

Mohun Creek Watershed Overview

Prepared for

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1.0 Introduction

Since the mid 1980's, the Campbell River and District Fish and Wildlife Association (CRFW) have maintained an interest in the watershed health and stewardship of a tributary of Mohun Creek, which is known locally as Coho Creek. The club's past work in the tributary has included culvert improvements to provide fish passage, stocking the system with coho fry (in partnership with DFO), on-going fish population monitoring, and a fish and fish habitat assessment, including plans for potential restoration work.

Recently, the results of the fish population monitoring and conversations with local Fisheries and Oceans Canada staff have lead the CRFW to broaden their interest to include the entire Mohun Creek watershed. Overall, a decreasing trend in the number of adult fish returning to spawn in the mainstem has been observed (by DFO staff), while fry stocking in the system has continued on a nearly yearly basis. At this time, the status of the anadromous fish populations in the watershed is unclear.

The completion of a watershed overview is the first step in the CRFW's developing interest in the Mohun Creek watershed. The purpose of creating the watershed overview is to use existing physical and biological information for the watershed to develop a strategy for future assessment and possible restoration work within the drainage. Ultimately, the collection and presentation of the watershed information may lead to the development of a fisheries recovery plan for the Mohun Creek watershed.

The information collected during the overview is presented in three main sections. The first section contains a summary of the known physical characteristics of the watershed determined primarily from maps and a previous watershed inventory (Rutherford, SE. et al, 2000). The second section outlines the biological characteristics of the watershed, specifically focusing on the wildlife and fisheries resource within the drainage. The third and final section presents a summary of the land use and development within the watershed, with a focus on activities with the potential to impact the fisheries resource.

At the conclusion of the existing information summary, significant data gaps are noted. This information is used to develop a list of potential future activities geared towards a sustainable fish population in the Mohun Creek watershed.

2.0 Methods

The collection of information for the watershed overview was solely an office exercise, with no fieldwork completed. A wide variety of information sources were consulted in order to obtain a thorough collection of the existing information (Section 2.1). This information was reviewed, categorized, updated or confirmed when necessary and presented in the various sections of this report.

Information regarding the physical characteristics of the watershed from existing sources was tabulated for presentation in the report. A major source of physical data information was the database (FDIS) prepared during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek Watershed (Rutherford, S.E. et al, 2000). Information regarding stream lengths and average gradients were taken from the database. Stream order of the sub-basins was determined from the 1:20000 and compared with the orders recorded in the database. The results of fish sampling and the location of fish barriers were also obtained from the inventory information.

Sub-basin areas (hectares) were measured digitally using the “Online Cadastre” (<http://srmwww.gov.bc.ca/sgb/IMF/index.html>) at scales ranging from 1:30000 to 1:60000, and therefore should be considered estimations only.

Lake inventory reports had previously been prepared by MJ Lough Environmental Consultants (1996-1998) for 25 lakes in the Mohun Creek watershed. Information regarding lake size, elevation, maximum and mean depths and fish presence or absence was obtained from the reports. The remaining lake and wetland areas (N = 22) were measured on the 1:20000 TRIM maps using an analog planimeter. Any fish information for lakes not inventoried was obtained from FISS (<http://srmapps.gov.bc.ca/apps/fidq/>).

2.1 Information Sources

Table 1 contains a summary of the information sources that were consulted during the overview, and the information obtained from each source.

Table 1. Sources of information consulted during the creation of the Mohun Creek watershed overview.

Source	Information provided
<i>Consultant and government reports</i>	
Reconnaissance (1:20000) Fish and Fish Habitat Inventory of Mohun Creek Watershed, MJ Lough Environmental Consultants. (Rutherford, SE. et al. 2000)	Summary of watershed information to 1998, results of fish and fish habitat inventory field assessment
Reconnaissance (1:20000) Fish and Fish Habitat Lake inventory reports – MJ Lough Environmental Consultants 1996-98	Fish presence / absence, habitat characteristics for 25 lakes in the Mohun Creek watershed
Overview and Level 1 Fish Habitat Assessment of Unnamed Tributary of Mohun Creek *(locally known as Coho Creek) – Mainstream Biological Consulting 2000	Fish and fish habitat information for Coho Creek sub-basin
Water Quality and Fish Population Assessment of Unnamed Tributary of Mohun Creek (locally known as Coho Creek) - Mainstream Biological Consulting 2002	Water quality and fish species information for Coho Creek sub-basin
Sayward Landscape Unit Plan – Feb. 27, 2003 (BC Ministry of Sustainable Resource Management)	Areas identified for preservation for wildlife use, fisheries protection and recreation
<i>Maps</i>	
1:20000 BCGS TRIM maps (92K.003, 004, 013, 014)	Stream and lake location and size, sub-basin boundaries, road locations
1:20000 Forest Development Plan maps (2002-2006), BC Timber Sales (formerly Small Business Forest Enterprise Program), Ministry of Forests	Proposed harvesting locations, forest cover data
1:50000 FISS maps	Fish species distribution and barrier information from the BC Fisheries database
Snowden Demonstration Forest – Forest Recreation Map (1:20000) – BC Ministry of Forests	Recreational trail locations and distances
<i>Data files and on-line information</i>	
BC Fisheries Data Inventory (http://srmapps.gov.bc.ca/apps/fidq/)	Fish species distribution and barrier information, FISS data, stocking information
Online cadastre (http://srmwww.gov.bc.ca/sgb/IMF/index.html)	Sub-basin and lake areas, legal property boundaries
Conservation data center (http://srmwww.gov.bc.ca/cdc/)	Rare and endangered plants, animals and plant communities of British Columbia.
Sensitive ecosystems inventory homepage – Province of BC and Canadian Wildlife Service (http://srmwww.gov.bc.ca/cdc/sei/vancouverisland/)	Information on occurrence of identified sensitive ecosystems in the lower Mohun watershed
Land and Water BC – www.lwbc.bc.ca	Water license report

Table 1. Continued.

Source	Information provided
Canadian climate normals (www.climat.meteo.ec.gc.ca/climate_normals/stnselect_e.html)	Climate data 1971-2000
DFO files – Quinsam Hatchery and Campbell River office	Stream walk and snorkel data (1944-2002), stream stocking data (1980-2000)
Ministry of Water, Land and Air Protection files (Nanaimo, BC)	Stream and lake inventory reports, water quality sampling reports

3.0 Physical Characteristics

3.1 Location

The Mohun Creek watershed is located within the Sayward Provincial Forest on the east coast of Vancouver Island. The watershed drains into Menzies Bay on the west side of Discovery Passage (Figure 1). Table 2 contains a summary of location information for the Mohun Creek watershed. Mohun Creek is also known locally as “Trout Creek”.

Table 2. A summary of location information for the Mohun Creek watershed.

Watershed name	Mohun Creek (alias Trout Creek)
Watershed code	920-643100
UTM at mouth¹	10.330275.5553860
Neighbouring watersheds	Menzies Creek (to the northeast) Amor de Cosmos Creek (to the northwest) Campbell River (to the west and south)
Nearest community	Campbell River – approximately 10km to the southeast
Biogeoclimatic zone	CWH
NTS (1:50000) maps	92K/3, 92K/4
TRIM (1:20000) maps	92K.003, 92K.004, 92K.013, 92K.014
Forest district	Campbell River
MWLAP region and district	1 (Vancouver Island) - Campbell River
Fish and Wildlife management unit	10 (sub-unit 1)
DFO sub-district	13

1 – from Rutherford, S.E. et al, 2000

3.2 General Characteristics

The Mohun Creek watershed is a coastal watershed that drains to the northeast. The elevation range within the watershed changes from 0m at the mouth to approximately 450m at the headwaters to the east of Mohun Lake. In general, the watershed topography is characterized by small, rolling hills and low gradient floodplain.

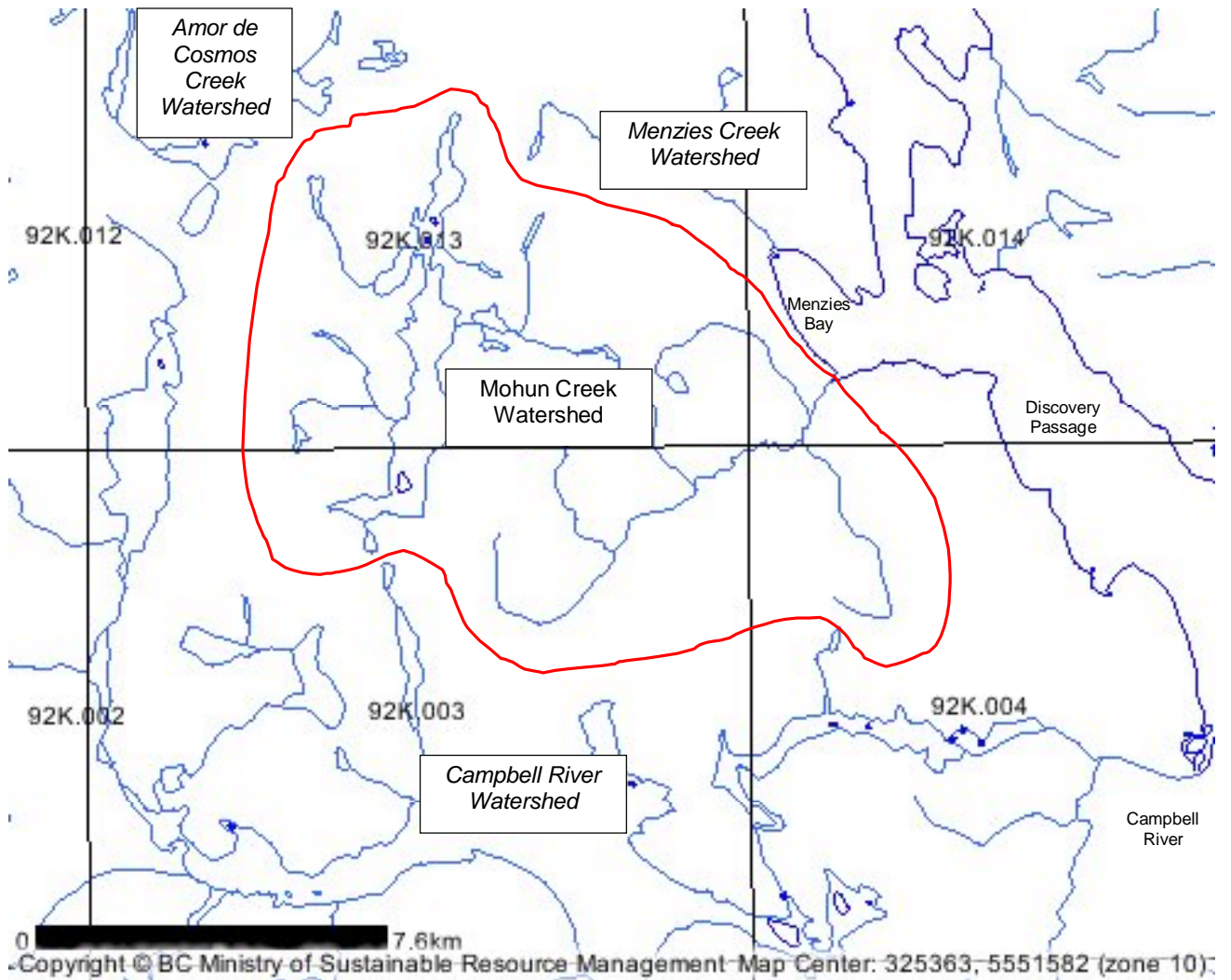


Figure 1. An overview map of the Mohun Creek watershed.

3.2.1 Watershed size

Mohun Creek is a 5th order watershed, with a reported drainage area of 12805 Ha (Rutherford, S.E. et al., 2002). Eight sub-basins within the watershed have been identified for this overview, either with stream orders greater than 3, or as second order drainages with significant anadromous habitat¹ (Table 3).

¹ Stream order is a relative measure of watershed size. Determining watershed order begins at the headwaters, working downstream to the mouth. Streams with no tributaries are 1st order streams. Stream order increases to 2 when two 1st order streams come together, order increases to 3 when two 2nd order streams come together and so on. Refer to the Reconnaissance (1:20000) Fish and Fish Habitat Inventory: Standards and Procedures Manual (RISC, 1999) for further information and a diagram.

Table 3. Drainage area and stream order of the eight sub-basins identified in the Mohun Creek watershed.

Sub-basin	Watershed code	Order	Area (Ha)
Welch Creek	920-643100-04800	2	480
Coho Creek	920-643100-09200	2	1550
Snowden Creek	920-643100-09200-23610 ¹	2	1125
unnamed anad. Trib	920-643100-26200	4	2500
Crane Lake outlet	920-643100-54400	3	615
upper Mohun Inlet	920-643100-64300	3	670
Crescent Lake outlet	920-643100-64700	3	900
Comida Lake outlet ²	920-643100	3	870

1 - The watershed code for Snowden Creek incorrectly indicates that it is a tributary of Coho Creek, when in fact it is a separate drainage

2 - The Comida Lake outlet stream is the headwater drainage for the Mohun Creek mainstem

3.2.2 Bedrock geology and surficial materials

The main type of bedrock in the Mohun Creek watershed is the basalt lavas of the Karmutsen formation, the most common rock formation on Vancouver Island (Geological Survey of Canada).

A summary of the surficial materials overlying the bedrock formations can be found on the 1:50000 soil and terrain maps (www.em.gov.bc.ca/mining/geolsurv/terrain&soils/frbcguid.htm). Information for the Mohun Creek area is found in Terrain Library Project – FRBC_14.

3.2.3 Land cover

The vast majority of the Mohun Creek watershed consists of maturing second growth forest, which is managed by British Columbia Timber Sales (Ministry of Forestry). At the downstream end of the watershed, industrial activity (mainly log sorts) is present. Small residential areas are located within the Coho Creek watershed, but do not account for a significant portion of the drainage area. A tree nursery (Pacific Regeneration Technology) operates near the headwaters of Coho Creek.

Virtually all of the forest in the Mohun Creek watershed has been harvested since the early 1900's, or destroyed in a large wildfire in 1938. Much of this forest was re-planted and the resulting second growth is now approaching harvestable size. While the exact amount of old growth forest remaining in the watershed has not been determined, the Sayward Landscape Unit Plan notes that old growth is limited to approximately 2% of the

land base of the Sayward Forest. This figure is likely to be representative of the Mohun Creek watershed.

An extensive road network exists throughout the Mohun Creek watershed (total length = 192.4km), a portion of which originated as railway grade in the early 1900's. The breakdown of distance of each road type (measured from the 1:20000 TRIM maps) is:

- **Paved** (all Highway 19, near mouth and at north end of Mohun Lake): 1.3km
- **Gravel** (mainline, maintained roads): 81.0 km
- **Rough gravel** (secondary roads, trails, old railway grades): 110.1km

The amount of road surface may increase in the near future due to the anticipated increase in logging activity in the watershed.

The overall low gradient topography of the watershed reduces the possibility of slope failures caused by road building (a potential sediment source in the streams and lakes). However, the road network could impact fish distribution where improperly installed or failing crossing structures prevent fish passage. During the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek watershed (stream and lakes), any crossings found that represented obstacles or barriers to fish passage were noted, and are discussed in the reports' text (MJ Lough Environmental Consultants, 1996-1998; S.E. Rutherford et al., 2000).

3.2.4 Climate

The Mohun Creek watershed falls entirely within the coastal western hemlock (CWH) biogeoclimatic zone. Climate in this area is typically referred to as "temperate rainforest" with abundant rainfall and little variation in temperature between the mild winters and relatively cool summers.

There are no climate stations within the Mohun Creek watershed, but there has been at least seven stations operating nearby (around the community of Campbell River) at different times over the past 80 years. Average precipitation data from three nearby stations (Duncan Bay, Quinsam River Hatchery and Upper Campbell River) and daily mean temperature data from two stations (Quinsam River Hatchery and Upper Campbell River) is presented below (Figures 2 and 3). These stations were selected as they provided the most recent data at a range of elevations similar to that found in the Mohun Creek watershed.

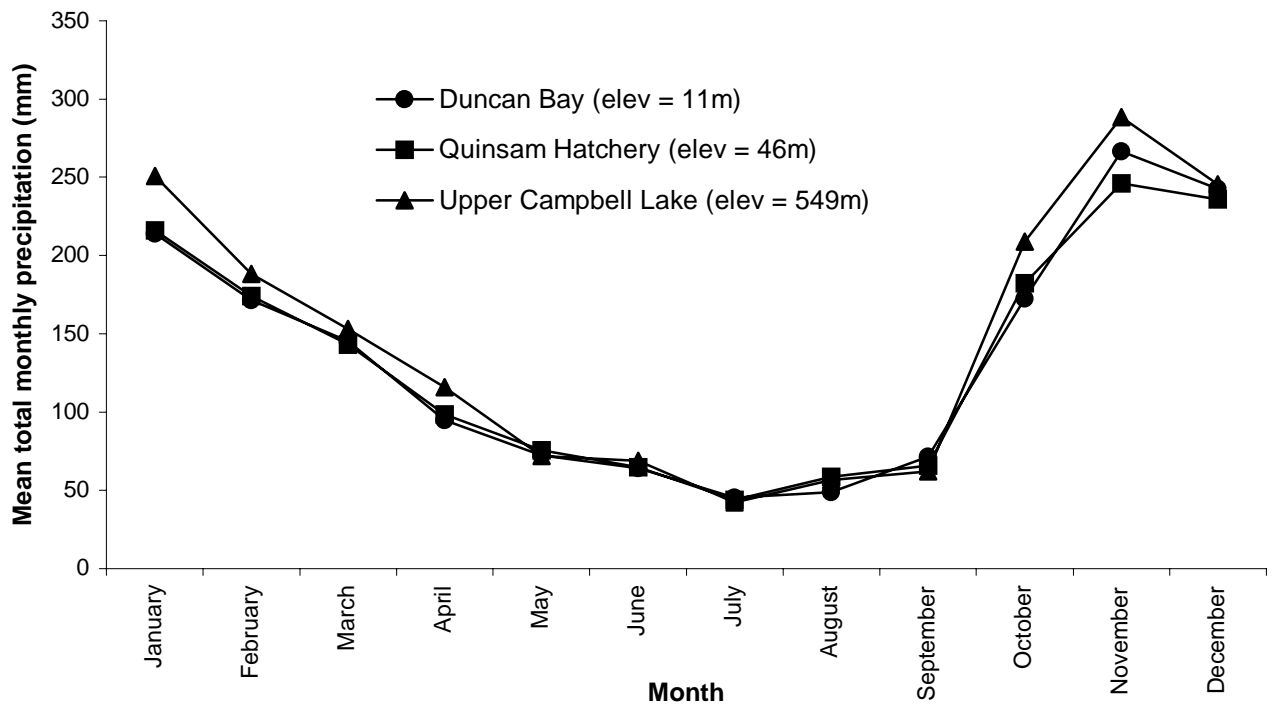


Figure 2. Mean monthly precipitation (rainfall and snowfall) at three climate stations near the Mohun Creek watershed. (Duncan Bay data – 1971-1994, Quinsam River Hatchery data – 1975-2000 and Upper Campbell Lake data – 1980-1998).

Total annual precipitation at the three stations ranged from 1609mm (Duncan Bay) to 1752mm (Upper Campbell River). At all sites, rainfall contributed most significantly to the total annual precipitation, with snowfall accounting for only 4% (Duncan Bay) to 13% (Upper Campbell Lake) of the total annual precipitation. Also common amongst all sites were the driest month (July) and the wettest month (November).

Daily mean temperatures at the Quinsam River Hatchery ranged from a maximum of 17.2 degrees Celsius (August) to a minimum of 2.1 degrees Celsius (January). Similarly, the maximum daily mean temperature at the Upper Campbell Lake site was 17.2 degrees Celsius (August), while the minimum daily mean temperature was slightly lower at 1.1 degrees Celsius (January).

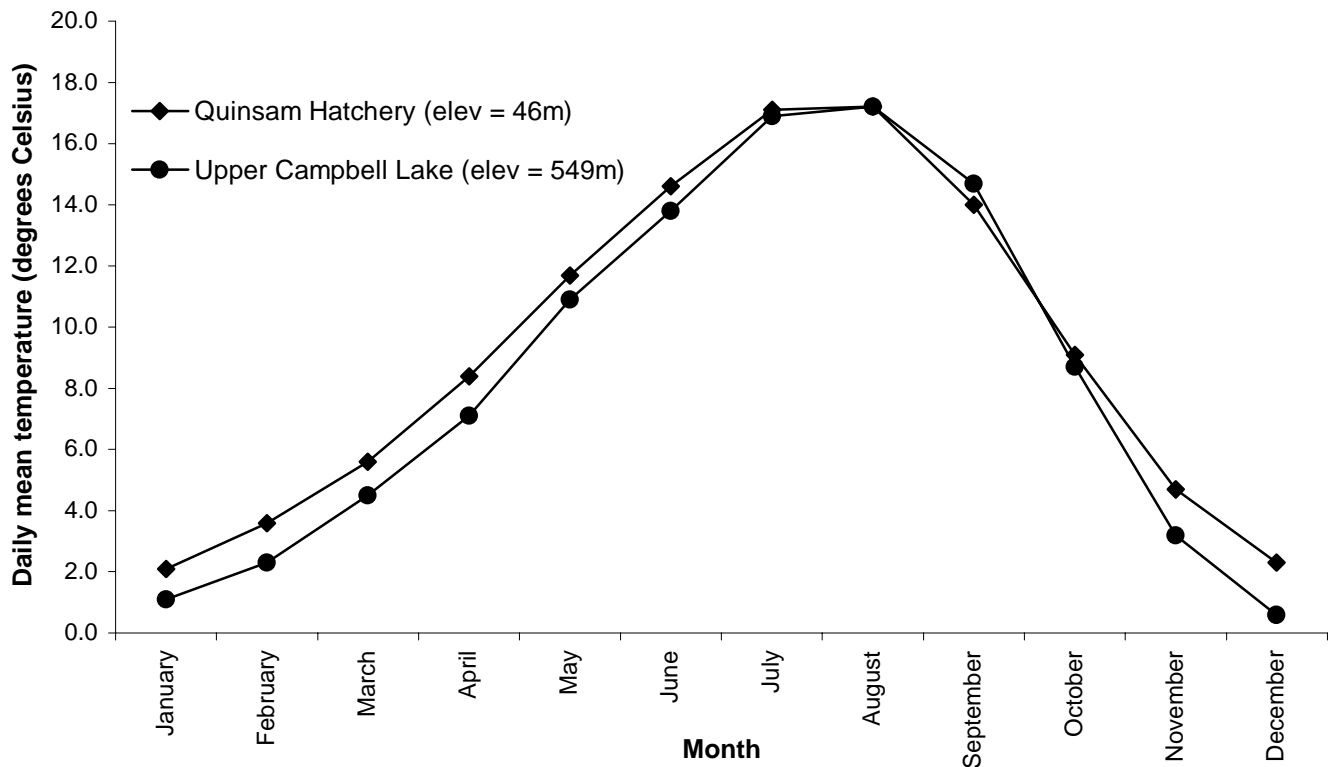


Figure 3. Daily mean temperatures (degrees Celsius) for two climate stations near the Mohun Creek watershed (Quinsam River Hatchery data – 1975-2000, Upper Campbell River data – 1980-1998).

3.3 Surface drainage characteristics

Surface water flow in the Mohun Creek watershed is largely regulated by the numerous lakes and wetlands in the drainage (n = 47) and generally low gradient topography. The following sections contain a description of the stream and lake characteristics, as well as any known water quality information.

3.3.1 Stream characteristics

Using stream reach data generated during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek watershed (Rutherford, S.E. et al., 2000), the total length of stream channel in the drainage was calculated. This information is presented below for the entire watershed and each of the identified sub-basins, along with average channel gradient from the same source (Table 4). This information was measured from 1:20000 TRIM maps as part of the pre-field portion of the inventory project.

Table 4. Total stream lengths and average channel gradients for the Mohun Creek watershed, and identified sub-basins within the watershed.

Sub-basin	Watershed code	Stream length (km)		Average gradient (%) (range)	
		Mainstem	All other streams	Mainstem	All other streams
Welch Creek	920-643100-04800	5.6	2.0	4.9 (1.7-8.3)	9.8
Coho Creek ¹	920-643100-09200	7.6	5.4	1.9 (0.5-9.0)	2.7 (0.5-27.0)
Snowden Creek	920-643100-09200-23610	4.7	11.5	5.0 (0.6-1.8)	6.0 (1.5-12.1)
unnamed anad.trib	920-643100-26200	7.5	28.8	3.2 (1.0-5.5)	5.3 (0.2-13.6)
Crane Lake outlet	920-643100-54400	2.3	4.9	3.7 (0.5-11.1)	5.1 (0.2-12.5)
SW Mohun Inlet	920-643100-64300	3.0	12.4	3.4 (0.7-7.0)	9.5 (0.5-22.5)
Crescent Lake outlet	920-643100-64700	3.2	4.8	2.8 (0.2-10.0)	7.0 (0.3-13.9)
Comida Lake outlet	920-643100	2.7	7.9	7.4 (0.2-32.0)	9.5 (0.3-40.0)
Mohun Creek watershed	920-643100	14.6	130.4	4.4 (0.2-32.0)	6.2 (0.2-40.0)

1 – Stream length and channel gradient data for Coho Creek is from field measurements during the Overview and Level 1 Fish Habitat Assessment (Stewardson, M., 2000). Incorrect mapping of this drainage results in the Reconnaissance (1:20000) Fish and Fish Habitat Inventory data being incorrect.

Approximately 145km of stream channel is found within the Mohun Creek watershed. Of this, virtually all is of low to moderate gradient (Figure 4), with the vast majority at gradients less than 20% (99.6%). This indicates that physical barriers such as waterfalls, temporary debris jams, beaver dams and seasonally dry areas, would be the dominant factors controlling fish distribution within the Mohun Creek watershed.

Other information on channel characteristics, such as morphology, channel width, channel depth, instream cover and substrate was collected at 40 sites in the Mohun Creek watershed during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory. This detailed habitat information is presented as part of the inventory report (Appendix 1) and in the FDIS database prepared for the project.

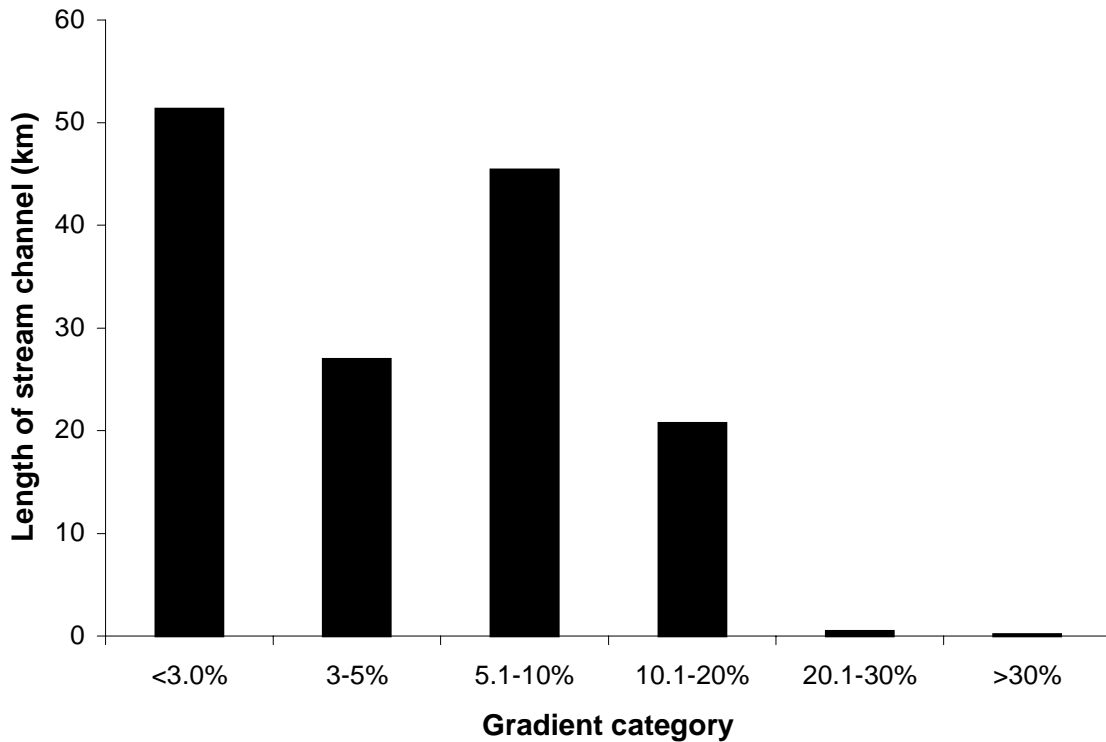


Figure 4. The amount of stream channel (total kilometers) per gradient category within the Mohun Creek watershed.

3.3.2 Lakes and wetlands

Lakes and wetlands are abundant within the Mohun Creek watershed, and play a significant role in regulating the stream flows and water quality parameters of the watershed. In particular, Mohun Lake, with an area of 621 ha, plays a large role in regulating stream flows in the mainstem throughout the year. Lakes and wetlands account for at least 6.3% of the total area of the watershed.

Table 5 contains a summary of information on 25 lakes in the Mohun Creek watershed that were inventoried between 1996-1998, as part of a large scale Reconnaissance (1:20000) Fish and Fish Habitat Inventory of lakes in the Sayward Landscape Unit (MJ Lough Environmental Consultants, 1996-1998). These 25 lakes have a combined area of 762.6 ha.

The remaining 22 lakes in the watershed were identified from the 1:20000 TRIM maps, and had a total area of 48.8 ha. Most of these lakes were smaller than 3.0 ha, and some may actually be determined to be wetlands in the field.

The type of inventory (primary, secondary or tributary survey) completed on each of the 25 lakes was dependent on the lake size and amount of historical survey data available. Complete inventory data and summaries of existing information are presented in an individual report for each of the 25 inventoried lakes, and in the project databases (MJ Lough Environmental Consultants, 1996-1998).

Table 5. A summary of information for the 25 lakes in the Mohun Creek watershed inventoried by MJ Lough Environmental Consultants, 1996-1998.

Lake name ¹	WBID	Watershed Code	Size (ha)	Elevation (m)	Max Depth (m)	Mean Depth (m)
Bluff Lake	00646SALM	920-643100-26200-34600	3.7	280	4.1	1.5
Boomerang	00636SALM	920-643100-64700-14800	5.7	380	7.0	2.1
Bracket	00520SALM	620-643100-64700-70200	2.8	250	6.3	2.4
Comeback	00395SALM	920-700700-84700-65400	2.6	230	10.0	4.6
Comida	00412SALM	920-643100	21.1	213	14.0	na ²
Cranberry	00706SALM	920-643100-26200-34600	5.7	190	4.8	na ²
Crane	00446SALM	920-643100-54400	8.7	250	12.4	4.2
Crescent	00530SALM	920-643100-64700	10.0	238	20.9	6.7
Duckwing	00448SALM	920-643100-90561	1.7	250	7.1	3.0
Elmer	00796SALM	920-643100-26200-14100	3.1	183	7.0	3.1
Flag	00536SALM	920-643100-65100	1.8	230	5.0	2.3
Frog900	00767SALM	920-643100-24600	5.4	198	3.0	1.3
Goose	00485SALM	920-643100-73500	5.9	244	4.3	1.6
Hemp	00398SALM	920-643100-93800	1.6	210	4.3	1.7
Lil	00774SALM	920-643100-26200	2.4	235	6.4	3.6
Loon	00544SALM	920-643100-58800	7.1	213	2.7	1.6
Mary	00576SALM	920-643100-04800	13.0	174	10.0	6.1
Merland	00624SALM	920-643100-26200-34600-7250	2.8	290	4.0	1.4
Mohun	00385SALM	920-643100	620.9	210	43.0	14.0
Morton	00517SALM	920-643100	22.6	208	15.0	2.3
Snake	00742SALM	920-643100-58800	5.0	244	8.0	3.3
Teardrop	00641SALM	920-643100-64700-14800-7620	2.5	380	11.0	4.9
Topper	00409SALM	920-643100	1.8	260	1.4	1.1
Vee	00542SALM	920-643100	3.0	245	1.5	1.0
Vulture	00423SALM	920-643100	1.7	250	1.9	1.0

1 – Most of these names are not gazetted, and were assigned during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory
 2 – information not available

3.3.3 Discharge

There are no water survey stations in the Mohun Creek watershed at this time, so data on discharge rates and volumes is not available. As mentioned above, the flow rate

and volume of the Mohun Creek mainstem would be largely regulated by the large volume of water stored in the lakes within the drainage. Also, the overall low gradient topography of the watershed would generally result in a more gradual increase in discharge in response to rainfall than in other, steeper coastal watersheds.

3.3.4 Water quality

Water quality testing was performed in six lakes in the Mohun Creek watershed between 1975 and 1990. A summary of the historical water quality testing in these lakes is presented in Rutherford, SE. et al., 2000. In general, water quality testing from 1975 – 1990 consisted of field and lab water testing in all six lakes. This information is summarized in the BC Fisheries Data Queries database (<http://srmapps.gov.bc.ca/apps/fidq/>) or on file at the Ministry of Water, Land and Air Protection regional office in Nanaimo, BC.

Water quality testing was also completed during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of 25 lakes in the Mohun Creek watershed, completed by MJ Lough Environmental Consultants (1996 – 1998). The intensity of the water quality testing was dependant on the type of inventory completed (primary, secondary or tributary).

A primary inventory was completed on six lakes, and involved taking a water sample for laboratory analysis, plus field water chemistry measurements. Parameters measured in the field included:

- pH
- temperature profile
- dissolved oxygen profile
- specific conductance
- total alkalinity
- turbidity and water color

A secondary inventory was completed on 20 lakes during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory. No water sample was taken for lab analysis during this type of inventory, but the following parameters were measured in the field:

- ph
- temperature profile
- dissolved oxygen profile
- specific conductance (converted to total dissolved solids)
- total alkalinity
- turbidity and water color

The remaining five inventory studies were completed in lakes that had previously been inventoried. Therefore, no new lake information was collected but water chemistry information was collected for the lake inlet and outlet streams.

The information collected during the lake inventories is available in the digital database files created during the project, or in the hardcopy reports on file at the Ministry of Water, Land and Air Protection regional office in Nanaimo, BC. An analysis of the results was not completed for this overview.

Water quality information (pH, temperature, specific conductance and turbidity) was measured at 31 stream sample sites during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek watershed (Rutherford, S.E. et al., 2000). This information is available in the digital database file created during the project (FDIS) or in the hardcopy report on file at the Ministry of Water, Land and Air Protection regional office in Nanaimo, BC. A summary of the temperature, pH and conductivity measurements is presented in Table 6. The data was collected between August 17 and October 23, 1998.

Presently, there are two water temperature data loggers installed in the Mohun Creek mainstem. One data logger is located at the Highway 19 crossing, and the other is located upstream at the upper Menzies Mainline crossing (immediately downstream of the anadromous barrier). The data loggers are set to record the water temperature each hour, and are being downloaded at the beginning of each month. The water temperature data is to be collected for a total of 12 months (ending October 2004).

The Campbell River and District Fish and Wildlife Association have collected water chemistry and water temperature data in the Coho Creek sub-basin since 2000. This data is presented in two separate reports (Stewardson, M. 2000; Stewardson, M. and L. Stewardson, 2002) and is being stored by the CRFWA.

Table 6. A summary of temperature, pH and conductivity measurements recorded at 31 stream survey sites in the Mohun Creek watershed (Rutherford, S.E. et al., 2000).

Stream name or reference	Reach no.	Survey site location (UTM)			Water temp. (°C)	pH	Cond. (µS/cm)
		Zone	Easting	Northing			
Mohun Creek	1.0	10	329921	5553274	16	6.4	74
Mohun Creek	2.0	10	327996	5551974	17	6.4	74
Mohun Creek	4.0	10	326488	5552352	16	6.4	38
Mohun Creek	5.0	10	326363	5553374	17	6.4	38
Mohun Creek	8.0	10	324824	5554619	20	6.4	38
Welch Creek	2.0	10	328216	5555092	13.1	7.4	47
Welch Creek	3.0	10	327359	5554967	12	7.5	50
Snowden Creek	1.0	10	329700	5551385	13	6.5	76
Snowden Creek trib	2.0	10	329531	5550839	14.5	6.4	67
Snowden Creek	1.0	10	331321	5548987	14	6.4	67
Snowden Creek	2.0	10	331162	5548570	12	6.1	70
Coho Creek	1.0	10	331548	5551543	11.7	7.2	112
Mary Lake outlet	1.0	10	327972	5552519	14	7.6	43
Frog Lake outlet	1.0	10	327691	5550548	14.5	6.1	45
Cranberry Lake trib	2.0	10	322473	5551338	10.5	6.7	71
Mohun Cr. trib near Loveland Bay	2.0	10	325059	5549248	10.4	6.0	59
Mohun Creek trib	3.0	10	324774	5548237	13	6.4	79
Mohun Cr. trib near Loveland Bay	5.0	10	324469	5547577	9	6.2	53
Mohun Cr. trib near Loveland Bay	1.0	10	322907	5547528	13	6.3	55
Mohun Cr. trib	2.0	10	326294	5551651	12.1	7.2	52
Crane Lake outlet	1.0	10	323656	5555184	18	7.0	36
Merland Lake outlet	6.0	10	323570	5554483	9.9	6.9	50
Mohun L. SW inlet trib	3.0	10	318242	5551880	14	6.9	83
Mohun L SW inlet trib	3.0	10	318535	5550537	10.8	6.8	88
Mohun L. SW inlet trib	4.0	10	316886	5551502	8.9	5.9	27
Crescent L. outlet	2.0	10	320509	5553483	13.1	5.9	43
Crescent Lake W inlet	8.0	10	318176	5555355	10	6.2	44
Crescent L. outlet trib	1.0	10	319955	5553667	11	6.4	53
Crescent Lake S inlet	5.0	10	317436	5554579	10	6.5	54
Mohun L. N inlet	2.0	10	322345	5560491	7.6	6.5	39
Comida L. outlet trib	3.0	10	319096	5556504	11	6.3	46

4.0 Biological Characteristics

4.1 Wildlife and wildlife habitat

No formal wildlife inventories have been located for the Mohun Creek watershed. A summary of species reported within the watershed, as well as the potential wildlife habitat within the watershed, is presented in the sections below.

4.1.1 Habitat description

Potential wildlife habitat in the Mohun Creek watershed is present throughout most of the drainage, and includes the forested areas, lakes, streams, wetlands and estuary. Two different reports (Sensitive Ecosystems Inventory: East Coast Vancouver Island and Gulf Islands, and the Sayward Landscape Unit Plan) have recently been completed that identify habitat areas of particular importance within the watershed.

The first report was prepared at the completion of the Sensitive Ecosystems Inventory (SEI) for the east coast of Vancouver Island and Gulf Islands (Ward, P. et al., 1998). The lower portion of the Mohun Creek watershed (mainly the anadromous portion) was included within the “Comox” sub-unit of the study area for the SEI.

Polygons identifying two types of sensitive ecosystems (wetlands and riparian) are indicated within the Mohun Creek watershed. Wetlands are deemed to be sensitive due to their rarity within the study area, the high biodiversity generally associated with wetlands and their vulnerability to change in hydrology and water quality (due to natural or anthropogenic disturbance). Riparian ecosystems are considered sensitive also due to the high biodiversity, their importance in protecting aquatic habitat and their use as wildlife migration corridors.

Although the exact area of each type of sensitive ecosystem identified in the Mohun Creek watershed is not known, the wetland and riparian ecosystems were the most common sensitive ecosystems in the Comox sub-unit of the study area (3.0% and 2.6% of the total area).

The SEI methodology included initially identifying sensitive ecosystems from aerial photographs, and then field checking a proportion of the identified areas for accuracy. It was not determined during this overview which (if any) of the SEI polygons in the Mohun Creek watershed were field checked nor was the data from field surveys reviewed. This

information is available upon request from the British Columbia Conservation Data Center (Ministry of Sustainable Resource Management).

The Sayward Landscape Unit Plan (Anonymous, 2003) was prepared in order to “provide strategic direction on key resources” within the Sayward Landscape Unit (which includes the Mohun Creek watershed). The plan outlines goals and objectives (some of which were to be legislated as part of a “Higher Level Plan Order” under the Forest Practices Code of British Columbia) for managing biodiversity, wildlife, timber, recreation, visual resources, fisheries and drinking water resources.

As most of the forest within this landscape unit has been modified by harvesting or wildfire over the past 100 years, the proportion of old growth forest accounts for only 2% of the land base. Much of the second growth is approaching harvestable age, which will lead to timber harvesting becoming a much more prevalent activity within the Sayward Landscape Unit. In recent years, recreational use and wildlife habitat were the predominant resource uses, but this balance is due to shift as timber harvesting increases.

During the creation of the Sayward Landscape Unit Plan, the following goals were identified related to the management of wildlife habitat:

- 1) maintain or restore old forest structural elements by not permitting timber harvesting activities within old growth management areas (OGMA), many of which (approximately 73%) have been identified as “ungulate winter range”
- 2) maintain the diversity of habitat and ecosystems by retaining wildlife tree patches (WTP)
- 3) provide critical habitat attributes for deer and elk populations by identifying habitat important as ungulate winter range, providing for spring forage areas adjacent to ungulate winter ranges and providing hiding cover for elk in identified areas (Elk Visual cover Area).

Polygons designating OGMA’s as deer winter range (approximately 76 ha), elk winter range (approximately 559 ha) and deer and elk winter range (approximately 297 ha) are located within the Mohun Creek watershed. Polygons identifying areas as “Elk Visual Cover Area” are also indicated. Information regarding the location and size of these polygons is available in the “Sayward Landscape Unit Plan” report and maps, which can be downloaded at http://srmwww.gov.bc.ca/cr/srmp/campbell_river/sayward.htm.

4.1.2 Mammals

The following species of mammals are reported to be present within the Mohun Creek watershed (from Reconnaissance (1:20000) Fish and Fish Habitat Inventory reports, personal communication from Kim Brunt, Wildlife Biologist, BC Ministry of Water, Land and Air Protection, and the fish and fish habitat assessment of Coho Creek):

- Columbia black tailed deer (*Odocoileus hemionus columbianus*)
- Roosevelt Elk (*Cervus elephus roosevelti*)
- Black bear (*Ursus americanus*)
- Cougar (*Felis concolor*)
- Gray wolf (*Canis lupus*)
- American beaver (*Castor canadensis*)
- Mink (*Mustela vison*)

Population estimates for Columbia black tail deer and Roosevelt elk have been generated by the BC Ministry of Water, Land and Air Protection (K. Brunt, Wildlife Biologist, MWLAP, personal communication, Dec. 16, 2003). The estimates are calculated by fish and wildlife management sub-unit, based on radio telemetry data for similar areas and other direct population knowledge.

The Mohun Creek watershed falls within the Brewster – Mohun management sub-unit, which as a total area of 404 km² (Mohun watershed = 128 km²). Population estimates for this management sub-unit are as follows:

- Columbia black-tailed deer – 950 (reliability = ± 50%)
- Roosevelt elk – 90 (reliability = ± 25%)

4.1.3 Birds

The following species of birds were observed during the Reconnaissance (1:20000) Fish and Fish Habitat Lakes Inventory (MJ Lough Environmental Consultants, 1996-1998) and the fish habitat assessment of Coho Creek (Stewardson, M., 2000).

- Piliated woodpecker (*Dryocopus pileatus*)
- Turkey vulture (*Cathartes aura*)
- Belted kingfishers (*Ceryle alcyon*)
- American dippers (*Cinclus mexicanus*)
- Stellar jays (*Cyanocitta stelleri*)
- Unidentified dabbling ducks
- Hairy woodpecker (*Picoides villosus*)
- Mallard duck (*Anas platyrhynchos*)
- Winter wren (*Troglodytes troglodytes*)

4.1.4 Amphibians and reptiles

No species of reptiles have been reported in the Mohun Creek watershed, but the range of at least three garter snakes (*Thamnophis sp.*) known on Vancouver Island includes the Mohun Creek area.

Two amphibian species, rough skinned newts (*Taricha granulosa*) and northwestern salamanders (*Ambystoma gracile*) were frequently captured in minnow traps set around the perimeter of lakes during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory. Also observed were red-legged frogs (*Rana aurora*).

4.1.5 Invertebrates

Studies on invertebrate species (aquatic or terrestrial) have not been found for the Mohun Creek watershed. Freshwater mussels were found to be prevalent in the first reach of the Coho Creek mainstem (Stewardson, M, 2000), and Reach 2 of the Mohun Creek mainstem (Rutherford, S.E. et al., 2000) during the habitat assessments in those areas.

4.1.6 Rare and endangered species

A request for information on rare species within the Mohun Creek watershed was made to the BC Conservation Data Center (BC Ministry of Sustainable Resource Management). At this time, there are no records of rare species within the watershed.

A list of species within the Campbell River Forest District (and therefore potentially in the Mohun Creek watershed) that have been identified as red listed (endangered or threatened) or blue listed (species of “special concern”) can be generated online at <http://srmwww.gov.bc.ca/atrisk/>. The list is also presented in Appendix 1.

4.2 Fish and fish habitat

Information on the fish and fish habitat present in the Mohun Creek watershed is available from several sources, including the FISS database, recent fish and fish habitat inventories and local government agencies. This information has been reviewed, and is summarized in the following sections.

Six species of anadromous salmonids have been reported in the Mohun Creek watershed. These include:

- chinook salmon (*Onchorhynchus tshawytscha*)

- chum salmon (*O. keta*)
- coho salmon (*O. kisutch*)
- pink salmon (*O. gorbushca*)
- steelhead trout (*O. mykiss*)
- sea-run cutthroat trout (*O. clarki*)

Resident salmonid species reported upstream of the anadromous barrier in the Mohun Creek watershed include:

- cutthroat trout (*O. clarki*)
- kokanee (*O. nerka*)
- rainbow trout (*O. mykiss*)

Other fish species reported in the Mohun Creek watershed (both anadromous and resident waters) are:

- prickly sculpins (*Cottus asper*)
- coastrange sculpins (*C. aleuticus*)
- three-spine sticklebacks (*Gasterosteus aculeatus*)
- river lamprey (*Lampetra ayresii*)

4.2.1 Habitat description

Habitat for anadromous and resident fish species is present in the Mohun Creek watershed. Due to the overall low gradient of the stream habitat, the distribution of anadromous habitat in the watershed is limited only by physical barriers such as waterfalls (Section 4.2.2). Resident fish habitat, located above the anadromous barriers, typically extends to the furthest extent of the drainage (except where occasionally limited by barriers).

A quantitative breakdown of the anadromous and resident fish habitat in the watershed is presented in Table 7. The amounts of anadromous habitat, resident habitat, confirmed non-fish bearing habitat and areas where fish status has not yet been confirmed, were determined from the previous inventory and habitat assessment results. Total stream lengths for each habitat type were calculated using the reach tables generated during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek watershed (Rutherford, S.E. et al., 2000), and field data from the habitat assessment of Coho Creek (Stewardson, M. 2000).

Anadromous habitat is defined as habitat located downstream of barriers to the upstream migration of fish, that is accessible to anadromous species from the ocean. It is assumed that both resident and anadromous populations of fish may co-exist in the

anadromous habitat. Resident habitat is located upstream of the “anadromous” barriers, and only resident fish species are present. Non-fish bearing habitat is habitat upstream of impassable barriers where the absence of fish has been confirmed by fish sampling. When the fish status could not be conclusively determined from the existing information, the habitat status was classified as “unknown”.

In general, anadromous fish habitat is abundant downstream of the anadromous barrier on the Mohun Creek mainstem. The amount of anadromous habitat calculated (25.2km) for Table 7 is likely to be an underestimation of the total amount, due to the incomplete information for the Snowden Creek sub-basin and Mary Lake outlet stream. Additional surveys in these two tributaries are needed to determine the location of the anadromous barrier(s), and to complete the species distribution information.

All of the anadromous habitat in the Mohun Creek watershed exists in the stream portions of the drainage, as none of the lakes are accessible to anadromous fish.

The anadromous habitat in the Mohun Creek mainstem and accessible tributaries is typically described as “good quality rearing and spawning” habitat. The specific locations of spawning areas in the Mohun Creek mainstem were not identified from the existing information. Observations made during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the Mohun Creek Watershed (Rutherford, S.E. et al., 2000) and the fish habitat assessment of Coho Creek (Stewardson, M. 2000) mention potential anadromous spawning habitat in the following areas:

- Mohun Creek – Reach 1: patches of spawning substrate for salmon and trout
- Mohun Creek – Reach 2: excellent spawning habitat for all fish
- Coho Creek – Reaches 8 and 9: abundant spawning substrate, good cover for adult salmon
- Mary Lake outlet stream – Reach 1: moderate quality spawning habitat for cutthroat and coho, gravel present in pool tail outs

An abundant amount of resident stream and lake habitat is found in the Mohun Creek watershed, both downstream and upstream of the anadromous barrier on the Mohun Creek mainstem. The total amount of potential resident fish habitat in the streams will include both the anadromous habitat and resident habitat amounts calculated for Table 7. It is likely that a significant portion of the fish habitat with unknown fish status will also be found to be resident habitat once additional sampling can be conducted.

Of the 47 lakes identified in the watershed, 19 have been confirmed to be fish bearing (resident fish only) and four are confirmed to be non-fish bearing. The fish status of the remaining 24 lakes was not determined, but many of them are situated in areas that appear to be accessible to resident fish (1:20000 TRIM maps). Information on the fish status and fish species present is available in the Reconnaissance (1:20000) Fish and Fish Habitat Inventory Lake reports for 25 of the lakes (MJ Lough Environmental Consultants, 1996-1998).

Potential spawning habitat for the resident trout populations is reported in many of the inlet and outlet streams associated with the numerous lakes (MJ Lough Environmental Consultants, 1996-1998; S.E. Rutherford et al., 2000). Ephemeral or intermittent flows in the streams were the main limiting factor to the quality and quantity of trout spawning and rearing habitat.

Table 7. The approximate amount (km) of anadromous and resident fish habitat in the streams of the Mohun Creek watershed.

Drainage area	Anadromous habitat (km)	Resident habitat (km)	Non-fish bearing habitat (km)	Fish status unknown (km)
Mohun Creek mainstem	7.2	6.9	0.5	-
Welch Creek sub-basin	3.0 ¹	0.9	-	3.6
Coho Creek sub-basin ²	10.8	-	0.1	1.4
Snowden Creek sub-basin	1.0 ³	5.2	-	9.9
Unnamed anad. tributary sub-basin	2.0 ⁴	9.6	3.3	21.8
Other tributary streams (below Mohun anad barrier)	1.2	4.8	-	2.1
Crane Lake outlet sub-basin	-	2.3	-	5.1
SW Mohun L. inlet sub-basin	-	-	-	15.4
Crescent Lake outlet sub-basin	-	3.4	-	4.7
Comida Lake outlet sub-basin ⁵	-	2.3	-	6.7
Other tributary streams (above Mohun anad. barrier)	-	4.2	0.4	11.8
<i>Total for entire watershed</i>	<i>25.2</i>	<i>39.6</i>	<i>4.3</i>	<i>82.5</i>

1 – A debris-blocked culvert at 1.5km upstream of the mouth of Welch Creek is reported as the anadromous barrier in Rutherford, S.E. et al., 2000. However, a culvert is not considered a permanent barrier. Therefore, the next barrier upstream (6m concrete dam at 3km) is being used as the anadromous barrier for this overview.

2 – As no physical barriers to anadromous fish migration were located, nearly all of the habitat in the Coho Creek sub-basin is considered anadromous. However, anadromous access throughout the upper portions of the sub-basin may be limited by seasonal flow levels and poorly defined channels.

3 – This is the amount of confirmed anadromous habitat. The location of the anadromous barrier was not located for Snowden Creek. Cutthroat trout were captured upstream of this point in the mainstem and tributaries, but it is not known how far upstream anadromous fish can travel.

Therefore, it is likely that some of the habitat considered “resident” is in fact anadromous habitat.
4 – No reports of anadromous fish are available for this sub-basin, but it appears to be accessible to anadromous fish up to a cascade approximately 2km from the mouth.

5 – Includes all drainage in this sub-basin except for the Mohun Creek mainstem (Vee lake outlet)

4.2.2 Barriers to fish migration

The locations of many barriers in the Mohun Creek watershed were confirmed during the Reconnaissance (1:20000) Fish and Fish Habitat Inventory of the stream and lakes (MJ Lough Environmental Consultants, 1996-1998; S.E. Rutherford et al., 2000). Detailed information regarding the location and types of barriers (falls, cascades, gradient, etc) is discussed in the individual lake reports, and summarized in Appendix 3 of the Mohun Creek Watershed inventory report (S.E. Rutherford, 2000). A few of the significant barriers in the watershed are indicated on Figure 5.

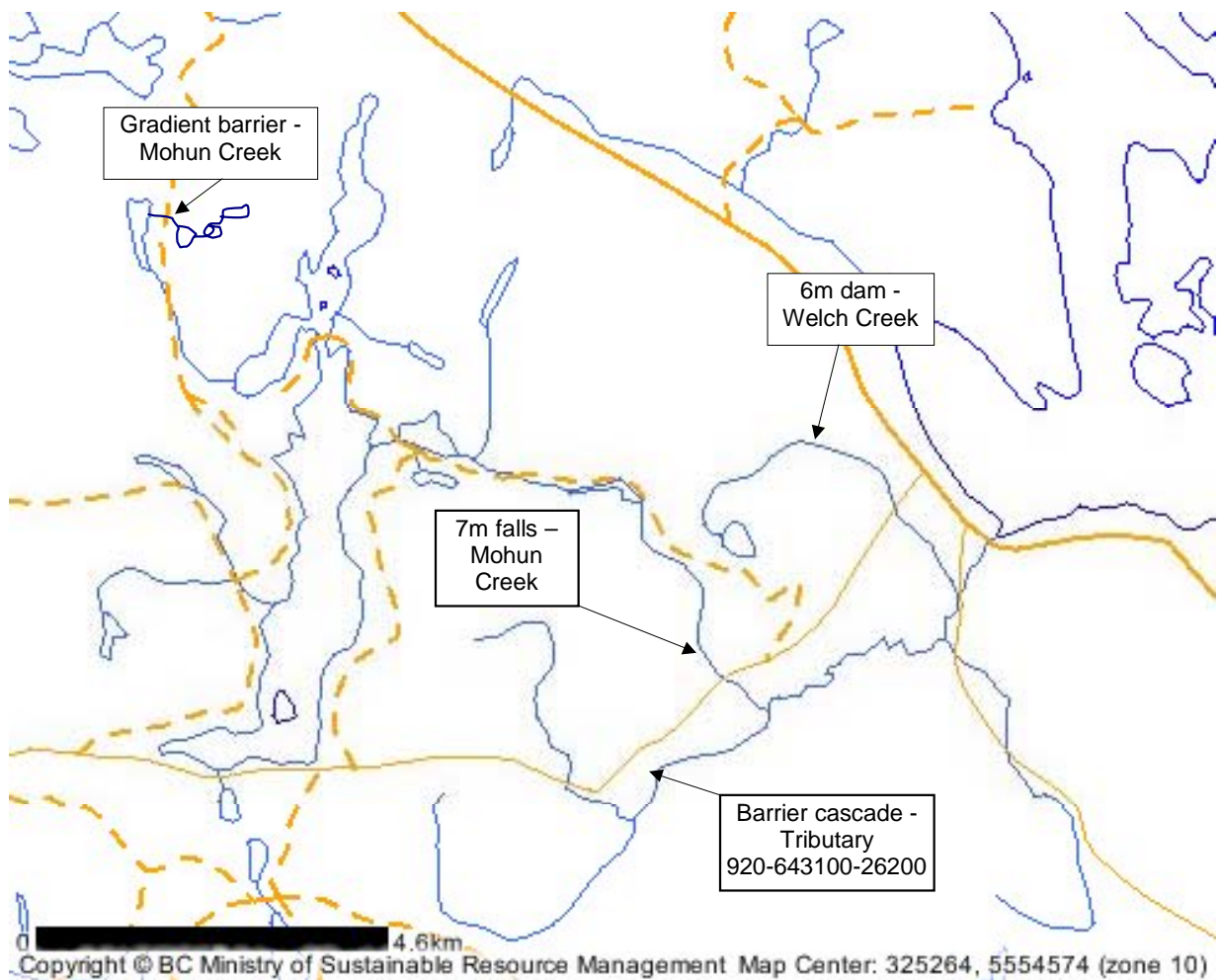


Figure 5. The location of some of the significant barriers to the upstream migration of fish in the Mohun Creek watershed.

The most significant barrier to fish migration in the Mohun Creek watershed is the anadromous barrier located approximately 7.2km upstream of the mouth of the Mohun Creek mainstem. This 7m bedrock falls is the first of a series of at least four falls and cascades over 1.3 km of the mainstem. The anadromous barrier effectively prevents

anadromous species from utilizing the extensive, low gradient stream habitat in the upper portion of the watershed.

The falls also isolate the anadromous population from the abundant lake habitat in the upper watershed, in particular Mohun Lake (621 ha). The reported presence of kokanee in Mohun Lake, Morton Lake and Comida Lake indicate that the barriers may have been breached at some time in the past (or the species was introduced), but there is no recent reports of sockeye salmon returning to this watershed.

The upper limit of all fish in the Mohun Creek mainstem was found to be a section of steep gradient stream located between Comida Lake and Vee Lake (WBID 00542SALM), in the Comida Lake sub-basin. The absence of fish in the three small lakes (Vee, Vulture and Topper) and low gradient stream habitat was confirmed by sampling during the reconnaissance inventory surveys of this area.

The distribution of anadromous fish in the Welch Creek sub-basin is limited by a 6m high concrete dam, located 3.0km upstream of the mouth. A culvert located 1.5km upstream of the mouth that becomes blocked with debris is also mentioned as an anadromous barrier, but this barrier is not permanent. It is not known if the natural anadromous barrier is located where the 6m dam is situated, or if the natural distribution of anadromous fish should extend upstream of that point.

No physical barriers (falls or cascades) were located in the Coho Creek mainstem that would prevent the upstream migration of fish. The gradient of the mainstem increases to 9% in Reach 10, which may restrict the migration of adult coho, but juvenile coho have been captured upstream of that reach. It is more likely that the distribution of anadromous fish in the Coho Creek sub-basin is limited by habitat restrictions (poorly defined channels and low water levels).

The location of an anadromous barrier on Snowden Creek was not determined during the review of existing information. The morphology of the sub-basin is similar to Coho Creek, which suggests that the distribution of anadromous fish (particularly coho) may extend throughout the majority of the drainage area.

A cascade of unknown size is reported by FISS as the upper limit of anadromous fish in the unnamed anadromous 4th order tributary (920-643100-26200) of the Mohun Creek mainstem. Cutthroat trout have been confirmed upstream of this barrier.

4.2.3 Species distribution

A short description of the distribution of salmonid species present in the Mohun Creek watershed is presented in the following paragraphs.

Coho salmon

The distribution of coho salmon includes all of the known anadromous habitat in the Mohun Creek watershed. Adult spawning areas have been identified in the Mohun Creek mainstem (Reaches 2 and 3), and in the Coho Creek mainstem. Coho are likely to spawn in at least the lower portions of the other four major sub-basins (Table 7). Summer and winter rearing habitat for juvenile coho is present in the low gradient stream and wetland habitat that has been found to be abundant in the lower Mohun Creek watershed. The presence of juvenile coho has been confirmed in many of these areas, and should be assumed in any areas accessible from the mainstem and tributaries.

Chinook salmon:

The presence of chinook salmon in the Mohun Creek watershed is not well documented. Adult chinook have been reported in the escapement data for the Mohun Creek mainstem only five times between 1947 and 2000, and always at very low levels of abundance (range = 1 to 25 individuals). During the reconnaissance inventory survey in 1998, juvenile chinook were captured in Reach 1 of the Mohun Creek mainstem. Based on this information and the known life history characteristics of chinook, the distribution of this species should include the Mohun Creek mainstem, up to the anadromous barrier. It is possible that chinook may occasionally enter the major tributaries.

Pink salmon:

Pink salmon have been reported in the Mohun Creek mainstem, Welch Creek mainstem and Coho Creek mainstem. It is not known if the distribution of this species extends throughout the entire 7.2km to the base of the anadromous barrier on the Mohun Creek mainstem. Adults have been reported in Welch Creek to approximately 1km downstream of the concrete dam at 3km (Ally Gibson, Area Engineer. Weyerhaeuser, North Island Timberlands). An observation of six adult pinks holding in

Coho Creek was made at the Iron River mainline crossing in 2000 (F. Voysey, DFO, personal communication to K. Furber, CRFWA).

Chum salmon:

Chum salmon have only been reported in the Mohun Creek mainstem. It is not known if the distribution of this species extends throughout the entire 7.2km to the base of the anadromous barrier, or if adults will also utilize the mainstems of the sub-basins.

Steelhead / Rainbow trout:

Individuals of this species found downstream of the anadromous barrier are generally referred to as steelhead, although it is possible for a resident rainbow trout population to co-exist with the anadromous population. Escapement data, angler activity records and anecdotal information all confirm the presence of a historic steelhead run in this watershed. Juvenile steelhead were captured in Reach 1 and 2 of the Mohun Creek mainstem during the 1998 Reconnaissance Inventory, but have not been reported in any of the tributary streams. Based on the watershed morphology and the known life history characteristics of this species, the distribution of steelhead trout downstream of the anadromous barrier may include all of the mainstem and accessible tributary habitat.

Upstream of the anadromous barrier, reports of rainbow trout are limited to one report of rainbow trout stocking in Mohun Lake (1949) and one report of rainbows captured in the lake in 1969. No rainbow trout were captured at 11 sites upstream of the anadromous barrier during the more recent Reconnaissance Inventory (1998) sampling. The lack of recent rainbow trout captures suggests that either the abundance of this species is very low and / or their distribution is extremely limited. Alternately, rainbow trout may not naturally exist in the Mohun Creek watershed upstream of the anadromous barrier.

Cutthroat trout:

Cutthroat trout is the most abundant and widespread species found in the Mohun Creek watershed. This species is found throughout the anadromous and resident habitat (stream and lake), with the distribution limited only by physical barriers or seasonal low flows. Cutthroat trout are present in the Mohun Creek mainstem up to the upper limit of fish, found between Comida Lake and Vee Lake (WBID 00542SALM) in the Comida Lake sub-basin.

Kokanee:

The presence of kokanee has been reported in three lakes upstream of the anadromous barrier in the Mohun Creek watershed. Kokanee were captured during reconnaissance inventory surveys on Mohun Lake (1976), Morton Lake (1976-1980) and Comida Lake (1990). No barriers exist that would restrict movement of fish between these lakes, and their distribution into the other lakes may only be restricted by lake area and depths. Reports of kokanee in the streams in the upper watershed have not been located, but the species is likely to move into the inlet and outlet streams of the lakes to spawn.

4.2.4 Escapement information

The Department of Fisheries and Oceans (DFO) have recorded adult escapement data for the Mohun Creek watershed since 1944. The data available from 1944 to 1997 is escapement estimates recorded in the BC16 stream files. Therefore, the escapement numbers for this period are typically estimates of returning adults, based on field observations during stream walks or snorkel surveys. Information on the location and intensity of the surveys was not obtained, and these values should not be considered to be entirely representative of the actual numbers of returning fish. Instead, the data can be evaluated to look for trends in population abundance.

From 1998 to 2003, the escapement data records are more complete, with information on the area surveyed, type of survey conducted (snorkel or stream walk), dates of surveys and actual counts of adult fish. This information is summarized in Table 8. As the information for each year was collected over a period of time, there is the possibility that individual fish would be observed on more than one occasion. Therefore, only the maximum number of individuals of each species observed (and the date of the observation) is reported in Table 8.

Escapement estimates for adult coho were at a peak (7500 individuals) in 1944, but decreased to approximately half that value immediately after (Figure 6). The last large report of coho in Mohun Creek was in 1968, with an estimate of 3500 individuals. From 1968 to 1997, estimates ranged from 0 to 1500 adults. The maximum number of adult coho observed since 1999 was 165 individuals in 2000 (Table 8).

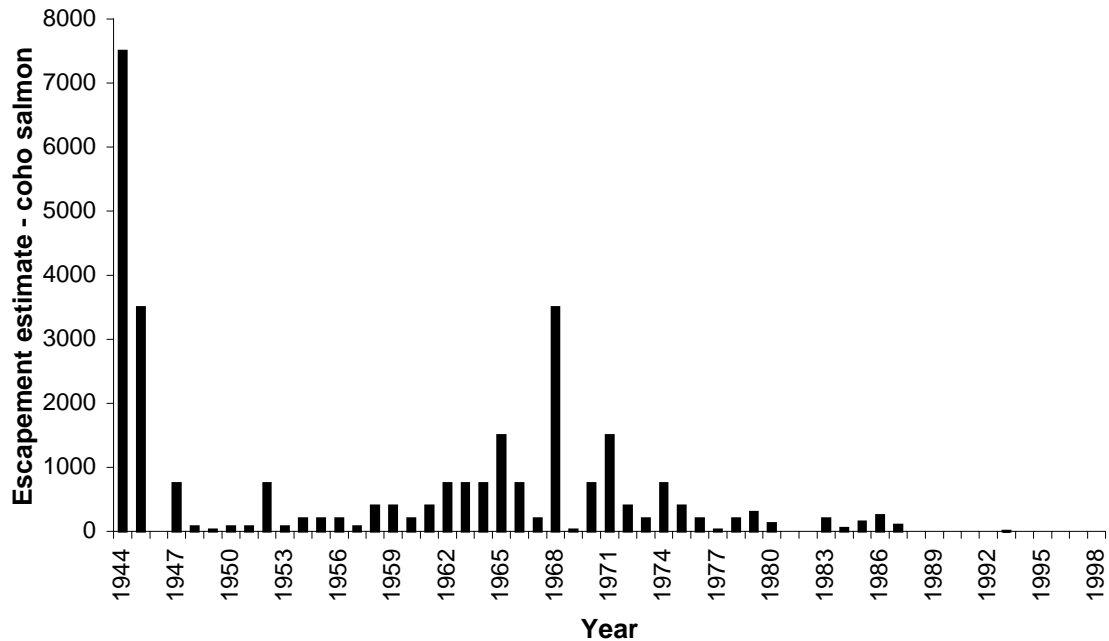


Figure 6. Escapement estimates of adult coho salmon in the Mohun Creek watershed from 1944-1997.

The dominant run of pink salmon occurs in even years in Mohun Creek (Figure 7). Escapement estimates for this species have been extremely variable over the years, with estimates of 0 for 14 years (odd and even years) between 1970 and 1989. Recent escapement counts (1999-2003) range from 0 individuals (2002) to 30 (2000).

The BC16 escapement estimates for chum ranged from 400 to 7500 individuals between 1944 and 1954 (Figure 8). Between 1955 and 1997, the estimates typically ranged between 0 and 750 individuals, with an unusual peak in abundance in 1984 and 1985 (1200 and 3000 individuals respectively). Recent counts of adult chum in Mohun Creek have ranged from 4 (2002) to 530 (2001) individuals.

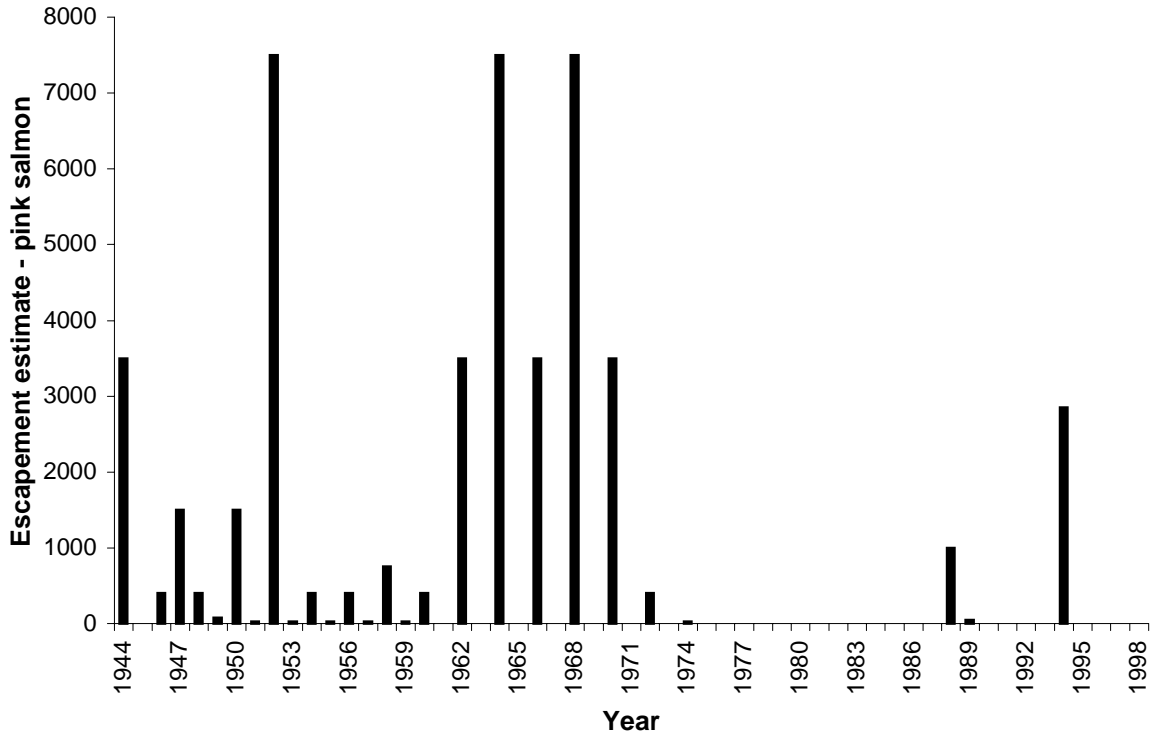


Figure 7. Escapement estimates of adult pink salmon in the Mohun Creek watershed from 1944 – 1997.

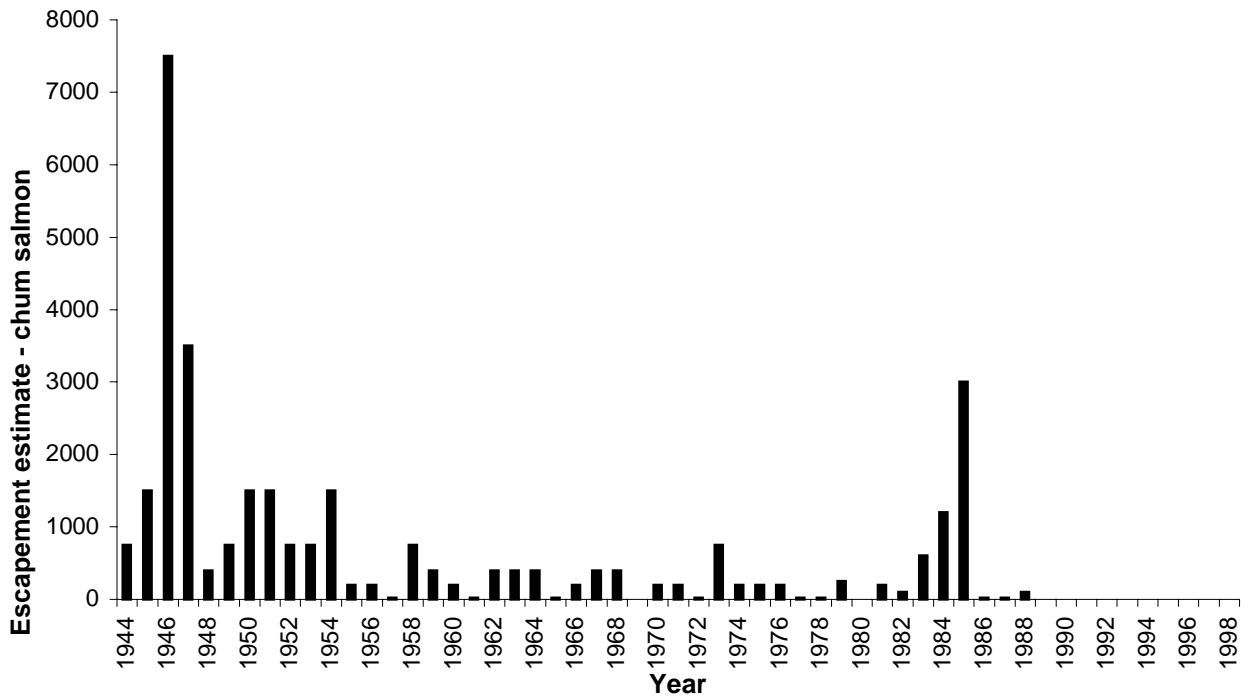


Figure 8. Escapement estimates of adult chum salmon in the Mohun Creek watershed from 1944 – 1997.

Other species recorded periodically in the escapement data include chinook salmon and steelhead trout. The most chinook reported was an estimate of 25 individuals in 1947 and 1948. More recently, maximum counts of 1 and 2 adult chinook (2000 and 1999 respectively) have been recorded. The highest estimate of steelhead in the watershed was 400, recorded in 1947. A maximum of 2 steelhead were observed in the Mohun Creek watershed during a snorkel survey in 1999.

Table 8. A summary of adult escapement survey information from 1999 – 2002, in the Mohun Creek watershed.

Year	Period	No. of surveys		Max no. fish observed (date) ¹				
		snorkels	stream walks	CO	PK	CM	CH	ST
1999	Oct 18 - Nov 30	4	4	26 (Nov 23)	2 (Oct 18)	25 (Nov 17)	2 (Nov 23)	2 (Nov 30)
2000	Sept 14 - Dec 7	8	1	165 (Nov 2)	30 (Oct 19)	150 (Nov 2)	1 (Oct 19)	0
2001	Sept 26 - Nov 7	3	1	57 (Nov 7)	3 (Sept 26)	530 (Nov 7)	0	0
2002	Oct 21 - Dec 4	3	2	3 (Nov 22)	0	4 (Nov 4)	0	0

1 – CO – coho salmon, PK – pink salmon, CM – chum salmon, CH – chinook salmon, ST – steelhead trout

All of the escapement information suggests that the overall abundance of each of the fish species in Mohun Creek has decreased from historically reported levels, and that at this time, escapements may be variable from year to year.

4.2.5 Stocking information

Stocking of anadromous adults and juveniles by DFO, and juvenile resident trout by the BC Ministry of Water, Land and Air Protection (formerly Ministry of Environment, Lands and Parks), has taken place in the Mohun Creek watershed.

Cutthroat trout are the most commonly stocked trout species, with all stocking occurring in lakes upstream of anadromous barriers. The only other recorded species to be released is rainbow trout, in Mohun Lake in 1949. Table 9 summarizes the recorded stocking of trout species in the Mohun Creek watershed.

Table 9. A summary of trout stocking information for the Mohun Creek watershed, from the BC Ministry of Water, Land and Air Protection stocking records.

Location	Watershed code	Species	Release dates	Range of no. released yearly
Mary Lake	920-643100-04800	Cutthroat trout	1990-1992 1995-2003	235-500
Mohun Lake	920-643100	Rainbow trout	1949	2500
Morton Lake	920-643100	Cutthroat trout	1986-2003	500-1500
Cranberry Lake	920-643100-26200-34600	Cutthroat trout	1990-1992	235-500

DFO (Quinsam Hatchery) has outplanted juvenile coho and adult pink salmon to the Mohun Creek watershed. Reports of four occasions where adult pink salmon were transplanted from the Quinsam River to the Mohun Creek mainstem were obtained (Table 10).

Table 10. Reports of adult pink salmon transplants from the Quinsam River to the Mohun Creek mainstem (Quinsam Hatchery, Department of Fisheries and Oceans).

Transplant date	Number transplanted
September 1988	14,176
September 1994	2848
October 1999	2000
September 2000	1067
Total reported transplants	20,091

Coho fry have been released by DFO at least four locations within the Mohun Creek watershed (Table 11). Rutherford (2000) reports the stocking of coho fry upstream of the anadromous barrier in the Mohun Creek mainstem, but this information has not been confirmed.

Table 11. Reports of coho fry releases by the Quinsam Hatchery, Campbell River (DFO) in the Mohun Creek watershed.

Location	Watershed code	Release dates	Total no. released
Mohun Creek	920-643100	July 1984	11738
		June 1986	14000
		Sept 1987	20000
		Aug 1989	12000
		July 1990	15000
		July 1991	14970
		June 1992	15000
		Apr 1995	43109
		Sept 1996	30300
		Sept 1997	13058
		June 1998	9000
		Aug 1998	12813
		Sept 1999	14272
		Sept 2000	11700
		Aug 2001	14386
			<i>Total</i>
Coho Creek	920-643100-09200	May 1989	25314
		July 1990	20000
		July 1991	20191
		July 1992	27200
		July 1993	5000
		May 1995	16000
		July 1997	3158
		June 1998	3000
		June 2000	2500
		July 2001	2500
			<i>Total</i>
Snowden Creek	920-643100-09200-23610	July 1991	8405
		July 1997	3158
		July 1998	3000
			<i>Total</i>
Welch Creek	920-643100-04800	June 1981	18165
		Sept 1982	8408
		Aug 1983	22000
			<i>Total</i>
		<i>Watershed total</i>	<i>439,345</i>

5.0 Development, Land and Water Use

The majority of land use in the Mohun Creek watershed involves forestry-based activities. Approximately 80% of the watershed is public crown land, managed by British Columbia Timber Sales (BC Ministry of Forests) for the purpose of logging (Figure 9), as part of the Sayward Provincial Forest. The remaining 20% of the watershed is private land, with use ranging from industrial (log sorts and tree nursery) to residential. There is also one provincial park located at Morton Lake.

The John Howard Society operates a small youth rehabilitation camp within the Coho Creek sub-basin on public land. This youth camp is a no to low impact operation within the watershed.

Further discussion regarding land use in the Mohun Creek watershed is found in the Reconnaissance (1:20000) Fish and Fish Habitat Inventory report (S.E. Rutherford et al., 2000).

5.1 Logging

Timber harvesting activities have been occurring in the Mohun Creek watershed since at least the early 1900's. The development of the logging industry in the watershed has included the construction of railway grades, an extensive road network and work camps in the past. A logging based community, Bloedel, was established in Menzies Bay near the mouth of Mohun Creek during the early 1900's. While this community no longer exists, the remnant of it and other camps can be found throughout the area. Log booms have been stored in Menzies Bay (within the Mohun Creek estuary area).

Due to the past logging activities, and a large wildfire in 1938 that burnt 30000 ha within the Sayward Forest, nearly all of the forest in the Mohun Creek watershed is second growth timber (60-80 years old).

British Columbia Timber Sales (BCTS) has developed a 5 year development plan for the Sayward Provincial Forest for the period of 2002 – 2006. As of October 2003, cutblocks totaling 425.6 ha (n = 18) had been approved for harvesting and another 15 cutblocks totaling 526.7 ha were proposed as part of the 5 year plan.

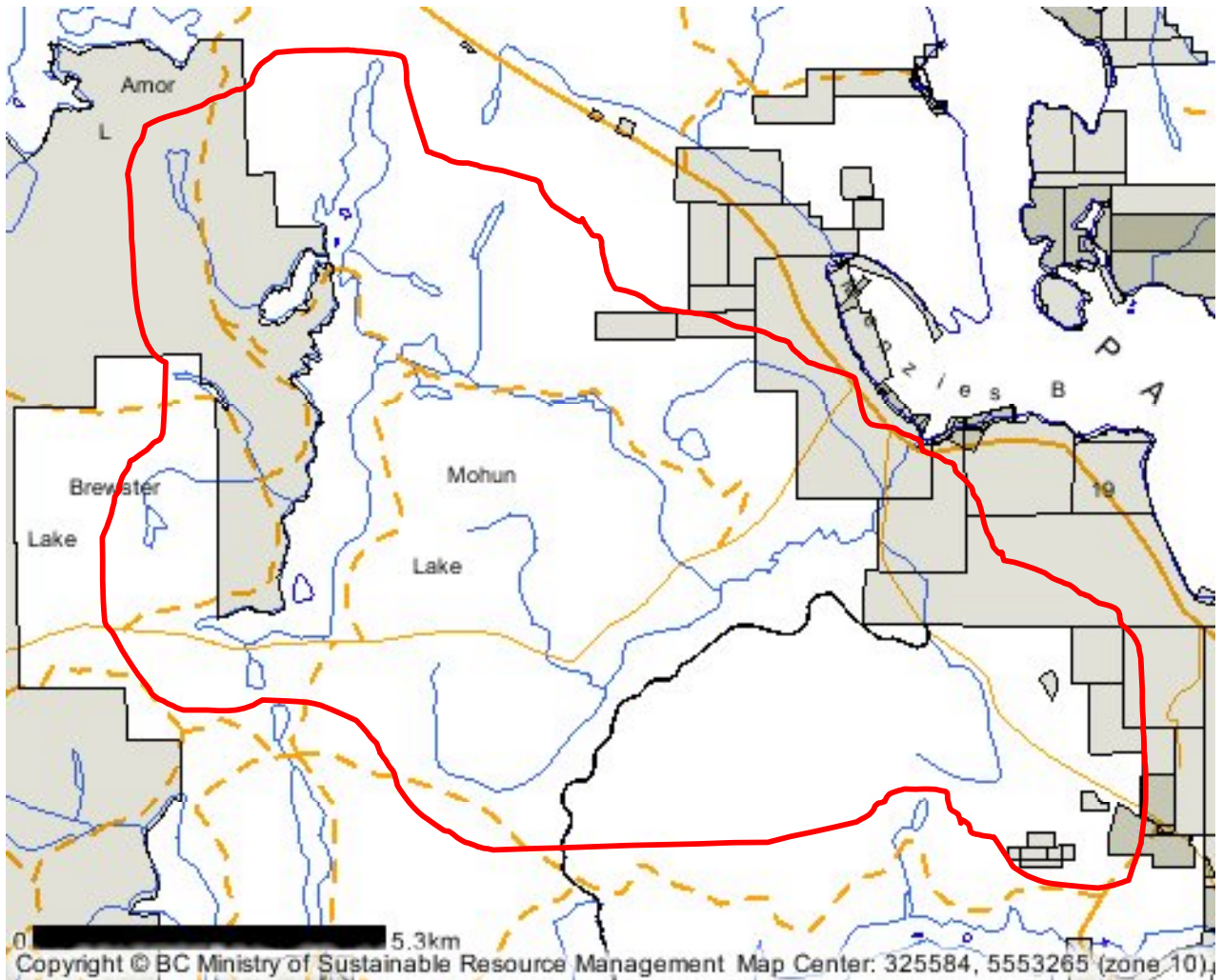


Figure 9. An overview map of the Mohun Creek watershed, showing the boundaries of private land within the watershed. The brown shaded areas are district lots within the Sayward District.

5.2 Private lands

The private land present in the Mohun Creek watershed (Figure 9) is currently being utilized for a variety of purposes including:

- Private residences – District Lots 1578, 1579, 1545, 1583, 1584 and 1585: all fall within the Coho Creek sub-basin
- Private residence and agriculture – District Lot 128: Coho Creek sub-basin
- Commercial agriculture – District lot 1644 (Pacific Regeneration Technology Tree Nursery): Coho Creek sub-basin
- Industrial – Log sorts (Weyerhaeuser Ltd. and Timberwest Forest Company): mouth and estuary of Mohun Creek (Figure 10)
- Industrial – Logging (Merrill – Ring and Weyerhaeuser Ltd): lower Mohun Creek and Coho Creek sub-basin

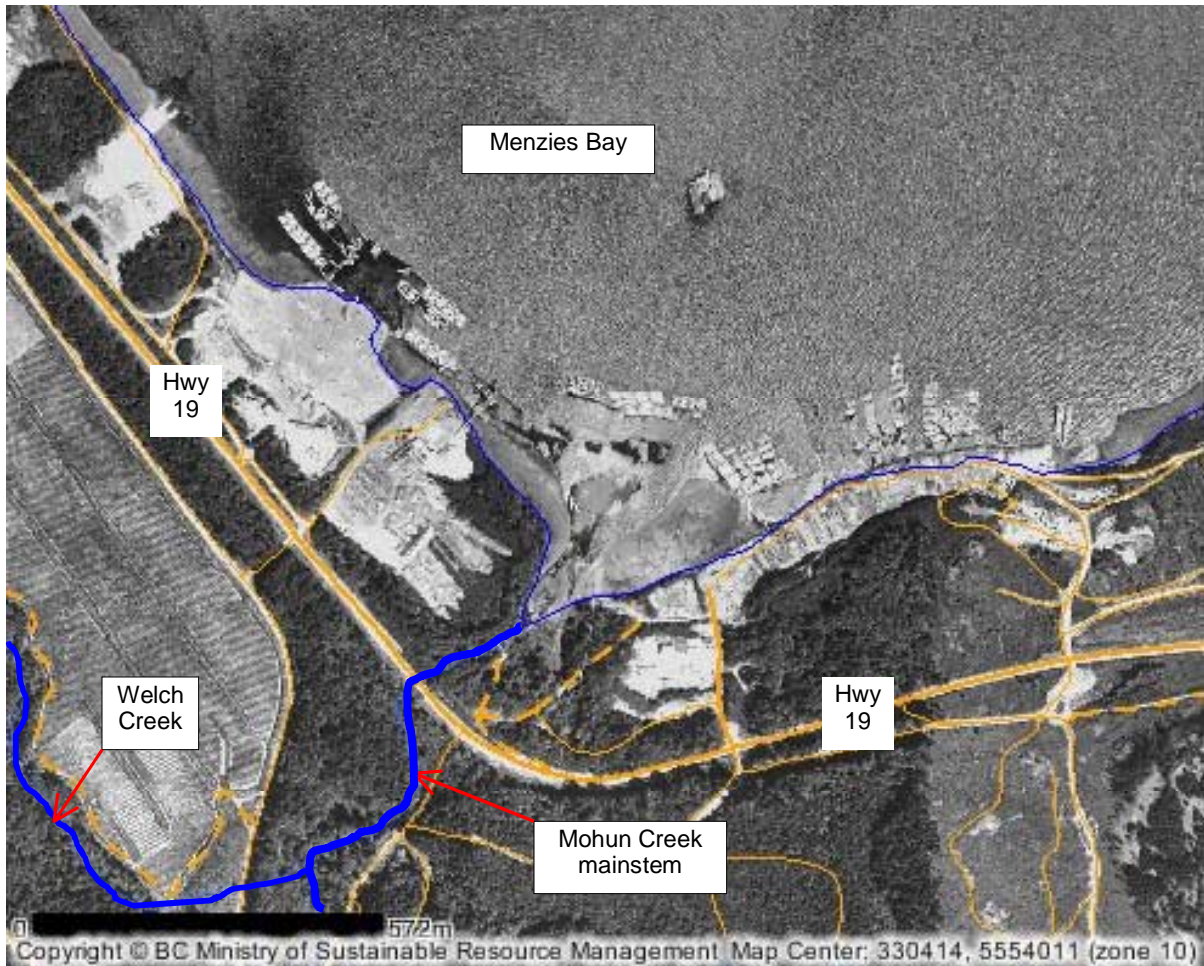


Figure 10 Orthophoto showing the log sort and booming activities at the mouth of Mohun Creek. Photo taken 1996 (BC Online Cadastre).

5.3 Recreational use

Recreational use is an important component of the land use activities within the Mohun Creek watershed. The following is a general list of the recreational features of the watershed.

- Morton Lake Provincial Park: 72 ha park, with 24 vehicle access campsites and a day use area. Situated adjacent to Morton and Mohun Lakes.
- Snowden Demonstration Forest: “designed to raise public awareness about Integrated Resource Management of Provincial Forests” (BC Ministry of Forests brochure). Includes approximately 30km of interpretive and mountain biking trails, many of which originated as old railway grade
- Recreational fishing: Sport fishing for anadromous fish (particularly pink salmon and sea-run cutthroat trout, and including steelhead trout) in the lower Mohun Creek mainstem and estuary was a popular pastime until the recent past

(possibly due to a decline in returning fish populations). Trout fishing is still popular throughout the watershed, in both the streams and lakes.

- Canoeing: The Sayward Forest Canoe Route established by the BC Ministry of Forests includes two lakes within the Mohun Creek watershed (Mohun Creek and Lawier Lake). This portion of the canoe route includes 9.7km of canoeing and approximately 2.2km of portage and two unserviced campsites.
- BC Forest Service trails: located near Mary Lake and between Morton and Mohun Lakes
- Hunting: Hunting for several species is permitted, with Columbian black tailed deer the most commonly sought. A limited entry draw (LEH) for Roosevelt elk (four cow tags and eight bull tags for Zone E of Management Unit 1-10, 2003 LEH Hunting Regulations Synopsis) also occurs (<http://wlapwww.gov.bc.ca/fw>).

5.4 Water Licenses

There are currently two provincial water licenses issued for the Mohun Creek watershed, both to Weyerhaeuser Company Ltd (Land and Water BC Inc, 2003). The first license is for Mohun Creek, with water use specified for dust control (50 000 gallons/day) and storage (7 acre feet / annum). The second water license is on Welch Creek, with 10000 gallons/day allowed to be taken from the impoundment behind the 6m concrete dam. The purpose of this water collection is for use in work camps.

6.0 Conclusions and Recommendations

The following is a summary of some of the key findings, with regards to the fish habitat and populations, identified during the review of existing information for the Mohun Creek watershed.

- Anadromous fish species are able to travel 7.2km up the Mohun Creek mainstem before encountering an impassable barrier (7m falls).
- The distribution of fish upstream of the anadromous barrier is most frequently limited by small cascades or seasonal low water flows. High gradient stream habitat is very rare in the watershed (less than 1%).
- Chinook, chum, coho and pink salmon have been reported in the watershed. Recent escapement counts of these species indicate that at this time, coho and chum are the most abundant with pink and chinook observed less frequently.
- Steelhead were once a viable recreational pursuit in the Mohun Creek watershed. However, recent escapement counts and angler information indicates that the population of this species is very depressed, and anglers less frequently target the species.
- Cutthroat trout are widespread throughout the watershed, in both the anadromous and resident habitat, and in both lakes and streams. This is the most commonly encountered salmonid species in the drainage
- Kokanee, a species not frequently encountered on northern Vancouver Island, has been reported in three lakes in the Mohun Creek watershed (Mohun, Morton and Comida Lakes). The status of this species in the watershed is not known
- Past impacts to the watershed that are likely to have impacted the fish populations to some degree include logging, road construction, railway construction and wildfire. Of these, the most significant is likely to be the loss of riparian vegetation due to logging and wildfire.
- The development of the Sayward Landscape Unit Plan will work to protect the fish and wildlife habitat in the watershed during future logging activities by identifying key habitat areas for preservation and reduced impacts

Future projects that are suggested to improve the base of knowledge for the Mohun Creek watershed, and provide guidance to improve the status of the fish populations (where required) include:

- Further assessment of the anadromous habitat in the lower watershed, with a focus on identifying key habitat areas (spawning and rearing) in the mainstem and tributaries
- Identification and confirmation of the anadromous barriers on Snowden Creek and the Mary Lake outlet stream
- Assessment of the habitat upstream of the anadromous barrier (6m dam) on Welch Creek, to determine the value and feasibility of allowing anadromous fish access upstream of the barrier

- More intensive assessment of the status of the anadromous species populations, including adult surveys and / or juvenile outmigration assessments
- Further assessment of the resident fish population, with a focus on the status of the kokanee and rainbow trout populations in the upper watershed
- Additional review of the water quality for the watershed, including an analysis of water quality testing results for the 25 inventoried lakes in the watershed.
- Completion of water temperature data collection until at least October 2004.
- Complete GPS mapping of the watershed to allow for the production of GIS maps. Current maps (TRIM based) have been shown to be inaccurate in at least the Coho Creek and Snowden Creek sub-basins. The generation of digital maps will also allow for more accurate and easily read presentation of watershed information.
- Historical overview and field assessment of the Mohun Creek estuary, to study the impacts of log booming activities to the fish populations

7.0 References

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Appendix 1 – Campbell River Forest District Identified Species

(List generated November 2003 – from <http://srmwww.gov.bc.ca/atrisk/>)

Scientific Name	English Name	G Rank	Provincial	COSEWIC	BC Status	Identified Wildlife
<i>Accipiter gentilis laingi</i>	Northern Goshawk, laingi subspecies	G5T2	S2B,SZN	T (NOV 2000)	RED	I (FEB 1999)
<i>Aeshna tuberculifera</i>	Black-tipped Darner	G4	S3		BLUE	
<i>Ardea herodias fannini</i>	Great Blue Heron, fannini subspecies	G5T4	S3B,S4N	SC (1997)	BLUE	
<i>Ascaphus truei</i>	Coastal Tailed Frog	G4	S3S4	SC (MAY 2000)	BLUE	I (FEB 1999)
<i>Asio flammeus</i>	Short-eared Owl	G5	S3B,S2N	SC (1994)	BLUE	
<i>Botaurus lentiginosus</i>	American Bittern	G4	S3B,SZN		BLUE	I (FEB 1999)
<i>Brachyramphus marmoratus</i>	Marbled Murrelet	G3G4	S2B,S4N	T (NOV 2000)	RED	I (FEB 1999)
<i>Branta canadensis occidentalis</i>	Canada Goose, occidentalis subspecies	G5T2T3	S1N		BLUE	
<i>Butorides virescens</i>	Green Heron	G5	S3S4B,SZN		BLUE	
<i>Cathartes aura</i>	Turkey Vulture	G5	S4		YELLOW	I (FEB 1999)
<i>Cercyonis pegala incana</i>	Common Woodnymph, incana subspecies	G5TNR	S3		BLUE	

Scientific Name	English Name	G Rank	Provincial	COSEWIC	BC Status	Identified Wildlife
<i>Cervus elaphus roosevelti</i>	Roosevelt Elk	G5T4	S2S3		BLUE	
<i>Colias occidentalis</i>	Western Sulphur	G3G4	S3S4		BLUE	
<i>Columba fasciata</i>	Band-tailed Pigeon	G4	S3S4B,SZN		BLUE	
<i>Corynorhinus townsendii</i>	Townsend's Big-eared Bat	G4	S2S3		BLUE	
<i>Enhydra lutris</i>	Sea Otter	G4	S2	T (MAY 2000)	RED	
<i>Eschrichtius robustus</i>	Grey Whale	G3G4	S2N	NAR (1987) NE PACIFIC POPULATION	BLUE	
<i>Eubalaena glacialis</i>	Northern Right Whale	G1	SH	E (1990)	RED	
<i>Eumetopias jubatus</i>	Northern Sea Lion	G3	S2B,S3N	NAR (1987)	RED	
<i>Euphyes vestris</i>	Dun Skipper	G5	S3	T (NOV 2000)	BLUE	
<i>Fratercula cirrhata</i>	Tufted Puffin	G5	S3B,S4N		BLUE	
<i>Glaucidium gnoma swarthi</i>	Northern Pygmy-Owl, swarthi subspecies	G5T3Q	S3		BLUE	
<i>Gulo gulo luscus</i>	Wolverine, luscus subspecies	G4T4	S3	SC (2003) WESTERN POPULATION ONLY	BLUE	

Scientific Name	English Name	G Rank	Provincial	COSEWIC	BC Status	Identified Wildlife
<i>Gulo gulo vancouverensis</i>	Wolverine, vancouverensis subspecies	G4T1Q	SH	SC (1989)	RED	
<i>Hesperia colorado oregonia</i>	Common Branded Skipper, oregonia subspecies	G5T3T4	S3		BLUE	
<i>Lagopus leucurus saxatilis</i>	White-tailed Ptarmigan, saxatilis subspecies	G5T3	S3		BLUE	
<i>Lampetra richardsoni pop. 1</i>	Western Brook Lamprey, (Morrison Creek population)	G5T1Q	S1	E (MAY 2000)	RED	
<i>Marmota vancouverensis</i>	Vancouver Island Marmot	G1	S1	E (MAY 2000)	RED	I (FEB 1999)
<i>Martes pennanti</i>	Fisher	G5	S2		RED	I (FEB 1999)
<i>Megaptera novaeangliae</i>	Humpback Whale	G3	S1N	T (MAY 2003)	BLUE	
<i>Melanitta perspicillata</i>	Surf Scoter	G5	S3B,S4N		BLUE	
<i>Mustela erminea anguinae</i>	Ermine, anguinae subspecies	G5T3	S3		BLUE	
<i>Myotis keenii</i>	Keen's Long-eared Myotis	G2G3	S2	SC (1988)	RED	I (FEB 1999)

Scientific Name	English Name	G Rank	Provincial	COSEWIC	BC Status	Identified Wildlife
<i>Oeneis nevadensis</i>	Great Arctic	G5	S3		BLUE	
<i>Oncorhynchus clarki clarki</i>	Cutthroat Trout, clarki subspecies	G4T4	S3S4SE		BLUE	
<i>Orcinus orca pop. 1</i>	Killer Whale (Northeast Pacific resident population)	G4G5T3Q	S2	E SOUTHERN POPULATION; T NORTHERN POPULATION (NOV 2001)	RED	
<i>Orcinus orca pop. 2</i>	Killer Whale (Northeast Pacific offshore population)	G4G5TUQ	S3	SC (NOV 2001)	BLUE	
<i>Orcinus orca pop. 3</i>	Killer Whale (West Coast transient population)	G4G5T4Q	S2	T (NOV 2001)	RED	
<i>Otus kennicottii kennicottii</i>	Western Screech-Owl, kennicottii subspecies	G5TNR	S3	SC (MAY 2002)	BLUE	
<i>Pachydiplax longipennis</i>	Blue Dasher	G5	S3		BLUE	

Scientific Name	English Name	G Rank	Provincial	COSEWIC	BC Status	Identified Wildlife
<i>Pinicola enucleator carlottae</i>	Pine Grosbeak, carlottae subspecies	G5T3	S3B,SZN		BLUE	
<i>Progne subis</i>	Purple Martin	G5	S2B		RED	
<i>Ptychoramphus aleuticus</i>	Cassin's Auklet	G4	S2S3B,S4N		BLUE	I (FEB 1999)
<i>Rana aurora</i>	Red-legged Frog	G4	S3S4	SC (MAY 2002)	BLUE	
<i>Salvelinus malma</i>	Dolly Varden	G5	S3S4		BLUE	
<i>Sialia mexicana pop. 1</i>	Western Bluebird (Georgia Depression population)	G5TNRQ	SHB,SZN		RED	
<i>Sorex palustris brooksi</i>	Common Water Shrew, brooksi subspecies	G5T2	S2		RED	
<i>Tanypteryx hageni</i>	Black Petaltail	G4	S3		BLUE	
<i>Thaleichthys pacificus</i>	Eulachon	G5	S2S3		BLUE	
<i>Tyto alba</i>	Barn Owl	G5	S3	SC (NOV 2001)	BLUE	
<i>Uria aalge</i>	Common Murre	G5	S2B,S4N		RED	
<i>Ursus arctos</i>	Grizzly Bear	G4	S3	SC (MAY 2002)	BLUE	I (FEB 1999)