean migrants, ie. pink, chum, some chinook & sockeye poplns) | - Sockeye are stream/estuary rearing type but information regarding habitat requirements for juvenile sockeye in the Sarita watershed was not available<br>- There is limited woody debris for cover in the Sarita and South Sarita Rivers[6] | | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: juvenile rearing | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Juvenile rearing 15ºC | Identify rearing habitat requirements and duration of residence in stream or estuary | Add more LWD structures for cover and pool formation | | - None focused on sockeye<br>- In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |
| **Fry/Juvenile Winter** (N/A for immediate ocean migrants as above) | Not Applicable. By winter, fry have moved into the estuary. | - Not Applicable. Fry have left the stream by winter and rear in the Sarita River estuary.<br>- Fringing eelgrass bed in estuary provides high quality rearing and refuge habitat[2,3]. | Not Applicable. By winter, fry have moved into the estuary. | Not Applicable | Not Applicable | | | | |
| **Smolt** | - Rearing capacity of estuary degraded by deposition of sediment (gravels, fines, cobble) from Sarita River[2,3].<br>- Reduced habitat complexity from infilling of tidal channels and burial of small islands[2,3].<br>- More estuarine areas become dry at low tide due to higher elevation of the seafloor from sedimentation[2]. | - Fringing eelgrass bed provides high quality feeding and refuge habitat[2,3]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | - Enhance eelgrass habitat with plantings.<br>- Develop restoration prescriptions for intertidal habitat restoration. | -Control sedimentation from upstream sources | None in estuary |

**Table 5 - Sockeye Conservation Unit - Sarita Watershed Habitat Status Report**

**Notes: TBD = To Be Determined, a blank cell indicates no information available**

| Life Stage | Possible limiting factors | Known high value habitats | Performance Indicator(s) for habitat limiting factors | Performance Indicator(s) Status | Performance Indicators Thresholds | Information Gaps | Possible measures to address limiting factors | Possible measures to maintain productivity | Habitat Protection & Restoration Measures Undertaken |
|---|---|---|---|---|---|---|---|---|---|
| **Marine Coastal** | - Eelgrass bed has been reduced to a narrow fringe[2]<br>- Nearshore kelp bed seems less abundant[4]. | - Good quality habitat with high complexity is located in the channel between Santa Maria Island having deeper areas and small islands[2]. | -Esturarine habitat area (eelgrass) | -Ramona de Graaf has conducted eelgrass mapping in the area<br>-Aerial photos could be used to measure changes in eelgrass bed size over time | Estuary size (ha): estuary boundaries defined to include the intertidal and supratidal zones as well as habitat features connected to each river or stream above the coastline to an upstream distance of 500m. Document changes over time. Threshold of inacceptable change to be determined. | Assess estuary utilization and productivity. | | -Control sedimentation from upstream sources | |
| **Marine Offshore** | - Ocean conditions can affect marine survival of salmon with high degree of variation among years[9].<br>- Many species and populations of wild salmon from Barkley Sound rear in offshore waters of the Gulf of Alaska, thus any climate change impacts there (eg. salmon distribution, thermal stratification, nutrient delivery, primary production, ocean acidification) could have a signifcant effect on Barkley Sound and West Coast Vancouver Island salmon. The ultimate consequences of these changes are unknown but southern salmon populations, such as those of the Barkley Sound area, could be at greater risk of future losses from climate change compared to northern populations[12]. | | | | TBD | Studies of causes of low ocean survival are underway | | | |
| **Returning Adult Migration** | In low flow years, upstream migration may be delayed. Limited deep pools for adult holding. | - 4 main pools are known in Sarita River: Deep Hole near Frederick Creek, Cable Car pool near Hunter Creek, Corner pool near the South Sarita River, pool at Blenheim bridge, and a deep pool at the base of Sarita River falls[2]. | - Riparian disturbance<br>- Total land cover alteration (forestry)<br>- Watershed road development<br>- Suspended sediment<br>- Stream discharge<br>- Water temperature: migration and spawning | - Flow data available in Graham's Hydrology report (1997)<br>- Discharge data available in Ochman's Habitat Assessment Report (1998)<br>- TSS, TDS and Turbidity data (and other water chemistry parameters) available in Ochman's Habitat Assessment Report (1998)<br>- Road density and other land use data (# stream crossings, area logged) available in Horel's Watershed Assessment report (1996) | - Proportion of stream length with disturbed riparian zone: Functioning condition (NOAA 1996) Proper: < 20 disturbed and > 50% of riparian vegetation similar to natural community composition<br>- Equivalent clearcut area (ECA): area harvested, cleared, or burned: proper: < 15 % ECA with no concentration of disturbance in unstable or potentially unstable areas<br>- Road density (length per unit area, e.g., km / km2): Properly functioning: < 1.24 km/km2, no valley bottom roads<br>- Total suspended sediments as identified by EIFAC 1964 and DFO 2000: < 25 parts per million (ppm) of suspended solids - no evidence of harmful effects on fish and fisheries;<br>- Magnitude of flow events (Richter et al. 1997): 10% MAD minimum instantaneous flow for survival of most aquatic life (though 20% of MAD has been recommended as a minimum instream flow for some streams)<br>- 7-day average of mean daily temperature: Adult migration 16ºC | | - Install structures to create more deep holding pools in the mainstem of Sarita and lower South Sarita rivers<br>- Remediate any impassable culverts.<br>- Improve habitat complexity with pools and woody debris in Sarita and South Sarita rivers.<br>- Restore riparian vegetation especially gravel bars and banks of Sarita and South Sarita rivers. | - Protect existing riparian zone<br>- Strict guidelines regarding stream crossing design and construction should be applied to ensure fish passage is maintained and that erosion is controlled.<br>- Enforcement to reduce poaching. | - In 1998, log cover structures were installed at several sites on the Sarita River and at the confluence of the Sarita & South Sarita to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- In 1999, several log structures were installed in reaches 3 and 4 to increase habitat complexity, cover and promote pool formation and stabilize banks.<br>- From 1998-2000, several log stuctures and woody debris were added to the South Sarita River and also to Hunter Creek increase habitat complexity, cover and promote pool formation and stabilize banks [10,11]. |

**REFERENCES:**


1) Brad Rushton, personal communication
2) Stefan Ochman, personal communication
3) Jim Lane, personal communication
4) Rob Brouwer, personal communication
5) Randy Stennes, personal communication
6) LGL, 1997
7) Horel, 1996
8) SHIM
9) Crawford & Irvine, 2009
10) Ochman, 2002
11) Huu-ay-aht, 2000
12) Pestal, G. 2009