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27 November 2001

Coldwater River Recovery Team

Dear Participant:

Enclosed is the final version of the Recovery Plan for salmonids in the Coldwater River watershed. The Pacific Salmon Foundation in it's capacity as Program Manager will use this document to commence delivery of the specific projects identified in the plan.

Part of the recovery plan includes continuing public meetings and dissemination of information regarding recovery progress so that the open process that each of you have willingly participated in so far will continue for the duration of the recovery period (and hopefully beyond). This plan is intended to be dynamic and flexible to change as we learn more about the Coldwater River and it's fish stocks. The plan represents an important first step towards recovery of Coldwater River steelhead and salmon stocks.

Sincerely yours,

Robert Bocking
Fisheries Biologist

EA1398

COLDWATER RIVER WATERSHED RECOVERY PLAN

Prepared for

Pacific Salmon Endowment Fund

November 2001

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COLDWATER RIVER WATERSHED RECOVERY PLAN

Prepared by

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1 Introduction

The Coldwater River has been selected by the Pacific Salmon Endowment Fund Society as the first watershed to receive attention in the Thompson-Nicola Region salmon recovery planning process for coho and steelhead (PSEF Technical Committee 2001). The Coldwater River is a tributary to the Nicola River, and is one of the most important systems in the Nicola River watershed for coho and early-run chinook, and the most-important system for steelhead, in the Nicola River watershed. Other resident fish species (indigenous to the Coldwater River) are bull trout, Rocky Mountain whitefish, longnose dace, bridgelip sucker, slimy sculpin, prickly sculpin, redside shiner, Pacific lamprey, leopard dace, longnose sucker, and possibly resident rainbow trout. Forestry, agriculture, linear, urban developments, and recreation are the primary land uses in the watershed.

The development of a comprehensive recovery plan is the first step in the recovery of coho, early-run chinook, and steelhead in the Coldwater River watershed.

1.1 Purpose of a Recovery Plan

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

1.2 Watershed Selection Criteria and Rationale

At a meeting with regional biologists from the Department of Fisheries and Oceans (DFO) and the BC Ministry of Environment, Lands and Parks (MELP), a number of watersheds were discussed as potential candidates for initial salmon recovery activities in the Thompson-Shuswap region. The following watersheds were recommended for further discussion: Coldwater, Deadman, Eagle, Salmon, and Bessette/Duteau (PSEF Technical Committee 2001).

From this list, subsequent research and consultation was applied to choosing a good starting point for Pacific Salmon Endowment Fund (PSEF) initiatives in the Thompson-Shuswap region. The Coldwater River was identified as the top candidate, owing to its mix of anadromous species, importance to the Nicola River, the current fisheries management infrastructure (active assessment and monitoring programs supported by federal, provincial, and First Nations governments), manageable size, development concerns, and good chance for successful stock rebuilding. Initial PSEF efforts on the Coldwater River will hopefully attract the support and commitment required to initiate comprehensive recovery programs on other high-priority streams in the Thompson-Shuswap region.

1.3 Guiding Principles for Recovery Planning

In the US, the National Marine Fisheries Service (NMFS 1996) identified three primary components of a successful fisheries recovery strategy as:

- substantive protective and conservation elements;
- a high level of certainty that the strategy will be properly implemented, including necessary authorities, commitments, funding, staffing, and enforcement measures; and
- a comprehensive monitoring program.

NMFS then identified nine components of a conservation or recovery plan which have been adopted by the PSEF:

- identify, at appropriate scales, the factors that have contributed to the species or stock declines;
- establish clear objectives and time frames for eliminating or reducing all major factors for population decline and for achieving desired population characteristics;
- establish quantifiable criteria and standards by which progress toward each objective will be measured;
- establish priorities for action;
- adopt measures needed to achieve the explicit objectives. A plan should include actions to protect and restore habitat wherever habitat condition is a factor of decline, whether on private or public lands;
- provide high levels of certainty that identified measures and actions will be implemented;
- establish a comprehensive monitoring/reporting program, including methods to measure whether objectives are being met, and to detect stock declines and increases in each area of concern;
- as much as possible, integrate federal, state, tribal, local, corporate and non-government activities/projects that are designed to recover salmon populations and the habitat upon which they depend; and
- use an adaptive management approach that actively shapes recovery/management actions to produce needed information.

The PSEF also endorses the notion that recovery plans for Pacific salmon stocks adhere to the principles laid out in the draft Wild Salmon Policy:

- Principle 1 - Wild Pacific salmon will be conserved by maintaining diversity of local populations and their habitats;
- Principle 2 - Wild Pacific salmon will be managed and conserved as aggregates of local populations called Conservation Units;
- Principle 3 - Minimum and target levels of abundance will be determined for each conservation unit;

- Principle 4 - Fisheries will be managed to conserve wild salmon and optimize sustainable benefits;
- Principle 5 - Salmon cultivation techniques may be used on strategic intervention to preserve populations at greatest risk of extirpation; and
- Principle 6 - For specified conservation units, when genetic diversity and long term viability may be affected, conservation of wild salmon populations will take precedence over other production objectives involving cultivated salmon.

1.4 Recovery Planning

The PSEF approach to recovery planning is similar to Stage II of the Watershed-based Fish Sustainability Planning Guidelines (WFSP, draft November 2000). In Stage II of the WFSP, a watershed profile is developed which describes the current condition of the watershed and fish stocks. Objectives, targets and strategies are then developed to guide recovery. Finally, a monitoring and assessment framework is established. Throughout the process of developing the plan, public involvement is integrated into the planning. This recovery plan for the Coldwater River includes each of these components.

1.5 Public Participation

Local stewardship groups with an interest in the Coldwater River watershed and its anadromous fish stocks were involved throughout the planning process. Public meetings were held on four occasions (04 April, 31 May, 24 July, and 11 October) to provide input to the planning process and review drafts of the plan. Additional meetings and site visits with local First Nations representatives, community stakeholders, and both federal and provincial resource managers were also conducted. Appendix A contains a list of participants in the planning process.

2 Stock/Watershed Profile

The Coldwater River originates on the northeastern slopes of the Cascade Mountains and flows in a northeasterly direction for approximately 95 kms to its junction with the Nicola River at Merritt (Figure 1). The Coldwater River drains an area of roughly 914 km^2, and has 85 mapped (24 permanent and 56 intermittent streams) tributaries (1:20K TRIM). Channel width ranges from 2 to 25 m, with a low to moderate gradient (average 0.6%; Coast River 1996). Main tributaries include Midday, Voght, Brook, Juliet, and July creeks, all of which are reported to provide fish habitat. The Coldwater River flows primarily through two biogeoclimatic zones: 1) the Interior Douglas Fir Zone (middle and upper reaches); and 2) the Ponderosa Pine/Bunch Grass Zone (lower reaches form Kingsvale to Merritt; Wightman 1979). There are also zones within the watershed of Mountain Spruce and Engelmann Spruce-Sub-Alpine Fir. Precipitation in the watershed varies greatly with altitude; average annual accumulations for the lower reaches near Merritt are 255 mm/year while precipitation in the upper watershed averages 1000 mm/year (Coast River Environmental Services Ltd., 1996).

2.1 Fish Population Status and Trends

The Coldwater River supports populations of coho salmon, chinook salmon, and steelhead. Table 1 shows when the various life stages for each species are present, by month, within the

Coldwater River. Other resident indigenous fish species observed in the watershed are bull trout, Rocky Mountain whitefish, longnose dace, redside shiner, bridgelip sucker, slimy sculpin, prickly sculpin, redside shiner, Pacific lamprey, leopard dace, longnose sucker, and resident rainbow trout/resident steelhead. In addition, brook trout were introduced to lakes in the Voght Creek drainage. Map 1 in Appendix B shows the distribution of salmonids within the watershed.

2.1.1 Adult Abundance

Coho

Escapement records for coho salmon in the Coldwater River date back to 1948. The majority of these estimates are from Fishery Officer observations as recorded on BC16s. In 1998, a counting fence was installed in the lower Coldwater River (in Merritt) near the confluence with the Nicola River. Escapement estimates range from a high of 7,500 in 1955 to a low of 75 in 1967, with several years of no estimate (Figure 2). Prior to 1998 the estimates of annual coho escapement are considered to be unreliable (R. Bailey, DFO Kamloops, pers. comm.)

Chinook

Chinook that return to the Coldwater arrive during two distinct timing periods. "Early" chinook enter the Coldwater River as early as April and as late as late June or early July. "Late" chinook do not arrive in the Coldwater River until July and, in some years, well into August. Early-run chinook spawn in locations upstream of Kingsvale (Figure 1), whereas late-run chinook tend to spawn downstream of Kingsvale. While the early run is thought to be a dedicated Coldwater River stock, the late run (that spawns in the lower river) may be made up at least in part from Nicola River stock (R. Bailey, DFO Kamloops, pers. comm.). The numbers of early-run Coldwater River chinook are currently below historic levels, although shifts in abundance since 1986 appear to track changes observed in other BC interior early-run chinook stocks (Spius Creek, Upper Chilcotin River, Birkenhead River; Figure 3). Late-run chinook escapement estimates to the Coldwater River are not monitored as a discrete stock but rather as a component of the total Nicola River escapement (Figure 4).

Steelhead

Steelhead escapement estimates to the entire Nicola River watershed have been produced since 1983, but the reliability in these estimates varies depending on the year. Estimates of total annual Nicola River steelhead escapements range from 550 in 1992 to 3300 in 1985 (Figure 5). There are strong indications that Coldwater steelhead can in some years provide the highest contribution to the total Nicola River steelhead escapement (these estimated contributions can range from 23-42% of the annual estimated steelhead returns to the Nicola River watershed; Figure 5). Until 1999, estimates (conducted by MELP Kamloops) of abundance were based on peak counts from limited helicopter and stream surveys. Because high and turbid freshet conditions through much of the 1990’s precluded the use of visual surveys in the Coldwater River itself, estimation methods needed to be changed in order to improve reliability of generating estimates on an annual basis. Since 1999. steelhead escapement estimation has been

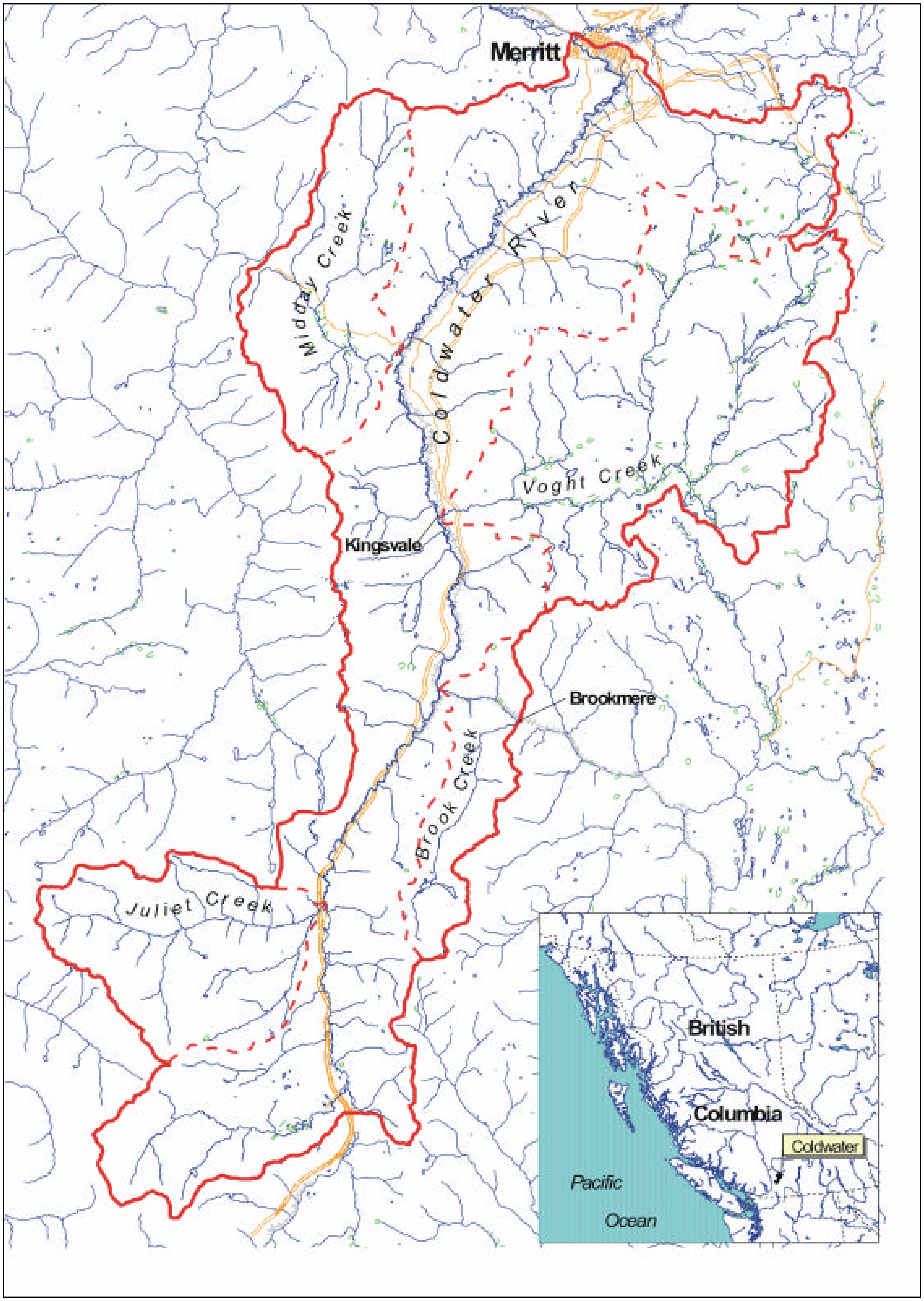
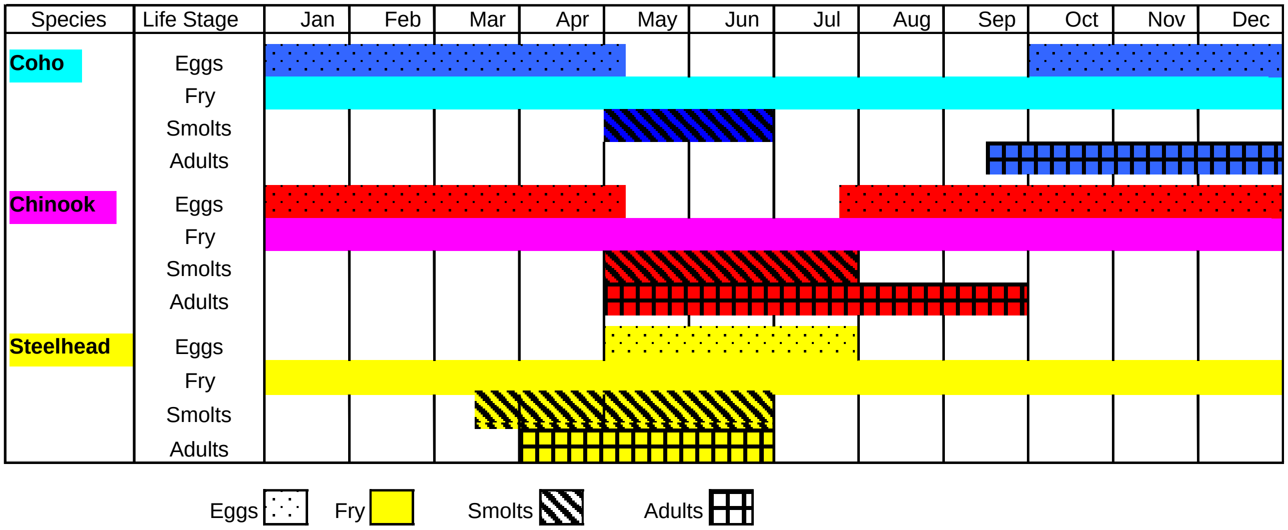


Figure 1. Coldwater River watershed and location within British Columbia.

Table 1. Life history timing for anadromous salmonids within the Coldwater River.



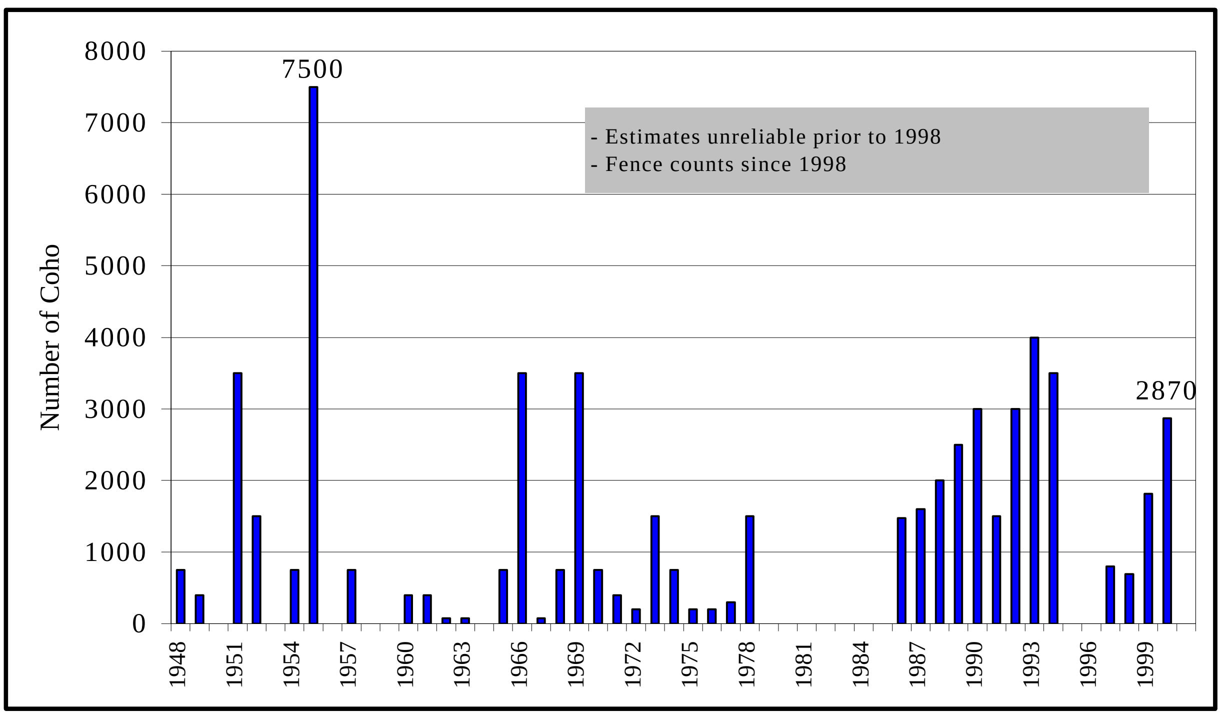


Figure 2. Estimates of coho escapement to the Coldwater River, 1948-2000.

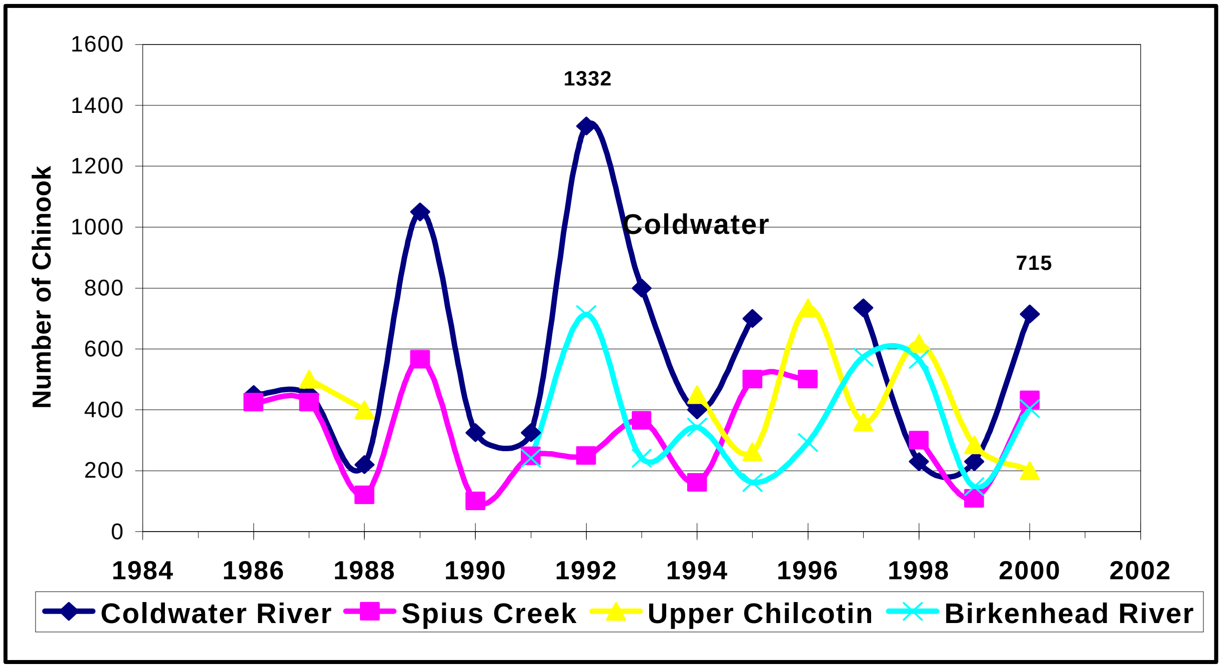


Figure 3. Comparison of escapement estimates of early-run chinook to the Coldwater River, and other BC Interior watersheds (Spius Creek, Upper Chilcotin, Birkenhead River), from 1984-2000. Data provided by Fisheries and Oceans Canada.

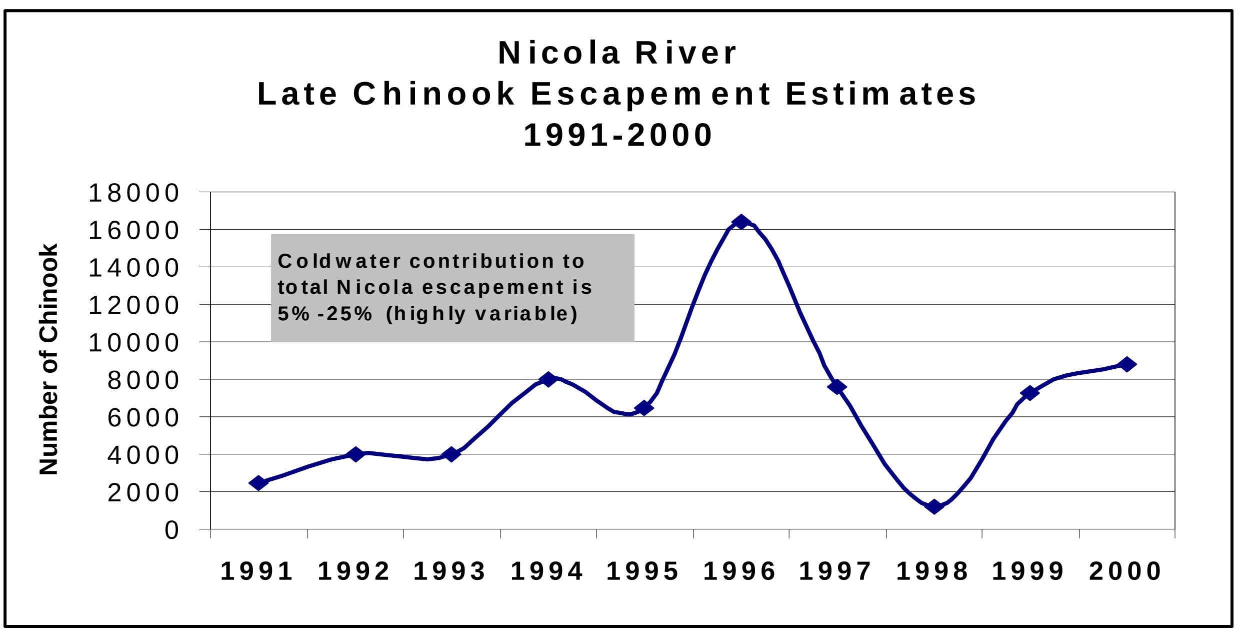


Figure 4. Escapement estimates of late-run chinook to the Nicola River, 1991-2000. Data provided by Fisheries and Oceans Canada, Kamloops.

based on periodic visual counts from another major spawning tributary (Spius Creek). Estimates of escapement to other parts of the Nicola watershed including the Coldwater watershed is then extrapolated based on the distribution of a random sample Nicola watershed steelhead which are radio tagged prior to their upstream spawning migration into the Nicola watershed. (Robert Bison, MELP Kamloops, pers. comm.).

2.1.2 Juvenile Abundance

There have been numerous assessments and studies by both DFO and the BC Fish and Wildlife Branch that have documented fish use within the Coldwater drainage. Most of these efforts were associated with comprehensive assessments with reference to construction of the Hope-Merritt Highway. Wightman (1979) assessed fish production characteristics of the Coldwater River drainage in 1977-78. Russell and Wightman (1981) and Russell (1982) conducted juvenile salmon inventories of the Coldwater system in 1980 and 1981, respectively. Extensive juvenile studies and assessments were conducted as part of post-construction monitoring for the Hope-Merritt Highway (Beniston et al. 1987, 1988; Beniston 1987; Beniston and Lister 1992). Beniston et al (1987) found that 99% of juvenile salmonids were captured in the mainstem Coldwater River. In early summer, chinook juveniles were the most abundant, followed by coho and steelhead. By late summer, coho and steelhead were dominant, and in winter, steelhead were most abundant in the mainstem. The low abundance of coho and chinook in the winter period may be due to emigration in the case of chinook and, in the case of coho, movement into off-channel areas for overwintering (Beniston et al. 1987).

More recent juvenile assessments have been primarily associated with inventory or watershed restoration assessments within the drainage (e.g. Nicola Tribal Association 1998).

Coho

The majority of coho juveniles spend one year or less in the Coldwater system before leaving as smolts (Wightman 1979, Beniston et al. 1987). Wightman (1979) estimated the standing crop of coho in August of 1978 for the Coldwater mainstem at 165,000 fry and 16,500 parr (Age 1+). Standing crop of coho in Juliet and Voght creeks in August, 1978 was 9,000 fry and 1,000 parr. Based on this estimate of standing crop, Wightman calculated a total potential coho smolt yield of 29,500. In terms of absolute smolt yield, the Merritt-Kingsvale section of the Coldwater River likely produces nearly 50% of the total yield for coho (Wightman 1979).

Chinook

Chinook juveniles follow a similar pattern to coho with most spending less than one full year in the system before emigrating (Wightman 1979, Bensiton et al. 1987). These fish likely continue to rear in the lower Thompson River and/or Fraser River before migrating to marine waters in late March and April.

Wightman (1979) estimated the standing crop of chinook in August of 1978 for the Coldwater mainstem at 64,500 fry and 4,000 parr (Age 1+). Standing crop of chinook in Juliet and Voght creeks in August, 1978 was 4,300 fry and 400 parr. Based on this estimate of standing crop, Wightman calculated a total potential chinook smolt yield of 19,250. In terms of absolute smolt yield, the Brodie-Kingsvale section of the Coldwater River likely produces nearly 35% of the total yield for chinook. In 1978, this reach was extremely complex in terms of rearing habitat diversity as well as having some of the best spawning habitat, not only for chinook, but also for coho and steelhead (Wightman 1979). Juvenile chinook generally utilize all types of habitat (riffles, glides, pools) with seasonal preferences.

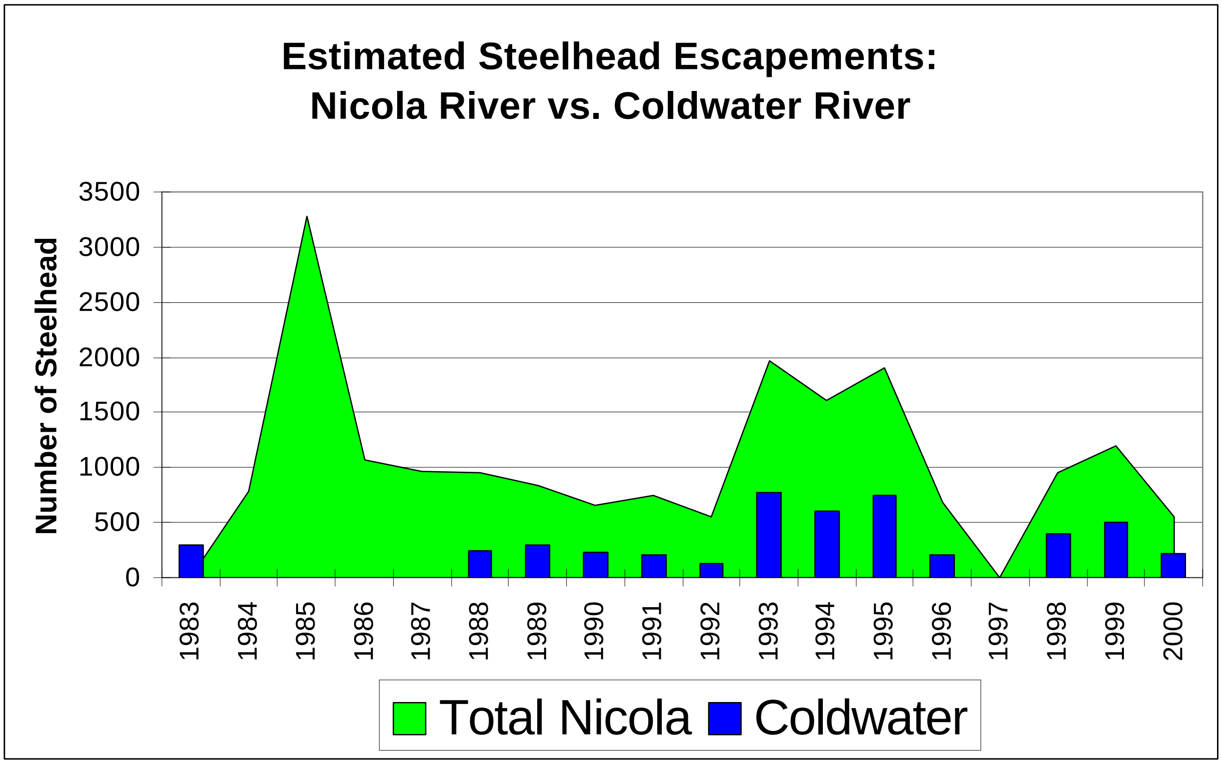


Figure 5. Annual estimated steelhead escapements to the total Nicola River watershed, and respective estimated steelhead escapements to the Coldwater River (as portions of total Nicola River escapements), for years where steelhead escapements could be estimated, from 1983-2000. Data provided by MELP Kamloops.

Steelhead

Average smolt age for steelhead in the Coldwater River drainage is approximately 2-4 years (I. McGregor and R. Ptolemy pers. comm.). Wightman (1979) estimated the standing crop of rainbow trout in August of 1978 for the Coldwater mainstem at 248,400 fry and 68,000 parr (Age 1-4). Standing crop of steelhead in Juliet and Voght creeks in August 1978 was 2,900 fry and 4,500 parr. Based on this estimate of standing crop and assuming a 50% (unverified) ratio between resident and anadromous rainbows, Wightman calculated a total potential steelhead smolt yield of 8,000. In terms of absolute smolt yield, the Merritt-Kingsvale section of the Coldwater River likely produces nearly 50% of the total yield for steelhead (Wightman 1979).

Other Species

Beniston et al. (1987) documented relative abundance and distribution of mountain whitefish and Dolly Varden (bull trout) in 1986-87. Only low numbers of these species were observed in the mainstem of the Coldwater.

2.1.3 Enhancement History

Enhancement of Coldwater salmon stocks began in 1984 with coho and chinook. Since 1984, Coldwater coho have been reared at Spius Creek hatchery and released back into the Coldwater River as both fry and smolts (Figure 6a; Appendix C). Production of coho peaked in the mid 1980's when different enhancement strategies were tested on the Coldwater (Irvine et al. 2000). A portion of all coho juveniles released to the Coldwater River were coded-wire tagged to monitor and compare survivals among the different release types (fry, smolt). From an enhancement perspective, the Coldwater coho program was successful (Irvine et al. 2000); annual escapements increased and there appeared to be no negative effects on the survival of wild fish. Coho continue to be released into the Coldwater River where interactions between wild and enhanced coho are judged to be minimal (Irvine et al. 2000).

In the 1980's, chinook were released to the Coldwater River as 0+ smolts (Figure 6b, Appendix C). Later in the 1990's, this release strategy was changed to 1+ smolt with infrequent releases of fry and 0+ smolts. Chinook were also coded-wire tagged (Appendix C).

Steelhead enhancement of the Coldwater began in 1986 (Figure 6c, Appendix C). Steelhead were always released as fry to the Coldwater with the stock being raised in Spius Creek Hatchery. None of the steelhead fry released in the Coldwater River were marked.

A notable feature of Coldwater River steelhead (revealed during broodstock collections) is their high fecundity; females averaged over 11,000 eggs/female, which is almost twice as many eggs/female as most other BC steelhead stocks; the egg size (diameter) tends to be small (N. Todd, NTA Merritt).

2.1.4 Survivals

Coho

There are no direct measures of freshwater survival for Coldwater River coho. Irvine et al (2000) examined smolt-to-adult survivals for several enhanced South Thompson drainage systems (Eagle, Salmon, and Spius). Figure 7 shows the exploitation rates and survivals for these three stocks. It is reasonable to assume that Coldwater coho have experience similar trends in marine survival and exploitation. Marine survivals have decreased from 7.5% in 1989 to extremely low levels. During this period of decreasing marine survival, fishery exploitation rates remained high (40 – 80%). There has been some slight improvement in smolt to adult survival in 1999 and 2000, but is premature to assume that this increasing trend will continue.

Overall exploitation rates on South Thompson coho remained relatively high (40-80%) through the late 80's and early 90's (Figure 7). However, these rates were not as high as those on Georgia Basin coho (70-80%).

Steelhead
There are no direct measures of freshwater or marine survivals for Coldwater River steelhead. Marine survivals for Keogh River steelhead have been declining since the early 1990's (less than 4% compared to 15% during the previous decade; Ward 2000). Trends in escapement estimates of interior Fraser steelhead stocks, and trends in test fishery data (Albion test fishery), suggest that survival rates of interior Fraser steelhead stocks have also been strongly affected by changes in marine survival. Wightman et al. (1998) provide a good summary of possible reasons for the decline in marine survivals of Strait of Georgia steelhead.

2.2 Salmon Resource Use

Overall, exploitation rates remained high through the early 1990's even though smolt-adult survivals were in serious decline (Figure 7).

2.2.1 Commercial Fisheries

Coho
Thompson River coho are harvested in marine fisheries from Alaska to Washington State. The majority are taken in troll and sport fisheries off the west coast of Vancouver Island and in Georgia Strait. Net fisheries for other species in Johnstone Strait, Juan de Fuca Strait, Georgia Strait, San Juan, and the lower Fraser also harvest Thompson coho incidentally.

The distribution of catches of lower Thompson coho has changed considerably (Figure 8). In 1994, the majority were taken in fisheries in Georgia Strait (troll and sport). In 1996, the majority were taken in fisheries on the west coast of Vancouver Island. In 1997, with the coho restrictions in BC, most coho were taken in US fisheries.

Chinook
Prior to 1994, most of the commercial harvest of Nicola River chinook was taken in the Fraser gillnet fishery (Figure 9) as incidental catch in the directed sockeye fisheries. In years of significant Fraser sockeye runs, this is expected to still be the case. Other important fisheries are West Coast Vancouver Island and Northern troll and Georgia Strait and Juan de Fuca Strait sport.

Steelhead
Coldwater River steelhead are managed as a component of "fall-run"[1] Thompson/Nicola River steelhead are intercepted during late summer and fall seine and gillnet fisheries in Johnstone Strait and on the west coast of Vancouver Island (R. Bison, MELP Kamloops, pers. comm.). Although there is not a direct measure of commercial catch or bycatch mortality for Coldwater steelhead, estimates have been produced for the catch and interception of fall-run Fraser

[1] Returning adult steelhead that enter the Fraser River from marine waters in the fall (October and November) are termed "fall run" and are composed mostly of interior stocks (upstream of Hells Gate), including all Thompson /Nicola River stocks.

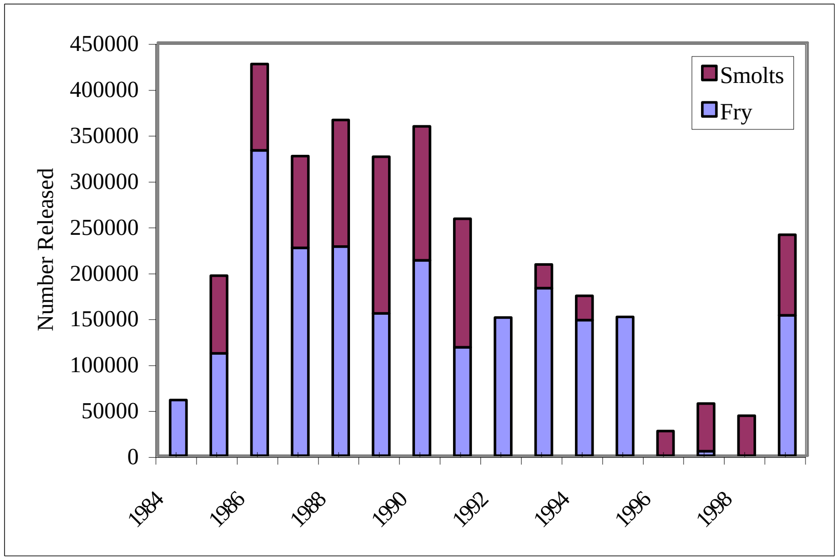


Figure 6a. Coho releases to the Coldwater River 1984-99.

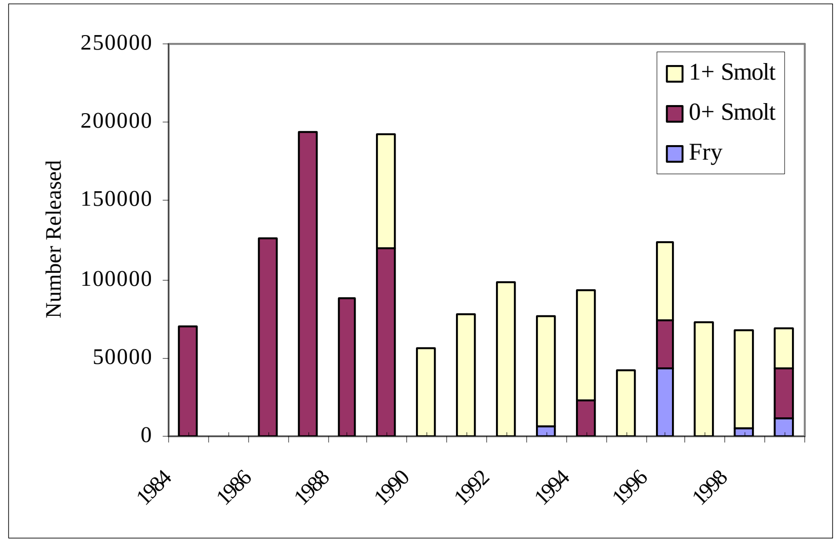


Figure 6b. Chinook releases to the Coldwater River 1984-99.

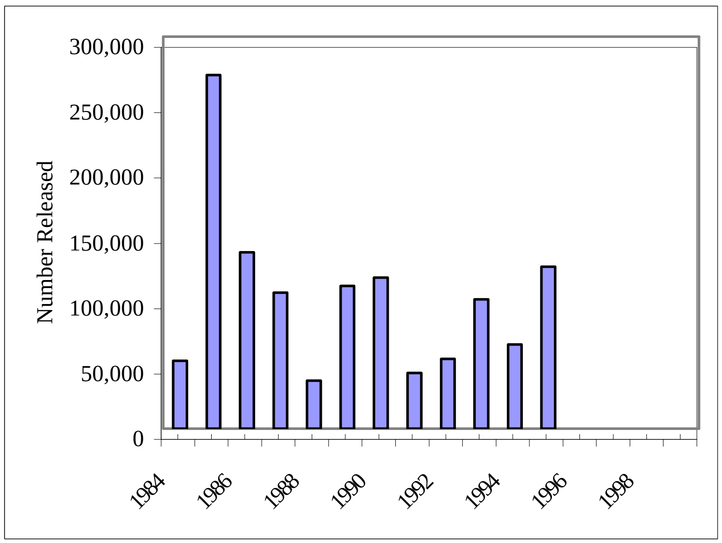


Figure 6c. Steelhead releases to the Coldwater River 1984-95.

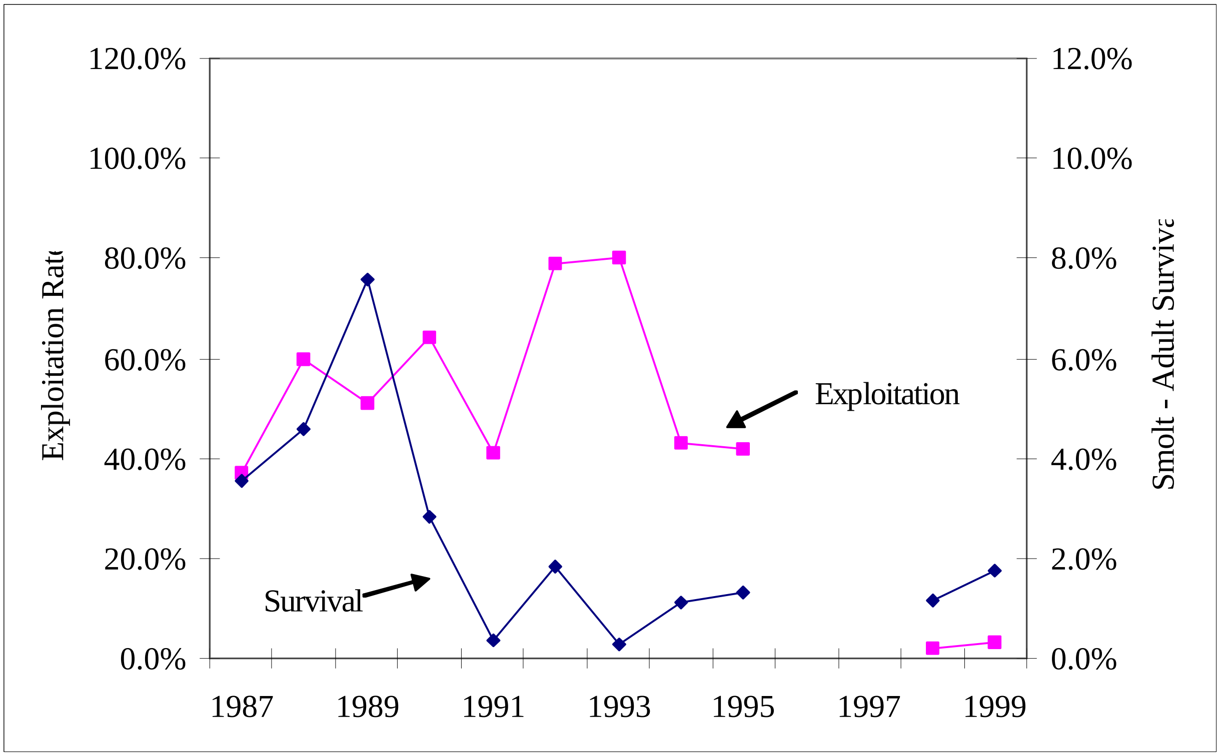


Figure 7. Exploitation rate and smolt to adult survivals for Eagle (1987-1993), Salmon (1994-1995), and Spius (1998-1999) enhanced coho (Irvine et al. 2000).

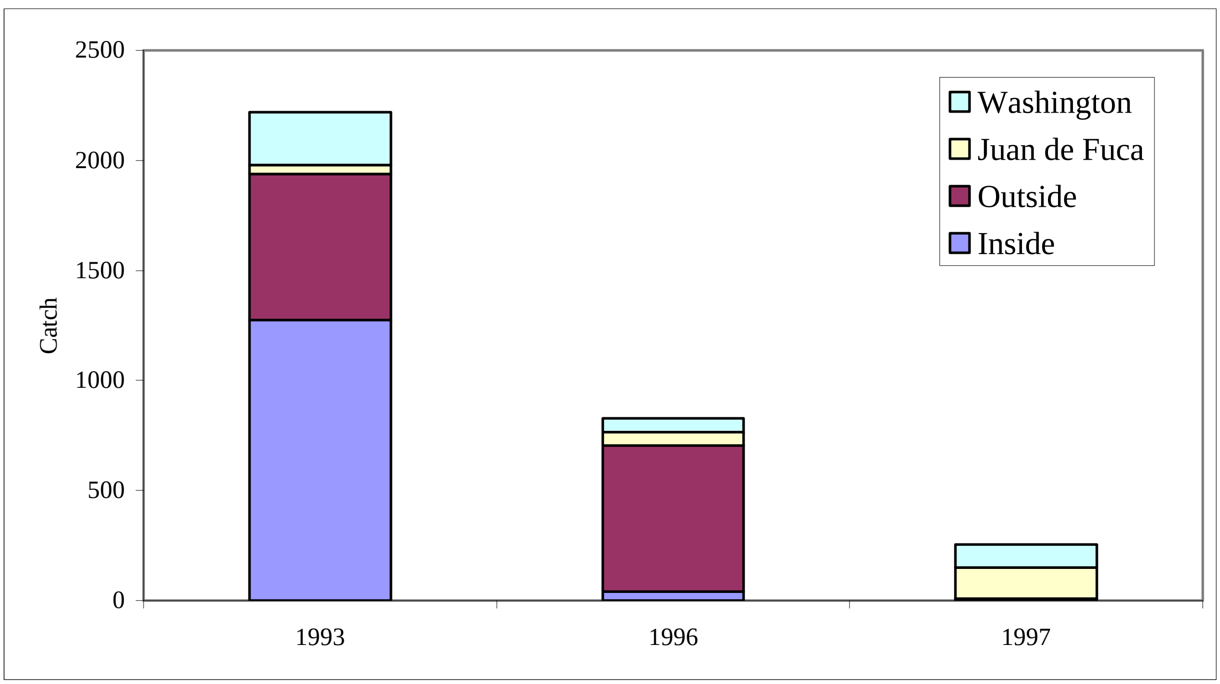


Figure 8. Estimated marine catch of coded-wire tagged Lower Thompson coho salmon from fisheries inside and outside Georgia Strait, Juan de Fuca Strait, and Washington State.

steelhead stocks. Historically, fishing mortality of fall-run Fraser steelhead stocks (based on theoretical simulation models that include commercial, sport, and First Nation catch) have been estimated to be as high as 80%; recent estimates of fishing mortality (since 1996) have been estimated at between 10-20% (R. Bison, MELP Kamloops, file data).

2.2.2 Recreational Fisheries

Coho

Thompson River coho have historically been taken in both saltwater and freshwater sport fisheries. However, from 1989-1995, the only freshwater recreational fishery on Thompson coho took place on the Eagle River, an enhanced stock (Irvine et al. 1999). In 1996, all freshwater recreational fisheries for coho in the Fraser River and tributaries above Alexandra Bridge were closed and they remain closed today. Prior to1989, there were catches in the Fraser River from Boston Bar to Lillooet. These fisheries would have most likely intercepted Coldwater coho. Thompson coho are also angled in the lower Fraser River. There is no recent data to suggest what the harvest level of Thompson coho was prior to the coho restrictions implemented by DFO in 1997.

Recreational fisheries in the Strait of Georgia intercept Thompson coho. These fisheries have been closed in recent years. In 1999, approximately 30 Thompson River coho were taken in saltwater fisheries in Area 1 (Irvine et al. 1999).

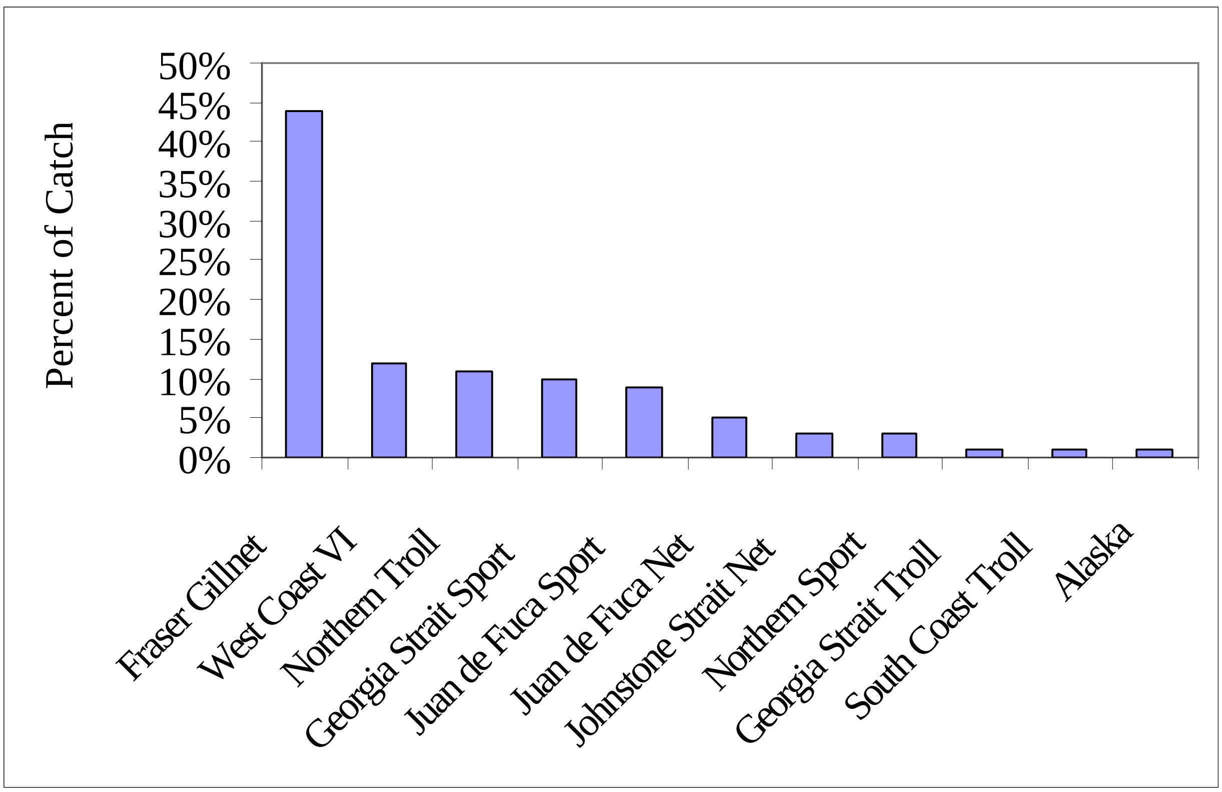


Figure 9. Commercial and sport catch distribution of Thompson – Nicola chinook (below Kamloops), 1988-94 (from DFO 1998).

Chinook
As shown in Figure 9, ocean sport fisheries can take a significant proportion of Nicola chinook. The Fraser in-river sport fisheries were terminated in 1980 due to low chinook returns (DFO 1998). Coldwater chinook are likely harvested in sport fisheries that take place on the lower Fraser River. Since 1988, a sport fishery (100-300 catch ceiling) has been conducted in the lower Thompson near Spences Bridge. This fishery is supported by Spius Creek hatchery releases. A small number of Coldwater chinook are harvested in this fishery in most years.

Steelhead
Since 1989, recreational fishing regulations for Thompson watershed steelhead has been restricted to catch-and-release only (wild fish). Current regulations also allow limited retention of hatchery/adipose-clipped steelhead, however adipose-clipped steelhead are no longer available since stocking of marked Thompson River steelhead was discontinued in 1992. Rates of mortality from catch-and-release fishing are generally low (Barnhart and Loelofs 1977, Barnhart and Loelofs 1987; Nelson et al. 2001). Records from the provincial government hatchery broodstock collection programs conducted in the spring indicate that the mortality rate on Thompson River steelhead from angling is also low (1.6% based on 436 captures). Coldwater River steelhead are subjected to an intensive catch-and-release sport fishery that occurs on the lower Thompson River when steelhead arrive to overwintering areas from October through December. During the overwintering and spring migrations, angling is closed in the lower Thompson River and its tributaries. Adult steelhead present within the Coldwater River watershed are virtually protected from sportfishing impacts by seasonal and size restrictions enacted in the Region 3 freshwater sport fishing regulations. However, under current sportfishing regulations, juvenile steelhead are subject to catch-and-release sport fishery impacts from 1 July through 31 December.

2.2.3 First Nation Fisheries

Coho
From the mid 1970's to present, Fraser First Nations have not carried out significant directed fisheries on coho (Irvine et al. 1999). Most harvests in recent years occurred at enumeration fences and on enhanced stocks (e.g. Spius Creek). Since 1995, fishing in the lower Fraser has been restricted during October and November and in 1996, First Nations voluntarily further restricted their fisheries to conserve coho. Most of the coho now caught in the lower Fraser are presumed to be of lower Fraser origin rather than Thompson origin (Irvine et al. 1999).

Chinook
Catch data for First Nation harvests of Nicola chinook are not available. However, the majority of the native catch of Fraser chinook is taken below North Bend (DFO 1998). Some chinook are harvested by First Nation fishers in the Nicola River by gillnet, angling, weir, or spearing (DFO 1998).

Steelhead
The level of Coldwater River steelhead harvest by First Nations is unknown. The majority of fall-run Fraser steelhead catch by First Nations occurs in the lower Fraser and the Fraser canyon DFO monitors fall gillnet fisheries in the lower Fraser River, but winter and spring fisheries in

the Fraser River upstream of Sawmill Creek, in the Thompson River, and in the tributaries to the Thompson, are not monitored.(R. Bison, MELP Kamloops, pers. comm.).

2.3 Land Use

Forestry is the largest land use in the drainage, followed by rangeland, agricultural use, and then urban use. (Table 2). However, over 65% of the watershed was still young or old forest in the mid 1990s. Map 2 in Appendix B shows water features, contours, and land title in the Coldwater River watershed.

2.3.1 Recreational Areas

There are 10 recreation sites within Coldwater drainage and 1 provincial park.

2.3.2 Forestry

The Coldwater River lies within the Merritt Forest District and is part of the Kamloops Forest Region. Logging is a major resource development activity within the watershed. Forestry activities are primarily concentrated in the tributaries of the Coldwater River, with approximately 20% of the total Coldwater drainage area being recently logged (as of mid 1990’s) (Table 2). The Level 1 Watershed Assessment on forestry development revealed high hazard indices for surface erosion, riparian habitat and peak flows (MOF 1997).

2.3.3 Agriculture

Agricultural use within the Coldwater drainage is concentrated along the lower, more productive reaches of the river. Some agricultural development in his area occurs on the flood plane and on the banks of the Coldwater River immediately adjacent to the mainstem channel. Some of the developed areas adjacent to the river are used for livestock (rangeland), and other areas are cultivated.

2.3.4 Rural Residential

Most rural holdings in the Coldwater watershed are agricultural. Kingsvale represents a small pocket of semi-urban or rural land holdings. The Coldwater Indian Reserve represents the largest population within the watershed, outside of Merritt. The Coldwater Indian Reserve #1 is located 14 km south of Merritt and is approximately 14,000 acres in size, straddling the Coldwater River. IR #2 (Paul’s basin) is located about 20 km south of Merritt and is approximately 1,500 acres in size, straddling Midday Creek. IR #3 is located at Gwen Lake, east of IR #1 and is approximately 43 acres in size. IR #1 and IR #2 have 320 members living on them of a total population of 710 members in the band.

2.3.5 Urban

Merritt is the only large urban settlement within the Coldwater drainage. The City of Merritt has a population of approximately 8,000, with up to an additional 7,000 people residing in nearby areas (City of Merritt 2001)

Table 2. Summary of land use (in hectares), by sub-basin, within the Coldwater River watershed (mid 1990s data from Ministry of Water, Land and Air Protection, Kamloops, BC; as compiled from the Watersheds BC database).

Sub-basin:	Coldwater-	Godey	Kwinshatin	Midday	Gillis	Voght	Juliet	Coldwater-	Coldwater-
Land Use	Main (residual)	Creek	Creek	Creek	Creek	Creek	Creek	Total (ha)	Total (%)
Urban	313	76	12	0	0	0	0	401	0.4
Agricultural	1486	70	21	178	3	4	0	1762	1.9
Rangeland	1806	1367	0	451	0	1424	0	5048	5.5
Old forest	9356	244	531	1875	48	1540	3326	16920	18.4
Young forest	26168	1096	1394	4416	780	8001	3161	45016	49.1
Clearcut forest	1359	0	50	19	285	90	693	2496	2.7
Selective-cut forest	4749	2538	825	1999	98	5040	0	15249	16.6
Burned forest	197	0	0	0	0	228	0	425	0.5
Total forest	41828	3877	2799	8319	1211	14899	7181	80114	87.4
Wetland	393	27	0	0	0	539	0	959	1.0
Bare rock, etc	123	0	0	0	0	0	36	159	0.2
Avalanche slopes	138	0	0	0	0	0	365	503	0.5
Alpine	1060	0	0	0	0	0	1347	2407	2.6
Fresh water	41	34	0	0	18	82	0	175	0.2
Mined land	157	27	0	0	0	0	17	201	0.2

2.3.6 Industrial

Linear developments are significant within the Coldwater drainage. The Coldwater River is confined by: 58 km of highway, 46 km of railway (now abandoned Kettle Valley Railway - KVR), and 88 km of pipelines (Sigma Engineering Ltd., 1991). These encroachments have resulted in a shortening of the mainstem length, a reduction in the number of side-channels or off-channel wetlands, and extensive damage or elimination of riparian vegetation. Also, 13% of the lower Coldwater mainstem length has been rip rapped to protect this infrastructure (Morantz and Haefele 1996).

2.4 Water Use

The Coldwater River watershed has a total of 179 water licenses, with a total licensed volume equivalent to 7,765 acre-feet (6,298 cubic decametres). Of the total of 179 licenses: 71 are for irrigation, 69 for domestic use, 23 for storage to back up irrigation, 7 for conservation purposes (mainly conservation storage), 7 for waterworks (community water supplies), one for stock watering, and one for lawn watering. There are 15 applications for licenses that have not yet been adjudicated. (W. Weber, Water Management, Kamloops, pers. comm.)

In terms of licensed water demand per year, the licensed volumes accounted for by different purposes are as follows:

Irrigation	5,033 acre-feet	(64.8% of total)
Waterworks	2,673 acre-feet	(34.4%)
Domestic	58 acre-feet	(0.7%)
Other uses	1.4 acre-feet	(0.0%)

There are currently no licensed industrial water users (such as mines or manufacturing plants) in the Coldwater drainage.

Licensed water use is the maximum amount allowed to be withdrawn from a stream during a year. In most large watersheds, actual water demand is somewhat less than licensed demand in most years.

The Coldwater watershed has a total licensed storage volume of 1,459 acre-feet to back up irrigation, which is only about 29% of the annual licensed irrigation volume. In addition, there are 594 acre-feet licensed for conservation storage purposes, most of it for wildlife (waterfowl) rather than fish. The 29% figure is lower than for most comparable watersheds in the Southern Interior, and it limits the ability to augment low summer flows by releasing water from storage.

It should be stressed that most of the licensed waterworks demand in the basin is not currently being used. Four large waterworks licenses, accounting for 98% (2613 acre-feet) of the total waterworks demand, are held by the City of Merritt. The city is not currently using these licenses, and gets all its water supply from groundwater.

In terms of the distribution of licenses and licensed demand by sub-basin, the Voght Creek watershed accounts for 50 water licenses and 23.5% of the total licensed demand (plus 79% of the irrigation storage and all of the conservation storage); Godey Creek, for 23 licenses and 4.6% of licensed demand; Midday Creek, for 13 licenses and 5.0% of demand; and Brook Creek, for 45 licenses (mostly domestic) but only about 1.1% of demand. The Coldwater River mainstem and smaller tributaries account for the remainder of the licenses (48) and demand (65.7%).

Water licensing on the Coldwater River and tributaries is restricted by a "Fully Recorded" designation that was applied to the entire Nicola River watershed in 1981, including the Coldwater. This means that a new water license application would not be approved unless the applicant could provide water storage equivalent to the volume of water being requested for diversion.

2.4.1 Water Shortages, Potential and Actual

The Coldwater River, for the size of its watershed, is a "flashy" stream by Southern Interior standards. Of the total annual runoff of about 216,200 acre-feet, about 57% occurs in May and June, and 76% between 1 April and 31 July. There are no glaciers to provide flow in late summer, nor large lakes to slow down the runoff. Thus, the average discharge in August and September is quite low for the size of the river (1.78 and 1.26 m^3/sec, respectively). In addition, there are large year-to-year variations in late summer and early fall flow. Mean August flow, for instance, has varied from 244 cfs in 1976 to 13.7 cfs in 1994. Daily flow can drop well below 13.7 cfs at times (these data are from Water Survey of Canada gauging station 08LG010, for the Coldwater River at Merritt, which operated for about 44 years but was discontinued in 1995).

Although there is enough water for both fish and off-stream uses such as irrigation in most years, significant water shortages for fish can be expected at least two or three years per decade. These water shortages occur mainly because of the natural hydrograph (stream flow pattern) of the river, but can be exacerbated by diversion of water in low-flow years.

Low flows, whether entirely natural or partly human-caused, can affect fish both by making migration and spawning more difficult, and by helping to create dangerously high water temperatures. Walthers and Nener (1998) studied water temperatures in the Nicola watershed, including the lower Coldwater River, in the summers of 1994 and 1995. Water temperatures as high as 29 °C were reported in the Coldwater in the hot, dry low-flow summer of 1994, and temperatures reached 25 °C on several days in the more normal summer of 1995. Temperatures above a range of 21 to 25 °C are lethal to salmon, and any factor that elevates summer and early fall water temperature will increase mortality and decrease productivity of anadromous salmonids.

The development of additional water storage capacity, especially if it were licensed for conservation purposes (fishery flows, in this case) could greatly reduce the impact of low-flow years on fish.

2.5 Freshwater Habitat Description and Condition

The Coldwater River has a drainage area of 914 km^2, a mean annual flow of 8.4 m^3/s, and 100-year flood (mean daily) of 130 m^3/s (Doyle 1992). Morphologically, the Coldwater River can be classified as a gravel-bed river that is irregularly meandering and laterally unstable, but occasionally confined by bedrock outcrops or glacial deposits (Harding et al. 1981). The upper Coldwater channel upstream of Kingsvale has been confined by linear developments while the lower Coldwater channel has been impacted primarily by the loss of riparian vegetation that has precipitated lateral instability, over-widening and extensive gravel bars.

An extensive fire that occurred about 1938 consumed the riparian vegetation on the east side of the upper Coldwater River, upstream of the Brook Creek headwaters (Map 2). In 1960, a fire also burned much of the southwest side of Midday Creek.

There have been few comprehensive habitat assessments for the Coldwater River. Most of the assessments have been specifically undertaken to evaluate the impacts and mitigation opportunities / works associated with the development of the Coquihalla Highway. Wightman (1979) completed a biophysical evaluation of the Coldwater River and several of its major tributaries. The evaluation concentrated on fish production characteristics, anticipated impacts of highway construction on fish habitat, and mitigation opportunities. Other fish population assessments by Beniston et al. (1987, 1988) have evaluated mainstem and off-channel habitat but in the context of the effectiveness of mitigation and compensatory measures undertaken during Coquihalla Highway construction.

The Nicola Tribal Association (1998) completed a Fish Habitat Assessment Procedure (FHAP), following methodology by Johnston and Slaney (1996), on the Upper Coldwater River and several tributaries. The area studied was within the forest license operating area managed by Tolko Industries Ltd. Except for a few chronic sediment sources, the portions of the upper mainstem and tributaries examined were in relatively good habitat condition.

Overall, there were six principal causes of the impacts to channel and habitat condition within the Coldwater River watershed that were identified by various authors (Wightman 1979; Harding et al. 1981; Millar et al. 1994; Borrett Engineering Inc. 1998; MOF 1997):

$ channel is confined by linear developments in the upper Coldwater mainstem;
$ riparian and floodplain areas are degraded by agriculture development and livestock grazing in the lower Coldwater;
$ streamflows and water temperatures are affected by water withdrawal and the loss of riparian vegetation in the mainstem and tributaries;
$ sediment is being generated from slope instability and bank erosion in the mainstem and tributaries; and
$ hydrology of the basin has changed as a result of forest clearing associated with logging and agricultural activities, and urban and linear developments.

Furthermore, the authors identified specific fish habitat concerns that stemmed from these impacts as:

$ lack of rearing habitat complexity (i.e., pool in-filling, predominance of riffles and glides), and lack of cover (i.e., sedimentation of boulder habitat; limited LWD recruitment) in the mainstem;
$ seasonal low flows in the lower Coldwater and some tributaries;
$ loss of side and back channel rearing and overwintering areas;
$ substrate sedimentation and consolidation limiting rearing and spawning; and
$ sub-optimal to lethal water temperatures for salmonids of 21-29 °C.

The following sections summarize what is currently known about critical salmon habitats in the Coldwater River watershed.

2.5.1 Spawning Habitat

Coho spawn throughout the Coldwater River system whereas steelhead spawn primarily downstream of Brodie (Wightman 1979; Harding et al. 1981). Wightman (1979) believed that substrate sedimentation and consolidation was reducing spawning and incubation success. The abundance of fine sediments is due partly to the geology of the basin that is comprised of glaciofluvial and lacustrine deposits. In addition, fine sediments have increased, in part, as a consequence of agriculture, logging, road, and pipeline developments. Not withstanding sedimentation concerns, coho and steelhead production does not appear to be spawning-limited in the mainstem.

2.5.2 Summer Rearing Habitat

Summer rearing habitat is considered one of the primary limiting factors of coho and steelhead production within the watershed. Wightman (1979) observed a lack of rearing habitat complexity in the Coldwater mainstem, particularly between Merritt and Kingsvale. Shallow riffle-glide habitat predominates in this section with very few pools or suitable cover elements. Harding et al. (1981) identified irrigation activities and low water levels in off-channel areas as reducing available rearing habitat. Off-channel irrigation canals on private land have been constructed in the past 20 years that may provide off-channel fish habitat, however this has not been thoroughly assessed (J. Anderson, Nicola Valley Roundtable, Merritt, pers. comm.). Also, many historic off-channel areas have been isolated or eliminated by the diversions and channelization associated with linear developments (M. Miles, pers. comm.). Beniston et al. (1988) indicated that the extent of rearing habitat at low flow in late summer and in winter is primarily responsible for limiting salmonid production in the Coldwater mainstem.

Rearing habitat is considered to be in fair condition for rainbow trout/steelhead and bull trout in Juliet Creek and the upper Coldwater River (Nicola Tribal Association (1998). Rearing habitat is considered fair for coho and steelhead in Brook Creek but limited by low summer flows and a barrier in Midday Creek (S. Maricle, MELP Kamloops, and M. Crowe, DFO Kamloops, pers. comm.).

Low discharges and a lack of riparian vegetation have aggravated a naturally elevated thermal regime in the mainstem as described in Section 2.4.1. Temperature monitoring of some tributaries and the mainstem, initiated in 2000 by Tolko Industries Ltd., is continuing (G. Henderson, pers. comm.).

2.5.3 Overwintering Habitat

As noted above, the elimination of side-channel, back-channel and wetland habitats and the lack of instream cover in the mainstem has reduced the quantity of typical refuge areas for over-wintering salmonids. Fry and pre-smolts are likely flushed from the system due to inadequate refuge from the high flows. Conversely, remaining off-channel habitats may be de-watered or inaccessible under low flows. Accordingly, in years with extremely high or low flows, winter rearing conditions may become a greater limiting factor than summer rearing.

2.5.4 Flow Regime

Mean annual discharge (MAD) measured at Merritt has remained relatively constant with a mean of 8.4 m^3/s since 1961 with high fluctuations year to year (Figures 10 and 11). The 1980’s were a period of particularly low MAD. August to September mean discharges have also remained relative constant with yearly fluctuations and the 1980's being a noticeably period for low summer flows. The average August to September flow for the period 1961-1995 was 1.43 m^3/s or 18% of MAD.

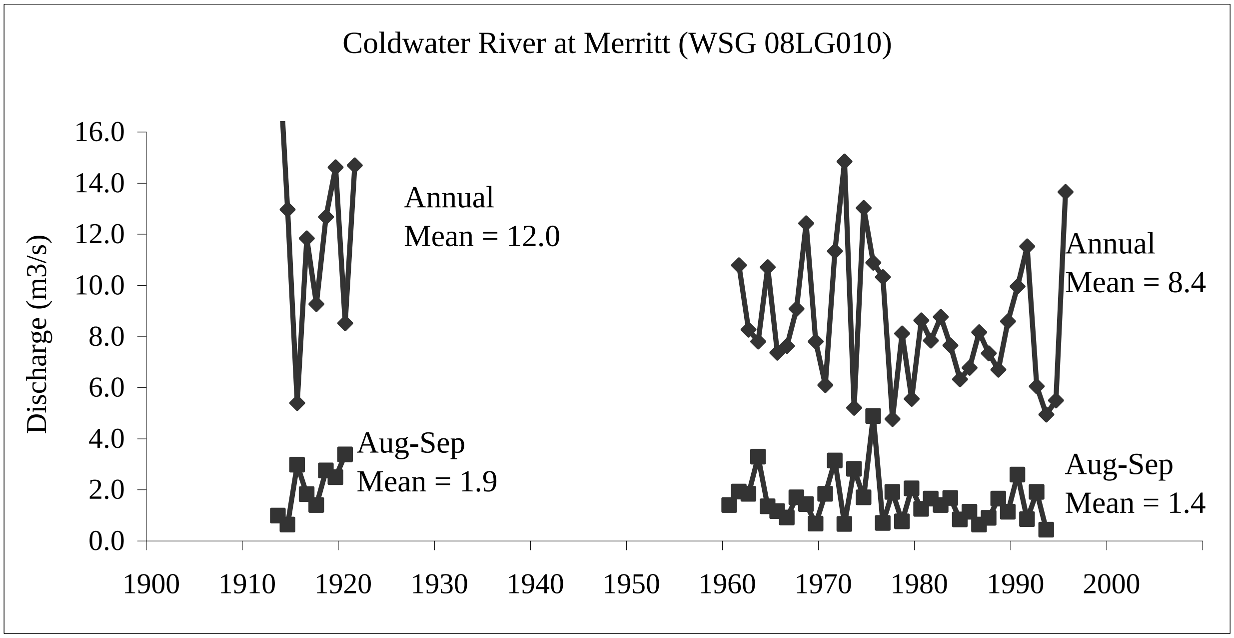


Figure 10. Mean annual discharge and August-September mean discharge for Coldwater River. Data from Water Survey of Canada.

Licensed water withdrawal has aggravated natural low summer flows in the basin and has caused stranding of fish in irrigation ditches (Harding et al. 1981); however, the current extent of such stranding is unknown and could be lower than it was 20 years ago due to a reduction of ditches (J. Anderson, pers. comm.). The flow regime in the Coldwater River mainstem is likely the most critical factor affecting smolt production. Low summer flows is considered one of the limiting factors affecting fish populations in the creek. Seven day minimum daily discharge of Coldwater River at Merritt is:

Return Period	7-day Minimum Daily Discharge (m3/s)
2-year	0.55
5-year	0.32
10-year	0.24
50-year	0.12
100-year	0.09
200 year	0.07

Large floods with return periods between 20 and 30 years have occurred in 1980, 1984, 1990 and 1995 (Water Survey of Canada 1999; Miles and Associates Ltd. 1996). The large floods caused

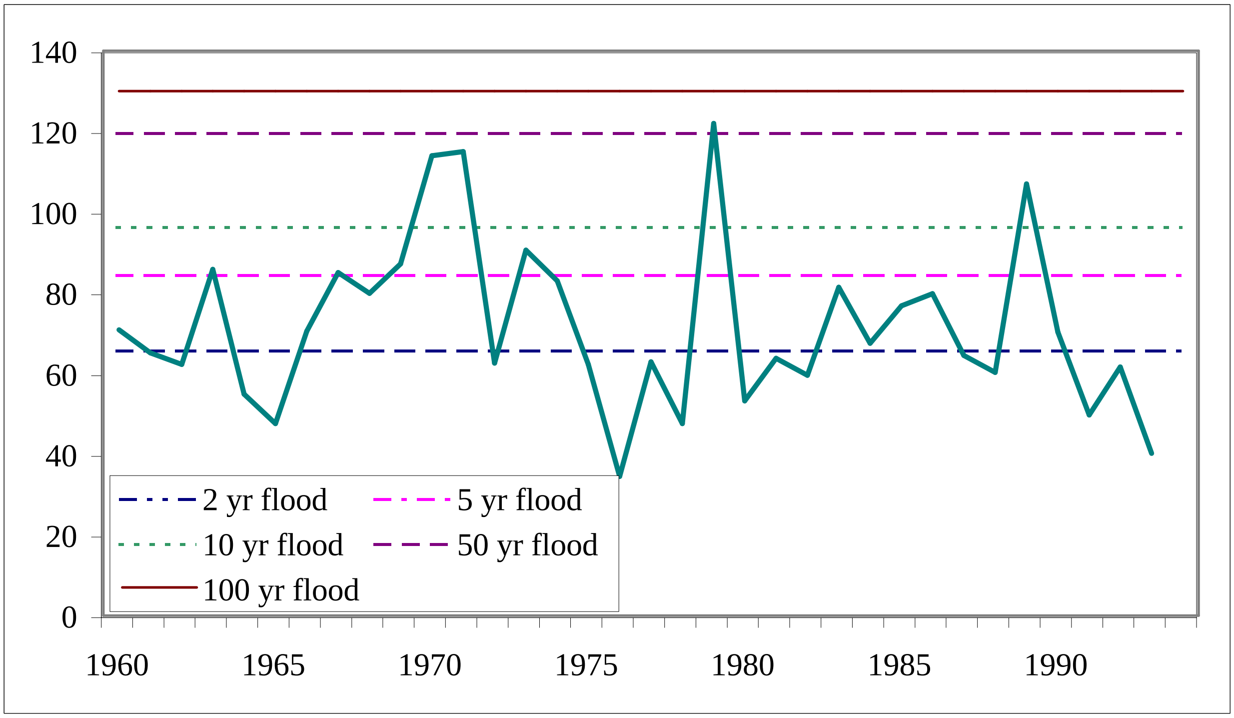


Figure 11. Maximum daily discharge for the Coldwater River at Merritt.

extensive erosion of the mainstem streambanks and were probably particularly destructive to the recently modified channel and streambanks following completion of the Coquihalla Highway in 1986.

Large ice flows during the winter as a consequence of rain-on-snow events have been documented in 1979, 1980, 1984, 1991 and 1995 (Coast River Environmental Services Ltd., 1996). These ice flows removed riparian vegetation, destabilized bank and streambed materials, and probably scoured fish eggs and crushed juvenile fish. Mean winter flows (2.6 m^3/s) have exceeded mean summer flows (1.4 m^3/s), on average, in the Coldwater since 1961.

2.5.5 Habitat Mitigation and Compensation

Fish habitat mitigation and compensation works were undertaken in the 1980's because of Coquihalla Highway construction. Five groundwater fed off-channel sites were constructed at Juliet Creek, Bridge 3, Zoltan Kuun Channel near Bridge 4, near Diversion 3, and at Bridge 5. The total area of the channels is approximately 12,000 m^2 (Beniston et al. 1988). Also, numerous types of boulder structures were installed at bridge and river diversion sites. Biological effectiveness monitoring of the constructed works occurred from 1986 to 1990 (Beniston et al. 1987, 1988). Overall, results (up to Year 2: 1987-1988) indicated that, in comparison to control sites, rearing capability of the mitigative works was lower for chinook and coho during spring, summer and winter, but higher during the late summer low flow period. Also, the mitigation works showed a positive benefit for steelhead during all seasons. In-stream monitoring carried out by Miles and Associates (1996) in 1995-1996 found that about 78% of the boulder structures had lost at least 50% of their material.

2.6 Downstream Habitat Description and Condition

The Coldwater River flows into the Nicola River that, in turn, flows into the Thompson River and then the Fraser River. In total, Coldwater anadromous salmon must travel over 350 river kilometres (between marine waters and the Coldwater - Nicola confluence), first as juveniles and then as adults. Habitat condition in each of these watercourses impacts on the survival of migrating salmon. Clearly, the condition of the marine environment is also critical to the survival of the Coldwater stock.

2.7 Productive Capacity

2.7.1 Coho

The average number of coho smolts produced annually by a particular stream is a measure of the stream's potential to produce coho salmon (Bradford et al. 1997). Coho production is primarily regulated by density-dependent factors, probably related to the quality and quantity of suitable rearing habitat in the stream (Bradford et al. 1997) and species choice for small streams. It is generally assumed by the models described (below) that available fry habit is the limiting component that ultimately determines smolt production.

Given this assumption of limited rearing space, Marshall and Britton (1990), using data collected up until 1979, developed predictive models for smolt yield from west coast streams. Marshall and Britton (1990) found a correlation between smolt abundance and stream area or stream length. Barnanski (1989) found a similar relationship for Washington streams, as did Holtby et al. (1990) for 36 streams on the west coast of North America, and subsequently Bradford et al. (1997) for a larger data set for western North America. Of these relationships, the linear form model of Marshall and Britton (1990) was the best predictor in terms of the number of smolts produced per unit of stream length. A comparison of each of these models with actual smolt abundances for nine coastal BC wild coho streams revealed that the Marshall and Britton (1990) model predicts smolt abundances that are within 82% of actual abundances (averages for the period 1980-1999; Table 3, Figure 12).

Table 3. Coho smolt productivity models for streams in the Pacific Northwest.

Model	Relation	R	Sample Size
Marshall and Britton (1990)	$y=1924.6x-894.75$	0.94	24
Holtby et al. (1990)	$y=941.4x^{1.074}$	0.92	36
Bradford et al. (1997)	$Lny=6.90+0.97lnx$	0.84	83

x is stream length in kilometers; y is smolt abundance

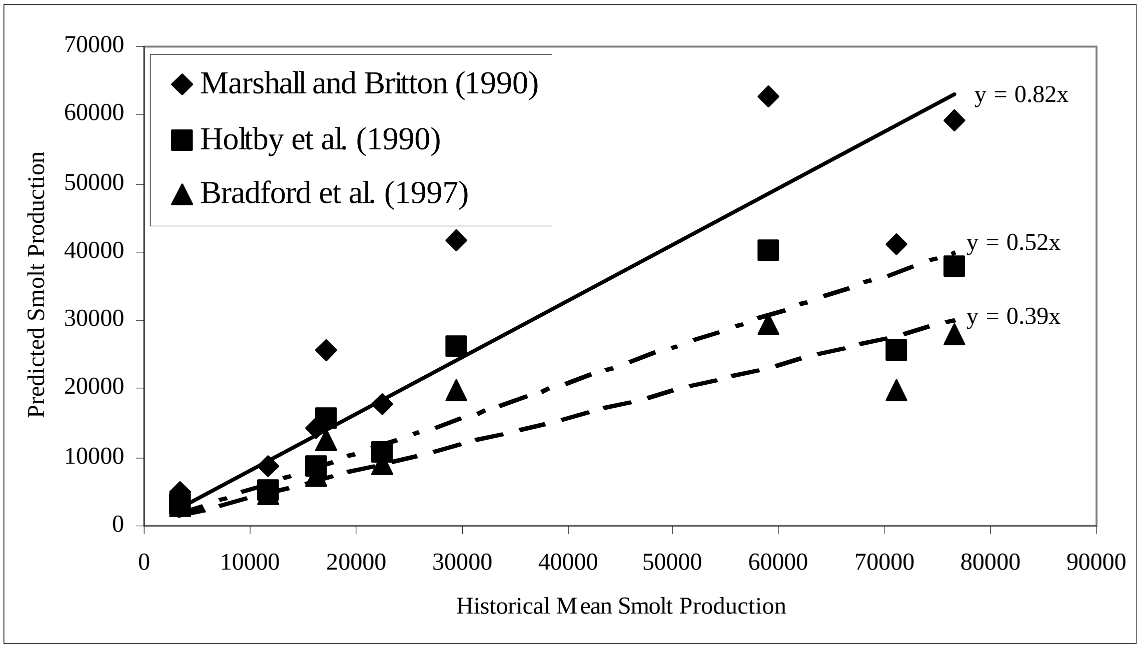


Figure 12. Relationship between predicted smolt abundance using three different models and historical mean-smolt production.

In contrast, the Holtby et al. (1990) and Bradford (1997) models predicted smolt abundances that were 52% and 39% of actual abundances, respectively, and presumably because the larger data set (*n*>35) included streams from a much wider geographic area.

Using the model of Marshall and Britton (1990), we estimated average coho smolt production at capacity for the Coldwater River at 180,894 or 1,887 smolts/km (Appendix D). However, this model may not be appropriate for a large, interior stream, such as the Coldwater River, as it was derived from predominantly coastal systems. The model of Bradford et al. (1997), which used a larger data set from a wider geographic setting, may be more appropriate. This model suggested a smolt carrying capacity of 83,7000 or 873 smolts per kilometer. Until further investigations, we recommend that the lower productivity estimate be used to set recovery abundance targets.

Determining the number of coho spawners required to fully seed the freshwater habitat of the Coldwater River and produce 83,700 smolts requires an understanding of freshwater survival (egg-smolt). Survival of salmon eggs and juveniles in freshwater is related to the frequency of floods, droughts, and freezing in the river (Wickett 1958), the quality of gravel and density of spawners (Chapman 1988). Bradford (1995) found that, on average, coho egg-fry survival was higher than for the other species of salmon (19.8%) while fry-smolt survival for coho was generally lower (7.6%).

Using the Bradford et al. (1997) model and applying Bradford (1995) mean survival estimates, approximately 6,266 coho spawners would be required to fully seed the freshwater coho-rearing habitat in the Coldwater River. Figure 13 shows the distribution of spawners required to seed the available fry habitat in each sub basin within the Coldwater watershed. Figure 14 shows the number of spawners required over a wide range of egg-smolt survivals. Over the range of 1.5-2.5% egg-smolt survival, the required number of spawners ranges from 4,000-7,000, respectively; thus, an increase of 1% juvenile survival in this range translates to 3000 less adults required (to fully seed the available habitat).

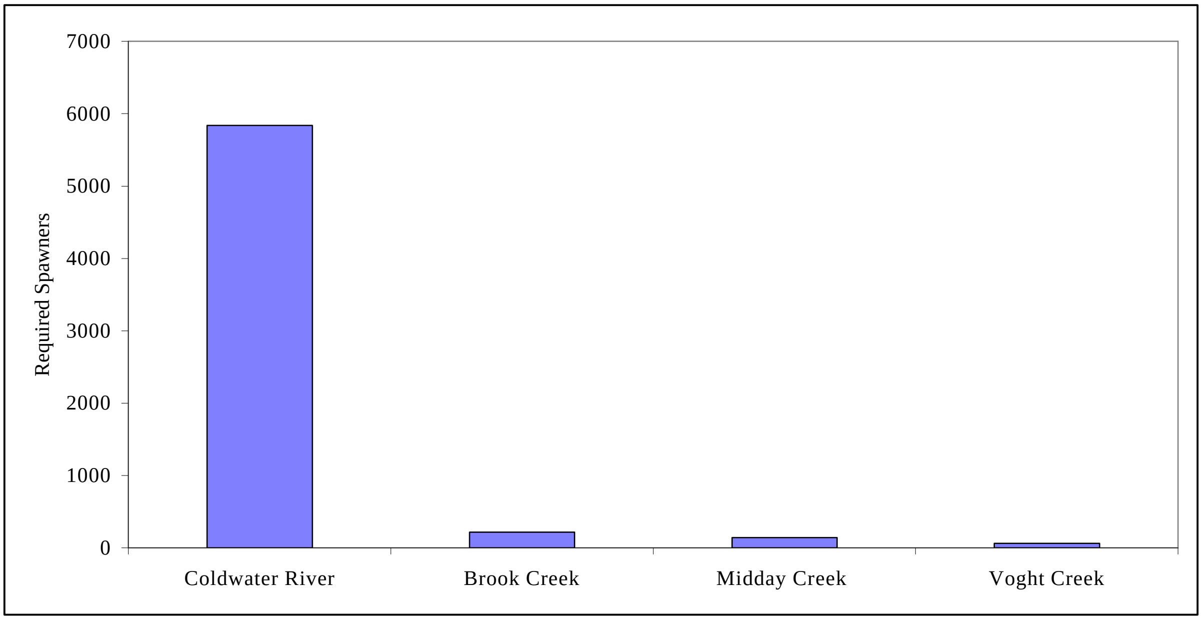


Figure 13. Distribution of required number of coho spawners required to fully seed the available fry habitat within the Coldwater River watershed.

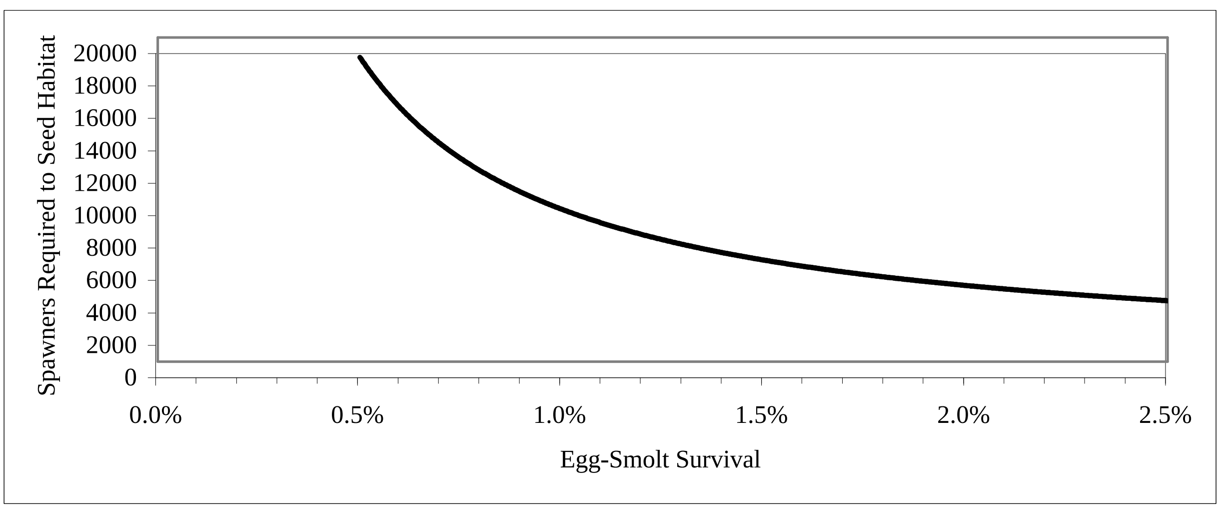


Figure 14. Relationship between freshwater survival (egg-smolt) and coho spawners required to fully seed available habitat.

2.7.2 Steelhead

Steelhead productive capability has been modeled using habitat parameters for several systems throughout BC (e.g. Tautz et al. 1992; Bocking and English 1992; Nelson et al. 1998; Bocking 2000; Bocking et al. 2000 [in prep]). Using the methods described in detail in Bocking and English 1992), we estimated 44,275 steelhead smolts could be produced from the available habitat area (43,000 from mainstem areas; Appendix D). The model applies Keogh River smolt densities of 0.058 per m^2 of useable habitat area and adjusts this based on Coldwater River alkalinity and mean-smolt age. The model uses available habitats from the Coldwater River, and Brook, Midday, and Voght creeks (Appendix D). This model assumes that available fry habitat is the limiting component that ultimately determines smolt production.

Applying known fecundity estimates for Coldwater River steelhead and an assumed egg-fry survival of 10%, this translates to 822 adult steelhead spawners required to adequately seed the available fry habitat within the Coldwater. It is generally acknowledged that Coldwater steelhead emigrate to downstream rearing areas in the Nicola and Thompson drainages sometime between the fry and smolt stage (R. Bison, MELP Kamloops, pers comm.). However, because the productivity model used here defines smolt capacity as a function of available fry habitat, only the available habitat in the Coldwater itself is used in the model. If egg-fry survival were as low as 5%, then 1,643 spawners would be needed to fully seed available fry habitat in the Coldwater.

We do not know what current freshwater survival levels are for Coldwater River steelhead. Ward (2000) documented a significant reduction in freshwater survival from spawner to smolt at the Keogh River from 1976 to 1994. As a minimum, accurate data on adult and smolt populations are required to measure freshwater survival. Counts of steelhead parr may be used as a surrogate for potential smolt yield and can be used to assess freshwater fry-parr survival.

2.7.3 Chinook

While there are no productive capacity targets established for chinook for the Coldwater River, an interim escapement goal of 1,005 spawners was set as part of the Canada-US Agreement (1985). This escapement goal has been met or exceeded in only two years since 1984 (Figure 3).

3 Information Needs

3.1 Stock Condition

Coho

The coho fence installed on the lower Coldwater River at Merritt has provided the most reliable estimates of annual coho escapement to the watershed. The operation of this fence should be fully supported and expanded, if necessary, as a means of assessing recovery operations. Coho escapements are currently at the low end of historic escapements; recent estimates of coho escapement have shown a steady increase in abundance (since 1998). In addition, a smolt enumeration program should be explored (use of snorkel surveys, fence facilities on tributaries, and rotary traps in the mainstem Coldwater River). This program should also attempt to address the emigration of presmolts from the Coldwater to the Nicola.

Chinook
The current enumeration program for early-run chinook (operated by NWSFA) should be supported and expanded, if possible, to provide escapement estimates with a high level of confidence. Estimates of early-run chinook indicate low but possibly improving abundance.

Steelhead
There is little doubt that Coldwater River steelhead have been in a state of decline, based on historic abundance estimates and recently expanded adult enumeration operations. Total abundance estimates of smolts and adults are required for the system as part of a recovery program. We recommend that any smolt enumeration program for coho be examined for the possible inclusion of steelhead smolt enumeration. Estimation of parr abundance should also be explored as it may prove more feasible and effective to assess parr abundance; a project of this nature is expected to commence in the fall of 2001 (R. Bison, MELP Kamloops, pers. comm.).

Because of the inherent difficulties with counting steelhead in high and turbid water conditions (typical conditions in the Coldwater during much the late winter and spring upstream migration period), different methods of enumerating adult steelhead should be explored. One of these is the use of the existing fence facilities used for enumerating coho. This infrastructure could be modified to incorporate a counting unit and thus provide relatively unrestricted (no holding) upstream passage. Although sizing data from this technique would not necessarily distinguish between very early chinook and late steelhead, the overlap in upstream migration timing between these two species is considered to be low (R. Bailey, DFO Kamloops, pers. comm.). The existing enumeration method for adult steelhead escapement to the Coldwater is potentially accurate and unbiased, although statistical precision is generally low (R. Bison, MELP Kamloops, pers. comm.).

3.2 Freshwater Habitat Condition

A comprehensive channel and fish habitat assessment for Coldwater River, and Brook, Voght and Midday creeks is required to properly determine habitat condition. The fish habitat assessment will concentrate on the anadromous (historical) sections of these streams and will lead to identifying the types and locations of restoration opportunities. Existing water temperature monitoring should continue and include the streams where most of the water withdrawals are occurring. Monitoring locations should include, at least, Coldwater River, and Voght, Midday, Godey, and Brook creeks. Streamflow gauging stations should also be established to monitor changes in flow in these streams where innovative projects to improve the use and distribution of water are envisaged.

3.3 Marine Survival

Low marine survival in the 1990's is believed to be one of the most important factors affecting the returns for coho and steelhead to the Thompson-Nicola system, including the Coldwater River. There are recent indications that the marine survival rates for coho salmon in the Strait of

Georgia may be higher in 2001 than in previous years. Data from 2001 trawl surveys and zooplankton sampling in the Strait of Georgia have revealed a coincident increase in coho and euphausiid abundance (Richard Beamish, DFO, pers. comm. 2001). While these and similar findings from Barkley Sound (Ron Tanasichuk, DFO, pers. comm. 2001) suggest that poor marine survival is related to inadequate food supply for juvenile salmon, there remains considerable uncertainty regarding the location and time period when the majority of marine mortalities occur. On 6 July 2001, the PSEF sponsored a meeting to discuss alternative proposals for addressing these marine survival questions. The current plan is to prepare and evaluate several research and monitoring options over the next few months and identify what role, if any, the PSEF should play in research, monitoring and the definition of management options related to the marine survival of salmon.

4 Prognosis

The prognosis for recovery of coho, chinook, and steelhead stocks in the Coldwater River is good. Coho escapements appear to be improving (in terms of abundance), primarily because of apparently improved marine survival of the 1996 and 1997 broods, and because of fishery restrictions imposed since 1998.

4.1 Biological Factors Influencing Recovery

The primary factors limiting the recovery of coho, chinook, and steelhead stocks in the Coldwater River are poor marine survival and poor freshwater survival, particularly at the egg-fry stage (gravel quality) and/or fry-parr stage (summer and winter rearing). Marine survival is for the most part beyond our control. Freshwater survival of coho and steelhead is primarily a function of available good quality habitat for spawning, incubation, rearing, and accessibility (for both adults and juvenile habitat requirements).

Measures to stabilize channel bars (and promote vegetation), improve cover, pool depth, and pool frequency as well as rehabilitate stream processes (i.e., sediment and flow regimes, riparian and floodplain functions) will also benefit recovery.

4.2 Socio-economic Factors Influencing Recovery

4.2.1 Land Use

The main concern regarding socio-economic factors influencing recovery is continued development pressures that may lead to further damage to riparian habitats and increased demand on water. Currently, impacts are primarily occurring in the lower Coldwater.

4.2.2 Fisheries

Severe restrictions on the harvest of Georgia Basin coho have been in place since 1998. Less than 10% exploitation rates have been maintained over this period. DFO has not yet announced its 2001 fishing plan for these stocks, but it is anticipated that exploitation on coho will still be significantly curtailed. It is also generally acknowledged that there will not be a return to the

80%-90% exploitation rates that these stocks suffered in the 1980's. In addition, exploitation levels for interior chinook stocks, and the interception of interior steelhead stocks, have been reduced as a result of recent fishery restrictions.

4.2.3 Water Use

A water management plan is required to ensure that salmon recovery efforts are not compromised by the lack of sufficient water for salmon and steelhead use.

5 Recovery Objectives, Targets, Strategies, and Options

A recovery strategy for coho and steelhead salmon in the Coldwater River must adhere to the PSEF principle of being holistic and comprehensive. To that end, the strategy should address the following:

- maintenance of low exploitation rates until sufficient numbers of adults have returned to fully seed available habitat;
- maintenance of adequate flows during summer rearing period;
- provision (rehabilitation/protection) of adequate quality coho, chinook, and steelhead rearing habitat including mainstem habitats; and
- measures (rehabilitation/protection) to ensure long term stability of spawning habitats.

5.1 Abundance Goals

The following production goals are recommended as preliminary recovery targets. They are species-specific. These targets will be refined as additional information on stock productivity, habitat condition, and interspecies capacity is collected.

We recommend that smolt output be the primary measure of recovery success as it best represents stock productivity. Adult returns are highly variable depending on marine conditions.

Coho
The habitat-based production capability model for coho (using Bradford et al. 1997) suggests that the Coldwater is capable of producing, on average, 83,700 smolts. Using an average egg-smolt survival of 1.5%, 6,266 coho spawners would be required to reach this smolt production level. These estimates of average productive capacity for coho are based on model relationships developed using data from the last two decades. We have generally no information on what productive capacity for a watershed might have been pre-development. Nor can we assume that we can hope to restore freshwater productive capacity to what it was in a pristine watershed. There are several approaches one can take:

1. Assume that there has been no loss of smolt productive capacity except in the obvious instances where man-made barriers have cut off stream habitat; and
2. Assume that the smolt productivity models of the last two decades are underestimating historical productivity.

Given the loss of off-channel habitat and mainstem pool habitat, assumption Number 2 seems more plausible. Beechie et al. (1994) estimated that habitat alteration on the Skagit River has resulted in a 24% to 34% loss of smolt production. At Keogh River, habitat rehabilitation measures including LWD complexing, off-channel habitat creation, and nutrient additions have resulted in increased smolt production for both coho and steelhead.

Confidence intervals around the prediction of coho smolt yield are wide (Bradford et al. 1997); as much as two times the slope of the regression. We recommend that a range of smolt yield be used for the Coldwater when setting abundance targets. Two times the slope would make planning for recovery impossible. Therefore, until further investigations into the productivity of the Coldwater River, we recommend a range that is ± 30% of the predicted smolt yield be adopted. Therefore, an interim recovery target of between

Accordingly, we recommend that an interim recovery target of 60,000 and 110,000 smolts and between 4,400 and 8,150 adult coho be set for the Coldwater River and that the recovery plan be carefully monitored.

Chinook
We recommend that the interim escapement goal of 1,005 spawners be set as the recovery target for early-run chinook, until such time as a biologically based escapement goal is determined.

Steelhead
The habitat-based production capability model for steelhead suggests that the Coldwater River is capable of producing, on average, 44,275 smolts. Using an established relationship between mean-smolt age and fry-smolt survival and a 10% egg-fry survival, 820 spawners would be required to reach this smolt production level. As for coho, we recommend a range that is ± 30% of the predicted smolt yield be used for recovery planning. This range is 31,000 to 57,000 smolts and 575 to 1,050 adults assuming a 10% egg-fry survival.

5.2 Habitat Protection

The mainstem of the Coldwater River is the main spawning area for coho, chinook, and steelhead. Maintenance of adequate flows in the mainstem will be critical to maintaining good fry-smolt survivals. Improving the effective use of water withdrawn from the mainstem and tributaries may augment existing discharges.

The loss of riparian vegetation has contributed to extensive bank erosion and channel overwidening, particularly apparent downstream of Kingsvale. In this section of the river, livestock access to the river has caused riparian zone damage and bank erosion (Morantz and Haefele 1996). They found that pasture and cultivated fields in this section of river were adjacent to 48% of the total length of streambank. In addition, about 14% of the total length of streambank was moderately to severely eroding. Protection of critical riparian habitats should be pursued within the watershed, particularly in the Coldwater River mainstem.

Through the dissemination of public information materials, workers and residents in the Coldwater basin will be better informed on best management practices for road maintenance, riparian zone management, water intake screening, livestock watering and pasture management. They will also become more aware of the Coldwater fish distribution and habitat requirements, including optimal instream flow, temperature, spawning, rearing and overwintering conditions.

5.3 Habitat Rehabilitation

It is premature to speculate on what specific habitat rehabilitation activities may take place. It is envisaged that rehabilitation prescriptions directed at riparian, floodplain, sediment, channel and instream / off-channel habitat components will precipitate from the focussed assessments (Table 4). Clearly, however, measures to improve or restore rearing and over-wintering habitat in the Coldwater should be an essential component of the plan. Restoring fish passage at all stream crossings or man-made obstructions to ensure access by anadromous salmonids to historic spawning, rearing and overwintering habitats may also be required. It is believed that establishing riparian vegetation in the lower Coldwater, stabilization of chronic sediment sources, restoring functioning channel width and length, and greater effectiveness in water use will be primary rehabilitation targets.

An overview sediment source assessment is presently being completed for the entire watershed by Tolko Resources Ltd., (M. Verschoor, Forsite Consulting, pers. comm.). Following this assessment, specific treatments should be prescribed to stabilize chronic sediment sources under the Coldwater recovery plan.

Opportunities to re-connect the mainstem to its floodplain, particularly where encroachments by linear developments, such as the KVR, pipelines and Coquihalla Highway have occurred will be assessed for their feasibility. The restoration objective of this initiative will be to improve or restore sediment and floodwater storage, and off-channel habitat.

Slope instabilities associated with the KVR have been identified by Reid Crowther & Partners Ltd., (1996) for specific sites between Brookmere and Merritt. Works should be prescribed to stabilize these chronic sediment sources to the Coldwater.

6 Monitoring and Evaluation Framework

Well designed and properly implemented monitoring is a prerequisite to determining the success or failure of watershed recovery. Monitoring and evaluation of the recovery of Coldwater River watershed and its coho and steelhead populations will consist of:

1. stock recovery monitoring;
2. physical works / activity effectiveness monitoring; and
3. an integrated evaluation of watershed recovery.

6.1 Stock Recovery Monitoring

Stock recovery monitoring is the monitoring of the progressive move toward full recovery as defined by the established abundance targets. Clearly, some semblance of ecological or watershed recovery will be critical to the successful recovery of the stocks. Monitoring of the watershed recovery is addressed in the next section.

Stock recovery monitoring will focus on the status of abundance of both smolt production and adult spawning populations. Accurate measures of smolt production are the most critical component of the monitoring program. Reasonably accurate measures of adults are also important, particularly if fisheries begin capturing a portion of the adult return. In the event that current fisheries restrictions are relaxed, Coldwater River coho smolts should be coded-wire tagged for future assessment purposes.

6.2 Physical Works / Activity Effectiveness Monitoring

A hierarchical framework for effectiveness monitoring of restoration works and activities within watersheds has been proposed by Gaboury and Wong (1999). Effectiveness monitoring in the Coldwater will involve two types or levels of monitoring: 1) routine; and 2) intensive. Preliminary monitoring of physical works falls into the category of routine monitoring.

The main objectives of routine monitoring are to:

1. assess whether the works are functioning as intended using response indicators;
2. determine if remedial work is needed; and
3. identify specific areas which may warrant more detailed monitoring or specific investigation.

Intensive monitoring will rely on direct measures of physical and biological parameters for select projects or subsets of sites rather than response indicators. Intensive monitoring will be implemented to determine the inter-relationships of specific recovery activities, and their independent and combined effectiveness at restoring watershed processes and physical habitats.

6.3 Evaluation of Watershed Recovery

The overall success of implementing the various activities in the Coldwater River recovery plan should be evaluated in terms of attaining coho, chinook, and steelhead population targets, and rehabilitating watershed processes in concert with addressing the habitat limitations to fish production. The evaluation will answer questions relating to the rate of recovery of watershed processes, and the combined effectiveness of watershed, hillslope, stream, and site-scale restoration treatments and protection activities on the recovery of limiting fish habitats and fish populations.

7 Implementation Plan

From a review of reports (DFO 1998; Coast Environmental Services Ltd., 1996; Millar et al. 1994; and Morantz and Haefele 1996) and interviews with individuals knowledgeable of the Coldwater, the habitat recovery effort in the watershed should focus initially in four key areas:

1. preservation and restoration of riparian areas;
2. floodplain management and rehabilitation;
3. treatment of chronic sediment sources; and
4. restoration of adequate instream summer flows.

Assessments will be required in the latter three subjects that will be concentrated, where feasible, within specific sections of the river or tributaries. The assessments will lead to restoration recommendations and specific action plans to achieve restoration objectives.

Table 4 lays out an implementation plan for the next three years. The plan is preliminary and will evolve as new information is acquired through monitoring and assessments. For 2001, the plan focuses primarily on the production of public information materials and assessments. The results of these assessments will determine priorities and schedules for future rehabilitation projects.

Table 4. Implementation plan for recovery of Coldwater River coho , chinook, and steelhead.

Component	Activity	Target Species	Location	Year	Season	Description of Activity	Priority
1. Public Information	Brochures, pamphlets	all	system-wide	2001-	all year	Produce public information documents on riparian zone management, fish stock dynamics and habitat requirements, and the Coldwater recovery plan.	High
2. Stock Assessment	Smolt enumeration	coho, steelhead		2001-	spring	Obtain an accurate estimate of smolt production using combination of tributary fences and rotary traps in the lower Coldwater.	High
	Adult enumeration	coho, steelhead, chinook	system-wide	2001-	spring-summer-fall	Obtain an accurate estimate of adults returning using a combination of visual counts (AUC) in the mainstem and fence counts in tributaries. Feasibility and cost of expanding the utility of the coho fence operation for adult steelhead enumeration (perhaps in conjunction with a resistivity counter) should be explored.	High
3. Habitat Protection	Flow and Temperature Monitoring	all	Coldwater at Merritt, Midday, Brook, Voght, Godey	2001-	all year	Establish stations on Coldwater at Merritt, Midday, Brook, Voght and Godey to monitor flows and temperatures and identify problems.	High
	Water Management	all	Lower Coldwater, Midday, Brook, Voght, Godey	2001-	all year	Work with landowners to produce water management plans and promote efficient water use. Begin with demonstration projects.	High
	Establish Riparian Corridors	all	mainstem and tributaries	2001-	n/a	Work with landowners in the watershed to establish riparian corridors and protected areas. Begin with demonstration projects.	High
4. Habitat Rehabilitation	Riparian	all	mainstem and tributaries	2001-2002	all year	Conduct riparian assessment of watershed to identify problem areas and prescribe works.	High
	Floodplain	all	Coldwater mainstem	2001-2002	summer/fall	Identify channel confinements, including Kettle Valley Railway, and determine feasible sites for re-connecting floodplain for sediment and floodwater storage, and off-channel habitat.	High
	Instream	coho, steelhead	Coldwater, Midday, Brook, Voght	2001-2002	summer/fall	Conduct channel and fish habitat assessment to identify problem areas and prescribe works	High
	Sediment	all	Coldwater, Midday, Brook, Voght, Juliet	2001-2002	summer/fall	Identify chronic sediment sources from overview assessment and prescribe works. Conduct assessment of Kettle Valley Railway and prescribe works.	High
	Riparian	all	TBA	2002-	spring/fall	Implement Riparian works. Begin with demonstration projects.	High
	Floodplain	all	Coldwater mainstem	2002-	summer/fall	Implement Floodplain works.	High
	Instream	all	TBA	2003-	summer/fall	Implement Instream works	High
	Sediment	all	TBA	2002-	summer/fall	Implement Sediment remedial works	High
5. Monitoring	Stock Recovery	coho, steelhead	Coldwater mainstem, Brook, Midday	2002-	spring-fall	Continue stock assessment programs	High
	Activity Effectiveness	coho, steelhead	TBA	2002-	all year	Conduct pre-and post-effectiveness monitoring as per FRBC guidelines for riparian and stream works, and on habitat protection activities	High
	Recovery Evaluation	all	TBA	2001-	all year	Evaluate combined effectiveness of Recovery Plan component activities from the PSEF perspective	High

8 Recommended Recovery Plan Projects

Table 5 contains a list of projects, objectives, timelines and approximate budget for each of the following recommended recovery projects. (Appendix E presents a list of additional projects recommended by the Coldwater River Recovery Plan Technical Advisory Group).

8.1 Information and Coordination (Project #1)

Part of the process of watershed recovery is the coordination of projects and dissemination of information to progress toward recovery. This can take the form of a Watershed Recovery Newsletter, public meetings, and other forms of communication. During the recovery planning process, this has been quite informal. A specific deliverable would be to produce public information documents on riparian zone management, fish stock dynamics and habitat requirements, and the Coldwater recovery plan. We recommend that this be established as a standalone project for the duration of the recovery plan implementation.

Estimated Project Duration *5 years*

8.2 Stock Assessment

A number of projects have been identified as essential, not only for determining current stock condition, but also for ongoing monitoring of the recovery effort. The following projects will satisfy much of the requirement for recovery monitoring as described in Section 6.1 of this plan.

8.2.1 Smolt Enumeration and Coded-Wire Tagging (Project #2)

A coho smolt enumeration program could be piloted on the Coldwater River. Estimates of coho smolt production could be obtained using a combination of tributary weirs and rotary traps in the lower Coldwater mainstem. Annual mark-recapture estimates of coho smolt production could be derived. Steelhead smolts could also be captured, marked, and recaptured downstream to produce a mark-recapture estimate.

This project should be conducted with the following objectives:

1. obtain a reliable mark-recapture estimate of total coho smolt production for the Coldwater River;
2. consult with Spius Creek Hatchery staff to determine optimal annual marking strategies for Coldwater River coho smolts;
3. obtain a reliable mark-recapture estimate of total steelhead smolt production for the Coldwater River; and
4. collect biological data for coho and steelhead, including size and freshwater age.

These objectives can be met by operating a smolt weir on suitable tributaries or at upper mainstem locations, marking the catch, and recapturing marked smolts in conjunction with unmarked smolts in two rotary traps as they migrate through the lower Coldwater River.

Proposals should be requested to conduct this work and must include a qualified biologist to direct the project

Estimated Project Duration 5 years

8.2.2 Adult coho enumeration (Project #3)

Adult coho are currently enumerated at a full-river fence facility located near the mouth of he Coldwater River in Merritt. The program is currently operated by the Nicola Tribal Association (Merritt) under the direction of Fisheries and Oceans Canada (Kamloops). Captured coho are tagged and released at this site, and mark rates are obtained during stream surveys conducted in upstream spawning locations.

We recommend that the current enumeration program be continued with the following augmentations to test some of the critical Area Under the Curve (AUC) assumptions:

1. annual estimates of coho stream life should be obtained using tagging and re-sighting methods;
2. annual estimates of observer efficiency should be made; and
3. adult weirs should be constructed and operated on suitable tributaries in an effort to estimate tributary-specific escapements.

It is presumed that matching funds will be available. This project will continue for the duration of monitoring.

Estimated Project Duration 5 years

8.2.3 Adult chinook Enumeration (Project #4)

A feasibility study would be conducted to identify enumeration needs and procedures to increase the quality and reliability of both early- and late-run chinook escapement enumeration programs in the Coldwater River. Specific planning sessions with fisheries staff from DFO and Nicola Valley Tribal Association would be conducted. Cost sharing of DFO and PSEF funds would be explored. Pilot and program feasibility projects would be recommended.

Estimated Project Duration 2 years

8.2.4 Adult steelhead Enumeration (Project #5)

Adult steelhead escapements to the Coldwater River are currently being estimated by means of a Nicola-wide tagging (radio tags) program that derives a mark rate for tags in Spius Creek and applies this rate to the tagged sample detected in the Coldwater River. A complete count is not currently obtained. We recommend a feasibility program to determine if the fence facility in the lower Coldwater (currently used for coho in the fall) could be used to enumerate upstream migrating steelhead in the late winter and spring. The fence facility could be modified to incorporate a resistivity or other counting device; migrating steelhead would be detected and counted by this apparatus, but would not necessarily be "blocked" or significantly delayed during their upstream passage. Other options include a capture and removal fence program (similar to the coho operation), or a video-counting facility. It is presumed that any spring fence operation would be limited to the period of time when the river is semi ice-free and pre freshet.

For this project, the PSEF should match funds. Depending on success, this project will continue for the duration of monitoring program.

Estimated Project Duration *2 years*

8.3 Habitat Protection

The establishment of habitat management plans, best practices for protection, and land/water stewardship programs will be critical to the ultimate success of the recovery plan.

8.3.1 Stewardship and Education (Project #6)

This project is for the distribution of educational materials to landowners within the Coldwater River watershed to promote the wise use of water and improved land practices. This project should also include a component to assist landowners in acquiring grants, covenants, or other incentives to protect riparian areas and improve water use practices.

Estimated Project Duration *5 years*

8.3.2 Land Use Demonstration / Public Awareness (Project #7)

Conceptually, this project would center around a demonstration project on private land. The landowner would be integral in the establishment and integration of habitat protection and rehabilitation activities prescribed following a habitat assessment. Control and treatment applications could be considered, and long-term monitoring and assessment of the areas could be documented. Public signage, public/school tours, and periodic progress reports could be arranged for public awareness impacts. The project should start in year 1 with a planning phase (could be its own project) that outlines a long-term (at least 5-year) plan, with a schedule and budgets. Year 1 should also receive financial support for initial site activities.

Estimated Project Duration *at least 10 years*

8.3.3 Establish Riparian Corridors (Project #8)

Work with landowners in the watershed to establish riparian corridors and protected areas. Begin with demonstration projects.

Estimated Project Duration *5 years*

8.3.4 Water Withdrawals (Project #9)

Work with landowners to produce water management plans and promote efficient water use. Begin with demonstration projects. Target Coldwater at Merritt, and Midday, Brook, Voght, and Godey creeks.

Estimated Project Duration *5 years*

8.3.5 Flow Monitoring (Project #10)

Water quantity and water quality stations should be established at the following locations for the purpose of monitoring changes in water quantity and quality. Establish stations on Coldwater at Merritt, Midday, Brook, Voght and Godey to monitor flows and temperatures and identify problems. Water chemistry should be measured on an appropriate time scale (e.g. quarterly or semi-annually).

Recovery plan monitoring would augment any current studies or programs and focus on nutrient levels and sediment levels in the water courses.

Estimated Project Duration *5 years*

8.3.6 Water Storage Feasibility Study (Project #11)

A feasibility and assessment study for water storage opportunities in the Coldwater River watershed could be conducted. This assessment would be conducted as a single-delivery project, the product being a report with recommendations for further consideration and/or implementation projects with estimated budgets.

Estimated Project Duration *1 year with works to follow*

8.4 Habitat Rehabilitation

This is a critical component to the recovery of coho and steelhead in the Coldwater. The first year will be dedicated primarily to assessment of habitat condition and the development of a rehabilitation plan that is specific to rehabilitative measures to address watershed processes. This will include upslope, riparian and instream rehabilitation activities.

Estimated Project Duration *1 year with works to follow*

8.4.1 Riparian Assessments (Project #12)

Riparian assessments should be conducted during September of 2001 to identify areas where riparian ecological function is poor and can be improved using best riparian ecology practices. Procedures identified in the WRP Technical Circular will be followed. The approach should be comprehensive and strategic to address the following key aspects of riparian habitat:

1. bank stability;
2. shading of stream habitats;
3. future LWD recruitment; and
4. etc.

Results from the project will be riparian rehabilitation prescriptions for priority areas within the drainage. Priority areas will be those with direct influences on valued fish habitat. This project will require access to private land.

Estimated Project Duration *1 year with works to follow*

8.4.2 Floodplain Assessment (Project #13)

Identify channel confinements, including Kettle Valley Railway, and determine feasible sites for re-connecting floodplain for sediment and floodwater storage, and off-channel habitat.

Estimated Project Duration *1 year with works to follow*

8.4.3 Channel Condition and Fish Habitat Assessment (Project #14)

This project is directed at determining channel and habitat condition within the Coldwater River drainage and identifying rehabilitation measures which can be undertaken to improve valued fish habitat for coho and steelhead. Assessments must be conducted in September and October of 2001. Assessments will follow those of the Watershed Restoration Program and will be a combined Condition Assessment with Prescriptions. This project will require access to private land.

Estimated Project Duration *1 year with works to follow*

Delivery Method *Request for Proposal from local group with retention of qualified fish biologist.*

8.4.4 Sediment Source Survey (Project #15)

This project will identify and prescribe rehabilitative measures for chronic sediment sources within the Coldwater watershed that are contributing to negative impacts on downstream fish or riparian habitat. Conduct Assessment of Kettle Valley Railway and prescribe works. Coordinate assessment activity an planning with recent and ongoing assessments conducted by contractors and Forest Companies (Tolko Industries) with FRBC programs. This project will require access to private land.

Estimated Project Duration *1 year with works to follow*

8.5 Monitoring

As described above, there are two components to monitoring. Neither of these requires funding in 2001.

8.5.1 Activity Effectiveness (Project #16)

This project is intended to monitor the success of various rehabilitative measures undertaken as a result of projects 8, 9 or 10. Effectiveness monitoring would commence in 2002 with pre-construction data collection at rehabilitation sites. For example, in the case of instream rehabilitation, juvenile densities and physical characteristics prior to construction will be critical.

Estimated Project Duration *4 Years (Year 2 – 5)*

8.5.2 Recovery Evaluation (Project #17)

This project is to monitor at a project level, whether PSEF goals and the recovery plan project goals are met. It also tracks and monitors progress toward recovery of coho and steelhead within the watershed. In other words, are the recovery objectives and targets being met. A key product of this Recovery Evaluation will be recommendations to the PSEF and the Pacific Salmon Foundation (PSF) regarding future projects and continuation of existing projects. A report that will serve as an addendum to the Coldwater River Recovery Plan will be produced by March of each year.

Estimated Project Duration *5 years*

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Table 5. Recommended recovery projects, objectives, timelines and approximate budget (includes 5% inflation factor).

Project	Objectives	Project Timing	Year 1	Year 2	Year 3	Year 4	Year 5
Information and Coordination	To keep public and recovery plan participants informed of progress and coordinate projects to maximize results	January – December	30,000	31,500	33,075	34,729	36,465
Smolt Enumeration and Coded Wire Tagging	To monitor freshwater productivity, marine survival, and exploitation for coho and steelhead	April – June	50,000	52,500	55,125	57,881	60,775
Adult Coho Enumeration	To monitor adult returns and spawner abundance, marine survival, and exploitation	September – December	Currently funded				
Adult Chinook Enumeration	Feasibility study to identify enumeration needs and potential procedures to increase reliability of escapement estimates for early and late Coldwater chinook	January-April	10,000	5,000			
Adult Steelhead Enumeration	Feasibility study to identify enumeration needs and potential procedures to increase reliability of escapement estimates	November – July	15,000	5000			
Stewardship and Education (including demonstration project)	To promote wise use of water and land use to protect salmon resource (includes fund for one-time grants to landowners to improve practices	January – December	30,000	Depends on first year results			
Establish Riparian Corridors	Work with landowners in the watershed to establish riparian corridors and protected areas. Begin with demonstration projects.	September – October	40,000	42,000	44,100	46,305	48,620
Water Withdrawals	Work with landowners produce water management plans and promote efficient water use. Begin with demonstration projects.	September - November	40,000	42,000	44,100	46,305	48,620
Flow Monitoring	To monitor critical flow quantity, quality and temperature at key locations within the drainage	January – December	40,000	15,000	15,750	16,538	17,365
Water Storage Feasibility Study	A feasibility and assessment study for water storage opportunities in the Coldwater River	September-June	40,000	15,000			

Riparian Assessments	Assessment to identify areas where riparian ecological function is poor and can be improved using best riparian ecology practices	September-October	20,000				
Floodplain Assessment	Identify channel confinements, including Kettle Valley Railway, and determine feasible sites for re-connecting floodplain for sediment and floodwater storage, and off-channel habitat	September-July	20,000				
Channel Condition and Fish Habitat Assessment	To assess condition of stream channel and fish habitat and recommend rehabilitation	August – September	50,000	Depends on results of assessments			
Sediment Source Survey	To identify sediment sources that are or have the potential to negatively impact on fish habitat recommend rehabilitation	August – September	15,000	Depends on results of assessments			
Activity Effectiveness	To monitor the effectiveness of recovery measures and make recommendations	January – December	20,000	21,000	22,050	23,153	24,311
Recovery Evaluation	To monitor progress toward recovery and make recommendations	January - December	20,000	21,000	22,050	23,153	24,311
		Totals	440,000	250,000	236,250	248,064	260,467

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APPENDIX A

List of Participants

Appendix A. List of participants in Coldwater River Watershed Recovery Plan Group.	
Name	Affliliation
John Anderson	Nicola Watershed Community Round Table
Chief Gorden Antoine	Chief - Coldwater Indian Band
Richard Bailey	Fisheries and Oceans Canada
Bruce Beech	Tolko Industries
Robert Bison	Ministry of Water, Land & Air Protection
Bob Bocking	LGL Limited
Jerry Canuel	Aspen Planers
Rich Chapple	Pacific Salmon Foundation
Shawn Clough	Thompson Basin Fisheries Council
Lou Cooke	Rancher
Michael Crowe	Fisheries and Oceans Canada
Karl English	LGL Limited
Mike Flynn	Fisheries and Oceans Canada
Marc Gaboury	LGL Limited
Frank Heller	Ministry of Forests
Rich Hodson	Nicola Watershed Community Round Table
Wesley Ilnsky	Thompson Basin Fisheries Council
Adrea Inwards	Ministry of Forests
Steve Maricle	Ministry of Water, Land, & Air Protection
Troy Nelson	LGL Limited
Elizabeth Salomon-de-Friedberg	Nicola Watershed Community Round Table
Tracy Sampson	Siska Indian Band
Ken Sehn	Apsin Planers
Katherine Shewchuck	Nicola Watershed Community Round Table
Will Sloan	Tolko Industries
Ron Smith	Ministry of Water, Land, & Air Protection
Gord Stewart	Nicola Watershed Stewardship Coordinator
Barney Stirling	Nicola Watershed Stewardship and Fisheries Authority
Bill Strand	Rancher
Neil Todd	Fisheries Consultant - advisor to Nicola Tribal Association
Wayne Weber	Ministry of Water, Land, & Air Protection

APPENDIX B

Maps

APPENDIX C

Salmon and Steelhead Stocking Records for the Coldwater River

Appendix C1. Coho stocking records for the Coldwater River.

COLDWATER RIVER -- HATCHERY RELEASES -- SPIUS CREEK HATCHERY

Coho

		Mark				Release	Release Dates	
Brood Yr	Stage	Type	Marked	Unmarked	Total	Site	From	To
84	Fry	Ad/CWT	49,894	10,606	60,500		1985-04-08	1985-04-14
84	smolts		-	-	-			
85	Fry	Ad/CWT	90,485	20,815	111,300		1986-05-06	1986-05-15
85	smolts	Ad/CWT	50,365	34,575	84,940		1987-04-28	1987-04-29
86	Fry	Ad/CWT	101,078	231,382	332,460		1987-04-24	1987-05-19
86	smolts	Ad/CWT	50,799	43,403	94,202		1988-03-16	1988-03-25
87	Fry	Ad/CWT	101,100	125,460	226,560		1988-05-11	1988-06-10
87	smolts	Ad/CWT	49,297	50,433	99,730		1989-04-03	1989-04-25
88	Fry	Ad/CWT	100,669	127,041	227,710		1989-05-24	1989-06-21
88	smolts	Ad/CWT	49,760	88,163	137,923		1990-03-12	1990-04-24
89	Fry	Ad/CWT	94,051	61,111	155,162		1990-05-01	1990-06-26
89	smolts	Ad/CWT	24,967	145,400	170,367		1991-03-20	1991-04-19
90	Fry	Ad/CWT	98,364	114,309	212,673		1991-04-30	1991-07-18
90	smolts	Ad/CWT	24,620	121,340	145,960		1992-04-28	1992-05-06
91	Fry		-	118,175	118,175		1992-05-05	1992-05-07
91	smolts	Ad/CWT	24,751	115,133	139,884		1993-05-04	1993-05-14
92	Fry		-	150,456	150,456		1993-05-14	1993-05-31
92	smolts	Ad/CWT	-	-	-			
93	Fry	Ad/CWT	98,404	84,163	182,567		1994-04-28	1994-05-03
93	smolts	Ad/CWT	19,657	6,025	25,682	Smolt pond	1995-05-04	1995-05-15
94	Fry		-	147,609	147,609		1995-04-25	1995-04-26
94	smolts	Ad/CWT	20,526	6,094	26,620		1996-04-22	1996-04-23
95	Fry		-	151,188	151,188		1996-04-26	1996-04-29
95	smolts		-	-	-			
96	Fry		-	-	-			
96	smolts	Ad/CWT	25,141	1,699	26,840	Smolt pond		1998-05-04
97	Fry		-	4,952	4,952			1998-05-13
97	smolts	Ad/CWT	28,599	23,381	51,980	Smolt pond		1999-05-18
98	Fry		-	-	-			
98	smolts	CWT only	21,693	6,078	27,771			2000-05-19
98	smolts	CWT only	13,786	2,133	15,919	Smolt pond		2000-05-20
99	*Fry*		-	*152,920*	*152,920*		*preliminary numbers*	
99	*smolts*	*Double Index*	*61,500*	*1,100*	*62,600*		*preliminary numbers*	
99	*smolts*	*Double Index*	*24,600*	*400*	*25,000*	*Smolt pond*	*preliminary numbers*	

Comments

Double Index groups have a Ad/CWT mark and a CWT only mark (50/50)

All releases to river, unless noted

Appendix C2. Chinook stocking records for the Coldwater River.

COLDWATER RIVER -- HATCHERY RELEASES -- SPIUS CREEK HATCHERY

Chinook

		Mark				Release	Release Dates		
Brood Yr	Stage	Type	Marked	Unmarked	Total	Site	From	To	
84	0+ smolt	Ad/CWT	63300	6535	69835		1985-04-04	1985-04-05	
85			0	0	0				
86	0+ smolt	Ad/CWT	50787	75733	126520		1987-04-03	1987-05-06	
87	0+ smolt		0	194270	194270		1988-04-20	1988-05-03	
88	0+ smolt	Ad/CWT	50416	37711	88127		1989-04-26	1989-05-08	
89	0+ smolt		0	120450	120450		1990-04-12	1990-04-27	
89	1+ smolt	Ad/CWT	49993	22444	72437		1991-04-03	1991-04-05	
90	1+ smolt	Ad/CWT	49735	5900	55635		1992-04-27	1992-04-28	
91	0+ smolt		0	29450	29450			1992-06-11	
91	1+ smolt	Ad/CWT	71767	6538	78305		1993-04-30	1993-05-04	
92	1+ smolt	Ad/CWT	47561	27503	75064		1994-04-25	1994-04-27	
92	1+ smolt	Ad/CWT	22547	666	23213	Smolt pond	1994-05-06	1994-05-09	
93	Fry		0	6136	6136			1994-10-03	
93	1+ smolt	Ad/CWT	0	49668	49668			1995-05-01	
93	1+ smolt	Ad/CWT	20423	0	20423	Smolt pond	1995-05-04	1995-05-15	
94	0+ smolt		0	23405	23405			1995-05-01	
94	1+ smolt	Ad/CWT	67675	1433	69108		1996-04-20	1996-05-02	
95	1+ smolt	Ad/CWT	41059	592	41651	Smolt pond	1997-05-17	1997-05-18	
96	Fry		0	43165	43165			1997-06-17	
96	1+ smolt		0	30576	30576		1998-04-30	1998-05-01	
96	1+ smolt		0	49939	49939	Smolt pond	??	??	
97	1+ smolt		0	73248	73248		1999-04-12	1999-04-15	
98	Fry		0	5435	5435			1999-04-21	
98	1+ smolt	Ad/CWT	17280	44736	62016		2000-04-13	2000-04-15	
99	Fry		0	11000	11000			2000-06-16	
99	*1+ smolt*	*Ad/CWT*	*23932*	*8757*	*32689*			*2001-04-12*	*preliminary numbers*
99	*1+ smolt*	*Ad/CWT*	*18337*	*6783*	*25120*	*Smolt pond*		*2001-04-12*	*preliminary numbers*
All releases to river, unless noted									

Appendix C3. Steelhead stocking records for the Coldwater River (BC Fisheries).

COLDWATER RIVER (3-13, Merritt, 50-7 120-48)

Steelhead

Date	Stage	Mark	Stock	Brood Year	Number	Comments
14-8-84	Fry		Nicola	84	52,000	
18-6-85	Emergent		Coldwater	85	98,305	
29-8-85	Fed fry	CWT	Coldwater	85	172,277	Tag Code 12/22/40
16-9-86	Fed fry		Coldwater	86	135,000	
11-9-87	Fed fry		Coldwater	87	22,000	
11-9-87	Fed fry		Coldwater	87	82,000	
01-9-88			Coldwater	88	36,708	
29-9-89	Fed fry		Coldwater	89	109,285	Spius 39,460; Coldwater 69,822
28-9-90	Fed fry		Coldwater	90	115,545	
02-10-91	Fed fry		Coldwater	91	42,500	
01-10-92	Fed fry		Coldwater	92	53,420	Released between Kingsvale and Toll booth
29-9-93	Fed fry		Coldwater	93	98,904	Released between Kingsvale and Toll booth
19-9-94	Fed fry		Coldwater	94	64,460	Released by Loon Creek staff
28-9-95	Fed fry		Coldwater	95	123,800	Released by Loon Creek staff

APPENDIX D

Coho and Steelhead Productivity Models

Table D1. Watershed area, Mean Annual Discharge, stream order and accessible length for Coldwater River coho and steelhead.

	Watershed	Area (km^2)	MAD (m^3/s)	Stream Order	Accessible length[1] (<8% gradient) (m)
1	Coldwater River	915.0	7.4		90000
2	Brook Creek	43.8	0.4		3000
3	Midday Creek	86.8	0.7		2000
4	Voght Creek	215.1	1.7		850

Table D2. Coho fry useable area predicted from MAD and September low flow stage.

	Watershed	Area (km^2)	MAD (m^3/s)	Stream Order	Actual Width (m)	Pred. Width (Main Order)	Low Flow Stage	Theor. % Useable Width (m)	Theor. Useable Width (m)	Theor. Useable Width (m)	Theor. Useable Area (m^2)	Theor. Useable Area (m^2)
							%MAD		(predicted width)	(actual width)	(pred. width)	(actual width)
1	Coldwater River	915.0	7.4			15.5	18.9	40%	6.2		560812	
2	Brook Creek	43.8	0.4			3.2	18.9	67%	2.1		6364	
3	Midday Creek	86.8	0.7			4.5	18.9	63%	2.8		5692	
4	Voght Creek	215.1	1.7			7.3	18.9	55%	4.0		3403	

Table D3. Smolt population estimates for Coldwater watersheds using relations from Marshall and Britton (1990), Holtby et al. (1990), and Bradford et al. (1997).
(Model 1 = Marshall and Britton 1990 (Linear); Model 2 = Marshall and Britton 1990 (Areal); (Model 3 = Holtby et al. (1990) (Linear); Model 4 = Bradford et al. 1997.

	Watershed	Area (km^2)	Stream Order	Useable Length (m)	Useable Area (m^2)	Total Smolts	Total Smolts	Total Smolts	Total Smolts
						Model 1	Model 2	Model 3	Model 4
1	Coldwater River	915.0		90000	560812	172319	107737	118204	78027
2	Brook Creek	43.8		3000	6364	4879	3133	3063	2880
3	Midday Creek	86.8		2000	5692	2954	2868	1982	1944
4	Voght Creek	215.1		850	3403	741	1911	791	848

Table D4. Estimate of the required number of coho spawners to fully seed available habitat using the model of Bradford et al. (1997).

Model4

	Watershed	Area (km^2)	Stream Order	Smolts[1] Produced	Fry[2] Produced	Required[3] Eggs	Female[5] fecundity	Required[6] Spawners	Spawner / km	Percent of Total escapement
					egg-fry =	19.8%				
				fry-smolt =	7.6%	1.5%				
1	Coldwater River	915.0		78027	1029385	5198916	1780	5841	65	93.22%
2	Brook Creek	43.8		2880	37999	191913	1780	216	72	3.44%
3	Midday Creek	86.8		1944	25643	129508	1780	146	73	2.32%
4	Voght Creek	215.1		848	11181	56472	1780	63	75	1.01%
	Total	1261		83699	1104208	5576809		6266		

[1] Number of smolts at maximum production for specified model
[2] Number of fry required to fully seed habitat and produce maximum smolts
[3] Number of eggs required to fully seed habitat given specified egg to fry survival
[4] Female length from either tributary specific data or average
[5] Female fecundity
[6] Required number of spawners calculated

Table D5. Steelhead smolt population estimates for Coldwater River, applying Keogh River smolt densities (Tautz et al. 1992).

	Accessible Stream	**Order**	**= 4**	**Keogh**	**Densities =**	**300**	**0.058**
	Watershed	**Area (km^2)**	**Stream Order**	**Useable [1] Length (m)**	**Theoretical[2] Useable Area (m^2)**	**Smolts[3] per km**	**Smolts[4] per sq m**
						Model 1	**Model 2**
1	Coldwater River	915.0	0	90000	560812	27000	32527
2	Brook Creek	43.8	0	3000	6364	900	369
3	Midday Creek	86.8	0	2000	5692	600	330
4	Voght Creek	215.1	0	850	3403	255	197
	Total			95850	576271	28755	33424

[1] Useable length of accessible stream portion

[2] Theoretical useable area determined as sum of product of accessible length and useable width, equation 6

[3] Smolts per kilometre using Keogh density of 300 smolts per linear kilometre

[4] Smolts per square kilomtre using Keogh density of 0.058 smolts per km^2

Table D6. Table of adjustment factors for alkalinity and mean smolt age using Tautz et al. (1992).

	Watershed	**Area (km^2)**	**Stream Order**	**Total[1] Alkalinity (mg/l)**	**Standing[2] Crop (kg/ha)**	**Adjust[3] 1**	**Smolt[4] Age (yr)**	**Smolt[5] Age (yr)**	**Smolt[6] Age (yr)**	**Space[7]**	**Adjust[8] 2**
							(7d)	**(avg)**	**(data)**		
	Keogh			**16.00**	**1.45**			**2.96**		**2.36**	
1	Coldwater River	915.0		39	2.27	1.56	3.30			2.78	0.85
2	Brook Creek	43.8		39	2.27	1.56	3.30			2.78	0.85
3	Midday Creek	86.8		39	2.27	1.56	3.30			2.78	0.85
4	Voght Creek	215.1		39	2.27	1.56	3.30			2.78	0.85

[1] Alkalinity derived from field measurements

[2] Late summer fry standing crop predicted from alkalinity

[3] Adjustment factor 1: ratio of Coldwater River standing crop to Keogh standing crop

[4] Mean smolt age predicted from growing season temperature

[5] Mean smolt age (Ptolemy, pers. comm..)

[6] Tributary specific mean smolt age from ageing (not available)

[7] Space requirements for smolts as determined from mean smolt age

[8] Adjustment factor 2: ratio of Keogh smolt space requirement to Coldwater River smolt space requirements

Table D7. Smolt estimates adjusted for nutrients and mean smolt age using Keogh smolt densities.

Accessible Stream Order = 4

	Watershed	Area (km^2)	Stream Order	Total[1] Alkalinity (mg/l)	Adjust[2] 1	Smolt[3] Age (yr)	Adjust[4] 2	Smolts[5] per km	Smolts[6] per m^2
								Model 3	Model 4
1	Coldwater River	915.0		39.0	1.56	3.30	0.85	35766	43087
2	Brook Creek	43.8		39.0	1.56	3.30	0.85	1192	489
3	Midday Creek	86.8		39.0	1.56	3.30	0.85	795	437
4	Voght Creek	215.1		39.0	1.56	3.30	0.85	338	261
	Total							38090	44275

[1] Alkalinity from Column J of Alkalinity Model Sheet
[2] Adjustment factor 1: ratio of Coldwater River standing crop to Keogh standing crop
[3] Mean smolt age using actual or pooled mean data
[4] Adjustment factor 2: ratio of Keogh smolt space requirement to Coldwater River smolt space requirements
[5] Smolts per kilometre x adjustment 1 x adjustment 2
[6] Smolts per km^2 x adjustment 1 x adjustment 2

Table D8. Estimate of the required number of steelhead spawners to fully seed available fry habitat.

Model4

	Watershed	Length (m)	Area (km^2)	Steelhead/Rainbow present (confirmed)	Smolts[1] Produced	Fry[2] Produced	Required[3] Eggs	Female[5] fecundity	Required[6] Spawners
						egg-fry =	0.10		
1	Coldwater River	90000	915.0	Y	43087	459731	4597306	11500	800
2	Brook Creek	3000	43.8	Y	489	5217	52173	11500	9
3	Midday Creek	2000	86.8	Y	437	4666	46660	11500	8
4	Voght Creek	850	215.1	Y	261	2790	27898	11500	5
	Total				44275	472404	4724036		822

[1] Number of smolts at maximum production for specified model
[2] Number of fry required to fully seed habitat and produce maximum smolts; equation 14
[3] Number of eggs required to fully seed habitat given specified egg to fry survival
[4] Female length from either tributary specific data or average
[5] Female fecundity predicted from female length; equation 15
[6] Required number of spawners calculated

APPENDIX E

Recovery Projects, Objectives, and Project Timing as Recommended by the Coldwater River Technical Advisory Group

Table E1. Recovery projects, objectives, project timing, and comments from the Coldwater River Technical Advisory Group (Merritt, September 2001).

Code	Project	Objectives	Project Timing	Comments
1.1	Information and Coordination	To keep public and recovery plan participants informed of progress and coordinate projects to maximize results	Jan– Dec	More local contact and information dissemination is needed. Brochures and similar initiatives should be put off until some projects have been started and could be included in them. A local person/organization is needed to represent the PSEFS and or the PSF in the capacity of overall project coordination, communication, and administration. A suggested partner would be the Nicola Watershed Community Round Table. The classroom incubation and salmonid education program is currently supported by the stewardship coordinator position and DFO. The stewardship coordinator position is due to end in March 2003. It is suggested that the PSEFS review the option of continuing the support of the program in 2003. Suggested partners would be the Nicola Watershed Community Round Table, the Nicola Watershed Stewardship and Fisheries Authority, and DFO.
1.2.1	Smolt Enumeration and Coded Wire Tagging	To monitor freshwater productivity, marine survival, and exploitation for coho and steelhead	April – June	It was recommended that the purpose of this project be clarified. Is CWT data needed to demonstrate the success of the recovery plan? The use of CWT's on Steelhead was questioned; there is no way to recover the tags. Some tagging is already conducted by DFO; additional funding may be an option. The point was raised that if the PSEFS comes forward with funding to partner or support projects like this that are already funded the current funding source may see it as an opportunity to pull out and leave the PSEFS funding more of, or the entire project. Steelhead parr work is already funded and scheduled for 2001 under MWLAP. This is a feasibility study of a method of assessing Steelhead Parr populations. The PSEFS should review this study when it is complete to determine if the method could be useful to the recovery plan.
1.2.2	Adult Coho Enumeration	Provide support and increase the assessment capacity of ongoing coho enumeration programs with potential procedures to increase reliability of escapement estimates	Sept – Dec	Again the point was raised that if the PSEFS comes forward with funding to partner or support projects like this that are already funded the current funding source may see it as an opportunity to pull out and leave the PSEFS funding more of, or the entire project.
1.2.3	Adult Chinook Enumeration	Provide support and increase the assessment capacity of ongoing chinook enumeration programs with potential procedures to increase reliability of escapement estimates for early and late Coldwater chinook	Jan-April	
1.2.4	Adult Steelhead Enumeration	Provide support and increase the assessment capacity of ongoing steelhead enumeration programs with potential procedures to increase reliability of escapement estimates	Nov – July	It was recommended that the recovery plan look at partnering with MWLAP to see if increasing the sample frequency could increase the accuracy of the results. The cost effectiveness of this option would have to be examined closely.
1.3.1 *	Stewardship and Education	To promote wise use of water and land use to protect salmon resource (includes fund for one-time grants to landowners to improve practices	Jan – Dec	This project is recommended for immediate startup

1.3.2 *	Demonstration Project / Public Awareness	To establish a demonstration site on private land the will provide a venue for restoration and rehabilitation practice education, and increase public awareness of the PSEF program activities	Jan – Dec	This project is recommended for immediate startup.
1.3.3	Establish Riparian Corridors	Work with landowners in the watershed to establish riparian corridors and protected areas. Begin with demonstration projects.	Sept – Oct	This project is recommended for immediate startup.
1.3.4	Water Use	Work with landowners produce water management plans and promote efficient water use. Begin with demonstration projects.	Sept - Nov	The Coldwater Reserve landowners currently use open ditch irrigation methods. This project would be working with the landowners to find options to improve the water use efficiency. This project could start soon.
1.3.5	Flow Monitoring	To monitor critical flow quantity, quality and temperature at key locations within the drainage	Jan – Dec	There may be an opportunity to get water-monitoring stations from FRBC. It is recommended that the Recovery Plan look into this option as soon as possible.
1.3.6 *	Water Storage Feasibility Study	A feasibility and assessment study for water storage opportunities in the Coldwater River	Sept -June	This project is recommended for immediate startup, with emphasis on Fig Lake. With a local partner already in place, it is recommended that this project be started immediately. The good will and proven results will be invaluable to the acceptance of the recovery plan and the process locally.
1.4.1	Riparian Assessments	Assessment to identify areas where riparian ecological function is poor and can be improved using best riparian ecology practices	Sept-Oct	There was a concern expressed that these projects may be too intensive for what is required to monitor the success of the recovery plan. It was recommended that this project look at finding options to combine and utilize less intensive inventories were possible to reduce the cost and time needed to gather the baseline data. As well, the inventories should be easily repeatable for monitoring purposes.
1.4.2	Floodplain Assessment	Identify channel confinements, including Kettle Valley Railway, and determine feasible sites for re-connecting floodplain for sediment and floodwater storage, and off-channel habitat	Sept-July	
1.4.3	Channel Condition Assessment	To assess condition of stream channel recommend rehabilitation	Aug – Sept	
1.4.4	Fish Habitat Assessment	To assess condition of fish habitat and recommend rehabilitation	Aug – Sept	
1.4.5	Sediment Source Survey	To identify sediment sources that are or have the potential to negatively impact on fish habitat recommend rehabilitation	Aug – Sept	
1.5.1	Activity Effectiveness	To monitor the effectiveness of recovery measures and make recommendations	Jan – Dec	Develop a simple, repeatable, in expensive assessment procedure that could be used to direct projects and assess the recovery plan progress. Emphasis would also be put on data already collected, such as the soon to be completed FRBC recovery plan.
1.5.2	Recovery Evaluation	To monitor progress toward recovery and make recommendations	Jan - Dec	

Additional Projects Suggested:

Project L4: Summer fry habitat utilization
To determine if the salmonid fry move in the coldwater throughout the year and if they do where do they move to. This could have impacts on the types of habitat we build and where best to locate them. This project would first require the adoption of a suitable cost effective method of assessing the fry habitat utilization and movements. In addition, historic studies should be fully reviewed before this project is undertaken. DFO and NWSFA are potential partners.

Project L10: Low Altitude Thermal Imagery
This could fit into several PSEFS assessment projects. It could be a valuable tool to assess the success of some type of projects. The cost was seen as reasonable compared to the product. It is recommended that this project be looked at for 2002.

Project L23: Lower Coldwater mill site "Cleanup"
This would be a good PR project for the PSEFS and the recovery plan. There is industrial "garbage" and other waste in the lower Coldwater River that could be removed. The local industry reps could be partners on this. The project was suggested and supported by local industry in 2001, but partner funding was not found.

Project L24: Eaton Beaten Channel
This project would be to add complexity to an existing constructed off channel habitat. DFO is supportive of this and would be a partner. It is recommended that this project be started immediately.

Project L25: Coquihalla HWY Channel
This project would be to add complexity to an existing constructed off channel habitat. DFO is supportive of this and would be a partner. It is recommended that this project be started immediately.

Project L26: Gravel bar stabilization
It is recommended that this project be delayed until the assessments are complete and the need is identified.