Bella Coola Watershed Conservation Society

Bella Coola Watershed-based Fish Sustainability Plan Stage II

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Prepared for:

Communities of Bella Coola Valley &
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January 2007

Acknowledgements

The draft Bella Coola Watershed-based Fish Sustainability Plan (WFSP) Stage II report, prepared by Nicola Swanney Koroluk, was used as a base to complete this report for the Bella Coola Watershed Conservation Society (BCWCS) and the Department of Fisheries and Oceans (DFO). Contributions to the report were made by Megan Moody (Nuxalk Fisheries), who wrote the Eulachon sections of the Fisheries Resources and Resource Use, and Hans Granander (HCG Forestry Consulting) who wrote the Logging History section (Appendix 3).

The author would like to acknowledge the support and contributions that made this Plan possible. Thanks are extended to the following DFO staff: Sandie MacLaurin for her many long hours including reviewing, technical advice, and for providing resource information, DFO data, and input to the Priority Issues section; Matt Mortimer for providing resource information and escapement data; Lyle Enderud for review of the Resource Use section; Wayne Levesque for providing escapement data; and Brad Koroluk for providing resource information and input to the Priority Issues section. We also extend our thanks to Russ Hilland and John Willis of the Snootli Creek Hatchery for reviewing, providing hatchery statistics and other resource information, and for input to the Priority Issues section. Special thanks to Neil Oborne (Consultant) for providing technical advice and resource information, reviewing, and input to the Priority Issues section. Thanks to David Flegel, Operations Manager with the Ministry of Forests and Range, for his review of the forestry information in Sections 2.0 and 6.0. Mike Ramsay and Tom Wilkinson of the Ministry of Environment (MOE) reviewed the document and provided much needed resource information for trout species. Thanks are offered to Cheryl Waugh and Donna Mikkelson of the Central Coast Regional District (CCRD) for providing resource information on land use development and restoration projects. Lastly, we would like to thank Hans Granander and Fraser Koroluk for their input to the Priority Issues section.

The following individuals have also contributed to the writing and/or preparation of the WFSP:

Mike Wigle	Photography and Graphics
Kay Kennes (DFO)	Mapping
Shirley Willson	General
Robert Tritschler	General
Karl Wilson (DFO)	General
Terry Palfrey (DFO)	Fisheries Management

Executive Summary

The Bella Coola Watershed Conservation Society (BCWCS) was formed in 2001 to act as a Planning Team or Technical Committee in order to prepare a Watershed-based Fish Sustainability Plan (WFSP) for the Bella Coola watershed. Since this time, various individuals have collaborated to complete a Stage I report, a draft Stage II report, and this Stage II "living document". This living document is intended to be updated on a regular basis as new fisheries related information becomes available.

This Stage II report contains information on the WFSP process and how it is applicable to the Bella Coola watershed. The Stage I report provided a watershed profile; however, this report expands on this profile to include a description of the past and current land and water uses within the Bella Coola Valley. The Fisheries Resource section contains watershed specific fisheries data on the five salmon and other fish species present within the watershed. Past and current information on the fisheries and enhancement of Bella Coola stocks is also discussed. The section on "Factors Affecting Fish and Fish Habitat" describes the land and water use activities that have a major impact on the watershed based on various habitat assessments and general fisheries literature.

The "Priority Issues" and "Objectives and Strategies" sections of this report were the most challenging to produce; however, these sections will likely play the most significant role in developing Stage III and IV of the WFSP. Therefore, this section is key to the report. It identifies 44 priority issues and 25 objectives with strategies outlined for each. The issues and objectives are divided into five sections: Priority Fish Stock Issues, Priority Fisheries Management Issues, Priority Land Use Management Issues, Priority Fish Habitat Issues, and Priority Data Gap Issues.

A few of the difficulties that were faced in the preparation of this plan included:

- increased workloads have limited input from the Technical Committee
- population size greatly restricts the number of people that are actively involved in watershed activities
- many documents have been moved or miss placed with government shuffling
- lack of community interest
- Some of the benefits of the planning process to date have been:
- the formation of a local planning team or round table (BCWCS)
- the development of a local Resource Centre
- receiving commitment from the Ministry of Environment that staff were able to participate in activities carried out by the BCWCS

Please contact the Bella Coola Resource Centre at (250) 982-0007 or at info@bellacoolawatershed.com if you have additional information that would be relevant to the Bella Coola WFSP.

1.0 Introduction

1.1 What is Watershed-based Fish Sustainability Planning?

Watershed-based Fish Sustainability Planning (WFSP) is a process that was jointly introduced by the Federal and Provincial governments to help manage fish populations and fish habitat to a sustainable level. “Its overall goal is to ensure effective long-term conservation of fish and fish habitat” (Fraser 2001).

The “WFSP: A Guidebook for Participants” was produced to assist watershed groups to develop sustainability plans. The planning phase is based on a four stage planning sequence.

Stage I Establishing Regional Priorities: This stage is led by government agencies and identifies watersheds, potential stakeholders, their interests and the resources available for fish and fish habitat conservation.

Stage II Establishing Watershed Priorities: During this stage, Local Planning and Technical Committees develop a detailed watershed profile describing fish populations, their habitats, and the factors affecting their health and productivity. Potential management options and a strategic overview of the watershed are prepared.

Stage III Developing a Watershed Plan: In this stage, local planning and Technical Committees identify how to achieve the objectives, targets, and strategies developed in Stage II.

Stage IV Implementing and Improving the Plan: In this stage, government and Planning Committees carry out the actions identified in Stage II and III.

1.2 Rationale for adopting WFSP

As is the case throughout British Columbia, managing resources is administered through different federal and provincial agencies. This often results in inadequate watershed management. Making the management of the Bella Coola watershed more complicated, the agencies involved in resource management are situated in different parts of the province, and in the case of the Ministry of Forests and Range (MOF) and the Ministry of Environmental Sustainability and Resource Development, the watershed is split between two regions. Local stakeholders realized that to properly manage the resources of the watershed it is essential to look at the entire watershed and not regional sections. WFSP allows the entire watershed to be managed as a single unit, which is one of the reasons why the process was chosen.

By pulling together information from other planning process and filling in the gaps, the WFSP will create a “living plan” for the Bella Coola watershed. This plan will be available to the public through the Bella Coola Watershed Conservation Society (BCWCS). This process and plan will assist local landowners, business, developers and industry to streamline research on projects, while at the same time ensuring that fish and fish habitat are protected.

1.3 Watershed Planning Process

1.3.1 Guiding Principles and Goals

Nine guiding principles and process goals provide the framework for the Bella Coola WFSP.

1. The project will focus on the sustainability of all fish stocks, both anadromous and non-anadromous species, including hatchery enhanced stocks.

2. The project will focus on the entire Bella Coola Watershed, including the land base in Tweedsmuir Park and the land base on the Chilcotin Plateau.
3. This project will be prepared by looking at the needs of “fish”; however, it is anticipated that this plan will evolve to deal with all ecosystems.
4. This project will identify priorities for the protection and restoration of fish and fish habitat.
5. This project will incorporate existing recommendations and processes.
6. This project will use the best information available, including scientific data, traditional ecological knowledge, land and resource development trends, and community knowledge and values.
7. This project will identify information gaps and make recommendations on filling the gaps.
8. This project will be a living document and will be updated as information becomes available or as changes are needed.
9. Participation in this project will be open to all community members, First Nations, stakeholders, and government agencies.

1.3.2 Additional Goals

- This report and all information gathered during the project will be stored at the BCWCS Resource Centre. It will be available for review and to assist in the development of a Watershed Plan for the Bella Coola Watershed.
- This project will produce a bibliography of previous studies, which will be available at the Resource Centre.
- This project will assist future watershed activities.
- Through this project, we hope to provide public awareness and education on the Bella Coola Watershed.
- This project will assist the Official Community Plan and encourage reinforcement and/or development of by-laws pertaining to private property that recognize conservation of fish and fish habitat as a priority.

1.3.3 Stage I WFSP

In November 2001, DFO initiated a meeting of relevant stakeholders to discuss the establishment of a “Watershed-Based Fish Sustainability Planning Team” or “Round Table” to work towards conservation of fish populations and their habitat, within the Bella Coola Watershed. Representatives from all relevant stakeholder groups, including First Nations, commercial fisheries, sport fisheries, industry and the general public began working together to meet the goals set out in the WFSP. Refer to Appendix 1 for a list of members of the WFSP Planning and Technical Committees. This group of stakeholders is responsible for the formation of the BCWCS, which was officially incorporated in the Province of British Columbia on September 9, 2002. The primary reason for the formation of the BCWCS was to have a group who would produce the WFSP for the Bella Coola Watershed and act as a steward of the watershed.

1.3.4 Stage II WFSP

Since its formation, the BCWCS has collected and catalogued resource material relevant to the Bella Coola Watershed. With the generosity of local business and individuals, the BCWCS was able to establish a Resource Centre to house documents, maps and other management tools. A GPS unit was also purchased through funding from DFO and the Coast Sustainability Trust. This unit will assist the BCWCS to map many of the features within the watershed.

In the fall of 2003, the BCWCS prepared an outline and applied for funding to prepare a WFSP. Funding was approved in January 2004, and the Planning Committee and Watershed Coordinator were able to start compiling data for the plan. The Technical Committee met in February 2004, and local DFO staff agreed to assist in the preparation of the salmon management and habitat sections of the document. The Nuxalk fisheries biologist agreed to prepare a section on eulachon. Ministry of Environment (MOE) staff were permitted to be involved in the process in March 2004.

A draft WFSP Stage II report was compelted in 2004.

1.3.5 Public Participation

There has been limited public participation throughout this process. Advertisements inviting local input have been placed in the local paper but response has been low. Planners have attempted to contact individuals with local fisheries knowledge, but they are skeptical about becoming involved in yet another process. Many individuals have provided information to other planning processes, such as the Land and Resource Management Plan (LRMP), and feel that their information was not considered; therefore, they are not interested in providing input to another group. Where possible, the WFSP Planning Committee has tried to incorporate public input from other processes.

1.3.6 Strategic Direction

Although the health of fish stocks and habitat in the Bella Coola Watershed can generally be considered good, the populations of eulachon and steelhead have declined in recent years. Measures must be put in place to prevent this from happening to other species.

The strategic directions for the Bella Coola WFSP are to:

a) Identify data and information gaps for the watershed.

b) Promote the health of the aquatic systems.

c) Ensure the populations of all aquatic species do not decline below sustainable levels.

d) Assist in rebuilding stocks that have declined below sustainable levels.

e) Assist in the assessment and improvement river access.

f) Work with stakeholders to ensure environmentally sustainable land development.

g) Provide community members access to watershed documents.

h) Provide strategic direction to local government in the preparation of the Official Community Plan.

1.3.7 Time Frame for the WFSP

It is expected that a Stage II document will be completed by March 31, 2007, whereas Stages III and IV should be compelted by March 31, 2008. Although the following Stage II document is nearly complete, some sections will require more information such as a section on Monitoring Framework. For further details on these requirements, refer to Section 10.0 on "Next Steps". It must be noted again that this plan is a living document and will always be evolving.

1.3.8 Linkages to other Planning Processes

One of the challenges that the Planning Committee has been faced with is that the communities of the Bella Coola Watershed have been "planned to death". Past planning processes have provided some general guidelines to the Bella

Coola WFSP; however, they have made many residents skeptical about participating in planning processes.

The following section describes the planning processes that have occurred to date.

Bella Coola Local Resource Use Plan (BCLRUP)

The Bella Coola Local Resource Use Planning (BCLRUP) Committee was formed in 1990 to address concerns that levels of timber harvesting in the Bella Coola Valley were unsustainable. The plan was completed in 1996, adopted by the Community, and signed off, in principle, by the Mid Coast Forest Service District Manager. Although the BCLRUP was primarily concerned with timber harvesting, management recommendations for many tributaries to the Bella Coola River were made. Many recommendations put forward in this plan were not carried forward as it was not within the jurisdiction of the Forest Service District Manager. Furthermore, since the plan was prepared, the Forest Practice Act became law and superseded the BCLRUP. However, general recommendations made in the BCLRUP will be considered when setting priorities and recommendations.

The Central Coast Land and Resource Management Plan (CCLRMP)

The Central Coast Land and Resource Management Plan (CCLRMP) was approved and finalized at the beginning of 2006. Results and recommendations will be incorporated into this plan as needed. The Hydroriparian Planning Guide has been released and will be incorporated in the monitoring section of this document when applicable.

The Inner Coast Pilot Project

The Inner Coast Pilot Project is a result of a CCLRMP initiative and was developed to provide a baseline of the current socio-economic and environmental conditions within the Bella Coola Valley. This project was complete in January 2004 and includes the following reports: “The Salmon of the Inner Central Coast”, “Socio-Economic Opportunities and Barriers – Bella Coola”, “Socio-Economic Analysis of Current Conditions within the Bella Coola Valley”, “Bella Coola Community-Based Plan for Economic Recovery – Forestry”, and “Summary of Health and Population Indicators”. Information gathered through this process has been incorporated into the Bella Coola WFSP.

Bella Coola Watershed Restoration Plan

Through a Regional Management Plan, DFO, MOE, and MOFR jointly chose Target Watersheds where restoration work was thought to be successful. International Forest Products (Interfor) allocated a portion of their Forest Investment Account (FIA) to have a Bella Coola Watershed Restoration Plan prepared for them. This document, completed in March 2003, outlines restoration objectives within Interfor’s chart areas, and has assisted in the preparation of the Bella Coola WFSP.

Anahim Round Table(ART)

The Anahim Round Table (ART) was a result of the Cariboo-Chilcotin Land Use Plan (CCLUP). The ART is the Sub-Regional Planning Group that is made up of community members and stakeholders and an Interagency Planning Team. The Hotnarko, Atnarko, and Charlotte Alplands Landscape Units fall within the Bella Coola Watershed. The ART made a number of recommendations for the management of the area. The document was signed by all stakeholders in

November 2000. As above, recommendations specific to the Hotnarko, Atnarko, and Alplands Landscape Units will be incorporated into the Bella Coola WFSP.

Cariboo Chilcotin Land Use Plan (CCLUP)

The results of the ART were incorporated into the CCLUP. For the purpose of the Bella Coola WFSP, only those sections dealing with the ART will be considered.

Level 1 Coastal Watershed Assessment – Bella Coola Watershed

In 1996, Summit Environmental Consultants of Vernon, British Columbia prepared a Level 1 Coastal Watershed Assessment (CWAP) for the Bella Coola River. The area covered under the CWAP includes the Bella Coola and Talchako rivers and the lower reaches of the Atnarko River. The draft document was presented at a local round table meeting, and comments and recommendations from this meeting were incorporated into the final plan. The CWAP was prepared for MOE and was funded through Forest Renewal BC (FRBC).

Objectives of this document included:

1. inventory baseline watershed conditions and basic information relevant to potential watershed conditions and basic information relevant to potential watershed impacts associated with forest harvesting,
2. identify watershed and sub-basins at risk of having previously experienced watershed impacts. These impacts include changes in peak flows, accelerated surface erosion and changes to riparian buffers as a result of activities associated with harvesting (Summit 1996).

2.0 Watershed Profile

2.1 Physiography

The Bella Coola Watershed is located within the Coast Mountains and the Interior Plateau of British Columbia. The watershed drains 514,939 ha, and encompasses the communities of Bella Coola, Four Mile, Hagensborg, Firvale, Stuie, and Charlotte Lake. The Bella Coola River flows westward through a broad U-shaped river valley and exits into North Bentinck Arm. Elevations within the watershed range from sea-level to over 2500 metres. The Atnarko and Talchako rivers join to become the Bella Coola River approximately 55 km east of North Bentinck Arm.

The Atnarko River originates in the Interior Plateau, and much of this river lies within Tweedsmuir Provincial Park. The Talchako River originates in the Monarch Ice Field. The east side of the Talchako borders Tweedsmuir Park.

The Bella Coola Watershed overlaps 4 ecoregions within the British Columbia ecological classification system. Burt (1998) provided a summary of each ecoregion in his report titled "Habitat, Abundance and Rearing Capacity of Salmonids in the Bella Coola Watershed", summarized below:

1. The Bella Coola and its southern tributaries are located in the Pacific and Cascade Ranges Ecoregion. The Pacific and Cascade Ranges are located on the windward side of the Coast Mountains. Climate in this ecoregion is controlled by the arrival of frontal systems from the Pacific Ocean, and the lifting of these systems over the coastal mountains. In the winter, low pressure systems bring moist, mild air into the region, however the high coastal mountains in the area impede the passage of this air into the interior. The Pacific and Cascade Ranges are a group of steep, rugged granite mountains capped with large glaciers.
2. The northern tributaries of the Bella Coola drain from the Coastal Gap Ecoregion. This ecoregion is located to the north of the Pacific and Cascade Ranges. Climate in this ecosystem is also controlled by the arrival of frontal systems from the Pacific Ocean and the lifting of these systems over the coastal mountains. However, frontal systems are much more frequent in this ecoregion than in the Pacific and Cascade Ranges. The mountain ranges along the central coast are smaller than any other mountains along the coast and allow moist oceanic air to move over the area and into the interior more easily. The Coastal Gap Ecosystem has round-topped, granitic mountains with steep sides that are much lower than those of the Pacific Cascade Ranges.
3. The Atnarko River and most of its tributaries are located within the Chilcotin Ranges Ecosystem. The Chilcotin Ranges are located in the rainshadow of the Pacific Ranges. Climate in this ecosystem is cold in the winter and warm in the summer. Precipitation is at the maximum during late spring to early summer. The Chilcotin Range is a high rounded mountainous area.
4. Mosher and Young Creeks and Hotnarko River drain from the Fraser Plateau Ecoregion. The Fraser Plateau Ecoregion is located north of the Chilcotin Ranges and east of the Coastal Gap Ecoregion. Climate is similar to the Chilcotin Ranges, but drier because of a greater rainshadow effect. The Fraser Plateau is a broad, rolling plateau with several shield volcanoes.

The Ministry of Forests and Range (MOFR) has divided the province into biogeoclimatic zones. Figure 2.1 shows a cross section of the zones from Bella Coola to the Chilcotin River. The biogeoclimatic zones that are represented in the watershed include:

- Alpine Tundra (AT);
- Coastal Western Hemlock (CWH);

- Mountain Hemlock (MH);
- Engelmann Spruce – Subalpine Fir (ESSF);
- Montane Spruce (MS);
- Interior Douglas Fir (IDF); and,
- Sub-Boreal Pine – Spruce (SBPS).

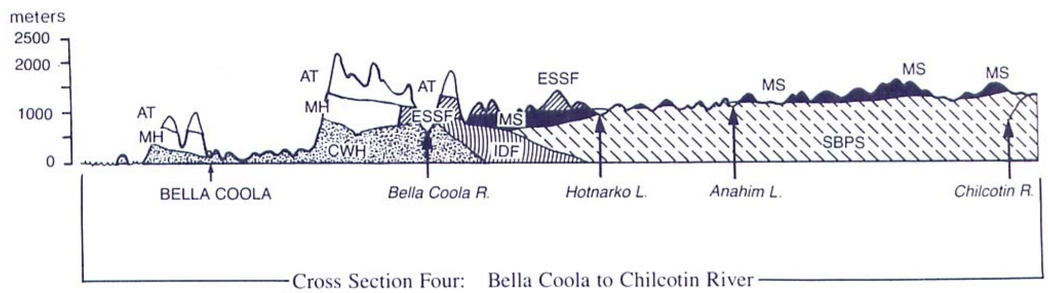


Figure 2.1 Cross Section of the Biogeoclimatic Zones of the Bella Coola Watershed (Meidinger and Pojar 1991)

Climatic data are recorded at two climate stations in the lower watershed (AES-Bella Coola and BC Hydro). Table 2.1 summarizes the temperature and rainfall records from these stations.

Table 2.1 Climate Data (from Environment Canada 2000)

Station ID	**Station ID 1060840**	**1060841**	**Average between stations**
Station name	BC Hydro	AES Bella Coola	
Latitude	52º22'N	52º23'N	
Longitude	126º41'W	126º36'W	
Elevation	18.30 m	35.70 m	
Location	Clayton Falls	Airport	
Daily mean temperature January	-.1.0ºC	0.0º	-0.5ºC
Daily mean temperature July	16.8ºC	17.2ºC	17.0ºC
Annual mean precipitation	1652.1 mm	1184.9 mm	
Annual mean rain fall	1492.2 mm	1081.7 mm	
Annual mean snow fall	160.0 mm	110.2 mm	

2.2 Hydrology

The Water Survey of Canada currently monitors four discharge stations within the watershed. Historically eight stations were operated. Table 2.2 presents the location and dates of operation for each of the discharge stations (Leaney and Morris 1981). Stations 08FB006 and 08FB007 can be viewed on the Real-Time Hydrometric Data website (http://scitech.pyr.ec.gc.ca/waterweb). There has been some discussion to discontinue monitoring the Salloomt and Nusatsum stations.

Table 2.2 Waters Survey of Canada Stations (Leaney and Morris 1981)		
Name	Station Number	Years Active
Bella Coola River near Hagensborg	08FB002	1948-1968
Bella Coola River at Hagensborg	08FB008	1930-32
Bella Coola River at Hagensborg	08FB001	1929-30
Tastquan Creek at Bella Coola	08FB003	1946-1950
Salloomt River	08FB004	1965-present
Nusatsum River	08FB005	1965 – present
Atnarko River near the mouth	08FB006	1965- present
Bella Coola River above Burnt Bridge Creek	08FB007	1965-present

Annual highwater varies throughout the watershed. This is primarily dominated by the ecoregion that each portion of the watershed is situated in. Stream discharge within the Pacific Cascade Ranges Ecoregion is dominated by glacial runoff during the summer. Discharge within the Coast Cap Ecoregion is dominated by a combination of snowmelt and rainfall during the spring to early summer and in the autumn. Stream discharge within the Chilcotin Ranges is dominated by a combination of snowmelt and rainfall during the late spring and early summer. The Fraser Plateau stream discharge is dominated by a combination of snowmelt and rainfall during late spring and early summer.

The mean monthly hydrographs in Figure 2.2 (below) demonstrate the stream discharge described above. The Salloomt River hydrograph has a peak in June, as is the result of snow and ice melt, and another smaller peak in October as a result of heavy autumn rainfall. The Salloomt River is part of the Coastal Gap Ecoregion. The Nusatsum and the Bella Coola river graphs indicate the peak flow in June and July, which is primarily driven by melting glaciers. The Talchako River, which is glacier-fed, is a major contributor to the Bella Coola River flow. Finally, the Atnarko River hydrograph indicates a peak flow in May and June, which reflects spring run-off coming out of the Chilcotin Plateau Ecoregion.

Figure 2.2 Mean Monthly Discharge

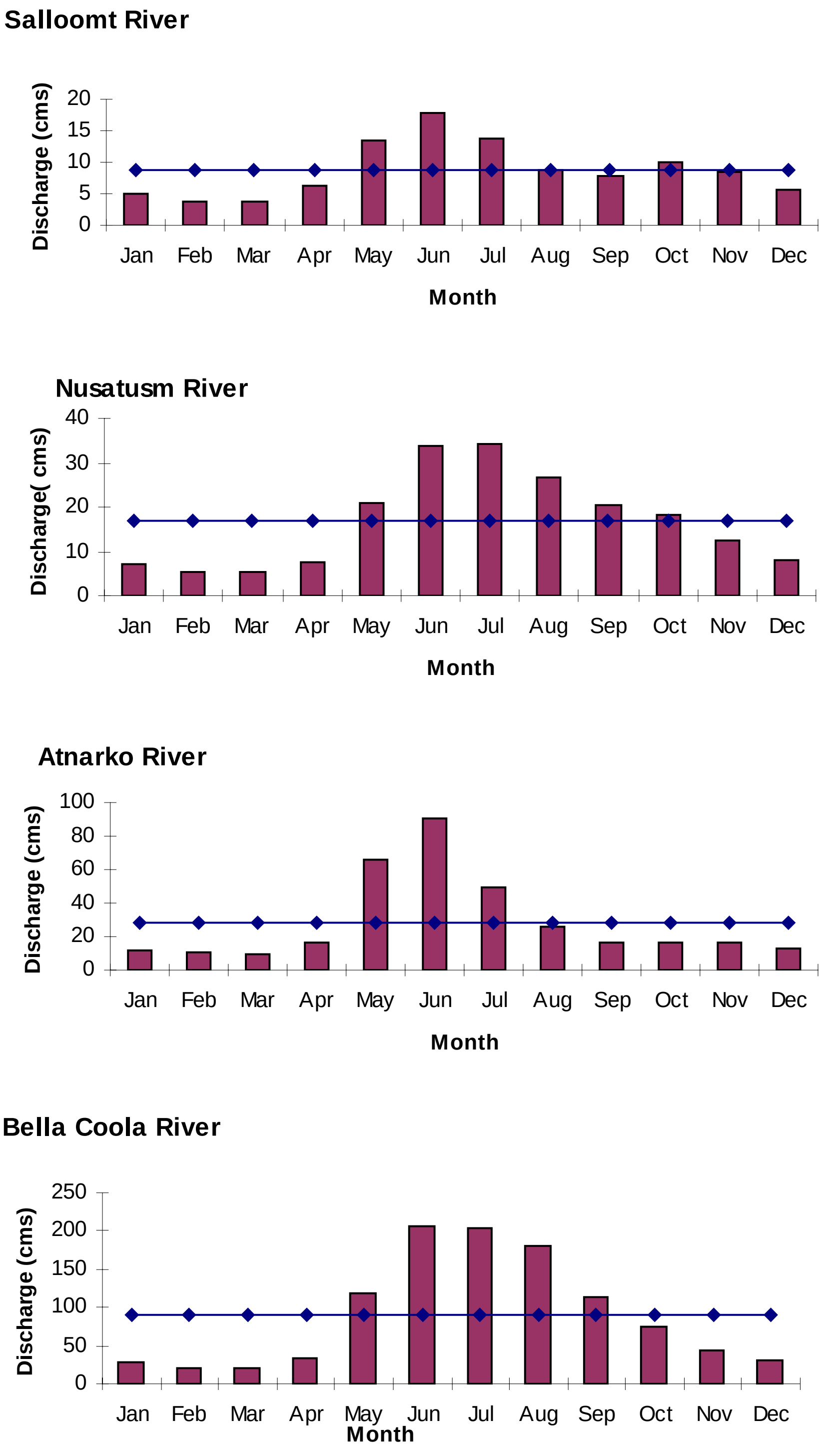


Figure 2.3 (below) shows the highwater level for station 08FB007 approximately 2 km above Burnt Bridge. The preceding aerial photos show how the flow of the Bella Coola River has changed over the years, at the same location as this water station.

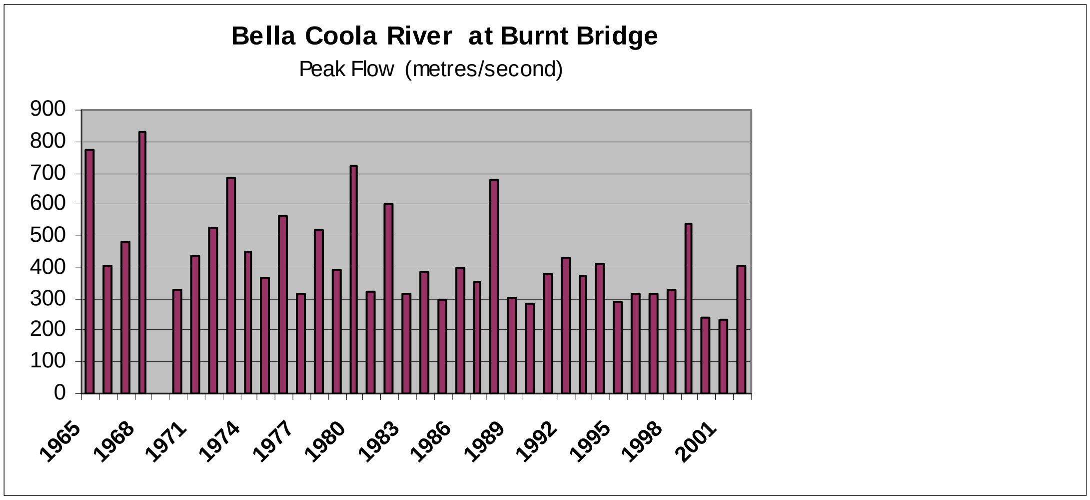


Figure 2.3 Bella Coola River Peak Flow 1995-2002

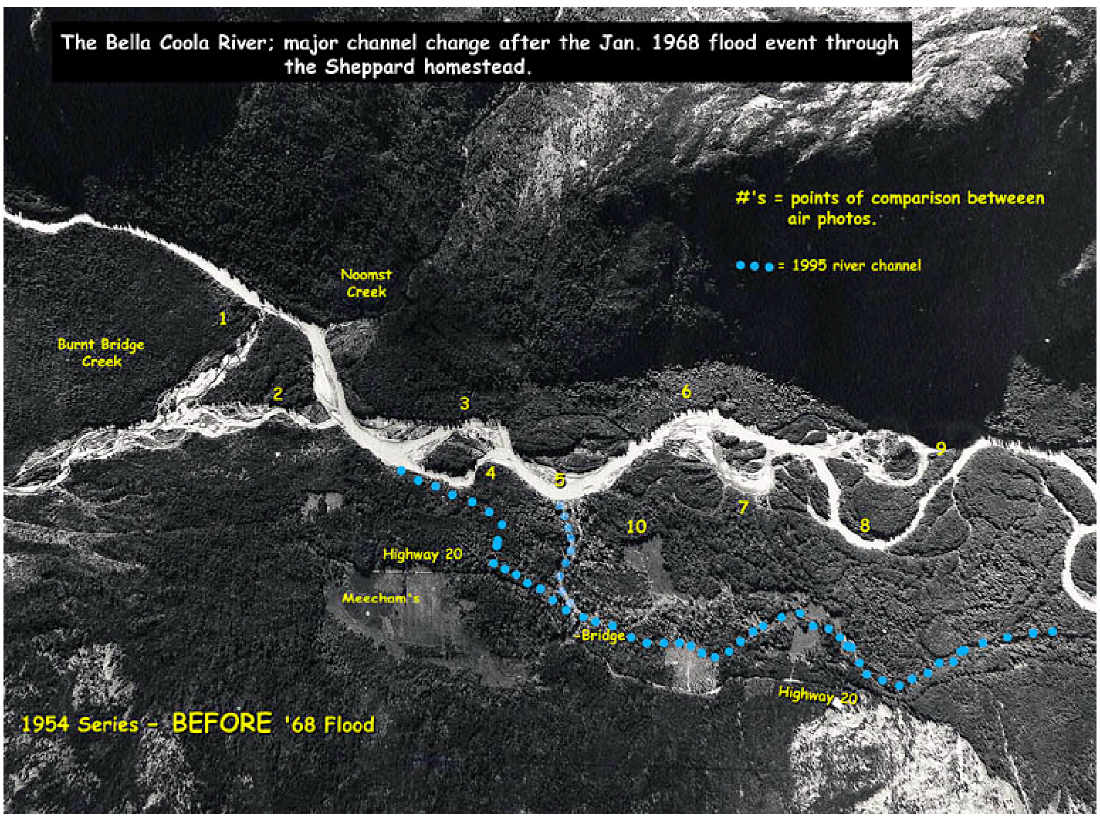


Figure 2.4 1968 Bella Coola River Aerial Photo

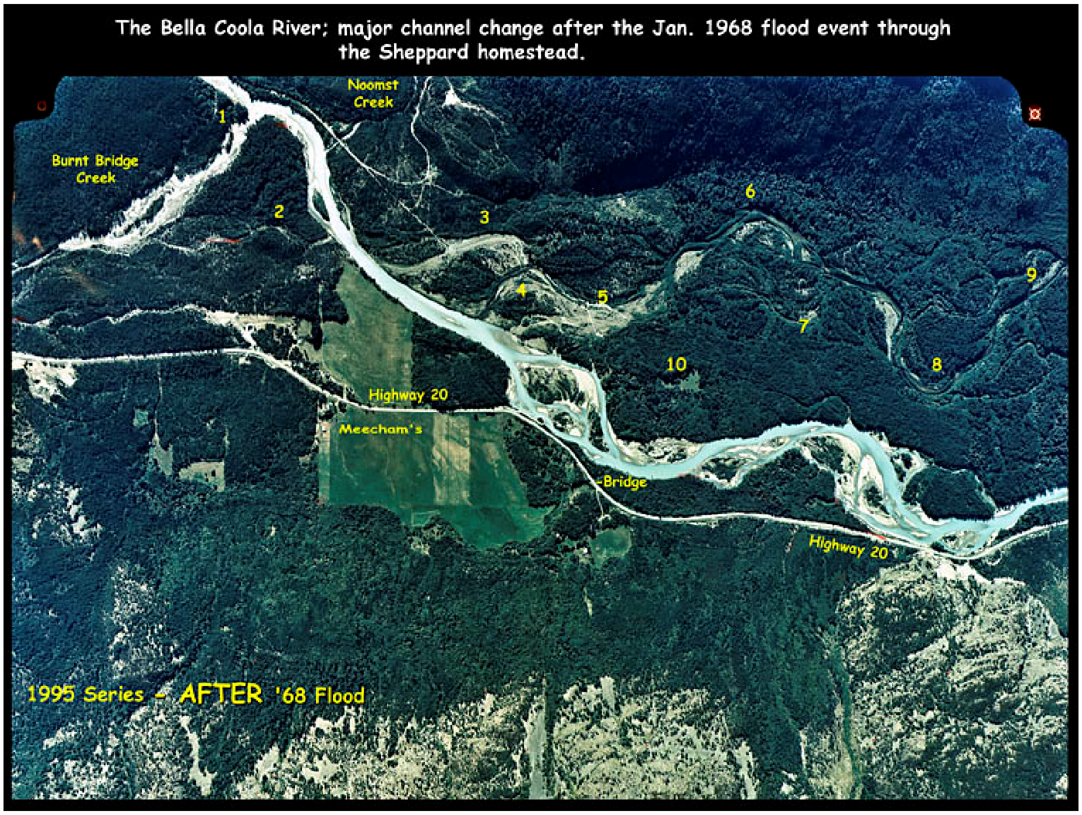


Figure 2.5 1995 Bella Coola River Aerial Photo

2.3 Water Quality

The Atnarko River is a clear water system buffered by many lakes. Total dissolved solids and pH are recorded for many of the lakes in the Atnarko system. Refer to the Appendix 2 for a list of lakes with water quality data.

Water quality data pertaining to the streams/rivers within the system are not readily available. Site specific data were collected during many restoration projects, but data collection is not continuous.

The local Community Advisor with DFO, Sandie MacLaurin, has been collecting temperature readings at 11 sites in the Bella Coola Valley since 1996. However, there are some gaps in the data for the first two years. Water quality data is also recorded at broodstock collection sites.

Observations, over the last two years indicate that there may be an increase in turbidity in the Talchako River. As the Talchako River is glacial-fed and there has been no new known sources of sediment (such as slides), the cause of increased turbidity is most likely due to receding glaciers exposing more glacial silt that is introduced into the system. Further sampling would be required to determine if this is an issue.

2.4 Employment and Income Profile

The structure and origin of employment in the Bella Coola Valley has drastically changed in the past 30 years. Historically, the main industries in the Bella Coola Valley have been forestry and fishing. At one time, 90% of the local population found employment in these sectors. However, results from the 2001 Census showed that only 7% of the population was employed in these sectors (Radstaak 2004).

Two events have significantly effected employment in forestry related jobs within the valley. Interfor's Bella Coola Office went from 20 employees in 1998, to zero in 2001. Down sizing of the Mid-Coast Forest District office in 2003 added to the unemployment rates within the communities. Historically about 30% of the employable population were employed through government-originated jobs, but with this downsizing, the majority of these jobs were eliminated (Radstaak 2004). With these employment losses came the departure of families and professionals from the Bella Coola Valley. Table 2.3 shows population losses of 21% and 19% in two of the sub-regions of the Bella Coola Valley between 1996 and 2001.

Table 2.3 Population Change by Community and Sub-Region Within the Bella Coola Valley (1996 to 2001). (Source: BC Stats and Stats Canada Data)

Community/Sub-Region	1996 Population	2001 Population	% Change
Central Coast C	925	730	(-21%)
Central Coast D	455	535	+18%
Central Coast E	215	175	(-19%)
Nuxalk	910	945	+4%

Currently there are 3 primary breakdown mills within the Bella Coola Valley. Little Valley Forest Products Ltd., is a wood processing mill that operates sporadically, although the operation is currently closed. There are also two small business loggers with small breakdown mills. It is estimated that these 3 mills and associated logging activities produce 20 person years of employment for the valley (Radstaak 2004; Lion's Gate Consulting Ltd., 2005b).

Commercial fishing was once seen as the economic powerhouse of the Bella Coola area; however, this industry has also seen significant decline in recent years. The mid 1990s saw a collapse in coho stocks throughout B.C.. Fishery closures and boat buybacks saw a reduction in both the amount of salmon caught and the value obtained (Radstaak 2004).

Today, tourism is a growing industry within the area. Radstaak (2004) reported that within the valley and surrounding area in 2001 there were approximately 60 jobs created by tourism (40 of these being year round).

The Bella Coola Valley supports some farming activity, but mainly on a part-time basis and few farms are the sole financial provider for families. The area lacks a central trade and service core because of transportation issues between local communities. Access is also poor to areas outside of the valley and this has restricted development (CCRD 2006).

Statistics Canada, indicates that community unemployment was 20% at the time of the 2001 Census. Unemployment among the Nuxalk Nation was even higher, reaching 69.5% in 1999 (Radstaak 2004). As a result of the economic crisis, 35% of the population was supported by either social transfer payments or employment insurance in 2001 (Radstaak 2004).

2.5 Land and Water Use

The following information on land and water use within the Bella Coola watershed has been obtained from various sources such as documents and/or personal communications with local, provincial, and federal government, Statistics Canada website, Land and Water BC Inc. website, and private industry reports. The latest information available from

Statistics Canada is the 2001 Census. The last Official Community Plan (OCP) was produced by the Central Coast Regional District (CCRD) in 1998 (CCRD 1998). Information that was still valid from an Official Settlement Plan that was produced for the CCRD in 1985, was used in this section (UMA Engineering Ltd. 1985).

2.5.1 Urban/Rural Development

The Bella Coola watershed encompasses 6 settlements: Bella Coola, Four Mile Indian Reserve, Hagensborg, Firvale, Stuie, and Charlotte Lake. The Bella Coola townsite, which includes the Bella Coola Indian Reserve No. 1, is situated on the south side of the Bella Coola River near its mouth into North Bentinck Arm. Proceeding eastward into the valley, is the "Four Mile" Indian Reserve and small farm holdings with interspersed larger farms. As a result of the topography, development has occurred in the floodplain of the valley and is linear in form. At Hagensborg the intensity of development increases (UMA Engineering Ltd. 1985). Hagensborg is a small community with limited commercial development, several public uses, and residences generally located on small acreage parcels. Nusatsum is a sizable settlement area located east of Hagensborg which includes a number of small commercial uses, the Ministry of Transportation and Highways work yard, a sawmill, and rural residential uses. Firvale consists of a small rural settlement at the eastern end of the valley, close to Tweedsmuir Provincial Park (UMA Engineering Ltd. 1985). Stuie is located on the Atnarko River. A small community, mostly consisting of seasonal cottages, is located on Charlotte Lake, near the headwaters of the Atnarko River.

Currently, the best population information comes for the 2001 census results. In 2001, the population of the Bella Coola Valley was 2385 people, of which 945 were of First Nation descent. Anecdotal information suggests that the population has declined further since this time due to the collapse of the local economy and subsequent emigration of valley residents (Radstaak 2004). Refer to Table 2.3 for the Bella Coola Valley population in 1996 and 2001.

2.5.2 Forestry

Over the last 50 years the west side of the Talchako, Nusatsum, Noosgulch and the Salloomt drainages have been heavily logged. Table 2.4 lists the total area that has been logged in each of these drainages. Current harvesting rates have slowed down. International Forest Products holds tenures in the Bella Coola and Talchako drainages. West Chilcotin Forest Products has tenures in the Atnarko drainage east of Tweedsmuir Provincial Park. The Provincial Forest Service continues to sell blocks through the Timber Sales program in all three drainages. As of February 2004, there were 10 proposed blocks around Telegraph Creek and approximately 10 sold blocks (northeast Charlotte Lake) in the Atnarko drainage. Kwatna Timber completed logging a small block on the east side of the Nusatsum Valley in the summer of 2004 (David Flegel pers. comm.). West Chilcotin Forest Products, a joint venture between the Ulkatcho, local community, and Carrier Lumber, also has tenure within the Atnarko drainage.

Table 2.4 Logged areas in four sub-basins of the Bella Coola watershed as of 2004 Ministry of Forest (MOF) pers. comm.)

Drainage	Area Logged (ha)*	Area not yet greened up (ha)*
Nusatsum	244.4	167.4
Salloomt	421.6	148.3
Noosgulch	263.0	222.0

Talchako	1038.6	558.6

The Nuxalk and CCRD have been working on acquiring a Community Forest License for over 10 years. In 2003, the Bella Coola Nuxalk Resource Society was formed (renamed the Bella Coola Resource Society in 2005) in order to plan, manage and apply for a community forest license. In November of 2004, a tenure opportunity of up to 30,000 m3 was offered. As of late 2005, the operating area selection process was underway through the submission of a "Proposed Operating Area" report (CCRD 2005; David Flegel pers. comm.).

Refer to Appendix 3 for a detailed history on logging in the Bella Coola Valley.

2.5.3 Parks

Tweedsmuir Provincial Park covers 173,612 ha, or 33.7%, of the Bella Coola watershed. There is a Management Plan for Tweedsmuir Provincial Park; however, it is out-dated and Park staff indicate that a new plan is needed. Once the plan is made available it will be included in the WFSP.

2.5.4 Protected Areas

The Central Coast Land and Resource Management Plan (CCLRMP) was approved and finalized at the beginning of 2006. The plan has designated two Protected Areas (Clayton/Thorsen and Burnt Bridge Creek) and one Biodiversity Area (Ape Lake) in the Bella Coola watershed. Land use zoning and governance for ecosystem-based management (EBM) is now underway. An initial suite of EBM legal objectives, implementation plans and designation of protected areas will be completed later in 2006. EBM will be fully in place in these areas by 2009 (Ministry of Agriculture and Lands 2006).

2.5.5 First Nations

The Nuxalk Nation and Ulkatcho Band both claim traditional territories within the Bella Coola watershed. The Ulkatcho were actively involved in the decisions and recommendations of the Anahim Round Table.

The Nuxalk are actively participating in the management of the food fishery. Guardians are hired by the band to monitor First Nation catches. The Nuxalk Resource Centre has been actively studying the Eulachon decline.

The Nuxalk and Ulkatcho are currently working on management options to deal with snagging fish during the food fisheries.

2.5.6 Private Land

The majority of the Bella Coola Valley bottom is private land. Some of the private land is held by Mill and Timber who logged a large proportion of it in 2000.

2.5.7 Industrial

The CCRD OCP states that future industrial activities will be directed to locate in specific locations, namely the harbour area (for those activities that require water access), the airport, and the Little Valley Forest Products Ltd. mill site. In certain circumstances, new industrial activity may be situated outside of these two areas, but only if certain criteria can be satisfied (Lion's Gate Consulting Ltd. 2005b).

Little Valley Forest Products Ltd. operates a small sawmill outside Hagensborg. A beehive burner continues to be in operation and has been opposed by some local residents. A fish creek running through the property was widened at one time to provide the mill with water in the event of fire. This is no longer maintained for water use; however, the creek was never restored.

2.5.8 *Agriculture*

The Agricultural Land Reserve (ALR) is located throughout the Bella Coola valley from the Necleetsconnay River, at its western extent, to east of Stuie, along the Atnarko River (ALC 2006). The Bella Coola Valley is comprised of a small number of cow, calf operations, hay farms, and small market gardens. There are 3 nursery/greenhouse businesses, and a growing and active Farmer's Market. Within the valley, there are approximately 18 beef /hobby farms with 742 acres in production which grow mainly hay for feed (Radstaak 2004).

Topography and soils restrict most agricultural activities to a narrow area along the Bella Coola River valley (CCRD 2006). The majority of this agricultural land is within the valley floodplain and therefore has a high potential for impacting fish and fish habitat (Lion's Gate Consulting Ltd. 2005b). There are well over 10,000 acres of potential agricultural land within the valley. However, only a small portion of this land is used for that purpose, owing to the short growing season and the distance from markets (Leaney and Morris 1981). In 2001 there were approximately 1,800 acres of land in production (Radstaak 2004). A substantially increase in agricultural activity in the region was observed between the 1991 and 2001 Census (CCRD 2006).

2.5.9 *Tourism*

The Bella Coola valley has seen strong growth in the tourism industry within the last ten years (Radstaak 2004). In 2001, tourism accounted for 5% of the employment in the valley. However, this percentage was seasonal and confined to summer and fall months when it catered to the recreational and sportfishing cohort. It has not been until recently that the valley has seen an interest in winter outdoor recreation. In 2003, Bella Coola Heli-skiing and Dreamcatcher Heli-skiing were awarded heli-skiing tenures on Crown land in the Bella Coola area (Lions Gate Consulting Ltd., 2005a).

The selection of adventure and eco-based opportunities within the area is limited, but growing. Hiking/backpacking, mountaineering, kayaking, canoeing, marine cruising, mountain biking, horseback riding, wildlife viewing, nature tours, cultural tours, air tours, snowmobiling, photography and general sightseeing are all possible within very short distance of the Bella Coola Valley. There are 31 adventure operators offering land-based and water-based activities, but the majority are part-time businesses, while others are based outside the region (Lions Gate Consulting Ltd. 2005a).

2.5.10 *Transportation*

Access to the waters of the Bella Coola watershed is limited. Many of the lakes along the Atnarko River are accessible only by plane. Although Highway 20 runs along the Bella Coola River, access to the river for fishing and boating is limited since much of the land adjacent to the river is privately owned.

There is a network of logging roads through the watershed. Many of the roads have been deactivated; although, there is local pressure from the tourism society and other residents to keep the Talchako Forest Service Road (FSR), Clayton Falls FSR, and Nusatsum FSR mainlines open. During the summer of 2005, MOF completed road maintenance works on the Clayton Falls FSR up to its proposed protected area (approximately 14 km), including bridge installation, brushing, culvert installation, ditching, repairing water bars, and widening slough. Also in 2005, maintenance works were completed on the Nusatsum FSR up to Odegaard Falls, including resurfacing, ditching, brushing, and filling (CCRD 2005). There are logging roads around Charlotte Lake and into Telegraph Creek on the plateau.

A voluntary motor boat ban has been placed on the Bella Coola River. The Nuxalk Nation has enforced this in areas where the river flows through reserve land. The Bella Coola Watershed Conservation Society (BCWCS) has formally applied for a motor boat restriction on the Bella Coola, Atnarko and Talchako rivers on behalf of the Nuxalk Nation, and the CCRD. The outcome of this application is pending government approval.

2.5.11 Utilities

The Bella Coola Valley relies on both hydro and diesel generation for its electrical needs. Clayton Falls Hydro Generation Station provides hydro powered electricity for the summer months and diesel generation takes over during the winter low flows period. There is interest in developing some small hydro-electric generating systems on watercourses within the valley. Currently, there is one proposal to develop a 1.5 megawatt plant on Cacoohtin Creek (Radstaak 2004). The Central Coast Power Corporation has active applications with Land and Water BC Inc. (LWBC) for power generation on the Noosgulch and Atnarko rivers.

2.5.12 Solid Waste Management

Solid waste in the Bella Coola Valley can be disposed of at the Thorsen Creek Landfill, which is located at the south end of Thorsen Creek Road. The Bella Coola Landfill services approximately 2139 individuals (Radstaak 2004). In 2004, an electric fence was installed around the landfill in an effort to bear proof all wastes.

Prior to the development of the Thorsen Creek Landfill there was a dump located 1 km east of the Bella Coola townsite. There are also many “private dumps” located throughout the Bella Coola Valley, since it is relatively common for some residents to dispose of garbage in their backyards.

2.5.13 Freshwater Withdraws

Residents of the Bella Coola Valley obtain their domestic water from one of four sources, depending on where they live within the valley. The Bella Coola Waterworks District supplies water diverted from Tastquan Creek to the Bella Coola townsite and “Four Mile” (Radstaak 2004). Residents living between Thorsen Creek and Nusatsum are supplied water from the Hagensborg Waterworks District. The district has a water license to draw from Snootli Creek, just upstream from the Snootli Creek Hatchery (Leaney and Morris 1981). The Nusatsum Waterworks District has a supply network located at Smith Subdivision, which supplies approximately 27 houses. The remainder of valley residents obtain their domestic water from wells or watercourses located near or on their properties (Radstaak 2004).

The number of water licenses per waterbody within the Bella Coola Watershed is shown in Table 2.5. These water licenses are associated with various uses including: conservation, domestic use, dust control, enterprise, hatchery, irrigation, land improvement, ponds, power, lawn/garden, stock and waterworks. For a complete list of water licenses and associated uses, quantity, waterbody, and licensee, refer to Appendix 4.

Table 2.5 Waterbodies with water licenses (LWBC 2004)

Waterbody	Number of Licenses	Waterbody	Number of licenses	Waterbody	Number of licenses
Allertson Spring	1	Corbould Creek	2	Schubert Spring	2
Andrew Creek	1	Earle Brook	3	Schulstad Spring	1
Assanany Creek	1	Evenson Creek	5	Snootli Creek	1
Atnarko River	3	Gibbs Brook	1	Snootli Creek	3
Bella Coola River	1	Gross Creek	3	Stener Creek	3
Bellay Creek	1	Henry Creek	1	Talchako River	2
Cacoohtin	1	Horsetail Spring	1	Tatsquan Creek	3
Carlson Creek	1	Hotnarko River	2	Thorsen Creek	1
Charlotte Lake	7	Maydoe Creek	4	Weldon Spring	1
Cliffe Creek	1	Nooklikonnik Creek	1	Young Creek	1
Collins Creek	2	Ratcliffe Creek	2		
Coral Spring	1				

2.5.14 Foreshore/Marine Development

The Bella Coola estuary covers approximately 150 ha (370 ac) at the mouth of the Bella Coola River (Leaney and Morris 1981). For information on the current licenses held with Land and Water BC Inc. (LWBC) for the land surrounding the estuary, as well those within the estuary and surrounding waters, refer to the map in Figure 2.6.

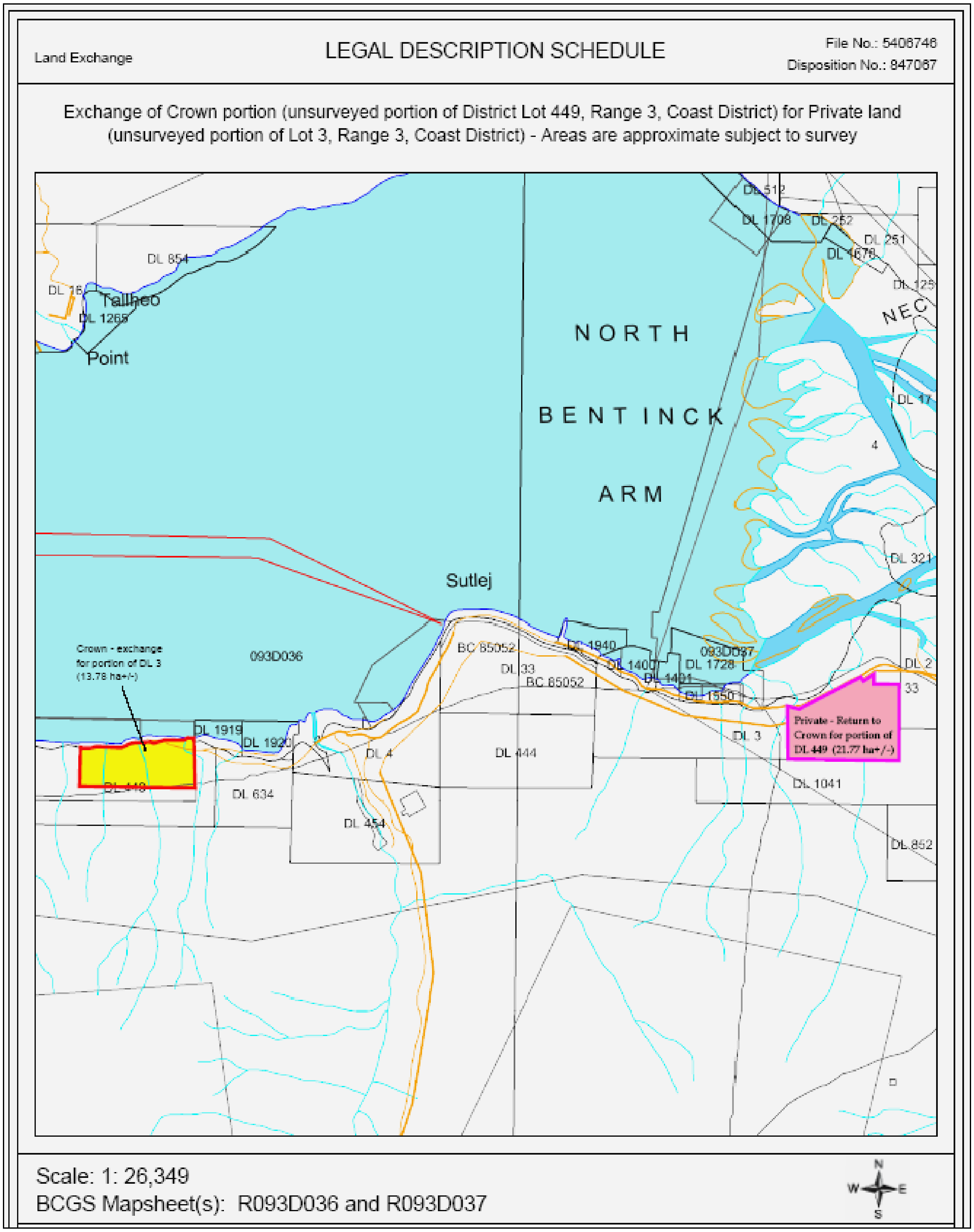


Figure 2.6 Land and foreshore licenses held with LWBC for the Bella Coola Estuary and adjacent areas (Source: LWBC website)

Current foreshore/marine development is concentrated near the southwest corner of the estuary. Two log sorts mark the western extent of development. Clayton Falls Hydro Generating Station is located immediately east of the log sorts, near the mouth of Clayton Falls Creek. East of this is Interfor's storage area which includes a floating breakwater, docks, floats, and floating and upland buildings. B.C. Ferries has a Ferry Terminal for the Discovery Coast Passage ferry, and adjacent to this there is a Government Wharf, which provides a place to dock commercial and private boats. The Bella Coola Harbour, operated by the Bella Coola Harbour Authority, is located in this concentrated area as well. Shell Canada (Saugstad Contracting Ltd.) has a bulk fuel storage facility upland from the harbour. Abandoned B.C. Packers Ltd. buildings are suspended over the marine waters beside the harbour and in the upland area. There is generally log booms located east of these buildings. On the north side of the estuary, is the Talheo Cannery Inn, which no longer operates as a cannery but for tourism purposes.

The Ministry of Lands, and Housing completed the “North Bentinck Arm Foreshore Study”, which made recommendations for foreshore use. Most of the foreshore within the Plan boundaries was slated for conservation use (UMA Engineering Ltd. 1985). Recently, a steering committee was formed as part of the Waterfront/Estuary Plan, and is in the process of collecting information on the current state of knowledge regarding the estuary (CCRD 2005).

2.5.15 Mineral Resource Development

There are numerous gravel extraction sites for local use within the Bella Coola watershed, three of which are located near Nusatsum River (Ministry of Transportation gravel pit), Thorsen Creek, and Noosgulch River. The Cariboo-Chilcotin Land Use Plan identifies a high potential for mineral extraction in the land surrounding Charlotte Lake (Commission on Resources and Environment 1994).

A granite and gravel quarry has been proposed to be developed immediately southeast (inland) of the existing Government Wharf (on District Lot 444). The next step in the planning process for this development is the preparation of an Environmental Assessment. Since the product would be for export purposes, a marine loading facility is proposed to be constructed in conjunction with this development. The loading facility would be located on the shore of North Bentinck Arm, further west from the quarry site (District Lot 449) (Refer to Figure 2.6) (Gartner Lee Limited 2004; LWBC website; Radstaak 2004).

2.5.16 Sewage Treatment

There is no organized sewage treatment system in the Bella Coola area. Sewage is treated in individual septic tanks located throughout the valley.

2.5.17 Flood Control

Efforts have been made to control the Bella Coola River in the Hagensborg area since it was first settled in 1894. However, it was not until two severe floods occurred in 1965 and 1968, that more organized and extensive flood-control measures were taken by the Provincial Government. The following provides a timeline of these flood control measures on the Bella Coola River and Thorsen, Snootli, and Nooklikonnik creeks between the years of 1968 and 1974.

1968 and 1972 1,417 m long dike constructed on the Bella Coola River, in eastern area of Hagensborg

1968 1,036 m long dike constructed on the Bella Coola River, in western area of Hagensborg

1968 732 m upstream of Highway 20 bridge on Nooklikonnik Creek, diked roads and other bank protection structures were constructed on protruding river banks

1968 Rock dike built on the right bank of Snootli Creek

1968 Dike roads and bank protection works constructed on outside bends of Thorsen Creek for 914 m upstream of the Highway 20 bridge and 244 m downstream

1968 Riprapping installed along the Thorsen Creek side of the dividing wall that separates Noohalk and Thorsen creeks (Leaney and Morris 1981).

Tempest (1974) reviewed the efforts to control flooding in the Bella Coola Valley and recommended the following major improvements which have been undertaken since 1974. The Provincial Government repaired and reinforced existing works on the Bella Coola River. A long rock groyne was constructed to divert water away from the village of Firvale into an old river channel. In the lower reached of Burnt Bridge Creek, the streambed was deepened and banked to confine the flow in one channel. Gravel and log debris were removed from the lower reaches of the Salloomt River and used to reinforce the adjacent left bank of the stream. The groynes in Thorsen Creek were replaced. In addition, 66 m (200 ft) of riprap were placed along the right bank of Thorsen Creek, near its mouth (Leaney and Morris 1981).

Soon after 1974, The Department of Indian and Northern Affairs conducted bank protection works along Tastquan Creek, near its confluence with the Bella Coola River. These measures were to protect the Bella Coola Indian Reserve on the south side of the Bella Coola River, which was threatened by flooding of the creek. In conjunction with this work, bank protection was constructed along the Bella Coola River, downstream of the mouth of Tastquan Creek (Leaney and Morris 1981). The height of the Snootli Creek dike was increased in 1981.

For a complete list of the current flood control structures that exist on watercourses within the Bella Coola watershed, refer to Table 2.6.

Table 2.6 Bella Coola Flood Control Structures (Mckim 2003)

Water Body	Structure	Length of Structure	Height of Structure
Bella Coola River (McLellan Rock)		150 m	2.0 m
Bella Coola River (Airport)	Riprap and berms	1223 m	6-8 m
Thorsen Creek	Berms	1817 m	4-8 m
Bella Coola R (Upper Hagensborg)		1413 m	3-6 m
Nooklikonnik Ck		1250 m	3-6 m
Nusatsum River	Berm and riprap	370 m	3-6 m
Snootli Creek	Berms	273 m	Varies
Salloomt River	Gravel and riprap	300 m	1.2 m
Burnt Bridge Ck		237 m	3 -6 m
Bella Coola River (Firvale)		131 m	3-6m

3.0 Fisheries Resources

The Bella Coola watershed can boast the presence of five species of pacific salmon, rainbow/steelhead trout, Dolly Varden, cutthroat trout and numerous other fish species. The watershed has one of the largest returns of pink salmon in British Columbia.

Both the Nuxalk and Ulkatcho Nations rely on fish resources in the watershed for their food fishery, and sport fisherman from all areas of the world come to Bella Coola to take advantage of the fishing opportunities available within the watershed and the connecting marine area. Commercial fishers also benefit from the salmon produced in the watershed.

Information on fisheries resources within the Bella Coola watershed was collated by conducting a thorough review of fish and fish habitat studies in the watershed. During this research process, it became evident that limited fisheries data exists for some watercourses and species within the watershed, and much of the information is decades old. For example, detailed information pertaining to fish habitat and fish density is available for the Bella Coola River and most of its tributaries; however, most of the information is limited to the extent of coverage in any given tributary, and for several tributaries there is virtually no information available. Consequently, some of the fish species discussed in the following section will contain a more detailed description than others. Any pertinent watershed-specific information contained within the reviewed studies has been included in this section to provide at least a broad overview for each species.

A number of adult, juvenile, and habitat assessments have been conducted within the Bella Coola watershed. However, in many cases the data collected is limited to particular locations and times (in some cases only one year of counts). Therefore, this data is often too general to provide even a rough indication of relative run strength for Bella Coola/Atnarko fish (i.e. it cannot be included in the Adult and Juvenile Abundance sections), but it is useful in determining fish presence and habitat utilization of the Bella Coola River and its tributaries. Therefore, relevant data from these assessments has been included in various sections including: Life History, Fish Distribution, Spawning Habitat, and Rearing Habitat.

The following section also discusses some of the limiting factors to production for each fish species. It should be noted that limiting factors to production are site specific and vary with time; therefore, the factors discussed in this section should not be considered static. That being said, this section does include stream-specific limiting factors that have been identified in recent habitat assessments, as well as, general limiting factors that are known to pertain to particular species. It is also important to note that the fry productive capacities presented in this section may vary from year to year. Higher values will occur in years with smaller mean fry sizes and lower values occur in years with larger mean fry sizes.

The following section provides an overview for all known fish species present in the Bella Coola watershed. In some cases, the information presented is general (i.e. from reference books) since watershed-specific data does not exist.

3.1 Chinook Salmon (*Oncorhynchus tshawytscha*)

3.1.1 Life History

There are two general types of chinook in the Bella Coola watershed; the Atnarko group with adult returns that peak in September, and the Bella Coola tributary group (i.e. Nusatsum, Salloomt and Noosgulch chinook) with most adults returning in July (Hilland Unpublished(b)). The eggs incubate throughout the winter and emerge as fry in March (Leaney and Morris 1981). Chinook will typically out-migrate after rearing for a period in freshwater; however, some will remain in freshwater for up to a year. Some “spring type” chinook will smolt in the estuary. Most chinook will spawn in their 4th or 5th year, but some will spawn as late as their 7th year. Chinook that return to spawn in their 3rd year are referred to as jacks (Hart 1973).

This general life history information mentioned above is supported by recent data collect by DFO through dead-pitches of Atnarko chinook which shows that the majority of chinook are ages 41 and 51 (See Table 3.1).

Table 3.1 Atnarko Chinook Ages from Dead-pitch Only.
(Data from: Matt Mortimer, DFO, Biologist, Stock Assessment)

	Percent Age Composition				
G-R Age	**2005**	**2004**	**2003**	**2002**	**2001**
2_1			1.0	0.3	
3_1	2.7	2.9	5.6	7.1	13.9
3_2					
4_1	40.5	29.4	24.5	47.6	11.1
4_2			6.1	2.4	7.2
5_1	31.1	52.9	23.0	22.0	33.2
5_2	16.2		31.6	7.8	23.2
6_1	4.1	14.7		0.7	0.8
6_2	5.4		8.2	12.2	10.1
6_3					0.3
7_2					0.3
# Samples	68	34	238	296	388

Note: 2001 to 2004- scales read at lab after CWT's

Note: 2005- scales read at lab before CWT's (ages were corrected after)

The Snootli Creek Hatchery has compiled run and spawning timing data for the Salloomt and Nusatsum rivers (Bella Coola tributary chinook group). The run timing data was obtained from CWT recoveries in the Nuxalk food fishery (1990-2005) and the spawning timing data is from egg takes conducted by the hatchery over the last 10 years. The results show that Nusatsum chinook enter this system between June and July and Salloomt chinook enter at the end of May to July. In both stocks, spawning took place from August to early September (Willis Unpublished).

Fisheries data compiled by Hilland (1979b) provides information on chinook fry/smolt out migration times. A chinook fry trapping study was conducted on the Atnarko River in 1974 to assess ocean migration patterns and fishery contribution. The trapping results showed that chinook fry migration peaked in May. Another fry study conducted on the Atnarko River in 1979 resulted in some catches of chinook smolts. The majority of chinook smolts were caught between July and early August (Hilland 1979a). This indicates that some chinook fry will remain in freshwater for some time following emergence.

3.1.2 Fish Distribution

Distribution of chinook is mainly concentrated in the Atnarko River; although, some chinook utilize the waters of the Talchako and tributaries in the Lower Bella Coola. Within the Atnarko River, chinook are primarily distributed from Hotnarko River to Janet Creek in the upper Atnarko River, and from Alger Creek to the confluence of the Talchako River in the lower Atnarko River (Sandie MacLaurin pers. comm.). The South Atnarko River is the upper limit for chinook on the Atnarko River (DFO 1989; FISS 2005). Chinook have also been documented in Reaches 1 through 7 in the Talchako River (Summit 1997).

Tributaries in the Lower Bella Coola that support small populations of chinook include the Salloomt, Nusatsum and Noosgulch rivers. Chinook have also been documented in Thorsen, Snooka, Snootli, Nooklikonnik, and Cacoohtin Creeks (FISS 2005).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.1.3 Population Abundance and Status

To Be Added

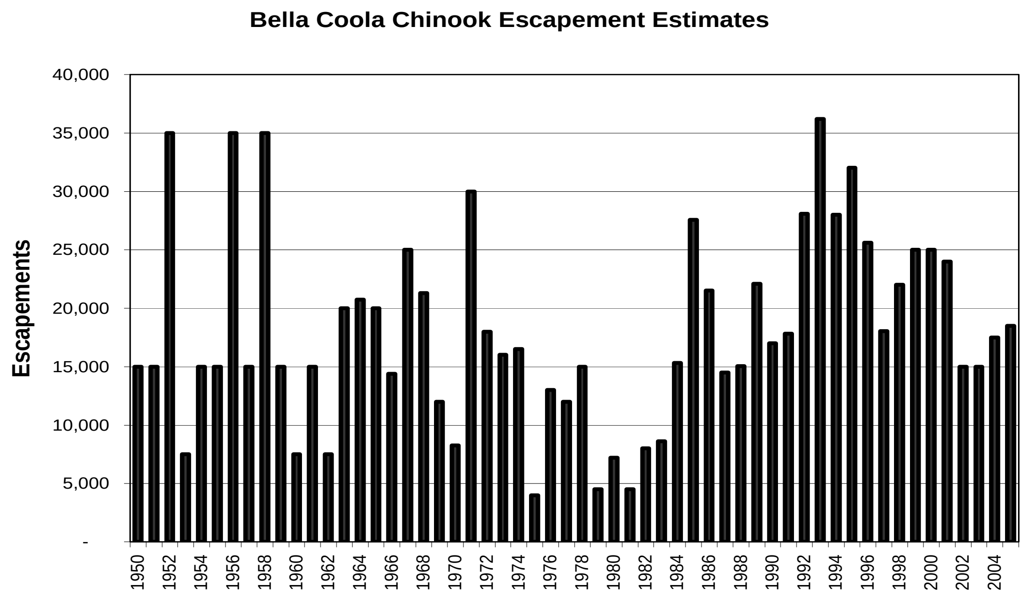
3.1.3.1 Adult

DFO has estimated chinook escapements to the Bella Coola watershed since 1950 and these estimates are presented in graph form in Figure 3.1. For a list of total estimated escapements to the Bella Coola watershed for all available species and years, refer to Appendix 6. These escapement estimates include a portion of enhanced fish. For a detailed description of enhancement activities in the Bella Coola watershed, refer to the "Enhancement History" section of this report.

During the 1950's and 1960's, annual escapement estimates averaged about 20,000 chinook. There was a period of low escapement between 1979 and 1983 when the number of spawners was estimated at less than 10,000. Since 1984, adult abundance has increased and within the last 15 years, chinook salmon escapement to the Bella Coola have ranged between 14,000 and 35,000 in 1993 (which had not occurred since 1958). This increase may be due in part to local hatchery production that commenced in the 1980's and, possibly, increased enumeration effort associated with broodstock collection. In some years, an estimated 30-40% of the total chinook escapement to the Bella Coola watershed are of hatchery origin (Hilland and Lehman 2005).

The fisheries management target escapement for Bella Coola chinook is 25,000 (Thompson 1989). Escapements have exceeded this target for 4 of the last ten years and have been lower than the target in the past 5 years, ranging between 15,000 and 24,000.

Figure 3.1 Bella Coola Chinook Estimated Escapement (Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit, DFO). Please note that 2005 escapement figures shown are preliminary.



3.1.3.2 Juvenile

Data on juvenile chinook abundance in the Bella Coola watershed is limited. D. Burt and Associates undertook an assessment of most anadromous portions of the Bella Coola watershed in 1997 to determine the status of steelhead and anadromous cutthroat populations and their freshwater habitats (Burt 1998). Other rearing species, such as chinook, coho, and Dolly Varden, were also included in the assessment; however, they were reported in less detail than the target species. Fry abundance was determined using 2-catch electrofishing removal techniques within a netted enclosure. Based on the summary and analysis of population statistics for chinook fry, the total chinook fry population for the Bella Coola watershed in 1997 was estimated at 332,032 fish (above the projected capacity as determined by this report). It is important to recognize; however, that this estimate is based on only one year of data. For a complete list of the estimated chinook fry population in 1997 per sampled stream, refer to Table 3.2 below.

Stream	Reach	1997 Pop	Max Pop
Atnarko System			
Mainstem	1	119,260	61,544
	2	29,839	34,955
	3	0	33,706
	4	10,263	12,316
	5	-	-
	6	471	1,220
	7	-	-
	8	0	2,498
Total Atnarko Mainstem		**159,833**	**146,239**
Camera Channel	1	515	2,959
Sugar Camp Ck.	1	25	22
Hotnarko Cr.	1	2,993	9,265
South Atnarko R.	1	0	2,190
Total Atnarko System		**163,366**	**160,675**
Bella Coola System			
Mainstem	1	101,942	71,179
Walker Is. Sidechannel	1	0	1,169
Airpotr Sidechannel	1	0	4,278
Tastsquan Ck.	1	8,317	452
Thorsen Ck.	1	3,202	1,494
Noohalk Ck.	1	270	4,326
Snooka Ck.	1	260	1,287
Nooklikonnik Ck.	1	810	1,282
Fish Ck.	1	612	1,827
Hagensborg Sl.	1	1,033	2,921
Salloomt R.	1	6,212	5,986
Mill Pond Ck.	1	17	75
Nusatsum R.	1	30,776	15,455
Noosgulch R.	1	1,440	2,942
Talchako Mainstem	1	13,775	20,840
Total Bella Coola		**168,666**	**135,513**
Grand Total		**332,032**	**296,188**

Table 3.2 Chinook salmon estimates of 1997 and capacity fry rearing populations. Reproduced from Burt 1998.

3.1.4 Genetic Distinctiveness

Upper and Lower Atnarko River chinook and lower Bella Coola tributary chinook are spatially discrete (their upstream migration and spawning times differ) (Hilland Unpublished(b)). DFO has collected DNA samples from chinook in the Nusatsum River in 1996 (43 samples), the Salloomt River in 1996 (96 samples), the Atnarko River in 1991 and 1996 (275 samples), and the Upper Atnarko River in 1996 (155 samples).

3.1.4 Habitat

To Be Added

3.1.5.1 Spawning

Chinook have been documented to spawn throughout the Atnarko River, in the Talchako River, and in tributaries to the Bella Coola River. Chinook spawning is heaviest from Hotnarko River to Janet Creek in the upper Atnarko River, and from Alger Creek to the confluence of the Atnarko River in the lower river. (DFO 1989; Leaney and Morris 1981; Sandie MacLaurin pers. comm.). There is also a major chinook spawning area located between Elbow and Rainbow Lake on the South Atnarko River (FISS 2005). The area above Elbow Lake has been described as good spawning and rearing habitat; however, the South Atnarko River itself was described as having only fair holding habitat and limited spawning habitat (FISS 2005). Adult chinook are known to hold in lakes prior to spawning (Pollard et al. 1997). Limited data exists on spawning locations above Stillwater Lake due to public access issues. Chinook also utilize the Atnarko Channel for spawning (Hilland and Lehman Unpublished).

A Talchako River study was conducted in 1977 as part of a wildlife and fisheries inventory of Tweedsmuir Park, which was initiated in 1975. This study confirmed the existence of spawning and rearing habitat for chinook in the Talchako River (Nelson et al. 1998).

Within the Bella Coola tributaries, chinook will spawn in the lower Noosgulch River (Reaches 1-3) (Summit 1997), Reach 1 of Nooklikonnik Creek, Reaches 1-3 of the Salloomt River, and in Reaches 1-3 of the Nusatsum River (although Reach 2 of the Nusatsum River has been documented as poor spawning habitat) (FISS 2005). A major spawning area is located in the lower 4.0 km of the Salloomt River (DFO 1989).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.1.5.2 Rearing

Hilland (1979a) conducted a study in 1979 on Atnarko River chinook fry using inclined plan traps. During the study, young chinook were observed utilizing the tributaries and side channels of the lower Bella Coola River for rearing purposes.

As mentioned above, chinook spawning has been documented between Elbow and Rainbow Lake on the South Atnarko River system. The area above Elbow Lake has been described as good rearing habitat (FISS 2005).

The Talchako River study conducted in 1977, confirmed the existence of rearing habitat for chinook in the Talchako River (Nelson et al. 1998).

3.1.5.3 Productive Capacity

Productive capacity assessments have been conducted for some streams within the Bella Coola watershed; however, these assessments are limited since they have been conducted sporadically for only a few streams and species.

Burt (1998) calculated the carrying capacity for various streams in the Bella Coola watershed using two models developed by the Province to estimate maximum salmonid densities in fluvial habitats in British Columbia. These models were based on field data collected in 1997, including mean fish size and alkalinity of the stream at its critical period stream flow. The results are presented as maximum population estimates in Table 3.2. The fry population data from 1997 showed that the Bella Coola watershed was operating above carrying capacity for chinook fry; this included the Bella Coola mainstem, which was underutilized by other salmonid species. Reaches 3, 6, and 8 of the Atnarko mainstem were the only areas that appeared under-recruited in 1997. It is important to note that these estimates represent only one year of data which is based on a selected model.

3.1.5.4 Limiting Factors to Production

The limiting factors for production of chinook in the Bella Coola watershed have not been fully investigated. However, it has been observed that Atnarko River chinook production is somewhat stable, whereas populations in the Lower Bella Coola tributaries are at less than historic levels. Therefore, this may indicate that there are some limiting factors to production in the lower tributaries (Sandie MacLaurin pers. comm.).

Predation may also be a limiting factor for chinook salmon since they may be consumed during incubation, alevin, fry, and adult life stages by other salmonids, caddisfly larvae, sculpins, water ouzels (birds), herons, mergansers, mink, martin, bears, seals, and otters. However, in abundant years, this is likely not critical in controlling numbers (Sandie MacLaurin pers. comm.).

3.2 Coho Salmon (*Oncorhynchus kisutch*)

3.2.1 Life History

Coho adult migration into the Bella Coola watershed generally occurs between July and December (Sandie MacLaurin pers. comm.). Spawning takes place between September and January (Hilland Unpublished(b)) and peaks in November (Leaney and Morris 1981). The eggs hatch in the winter where they will remain in the gravel for about 2-3 months, emerging predominantly in April. After emergence, the fry will rear in the streams and side channels of the Bella Coola/Atnarko River for varying periods of time, but typically for one year (Hart 1973; Leaney and Morris 1981). Some fry will migrate to saltwater immediately. Coho will spend 18 months to 3 years in the ocean before returning to freshwater to spawn.

This general life history information mentioned above is supported by fisheries data collected at the Hagensborg Slough Fish Fence from 1998 to 2001 by the Central Coast Fisherman's Protective Association (CCFPA) (CCFPA 2000; Willson 2001a; Anon 1999). The Hagensborg Slough is located on the South side of Bella Coola River mainstem opposite the confluence of the Salloomt River. The Association monitored the fence in the spring to determine the timing and abundance of coho smolts and again in the fall to estimate spawner abundance.

The 1998 data showed that, out-migration of coho juveniles took place from the beginning of the project (April 16th) until the 1st week in July. Adult coho salmon were first observed at the Hagensborg Slough Fence at the beginning of October in 1998.

In 2000, migration of adult coho salmon into the Hagensborg Slough and tributaries occurred from October 20th until the last day of monitoring, December 18th. Out-migration of coho juveniles from the Hagensborg Slough occurred throughout the monitoring period (March 29th to June 23rd). Peak out-migration took place in mid-May (CCFPA 2000).

In 2001, the downstream coho migration took place from April until the end of monitoring, in June. Peak of out-migration was from the 1st to the 2nd week of May. Coho fry-of-the-year were captured from the end of May to the end of June when the program ceased. Adult coho were migrating into the system from mid-October to 3rd week in November with the peak occurring during the first two weeks of November (Willson 2001a).

The CCFPA undertook an adult enumeration study at the Atnarko Tower on the Atnarko River from August 1st to October 26th, in 2001. It was observed that the coho run occurred from mid-August through until January. The peak of the Atnarko coho run was observed on October 16th (Willson 2001b).

In October 2000, MidCoast Aquatics (2000) conducted a fish habitat survey of the Firvale Back Channel, which is a side channel area of the Bella Coola River. Coho were captured during the survey and ranged in size from 45 mm to 111 mm. G3 Consulting Ltd. (2000a) conducted a Level 1 and Level 2 Fish Habitat Assessment in March of 2000 on The Ponds, an off-channel area of the Bella Coola mainstem. During the assessment, coho were captured which ranged in size from approximately 62 mm to 87 mm. Results from these surveys suggest a varied composition of age classes of juvenile coho within off-channel habitat of the Bella Coola River.

3.2.2 Fish Distribution

Coho generally utilize all accessible reaches of streams, including small 1st and 2nd order streams (Pollard et al. 1997), and the same is true for the Bella Coola system.

Coho have been documented in virtually every system in the Bella Coola watershed, including the Bella Coola River and its tributaries, in the Atnarko River from 0 – 55.0 km (DFO 1989), and in Reaches 1 through 7 on the Talchako River (Summit 1997). Coho are present within the following tributaries: Tastquan, Thorsen, Snooka, Noohalk, Snootli, Fish, Stenner, Croft, Molly Walker, Sato, McLellan, Hagensborg Slough, and Cacoohtin creeks, as well as the Salloomt and Nusatsum rivers (FISS 2005; Sandie MacLaurin pers. comm.).

The Bella Coola Valley Coho Initiative has documented coho in Molly Creek, which is a tributary to the Talchako River (FISS 2005).

The South Atnarko River has been documented as the upper limit for coho in the Atnarko system. Coho have been described as numerous in the lagoon at the southern end of Elbow Lake. The area above Elbow Lake has been described as good spawning and rearing habitat; however, the South Atnarko River itself was said to have only fair holding habitat and limited spawning and rearing habitat (FISS 2005).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.2.3 Population Abundance and Status

To Be Added

3.2.3.1 Adult

"At present there is a lack of reliable information regarding Central Coast coho stocks" (Mortimer 2002). However, there have been indications that coho stocks in Thorsen Creek and the Lower Bella Coola River have declined below historical levels. This prompted an adult coho assessment to be conducted on Thorsen Creek in 1999 to estimate escapement (Mortimer 2002).

DFO has estimated coho escapements to the Bella Coola watershed since 1950 and these estimates are presented in graph form in Figure 3.2. For a list of total estimated escapements to the Bella Coola watershed for all available species and years, refer to Appendix 6. These escapement estimates include a portion of enhanced fish. For a detailed description of enhancement activities in the Bella Coola watershed, refer to the "Enhancement History" section of this report.

Escapement estimates for the Bella Coola coho have ranged between 4,000 (in 1967) to 75,000 which occurred most recently in 1964. Low coho abundance levels on the coast in the 1990's resulted in closures and/or restrictions to the recreational and commercial fisheries from 1998-2003. Escapements to the Bella Coola watershed increased during this period. Escapements are available for 2 years between 1998 and 2003 and were 30,000 and 30,100. There are 3 years of available escapements from 1992 to 1997; 15,800, 16,000, and 22,000. Escapement estimates are only available for 2 of the past 10 years (1998 and 2002), with estimates at or above 30,000 coho.

The target escapement for coho in the Bella Coola watershed is currently under review by DFO (Matt Mortimer per. comm.). The historical target was 80,000.

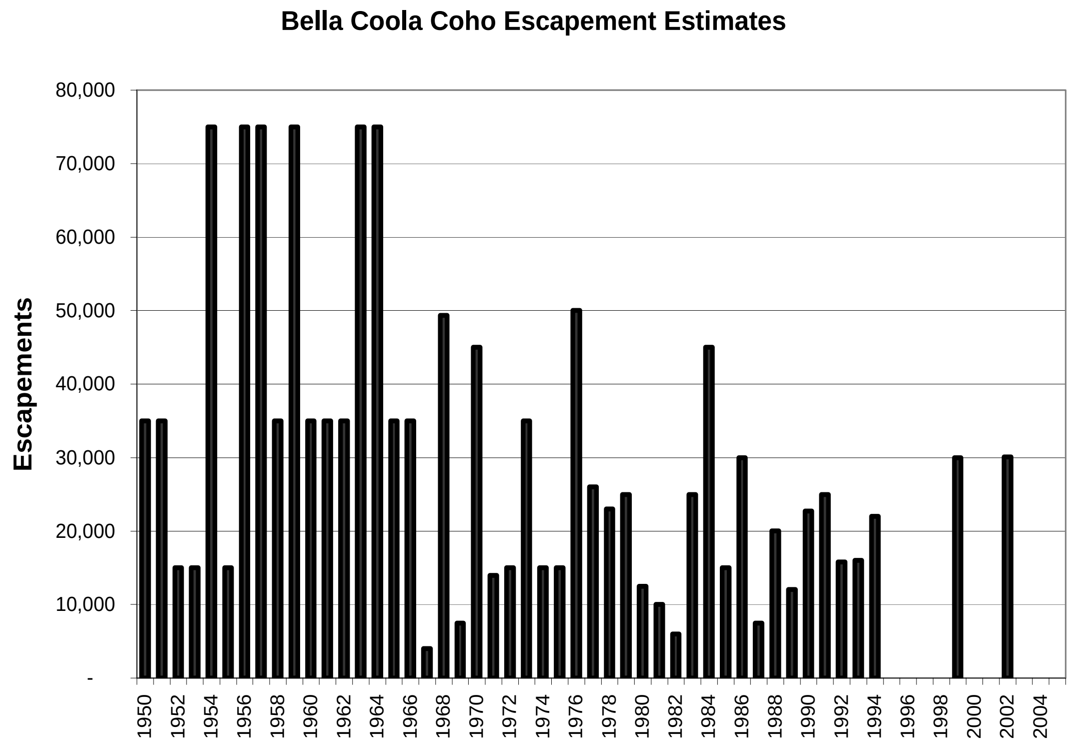


Figure 3.2 Bella Coola Coho Estimated Escapement 1950-2002
(Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit, DFO).

3.2.3.2 Juvenile

Several juvenile coho assessments have been conducted for various years and various systems within the Bella Coola watershed by the following companies/organizations: the CCFPA, G3 Consulting, and D. Burt and Associates.

The CCFPA undertook juvenile coho assessments at a number of predetermined sample sites within the Bella Coola watershed during the fall months of 1994 to 2000. Using a three-person electrofishing crew, fry were sampled by species for length, weight, and scales at each site. Several draft reports have been produced from these assessments and Table 3.3 provides a summary of the juvenile coho population and density estimates for the sampled systems between 1994 and 2000.

Table 3.3 Summary of Juvenile Coho Density Estimates for 0+Fry for Traditional DFO Sample Sites from 1994-2000.
(Reproduced from MacLaurin and Palfrey Unpublished).

	1994	1995	1996	1997	1998		1999		2000	
SITE	Density Est (fry/m^2)	Density Est (fry/m^2)	Density Est (fry/m^2)	Density Est (fry/m^2)	Pop Est	Density Est (fry/m^2)	Pop Est	Density Est (fry/m^2)	Pop Est	Density Est (fry/m^2)
Ann Creek	-	0.94	1.68	1.49	32	1.62	136	5.89	39	1.93
Fish Creek	-	1.72	0.84	0.56	17	0.28	142	2.33	78	0.93
Molly Walker Ck	0.42	0.92	0.43	0.28	0	0.00	52	0.65	29	0.41
Sato Creek	1.18	4.5	3.65	2.06	0	0.00	162	3.48	104	1.01
Upper Dump Ck	1.56	0.03	0	0	0	0.00	52	0.91	0	0.00
Atnarko River Sl	-	-	-	-	7	0.12	40	1.17	16	0.55
Talchako River	-	-	-	-	48	0.80	160	2.76	351	8.07
Nusatsum River	-	-	-	-	42	0.46	40	0.44	18	0.22

In 1997, D. Burt and Associates (Burt 1998) undertook an assessment of most anadromous portions of the Bella Coola Watershed which provided information on the status of some anadromous populations. Based on the summary and analysis of population statistics for coho fry, the estimated total coho fry population for the Bella Coola watershed in 1997 was 563,478 fish (or 56% of the projected capacity as determined by this report). For a complete list of the estimated coho fry population in 1997 per sampled stream, refer to Table 3.4 below.

Table 3.4 Coho salmon estimates of 1997 and capacity fry rearing populations. Reproduced from Burt 1998.

Stream	Reach	1997 Pop	Max Pop
Atnarko System			
Mainstem	1	97,158	96,687
	2	14,174	61,298
	3	13,825	48,239
	4	0	19,205
	5	-	-
	6	12,878	12,846
	7	-	-
	8	0	3,730
Total Atnarko Mainstem		**138,035**	**242,005**
Camera Channel	1	110	4,224
Sugar Camp Ck.	1	37	52
South Atnarko R.	1	7,377	7,344
Total Atnarko System		**145,559**	**253,625**
Bella Coola System			
Mainstem	1	71,892	170,250
Walker Is. Sidechannel	1	4,661	6,425
Airpotr Sidechannel	1	0	4,353
Tastquan Ck.	1	3,698	3,779
Dump Ck.	1	422	666
Noohalk Ck.	1	25,401	27,287
Snooka Ck.	1	4,192	4,382
McCellan Ck.	1	21,750	21,970
Snootli Ck.	1	970	2,525
Charter Ck.	1	4,702	5,434
Edlyn Ck.	1	2,875	2,872
Fish Ck.	1	66,743	66,801
Sawmill Ck.	1	213	350
Hagensborg Sl.	1	43,319	47,035
Salloomt R.	1	4,862	6,304
Croft Ck.	1	7,680	8,141
Sato Ck.	1	1,285	1,410
Mill Pond Ck.	1	1,687	1,748
Nusatsum R.	1	95,854	96,512
Molly Walker Ck.	1	4,315	4,797
Tseapseahoolz Ck.	1	334	1,336
Noosgulch R.	1	1,468	3,114
Talchako Mainstem	1	44,363	258,781
Talchako Off Channel	1	5,233	5,239
Total Bella Coola		**417,919**	**751,511**
Grand Total		**563,478**	**1,005,136**

3.2.4 Genetic Distinctiveness

DFO has collected DNA samples from coho in various rivers within the Bella Coola watershed (refer to Table 3.5).

Table 3.5 DNA Spawning Data for Rivers Within the Bella Coola Watershed

Population Name	Year(s) Collected	Sample Size
Atnarko River	1991 1992 1996 1997 2000	225
Bella Coola River	1998 2000	25
Hagensborg Slough	1998 2000	133
Noohalk Creek	1998	2
Salloomt River	1996 1997 1998 2000	220
Snootli Creek	1992 1996 1998 2000	202
Thorsen Creek	1996 1997 2000	117

3.2.4 Habitat

To Be Added

3.2.5.1 Spawning

Coho have been observed spawning throughout the Bella Coola River and its tributaries (DFO 1989; FISS 2005). Table 3.6 provides a list of specific locations (and associated references) where coho spawning has been documented in Bella Coola River tributaries.

Table 3.6 Specific Locations of Coho Spawning in Bella Coola River Tributaries

Bella Coola Trib.	Location	Reference
Stener Creek	0-2.5 km	FISS, 2005; DFO, 1989
Croft Creek	0-1.0 km	FISS, 2005; DFO, 1989
Snooka Creek	Reaches 1-5	FISS, 2005; DFO, 1989
Salloomt River	Reaches 1-3	FISS, 2005; DFO, 1989
Nusatsum River	Reaches 1-3	FISS, 2005; DFO, 1989
Thorsen Creek	0-3.0 km	FISS, 2005; DFO, 1989

Reach 1 of Thorsen Creek has been documented as having high quality spawning gravels and good holding habitat due to large woody debris and deep pools in this section (Summit 1997; FISS 2005). During a habitat assessment conducted by Summit in 1996 (1997), two side channels at the mouth of Cacoohtin Creek were identified as providing important spawning habitat for coho. In March 2001, MidCoast Aquatics (2001) conducted a fish habitat survey of Charter Creek, a tributary to Snootli Creek, and identified coho spawning areas in the lower portion of that system.

The following Bella Coola tributaries have also been documented as major spawning locations: an unnamed tributary of the Salloomt River (Watershed Code: 910-290700-30900-10300) from 0 to 1.0 km, from 0 to 1.2 km in Noohalk Creek, and in the lower 4.0 km of the Salloomt River (FISS 2005).

A Talchako River study was conducted in 1977 as part of a wildlife and fisheries inventory of Tweedsmuir Park, which was initiated in 1975. This study confirmed the existence of spawning habitat for coho in the Talchako River (Nelson et al. 1998).

Coho also utilize the Atnarko River and Atnarko Channel for spawning (Hilland and Lehman Unpublished).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.2.5.2 Rearing

Generally, coho rear in all accessible stream reaches, including small 1st and 2nd order streams. In large rivers, coho will use the margins, debris piles and undercut banks within the mainstem. In smaller streams, coho prefer pool and glide sections. For overwinter rearing, coho prefer slow velocity and seasonally wetted areas such as off-channel alcove pools, beaver ponds, offchannel sloughs, swamps, and their tributaries (Pollard et al. 1997; Summit 1997; Keeley and Slaney 1996). During rearing, coho are territorial, and will hold selected positions within a stream where they feed on drifting terrestrial or aquatic insects (Hart 1973).

Several recent studies have been conducted that provide detailed information regarding coho habitat in the Bella Coola watershed (Summit 1996; Summit 1997; Burt 1998); however, for several Bella Coola tributaries there is virtually no specific information available on rearing habitat. Therefore, the following discussion on observed coho rearing areas within the watershed should not be considered exhaustive.

In an assessment conducted by Summit (1997), two side channels at the mouth of Cacoohtin Creek were identified as important rearing habitat for juvenile coho. The assessment determined that there was little juvenile rearing habitat available in Reach 1 of Cacoohtin Creek, yet juvenile coho were sighted in this section.

A study conducted by Environment Canada in 1973 established that most of the coho fry production in Thorsen Creek rear elsewhere due to the cool water temperatures, lack of cover, and abundant predators in this system (FISS 2005).

In March 2001, MidCoast Aquatics (2001) conducted a fish habitat survey of Charter Creek, a tributary to Snootli Creek, and observed juvenile coho rearing in the tributaries of that system.

The Talchako River study conducted in 1977 confirmed the existence of rearing habitat for coho in that system (Nelson et al. 1998).

A lake survey conducted by the Province on Tenas Lake in 1975, identified the lake as coho rearing habitat (FISS 2005).

3.2.5.3 Productive Capacity

Productive capacity assessments have been conducted for some streams within the Bella Coola watershed; however, these assessments are limited since they have been conducted sporadically for only a few streams and species.

Burt (1998) calculated the carrying capacity for various streams in the Bella Coola watershed using two models developed by the Province to estimate maximum salmonid densities in fluvial habitats in British Columbia. The results are presented as maximum population estimates in Table 3.4. These results showed that the total coho fry population for the Bella Coola watershed in 1997 was 56% of the projected capacity of 1,005,136 fish. The smaller tributaries, particularly those associated with the Bella Coola River, had healthy coho populations that were at or near capacity. It is important to note that these estimates represent only one year of data which is based on a selected model.

A Level 1 and Level 2 Fish Habitat Assessment that was conducted by G3 Consulting Ltd. (2000a) in March of 2000 on The Ponds, an off-channel area of the Bella Coola mainstem. Based on their assessment and previous estimates for similar off-channel fish habitat areas, coho smolt production for The Ponds was estimated as approximately 50,000 fish.

3.2.5.4 Limiting Factors to Production

The following is a discussion of some general limiting factors that can affect coho production in B.C. streams. Nickelson et al. (1992) examined limiting factors to juvenile coho production by comparing their habitat in Oregon coastal streams. The researchers determined that coho in this area are most likely limited by the availability of winter habitat, due to coho's strong preference of alcove and beaver pond habitat during winter and given the rarity of that habitat in coastal streams. Provided that adequate spawning escapement occurs in these systems, the number of coho smolts is limited by this so called "bottleneck". Studies have indicated that similar processes may operate in coho populations in B.C. streams. In spite of considerable variation in September juvenile coho within Carnation Creek, the smolt output from the creek remained relatively constant. This pattern can be explained by a winter habitat bottleneck operating within this population (Levy and Slaney 1993).

Anthropogenic and natural factors such as overfishing, changing marine conditions, and habitat perturbations, can all limit coho salmon populations. Human population growth has resulted in an increased demand for water, waste disposal, and as a result of altered land-use patterns, habitat degradation. Since many coho live in nearshore marine habitats, they are susceptible to natural and human-made changes to the marine ecosystem. However, it is often difficult to quantify the impacts of human activities on salmon populations, especially in the coastal ecosystem where interrelationships among physical and biological processes are not well understood. In contrast, various studies have documented the role of climate change in altering the marine ecosystem and related this to shifts in ocean survival for salmon (Irvine 2002).

Since coho salmon spend a full year in freshwater, they are also susceptible to freshwater habitat degradation. The extent of human activity within a watershed, such as agricultural land use and road density, correlates with the rate at which the abundance of coho returning to an individual spawning stream decline. The freshwater habitat can be an important limiting factor, since productive freshwater habitats can help sustain salmon populations during periods of adverse marine conditions (or overexploitation) because they maximize the number of smolts produced per spawner. Freshwater habitats that have been extensively modified will pose a greater risk to the spawning populations of that system (Irvine 2002).

Several studies and observations have also been made that examine limiting factors to production that are specific to the Bella Coola watershed. Low flow periods (i.e. mid-winter to early summer) may limit coho production by causing low oxygen levels, freezing, stranding, and increased temperatures. Summit (1997) identified limiting factors to coho production in Noohalk and Fish creeks based on habitat assessment data collected in September 1996. In Noohalk Creek, it was suggested that coho production was limited by inadequate adult holding pools for adult coho. Inadequate adult holding pools was also identified as a possible limiting factor to coho production in Fish Creek, as well as a low abundance of pool rearing habitat for this pool-dependent species.

Predation may also be a limiting factor for coho salmon since they may be consumed by other salmonids, sculpins, water ouzels (birds), herons, mergansers, mink, bears, seals, otters, and caddisfly larvae during incubation, alevin, fry, and adult life stages. However, in abundant years, this is likely not critical in controlling numbers (Sandie MacLaurin pers. comm.).

Lack of stream cover for coho spawners can increase predation which may limit production (Neil Oborne pers. comm.). G3 Consulting Ltd. (2000a) conducted a Level 1 and Level 2 Fish Habitat Assessment in March of 2000 on The Ponds, an off-channel area of the Bella Coola mainstem. Beaver dams were observed throughout the area which often limited access into considerable summer and winter coho rearing habitat. Access to important habitat is also a potentially limiting factor for Dump Creek (Sandie MacLaurin pers. comm.).

3.3 Pink Salmon (Oncorhynchus gorbuscha)

3.3.1 Life History

Pinks adults tend to return to the Bella Coola watershed in July and are generally first observed at the Atnarko Tower at the end of July or beginning of August (Matt Mortimer pers. comm.). Spawning occurs from August to October and peaks in mid-September. Emergence occurs in late February to April though the exact timing each year depends on the water temperatures (Sandie MacLaurin pers. comm.). They will then make an immediate migration downstream, to the estuary (Hart 1973). Pink out-migration occurs between late March and early May and takes place near the surface of streams, where currents are strongest (Hilland 1975a). Once in the estuary, juvenile pinks tend to remain close to the shore for a few months before moving into deeper water by early June (Leaney and Morris 1981). Pinks live for two years and will return to the Bella Coola watershed to spawn in the second year.

This general life history information mentioned above is supported by fisheries data collected on Thorsen Creek, where adult pink salmon have been observed between August and the beginning of September (Mortimer 2002; FISS 2005). Furthermore, pink fry were observed during a trapping program conducted by the Snootli Creek Hatchery on Tastquan Creek between February and April, 1992 and in the annual operation of downstream traps, especially on the Atnarko River (Hilland Unpublished(a); FISS 2005).

The CCFPA operated a fish fence at the Hagensborg Slough from 1998-2001 to estimate coho spawner abundance. Adult pinks were also observed at the fence (CCFPA 2000; Willson 2001a; Anon 1999). In 1998, adult pink salmon were first observed at the Hagensborg Slough Fence on September 5th.

In 2001 the CCFPA undertook an adult enumeration study at the Atnarko Tower on the Atnarko River from August 1st to October 26th. It was observed that the pink salmon were observed at the Tower at the start of the count and the run was complete by the middle of October. The peak adult pink migration in the Atnarko River occurred during the 1st week in September for 2001 (Willson 2001b).

3.3.2 Fish Distribution

Pink salmon are distributed throughout the Bella Coola River and to 10 km upstream in the Talchako River, but are mainly in the Atnarko River (DFO 1989). Pinks have also been documented in the majority of tributaries to the Bella Coola River including, Tastquan, Thorsen, Snooka, Snootli, Noohalk, Nooklikonnik, Fish, Croft, Tseapseahoolz, and Cacoohtin creeks, as well as Salloomt, Nusatsum , and Noosgulch rivers. Within the Atnarko River, pinks are distributed from 0 – 55.0 km, but predominantly from above Lonesome Lake to the Talchako River confluence (FISS 2005; Summit 1997).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.3.3 Population Abundance and Status

To Be Added

3.3.3.1 Adult

DFO has estimated pink escapements to the Bella Coola watershed since 1950 and these estimates are presented in graph form in Figure3.3. For a list of total estimated escapements to the Bella Coola watershed for all available species and years, please refer to Appendix 6.

Pink escapement was relatively low during the 1950's, increased during the early 1960's with a historic high of 3,500,000 pinks in 1962. From the mid-1960's to the late 1970's, odd-year pink returns decreased to historic lows (15,000 in 1969), then began to increase during the 1980's. Over the last 10 years escapements have ranged from 500,000 to 1,540,000 (for even-year fish) and 500,000 to 1,900,000 (for odd-year fish). Populations spawning in the Lower Bella Coola tributaries appear to be stable (Hilland Unpublished(b)).

From the 1930's to the 1950's, there was no clear dominance between even- and odd-year abundance. Between the 1960's and 1990's, even-year stocks were dominant, aside from a few years in the 1980's when odd-year stocks were dominant. Since the early 1990's dominance and associated high productivity have disappeared.

The target escapement for pink salmon is 1 million for the Bella Coola River and 4,000 for the Atnarko Spawning Channel (Thompson 1989). Pink returns to the Bella Coola River system continue to improve (DFO 2002) with returns above the target escapement for 5 of the last 10 years.

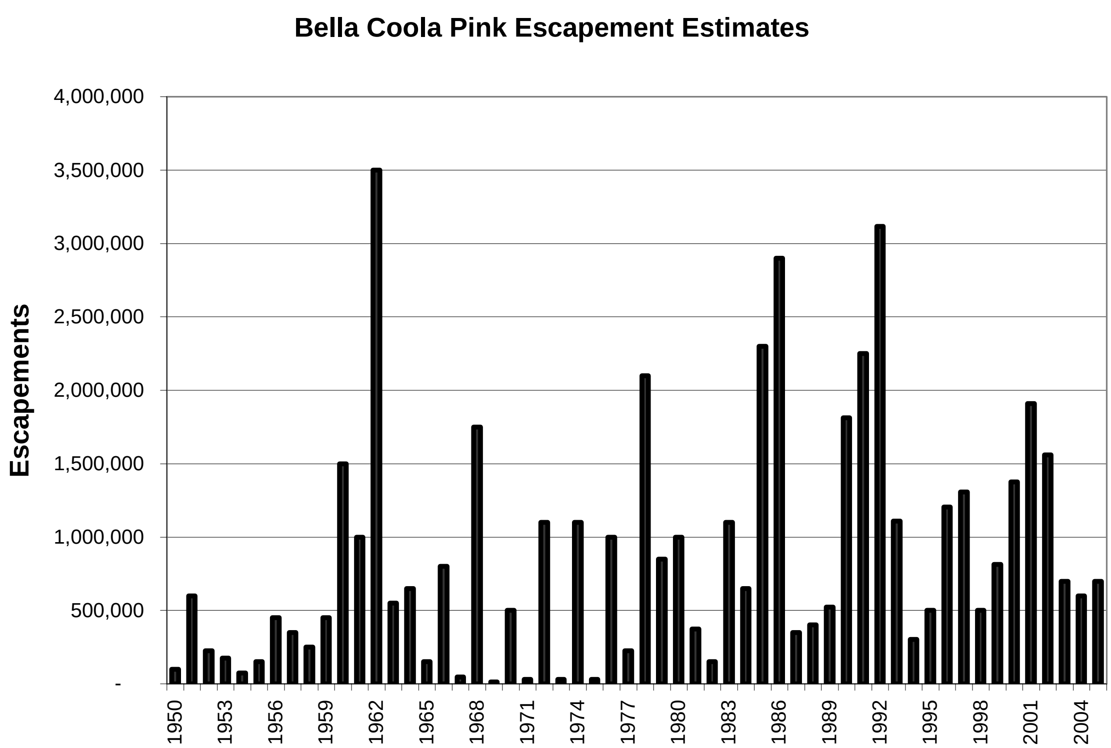


Figure 3.3 Bella Coola River Pink Estimated Escapement 1950-2005 (Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit)

3.3.3.2 Juvenile

Pinks out-migrate immediately upon emergence; therefore, hydraulic sampling conducted by Snootli Creek Hatchery staff is the only available indicator of fry production.

3.3.4 Genetic Distinctiveness

With few exceptions, the 2-year life cycle of pink salmon is so consistent that odd-year fish are effectively isolated from even-year fish so that there is no gene flow between them. Therefore, the two cycles require separate consideration for exploitation and conservation issues (Hart 1973).

Hilland (1976) investigated the morphology and timing of groups of pink salmon fry (from the 1973 brood-year) as they migrated from the Atnarko River. The 1974 pink spawners returning from the 1972 brood-year were also studied for differences in timing and distribution. The objective was to examine the existence of discrete populations within the Atnarko River pink salmon runs. The results did indicate that several spatially and/or temporally isolated groups may exist within the runs. However, it was inconclusive whether these differences were significant enough to have genetic implications (Hilland 1976).

DFO has collected DNA samples of odd and even year pinks in 2002 and 2003 from the Atnarko River. Two hundred operculum tissue samples were obtained in each year.

3.3.4 Habitat

To Be Added

3.3.5.1 Spawning

Usually pink salmon will utilize the lower reaches of rivers for spawning, but occasionally they run for considerable distances upstream (as is the case in the Bella Coola watershed) (Hart 1973).

Pink spawning occurs in the Bella Coola River mainstem as well as many of the tributaries. Spawning has been observed in the lower 3.5 km of the Bella Coola River (FISS 2005). Pink salmon utilize the following Bella Coola River tributaries for spawning: Reaches 1-3 of the Noosgulch River, the lower 1.0 km of Fish Creek, Reaches 1 and 2 of the Salloomt River, from 0-1.0 km in Croft Creek (a tributary to the Salloomt River), from 0 to 0.5 km in Nooklikonnik Creek, Reaches 1-5 of Snooka Creek, Reaches 1-3 of Snootli Creek, Cacoohtin Creek, and near the mouth of Tseapseahoolz Creek (FISS 2005; Summit 1997; DFO 1989).

Major spawning areas have been documented in the following tributaries: from 0 to 0.8 km on Tastquan Creek, from 0-1.2 km on Noohalk Creek, in the lower 4.0 km of the Salloomt River, between 0-3.8 km on Snootli Creek, and from 0-0.5 km on the Nusatsum River (FISS 2005). Thorsen Creek also has an extensive spawning area in Reach 1 where spawning adults were documented during a biological study of the Lower Bella Coola Valley conducted in 1973 (Summit 1997). A field assessment conducted by Summit (1997), described Reach 1 and 2 of Thorsen Creek as high quality spawning habitat. Reach 1 was also documented as having good holding habitat due to the presence of large woody debris and deep pools in this section.

Pink salmon have been observed spawning throughout the Atnarko River; however from Hotnarko River to Janet Creek in the upper Atnarko River, and from Alger Creek to the confluence of the Talchako River in the lower Atnarko River, are the preferred areas (Russ Hilland pers. comm.; DFO 1989). Spawning has been observed in the lower 1.0 km of the Hotnarko River; however, habitat assessments have described this section as having “no suitable areas for spawning” and “low productivity” (FISS 2005).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.3.5.2 Rearing

Juvenile pink salmon undergo a distinct estuarine rearing stage in the Bella Coola estuary from late April or early May, until the 1st or 2nd week of June. During this time they will rear in aggregations along the shoreline, or in sheltered bays, in the region of the water column above the halocline. They will move into deeper waters by early June to continue rearing (Leaney and Morris 1981; Lebrasserr and Parker 1964).

Several recent studies have been conducted that provide detailed information regarding pink habitat in the Bella Coola watershed (Summit 1996; Summit 1997; Burt 1998); however, for several Bella Coola tributaries and the estuary there is virtually no information available. Therefore, data specific to pink juvenile abundance in the Bella Coola watershed and estuary are required and the following discussion on juvenile pink observations within the watershed should not be considered exhaustive.

Pink salmon fry have been captured during fry trapping programs conducted on Nooklikonnik Creek, Airport Side Channel, Atnarko River and Thorsen Creek (FISS 2005). Pink fry were also observed in a fry trapping program conducted by the Snootli Creek Hatchery on Tastquan Creek between February and April, 1992 (Hilland Unpublished(a); FISS 2005).

3.3.5.3 Productive Capacity

Based on the reviewed literature, no studies have been conducted within the Bella Coola watershed on the productive capacity of streams for pink salmon.

3.3.5.4 Limiting Factors to Production

Summit (1997) identified limiting factors to pink production in Noohalk Creek based on habitat assessment data collected in September 1996. The assessment identified that spawning habitat was a limiting factor since pink salmon were forced to spawn in sub-optimal gravels.

Predation can also be a limiting factor for pink salmon since they may be consumed by Dolly Varden, cutthroat trout, coho, sculpins, water ouzels (birds), herons, mergansers, mink, bears, seals, otters, and caddisfly larvae during incubation, alevin, fry, and adult life stages. However, in abundant years, this is likely not critical in controlling numbers (Hart 1973).

A limiting factor to pink production on the Atnarko River may be due to severe flooding events that have occurred. On average, the Atnarko pinks are subjected to severe flood once every ten years (DFO 1986). In late January of 1968, a flood of 10,200 cfs destroyed much of the 1967 pink salmon run spawn in the Atnarko River. This, combined with fishing pressures on the decreased stocks during the next two cycles, decreased the runs of odd-year pink salmon to critically low levels in the 1970’s (Environment Canada 1975). Again in 1980, flooding severely affected the even-year Atnarko pink stocks. Returns from a brood year escapement of 1 million were only 150,000, but fortunately, the stock rebounded to an escapement of 650,000 in 1984 (DFO 1986).

3.4 Chum Salmon (Oncorhynchus keta)

3.4.1 Life History

There are both summer and fall chum in the Atnarko and Bella Coola rivers (FISS 2005). Summer adult chum migrate towards freshwater in July while fall chum migrate in September. Spawning occurs between late July and November (Leaney and Morris 1981). Alevins will hatch around November but remain in the gravel until February or March (Sandie MacLaurin pers. comm.). The fry will then proceed directly to sea where they will remain inshore, near the surface growing rapidly during the summer. Chum fry will start entering the estuary at the beginning of March and have not been reported in the river after July. They will generally start moving offshore in September (Hilland 1979a). Hilland analyzed age composition of chum adults taken in the Bella Coola gillnet area from 1973-1977 and determined that returning chum were between 3 and 5 years (Hilland 1979a).

This general life history information mentioned above, is supported by several studies that were conducted prior to 1979 on a number of chum salmon spawning streams in the Bella Coola Valley. The biological data collected from these studies was compiled into a report by Hilland (1979a), and the following is a summary of the chum life history information presented in this report.

A fry trapping study was conducted on the Atnarko River in 1974 by Hilland (1976) to assess ocean migration patterns and fishery contribution. The inclined plane traps captured significant numbers of chum from March 31 to May 24, with the largest catches occurring from April 11-28.

An unpublished survey was conducted in 1975 on Lower Bella Coola chinook and coho. Fyke nets were utilized to fish the Bella Coola River at McCall Flats, the mouth of the Noosgulch River, and the Salloomt Bailey Bridge. Chum fry were caught at all three trapping sites from April 28 to June 4, and the peak migration was from April 28 to May 9. Pole seine and beach seine survey were also conducted in the Bella Coola estuary which found chum fry present in the estuary throughout the month of June (Hilland 1979a).

In 1979, a chum fry migration study, using fyke nets, was conducted on Noohalk Creek, Snootli Creek, Fish Creek, the Salloomt River and the Bella Coola River. Chum fry were present in the study area from March 13 to May 2, and peak migration occurred from March 20 to April 7 (Hilland 1979a).

The CCFPA operated a fish fence at the Hagensborg Slough from 1998-2001 to estimate coho spawner abundance; however, adult chum were also observed at the fence (CCFPA 2000; Willson 2001a; Anon 1999). In 1998, adult chum salmon were first observed at the Hagensborg Slough Fence at the beginning of October.

The Snootli Creek Hatchery assisted by the Nuxalk Fisheries Co-Management crew, conducted a downstream fry trapping program in the Bella Coola River and selected tributaries from February to March 1992. Chum out-migration occurred throughout the trapping program (mid-February to the end of March) on the Bella Coola and Salloomt rivers, Snootli Creek, and Airport Side Channel (Hilland Unpublished (a)).

3.4.2 Fish Distribution

Chum are distributed throughout the Bella Coola watershed. Chum have been documented in Reaches 1 through 7 on the Talchako River, downstream of Gyllenspetz (Summit 1997), and in the Atnarko River from 0 – 55.0 km (DFO 1989). They have also been documented in the following Bella Coola River tributaries: Tastquan, Thorsen, Snooka, Noohalk, Snootli, Nooklikonnik, Fish, Stenner, Croft, and Cacoohtin creeks, as well as, Salloomt, Nusatsum and Noosgulch rivers (FISS 2005).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.4.3 Population Abundance and Status

To Be Added

3.4.3.1 Adult

DFO has estimated chum escapements to the Bella Coola watershed since 1950 and these estimates are presented in graph form in Figure 3.4. For a list of total estimated escapements to the Bella Coola watershed for all available species and years, please refer to Appendix 6. These estimated escapement include both summer and fall chum. The estimates also include a portion of enhanced fish. For a detailed description of enhancement activities in the Bella Coola watershed, refer to the "Enhancement History" section of this report. Table 3.7 provides escapement estimates for Bella Coola tributary chum from 1972 to 1978 (Hilland 1979a).

Escapement estimates for Bella Coola chum have ranged from 3,500 in 1965 to 197,000 in 2003. In the late 1960s populations began to decline and later increased in the mid-1990s. Chum in Area 8 appear to have gone through four productivity cycles, which started in the 1920s. The cause of these production cycles is unknown (Wood 2000).

The target escapement for the Bella Coola River chum is 60,000 for the summer run and 20,000 for the fall rum. Returns were below this target for several decades until the mid-1990s, but have been above target for 7 of the past 10 years.

Figure 3.4 Bella Coola River Chum Estimated Escapement 1950-2005 (Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit).

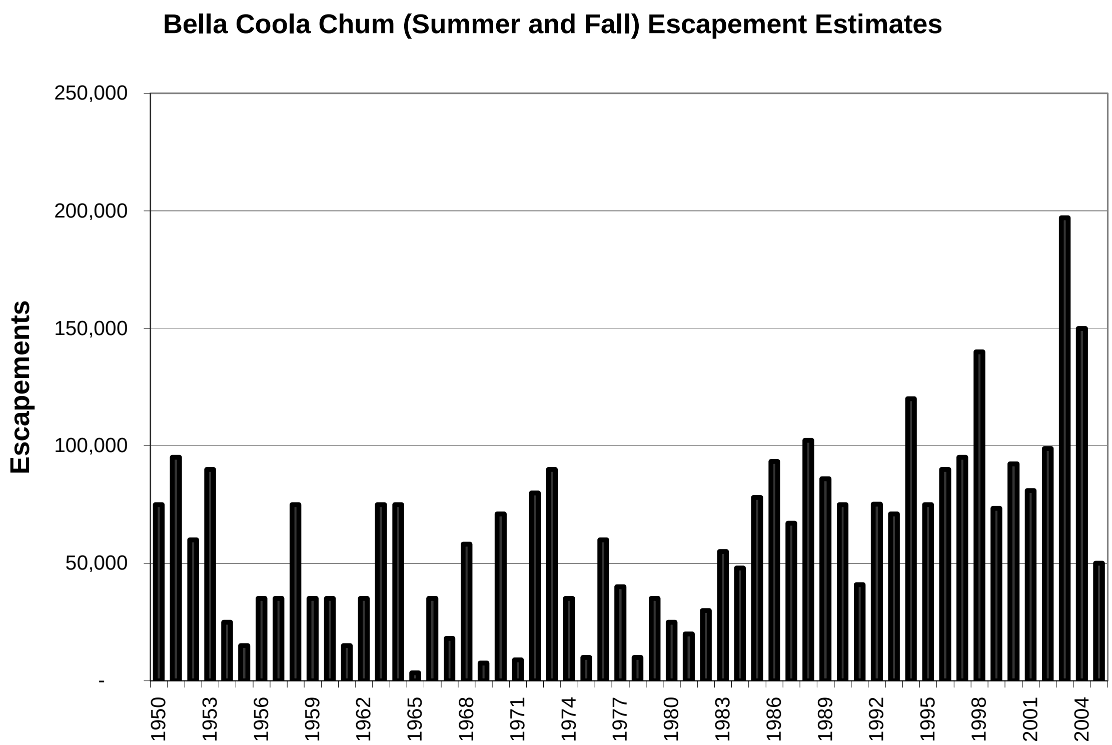


Table 3.7 Bella Coola Tributary Chum Salmon Estimated Escapements (Reproduced from: Hilland 1979a)

	1978	1977	1976	1975	1974	1973	1972
Fish Creek	75	300	550	700	200	1000	700
Nooklikonnik Creek	50	100	400	250	100	50	150
Noosgulch River	50	100	50	40	100	75	200
Nusatsum River	35	50	800	150	600	125	1000
Salloomt River	250	1000	2000	400	1400	2500	2000
Snootli Creek	175	600	800	20	700	2000	1000
Tatsquan Creek	20	25	300	10	10	10	10
Thorsen Creek	400	500	600	200	600	700	500
TOTAL	**1055**	**2675**	**5500**	**1770**	**3710**	**6460**	**5560**

3.4.3.2 Juvenile

Numerous habitat and fish surveys have been conducted within the Bella Coola watershed (i.e. stream classification surveys, fry trapping programs, CWAP, FHAP, etc.); however, there are some limitations to the studies since they provide no quantitative information regarding juvenile chum abundance. Therefore, data specific to chum juvenile abundance in the Bella Coola watershed and estuary are not available.

3.4.4 Genetic Distinctiveness

The Bella Coola has two distinct species of chum, summer and fall (FISS 2005). Snootli Creek Hatchery staff collected DNA samples of chum in 2002 from the Bella Coola River. Two hundred operculum tissue samples were obtained.

3.4.5 Habitat

3.4.5.1 Spawning

Chum will frequently spawn in close proximity to river outlets, but occasionally they will migrate great distances upstream to spawn in large rivers (as is the case in the Bella Coola watershed) (Hart 1973).

Chum have been documented to spawn in Reaches 1-5 in the Bella Coola River with a major spawning area located from 0-2.5 km (FISS 2005). Significant numbers of chum will also spawn in the side channels of the Bella Coola River, during certain years (Hilland 1979a), which is evident from the data in Table 3.6. The following is a list of specific areas within the Bella Coola tributaries where chum spawning has been observed; Reaches 1-5 of Snootli Creek (to 4 km), the lower Noosgulch River (Reaches 1-3), the lower 1.0 km of Fish Creek, from 0-2.5 km in Stenner Creek, Reaches 1-3 of the Salloomt River, from 0-1.0 km in Croft Creek (a tributary to the Salloomt River), from 0-1.2 km on Noohalk Creek, from 0-1.5 km on Nooklikonnik Creek, Cacoohtin Creek, and Reaches 1-5 of Snooka Creek (FISS 2005; Summit 1997; DFO 1989). Chum salmon have also been observed spawning in Reaches 1-3 of the Nusatsum River; however, Reach 2 has been described as poor spawning habitat (FISS 2005).

The Bella Coola tributaries that provide major spawning habitat include, upstream from the mouth on the Nusatsum River, the lower 4.0 km in the Salloomt River, and from 0-0.8 km on Tastquan Creek (FISS 2005). Thorsen Creek also has an extensive spawning area in Reach 1 where spawning adults have been documented (Summit 1997). A field assessment conducted by Summit (1997), described Reaches 1 and 2 of Thorsen Creek as high quality spawning habitat. Reach 1 was also documented as having good holding habitat due to the presence of large woody debris and deep pools in this section.

Chum spawning in the Atnarko River primarily occurs in the lower section, below Young Creek (DFO 1989).

A Talchako River study conducted in 1977 confirmed the existence of spawning and rearing habitat for chum in that system (Nelson et al. 1998).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.4.5.2 Rearing

Chum salmon fry migrate downstream immediately after emerging from the gravel to rear in the Bella Coola estuary. Limited information exists on juvenile chum once in the estuary; however, R. Hilland conducted an estuary sampling program in June of 1975 where chum fry were captured. All of the chum were captured in the southern section of upper North Bentinck Arm. It was observed that chum fry remained near the surface during the first 40 days and grew rapidly while feeding on abundant plankton resources present in North Bentinck Arm and Burke Channel at this time (Leaney and Morris 1981).

3.4.5.3 Productive Capacity

Based on the reviewed literature, no studies have been conducted within the Bella Coola watershed on the productive capacity of streams for chum salmon.

3.4.5.4 Limiting Factors to Production

Data specific to the limiting factors to chum production within various streams in the Bella Coola watershed has not been collected.

However, predation may be a limiting factor for chum salmon since they may be consumed by other salmonids, sculpins, water ouzels (birds), herons, mergansers, mink, bears, seals, otters, and caddisfly larvae during incubation, alevin, fry, and adult life stages. However, in abundant years, this is likely not critical in controlling numbers (Sandie MacLaurin pers. comm.).

Late fall/winter flooding is an issue for chum fry in the lower Bella Coola tributaries which may limit production. Also, late winter low water levels combined with freezing occurs which can cause eggs to dry out or freeze. Ice scouring may also result in egg kills in some systems (Neil Oborne pers. comm.; Sandie MacLaurin pers. comm.).

3.5 Sockeye Salmon (*Oncorhynchus nerka*)

3.5.1 Life History

Sockeye adults begin migrating upstream in the Bella Coola River in June. After the freshwater migration, sockeye adults may hold in nursery lakes for varying amounts of time (times vary between different runs and different individuals in each run). Spawning occurs between September and November (Leaney and Morris 1981). Incubation and emergence times will vary depending on temperature, but generally emergence occurs in December and emergence occurs in the spring (approximately 2 to 3 months after hatching) (Sandie MacLaurin pers. comm.). Most sockeye in British Columbia will spend one year rearing in lakes before migration to sea. However, some will out-migrate immediately upon emergence and others may remain in freshwater for up to 2 years. When the surface temperatures of the lake approach 4 to 7 oC, most young sockeye migrate to sea where most will spend 2 years, while others will spend 3, 4, or 1 year(s) (Hart 1973).

This general life history information is supported by a study conducted by Wood (Unpublished) in which the freshwater age of adult sockeye was determined by sampling from the First Nations food fishery in the Bella Coola River. The first sockeye was caught in June and the last was caught in mid-August. The majority of fish sampled were age 4; however, age 3 and 5 sockeye were also caught.

3.5.2 Fish Distribution

Generally, sockeye will occur in systems where young have access to a lake for rearing; however, small populations will also spawn and rear in the lower reaches of large rivers (Pollard et al. 1997). Such is the case in the Bella Coola watershed where most sockeye returning to the system, spawn in the Upper Atnarko River and rear in Lonesome Lake and Stillwater Lake (Hilland Unpublished(b)). Holding/staging will occur at the outlet of Stillwater Lake. (FISS 2005). A report that summarized salmon spawning in the Atnarko River from 1960-1973, noted the presence of sockeye throughout the South Atnarko River as well (FISS 2005).

To a lesser extent sockeye are present in the Bella Coola River and its tributaries including, the Noosgulch River, Salloomt River, Noohalk Creek, and Thorsen Creek (FISS 2005). They are also present in Molly Walker Creek (Sandie MacLaurin pers. comm.).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.5.3 Population Abundance and Status

To Be Added

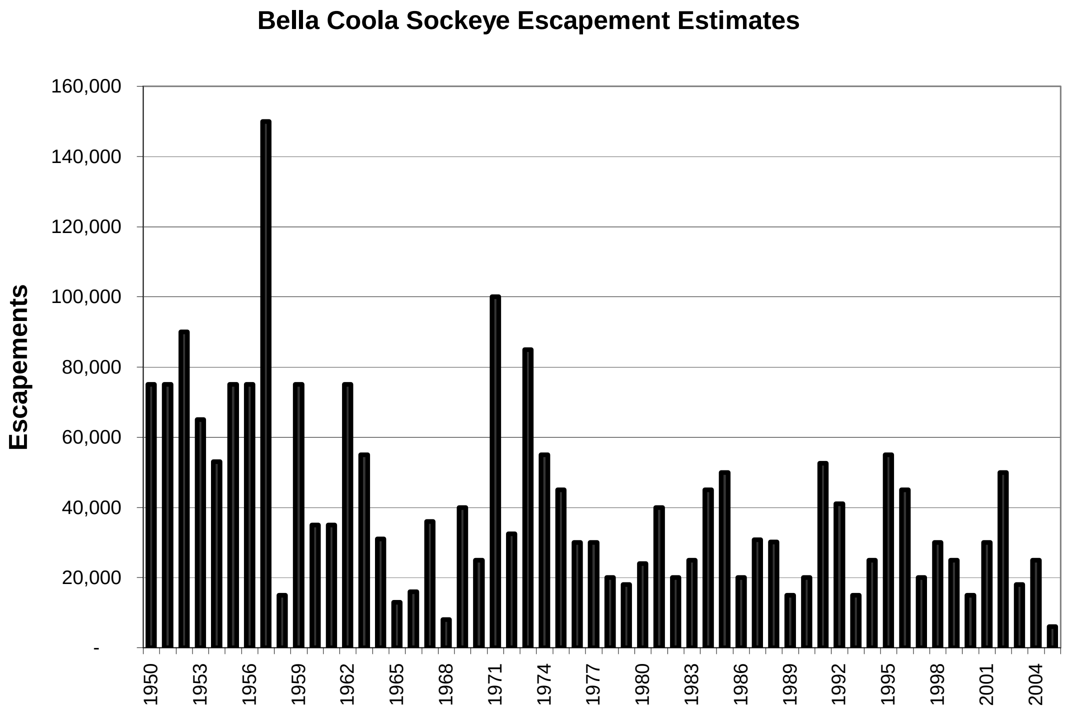
3.5.3.1 Adult

DFO has estimated sockeye escapements to the Bella Coola watershed since 1950 and these estimates are presented in graph form in Figure 3.5. For a list of total estimated escapements to the Bella Coola watershed for all available species and years, please refer to Appendix 6.

The Bella Coola River has reported escapement estimates ranging from 150,000 fish in 1957 to as low as 8,000 in 1968. Escapement was relatively high during the 1950's and began to decline in the late 1950's and 60's. From 1970 to present, escapements to the Bella Coola system have been variable, and no increasing or decreasing trend can be observed. During the past 10 years, they have ranged from 15,000 in 2000 to 55,000 in 1995.

The target escapement for Bella Coola sockeye is 75,000 (Thompson 1989). Escapements have been below this target since 1973.

Figure 3.5 Bella Coola River Sockeye Estimated Escapement 1950-2005 (Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit)***.***



3.5.3.2 Juvenile

Data specific to sockeye juvenile abundance in the Bella Coola watershed are required. However, one known study has been conducted to estimate juvenile sockeye abundance in Lonesome Lake. The study utilized hydroacoustic assessment techniques to estimate abundance and was conducted on September 28 and 29, 1999. Results showed that sockeye density was the highest between 20-30 m, which was restricted to an area near the outlet end of the lake. Sockeye density in this restricted area was relatively high, averaging 1007 fish/hectare; however, when averaged across the entire lake, the density was only 293 fish/hectare (Rutherford et. al Unpublished).

3.5.4 Habitat

To Be Added

3.5.4.1 Spawning

Generally, sockeye will spawn in areas located either upstream or downstream of a lake so that young can migrate to the lake for rearing. Small populations of sockeye will also spawn and rear in the lower reaches of large rivers (Pollard et al. 1997). There is evidence to suggest that sockeye salmon return to spawn in the same part of the river system where they originated (Hart 1973). It is also not uncommon for sockeye to spawn on the beaches of some coastal lakes (Pollard et al. 1997) or in spring areas along lake shores (Hart 1973).

Within the Bella Coola watershed, most sockeye spawn between Stillwater Lake and Tenas Lake on the Atnarko system (DFO 1989; Leaney and Morris 1981). Sockeye will hold/stage at the outlet to Stillwater Lake before spawning. The overall productivity of the reach between Lonesome Lake and Stillwater Lake has been described as high with both spawning and rearing areas (FISS 2005). Spawning also occurs in the lower 30 km of the Atnarko River and in Camera Channel. There is a major spawning area located on the South Atnarko River between Elbow Lake and Rainbow Lake (FISS 2005).

Aside from the Atnarko system, spawning has also been documented in the Bella Coola River (FISS 2005), and on the lower Noosgulch River (Reaches 1-3) (Summit 1997). A major sockeye spawning area was located from 0-1.2 km on Noohalk Creek (FISS 2005); however, this population has recently been considered at risk of decline (Summit 1997).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.5.4.2 Rearing

Small populations of sockeye will rear in the lower reaches of large rivers (Pollard et al. 1997). However, most sockeye in British Columbia will spend one year rearing in lakes before migrating to sea. When fry first enter the lake, they remain along the shore for a few weeks before moving out to deeper water where they will concentrate in the top 10 to 20 meters. Some sockeye will out-migrate immediately upon emergence (Hart 1973). Data specific to the utilization of the Bella Coola estuary by juvenile sockeye are lacking. Research is required to clarify the estuarine ecology of sockeye salmon inhabiting the Bella Coola watershed.

Several recent studies have been conducted that provide detailed information regarding fish habitat in the Bella Coola watershed (Summit 1996; Summit 1997; Burt 1998); however, for several Bella Coola tributaries there is virtually no information available. Therefore, the following discussion on sockeye rearing habitat within the watershed should not be considered exhaustive.

A lake survey conducted on Tenas Lake by the Province in 1975, identified sockeye rearing habitat (FISS 2005). Sockeye that spawn in the South Atnarko River will rear in Elbow Lake or Rainbow Lake. The area above Elbow Lake was described as good rearing habitat (FISS 2005). The majority of Bella Coola sockeye spawn in the Upper Atnarko River and rear in Lonesome Lake and Stillwater Lake (Hilland Unpublished(b)). The overall productivity of the reach between Lonesome Lake and Stillwater Lake has been described as high with rearing areas (FISS 2005).

3.5.4.3 Productive Capacity

Data specific to the productive capacity of streams/lakes for sockeye salmon within the Bella Coola watershed are lacking. However, it is estimated that the optimum spawning capacity for the Atnarko River is approximately 50,000 fish (Leaney and Morris 1981).

3.5.4.4 Limiting Factors to Production

Most sockeye require lakes for rearing, and the productive capacity of this rearing habitat is key to their survival. Limited lake rearing habitat may be a potentially limiting factor to production for Bella Coola sockeye. This was locally observed in a study conducted by Rutherford et. al (Unpublished) in 1999 where juvenile sockeye density was restricted to an area near the outlet end of Lonesome Lake.

Morton and Shortreed (Unpublished) conducted a limnology survey on Elbow, Rainbow and Lonesome lakes to determine the trophic status and rearing capacity of these lakes for juvenile sockeye. The results indicated that of the three lakes, Lonesome Lake would provide the best rearing habitat for juvenile sockeye since it had a favourable thermal regime and an under-exploited population of large Daphnia (food source). Limiting factors to production in Rainbow and Elbow lakes included water depth, an isothermal regime, and higher predation-resistant copepod numbers. There have been no assessments conducted in the Bella Coola watershed to examine limiting factors for river-type sockeye production.

Competition and predation can also be a limiting factor for juvenile and adult sockeye. During upstream migration and spawning, adult sockeye can be preyed upon by seals, bears, gulls, and human poachers; however, it is doubtful if this drain on the populations is significant in reducing the reproductive capacity of the runs. Sockeye fry must compete for food with species such as threespine stickleback and possibly other freshwater fish. They are also preyed upon by squawfish, rainbow trout, coho, prickly sculpin, Dolly Varden, other char (Hart 1973).

The sockeye population that spawns in the Upper Atnarko River is depressed but stable and low ocean survival is considered the most likely factor affecting this population (Hilland Unpublished(b)).

3.6 Steelhead Trout (*Oncorhynchus mykiss*)

3.6.1 Life History

Steelhead adults enter the Bella Coola River throughout most of the year; however, three distinct run peaks have been recognized; a summer, winter and spring run.

The summer run adults enter the Bella Coola River during July and August, hold in the mainstem of the Atnarko River during the fall and winter, and spawn in March, April and sometimes May. Steelhead kelts migrate out of the Bella Coola watershed in April, May, and sometimes June (Nelson et al. 1998).

Winter run steelhead adults enter the Bella Coola watershed in October and continue to enter until early March. They will hold during the fall, winter and/or part of the spring in the Atnarko and Bella Coola rivers, where spawning occurs in May. Kelt migration is likely to occur in May and June (Nelson et al. 1998).

The spring run adults return to the Bella Coola system between March and June. This group will spawn within two months of entry (May, June, and early July) in the upper Bella Coola and lower Atnarko rivers, as well as in tributaries to the lower Bella Coola River. Kelt migration occurs from May to July, but peaks in May and June.

After spawning, the eggs will generally hatch within 28 to 49 days (from mid-July to mid-August), depending on the water temperatures. The fry will then migrate to the saltwater any time between 3 and 5 years. When old enough to migrate to saltwater, they are called smolts. Bella Coola steelhead will spend between 4 months and 4 years in the ocean before returning to spawn in freshwater (Nelson et al. 1998). Some adults will return to spawn two or three times (Hart 1973); however, few steelhead live longer than nine years (Nelson et al. 1998).

This life history information is supported by Wilkinson (1979) who analyzed adult steelhead scales and found that maiden spawners spent 2 to 4 years in freshwater before smolting. The mean smolt age for Bella Coola/Atnarko steelhead was estimated to be 3.2 years. The study also found that the adults spent 2 or 3 years feeding in saltwater before returning their natal streams to spawn (Nelson et al. 1998).

3.6.2 Fish Distribution

Generally, steelhead are found in main channels, permanent tributaries, stable side channels, and in lakes. Steelhead will coexist with cutthroat trout in anadromous waters, and occasionally in large rivers and lakes (Pollard et al. 1997).

Adult and juvenile steelhead distribution in the Bella Coola watershed is well documented. Adult steelhead utilize the entire reaches in the Bella Coola and Atnarko rivers (including tributaries: Mosher Creek, Camera Channel, Young Creek, and the Hotnarko River). Juvenile and/or adult steelhead are prevalent in the Talchako, Nooklikonnik, Snootli, Salloomt, Noosgulch, and Burnt Bridge systems (Mike Ramsay pers. comm.).

Steelhead are abundant in the mainstem of the Atnarko River from its confluence with the Talchako River to an impassable set of falls below Charlotte Lake. Within this system, they are primarily located from the Hotnarko River to Janet Creek and Alger Creek to the confluence of the Talchako River. Steelhead do not tend to utilize the South Atnarko River due to high summer temperatures. Steelhead occur in low numbers in most Bella Coola/Atnarko river tributaries with appropriate gradient and flows. Significant populations of steelhead occur in the Noosgulch River, Salloomt River, and Burnt Bridge Creek (Mike Ramsay pers. comm.).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.6.3 Population Abundance and Status

To Be Added

<u>3.6.3.1 Adult</u>

The primary methods used to assess adult steelhead abundance in the Bella Coola watershed have been conducted through aerial and snorkel counts. In-river fisheries can also provide a rough estimate of the relative abundance of adult steelhead. These estimates suggest that there was a rapid decline in steelhead returns from 1987 to 1991 (Nelson et al. 1998).

A comprehensive study of the freshwater migration and spawning behaviour of adult steelhead returns to the Bella Coola watershed was conducted by LGL Limited. The study was based on snorkel surveys, aerial surveys, catch monitoring and radio-telemetry techniques conducted in 1997 and 1998. The survey results showed that escapement estimates were 200 and 220 for 1997 and 1998, respectively (for the summer/fall-run component of the Bella Coola steelhead population) (English et al. 1998). Snorkel surveys have continued through until the present, and 324 steelhead were counted at index sites in 2006 (Mike Ramsay pers. comm.).

A study conducted by Burt (1998) provided information on the status of Bella Coola steelhead in 1997. The results suggested that, at that time, steelhead escapements to the lower portion of the watershed were reasonably strong, while escapements to the upper watershed continued to return in low numbers.

3.6.3.2 Juvenile

Numerous habitat surveys have been conducted within the Bella Coola watershed (early studies by MOE on the Atnarko, Salloomt, and Noosgulch rivers, and on Burnt Bridge Creek; by Summit on the Lower Bella Coola tributaries; and the Tweedsmuir Park ecology studies); however, there are some limitations to the studies and in some case, they provided little quantitative information regarding steelhead abundance (Nelson et al. 1998). That being said, there is significant information known about juvenile steelhead, probably more than any other species of fish in the Bella Coola watershed (Mike Ramsay pers. comm.).

In 1988, annual (September and October) monitoring of Bella Coola/Atnarko juvenile steelhead was initiated to collect habitat and fry/parr abundance data (Nelson et al. 1998). Nelson et al. (1998) used the 1988 sampling data to estimate maximum fry densities for all known steelhead rearing areas within the Bella Coola River watershed (including some preliminary adjustments for fry size, stream productivity, and interactions with resident rainbow trout). The 1988 data was used because steelhead escapements to the Bella Coola system were believed to be near peak levels in 1988. (Note: No extensive sampling occurred before 1988; therefore, it is uncertain if these levels were maximum). The juvenile abundance estimates for 1988 are listed as the maximum fry densities in Table 3.8 below.

Table 3.8 Preliminary habitat-based estimates of fry carrying capacity and maximum fry density for all known steelhead rearing areas within the Bella Coola River watershed. Reproduced from Nelson et al. 1998.

In 1997 Burt (1998) undertook an assessment of most anadromous portions of the Bella Coola Watershed to determine the status of steelhead and anadromous cutthroat populations and their freshwater habitats. By multiplying the mean number of fry per usable unit per stream against the number of usable units per stream, Burt was able to estimate the size of the 1997 steelhead population in each study stream. For a complete list of the estimated steelhead fry population in 1997 per sampled stream, refer to Table 3.9 below.

Table 3.9 Steelhead estimates of 1997 and capacity fry rearing populations. Reproduced from Burt 1998.

Stream	Reach	1997 Pop	Max Pop
Atnarko System			
Mainstem	1	109,542	83,145
	2	53,517	156,337
	3	4,825	50,196
	4	18,865	64,211
	5	-	-
	6	0	2,915
	7	-	-
	8	0	7,351
Total Atnarko Mainstem		**186,749**	**364,155**
Mosher Ck.		4,720	3,388
Camera Channel		13,074	37,352
Young Ck.		21,781	15,640
Janet Ck.		-	4,773
Hotnarko Cr.		31,792	69,079
Total Atnarko System		**258,116**	**494,387**
Bella Coola System			
Mainstem		5,920	38,999
Walker Is. Sidechannel		0	
Airpotr Sidechannel		0	
Thorsen Ck.		0	1,283
Snootli Ck.		0	1,682
Nooklikonnik Ck.		0	2,533
Fish Ck.		2,046	4,257
Sawmill Ck.		0	178
Hagensborg Sl.		160	82
Salloomt R.		6,434	15,933
Nusatsum R.		16,296	17,718
Tseapseahoolz Ck.		1,825	1,841
Noosgulch R.		15,109	15,263
Burnt Bridge Ck.		64,389	70,151
Talchako Mainstem		0	0
Talchako Off Channel		5	463
Total Bella Coola		**112,184**	**170,383**
Grand Total		**370,300**	**664,770**

Based on this population data, steelhead fry were most abundant (biomass > 50 g/100 m2) in the Atnarko River and its main tributaries up to Stillwater Lake, as well as the major tributaries on the north side of the Bella Coola River (Sawmill, Burnt Bridge, Mosher, and Young creeks, Salloomt, Noosgulch and Hotnarko rivers, and Camera Channel). The most important rearing areas were Burnt Bridge Creek, and the first 2 reaches of the Atnarko River with populations greater then 40,000. Lower densities were observed in the streams sections in the upper portion of the steelhead distribution (i.e. reaches 2 to 8 of the Atnarko mainstem). The total steelhead fry population for the Bella Coola watershed in 1997 was estimated at 370,300 (Burt 1998).

3.6.4 Genetic Distinctiveness

To Be Added

3.6.5 Conservation Status

At one time the Bella Coola watershed supported a large run of steelhead. During the mid 1970's, catch statistics indicated that steelhead stocks in the watershed were declining. In response to a potential decline, recreational fishing restrictions were adjusted and finally, in November 1995, a complete closure on the steelhead fishery was imposed by Director's Order for stock conservation purposes (Nelson et al. 1998).

3.6.5 Habitat

To Be Added

3.6.6.1 Spawning

Until recently there was limited information available on the extent of use or relative proportions of steelhead spawning habitat in the Bella Coola watershed (Nelson et al. 1998). However, in 1997, a radio-telemetry study was initiated to determine spawning destinations for the spring-run component of Bella Coola steelhead. Based on the results, the major spawning destinations were the Atnarko River (42%) and Burnt Bridge Creek (33%); other spawning areas were Salloomt (13%), Nusatsum (4%) and Noosgulch (4%) rivers. (Note: This data is from a small number of radio tagged fish (24) that were captured at or near their spawning area).

Tags were also applied to summer/fall-run steelhead on the Atnarko River in 1997 (9 fish tagged). The majority of these steelhead were tracked to spawning areas in the middle Atnarko between Young Creek and to a section immediately above the Hotnarko River. The study indicated that both summer/fall-run and spring-run steelhead spawn in similar locations in Burnt Bridge Creek, and in the Upper Bella Coola, the middle Atnarko and Hotnarko rivers. Lonesome Lake is the furthest upstream migration documented for Bella Coola/Atnarko steelhead (English et al. 1998).

Aside from these streams, steelhead have also been observed spawning in the following locations: Nooklikonnik Creek from 0-0.5 km, Reaches 1-5 of Snooka Creek, Reach 1 of Snootli Creek, from 0-1.5 km on Tastquan Creek (a small winter-run), Thorsen Creek, and from 0-1.2 km in Noohalk Creek (FISS 2005).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.6.6.2 Rearing

Generally, juvenile steelhead will occupy riffles and pools, and prefer water temperatures from 10-13 oC, with high water velocities, and nearby overhead cover. In the winter, juveniles migrate into overwintering areas with large substrate or other cover. It is commonly observed that in watercourses like the Bella Coola and Atnarko rivers, where summer baseflows are relatively high compared to mean annual discharge, rearing conditions for small juvenile fish are restricted to the margins of the stream channel (Nelson et al. 1998). "Steelhead fry are particularly affected due to their preference for shallow depths as well as low velocities" (Burt 1998).

Several recent studies have been conducted that provide detailed information regarding steelhead habitat in the Bella Coola watershed (Nelson et al. 1998; Summit 1997; Ptolemy 1996; Burt 1998); however, for several Bella Coola tributaries there is virtually no information available. Therefore, the following list of steelhead rearing areas within the watershed should not be considered exhaustive.

Juvenile steelhead/rainbow trout have been observed throughout the Atnarko River and several other tributaries to the Bella Coola River. Juveniles are present in the following Bella Coola River tributaries: Noomst Creek, Anne Creek, Assanany Creek, Cachootin Creek, Tseapseahoolz Creek, Thorsen, Nooklikonnik, Snootli, Fish, Salloomt, Nusatsum, Noosgulch, Burnt Bridge (below barriers). Juveniles have also been observed in the following tributaries to the Atnarko River: Young, Deer, Mosher, Sugar Camp, Janet, Goat, Hunlen, Success, East, and West creeks and the Hotnarko River (Nelson et al. 1998). The Atnarko River to Lonesome Lake and Burnt Bridge Creek, is believed to be the major rearing area in the watershed, with lesser numbers in most other main tributaries (e.g. Noosgulch, Salloomt, and Nusatsum Rivers, Young and Mosher Creeks) (Burt 1998).

A study conducted on the Talchako River in 1977, confirmed the existence of rearing habitat for steelhead in that system (Nelson et al. 1998).

A stream survey was conducted at a proposed logging block (Block 19) on the Nusatsum River East Fork, which observed juvenile steelhead rearing in a sidechannel to the Nusatsum River (FISS 2005).

3.6.6.3 Productive Capacity

Productive capacity assessments have been conducted for some streams within the Bella Coola watershed; however, these assessments are limited since they have been conducted intermittently, and have pertained to only a few streams and species. However, the following section discusses the results of two productive capacity assessments for steelhead.

Nelson et al. (1998) combined information from juvenile surveys and habitat assessments with estimates of stream length, width and usable area to calculate a preliminary estimate of the production capacity of steelhead fry for each of the major steelhead producing tributaries to the Bella Coola River watershed. These production estimates were then converted into estimates of the maximum number of adults that could be produced by each tributary/reach. The results (presented in Table 3.8) suggest that, at capacity, the Bella Coola watershed could produce a total annual return of approximately 4157 adult steelhead (total of all three runs) (Nelson et al. 1998). It was suggested that if all areas were producing at capacity, approximately 72.5% of production would be from the Atnarko system, 15% from Burnt Bridge Creek, and 12.5% from other tributaries and the lower Bella Coola River.

Burt (1998) calculated the carrying capacity for various streams in the Bella Coola watershed using two models developed by the Province to estimate maximum salmonid densities in fluvial habitats in British Columbia. The results are presented as maximum population estimates in Table 3.9. The study determined that in 1997, overall fry abundance was approximately 55% of habitat capacity. Steelhead fry rearing capacity for the entire Bella Coola watershed was estimated to be 664,770 fish. The areas with the greatest potential to produce steelhead fry were Burnt Bridge Creek, the first 4 Reaches of the Atnarko River, and the Hotnarko River, which together comprised approximately 75% of the total Bella Coola rearing capacity. Steelhead fry densities were relatively healthy in the lower portion of their distribution in 1997 with many locations at, or close to, the estimated rearing capacity (i.e. Hagensborg Slough, the Nusatsum and Noosgulch Rivers, Tseapseahoolz, Burnt Bridge, Mosher, and Young Creeks, and Reach 1 of the Atnarko River). Lower densities were observed in the streams sections in the upper portion of steelhead distribution (< 40% of capacity; i.e. reaches 2 to 8 of the Atnarko mainstem) (Burt 1998).

3.6.6.4 Limiting Factors to Production

In general, the primary limiting factor for population densities of juvenile steelhead is suitable habitat availability. Food availability and total fish biomass, of juvenile steelhead and other similar sized species, will impose further density limitations within suitable habitats. Furthermore, fish densities can be limited by feeding territoriality, which is a behavioral response of juvenile salmonids. For steelhead, juvenile rearing and over-winter habitat is often the limiting factor (Wood 2000).

Nelson et al. (1998) reviewed existing information on the extent and quality of fish habitat in some of the key steelhead streams within the Bella Coola watershed (Atnarko, and Salloomt Rivers, Burnt Bridge Creek, and Camera Sidechannel). The Watershed Restoration Program (WRP) assessment by Summit (1997) provided habitat quality in other steelhead streams. Burt (1998) also described and quantified juvenile steelhead habitat for a number of streams in the Bella Coola system. The main conclusion reached in these reports is that steelhead streams within Tweedsmuir Provincial Park are in a relatively pristine state, whereas those outside the Park have experienced various levels of habitat degradation.

Based on the above-mentioned sources, the most seriously impacted steelhead streams are the Salloomt and Nusatsum Rivers, as well as Thorsen, Snootli, and Nooklikonnik Creeks. Summit (1997) determined that the main causes of habitat degradation in these streams were landslides from roads and hillslopes, riparian area disturbance, and channelization as a result of diking. The effects have been, increased sediment delivery rates resulting in lateral shifting of channels, stream bed aggradation, and channel avulsions. Observations by Burt (1998) confirmed that the fish habitats affected by these conditions had a shortage of holding and rearing pools, a high degree of redd scour, and the Salloomt River specifically has excessive fines among the spawning gravels. Burt's report stated that fish production has been compromised by diking, particularly in Thorsen, Snootli and Nooklikonnik Creeks. He observed that the dykes have created channelization, lack of meander, and maintenance of high stream energy which in turn, has produced extensive riffle zones within the diked reaches. In these reaches, the spawning gravels are sparse and are not permitted to accumulate, and rearing habitats are constrained due to a lack of complexity (i.e., backeddies, offchannel areas, undercut banks, etc.) (Burt 1998).

3.7 Eulachon (Thaleichthys pacificus)

3.7.1 Life History

Eulachon are small anadromous fish, weighing between 40 and 60 grams and with a length between 15 and 20 cm. The first onset of maturation generally occurs around the end of the third year. Spawning on the Bella Coola River begins in early March and lasts until mid May. Eulachon deposit their eggs, which have a very sticky surface that anchors to sand grains in the river bottom. Eulachon fecundity averages approximately 25,000 eggs per female. The eggs hatch in 3-5 weeks at ambient temperatures, which are usually between 3 and

10oC. Once the larvae hatch, they are rapidly flushed to marine waters (Hart 1973). They live in the sea for the next 2 to 5 years before maturing.

3.7.2 Distribution

Eulachon distribution is limited to the lower reaches of the Bella Coola River to as far upstream as Walker Island.

3.7.3 Population Abundance and Status

3.7.3.1 Adult

DFO staff have observed the Eulachon fishery of the Nuxalk people on the Bella Coola River for over 40 years (Fisheries Officer reports). Based on direct observation, total eulachon catch in tonnes was estimated for most years from 1944-2000. Historically, the Bella Coola has supported catches as high as 70 tonnes but more typically around 10-20 tonnes per year. The last fishery on the Bella Coola River was in 1998 where, approximately, 12 tonnes were taken. In the spring of 1999, the eulachon never arrived. Although the size of the eulachon run varies from year to year, their complete absence was a mystery. For 4 years, (1999-2003) the eulachon run has been virtually non-existent. An annual population study has been implemented since 2001, and has found the run to be extremely small: 2001 estimated the run at 0.030 tonnes; 2002 at 0.047-0.049 tonnes; and 2003 at 0.013 tonnes. This is a small fraction of the historical estimated run size, which was approximately 100 tonnes.

The apparent decline of eulachon in the rivers of the Central Coast has paralleled declines in populations along the coast of the Pacific Ocean from California to Alaska. Hay and McCarter (2000) reported that nearly all known eulachon spawning runs have declined over the last twenty years. Since the mid 1990's numbers have drastically declined. While results from field surveys and observations suggest that the populations of the Northern (Nass and Skeena Rivers) and Southern (Columbia and Fraser Rivers) appear to be recovering (Doug Hay pers. comm.), researchers maintain that several rivers in the central coast of B.C. may be extirpated (Hay and McCarter 2000).

3.7.3.2 Juvenile

It is difficult to assess the juvenile abundance since little is known of the marine part of the eulachon lifecycle. However, DFO does conduct an independent trawl survey in Shrimp Management Area, Queen Charlotte Sound. This survey is conducted during the month of May to provide an estimate of shrimp biomass. In addition, an estimation of eulachon biomass is also estimated using the shrimp trawl survey data. Table 3.10 displays the eulachon biomass indices and estimates from 1998-2003.

Table 3.10 Eulachon biomass indices and estimates of abundance by age class. (DFO, Shrimp Survey Bulletin 03-02)

Number (in thousands)				
Year	SMA	Biomass	Age 1+	Age 2+
1998	QCSnd + 9IN	473	-	-
1999	QCSnd + 9IN	579	1743	23695
2000	QCSnd + 9IN	473	3313	19327
2001	QCSnd + 9IN	3249	29099	127995
2002	QCSnd	3940	11515	122330
2003	QCSnd	4366	49637	118868

3.7.4 Genetic Distinctiveness

The eulachon populations of northern British Columbia are separate from those of the Fraser River (Hart 1973).

3.7.5 Conservation Status

Runs have been declining based on reports from First Nations and from the reduced catches of the small commercial fishery. In recent years, the eulachon fishery has closed due to low returns.

This trend prompted MOE to add eulachon to their blue list of threatened species. COSEWIC has selected eulachon as a high priority species selected for report preparation in the near future (DFO 2005).

3.7.6 Habitat

To Be Added

3.7.6.1 Spawning

Eulachon spawning is limited to the lower reaches of the Bella Coola River; however, there is traditional knowledge of eulachon spawning as far up as Walker Island.

3.7.6.2 Rearing

After hatching, eulachon are rapidly flushed to the ocean where they will rear for the next 2 to 5 years (Hart 1973).

3.7.6.3 Productive Capacity

Based on the reviewed literature, no studies have been conducted within the Bella Coola watershed on productivity capacity for eulachon.

3.7.6.4 Limiting Factors to Production

There is concern for the long-term sustainability of eulachon runs all along the BC coast.

Reasons for the declines are unclear but possible explanations include: increased by-catch in offshore shrimp-trawl fisheries in the late 1990's, climate change, changes in the hydrology of the rivers used for spawning, industrial pollution and increased mammal predation.

3.8 Cutthroat Trout (*Oncorhynchus clarki clarki*)

3.8.1 Life History

Both anadromous and nonanadromous cutthroat trout reside in the Bella Coola watershed. Anadromous cutthroat range from 1.5 to 4 pounds (0.68-1.8 kg) and nonanadromous individuals can reach 17 pounds (7.8 kg) (Hart 1973). Anadromous cutthroat adults return to freshwater during the first week in September and upstream migration peaks between October and November (Leaney and Morris 1981). Spawning typically occurs in smaller streams mostly between March and June. Fry emergence occurs in the spring and early summer. Juvenile anadromous cutthroat will migrate to sea when they are relatively small in size, where they will remain in the estuary for 1 or more years. Cutthroat will typically mature at 3 or 4 years of age (Hart 1973).

"Information on the biology and life history of anadromous cutthroat trout using the Bella Coola system is sparse" (Burt 1998). However, the general life history information presented above is supported by one study conducted by Burt

(1998). Using electrofishing survey data collected in 1997, Burt estimated the mean smolt age (MSA) of juvenile cutthroat for various streams in the Bella Coola watershed. The smolt ages ranged from 2.4 in Tastquan Creek to 4.5 in Snootli Creek.

3.8.2 Fish Distribution

In general, cutthroat trout in British Columbia tend to utilize smaller tributaries and headwaters (Scott and Crossman 1979). This general distribution information is supported through sampling conducted by Provincial biologists and Burt (1998) which revealed that juvenile anadromous cutthroat trout were found mainly in the smaller tributaries draining into the Bella Coola River.

Cutthroat trout are distributed throughout the Bella Coola River and its tributaries, but mostly inhabit the Lower Bella Coola River (Leaney and Morris 1981). They have been observed in the following tributaries to the Bella Coola River: from 0 to 5 km in Snootli Creek, from 0 to 2.5 km in Nooklikonnik Creek, in Noohalk Creek, and in Tseapseahoolz Creek (FISS 2005). A stream survey conducted at a proposed logging block on South-East Nusatsum River, observed cutthroat in that system (FISS 2005).

Cutthroat trout are also distributed throughout the Atnarko River, South Atnarko River, Hunlen Creek and its tributaries, and in Reaches 1 through 7 on the Talchako River (Summit 1997; DFO 1989; FISS 2005).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.8.3 Population Abundance and Status

To Be Added

<u>3.8.3.1 Adult</u>

Cutthroat trout in the Bella Coola watershed have been enhanced. For a detailed description of enhancement activities in the Bella Coola watershed, refer to the "Enhancement History" section of this report.

Abundance data for cutthroat trout in the Bella Coola system is sparse. However, Burt (1998) assessed the status of cutthroat stocks through a review of data collected from index sample sites to detect possible trends in either density or biomass during the period of record (1994-97). This time-series data indicated a low but consistent recruitment level for cutthroat during the 1994 to 1996 period (around 30% of capacity for the index sites), and a probable decline in recruitment in 1997.

<u>3.8.3.2 Juvenile</u>

Electroshocking surveys conducted in 1994 and 1993 showed that average densities of juvenile anadromous cutthroat in Snooka Creek were 0.18 and 0.56 fish per m2, respectively (Summit 1997).

In 1997, D. Burt and Associates (Burt 1998) undertook an assessment of most anadromous portions of the Bella Coola Watershed which provided information on the status of some anadromous populations. The size of the 1997 cutthroat fry populations in each study stream was estimated by multiplying mean number of fry per usable unit per stream against the number of usable units per stream. Based on this population data, the most important cutthroat rearing areas were Snooka, McLellan, and Snootli Creeks with populations greater then 5,000. The total cutthroat fry population for the Bella Coola watershed in 1997 was estimated at 47,884 fry (Burt 1998). For a complete list of the estimated cutthroat fry population in 1997 per sampled stream, refer to Table 3.11 below.

Table 3.11 Cutthroat estimates of 1997 and capacity fry rearing populations. Reproduced from Burt 1998.

Stream	Reach	1997 Pop	Max Pop
Atnarko System			
Sugar Camp Ck.	1	185	251
South Atnarko R.	1	988	7,215
Bella Coola System			
Tastquan Ck.	1	415	872
Thorsen Ck.	1	2,255	7,559
Dump Ck.	1	207	287
Noohalk Ck.	1	523	19,629
Snooka Ck.	1	7,042	7,815
McCellan Ck.	1	6,419	12,535
Snootli Ck.	1	25,745	27,589
Charter Ck.	1	0	16,154
Edlyn Ck.	1	112	532
Fish Ck.	1	470	9,640
Sawmill Ck.	1	103	964
Hagensborg Sl.	1	672	23,498
Croft Ck.	1	1,062	11,607
Stener Ck.	1	0	1,611
Sato Ck.	1	227	2,241
Mill Pond Ck.	1	0	1,379
Nusatsum R.	1	255	10,246
Molly Walker Ck.	1	863	5,337
Tseapseahoolz Ck.	1	341	848
Grand Total		**47,884**	**167,809**

3.8.4 Habitat

To Be Added

3.8.4.1 Spawning

Cutthroat spawning has been observed in the following tributaries to the Bella Coola River: Reaches 1-3 of the Salloomt River, Reaches 1-5 of Snooka Creek, Reach 1 of Snootli Creek, and in Thorsen Creek (FISS 2005).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

3.8.4.2 Rearing

Cutthroat trout juveniles will rear in tributaries of the Lower Bella Coola River, where low velocity pools and adequate cover exists (Leaney and Morris 1981). The CCFPA observed cutthroat trout rearing in Hagensborg Slough, during their fish fence monitoring activities (CCFPA, 2000; Willson 2001a; Anon 1999).

3.8.4.3 Productive Capacity

In 1996 Summit (1997) conducted electroshocking surveys at three sites in Fish Creek, and found that densities of juvenile anadromous cutthroat were well below the carrying capacity for this stream.

Burt (1998) calculated the carrying capacity for various streams in the Bella Coola watershed using two models developed by the Province to estimate maximum salmonid densities in fluvial habitats in British Columbia. The results are presented as maximum population estimates in Table 3.11. Burt determined that the overall cutthroat fry abundance for all streams combined was only about 30% of the predicted capacity in 1997. Dump, Snooka, and Snootli creeks were the only systems that showed strong fry recruitment with populations greater than 70% of the estimated capacity (Burt 1998). Noohalk, McLellan, Snootli, Croft, and Charter creeks, Hagensborg Slough, and the Nusatsum River were the streams with the highest capacity for cutthroat fry rearing populations ("Max Pop") of the systems surveyed, with capacities greater than 10,000. Together these systems comprised approximately 72% of the total Bella Coola rearing capacity. The total cutthroat fry rearing capacity for the watershed was estimated at 167,809 fish.

3.8.4.4 Limiting Factors to Production

Habitat assessments of various streams were conducted by Summit (1997) in 1996. The results determined that one limiting factor to fish production in Fish Creek was a low abundance of pool rearing habitat for pool-dependent species such as cutthroat.

The status of cutthroat trout habitat and the consequent limiting factors to production are discussed in the WRP assessments by Summit (1997) and Radstaak (1998). The results showed that in the larger tributaries (3rd order and larger, except Noohalk Creek) where cutthroat are present, habitat degradation included lateral shifting of channels, stream bed aggradation, and channel avulsions due to increased delivery rate of sediments. An assessment by Burt (1998) confirmed that the fish habitats affected by these conditions had a shortage of holding and rearing pools, a high degree of redd scour, and the Salloomt River specifically has excessive fines among the spawning gravels. Burt's report stated that fish production has been compromised by diking, particularly in Thorsen, Snootli and Nooklikonnik creeks. He observed that the dykes have created channelization, lack of meander, and maintenance of high stream energy which in turn, has produced extensive riffle zones within the diked reaches. In these reaches, the spawning gravels are sparse and are not permitted to accumulate, and rearing habitats are constrained due to a lack of complexity (i.e., backeddies, offchannel areas, undercut banks, etc.) (Burt 1998). Burt specifically examines the habitat conditions of smaller cutthroat streams in the Bella Coola Valley and found that many "had relatively good amounts of cover, although pool habitat was generally lacking."

Radstaak (1998) described the condition of cutthroat habitat in 1st and 2nd order streams in the Bella Coola watershed and Noohalk Creek. Common problems include high levels of substrate fines (compromises spawning, rearing, and insect production), a lack of pool habitat (for holding and rearing), a lack of channel complexity (important for optimum ecosystem function), beaver dams (impede adult and juvenile migration), and drainage pattern alteration (loss of portions of flow).

3.9 Dolly Varden (*Salvelinus malma*)

3.9.1 Life History

Both anadromous and nonanadromous Dolly Varden reside in the Bella Coola. Anadromous Dolly Varden tend to be larger (457 – 610 mm) than the resident stocks (Scott and Crossman 1979). Dolly Varden will generally mature in the fifth year and spawning occurs in streams during the fall. In many systems, a regular out-migration takes place in the spring (Hart 1973).

This general life history information is supported by data from a study which monitored the effectiveness of two off-channel salmonid restoration sites in the Bella Coola River watershed (McCall Flats and one site on the Talchako River) through the assessment of juvenile salmonid densities. Representative sites were sampled within the restored areas between Sept 25th and Oct 12th, 2000. Results showed that the restoration sites provide "important habitat for a significant number of juvenile salmonids". The results were used to calculate population estimates of Dolly Varden for the whole system, which were 4,783 in McCall Falls and 4233 in the Talchako restoration site (Bradan 2000).

3.9.2 Fish Distribution

Dolly Varden are distributed throughout the Bella Coola River and its tributaries, throughout the South Atnarko River, and to 10 km upstream in the Talchako River (DFO 1989; Summit 1997). They have been observed in the following tributaries to the Bella Coola River: from 0–5 km in Snootli Creek, throughout the Nusatsum River, in Reaches 1-3 of Nooklikonnik Creek, in Noomst Creek from 0 to 1.0 km, in Nordschow Creek, to 175 meters upstream in an unnamed tributary to the Nusatsum River (Watershed Code: 910-290700-37800-44700), above the barrier on the Salloomt River (a cascade acts as a velocity barrier in Reach 3), and from 0 to 1.5 km in Tastquan Creek (Leaney and Morris 1981; FISS 2005; Summit 1997).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.9.3 Habitat

To Be Added

<u>3.9.3.1 Spawning</u>

Dolly Varden have been observed spawning in lower 1.0 km of Fish Creek (DFO 1989), below the Highway 20 bridge on the Bella Coola River, Reaches 1-3 of the Nusatsum River, Reaches 1-5 of Snooka Creek, Reach 1 of Snootli Creek, and in Thorsen Creek (Leaney and Morris 1981; FISS 2005).

A Talchako River study was conducted in 1977 which confirmed the existence of spawning and rearing habitat for Dolly Varden in that system (Nelson et al. 1998).

For a summary of all documented spawning locations for this species, refer to Appendix 7.

<u>3.9.3.2 Rearing</u>

The CCFPA observed Dolly Varden rearing in Hagensborg Slough, during their fish fence monitoring activities (CCFPA 2000; Willson 2001a; Anon 1999).

3.10 Rainbow Trout (*Salmo gairdneri Richardson*)

Rainbow trout range in length between 305-457 mm (Scott and Crossman 1979). Rainbow can have either a freshwater or anadromous life history; however, anadromous fish are morphological different and are referred to as steelhead trout. Rainbow spawning occurs between March and August (Hart 1973).

Rainbow trout reside throughout the Bella Coola River and its tributaries, and to 40 km upstream in the Talchako River (DFO 1989; Summit 1997). Within the Atnarko River, steelhead/rainbow are distributed primarily in headwaters area (DFO 1989). The Tweedsmuir Park study conducted by Hazelwood in 1975, observed adult and juvenile rainbow trout in Tenas Lake and below Stillwater Lake (Nelson et al. 1998).

Rainbow trout were caught in Maydoe Creek during an electroshocking survey that was conducted on September 23, 1997. This creek was reported to provide good habitat for spawning and rearing rainbow trout. Fry and juvenile rainbow trout were also caught by electroshocking in Whitton Creek during the Charlotte Alplands Stream Inventory. Rainbow Trout were observed during a stream classification survey conducted on Telegraph Creek (FISS 2005). At the time of the survey, Telegraph Creek was reported to have little spawning gravel; however, good rearing potential was said to exist with a mature forest offering ample shade and small pools providing varied habitat. The CCFPA observed rainbow trout rearing in Hagensborg Slough, during their fish fence monitoring activities (CCFPA 2000; Willson 2001a; Anon 1999).

Rainbow Trout have been documented spawning in Reaches 1-3 of the Salloomt River below the barrier (a cascade acts as a velocity barrier in Reach 3) (Summit 1997; FISS 2005).

For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5. Refer to Appendix 7 for a summary of all documented spawning locations for this species.

3.11 Other Species

The following species have been observed within the Bella Coola watershed; however, detailed life history and abundance information is not available. For a summary of fish distribution within the Bella Coola watershed, refer to Appendix 5.

3.11.1 Pacific Lamprey (*Lampetra tridentata*)

This parasitic lamprey is elongate and generally about 680 mm long. Adults are blue-blackish to dark brown, and lighter underneath. Their teeth are generally yellow to orange (Scott and Crossman 1979).

The Pacific Lamprey generally migrates from saltwater to freshwater between July and September. Spawning occurs in sandy gravel typically between April and July, of the following year (Scott and Crossman 1979).

Lamprey were captured in a fish fence that was operated by the CCFPA at the Hagensborg Slough, which is located on the South side of Bella Coola River mainstem opposite the confluence of the Salloomt River (CCFPA 2000; Willson 2001a; Anon 1999).

3.11.2 River Lamprey (*Lampetra ayresi*)

This parasitic river lamprey is elongate and nearly cylindrical to the dorsal fin where it becomes laterally compressed. It is generally 311 mm long. The top and upper sides of the body are dark brown to lead-grey. They are silvery around the head, gill openings, and lower sides and are white on the undersurface (Scott and Crossman 1979).

There is very little known about the river lamprey other than they are parasitic and anadromous.

3.11.3 Western Brook Lamprey (*Lampetra richardsoni*)

This nonparasitic lamprey is nearly cylindrical to the dorsal fin were it becomes laterally compressed. The average length is 154 mm. Adults are brown through olive to black on the upper surface, and paler beneath. The fins are a translucent olive green and the caudal fin is marked with diffuse black pigment (Scott and Crossman 1979).

This nonanadromous lamprey spawns during the night in freshwater in the spring and early summer (Scott and Crossman 1979).

3.11.4 American Shad (*Alosa sapidissima*)

This anadromous species was introduced to the Pacific Coast from the Atlantic Coast in 1871. Numbers entering the Bella Coola watershed are not known, but it has been observed.

The shad's body is elongated with an average length of 381 mm. It is strongly compressed laterally, and rather deep; its depth is 17.2-19.4% of the total length. The overall colour is silvery, with a blue or blue-green metallic luster on the back. The sides are bright silvery, and there is a large black spot on the shoulder close behind the rear edge of the gill cover followed by several smaller dark spots (Scott and Crossman 1979).

Shad have not officially been documented in the Bella Coola watershed, but there have been reports of their presence. In general, the shad will enter river systems between May and July to spawn; however, spawning is dependent on the water temperature being at least 12oC.

3.11.5 Mountain Whitefish (*Prosopium williamsoni*)

The body is slender and elongate with an average length between 203-305 mm.

Overall colouration is silvery, but some have a light or dark brown or olive on their back which becomes silvery on the sides and white below. Scales, especially on the back, may have pigmented borders. The dorsal fin is often dusky whereas the pelvic and pectoral fins of adults have an amber tint (Scott and Crossman 1979).

Spawning occurs in late fall or early winter in river gravel or a mix of gravel and cobble. Mountain Whitefish have been observed spawning in Reach 1 of Snootli Creek (FISS 2005).

Mountain Whitefish have been documented from 0-5 km in Snootli Creek and on the South Atnarko River above Elbow Lake (FISS 2005).

3.11.6 Northern Squawfish (*Ptychocheilus oregonensis*)

Northern squawfish has an elongate body that matures at 305 mm. It is dark green or green-brown above, lighter on the sides and silvery white or cream ventrally. The males are colourful during mating when the lower fins become yellow or yellow orange (Scott and Crossman 1979).

Spawning takes place generally between May and July. Squawfish will spawn in gravelly shallows, sometimes along lakeshores, or in lakes that are near a tributary stream (Scott and Crossman 1979).

Northern Squawfish were also caught by electroshocking in Whitton Creek during the Charlotte Alplands Stream Inventory (FISS 2005).

3.11.7 Longnose Dace (*Rhinichthys cataractae*)

The Longnose dace has a stout body averaging about 76 mm in length. The colour varies on the back from olive-green to brown, and shades to cream or silvery white on the belly (Scott and Crossman 1979).

Long-nosed Dace were captured in a fish fence that was operated by the CCFPA at the Hagensborg Slough, which is located on the South side of Bella Coola River mainstem opposite the confluence of the Salloomt River (CCFPA 2000; Willson 2001a; Anon 1999).

3.11.8 Largescale Sucker (*Catostomous macrocheilus*)

The largescale sucker has a long, moderately deep body (330- 432 mm in length). The back and sides are a blue-grey to olive and the lower sides are cream to white. There is a dark lateral band below the lateral line from the snout to the base of the caudal fin. The largescale sucker spawns in the spring, generally in deep sandy areas of streams, but at times in gravelly or sandy shoals in lakes (Scott and Crossman 1979).

The largescale sucker is present in many of the lakes in the Atnarko system.

3.11.9 Threespined Stickleback (*Gasterosteus aculeatus*)

The threespined stickleback has a body that is compressed laterally and is elongated. This species has an average length of 51 mm. The upper portion of the stickleback can be silvery green, grey, olive, greenish brown or sometimes mottled with dark markings. The sides are paler and the belly is silvery. During breeding in April to September, stickleback prefer shallow sandy bottoms (Scott and Crossman 1979).

A stream survey was conducted at a proposed logging block (Block 19) on the Nusatsum River East Fork, which observed Threespine Stickleback in the wetland portion of a sidechannel to the Nusatsum River (FISS 2005). Stickleback were captured in a fish fence that was operated by the CCFPA at the Hagensborg Slough, which is located on the South side of Bella Coola River mainstem opposite the confluence of the Salloomt River (CCFPA 2000; Willson 2001a; Anon 1999).

3.11.10 Prickly Sculpin (*Cottus asper*)

This is a small fish, generally less than 200 mm in length. Their colour can vary from olive to dark brown or grey above and becomes yellowish-white or white below. The prickly sculpin generally has three dark bands under the second dorsal fin and sides with vague black molting. At spawning, both sexes have a thin orange band on the edge of the first dorsal fin (Scott and Crossman 1979).

Spawning generally occurs in the spring in streams with boulders, cobble and flat rock bottoms.

Prickly Sculpin were caught during electroshocking conducted in Maydoe Creek on September 22, 1997, and in Whitton Creek for the Charlotte Alplands Stream Inventory (FISS 2005). Coast Range Sculpin were captured in a fish fence that was operated by the CCFPA at the Hagensborg Slough, which is located on the South side of Bella Coola River mainstem opposite the confluence of the Salloomt River (CCFPA 2000; Willson 2001a; Anon 1999).

3.11.11 Red-sided Shiner (*Richardsonius balteatus*)

The Red-sided Shiner can be up to 127 mm in length. The dorsal surface of its body and head is a steely blue, olive or dark brown to black. A narrow unpigmented band is found from the operculum to the dorsal fin. Spawning generally occurs between May and July in streams and lakes (Scott and Crossman 1979).

4.0 Resource Use - The Fishery

Please note: DFO (Fisheries Management) has not conducted a formal review of this section as of yet. However, Lyle Enderud (DFO, Fisheries Management Section, Bella Coola) has conducted a preliminary review and his comments and corrections have been incorporated into this section.

The following section provides general information on the historic and current fisheries for various species of fish that are or were harvested within Area 8 (Bella Coola) and the Bella Coola watershed. Please refer to Figure 4.1 for a map of Area 8. The major commercial fisheries in Area 8 include: 1) the Fisher Channel/Fitz Hugh Sound seine and gillnet fisheries, 2) the Dean Channel gillnet fisheries, and 3) the Bella Coola gillnet fishery. Trollers are also permitted to fish in the waters of Fisher Fitz-Hugh; however, openings in this area have been infrequent during the past 10 years. Other fisheries in Area 8 include the recreational and First Nations fisheries. Catch data for all fisheries, all species, and all available years in Area 8, is presented in Appendix 8.

For current tidal and non-tidal sport fish regulations, refer to the Freshwater Fishing Regulations Synopsis, the Freshwater Salmon Supplement, and the In-season Regulation Changes.

The catch data presented in this section may not reflect the stock status. It is difficult to evaluate the state of each fish stock from catch data, since the data is collated by species and fishery. Escapement estimates provide the only indication of the state of an individual stock. Furthermore, without information on catch data by stock, it cannot be determined whether over-fishing or habitat changes are causing conservation problems (Wood 2000). It should also be noted that, during the early years of the commercial fishery, as well as in the current Area 8 fishery, low catches are/were often a result of low harvest efforts, rather than an indication of low stock abundance.

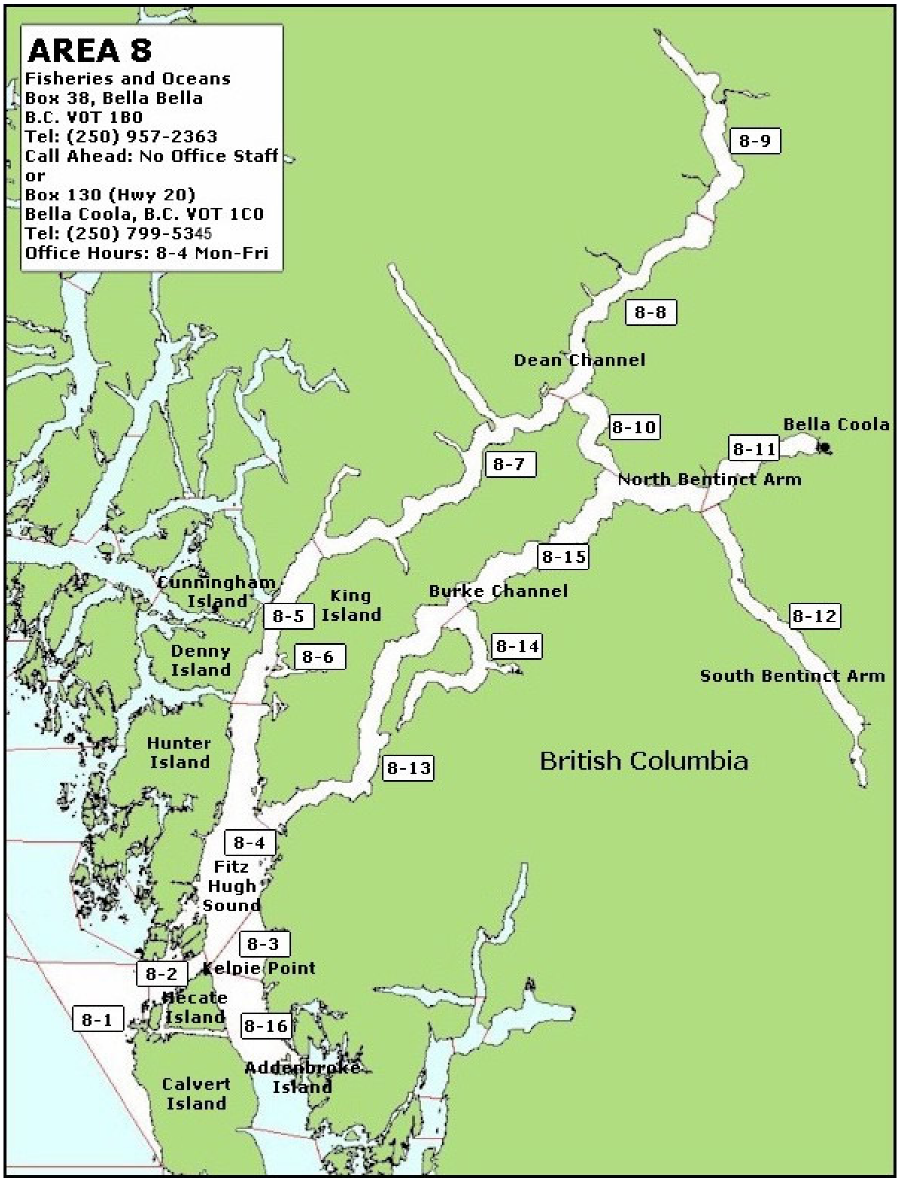


Figure 4.1 Map of Area 8 (Taken from: DFO website <http://www.pac.dfo-mpo.gc.ca/ops/fm/Areas/area_08_e.htm>)

4.1 Chinook Salmon

The only fisheries that target chinook in Area 8 include: 1) Bella Coola Gillnet Fisheries, 2) Bella Coola River First Nations net fishery, and 3) Bella Coola/Atnarko in-river sport fishery.

4.1.1 Commercial

Based on coded-wire tag recoveries, 43% of Atnarko chinook are harvested commercially in Alaska, 17% in the North Coast Area, and 40% locally in Areas 6-10 (most of which are in Area 8) (Anon 2001).

The Burke Channel, North Bentinck Arm and Labouchere Channel are the main gillnet fishing areas that target Atnarko chinook. Typically the earliest commercial fishery in Area 8 is the chinook gillnet fishery in the Bella Coola Gillnet Area. This fishery begins in mid-May or early June, before other species are present in large numbers. Fishermen are restricted to large mesh nets to protect out-migrant steelhead kelts, early chum, and sockeye stocks (DFO 1986). In-river coded wire tag recoveries indicate that most Nusatsum, Salloomt and Noosgulch chinook return in July, after the commercial fishery has switched to smaller mesh nets to harvest chum. Therefore the gillnet fishery is relatively benign with respect to harvesting other stocks and species (Hilland 2005). Chinook are also caught to a lesser degree in the Fisher/Fitz Hugh (English et al. 1998). Outside of the Bella Coola Gillnet Area, fishermen are requested to release all chinook (DFO 2002). Since the 1980s the commercial chinook fishery in Area 8 has not operated during certain years due to low stock levels (DFO 1986).

Refer to Figure 4.2 for a graph of all commercial catch data for chinook in Area 8. Refer to Table 4.1 for estimates on the contribution of enhanced chinook from the Snootli Creek Hatchery to the Area 8 commercial net fishery.

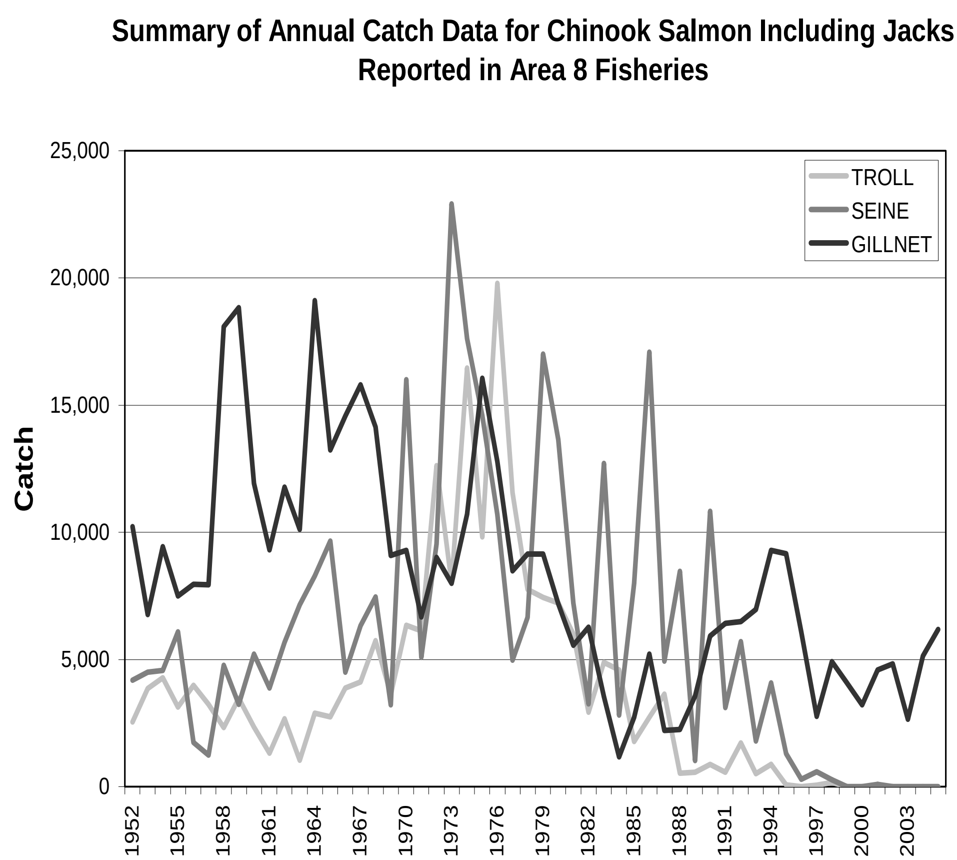


Figure 4.2 Summary of Annual Catch Data for Chinook Salmon Including Jacks Reported in Area 8 Fisheries.

Table 4.1 Estimates of Contribution of Enhanced Chinook Salmon from Snootli Creek Hatchery to the Area 8 Commercial Net Fishery for Years 1983-2002. (Data provided by: Sandie MacLaurin, DFO Community Advisor, Oceans & Community Stewardship Unit and Sue Lehman, DFO Biologist, Enhancement Support and Assessment Unit of Oceans Habitat and Enhancement Program. Dec. 13, 2005)

ESTIMATES OF CONTRIBUTION OF ENHANCED CHINOOK SALMON FROM SNOOTLI HATCHERY TO AREA 8 COMMERCIAL NET FISHERY FOR YEARS 1983-2002			
(RC) Recovery Year	Total Number Hatchery Fish Recovered	Area 8 Net Catch	Est.% Contribution
1983	4.76	16,260	0.03%
1984	16.19	3,997	0.41%
1985	29.26	10,718	0.27%
1986	92.65	22,289	0.42%
1987	262.26	7,156	3.66%
1988	331.79	10,712	3.10%
1989	541.95	4,586	11.82%
1990	659.11	16,746	3.94%
1991	1738.31	9,524	18.25%
1992	1722.79	12,192	14.13%
1993	1594.26	8,758	18.20%
1994	2395.75	13,359	17.93%
1995	4560.77	10,463	43.59%
1996	2680.28	6,374	42.05%
1997	1653.42	3,344	49.44%
1998	2422.29	5,187	46.70%
1999	1370.72	4,077	33.62%
2000	926.88	3,213	28.85%
2001	1255.07	4,686	26.78%
2002	949.91	4,826	19.68%
1983-2002 Mean			19.14%
1989-2002 Mean			26.79%

4.1.2 Recreational

The in-river sport fishery is somewhat self-regulating. Water conditions and lack of river access usually limit catch. Daily catch and possession limits could be altered to reduce catch if necessary (Hilland 2005).

Refer to Appendix 8 for tidal and non-tidal sport catch data.

4.1.3 First Nations

The Nuxalk Band harvests chinook from the Upper and Lower Bella Coola River (DFO 2002). The Ulkatcho Band also fishes the Atnarko River for chinook (Anon 2001) and the Upper Bella Coola River (DFO 2002).

The native food fishery is self-regulating. The Nuxalk First Nations have a self imposed fishing closure on the Lower Bella Coola River from 6 pm Thursday until 6 pm Sunday, of each week, to allow fish to migrate through to the spawning grounds. The driftnet fishery is further limited by water conditions since floods often pose a safety hazard. Fishing effort will switch to sockeye once the smokehouses are full. Annual catches are approximately 1,500-4,500 chinook (Hilland 2005).

In 1981, the Terminal Gillnet Fishery on Atnarko chinook was reduced to 1 day per week due to poor returns. In response, a pilot project for Atnarko chinook was initiated at the Snootli Creek Hatchery (Record of Enhancement Strategies, DFO).

4.2 Coho Salmon

Coho are targeted in the First Nations fishery, sport fisheries, as well as commercial fisheries (Anon 2001).

4.2.1 Commercial

The commercial fishery for coho started in the 1890s. Coho catches increased in the 1930s and stayed at a relatively constant level until 1960 (see Figure 4.3). Commercial catch of coho shows a peak of production in the 1960s and early 1970s, followed by a long decline to zero with special restrictions in the late 1990s. The Pacific Fisheries Resource Conservation Council stated that the "high catches in the 1960s and 1970s have been attributed to a combination of factors including favourable ocean conditions, increased hatchery production and intensive harvesting. The low catches in the 1990s have been attributed to unfavourable ocean conditions, but over-harvesting of wild stocks and consequent reduced spawner abundance are also important factors" (Anon 2001).

Non-retention of coho was in effect for all net fisheries in Area 8 between 1998 and 2003. Commercial harvest re-opened in 2004; however, in accordance with the 1998 coho conservation measures to reduce coho by-catch, commercial fishery openings are currently restricted to daylight hours (Hilland and Lehman 2004).

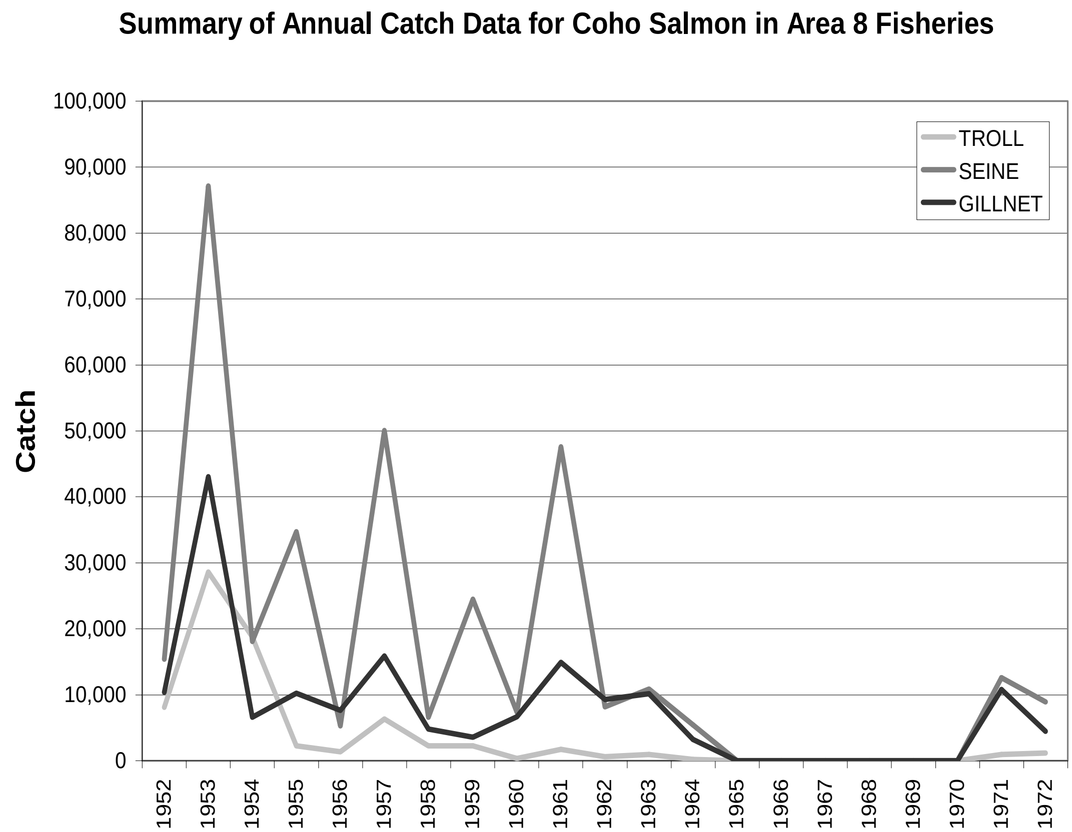


Figure 4.3. Summary of Annual Catch Data for Coho Salmon in Area 8 Fisheries.

4.2.2 Recreational

Coho are taken in the saltwater and Bella Coola River sports fishery (Hilland and Lehman 2004). The coho in-river fishery was closed for the year in 1998.

Refer to Appendix 8 for tidal and non-tidal sport catch data.

4.2.3 First Nations

The Nuxalk Band fishes for coho in the Upper and Lower Bella Coola River, North Bentinck Arm, and Burke Channel. The Lower Bella Coola First Nations catch averaged 1906 coho during the period from 1977 to 1997. The average catch in the 1970s was about 2,200 and in the 1990s average catch had decreased to less than 1,500 (Anon 2001).

The Ulkatcho Band harvests small amounts of coho salmon from the Upper Bella Coola River (DFO 2002).

4.3 Pink Salmon

4.3.1 Commercial

Pink are harvested in the Fisher/Fitz Hugh seine fishery and in the Dean Channel fishery, which harvests local stocks (DFO 2002). However, they are initially taken as incidental catches in the commercial chum fishery during the second week of July. Pinks do not become the target of fisheries, generally until the third week in July when seiners are permitted in Fisher Channel/Fitz Hugh Sound. The pink fishery is usually complete by the last week in August (English et al. 1998).

Pink production decreased sharply in the 1990s, and in response, harvest rates were reduced but production has not yet recovered (Wood 2000) (see Figure 4.4). Pink salmon catches in Areas 8 have dropped to an average of 530,000 for the past 10 years.

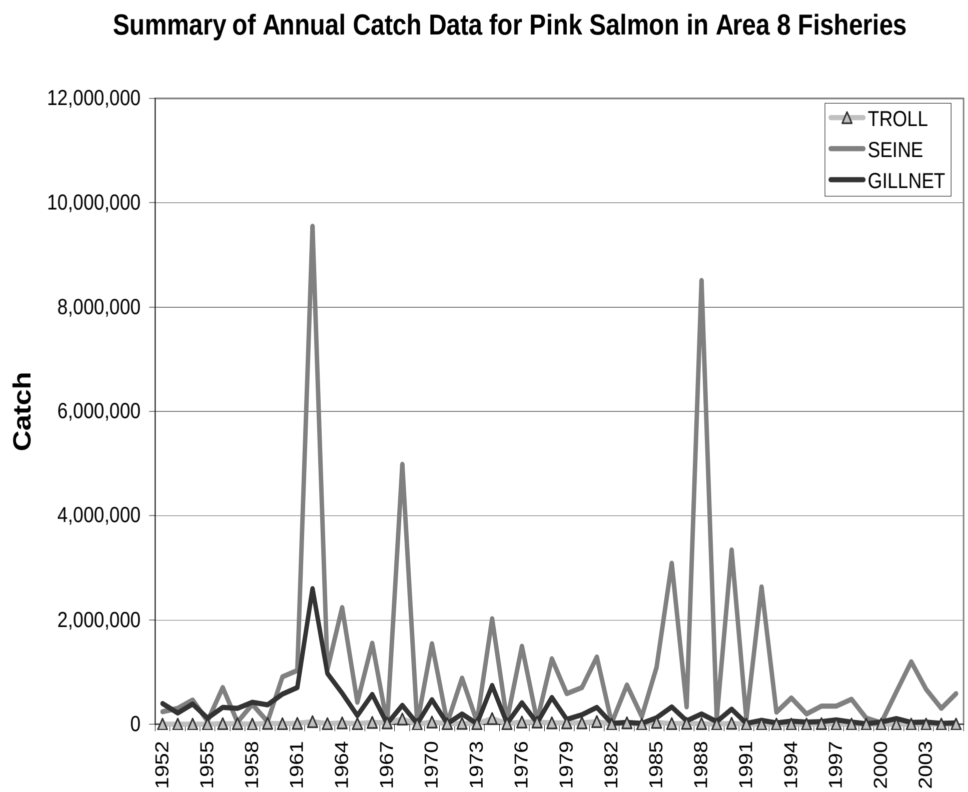


Figure 4.4 Summary of Annual Catch Data for Pink Salmon in Area 8 Fisheries.

4.3.2 Recreation

The in-river pink fishery first opened in 1992 and since this time catches have continued to slowly increase. Refer to Appendix 8 for tidal and non-tidal sport catch data.

4.3.3 First Nations

The Ulkatcho and Nuxalk Bands may have an incidental catch of pinks, but they are not targeted (DFO 2002).

4.4 Chum Salmon

4.4.1 Commercial

Chum are harvested in the Fisher/Fitz Hugh gillnet and seine fishery, in Dean Channel, and in the Bella Coola Gillnet Area after the chinook openings (DFO 2002). Chum become the target of fisheries generally in the third week in July, when seiners are permitted in Fisher Channel/Fitz Hugh Sound (English et al. 1998).

Bella Coola summer-run chum are harvested from Fitz Hugh Sound, Fisher Channel, Burke Channel and terminally in North Bentinck Arm. If necessary, other species passing through these areas during the chum fishery can be protected by mesh size and area restrictions (Hilland 2005). The summer chum fishery is generally complete by the last week in August (English et al. 1998). Refer to Figure 4.5 for a graph of all commercial catch data for chum in Area 8.

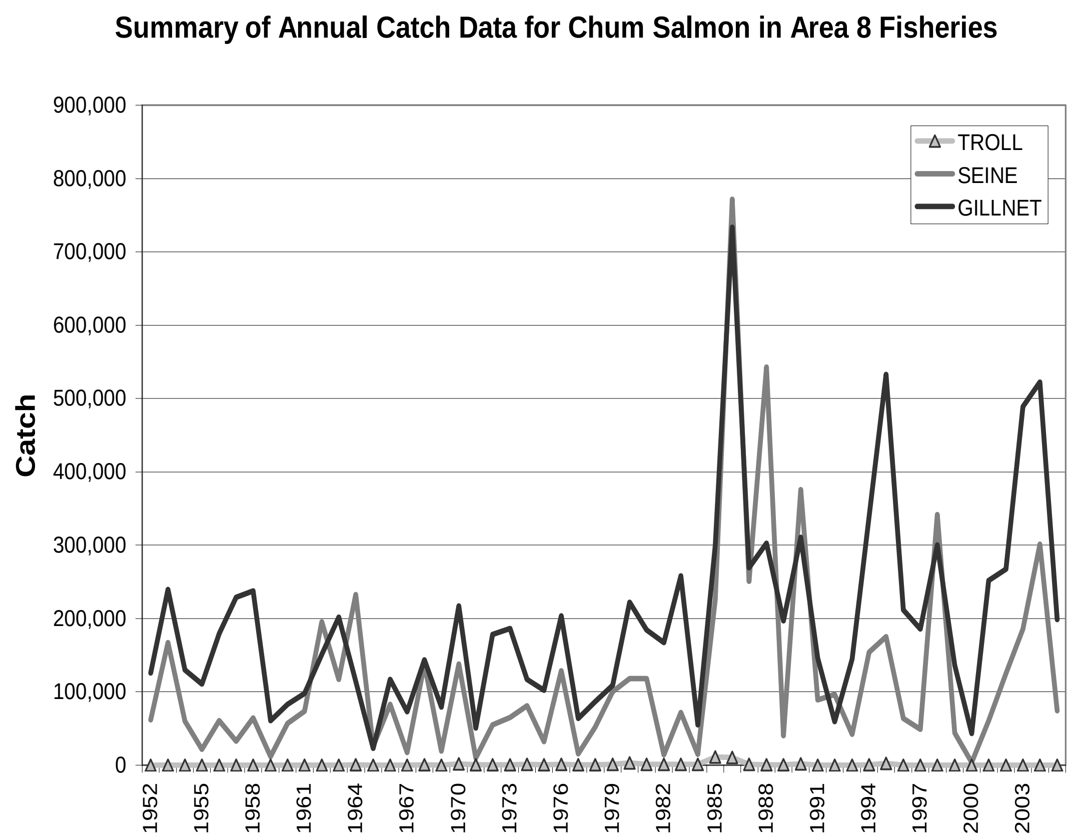


Figure 4.5 Summary of Annual Catch Data for Chum Salmon in Area 8 Fisheries.

4.4.2 Recreational

The in-river chum fishery first opened in 1994 and since this time catches have ranged between 21 in the first year to 487. Refer to Appendix 8 for tidal and non-tidal sport catch data.

4.4.3 First Nations

The Ulkatcho Band harvests small amounts of chum salmon from the Upper Bella Coola River. The Nuxalk harvest chum from the Upper and Lower Bella Coola River (DFO 2002).

4.5 Sockeye Salmon

4.5.1 Commercial

Sockeye have been protected in recent years through mesh restrictions for gillnets and non retention for seines. Thus, there currently is no directed commercial fishery on Bella Coola sockeye; however, some incidental sockeye catch inevitably occurs (DFO 2002).

In 1990 a mesh restriction of 149 mm was implemented for the Bella Coola Gillnet area for the first two weeks of July in an effort to conserve the sockeye population. During the third week of July 1990, this mesh restriction was removed, making this the last time in which the directed commercial fishery on Bella Coola sockeye occurred. Prior to this time, the commercial harvest of sockeye generally did not begin until the first week of July. The fishery was open to vessels equipped with small-mesh gill nets (DFO 1986; English et al. 1998). The current mesh restrictions (for the last 2 years) are as follows: 203mm until the beginning of July, then 158mm until the beginning of August, and finally 149mm for the remainder of the season (Terry Palfrey, pers. comm.).

Historically, commercial catch of sockeye salmon in Area 8 was variable from 1960 to the mid-1990s; however, since 1996 record lows can be observed (see Figure 4.6). The long-term trend for catches in Area 8 has been a long, slow decline. For example, the catch from 1990-99 was 60% of the 1900-1909 catch and less than 50% of the 1920s catch (Wood 2000).

Currently, commercial sockeye catch in Area 8 can be broken down into two areas. In Fitz Hugh the catch is drastically down due to lower escapement numbers, as well as the measures put in place to reduce sockeye by-catch. Fishers are no longer able to target sockeye, therefore passing stocks (Fraser, Rivers and Smiths) and local stocks (Koeye) are not intercepted as often. Catch is also drastically down for the inside portion of Area 8 (Burke, Labouchere and North Bentinck) due to the same reasons as Fitz Hugh. These returning sockeye are not passing stocks, but are predominantly stocks returning to the Atnarko and Kimsquit rivers (Terry Palfrey, pers. comm.).

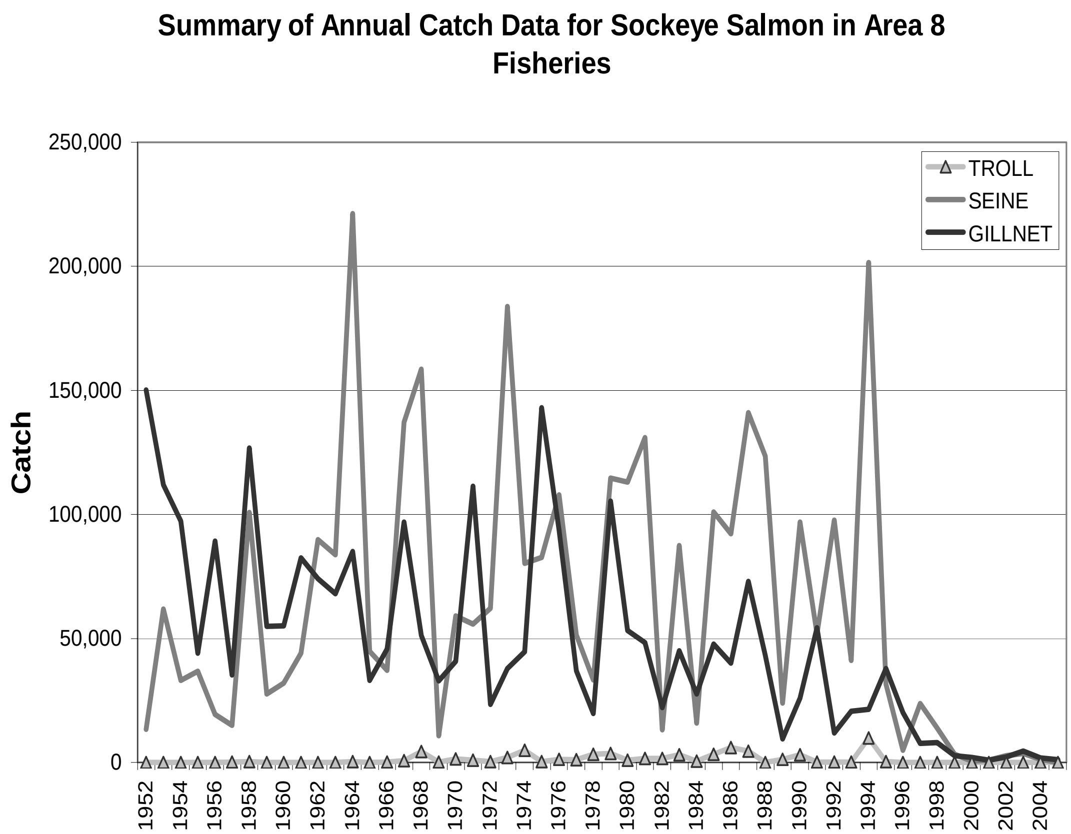


Figure 4.6 Summary of Annual Catch Data for Sockeye Salmon in Area 8 Fisheries.

4.5.2 Recreational

There is currently no recreational fishery on sockeye; however, incidental catches occur in the tidal sport fishery, but remain relatively low (maximum catch was 36). Refer to Appendix 8 for tidal and non-tidal sport catch data.

4.5.3 First Nations

The First Nations Fishery is the only targeted fishery for Bella Coola sockeye, and recent harvests are estimated at about 1000-4000 fish annually (Hilland 2005). The Ulkatcho and Nuxalk Bands harvest sockeye from the Upper Bella Coola River. The Nuxalk also harvests this species from the Lower Bella Coola River. (DFO 2002).

4.6 Steelhead Trout

Prior to the closure of the fishery in 1995, steelhead destined for the Bella Coola watershed were harvested in three distinct fisheries: 1) commercial fisheries targeting salmon in Statistical Area 8; 2) First Nation fisheries concentrated in the Lower Bella Coola River; and 3) recreational fisheries along the Bella Coola River and Lower Atnarko River (English et al. 1998).

4.6.1 Commercial

Steelhead are captured as bycatch by all commercial fisheries in Area 8 with the majority of the commercial steelhead harvest occurring between mid-July and the end of August when pink and chum stocks are being targeted. Some of the steelhead caught during the Area 8 commercial fisheries are destined for the Bella Coola watershed; however, the majority are believed to be Dean River steelhead (Nelson et al. 1998; English et al. 1998). Commercial fisherman are required to release all steelhead in all of Area 8.

The exact numbers of Bella Coola steelhead that are and were caught by the commercial fisheries is unclear. However, based on the catch results that are available (Refer to Figure 4.7 below), steelhead catch in the commercial fishery in Area 8 has decreased since the 1960s.

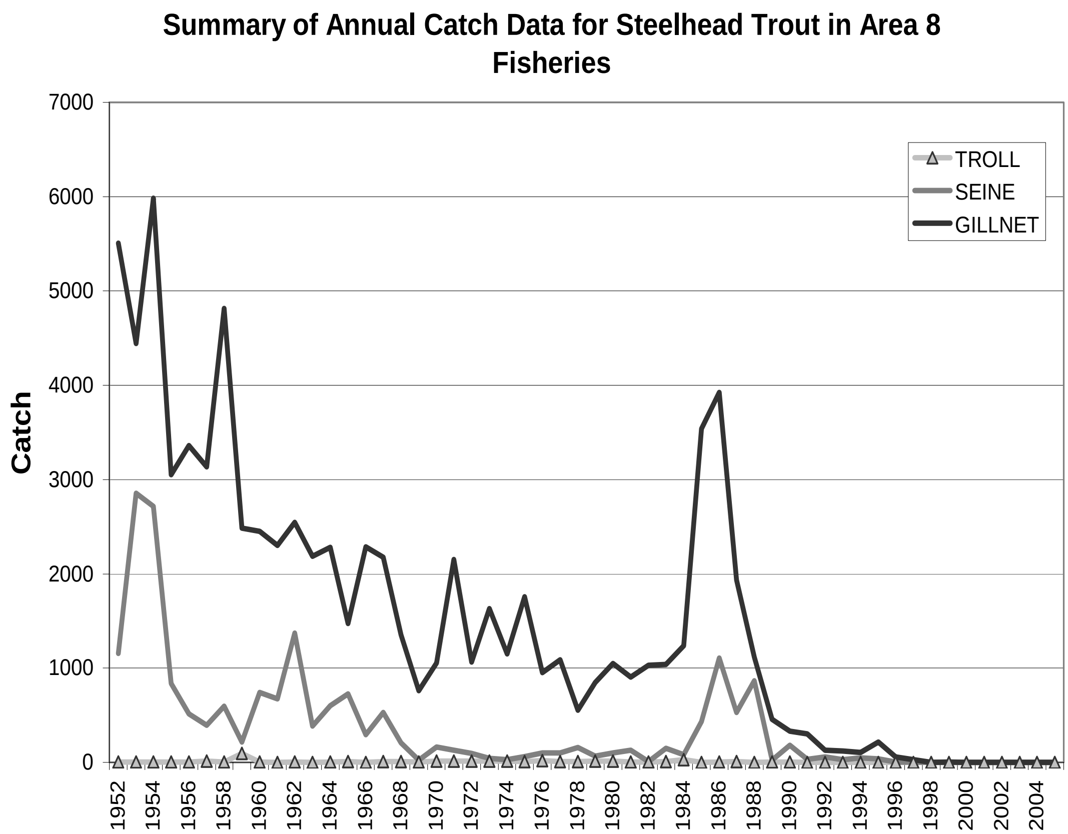


Figure 4.7 Summary of Annual Catch Data for Steelhead Trout in Area 8 Fisheries.

4.6.2 Recreational

In November 1995 a complete closure of in-river steelhead fisheries for the Bella Coola and Atnarko rivers was imposed by Director's Order (Nelson et al. 1998). Prior to this closure regulation, the recreational fishery for steelhead in the Bella Coola watershed was open throughout the year. Historic angler effort focused on the spring-run and late-summer/early-winter steelhead as they entered the river. Steelhead fishing activity generally peaked during March and April and decreased from early May through to mid-June (at which time the river typically becomes turbid with glacial silt, and anglers target returning chinook) (English et al. 1998).

Under the current closure regulations, steelhead continue to be incidentally captured during the salmon recreational fishery (English et al. 1998). It is hoped that all steelhead are released alive.

Satisfactory historic estimates of the total amount of steelhead taken in the recreational fishery are not obtainable (Hart 1973). However, the data that is available is presented below in Appendix 8.

4.6.3 First Nations

Prior to the 1995 closure, the Nuxalk Band targeted steelhead from late November through to late April using set gillnets; however, this component of the Nuxalk fishery has been virtually eliminated since 1995. The few steelhead that are currently harvested are mostly taken during the peak fishing period from May through to early July when chinook and sockeye salmon are targeted (English et al. 1998).

4.7 Eulachon

4.7.1 Commercial

There has never been a commercial fishery for Bella Coola eulachon. In northern British Columbia, eulachon are protected against commercial exploitation; therefore, it is essentially reserved for First Nations use (Hart 1973).

4.7.2 Recreational

Non-native populations have fished recreationally for eulachon in the Bella Coola River, mainly for fresh consumption.

4.7.3 First Nations

The Bella Coola River previously supported a spawning population of eulachon that sustained a fishery for the Nuxalk community until 1999. However, since the mid 1990s numbers have drastically declined (Hay and McCarter, 2000). The last Nuxalk fishery on the Bella Coola River was in 1998, and during the spring of 1999, the eulachon did not return.

Eulachon have been a fish of vital importance to the Nuxalk Nation. While the products of their harvest may include fresh, dried, smoked, salted, and frozen whole fish, the product of greatest cultural, economic, nutritional, and social value is the “grease” or oil rendered from the fish. Distributed widely in potlatches, traded with neighbouring Nations, and relied upon for its wealth of nutritional and medicinal uses, grease making has long been a tradition in Nuxalk territory.

5.0 Enhancement History

5.1 Atnarko Pilot Hatchery

In late January, 1968, a flood of 10,200 cfs destroyed much of the spawn of the 1967 pink salmon run in the Atnarko River. This, combined with fishing pressures on the decreased stocks during the next two cycles, reduced the odd year pink salmon runs to a critically low level (Environment Canada 1975).

In response, between 1974-1978 a pilot facility was constructed at the Fisheries Pool on the Atnarko River. The objectives of this hatchery were to:

- restore the odd year run pink salmon population (reduced from 1,000,000 to 30,000 spawners by the late fall 1965 and late winter 1968 floods); and,
- rear and coded wire tag Atnarko chinook (so that management options could be developed in order to arrest a 10 year decline in Atnarko chinook populations).

The original targets for the Atnarko Pilot Hatchery as follows: for pink, 4,000,000 eggs, 3,200,000 fry, 32,000 adults; and for chinook, 250,000 eggs, 200,000 fry, 2,000 adults.

The Atnarko pink stock recovered quickly, and the facility was closed and removed in 1979 (DFO 1986). Refer to Appendix 9 for a summary of eggtakes and hatchery releases of pink salmon for 1975-77.

5.2 Atnarko Spawning Channel

In 1986, a 1500 m long spawning channel (Atnarko Spawning Channel) was constructed 100 m downstream from Belarko using a side channel of the Atnarko River. In the event of a flood related catastrophic loss of spawn in the Atnarko River, such as that which occurred in the 1960's, the Atnarko Spawning Channel production was intended to allow the run to recover in 1 to 2 cycles (Hilland 1992). During the first several years of operation, it was determined that gravel size and gradient within the spawning channel were inappropriate for pink salmon and the channel has never produced to the estimated target capacity of 10 million fry. Although survivals from egg to fry are good when compared to bio-standards for spawning channels in British Columbia, fry production has never exceeded 6 million. In comparison to the Atnarko River, with estimated average fry production of between 150 to 300 million annually, this level of production is insignificant (Hilland and Lehman Unpublished).

In 1991, a decision was made to discontinue operation of the Atnarko Spawning Channel and the focus of the channel was changed from a human-operated production facility to a self sustaining habitat (Hilland 1992). Complexing was incorporated into the channel during the original construction; however, over the years, the habitat deteriorated due to siltation. In 1998, the intake was reconstructed and the channel was re-complexed to enhance spawning and rearing capacity (Hilland and Lehman Unpublished). Refer to Appendix 9 for a list of fry production estimates in the Atnarko Spawning Channel from 1896 to 2004.

5.3 Atnarko Rearing Channels

In 1986, two parallel rearing channels were constructed adjacent to the Atnarko Spawning Channel so release of river acclimated, ocean-ready, 90-day chinook smolts could be achieved. This enhancement strategy was adopted to increase chinook survival to adult. It also reduces impacts to wild stocks from fry releases (where fish need to stay in the river for a period of time to rear) and potential competition for habitat and food. It should be noted that the channels also allowed for production of yearling smolt chinook and coho in some years. Chinook smolts were first released from the rearing channels in 1987. The channels were first used for coho rearing in 1989. Operation of the rearing channels is ongoing with production of 90-day chinook smolts being the primary focus (Russ Hilland pers. comm.). The channels have an estimated capacity of 20,000,000 grams (4,000,000 5 gram chinook or coho smolts) (Hilland and Lehman Unpublished).

5.4 Snootli Creek Hatchery

5.4.1 Background

Snootli Creek Hatchery was built in 1978. With an initial capacity of 10 million eggs, the Snootli Creek Hatchery was designed to increase adult chum salmon returns to the Bella Coola River and its tributaries by 160,000 fish annually. Facility expansion and reconfiguration over the past 26 years has allowed for the enhancement of chinook, coho, cutthroat, steelhead, and sockeye. In addition, the hatchery is responsible for maintaining and operating the Atnarko Spawning Channel and Atnarko Rearing Channels previously discussed. Refer to Table 5.1a for a list of the expected adult returns for 2006 from the hatchery's standard release numbers.

Species	Run	Stock	Release Site	Stage	Eggs	Release	Expected Adult Returns
Chinook	Summer	Atnarko R Low	Atnarko R Low	Smolt 0+	1,050,000	904,000	3,616
	Summer	Atnarko R Up	Atnarko R Up	Smolt 0+	1,050,000	904,000	3,616
	Summer	Noosgulch R	Noosgulch R	Smolt 0+	50,000	43,000	172
	Summer	Nusatsum R	Nusatsum R	Smolt 0+	100,000	86,000	344
	Summer	Salloomt R	Salloomt R	Smolt 0+	100,000	86,000	344
Coho	Fall	Snootli Cr	Snootli Cr	Smolts	50,000	40,000	800
	Fall	Salloomt R	Salloomt R	Smolts	50,000	40,000	800
Chum	Summer	Fish+Airport	Fish+Airport	Fed FW	1,800,000	1,656,000	23,515
	Summer	Salloomt R	Salloomt R	Fed FW	1,800,000	1,656,000	23,515
	Summer	Snootli Cr	Snootli Cr	Fed FW	1,800,000	1,656,000	23,515
	Summer	Thorsen	Thorsen	Fed FW	1,800,000	1,656,000	23,515
Pink	Fall	Atnarko R Low	Atnarko R Low	Chan Fry	3,000,000	1,500,000	22,500
Sockeye	Fall	Atnarko R	Atnarko R	Fed FW	100,000	86,000	430

Table 5.1a Expected Adult Returns for 2006 from Snootli Creek Hatchery's Release Numbers

The contribution of Snootli Creek Hatchery to the Bella Coola watershed is to:

- restore/sustain Bella Coola chum salmon stocks to support a commercial fishery,
- rebuild/sustain the Atnarko chinook stocks to support a commercial fishery,
- rebuild Salloomt, Nusatsum and Noosgulch chinook stocks,
- rebuild/sustain coho stocks,
- stabilize pink salmon production to support a commercial fishery,
- participate in conservation enhancement initiatives with other stocks of concern where resources and opportunity permit (sockeye, steelhead, and cutthroat trout), and
- contribute to assessment programs through release of marked fish.

The Central Coast Fisherman's Protective Association (CCFPA) utilizes the Snootli Creek Hatchery to enhance Bella Coola River fall chum and coho.

Table 5.1b presents the timing of hatchery activities.

Table 5.1b Snootli Creek Hatchery activity time table.

SPECIES	EGG TAKE	INCUBATI0N	REARING	RELEASE
Chum	August	August -	January -	March

		January	March	
Chinook	August - October	August - March	February - June	June
Coho	October - December	October - March	Year Round	May
Sockeye	August - October	August - January	January - May	May
Pink	September	September - April	N/A	April

5.4.2 Timeline of Enhancement Activities

1978 -Construction of Snootli Creek Hatchery commenced.

1978 -Broodstock first collected from Noohalk and Snootli creeks and incubated in heath stacks adjacent to the current hatchery site.

1979 -Hatchery construction completed.

1979 -Chum broodstock first collected from the Salloomt River, Snootli Creek, Noohalk Creek, and Fish Creek.

1981 -Pilot project for Atnarko chinook was initiated in response to the closure of the Terminal Gillnet Fishery on Atnarko chinook due to poor returns.

1981 -Headwater stocking project was initiated on the Salloomt River involving Bella Coola fall-run steelhead eggs, at the request of the Provincial Fish and Wildlife Branch.

1981 -DFO Fisheries Management requested enhancement of Bella Coola coho.

1985 -Began enhancing Salloomt chinook stocks (due to concerns over low numbers of returns).

1985 -Began enhancement program with Lower Bella Coola cutthroat at the request of the Provincial Fish and Wildlife Branch.

1987 -Began using the Atnarko Rearing Channels to produce 90 day chinook using 1986 brood juveniles.

1987 -Coho egg target was increased due to concerns with the status of coho stocks in North Bentinck Arm during the mid-1980's. Started enhancing Nusatsum River chinook.

1990 -Undertook pilot project to produce yearling chinook smolts at the Atnarko Spawning Channel.

1991 -Steelhead program was terminated, at the request of the Provincial Fish and Wildlife Branch.

1994-2001-A Coho Initiative (CCFPA) was started in 1994 and ran until 2001. Coho enhancement was suspended in 2001 due to higher returns.

2004 -Request from DFO Fisheries Management to resume some coho enhancement in 2005 for assessment purposes (MacLaurin Unpublished).

5.4.3 History of Species Enhancement

The following section provides a current and historic overview for all fish species that have been enhanced within the Bella Coola watershed.

5.4.2.1 Chinook Salmon

In 1981 the Terminal Gillnet Fishery on Atnarko chinook closed indefinitely due to poor returns. In response, a pilot project for Atnarko chinook was initiated at the Snootli Creek Hatchery (Hilland 1992). The production target release for Atnarko chinook is 2 million smolts annually and this has been met in most years since 1985. The enhanced production represents an estimated 20-30% of the total Atnarko River production (Hilland and Lehman Unpublished; Hilland 1979b).

Salloomt, Nusatsum and Noosgulch chinook are also supplemented by the hatchery with production targets of 50-100,000 smolts each and releases ranging between 6,000 and 94,000 annually (Hilland 2005; Fisheries and Oceans Canada 2003).

There is insufficient data on wild juvenile production to estimate contribution of enhanced to total smolt production from these watersheds. It has been estimated that 30-40% of the chinook escapements to these tributaries are of hatchery origin in some years. These estimates are based on recoveries of marked fish in commercial, native and sport fisheries and broodstock capture programs (Hilland and Lehman Unpublished).

Refer to Appendix 9 for a list of hatchery releases of chinook into the Bella Coola watershed.

5.4.2.2 Coho Salmon

Coho escapements to the Bella Coola/Atnarko were below the management target of 80,000 and generally declining between 1960 to the mid 1990's (see Appendix 9). Since 1995 escapement estimates have only been generated in two escapement years, 1999 and 2002, both being about 30,000. A number of initiatives have been undertaken to improve coho production from the watershed including habitat restoration, juvenile out-planting and yearling smolt production. Whenever resources were available, yearling smolts were coded-wire tagged, to see if management strategies could be developed to increase spawning adult returns. (Note: assessment of CWT returns indicated that exploitation was as high as 45% in Alaska fisheries and 30 - 40% in the B.C. Northern Troll Fishery (Hilland and Bailey Unpublished).

The Snootli Creek Hatchery, either by itself or in partnership with a community group, has supplemented coho production since the 1980's. The hatchery currently enhances coho from the Lower Bella Coola River by over-wintering fish at the hatchery and returning yearling smolts to their natal streams. Production of Lower Bella Coola stocks has been variable with releases ranging from a high of 538,000 in 1988 to averages of 30-50,000 from 1994-2000.

The hatchery has also enhanced coho from the Upper (1998 and 2000) and Lower Atnarko River (1987-2000). Production of smolts from the upper Atnarko River was approximately 61,214 in 1998 and 46,712 in 2000 while production from the Lower Atnarko River ranged between approximately 44,000 and 346,500. This program was cancelled after the release of the 2000 brood (Russ Hilland pers. comm.).

In 1993 and in 2001-2004 coho enhancement was discontinued as marine survivals had seemed to improve. The 2001-2004 broods also benefited from management actions (closure of Northern Troll Fishery 1998 - 2000) which led to an increase in the number of spawners in the Bella Coola/Atnarko.

In recent years the Northern Troll Fishery has been reopened and coincidently, fewer coho adults have been observed in the tributaries of the Bella Coola River. In the fall of 2005 a cooperative coho enhancement project was initiated with the goal of augmenting the wild production and tracking interception of Bella Coola coho through the Alaska and B.C. Northern Troll fisheries through release of coded wire tagged smolts.

Refer to Appendix 9 for a list of hatchery releases of coho into the Bella Coola watershed.

5.4.2.3 Pink Salmon

Hatchery and spawning channel programs have contributed in augmenting the Atnarko pink population. The first enhancement work occurred between 1975 and 1979 at the Atnarko Pilot Hatchery which was previously discussed (DFO 1986). Enhancement of pink through the construction of controlled flow spawning channel (Atnarko Spawning Channel) began in 1986 and continues in a limited fashion (Russ Hilland pers. comm.; Hilland and Lehman Unpublished).

The estimated pink fry production from the Atnarko Spawning Channel has ranged between 39,525 in 1993 to 2,660,000 in 1990. Estimated fry production averaged 928,634 from 1995 to 2004.

5.4.2.4 Chum Salmon

The Snootli Creek Hatchery enhances chum from Thorsen Creek, Snootli Creek, Fish/Airport Sidechannel, and the Salloomt River. Enhancement began in 1978 to assist with rebuilding depressed chum stocks and has continued to sustain a commercial fishery. Annual hatchery production has ranged between 5.6 and 7.5 million smolts since 1983. The chum smolts are released to their natal streams during the peak of the wild fry migration (Hilland and Lehman Unpublished).

Between 1983 and 1997, the CCFPA enhanced the Bella Coola fall chum (Russ Hilland pers. comm.; DFO 2003). This involved broodstock collection, spawning, incubation and release of fry throughout various systems in the watershed. The CCFPA is interested in continuing the process, but are faced with difficulty in collecting the broodstock (Sandie MacLaurin pers. comm.).

Refer to Appendix 9 for a list of hatchery releases of chum into the Bella Coola watershed.

5.4.2.5 Sockeye Salmon

The Nuxalk Nation in cooperation with Snootli Creek Hatchery began enhancing stream-type Atnarko River sockeye in 2005 when approximately 40,000 eggs were taken from the Atnarko River. This pilot project was developed with an egg target of 100,000 and is intended to improve understanding of Atnarko sockeye stocks and increase the number of adult returns to the river.

5.4.2.6 Steelhead Trout

In 1981, The Ministry of Environment (MOE) initiated a five-year fry stocking program to establish a juvenile steelhead population in the Upper Salloomt River. The stocking took place above a fish impassable barrier, which is located 5 km upstream from the mouth. Steelhead juveniles continued to be released from 1986-90 and in 1992 (Nelson et al. 1998). Steelhead fry have also been released by Snootli Creek Hatchery into Hotnarko Lake, Blue Lake, Atnarko River, Noosgulch River and the Precipice. Refer to Appendix 9 for a list of hatchery releases of chinook into the Bella Coola watershed.

5.4.2.7 Cutthroat Trout

The Snootli Creek Hatchery, in partnership with MOE, enhanced Bella Coola cutthroat trout from 1985 to 1995. Eggs were obtained from the Lower Bella Coola stocks and fry were released to the Lower Bella Coola River, as well as Leech, Blue, and Octopus lakes. Refer to Appendix 9 for a list of hatchery releases of cutthroat into the Bella Coola watershed.

6.0 Factors Affecting Fish and Fish Habitat

6.1 Land and Water Use Activities

Various land use and management activities can affect fish and fish habitat. Although the activities themselves may differ widely, the environmental alterations they produce generally affect fish habitats in similar ways. The effects of increased sedimentation on spawning gravels, for example, will be the same whether or not the sediment resulted from road construction, logging, mining or livestock grazing. The same is true of other habitat variables such as water temperature, quantity and distribution of instream cover, channel morphology, and dissolved oxygen concentrations (Meehan 1991). The following is a discussion on some of the land and water use activities that have impacted fish and fish habitat in the Bella Coola watershed, with site-specific examples from various assessment reports.

6.1.1 Urban/Rural Development

Urban and rural development within the Bella Coola watershed tends to be concentrated in the lower Bella Coola Valley. Many homes and other land developments have been built on the floodplain and are susceptible to flooding. There is no sewage treatment centre in the valley and all septic systems are individual tanks and gravel over-flow fields. In the recent past many residents, rather than taking garbage to the Thorsen Creek Landfill, have disposed of their waste in backyard pits. Several homeowners, with watercourses on their property, have cleared the land adjacent to these watercourses, thus removing riparian cover. All of these developments/activities can negatively impact on water quality in the Bella Coola watershed. By developing impermeable surfaces, such as roads and buildings within the floodplain, it also reduces the amount of water that is absorbed by the floodplain and increases streamflows (Nener et al. 1997).

On floodplains where vegetation has been removed and drainage ditches have been created to ensure water flows away rapidly, the opportunity for soils to absorb and retain water is limited. Therefore, the watertable is lowered and streamflows are affected during low flow periods due to a lack of groundwater inputs (Nener et al. 1997). Channelization can impact fish and fish habitat by increased stream velocities and removing hydraulic diversity. This in turn can increase the rate of sediment being delivered to the downstream watercourses.

Summit (1997) conducted an inventory of sediment sources in the Lower Bella Coola watershed and compared 1995 aerial photographs with historical (1954) air photos. The comparison indicated that disturbance to riparian areas and channelization have likely increased the rates of sediment delivery to the Bella Coola River. Noohalk Creek was one example where the effects of channelization were observed. Two tributaries of the creek have been excavated in the past to encourage land drainage, which has resulted in the sub-surface interception of water from the marshy area to the east. In addition to the impact on the marshy area, this channelization may also be resulting in the previously mentioned impacts, such as lowering the watertable, lowering streamflows, increasing stream velocities, removing hydraulic diversity, and increasing sediment delivery.

Urban/rural development within the Bella Coola River floodplain has resulted in the installation of numerous bridges and culverts across watercourses. These structures can also channelize streams and impact riparian vegetation. Summit (1997) determined that this was of particular concern on Fish Creek, given the high number of stream crossings.

6.1.2 Forestry

The Bella Coola Valley is ideally suited for the growth of giant timber due to its rich alluvial soils and moist, temperate climate. This timber has considerable economic value and consequently, the most extensive developments adjacent to the Bella Coola River and its tributaries have been as a result of logging (Refer to Appendix 3 for a detailed history of logging in the Bella Coola area). Past logging practices generally did not take into consideration fish and fish habitat. Forest harvesting to the stream bank was common practice in much of BC until the introduction of the Coast Fisheries-Forestry Guidelines in 1988, and later the Forest Practices Code in 1995 (Slaney and Zaldokas 1997). Removal of riparian vegetation such as this can result in changes in solar radiation, water temperature, forest canopy and stream bank vegetation, stream bank stability, suspended solids, fine woody debris, coarse woody debris, channel morphology, substrate sediments, streambed stability, nutrient supply, and stream flows.

These changes can have long-lasting consequences to fish and fish habitat, which has been documented in the Bella Coola watershed through an assessment conducted by Summit (1997). The study found that historical removal of old growth forest from riparian areas and the subsequent regrowth of deciduous or mixed forest, shrubs, or replacement with agricultural land has resulted in a loss of LWD inputs, a decrease in scour pool formation, and loss of natural fish cover on Fish and Noohalk creeks, and Reach 1 of the Salloomt and Noosgulch rivers.

The activities and development associated with logging can also impact fish and fish habitat. Improperly constructed and/or poorly maintained forest roads can alter habitat in the watershed through chronic surface erosion that degrades water quality. Roads constructed in close proximity to streams may interfere with natural lateral movement and can lead to erosion of the road material. Bridges and culverts that have a smaller cross-sectional area than the natural stream in which they are installed can restrict or prevent fish passage (Slaney and Zaldokas 1997). The blockage of fish passages is one of the most serious difficulties for fish and can affect the fish population of entire streams (Meehan 1991).

Several studies have been conducted that provide information on some of the impacts and potential risks of past forestry activities within the Bella Coola watershed. The “Bella Coola Watershed Upslope Risk Summary”, prepared for International Forest Products Ltd. in March 2003, outlines the status of forest roads in the Bella Coola watershed (west of Tweedsmuir Provincial Park) as of 2002 (GeoWise Engineering 2003). This report evaluated the landslide risk associated with existing forest roads within the study area, and the feasibility of undertaking road deactivation activities along these roads. The results showed that most forest roads in the study area had low landslide risk and no action was required to stabilize or maintain these roads. However, for 302 of the assessed roads, 40 were rated with an overall risk greater than low. The study recommended that additional action was required to carry out more detailed surveys of the road conditions for deactivation and/or maintenance activities.

Summit (1997) conducted an inventory of sediment sources in the Lower Bella Coola watershed and the results indicated that 71 sediment sources were likely related to human or forestry-related activities. Comparison of 1995 aerial photographs with historical (1954) air photos indicated that since major forest harvest operations in the 1960s and 70s rates of sediment delivery have been modified. Summit (1996) also conducted a Level 1 Coastal Watershed Assessment and identified an Equivalent Clearcut Area (ECA) for various sub-basins within the Bella Coola watershed (see Table 6.1).

Table 6.1 Equivalent Clearcut Area (ECA) Within Sub-Basins of the Bella Coola Watershed

Sub-Basin	ECA km²	%
Tastquan Creek	0	0
Thorsen Creek	0.95	6.4
Snooka Creek	0.18	1.5
Snootli Creek	0.53	1.4
Nooklikonnik Creek	0.5	1.2
Salloomt River	7.09	8.8
Nusatsum River	8.26	8.6
Tseapseahoolz Creek	0.65	2.2
Noosgulch River	6.19	4.1
Cacoohtin Creek	0.44	0.8
Noomst Creek	2.09	2.1
Burnt Bridge Creek	0.11	0.2
Bella Coola River Residual	15.62	5.8
Tsill Creek	0	0
Atnarko River Residual	0.15	0.4
Tsini-Tsini Creek	1.1	2.7
Nordschow Creek	0.65	0.7
Gyllenspetz Creek	0.63	0.5
Ape Creek	0	0
Jacobsen Creek	0	0
Talchako River Residual	6.87	5.1

Modified from: CWAP Summit 1996

6.1.3 Agriculture

Livestock grazing within riparian areas poses a potential threat to the integrity of fish habitat since it can degrade instream habitat, streambank stability, the riparian environment, and fish populations. Upland soil can become compacted and vegetative composition can be altered, which can increase runoff and erosion. This combination of upland erosion, loss of riparian canopies, and breakdown of streambanks lowers local water tables and causes streams to become wider, shallower, and warmer in the summer, and cooler during the winter (Meehan 1991).

Furthermore, livestock that have access to riparian areas create manure which can impact fish and fish habitat. Excess nutrients from manure cause accelerated algal growth which damages fish habitat and depletes dissolved oxygen. Manure runoff also contains high levels of ammonia that is toxic to fish (Nener et al. 1997).

Agriculture land within the Bella Coola watershed has traditionally been clear-cut right to the edge of watercourses. Crop production that is located adjacent to watercourses will likely impact fish and fish habitat. Soil compaction caused by inappropriately timed tillage and heavy machinery traffic can result in soil compaction which increases the risk of overland flow, causing soil erosion as well as nutrient and other contaminant runoff directly into the watercourse (Nener et al. 1997).

Drainage systems (i.e. ditches) associated with some agricultural activities have a significant potential to impact fish and fish habitat if they are not properly designed, constructed, and maintained. Ditches present direct impacts to the fish and fish habitat that are supported by the ditch, as well as downstream impacts which are typically related to sediment or water quality problems (Nener et al. 1997).

Summit (1997) conducted a fish habitat and stream channel assessment for various sites within the Bella Coola watershed. The results of the study indicated various watercourses that have been impacted due to domestic livestock having access to riparian areas and/or to the watercourses themselves (i.e. Ann Creek, Hagensborg Slough, Fish Creek and Noohalk Creek, and Snooka Creek). In Reach 1 of Cacoohtin Creek land clearing and access to the stream by cattle have impacted water quality and riparian vegetation through grazing.

6.1.4 Transportation

Highway 20 runs parallel to both the Atnarko and Bella Coola rivers. Roads can impact fish and fish habitat through the construction of bridge and culverts, which can result in a loss of habitat, increased erosion, and can restrict or prevent fish movement within the watercourse. Road and ditch construction, operation, and maintenance can also impact fish and fish habitat through the release of sediment and other contaminants into watercourses.

In March 2001, MidCoast Aquatics (2001) conducted a fish habitat survey of Charter Creek, which is a tributary to Snootli Creek. The study identified that roadway ditches were the most significant limiting factor for salmonids in the creek, since the ditches that enter the creek provide little cover, shallow depths and fluctuating water levels.

DFO staff have worked with local contractors for the Ministry of Transportation (MOT) in the past to identify sensitive fish habitat within roadside ditches and to identify culverts that are fish barriers. DFO and MOT are currently working on a management plan to maintain highways and ditches so impact to fish and fish habitat is minimized.

6.1.5 Utilities

BC Hydro lines also run parallel to the Bella Coola and Atnarko rivers. In the late 1990's, BC Hydro began actively working with DFO to identify sensitive fish habitat areas in the valley that were adjacent to hydro poles. It is unknown whether a formal report was produced as a result. BC Hydro contractors have also worked with DFO staff to obtain guidance and a working protocol for operations around hydro poles and lines.

There are currently no hydroelectric power generation facilities within the Bella Coola watershed; however, proposals for Independent Power Projects (IPPs) on systems within the watershed have recently been submitted to Land and Water BC Inc. These proposals include a 1.5 megawatt plant on Cacoohtin Creek, as well as active applications on the Noosgulch and Atnarko rivers. The Clayton Falls Hydro Generation Station is not located within the watershed, but Clayton Falls Creek flows into North Bentinck Arm, near the Bella Coola estuary.

Numerous negative impacts to fish and fish habitat can result from the operation of hydro generation facilities. These impacts can include restricted spawning migrations and restricted mainstem spawning and rearing due to flow fluctuations, low flows and/or high water temperatures; flooding and sedimentation causing egg mortalities, rearing fry and habitats; fluctuating water levels leading to stranding and exposure of fry and eggs; migrating spawners being delayed at powerhouse tailraces or dam spillways; and smolt and fry mortalities occurring during passage through powerhouse turbines (Hirst 1991).

6.1.6 *Solid Waste Disposal*

The Thorsen Creek Landfill is located upstream of the Highway 20 bridge on the east side of Thorsen Creek. Summit (1997) suggested that the landfill may be affecting water quality in Thorsen Creek and/or nearby tributaries (i.e. Noohalk Creek). Local residents and government representatives have expressed concerns over possible run-off and seepage from the landfill (Summit 1997).

6.1.7 *Backshore/Marine Development*

Marinas have the potential to greatly impact fish and fish habitat through their infrastructure and operations. The intensive use of an enclosed water area by a concentration of boats can seriously reduce water quality through the introduction of contaminants and debris. Run-off from upland activities such as hull cleaning and vehicle parking can enter the marine/estuarine waters, and can result in the accumulation of solids, chemicals, and oil residues to sub-lethal or lethal levels for fish. Boat launching ramps that extend through the intertidal or shallow depth zones completely alienate productive shoreline habitats. Floats can impact marine/estuarine habitat by grounding on intertidal habitats, shading shallow water habitat, and creating a barrier to the circulation of surface water (DFO and MELP 1995).

The removal of vegetation from the land area adjacent to the shoreline (or coastal buffer zone) as a result of upland development can impact marine/estuarine habitats. This buffer zone protects water quality by trapping sediments, pollutants, and absorbing nutrients from surface water runoff and groundwater flow. Removal of shoreline vegetation can decrease the biodiversity in the surrounding marine/estuarine habitats. The coastal buffer zone also controls shoreline erosion by helping to stabilize the soil, and can aid in flood control (Desbonnet et al. 1994).

The Bella Coola River estuary and surrounding upland area has undergone relatively limited industrial development; however, future development has been addressed as an issue of potential concern by the Technical Committee.

6.1.8 *Flood Control*

The Bella Coola River is highly susceptible to flooding both during the autumn, when heavy rains and snowmelt under mild conditions can create a sudden freshet, and in the late spring and early summer when snow and ice-melt in the mountainous headwaters can cause flooding during years of heavy snowfall (Leaney and Morris 1981). The river is an irregular wandering type channel, and as such, it is a natural process for this type of river to migrate laterally on a regular basis. Air photo analysis shows this constant movement within the valley bottom (Refer to Figures 2.4 and 2.5). Although significant yearly changes are generally rare, the river shows significant lateral migration at various periods throughout the last 35 years.

Such river movement and flood risk, in some areas of habitation, have been countered with berming and other flood control structures, to the detriment of fish habitat. Many of these structures have seriously altered the natural flow of the water within the Bella Coola Valley, particularly adjacent to sidechannels. It is not uncommon for flood protection dikes to cut off an active flood channel or a channel that has been abandoned by the main river. The channelization that results from these flood protection structures can also reduce the availability of deep pools and runs. Deep pools and runs can provide rearing and holding habitat, especially during periods of critical low flow (Slaney and Zaldokas 1997).

Dike construction and maintenance activities have the potential to negatively impact fish and fish habitat when undertaken without appropriate forethought and care. Habitats along the edges of watercourses can be permanently lost or substantially altered due to filling and/or diking to protect property or create additional "usable" land. Marsh and riparian vegetation is often removed during diking construction and maintenance activities. These features provide refuge areas for juvenile salmonids from predators and from the higher velocities found mid-river. On smaller river systems, riparian vegetation can regulate water temperatures and filter surface water to prevent some sediment and pollutants from reaching the river. Dike construction and maintenance activities also have the potential to disturb spawning salmonids and incubating eggs (DFO and MELP 1999).

Summit (1997) compared 1995 aerial photographs of the Lower Bella Coola Valley with historical (1954) air photos and found that since the construction of major flood control works in the 1970s, rates of sediment delivery have been modified. This was observed on Snooka Creek where diking along the right bank of the creek, at the top of the fan, was creating changes to the stream channel and affecting sediment deposition. Snooka Creek is characterized by aggradation and lateral movement of the channel across the fan and this process was being constricted by the dikes. Aggradation in the Lower Bella Coola tributaries has been dealt with by conducting sediment removal on Snootli, Thorsen, Cacoohtin, and Nooklikonnik creeks. This practice has been undertaken in an effort to reduce the resultant flood risk to structures and properties; however, it too comes with its own set of impacts to fish and fish habitat, which are discussed in "Sediment Removal".

Summit (1997) also described the effects of dikes on Snootli, Cacoohtin, and Nooklikonnik creeks. The dikes have artificially maintained the energy of these streams and have consequently channelized the systems, thus decreasing the number and/or size of holding pools, and salmonid spawning and rearing habitat. The channelization caused by the flood control dikes also limits restoration opportunities on these systems (Summit 1997). In Nooklikonnik Creek, cobble and gravel have accumulated on mid-channel bars and along the bed. As a result, pools along the lower fan are elongated and shallow. Riparian vegetation has also been impacted. In Cacoohtin Creek it was observed that some of the stream energy was artificially maintained due to diking for about 150 m along the left-bank at the top of the fan. This diking, combined with a naturally high bedload, limit restoration opportunities on the upper fan.

6.1.9 Log Dumps

Coastal log-handling facilities (i.e. log storage, log dumps, transport facilities) have the potential to degrade subtidal, intertidal, and nearshore habitat. Log dumps/sorts Excessive accumulation of bark on the ocean floor can raise the biochemical oxygen demands in the water (Meehan 1991). This can affect the invertebrate populations that are used by anadromous species. The stored logs can also disrupt habitats if they are moved at low water. Invertebrate and vegetation communities can be subject to alienation of habitat through the accumulation of wood debris, reduced light intensity, and such mechanical affects as compaction and scouring of soft substrates, and scouring and abrasion of hard substrates. Furthermore, adverse water quality impacts can result from the decomposition of debris and spills of fuels and lubricants (Sedell et al. 1991; Williamson et al. 1999).

Log dumps were once located close to the mouth of the Bella Coola River; however, these dumps were relocated about 25 years ago due to some of the above-mentioned impacts (David Flegel pers. comm.).

6.1.10 Sediment Removal

Sediment removal can disturb the natural ecological balance of watercourses through the direct removal of aquatic life. For example, bottom-dwelling organisms on which fish depend for food may be eliminated from the food chain. Furthermore, any silt or sediment released from the dredging activities can cover and destroy rearing, spawning, and incubation habitats (Environment Canada 2006).

Sediment removal from watercourses within the Bella Coola watershed dates back a number of years. Immediately following the floods in 1965 and 1968, the Department of Highways removed gravel and boulders, washed downstream during floods, from the mouths of Thorsen, Snootli and Nooklikonnik creeks (Leaney and Morris 1981).

Summit (1997) determined that high rates of bedload deposition near the highway bridge has been an ongoing issue on Thorsen Creek. In July 1996, approximately 10,000 m3 of sediment was dredged from the channel by the Ministry of Transportation and Highways (MOTH). Prior to this, the creek had not been dredged for 10 years (Summit 1997). Summit also observed that diking structures on Nooklikonnik and Snootli creeks have resulted in channelization and subsequently have caused bedload problems downstream. In July 1996, approximately 2500 m3 of sediment was removed from the channel of Snootli Creek, and 4500 m3 of sediment was removed from Nooklikonnik Creek (Summit 1997).

Most recently, sediment was removed from Nooklikonnik and Snootli creeks during the winter of 2005. In response to the on going issue of sediment removal, a technical committee, comprised of Federal and Provincial agency specialists and contractors, has been formed to explore strategies and options for dealing with it.

6.2 Natural Factors

Streamflow is a major environmental factor that affects the survival and production of salmonids. Prolonged low flow periods can delay the movement of adults into streams, thus draining their energy reserves, and affecting upstream distribution and spawning success. High fall/winter flows can result in egg mortalities by scouring and/or sedimentation of the spawning beds. Low winter flows can cause freezing of eggs or stranding of fry, as well as impact on the overwinter survival of juvenile fish due to the loss of winter habitat. Extended periods of low flow in the summer reduce available rearing areas for juveniles. Water temperatures can also increase causing mortalities and stress for fish, including juvenile steelhead and coho (Slaney and Zaldokas 1997).

Bear predation on some drainages within the Bella Coola watershed is thought to have increased. It is not known if bear predation has negatively affected fish populations in the system.

In destabilized watersheds, excessive bedload from debris torrents and valley wall failures, in combination with higher than normal peak flows, may result in the filling of deep runs and pools further downstream in the mainstem, particularly where gradients and velocities decrease. Deep pools and runs can provide rearing and holding habitat, especially during periods of critical low flow (Slaney and Zaldokas 1997). Increased turbidity in the Talchako River as result of glacial melt can affect water quality, thus reducing freshwater survival of eggs and fry. Summit (1997) conducted an inventory of sediment sources in the Lower Bella Coola watershed and the results indicated that there were high rates of natural sediment delivery to streams and rivers in the study area.

Beaver activity is another natural factor that can have both a positive and negative impact on fish and fish habitat. Beavers can play a significant ecological role in watersheds, and in many cases, salmon have evolved in ecosystems regulated by beaver populations.

Impoundments created by beavers serve many physical, chemical, and biological functions (Slaney and Zaldokas 1997). Beaver ponds influence channel stability by regulating water flow and retaining sediment. Beavers modify the riparian species composition, contribute valuable rearing habitat for many freshwater fish species, and assist in nutrient cycling processes by retaining organics for regulated dispersal (Slaney and Zaldokas 1997). Therefore, managing beaver activity for ecosystem advantages can be a vital part of watershed restoration.

That being said, beavers can also have detrimental affects on fish and fish habitat. A beaver dam can sometimes be a barrier to adult and juvenile salmonids. Resident rainbow and cutthroat trout and juvenile steelhead are vulnerable to beaver encroachment. These species frequently rear in faster waters among boulders, LWD, and at head pools, and this is the type of habitat that is readily eliminated by beaver ponds on small streams (Slaney and Zaldokas 1997).

A fish habitat and stream channel assessment conducted by Summit (1997) indicated various areas within the Bella Coola watershed where beaver dams or natural debris jams were obstructing, or had the potential to obstruct, adult access to spawning grounds or other fish habitat (i.e. Fish Creek, Hagensborg Slough, Dump Creek, Skimlik Creek). MidCoast Aquatics (2000) conducted a fish habitat survey of the Firvale Back Channel, a sidechannel of the Bella Coola River. Some of the beaver dams identified during this assessment were also considered to impede fish movement within the channel and out-migration of smolts during periods of seasonal low flows.

In the Bella Coola Valley, some measures have been taken to prevent the obstruction of watercourses by beavers, including dam removal, construction of various structures to discourage beaver activities, and trapping. The CCFPA holds a permit to trap beavers when structures become impassible or the impounded water becomes too high. Although beavers fall under provincial jurisdiction there is little monitoring and no management plan; therefore, the CCFPA has volunteered time and money to address the problem.

7.0 Information Needs

Considerable information was required to complete this Stage II WFSP. That information was frequently difficult to access owing to the often multi-jurisdictional nature of the assessment or report, meaning physical reports were often scattered through offices around the province with no central repository. The Bella Coola Watershed Conservation Society Resource Centre has been acting as a repository for available data and has began a library of available reports and literature on the Bella Coola watershed and surrounding area and related topics.

There is still a need to compile data reports, mapped information, anecdotal and traditional knowledge and regularly collected information (e.g., DFO annual escapement) on a regular basis. Data gaps were identified as a key aspect to be addressed during Stage II and subsequent WFSP Stages. The largest single data gap appears to be a comprehensive sense of geographic and spatial data. The Bella Coola watershed encompasses approximately 514,939 ha making it very difficult to obtain accurate maps relevant to fish and fish habitat across such a large area. Although there have been several overviews, mapping projects, and inventories in the watershed a comprehensive base map does not exist. With current technology and advances in integration of spatial data in mapping software and map production, it appears feasible to create a usable map with the relevant fisheries data layered digitally for specific needs.

Additional information relevant to the WFSP process is that of ongoing progress and involvement of other committees, agencies and processes within the watershed. Although there are several groups working towards various conservation, development or other objectives in the watershed, it appears most ‘groups’ work autonomously and have little interaction with each other, limiting ability to share data and keep other organizations abreast of relevant developments.

A semi-annual Watershed and Resource Round Table may be beneficial in bringing several of these groups together to discuss advances in knowledge, development or conservation and could reduce redundancy in some aspects of often frustrating data or resource information collection.

8.0 Priority Issues, Objectives & Monitoring

A primary component of the WFSP is establishment of the following:

- Priority Watershed Issues;
- Objectives and Strategies for assessment/restoration of priority issues; and,
- Monitoring of success (i.e., restoration or ongoing assessment).

This report section identifies priorities, describes objectives and strategies to be implemented and prescribes monitoring to track success or changes over time.

Priority issues may include problems, concerns, risks, desires, and/or opportunities related to the protection, conservation, and restoration of fish stocks and habitat. The priority issues listed below were obtained through various forms of correspondence conducted in several stages. The first stage in this process was a meeting in December 2005 with two members of the Technical Committee to generate a preliminary list of priority issues within the watershed. In March 2006, this preliminary list was sent to members of the Technical Committee, the general public, stakeholders, First Nations and the government to elaborate on the existing issues and include any additional issues. Refer to Appendix 11 for the full list of general priority issues that were generated from this process.

For each priority issues identified below, a logical sequence of objectives and strategies have been developed and recommendations made for monitoring success of strategy implementation. The issues have been organized into five categories:

1. Priority Fish Stock Issues;
2. Priority Fisheries Management Issues;
3. Priority Land Use Management Issues;
4. Priority Fish Habitat Issues; and,
5. Priority Data Gap Issues (which have been further subdivided).

These priority issues are anticipated to change over time, reflecting a changing watershed (either improving or worsening conditions).

8.1 Fish Stocks

Through Technical Committee review, consultation with resource managers and historic data assessment, four (4) fish stocks in the Bella Coola watershed were identified as priorities, including:

1. Eulachon population decline;
2. Fall chum population decline;
3. Steelhead population decline (and failure to recover after 10 years of river closure and modifications to commercial fishery to conserve); and,
4. Sockeye population decline (Atnarko Rivers of major focus).

8.1.1 Fish Stock Objectives & Strategies

Objectives and strategies relating to priority fish stocks have been developed, as shown in Table 8-1.

Table 8-1: Priority Fish Stock Objectives and Strategies

Objective	Restore and rebuild stocks of concern, including eulachon, fall chum, steelhead and stream type sockeye populations, and manage to biologically, ecologically and socially acceptable levels. Target management levels have been suggested below, including: • Eulachon - interim target = 100 metric tones • Fall Chum – interim target = to be determined based on historical data • Steelhead – interim target = 2000 adult spawners (based on historic data) • Atnarko sockeye including stream type – interim target = 75,000 spawners based on current fisheries management target (stream type component unknown)
Strategy	• Identify current initiatives being conducted to protect populations of concern; • Ensure collaborative work between agencies, community groups, First Nations, NGO's and industry to develop action plan to protect and or enhance populations of concern; • Reduce mortality at all life stages; • Undertake studies to ensure that any harvest is sustainable over time for all species; • Undertake a continuous assessment program to develop an accurate index of abundance for all species at key life stages; • Support altering management of harvest or continue with current conservation measures such as with steelhead; • Selectively apply hatchery or other enhancement technology where appropriate; • Identify and eliminate data gaps; and, • Develop a multi –sectoral action plan for steelhead recovery.

8.1.2 Implementing Priority Fish Stock Strategies

To effectively implement issues associated with Priority Fish Stock Assessment and strategies identified above, it is recommended the following actions be undertaken:

1. Development of a Memorandum of Understanding (MOU) between Fisheries Management Agencies, BCWCS, First Nations, Sport Fishing Advisory Committee, other NGOs, and regional government (CCRD) to share information and compile data relating to the following:
   - stakeholder's resource use including harvest/utilization data, spatial data relating to harvest, catch per unit effort, harvest timing, etc.;
   - stakeholder's conservation initiatives;
   - stakeholder's conservation concerns; and,
   - standardize data collection and reporting methods.
2. Review and monitor outcomes of fish husbandry/hatchery activities and/or fish habitat restoration intended to enhance priority stocks;
3. Consult with fisheries management and assessment experts on an ongoing basis to determine relevance and applicability of established priority fish stock levels (over time, as these numbers may change).

8.1.3 Monitoring Priority Fish Stocks

To monitor effectiveness of those strategies applied to managing priority fish stocks of the Bella Coola Watershed it is recommended an annual meeting of agency representatives be held to discuss fish stock numbers and determine changes, declines or progress in achieving target stock numbers (described above, or otherwise agreed to).

8.2 Priority Fisheries Management Issues

Seven (7) Priority Fisheries Management issues for stocks returning to the Bella Coola watershed have been identified, including:

1. Potential threat of over-harvesting of salmonids through direct fisheries or through incidental catch by all user groups (i.e. commercial, First Nations and recreational)
2. Without hatchery production for harvest of chum and chinook salmon, commercial fishing opportunity would be reduced and more uncertain from year to year
3. Mixed stock fisheries have, and can, adversely impact smaller populations of non-target fish through unsustainable incidental catch
4. The Atnarko/Bella Coola steelhead population shows no sign of rebuilding in spite of complete fishing closures
5. The uncertainty in fisheries management caused by the inability to determine or predict changes in ocean survival (predator species, prey species, sea water temperature, etc.)
6. Inability to develop a management plan for eulachon (lack of information)
7. Potential impact of commercial netpen culture on wild fish (reduction of fish stocks through disease transfer and displacement of wild fish)

8.2.1 Fisheries Management Objectives & Strategies

Four Objectives and strategies relating to fisheries management issues have been developed, as shown in Table 8-2.

Table 8-2 Priority Fisheries Management Objectives and Strategies

Objective	**Ensure that all fish populations are maintained at sustainable levels. At this point, Fisheries Management escapement targets will be used as a measure of “sustainable” level of abundance.**
Strategy	• Inventory all species by subbasin, timing of return and support changes to IFMP and other planning processes to insure sustainability • Identify the limiting factors to production for these species and manage accordingly • Undertake studies to ensure that any harvest is sustainable over time for all species • Undertake a continuous assessment program to develop an accurate index of abundance for all species at key life stages

Objective	**Protect fish populations from the potential threat of over-harvesting and the incidence of by-catch of non-target stocks and species by all user groups (i.e. commercial, recreational, First Nations).**
Strategy	• Prevent this potential threat through good fisheries management and continuous assessment programs (all life stages) • Empower area based managers to implement immediate changes during fisheries to protect stocks of concern (catch of species of concern may increase during certain tides or when that species is seen to be entering the area) • Support the Nuxalk Fisheries Program and other monitoring programs

Objective	Provide opportunities for sustainable-harvest without adversely impacting fisheries resources in the watershed
Strategy	• Continue current risk averse fisheries management strategies • Continue with enhancement where it can be demonstrated that by-catch during harvest does not negatively impact other stocks or species from this or other watersheds • Eliminate data gaps associated with fisheries management • Provide local fisheries managers the authority to make decisions in a timely manner

Objective	Improve the ability to respond to fluctuating ocean survival rates
Strategy	• Timely collection, assimilation and distribution of data from existing sources that could be used in adaptive fishery management (i.e. by-catch in offshore fisheries, ocean current/temperature monitoring programs) • Monitor early marine conditions so can better forecast adult production potential

8.2.2 Implementing Priority Fisheries Management

Similar to objectives of Section 8.1 (Priority Fish Stocks), to monitor change over-time of priority fisheries management issues, it is recommended fisheries resource managers, the BCWCS and associated stakeholders regularly review and discuss key fisheries management issues, including:

- Ensuring sustainable fish stock abundance;
- Review annual enhancement production plans;
- Address issues of over harvesting and stock by-catch;
- Continued sustainable harvest; and,
- Improved understanding and response to ocean survival rates.

8.2.3 Monitoring & Assessment of Priority Fisheries Management

An annual meeting of representatives should be held to discuss fish stock and fisheries management (incorporating points of Sections 8.1 and 8.2) to determine changes, declines or progress in achieving target stock numbers and management strategies.

8.3 Priority Land Use Management Issues

Ten (10) priority Land Use Management issues in the Bella Coola watershed have been identified, including:

1. Managing impacts of past forestry operations (hillside destabilization, alteration to natural hydrology patterns, decommissioning and maintenance of roads and riparian zone integrity)
2. Potential impact of future forest operations (insuring forestry management and practices are in place to insure same problems do not occur again, pine beetle management and potential for large fires and resulting deforestation on plateau, private land logging where regulations are not the same)
3. Potential impacts to fish and fish habitat associated with development within the watershed and estuary (i.e. power projects, industrial and agricultural development, resource extraction, recreational facilities, etc.)

4. Adequacy of regulations and process to protect fish and fish habitat within the CCRD bylaws and OCP (habitat sensitive zones, riparian management, enforcement)
5. Lack of process for local citizens to have input into and influence the outcome of land use management plans (such as Forest Stewardship Plans)
6. Road network and corridor impacts (bridges and culvert placement and maintenance, ditching, disruption of natural hydrology, habitat alienation, pollution from road maintenance and use)
7. Flood management impacts (dike location and proximity to water course, management/maintenance of current dikes and necessity for bedload removal done on an emergency basis with no strategic plan for the future, ongoing need for bedload removal, water passage restriction)
8. Human settlement impacts (building on the active floodplain, land clearing, riparian management on both large and small streams, water use management, solid waste management, septic and other waste management)
9. Potential impacts of recreational fisheries and associated activities such as camping (increased angling pressure/number of anglers and use, river access, littering, pollution)
10. Potential impacts of water based activities (power boat operations, river access, fishing, drift boats/rafting/kayaking, snorkeling)

8.3.1 Land Use Management Objectives & Strategies

Seven (7) objectives and strategies relating to land use management issues have been developed, as shown in Table 8-3.

Table 8-3: Priority land Use Management Objectives and Strategies

Objective	**Protect fish and fish habitat from impacts associated with development within the watershed and estuary (i.e. power projects, industrial development, resource extraction, tourism and recreation facilities).**
Strategy	• Cooperate with agencies/companies responsible for the environmental review of proposed developments that have potential to impact fish and fish habitat • Create best management practices and work with the CCRD to develop bylaws that relate to development with a focus on protection of aquatic habitat • Establish a local review board (representing the community at large) with authority to insure all industrial and recreational development plans and current activities are consistent with the goals of the WFSP/local by-laws and BMP's • Acquire up-to-date and accurate base maps with overlays to assist planning • Consider purchase of land or explore use of covenants with private land owners to protect habitat • Educate land owners on the protection of fish and fish habitat (i.e. through events such as Rivers and Oceans Day and Open Houses)

Objective	**Prevent further degradation and restore damaged fish habitat associated with past forest harvest activities.**
Strategy	• Acquire up-to-date and accurate base maps with overlays to assist planning • Identify areas where habitat has been damaged or where there is potential for negative impacts • Develop management plan that includes assessments and mitigative and/or restoration options, risk analysis and implementation strategy

Objective	Insure that future forest harvest activities are part of a watershed plan that is sustainable, risk averse and recognizes all the fisheries values in the watershed
Strategy	• Acquire up-to-date and accurate base maps with overlays to assist planning • Encourage development of higher level watershed based forest harvest plan designed to recognize all values in the watershed and is consistent with WFSP • Establish a local review board to insure local communities are included throughout the development of Forest Stewardship Plans and have authority within the decision making process

Objective	Incorporate additional and improve existing fish and fish habitat protection into CCRD by-laws and OCP
Strategy	• Empower a committee to review by-laws and the OCP to identify areas of concern and conflict and suggest changes

Objective	Insure the maintenance and development of transportation corridors are consistent with WFSP
Strategy	• Acquire up-to-date and accurate base maps and add overlay • Identify existing problem areas and issues (habitat degradation and fish passage) • Develop local best management practices for road maintenance activities that may impact fish and fish habitat • Develop working relationship with agencies responsible for transportation corridor

Objective	Address fish and fish habitat impacts from existing flood management control structures
Strategy	• Acquire up-to-date and accurate base maps and add flood structure locations • Identify areas of concern • Develop best management practices specific to systems within the Bella Coola watershed to mitigate the effects of dike construction and maintenance • Develop a Multi-sectoral Management Strategy that will create a long term plan for future dike construction and maintenance

Objective	Minimize impacts to fish and fish habitat associated with human settlement
Strategy	• Acquire up-to-date and accurate mapping with current settlement plan (property lines, easements etc.) and watercourses • Identify areas of impact and develop restoration plans • Educate residents regarding fish and fish habitat values and WFSP process • Work with property owners to implement restoration plans (riparian planting, livestock fencing, etc.) • Incorporate additional fish and fish habitat protection into CCRD by-laws and OCP

8.3.2 Implementing Land Use Management Strategies

Land use management has a significant impact on the health and function of aquatic ecosystems and provides a tangible means of protecting, conserving and restoring fish habitat, fish populations and bio-diversity in a watershed. Land use management also encompasses a variety of stakeholders and projects, which can often be monitored to determine success of implementation and long-term effectiveness.

Establishing Community and Watershed Development Goals & Guidelines

Land development guidelines and objectives should be established at a regional level through consultation with industry, government, fisheries and natural resource managers, First Nations and other stakeholders to address local concerns and set standards for land development intended to protect fish habitat. Where provincial or federal government guidelines exist and are acceptable to stakeholders' requirements, it is recommended those guidelines be used as baseline standards.

Where no guidelines exist for unique development issues, or regional concerns or situations require more specific guidelines than those available for a specific or unique development scenario, it is recommended that stakeholders (DFO, MOE, CCRD, BCWCS, Nuxalk Nation, etc.) develop their own guidelines applicable to those situations.

A set of regional guidelines should be developed for application to a set of most likely development scenarios, including:

- Commercial or industrial development;
- Forest harvesting, forest roads and access points;
- Mining and quarrying;
- Large holdings, campgrounds, marinas, resorts;
- Recreational land development (Crown or private); and,
- Riparian, wetland or marine foreshore development.

Development guidelines should also include Best Management Practices applicable to site development, maintenance and monitoring. It is anticipated many of these guidelines and BMPs have been developed by other regional, provincial or federal government agencies throughout the province and are likely adaptable to the Bella Coola Watershed.

A review of the existing CCRD Official Community Plan, bylaws and guidelines should be completed so alterations, amendments or updates can be incorporated as required to ensure the OCP and guidelines/by-laws are commensurate with current environmental stewardship standards and regulations. A working document with a 'quick reference' section should be made available to the public and potential developers to facilitate improved development planning and further mitigate potential impacts on fish habitat.

Establishing Community Development Panel

To further assess potential impacts associated with proposed development it is recommended that a Land Development Panel including of a broad range of community, First Nations, resource management and business stakeholders review development plans and determine site specific applicability of Development Guidelines and/or BMPs specific to protection of fish and fish habitat. It is further recommended that this panel advise potential developers of any BMPs prior to development, and suggest alternative methods or require an amendment to the development plan. This panel should also advise on basic habitat measurement standards and be developed to assess projects for merit, not as a judiciary body. The panel should also be aware of and advise on any local bylaws and encourage enforcement of those bylaws for the protection of aquatic habitat.

Encouraging Community Involvement

Community involvement through workshops, presentation, literature/press releases and hands-on training should be used as a tool to bring awareness of habitat protection and land development issues to developers and the community at large. Opportunities for the BCWCS to contribute guidance, articles, new-releases and other media should be explored. The BCWCS office hours should be verified and published throughout the community to serve as a central community information center for development and stakeholder resources.

Opportunities for continued community support of such events as Oceans Day and Coho Festival should be supported by BCWCS, CCRD and other agencies.

BCWCS will take an active leadership role in securing funding from available sources (e.g., Job Creation Partnership Program offered through HRDC, or other funding sources). Where funding was received BCWCS would oversee hands-on implementation of recommendations from this Stage II Report through application of these funds for human resources, BCWCS administration expenses and community involvement programs.

Assess Forest Harvest Related Activities

The Forest and Range Practices Act and its regulations govern the activities of forest and range licensees in B.C. The statute sets the requirements for planning, road building, logging, reforestation, and grazing. BCWCS will utilize and follow these guidelines in advocating fish protection within the Bella Coola watershed and would be willing to liaise between licensees and resource management agencies as an advocate for the protection of the Bella Coola watershed, while remaining at arms-length from those groups. .

BCWCS will also work cooperatively with forest tenure licensees, Ministry of Forests and Range, Ministry of Environment and DFO to identify opportunities to rehabilitate or restore habitat previously impacted by forest harvesting. Section 10.4 (below) further describes those types of opportunities.

Develop Transportation Network Planning Resource

BCWCS will work to acquire up-to-date maps showing road networks and identify areas of potential impact to fish habitat, including fish passage, bank erosion or drainage/hydrology related issues. These maps could be used to recommend rehabilitation or restoration of habitat to appropriate agencies (DFO, MOT, etc.).

It is further recommended that future transportation planning should be completed in a manner consistent with planning and land development guidelines identified above.

Develop Flood Control Structure and Bedload Removal Activity Guide

BCWCS recognizes that though necessary, both flood control structures and their maintenance and flood prevention or mitigative activities can have significant impact on fish and fish habitat. BCWCS will work with responsible agencies and networks to develop a plan or guide that will help to minimize negative impacts to fish and fish habitat. The plan/guide will include:

- creating a list of flood control structures and activities, including dikes, culverts and bedload (gravel) removal;
- identifying areas of concern;
- locating and mapping these areas;
- developing BMP's specific to the Bella Coola watershed and for both established and new dike construction; and,
- developing a long term monitoring plan.

BCWCS will also contribute to development of a Multi-sectoral Management Strategy intended to create a long term plan for future dike construction and maintenance within the Bella Coola watershed.

8.3.3 Monitoring Land Use Management

Monitoring the success of strategies described above will require a combination of field assessments/audits as well as frequent review of compliance by stakeholders at the local government and planning level. Examples of specific monitoring plans relevant to strategies and implementation plans are described below.

Monitoring Development Guidelines

After implementation of CCRD (or other jurisdiction) application of guidelines complete an audit of development guideline compliance at regular intervals. Recommendations for improvements could be generated from audit results.

Monitoring Development Panel

Interview panel members to determine their satisfaction with panel recommendations, process and (project) outcomes and compare these results to results of Development Guidelines compliance audit and field visits to determine effectiveness of Development Panel recommendations.

Monitoring Community Involvement

Conduct a community survey to determine effectiveness of community involvement implementation strategies.

Monitoring Forest Harvest

Where feasible, assess operations and planning procedures of forest licensees to determine compliance with objectives and strategies described in this document. To the extent possible determine whether compliance is associated with recommendations of WBFSP guidance or higher authorities (e.g., Forest and Range Practices Act). Through communication records determine whether forest licensees initiated contact with BCWCS to seek guidance regarding habitat protection.

Monitoring Transportation issues

Resource and transportation agencies should convene regular (annual or biannual) meetings to discuss routine maintenance objectives and procedures and/or proposed upgrades to transportation corridors. Agencies could discuss effectiveness of habitat protection measures and compare results to past practices.

Monitoring Flood Control Issues

Monitoring success of flood control activities and habitat mitigation could be completed through assessment of a series of pre-determined habitat criteria and standard measurements in areas of flood control activities. This would include assessment of bed load aggradation/stability in areas where diking has resulted in channelization of streambeds (or something like that) (e.g., Nusatsum River, Nooklikonnik, Snootli, or Thorsen Creek). Where new structures were developed, assessment of BMP implementation could provide tool for monitoring WBFSP guideline application.

8.4 Fish Habitat

Six (6) Priority Fish Habitat issues in the Bella Coola watershed have been identified, including:

1. Reduced riparian function (cover, bank integrity, flows, water temperature, sedimentation, erosion, habitat complexity (LWD), shift in natural native fish

species composition and distribution in the watershed, introduction of beavers and resultant habitat impacts from dam placement)

2. Impacts of climate change (hydrology changes and subsequent reduction in available habitat for aquatic species, changes in water temperatures [higher temperatures in the Atnarko River], high and low water events more severe resulting in mortalities of eggs and juveniles due to freezing and stranding)
3. Sedimentation impacts (caused by human activity such as Snooka Creek, ongoing sediment introduction through natural clay bank erosion in Noosgulch River, Salloomt River and north side of Bella Coola near the airport, Talchako River glacial silt.)
4. Bedload aggradation and removal and loss of natural stream function in the lower portions of Thorsen, Snootli and Nooklikonnik creeks.
5. Loss of and reduction of off-channel and side channel habitat in lower valley (Nusatsum River down) (resulting in reduced flow in Hagensborg Creek, Hagensborg Slough and McLellan Creek and lack of access for salmonids)
6. Impacts of human settlement (removal of riparian vegetation on small streams, land clearing, road building, drainage ditch and culvert placement and maintenance, bank and streambed degradation from cattle, pollution from fertilizer, pesticides and manure).

8.4.1 Fish Habitat Objectives & Strategies

Five (5) objectives and strategies relating to fish habitat issues have been developed, as shown in Table 8-4.

Table 8-4: Priority Fish Habitat Objectives and Strategies

Objective	**Restore riparian function and prevent further loss of riparian zone**
Strategy	• Acquire up-to-date and accurate maps of watercourses • Identify and map areas of riparian loss as well as critical riparian sensitive zones that require higher level of protection than is afforded by current legislation • Work cooperatively with government, private property owners, industry, First Nations, and stakeholders to initiate recovery activities that would restore riparian function • Examine the OCP and CCRD bylaws to determine what fish and fish habitat protection is in place, assess adherence and enforcement and identifying areas where improved or additional protection measures are needed • Explore purchase of and/or application of covenants to protect critical habitat

Objective	**Manage watershed to minimize impacts associated with climate change**
Strategy	• Acquire up-to-date and accurate maps of the watershed (watercourses) • Review historic data to establish baselines and trends possibly associated with climate variation • Collect data that will facilitate evaluation of historic data • Adapt management plans accordingly

Objective	**Determine the potential impacts of large sediment sources as identified in 8.4 to well-being of fish and fish habitat**

Strategy	• Acquire up-to-date and accurate maps and add layer of large sediment sources • Review literature and collect data on sediment sources and natural sediment loads • Analyze risk associated with the known large sediment sources • Conduct risk analysis assessment to guide management plan • Develop a management plan that addresses current situation and provides direction for the future

Objective	**Reduce loss of natural stream function and mortality of fish due to current approach to bedload removal in Nooklikonnik, Snootli and Thorsen creeks.**
Strategy	• Acquire up-to-date and accurate maps and air photos to highlight areas of concern and to use for planning purposes • Establish a multi-sectoral working group to review information to date on the history of the problem, and hydrologic information including bedload sources and the factors that are contributing to the current situation) • Collect necessary data for making recommendations that will improve current situation and assist with development of longer term strategic plan for bedload removal

Objective	**To restore and protect off-channel and side channel habitat in the lower valley.**
Strategy	• Acquire up-to-date and accurate maps that include all off-channel, side channel and isolated habitats • Work collaboratively with government, private property owners, industry, First Nations, and stakeholders to identify opportunities for restoration and protection • Develop implementation strategy for restoration and protection • Consideration and/or protection of off-channel and side channel habitat in CCRD by-laws and OCP through a review and update

8.4.2 Implementing Fish Habitat Strategies

Priority fish habitat concerns of the Bella Coola watershed have been identified broadly as being related to the following habitat components:

- Riparian function;
- Hydrology;
- Sediment and bed load aggradations
- Off-channel habitat loss; and,
- Human impacts.

Implementing fish habitat strategies will require multi-stakeholder involvement in the WBFSP process. It is anticipated each objective and strategy (Table 8-4 above) will be approached on a project-specific basis, utilizing resources and funding from a variety of sources, including resource agencies (DFO, MoE, etc.), Forest Investment Account (FIA), volunteers and other sources to implement habitat assessments and/or restoration activities. It is beyond the scope of Stage II reporting to determine implementation logistics of all Fish Habitat restoration opportunities within the Bella Coola Watershed at this time, however; general guidelines for assessments can be provided, as described below.

Compile Riparian Zone Status Overview

Riparian function and related stream and habitat components (bank stability, LWD recruitment, etc.) are best assessed and monitored at the subbasin level. Priority subbasins should be identified and general assessment of riparian characteristics should be completed to identify priority stream sections (reaches) within those subbasins. Much of this work has been undertaken in various stages of previous assessment (e.g., Overview and Level 1 WRP projects). These data should be compiled to identify a prioritized list of streams and reaches requiring additional assessment and/or rehabilitation.

Ongoing (2006) updates to aerial and orthographic photos of the Central Coast Region as part of CCLRMP and other provincial initiatives are anticipated to result in production of up to date (2006) aerial photographs of the Bella Coola watershed. These photographs (or orthographic map layers) should be used for current data collection and for monitoring past activity and habitat condition.

For initial overview planning it is recommended a comprehensive review of existing documents be completed and a prioritized list of required assessments be compiled to determine overall riparian function of selected subbasins and mainstem sections of the Bella Coola watershed. It is anticipated a majority of subbasins and major tributaries of the Bella Coola River watershed would be candidates for this type of assessment and a thorough and detailed prioritization of those areas would be required in early planning to ensure most effective assessment based on reasonable goals of Stage II WFSP guidelines.

This type of overview would require a combination of trained personnel in office-based exercises (e.g., literature reviews, mapping and interpretation) and field assessment to implement monitoring and assessment methods (e.g., field measurements, stream assessments, etc.).

Develop Options for Responding to Hydrological Change

Stream hydrology and geomorphology are subject to change from a variety of anthropogenic and natural effects, including, but not limited to:

- climate change;
- ongoing land development;
- past land use;
- natural erosion; and,
- water use/withdrawal.

Opportunities to monitor climate change and associated predicted short and long-term trends on watershed hydrology should be assessed to determine potential affects on the Bella Coola River watershed.

Further opportunities to identify current areas where significant hydrological changes are occurring and how this has impacted fish habitat status should also be explored. Where possible it should be determined if actions can be taken to mitigate negative impacts, either through physical restoration or enhancement, or changes to land management or other proactive actions. Where feasible baselines to assess these changes should be established.

Future initiatives should enhance data collection and correlate water flow data with current changes in fish habitat to determine if changes are negatively affecting fish habitat and ultimately determine whether stream restoration or land and resource management can positively affect stream hydrology and habitat.

Develop Action Plan to Improve Sediment & Bed Load Management

Collection of prioritized subbasin bedload aggradation (bedload build-up) rates should be considerate of fish habitat, protection of riparian areas and associated upland/private property and long term watershed sustainability. Currently the stream channels of Thorsen Creek, Snootli Creek and Nooklikonnik Creek have been prioritized for monitoring, with recent (2006) data available for baseline channel profiles and elevations (MOE, 2005-2006 surveys of Nooklikonnik and Thorsen Creeks, unpublished data reports). Additional streams for assessment consideration could include Snooka Creek, Nusatsum River, Saloomt River and Atnarko River.

Opportunities for stream channel rehabilitation and ongoing mitigation should also be explored to react to continued aggradation in a way that does not impact fish habitat of those streams.

Develop Strategy for Addressing Off-channel Habitat Loss

Loss of off-channel habitat is a priority issue in lower reaches of the Bella Coola River and its downstream subbasins (west of Nusatsum River). Much of this area has been developed and/or utilized for forest harvest, or residential, commercial, agricultural and associated human development, often altering natural seasonal stream flows and alienating off-channel habitat of the Bella Coola River floodplain.

Assessment (and subsequent monitoring) of off-channel habitat will require a comprehensive inventory of existing off-channel habitat location and condition. Aerial or orthographic photographs of the watershed will provide an opportunity to compare historic and current (preferably 2006) extent of off-channel habitat, thus can be used as a monitoring method. Field work will be required to determine habitat condition and connectivity so habitat value can be assessed. It is recommended that complete comprehensive GPS based mapping also occur.

Where off-channel habitat is identified and opportunities for enhancement, restoration or rehabilitation exist, it is recommended high priority be placed on these types of activities, as off-channel habitat restoration has been proven to be a successful means of enhancing fish habitat in large watersheds, such as the Bella Coola River (Slaney and Zaldokas, 1997) and have proven successful in Bella Coola during past restoration activities.

Fish stranding and habitat alienation are also recommended to be considered during assessment and subsequent monitoring of off-channel areas. Fish stranding owing to improper road crossings, beaver activity, seasonal flooding and other developments can cause high numbers of fish mortalities and are generally avoidable. Identifying areas of past or ongoing fish stranding and habitat alienation are recommended to be high priority items.

Assessing Impacts of Agriculture on Fish Habitat

Negative impacts of agriculture and animal grazing on fish habitat may occur in areas of agricultural development or where grazing ranges encompass streams (including private and Crown Land). It is recommended fish habitat protection guidelines be established to ensure BMPs are in place to deal with issues most often associated with farming, ranching and grazing, including:

- Bank stability;
- Stream shading and riparian function; and,
- Nutrient input and water quality (pesticides, fertilizer and animal waste);

It is recommended the Bella Coola Valley Sustainable Agricultural Society (BCVSAS) be contacted and mutual development of fish habitat and environmental guidelines be undertaken by BCWCS, BCVSAS and other relevant agencies. A MOU could be developed and where agreed, BCVSAS could then be the lead proponent in implementing fish habitat protection in areas of their agricultural interest. Protection of fish habitat associated with agricultural activities outside of BCVSAS could be jointly overseen by BCWCS and BCVSAS.

8.4.3 Monitoring Fish Habitat

Monitoring of these habitat components to establish baseline data and track subsequent change is a complex procedure requiring site- and monitoring-specific design considerations. This monitoring section addresses general approaches to establishing baseline data for each habitat component and is intended for watershed or subbasin application (e.g., suitable for Bella Coola mainstem or tributary stream sections). For the most part. monitoring of these habitat functions within the Bella Coola watershed will require division of the watershed into specific subbasins.

Monitoring Riparian Function

Overview monitoring of riparian function should be completed using standardized methods such as the Hydroriparian Planning Guide (CIT, 2004) and other recognized methods (WRP, FPC, etc.). Riparian overview monitoring will identify key areas for field investigations to be assessed using appropriate methods. It is recommended that for initial overview planning subbasins and mainstem Bella Coola River reaches be prioritized based on three criteria, including:

- value and potential of fisheries resources;
- level of watershed development/disturbance (urban, forest harvest, recreation, etc.); and,
- feasibility/cost of assessment and/or rehabilitation or other follow-up.

Assessment methods described in various guidance documents would be incorporated in a broad reaching monitoring plan to collect baseline data from which to monitor change associated with implementation of further WSFSP programs (i.e., Stages III and IV)

Monitoring Hydrological Change

Monitoring key aspects of stream hydrology will be an important part in assessing change or recovery over time. Water levels and flows have been monitored at several locations in the Bella Coola Valley and surrounding/adjacent watersheds (e.g., Nusatsum River, Saloompt River, Tatsquan Creek) providing historic data for the watershed.

Similar to riparian assessment (and other watershed planning methods) hydrology should be assessed at subbasin levels, including prioritized assessment based on fish use or fish habitat requirements? and other criteria.

Key hydrological factors to be monitored at priority sites could include:

- stream discharge and flow data;
- water temperature;
- suspended solids/sediment load, and,
- ground water flow.

Coastal Watershed Assessment Planning (CWAP, MWLAP) data are available for most subbasins of the Bella Coola River Watershed and would provide a basis for prioritizing, and/or assessing change during further monitoring assessments.

Monitoring Sediment & Bedload Aggradations

Sediment and bed load aggradations have been identified as key factors affecting fish habitat in the Bella Coola River watershed. Monitoring sediment and bed load aggradation Identify current areas where significant hydrological changes are occurring and how this has impacted fish habitat status rates and seasonal fluctuations would provide a means of assessing need for rehabilitation (e.g., substrate removal) and its effectiveness over time in restoring fish habitat quality.

Baseline surveys to establish channel cross- and longitudinal-profiles should be completed for select reaches of these streams (where data do not exist) and permanent monitoring methods and stations developed for frequent monitoring into the future. Each of these streams are relatively accessible and monitoring stations could be established in conjunction with other assessment goals (e.g., discharge, water quality, riparian assessment, etc.).

Stream sedimentation rates should also be assessed beyond the scope of larger substrate aggradation. Fine sediment transport from subbasin streams to the Bella Coola River as well as deposition rates within those subbasins may be altering fish habitat. Streams with low energy areas in lower reaches may be suitable for sediment deposition monitoring to determine effects of sediment on fish habitat and rate and extent of sediment transport. Subbasins likely suitable for these types of assessment could include Snootli Creek, Saloompt River, Hagensborg slough, Noosgulch River, Snooka Creek and the Atnarko River.

Monitoring Off-channel Habitat

Monitoring off-channel habitat to determine change in fish habitat quality can be accomplished through basic monitoring of fish use of that 'habitat unit', including physical habitat structure and water quality (e.g., dissolved oxygen, pH, turbidity, etc.). Sampling for fish presence/absence during anticipated life-cycle use (e.g., winter or summer refugia/rearing periods) can provide a basic measure of habitat utilization. . More complex measures of population abundance and distribution could also be undertaken in areas where habitat was anticipated to be of higher quality or more abundant (i.e., in restoration ponds/channels created specifically for off-channel purposes.

Aspects of fish health, habitat condition, and basic water quality could also be included in off-channel monitoring, including relative condition factor, riparian function, stream flow/discharge, DO, pH, conductivity, etc.

Monitoring Fish Habitat and Agriculture

Similar to other habitat assessment components of the WBFSP for the Bella Coola watershed, impacts of agricultural practices on fish habitat could be assessed through basic stream habitat assessments over-time (e.g., stream and water quality measurements). Where other agencies or community groups implemented BMPs or environmental management strategies to protect aquatic habitat during agricultural activities, effectiveness audits of these plans could be completed to assess overall improvements or protection of aquatic habitat.

8.5 Priority Data Gap Issues

Data gaps were identified as a major concern in each of the primary management/physical aspects of watershed panning (i.e., Fish Stocks, Fisheries Management, Land Use Management, and, Fish Habitat).

Four (4) primary data gap issues for were identified, including:

1. Fish Stock Issues
    - Identification and understanding of limiting factors causing stock decline for priority fish stocks (eulachon, sockeye, fall chum and steelhead populations)
    - Up-to-date and accurate maps with species distribution for all life stages

- Stock abundance indicators for various life stages (a large spawning population does not always result in large smolt migration due to over-winter flooding or other impacts)
- Specific run timings for Noosgulch, Salloomt and Nusatsum chinook and river spawning sockeye
- Genetic information on fish species within the watershed (as an example it is not known if there is a genetic difference between lake and river type sockeye)
- Composition of Atnarko sockeye between lake and river type life histories

2. Fisheries Management Issues
   - Species specific information on potential limiting factors (i.e. marine vs. freshwater survival rates)
   - Reliable escapement/abundance estimates for stocks such as steelhead, fall chum, Atnarko River sockeye, Nusatsum River chinook and coho, any species in the Talchako River
   - Hatchery production plan for watershed (for managed and unmanaged species)
3. Land Use Management Issues
   - Up-to-date and accurate base maps with overlays showing property lines, road network, transportation routes, sensitive habitat, etc.
   - TEK knowledge and significant areas identified and incorporated on maps and in data
4. Fish Habitat Issues
   - Species and system specific data on productive capacity
   - Up-to-date and accurate base maps (currently only have 20 year old photos available to produce maps) for entire watershed with habitat classification overlay and species distribution for all age classes
   - Ongoing river/stream health monitoring (water temp., dissolved oxygen, clarity, pH, conductivity, flow, invertebrate production, and other significant factors)
   - Post-project monitoring of restoration activities
   - Inventory and mapping of habitat that has been isolated through natural or anthropogenic causes
   - No consistent watershed "logbook" that recounts significant environmental events and observations related to watershed health

8.5.1 Data Gap Objectives & Strategies

Five (5) objectives and strategies relating to fish habitat issues have been developed, as shown in Table 8-5.

Table 8-5: Priority Fish Habitat Objectives and Strategies

Objective	Obtain up-to-date base maps and ortho-rectified photos for entire watershed.
Strategy	• Work with all agencies and stakeholders in the watershed to obtain funding for maps and photos • Obtain/create ortho-rectified photos and base maps for the entire watershed at a useable scale (i.e. 1:5000)

Objective	**Produce map overlays of:** • **species distribution and residency by life stage** • **habitat classification and specifically for critical and sensitive habitat** • **human settlement and road system** • **TEK significant areas** • **off-channel and isolated habitat** • **Potential future and past restoration project sites**
Strategy	• Develop strategy for map overlay approach (focus areas, number of species and life stages on same overlay etc.) • Use FISS catalogue and other available data as starting point for overlay, identifying areas where more information is needed Work collaboratively to develop plan to collect additional data

Objective	**Pursue watershed health monitoring program that includes:** • **post-project monitoring of completed restoration activities** • **water flow and key water quality** • **ongoing logbook of significant events (extreme weather, floods etc.)**
Strategy	• Develop a coordinated monitoring plan that identifies parameters, sites, frequency and estimated cost

Objective	**Investigate development of stock abundance indicators for key life stages (spawners, fry, smolt production).**
Strategy	• List what is being done right now by species and identify gaps • Prioritize species and stocks • Work with professional stock assessment personnel to review methodologies for measuring stock abundance and determine what is feasible • Develop outline of projects and associated costs

Objective	**Improve run timing data for Noosgulch, Saloomt and Nusatsum chinook and river spawning sockeye.**
Strategy	• Consider use of strategic enhancement to produce groups of marked fish or DNA analysis that can be used to track migration of adults through terminal fisheries

Objective	**Improve baseline DNA data.**
Strategy	• Refer to records of what sampling and analysis has occurred to identify specific data gaps • Develop a prioritized plan for analysis of samples on file and collection and analysis of new samples

Objective	**Develop productive capacity estimates and production plan (including hatchery production) for the watershed.**
Strategy	• Develop strategy for approach (focus areas, species and life stages) • Identify what data is available and key areas where more information is needed • Work collaboratively to establish initial capacity estimates and targets that can form the basis of production planning

Objective	**Acquire more documents on fish and fish habitat of the Bella Coola watershed for storage and use at the BCWCS Resource Centre Library.**

Strategy	• Inventory existing reports and studies • Determine what reports and studies are missing • Locate and obtain copies of all missing reports and studies • Continually update library with new material (work with agencies to accomplish)

8.5.2 Implementing & Assessing Data Gap Strategies

Completing data collection to fill gaps in current watershed knowledge will be incorporated into above-mentioned assessment and monitoring scenarios and compiled in an organized manner.

Of key importance is the updating or creation of accurate base maps on which to base monitoring, implementation and rehabilitation projects. Maps will provide a means of recording data with spatial context and subsequently help identify areas of critical habitat, impacted habitat, lost habitat and other key features important in fish sustainability within the Bella Coola watershed.

Base maps will be built upon standardized TRIM or other acceptable media (e.g., government produced/approved orthophotos, etc.) with appropriate fisheries data collected from existing sources at other agencies (e.g., DFO, MOE, etc.) and/or collected in the field. Base maps will incorporate as broad a range of ecological factors as possible while remaining relevant specifically to fisheries resources. It is intended that these maps would be comprehensive, yet user-friendly enough to allow members of the general public as well as resource managers to use the maps in day to day activities relating to resource planning, land development or general interest.

Other data gap issues identified in above to be addressed as part of the Stage II monitoring (and subsequent WFSP Stages), include:

- Formal recording methods for significant watershed events (landslides, floods, extreme low water, etc.);
- Increased fish stock assessment by life stage and species;
- Collect improved run timing data on Chinook of tributary basins (Saloomt, Nusatsum and Noosgulch);
- Improve baseline DNA data for salmon runs of the watershed;
- Development of productive capacity numbers and plans for the Bella Coola Watershed.

8.5.3 Monitoring Data Gap Strategies

Monitoring improvements in filling data gaps will be an ongoing process incorporated into updates of this WBFSP. As data are collected for each identified gap, that data gap will be recognized as having been filled and noted as ‘completed’ in regular report updates.

9.0 Implementation Framework

To implement those activities identified in Section 8.0 it is recommended the order of implementation be realistic and considerate of ongoing results and data collected during implementation. It is recommended that activities related to each of the five identified priority items (e.g., Fish Stock, Fisheries Management, Land Use Management, Fish Habitat and Data Gap Issues) be combined in a comprehensive implementation plan intended to address as broad a range of items as feasible based on available resources, reasonable timing and achievable goals.

Achievement of these goals will require combined efforts in office and field activities to collect, correlate and report data and findings in a usable manner. Order of data collection, monitoring implementation and related assessment will vary and will be required to be somewhat flexible based on resources and timing. The following Implementation Framework is recommended for consideration to collect the most comprehensive set of data across the widest range of topics identified in this report (specifically in Sections 8.0 through 10.0).

10.0 Implementation

To implement a wide ranging monitoring and assessment plan it is recommended objectives be broken out into realistic goals. Those goals should start with collection/compilation of baseline data and add information and data layers to that baseline. Ultimately, interpretation and application of those data can result in more sophisticated use of information (e.g., policy and planning activities).

Based on this approach of assessment of key priority issues, it is recommended further activities be considered in the following order:

1. update baseline data and maps;
2. complete a comprehensive map-based overview of the watershed (using data compiled in step 1) to identify areas of priority for further fish habitat investigation (e.g., areas of concern or areas of limited knowledge);
3. ground truth those areas of priority to assess items of interest (e.g., bank erosion, riparian condition, fish access, etc.);
4. establish key watershed locations to collect as broad a range of data as possible based on recommendations of this report (e.g., riparian, hydrology, fish stock, etc.) using standardized methods and standardized sites;
5. plan or prepare to implement rehabilitation where required (may be completed as Stage III or IV of WFSP);
6. compile data from monitoring sites to update baseline data and maps;
7. use updated data and maps to determine appropriate parameters for planning and development strategies (e.g., land use planning and updating regional government policies, etc.); and,
8. proceed to Stage III and IV with flexibility in implementation timing.

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