Bull Trout Studies in the Salmo River Watershed: 2002

Report Prepared For:

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EXECUTIVE SUMMARY

This report summarizes the results of bull trout monitoring in the Salmo River watershed in 2002 by BC Hydro. Work conducted in 2002 included index swims within the mainstem Salmo River, and spawner and redd counts in known headwater and tributary spawning areas. In total, seven swim surveys were conducted from July 9 to August 1 2002. Bull trout were present in higher numbers in early summer within the surveyed section of the mainstem Salmo River, but had likely begun upstream spawning migrations by the end of July. In total, 21 redds and 89 spawners were enumerated in 2002. As previously documented, bull trout spawners and redds were observed in Sheep Creek, Clearwater Creek, the upper section of the Salmo River, and in Stagleap Creek and the South Salmo River (in the fall of 2002 all available South Salmo River habitat was surveyed in both the U.S. and Canada). The data suggested that 2002 was a poor year for bull trout spawning escapement within the Salmo River watershed. In particular, spawning activity in Clearwater Creek was reduced in 2002. Sheep Creek and the South Salmo River watershed were the areas of the highest concentration of spawning activity. As in 2001, swim observers enumerated more bull trout spawners and redds than traditional bank observers. This report also standardizes estimates of escapement over the past five years in order to allow annual comparisons of escapement.

ACKNOWLEDGEMENTS

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In particular we would like to thank John Hagen for continued discussion about small populations and conservation biology, and assistance with the development of stock assessment techniques that have improved the ability to monitor fish populations in the Salmo River watershed. Gerry Nellestijn also deserves special recognition for his devotion to this long term project. He has been with us from the start. Finally we would like to thank Gary Birch, Ric Olmsted, and Dean den Biesen at BC Hydro for the continued support to ensure this work has been carried out. Funding provided by the company has led to a greater understanding of fisheries resources in the watershed.

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INTRODUCTION

As part of ongoing environmental monitoring associated with the addition of the fourth turbine at the Seven Mile Powerplant, BC Hydro has studied the bull trout (*Salvelinus confluentus*) population of the Salmo River watershed over the past five years (see Baxter et al. 1998; Baxter 1999; Baxter and Nellestijn 2000; Baxter 2001a; Baxter 2001b; Baxter 2002; Decker et al. 2002). The projects (focussing on bull trout) that BC Hydro has undertaken, or provided funding for, have included:

- juvenile density and distribution studies through electroshocking;
- water temperature and water chemistry monitoring;
- adult abundance monitoring through snorkel surveys;
- adult escapement monitoring through redd and spawner counts;
- identification of adult movement, life-history and spawning sites through radio telemetry; and
- the initiation of a monitoring program associated with potential fertilization of the South Salmo River.

In 2002, the Kootenay Generation Area office of BC Hydro continued studies in the watershed, specifically focussing on monitoring the abundance of adult bull trout in the drainage through the continued annual indexing of redds and spawners in known spawning areas. The specific objective of the work in 2002 was to:

- conduct adult abundance surveys (snorkel surveys and redd surveys) to monitor the status of the spawning population of bull trout in the watershed.

This report summarizes the results of the adult abundance surveys, and compares redd and spawner counts to past years. In addition we have attempted to standardize the counts between years and areas (some areas have been sampled only in recent years) to provide a reasonable escapement estimate for the watershed each year that will allow annual comparisons to monitor management activities.

STUDY AREA AND BACKGROUND

The Salmo River rises from the Selkirk Mountains 12 km southeast of Nelson, B.C. (Figure 1). The river flows in a southerly direction for approximately 60 km from its origin to the confluence with the Pend d'Oreille River (Seven Mile Reservoir). Geographic information is summarized in Table 1. The system is a 5th order stream, and has a total drainage basin area of roughly 1,300 km^2.

Table 1. Summary of geographic information for the Salmo River study area.

Gazetted Name	Stream Length (km)	Area (ha)
Salmo River	60	1,300 km^2
Geographic Information		
Approximate distance and direction to the nearest town, city or landmark	12 km southeast of Nelson, B.C.	
MELP Region	4	
MELP Management Unit	4-8	
DFO District	Interior South East (#30)	
Ministry of Forests Region	Nelson	
Ministry of Forests District	Kootenay Lake	
NTS Base Map Reference	82 F/3 and 82 F/6	

Elevation in the basin ranges from 564 meters at its confluence to 2,343 meters at the height of land. Within this elevation range, the system comprises two biogeoclimatic zones (Braumandl and Curran 1992). At lower elevations, the valley lies within the Interior Cedar-Hemlock zone, while areas in the higher elevations are found within the Englemann Spruce-Subalpine Fir zone. The Salmo River has a total of eight 2nd and 3rd order tributaries (including Apex Creek, Clearwater Creek, Hall Creek, Barrett Creek, Ymir Creek, Porcupine Creek, Erie Creek, and Hidden Creek) and two 4th order tributaries (Sheep Creek and the South Salmo River) (Figure 1). The Water Survey of Canada maintains a gauging station on the Salmo River near the town of Salmo (Anonymous 1977). Mean annual discharge in the Salmo River (1949-1976) was 32.5 $m^3 \cdot sec^{-1}$, with mean monthly minimum and maximum values of 7.5 and 128.5 $m^3 \cdot sec^{-1}$, respectively. Runoff reaches a peak in May, with the highest flows between April and July each year. In addition to bull trout, many other fish species are distributed in the watershed. These include rainbow trout (*Oncorhynchus mykiss*), eastern brook trout (*S. fontinalis*), mountain whitefish (*Prosopium williamsoni*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*C. catastomus*), northern pikeminnow (*Ptychocheilus oregonensis*), longnose dace (*Rhinicthys cataractae*), redside shiner (*Richardsonius balteatus*), and slimy sculpin (*Cottus cognatus*) (Sigma Engineering Ltd. 1996). Natural populations of steelhead trout (*O. mykiss*) and chinook salmon (*O. tshawytscha*) have been extirpated from this system due to hydroelectric development on the lower Columbia and Pend d'Oreille rivers.

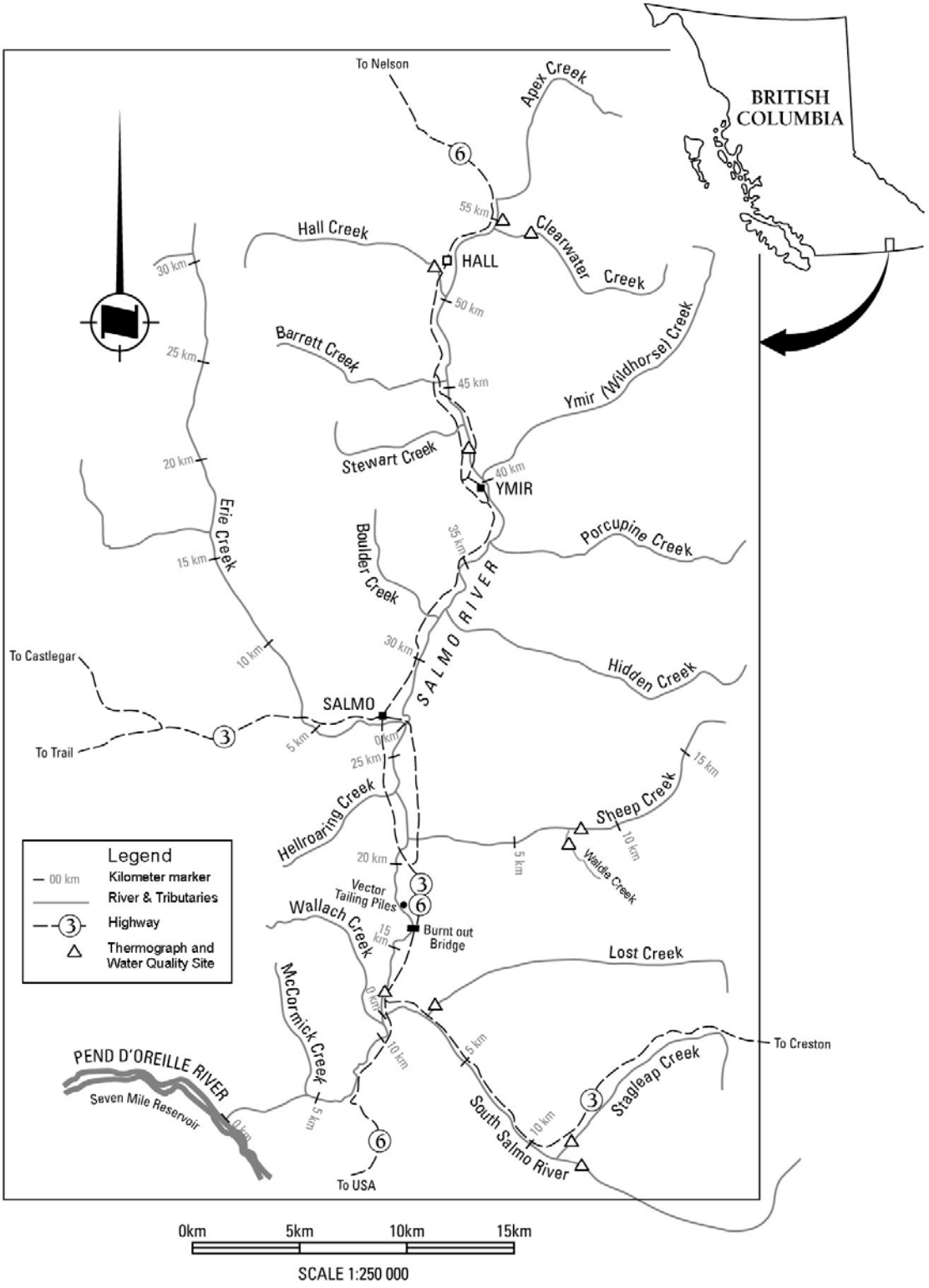

Figure 1. The Salmo River watershed study area.

METHODS

Snorkel Surveys

For this component of the study, observations were made in summer during seven repetitive snorkel surveys in a previously established index section in the mainstem Salmo River below the town of Salmo. During each sampling the river was surveyed by a crew of 4 swimmers (depending on water levels), and the swimmers aligned themselves perpendicular to stream flow to ensure adequate coverage of the stream. Each swimmer reported the total number of bull trout and other species observed in the section of river that was surveyed. Generally, counts were recorded every 200 to 250 m at known locations. This work was carried out in conjunction with a rainbow trout study being undertaken in the watershed. Using sightability estimates derived from the ongoing rainbow trout work, we expanded the count data to give a representation of how many bull trout (>30 cm) may have actually been in the section that was surveyed by snorkeling. Swims occurred during July and early August.

Redd Counts

Bull trout redds were enumerated in late-September in the main spawning locations that were identified or suspected from previous work. The areas surveyed were Clearwater Creek, Sheep Creek, the upper mainstem of the Salmo River, Stagleap Creek and the upper South Salmo River. A two person crew walked (one person) and swam (one person) sections of the stream looking for spawning fish on redds or the presence of redds. Bull trout redds were easily identified as recently disturbed areas of clean sorted substrate, and had a typical pit and mound associated with the disturbance. The total number of redds and the sex and estimated length of each observed bull trout were recorded during each survey. Surveys were carried out from September 12th to 24th. A comparison of observations made by the bank observer and the swim observer was made to determine what method provides a better estimate, and to estimate observer efficiency.

RESULTS

Snorkel Surveys

In total, one watershed wide survey and seven index section surveys were conducted. A summary of the total number of each fish species observed during the index surveys is presented in Table 2. The observations during the surveys suggested that bull trout (BT) were present in high densities in early summer within the surveyed section, but had begun their upstream spawning migrations by the end of July/early August (Table 2). During the surveys, rainbow trout (RB), eastern brook trout (EB), sucker (SU), northern pikeminnow (NPM), and mountain whitefish (MW) were also observed (Table 2).

Table 2. Summary of the number of fish species observed during snorkel surveys in the Salmo River in 2002.

Survey no.	Survey date	Section	RB					BT		EBT	MW
			0-20cm	20-30cm	30-40cm	40-50cm	50+cm	<30 cm	>30 cm		
1	09-Jul	index	15	14	5	9	1	0	9	1	1
2	11-Jul	index	31	14	17	18	3	1	7	0	0
3	16-Jul	index	119	50	29	16	5	1	11	8	0
4	18-Jul	index	276	112	25	26	5	0	16	12	2
5	22-Jul	index	287	139	43	27	11	1	7	18	5
6	30-Jul	index	670	267	57	44	10	1	5	9	2
7	01-Aug	index	341	158	55	42	6	0	4	17	1

In 2002, the sightability of rainbow trout on each snorkel survey within the index section (as estimated during a separate study) showed as increasing trend as water levels dropped and visibility increased (Table 3). Using these sightability estimates, the expanded counts of bull trout (>30 cm) are presented in Table 3.

Table 3. Sightability estimates, and expanded counts of bull trout (>30 cm) during snorkel surveys in the Salmo River in 2002.

Survey no.	Survey date	Section	Sightability	BT	Expanded Count
1	09-Jul	index	0.200	9	45
2	11-Jul	index	0.125	7	56
3	16-Jul	index	0.444	11	25
4	18-Jul	index	0.556	16	29
5	22-Jul	index	0.875	7	8
6	30-Jul	index	0.750	5	7
7	01-Aug	index	0.875	4	5

Redd Counts

The results of the redd surveys for individual systems are presented in Appendix I. In total, 21 redds and 89 spawners were enumerated in 2002. We observed spawners and redds in all areas that were previously identified (Clearwater Creek, Sheep Creek, the upper Salmo River, and the South Salmo River watershed), and we extended our surveys in 2002 to include the entire South Salmo River within the U.S. (Table 4; Appendix I). Sheep Creek and the South Salmo River watershed were the areas of the highest concentration of spawning activity.

Table 4. Summary of the total number of bull trout and redds observed in index areas within the Salmo River watershed in 2002.

Watercourse	Total Number of Redds	Total Number of Bull Trout
Clearwater Creek	1	9
upper Salmo River	3	27
Sheep Creek	5	30
South Salmo River	10	18
Stagleap Creek	2	5
TOTAL	**21**	**89**

In general, the swim observer saw more bull trout and redds than the bank observer in all streams that were surveyed (Appendix II). In 2002, these differences were significant for fish ($P<0.0001$) but not redds ($P=0.051$).

DISCUSSION

The initial stages of adult bull trout monitoring in the Salmo River watershed occurred in the fall of 1997, and were largely the result of incidental captures or observations of adults or redds while conducting juvenile monitoring work (see Baxter et al. 1998). Although redds were observed during surveys in 1997, and these counts have been included in past comparisons of redd numbers between years, it is likely that the 1997 data should be excluded for a number of factors. For example, incomplete sampling of spawning areas in space or time are important factors to consider when using redd counts as an index of population status (Dunham et al. 2001). In particular, if key spawning areas are not enumerated, or the timing of surveys does not coincide with the peak or end of spawning, an inaccurate index of spawning effort may result. In this vein it is fair to say that the 1997 redd data is limited in its utility (all areas were not sampled), although it was a key initial study in identifying major spawning areas for future surveys.

Based on this argument, we have chosen to only use redd and spawner count data from 1998 to 2002 as the basis for the annual estimates of spawning escapement. There are however a number of issues with regard to the data collection that have evolved over the past five years, and need to be taken into account in order to derive a reasonable escapement estimate. The first point is that there have been temporal differences in the dates at which surveys have occurred in past years. For example, in some years the surveys occurred in mid-September, while in other years surveys have occurred in late-September or early-October. We had planned over the last two years (2001 and 2002) to conduct our surveys in the fourth week of September with the goal that the majority of spawning activity would be completed. The estimate would then be derived as the number of redds multiplied by one and a half plus any observed fish. Even within the past two years however the timing of spawning has been highly variable, and this has resulted in variability of the data that must be taken into account when deriving an estimate.

The second consideration is that for the first three years (1998, 1999, and 2000) redds and spawners were observed by bank observers only, but as the project evolved we were concerned about observer efficiency for both fish and redds using this method. To address this unknown observer efficiency we conducted surveys in both 2001 and 2002 using a combination swim observer and bank observer. In both years we found that the bank observer was consistently underestimating both the number of bull trout and redds present (both fish and redds were sometimes located deep in cover). Thus, using the combined data from 2001 and 2002 we derived the relationship of fish seen vs fish present and redds seen vs redds present (Figures 2 and 3) to account for unseen fish and redds in past years (1998, 1999, and 2000). The recalculated estimates of redds and spawners were used to derive an escapement estimate for each year using the previously noted equation.

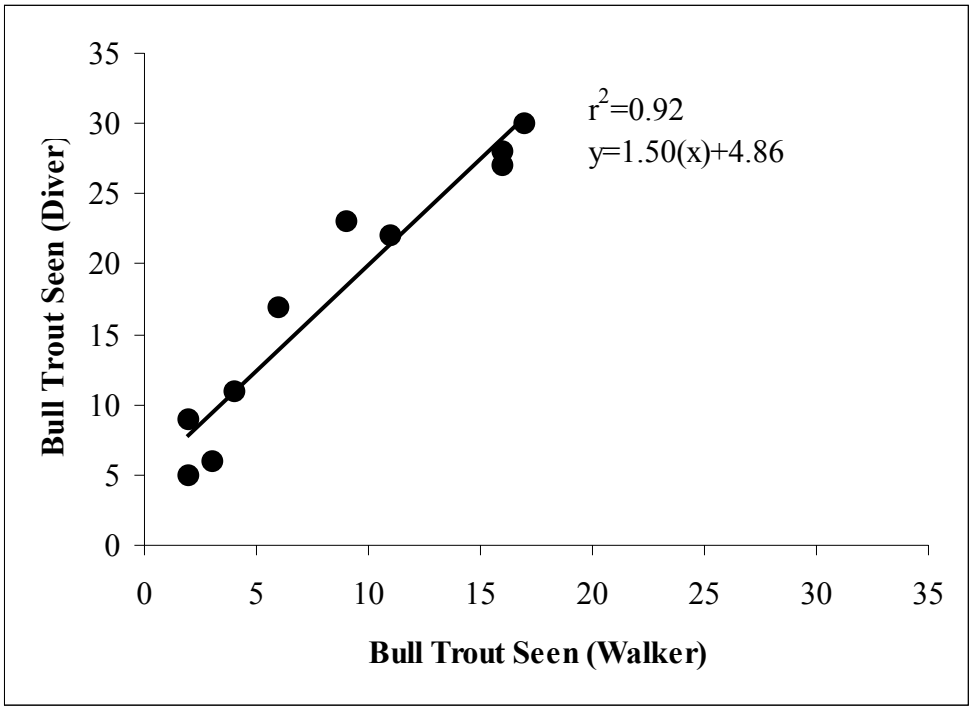

Figure 2. The relationship of the number bull trout seen by diver and seen by walker in the Salmo River watershed in 2001 and 2002.

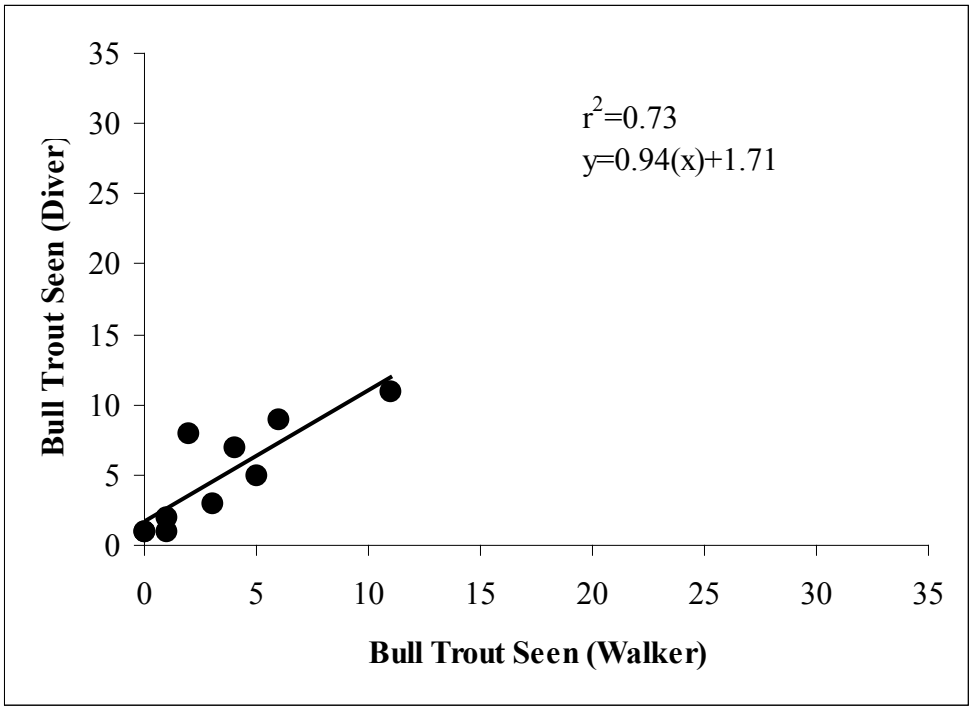

Figure 3. The relationship of the number bull trout redds seen by diver and seen by walker in the Salmo River watershed in 2001 and 2002.

The third point for discussion is that the surveys have not been spatially conducted in a similar fashion over the 1998-2002 study period. Specifically, until 2001 and 2002 the South Salmo River watershed had not been sampled due to logistical concerns (transboundary issues) and an incomplete understanding of the biology of bull trout in the watershed. After a three year radio telemetry study identified that a significant proportion of bull trout (40% of the samples tagged) migrated into the upper South Salmo River for spawning (see Baxter and Nellestijn 2000; Baxter 2001b) we included this watershed in the bull trout redd surveys. Doing this required back calculating an estimate for escapement in the South Salmo River watershed for 1998, 1999, and 2000 to allow annual comparisons to be made between years. This was done, and the escapement estimates for the 1998-2002 are summarized for comparison between years (Table 5; Figure 4).

Table 5. Summary of the estimated bull trout escapement in the Salmo River watershed from 1998-2002 (CC=Clearwater Creek, US=Upper Salmo River, SC=Sheep Creek, SS=South Salmo watershed).

Year	CC	US	SC	SS	Total
1998	36	23	70	50	180
1999	29	19	41	34	123
2000	37	47	50	52	185
2001	40	25	41	42	147
2002	11	32	38	39	119

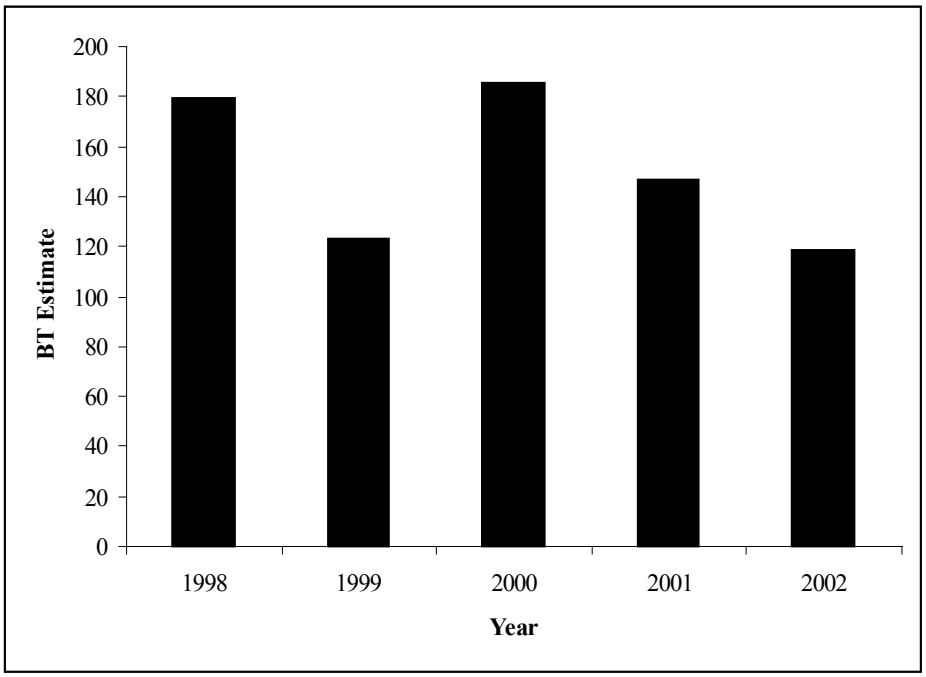

Figure 4 Annual estimates of bull trout spawning escapement in the Salmo River watershed from 1998 to 2002.

With regard to population and conservation biology, it is generally suggested that breeding populations of less than 200 individuals are marginally secure from extinction, and that populations of less than 50 individuals are insufficient for long term persistence (see Boyce 1992; McElhany et al. 2000). The data that we have collected over the last five years on the bull trout population of the Salmo River watershed suggest that the population is marginally secure from a conservation standpoint as long as the population growth rate is maintained or increased. Typically harvest and habitat destruction are external agents that can cause negative population growth rates in salmonid populations, and with the provision for no harvest of bull trout as of 1999, we have addressed a major factor that could potentially have led to population decline. This would have been the likely case with any increases in angler activity (as has been occurring on other Kootenay systems, and has been generally noted on the Salmo River over the past three years). We have taken a proactive role in ensuring the stability of this population by implementing a catch and release regulation prior to having to react if the population level was of a conservation concern. Continued monitoring is required. In addition, given that the spawning areas of the population are fairly concentrated in headwater tributary areas that are largely unimpacted, there is the potential for population impacts if these areas are disturbed. This suggests that all development in these areas be closely monitored and mitigated given the small population size.

In summary, the continuation of this project has provided a reliable long term index of the bull trout spawning population in the Salmo River watershed, and provides data that is useful from both a angler management perspective and to assess the success of mitigation projects. It is recommended that the annual surveys be continued at the end of the first week of October, and that they be conducted using both the bank observer and swim observer. This project has also been undertaken through extensive cooperation at both the provincial and international level, and is a demonstration of how effective teamwork can lead to the persistence of small populations of salmonids to ensure their stability and long term persistence.

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Appendix I. Summary data from bull trout redd counts conducted in the Salmo River watershed in 2002.

Clearwater Creek

Date	Location	Number of Redds	Number of Fish
September 19	Falls to mouth	1	5 Males (60-70 cm) 4 Females (50-65 cm)

upper Salmo River

Date	Location	Number of Redds	Number of Fish
September 19	Camp Busk to Barrett Creek	3	15 Males (30-70 cm) 12 Females (45-65 cm)

Sheep Creek

Date	Location	Number of Redds	Number of Fish
September 20	Log Jam to Aspen Creek	3	14 Males (50-65 cm) 11 Females (45-65 cm)
September 21	Curtis Creek to Log Jam	2	3 Males (50-70 cm) 2 Females (65 cm)

South Salmo River Watershed

Date	Location	Number of Redds	Number of Fish
September 18	South Salmo River-Stagleap Ck. confluence to 4 km d/s Stagleap Ck. confluence	0	1 Female (50 cm)
September 18	Stagleap Creek-Powerlines to mouth	2	3 Males (25-55 cm) 2 Females (25-53 cm)
September 24	South Salmo River-5.6 km u/s US Border to US Border	7	9 Males (20-70 cm) 4 Females (35-65 cm)
	South Salmo River-US Border to Stagleap Ck. confluence	3	2 Males (40-55 cm) 2 Females (45-60 cm)

Appendix II. Summary of differences in the number of bull trout and redds observed in the Salmo River watershed by a bank observer and swim observer in 2002 (DFS=Diver Fish Seen, WFS=Walker Fish Seen, DRS=Diver Redd Seen, WRS=Walker Redd Seen).

System	DFS	WFS	Difference	DRS	WRS	Difference
Stagleap Creek	1	0	1	0	0	0
	0	0	0	1	0	1
	1	0	1	0	0	0
	2	2	0	1	1	0
	1	0	1	0	0	0
Clearwater Creek	1	0	1	0	0	0
	0	0	0	1	1	0
	2	2	0	0	0	0
	3	0	3	0	0	0
	2	0	2	0	0	0
	1	0	1	0	0	0
Salmo River	1	1	0	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	1	1	0	0	0	0
	1	1	0	0	0	0
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	1	1	0	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	1	1	0	1	1	0
	1	1	0	1	1	0
	1	1	0	0	0	0
	1	1	0	1	1	0
	1	0	1	0	0	0
	1	1	0	0	0	0

System	DFS	WFS	Difference	DRS	WRS	Difference
Sheep Creek	1	0	1	0	0	0
	1	0	1	0	0	0
	1	1	0	0	0	0
	1	0	1	0	0	0
	0	0	0	1	1	0
	1	1	0	0	0	0
	1	1	0	1	1	0
	1	0	1	0	0	0
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	1	0	1	0	0	0
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	2	1	1	0	0	0
	1	1	0	0	0	0
	1	0	1	0	0	0
	1	0	1	0	0	0
	5	4	1	2	2	0
South Salmo River	2	1	1	2	2	0
	2	0	2	2	0	2
	0	1	-1	0	0	0
	1	1	0	1	1	0
	2	0	0	1	0	1
	1	0	1	0	0	0
	2	2	0	0	0	0
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	2	1	1	1	1	0
	0	0	0	1	1	0
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