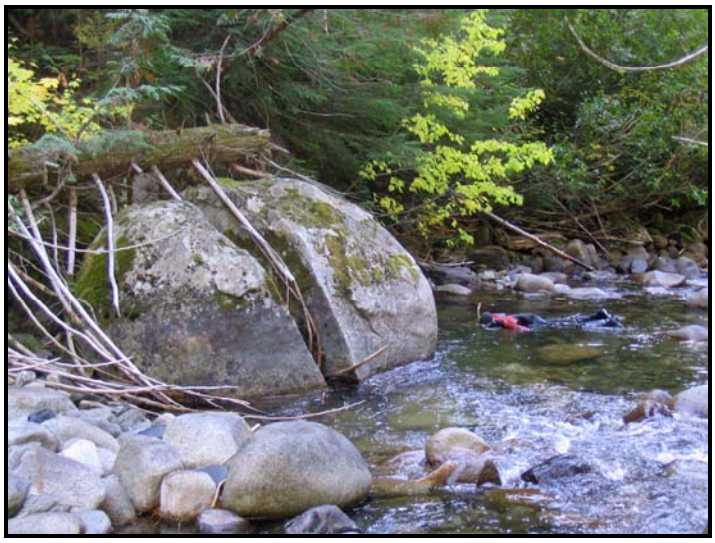
Bull Trout Studies in the Salmo River Watershed: 2003



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EXECUTIVE SUMMARY

This report summarizes the results of bull trout monitoring conducted by BC Hydro in the Salmo River watershed in 2003. Work undertaken included index swims within the mainstem Salmo River, and spawner and redd counts in known headwater and tributary spawning areas that have been surveyed over the past several years. In total, one watershed wide survey (over several days) and five index section surveys were conducted by snorkel survey. During redd surveys, a total of 105 redds and 38 spawners were enumerated. 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 continued our surveys in 2003 within the entire South Salmo River within the U.S. Sheep Creek and the upper Salmo River/Clearwater Creek area were the areas of the highest concentration of spawning activity in 2003. Spawning activity was extremely limited in the South Salmo watershed, but the upper barrier on the river was confirmed. When the counts of redds and spawners within the watershed are expanded to provide an estimate of escapement, 2003 marks the highest estimate of escapement in the 6 years the study has been undertaken (196 fish in 2003). It is possible we are observing the first response of the population to the implementation of the catch and release regulation in 1999, and future monitoring is recommended.

ACKNOWLEDGEMENTS

Field and technical support during this work was provided by a number of individuals who insured the project's success: **BC Hydro:** Gary Birch, Dean den Biesen; **BC Ministry of Water, Land and Air Protection:** John Bell, Colin Spence, Jeff Burrows; **Columbia-Kootenay Fisheries Renewal Partnership:** Bill Green, Jim Claircoates; **Columbia Basin Fish and Wildlife Compensation Program:** Steve Arndt, Harald Manson; **Mountain Water Research:** Jeremy Baxter; **Salmo Watershed Streamkeepers Society:** Gerry Nellestijn; **John Hagen and Associates:** John Hagen; **U.S. Forest Service:** Thomas Shuhda.

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INTRODUCTION

As part of ongoing environmental monitoring associated with the addition of the fourth turbine at the Seven Mile Powerplant and ongoing operational requirements, BC Hydro has studied the bull trout (*Salvelinus confluentus*) population of the Salmo River watershed over the past six years (see Baxter et al. 1998; Baxter 1999; Baxter and Nellestijn 2000; Baxter 2001a; Baxter 2001b; Baxter 2002; Decker et al. 2002; Baxter and Baxter 2003). 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 2003, 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 2003 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 previous years.

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.

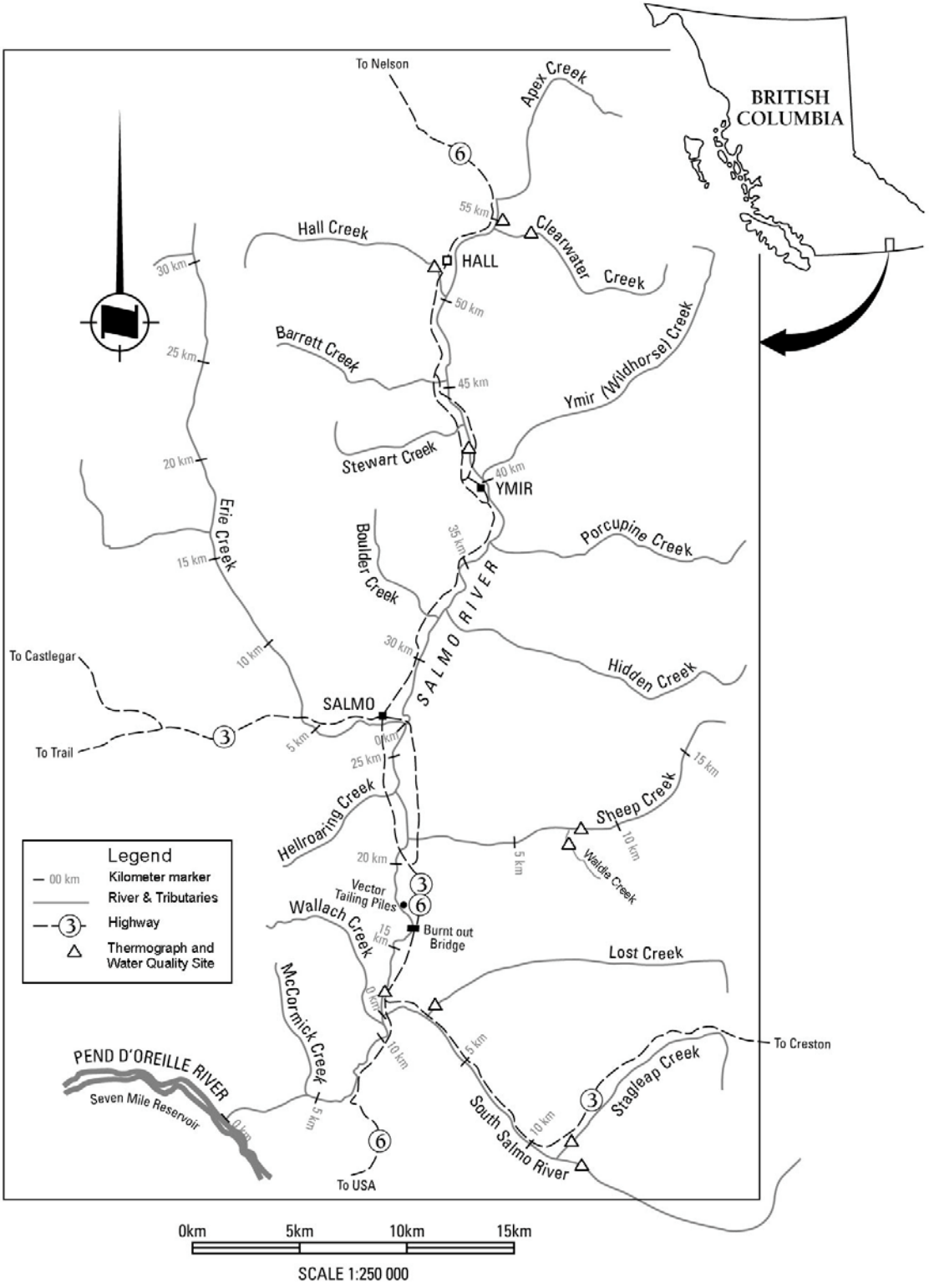

Figure 1. The Salmo River watershed study area.

METHODS

Snorkel Surveys

For this component of the study, observations were made in the summer during repetitive snorkel surveys in a previously established index section in the mainstem Salmo River below the town of Salmo, and throughout the mainstem river from Hall Creek to Seven Mile Reservoir. During each sampling the river was surveyed by a crew of 2-4 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 an ongoing rainbow trout study being undertaken in the watershed. Using sightability estimates derived from the rainbow trout work, I expanded the count data to give a representation of how many bull trout (>30 cm) may have actually been seen while snorkeling. Swims occurred from July 2nd to 18th.

Redd Counts

Bull trout redds were enumerated in late September and early October 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 (Appendix I-Plate A). 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 29th to October 9th. 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 during redd counts.

RESULTS

Snorkel Surveys

In total, one watershed wide survey (over several days) and five index section surveys were conducted. A summary of the total number of each fish species observed during the index surveys and watershed surveys are presented in Table 2. The observations during the surveys suggested that bull trout (BT) were present in higher densities in early summer within the surveyed section, but had begun their upstream spawning migrations by the mid July (Table 2). During the surveys, rainbow trout (RB), eastern brook trout (EB), and mountain whitefish (MW) were also observed (Table 2).

Table 2. Summary of the number of fish species observed during snorkel surveys in the index section of the Salmo River in 2003.

Survey	Section	RB					BT		EB	MW
date		0-20cm	20-30cm	30-40cm	40-50cm	50+cm	<30 cm	>30 cm		
02-Jul	index	40	94	52	19	12	0	8	0	0
04-Jul	index	68	76	41	33	14	2	16	0	0
07-Jul	index	175	109	54	24	9	1	17	1	4
10-Jul	index	168	114	81	40	12	5	19	9	3
18-Jul	index	291	225	96	45	25	7	15	4	3
07-Jul	Hall C-Canyon	4						1		
07-Jul	Canyon-Barrett C	17	8	5				1		
08-Jul	Barrett C-lower P. R. bdge	30	9					2		
08-Jul	Lower P. R. bdge-Porcupine C	17	14	13	3			2	1	
08-Jul	Porcupine C-Hidden C	12	39	9	5			2		
10-Jul	Hidden C-Erie C	55	31	7	3	2	5	5		
10-Jul	Erie C-Carney Mill Rd.	26	3	0	1	0	0	3		
10-Jul	Carney Mill-Sheep C	66	38	18	12	3	4	6	2	
10-Jul	Sheep C-Burned Out Bridge	102	76	63	28	9	1	13	7	3
09-Jul	Burned Out Bridge-Swift C	105	89	22	8	2	2	12	8	19
09-Jul	Swift C-WSC station	53	68	15	6	0				13
17-Jul	WSC station-top of canyon	246	90	40	5	1				2
17-Jul	Top of canyon-Reservoir	853	254	50	8		2			30

In 2003, 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 2003.

Survey date	Section	Sightability	BT	Expanded Count
02-Jul	index	0.40	8	20
04-Jul	index	0.50	16	32
07-Jul	index	0.50	17	34
10-Jul	index	0.6388	19	30
18-Jul	index	0.89	15	17
07-Jul	Hall C-Canyon	0.66352		
07-Jul	Canyon-Barrett C	0.66352	1	2
08-Jul	Barrett C-lower P. R. bdge	0.71914	2	3
08-Jul	Lower P. R. bdge-Porcupine C	0.62232	2	3
08-Jul	Porcupine C-Hidden C	0.62232	2	3
10-Jul	Hidden C-Erie C	0.7006	5	7
10-Jul	Erie C-Carney Mill Rd.	0.4534	3	7
10-Jul	Carney Mill-Sheep C	0.65425	6	9
10-Jul	Sheep C-Burned Out Bridge	0.46885	13	28
09-Jul	Burned Out Bridge-Swift C	0.443256	12	27
09-Jul	Swift C-WSC station	0.35349		
17-Jul	WSC station-top of canyon	0.46782		
17-Jul	Top of canyon-Reservoir	0.46782		

Redd Counts

The results of the redd surveys for individual systems are presented in Appendix II. In total, 105 redds and 38 spawners were enumerated in 2003. 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 continued our surveys in 2003 within the entire South Salmo River in the U.S. (Table 4; Appendix II). Sheep Creek and the upper Salmo River/Clearwater Creek area were the areas of the highest concentration of spawning activity in 2003. Spawning activity was extremely limited in the South Salmo watershed in 2003.

Table 4. Summary of the total number of bull trout and redds observed in index areas within the Salmo River watershed in 2003.

Watercourse	Total Number of Redds	Total Number of Bull Trout
Clearwater Creek	22	7
upper Salmo River	21	17
Sheep Creek	47	11
South Salmo River	15	3
Stagleap Creek	0	0
TOTAL	**105**	**38**

In general, the swim observer saw more bull trout and redds than the bank observer in all streams that were surveyed (Appendix III). In 2003, these differences were significant for fish ($P<0.002$) and redds ($P=0.012$).

DISCUSSION

For the first three years (1998, 1999, and 2000) redds and spawners were observed by bank observers only, but as the project has evolved there was concern about observer efficiency of both fish and redds using this method. To address this unknown observer efficiency, surveys in 2001, 2002, and 2003 were undertaken using a combination swim observer and bank observer. In these years I found that the bank observer was consistently underestimating both the number of bull trout and redds present (both fish and redds are sometimes located deep in cover; Appendix I-Plate B). Thus, using the combined data from all three years, I have plotted 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).

When the counts of redds and spawners within the watershed are expanded to provide an estimate of escapement, 2003 marks the highest estimate of escapement in the 6 years the study has been undertaken (Table 5; Figure 4). One point of interest in the 2003 data is the limited use of the South Salmo River watershed for spawning in 2003. It is likely that low water levels contributed to difficult access into the upper portion of the river in the summer/fall of 2003 (the few bull trout observed were heavily marked and scarred; Appendix I-Plate C). We did however confirm the barrier to upstream migration this year (Appendix I-Plate D and E), a series of small waterfalls in the U.S. above Watch Creek that is located at UTM coordinate (11N, 0492960 E, 5426290 N). We started our surveys above this barrier in both 2002 and 2003 and only observed rainbow trout and westslope cutthroat trout (*O. clarki lewisi*) above the falls.

Table 5. Summary of the estimated bull trout escapement in the Salmo River watershed from 1998-2003 (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
2003	40	49	82	26	196

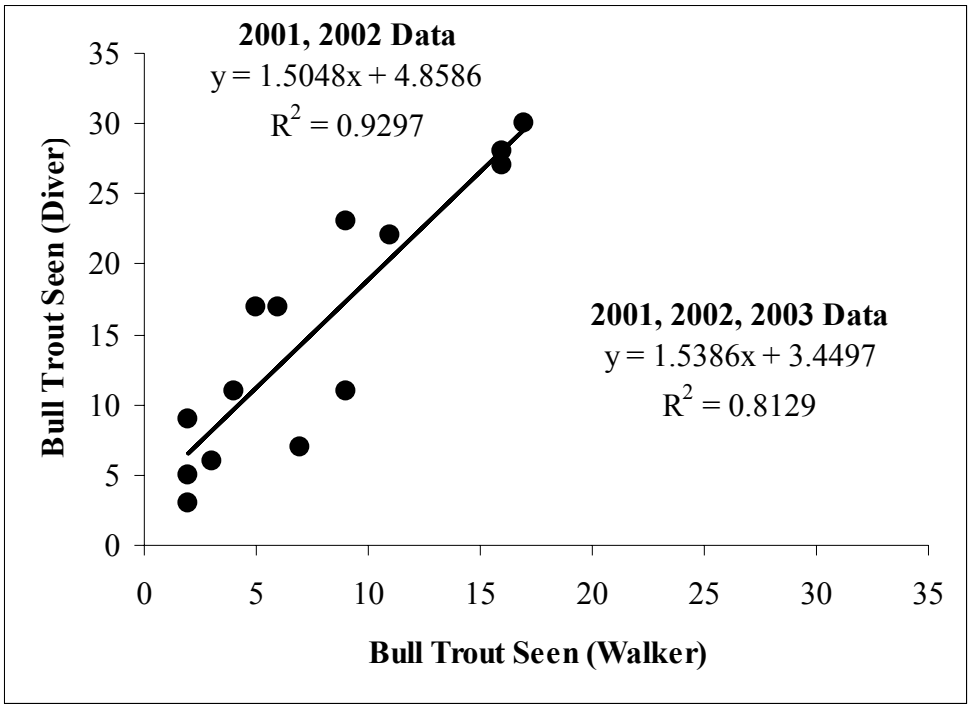

Figure 2. The relationship of the number bull trout seen by diver and seen by walker during redd counts in the Salmo River watershed in 2001-2003.

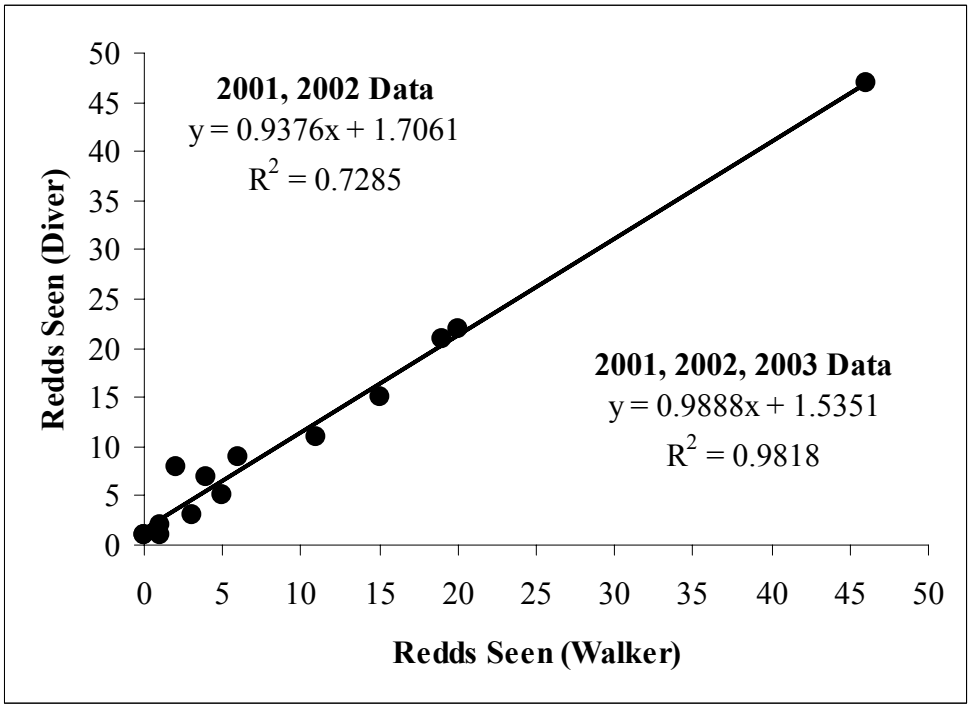

Figure 3. The relationship of the number bull trout redds seen by diver and seen by walker during redd counts in the Salmo River watershed in 2001-2003.

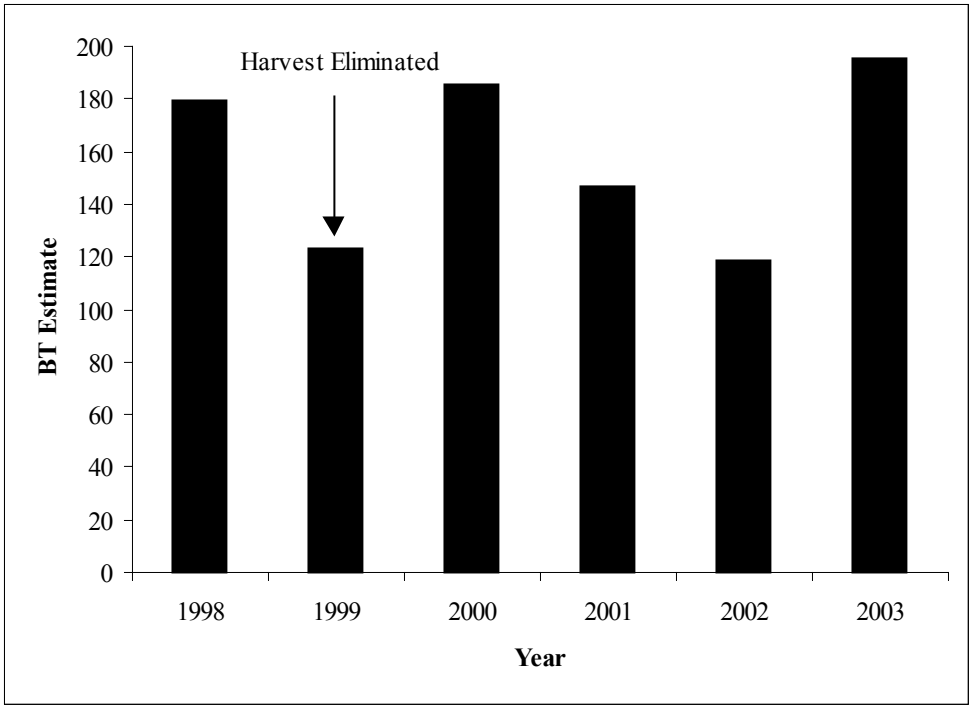

Figure 4. Annual estimates of bull trout spawning escapement in the Salmo River watershed from 1998 to 2003.

Typically harvest and habitat destruction are external agents that can cause negative population growth rates in salmonid populations (McElhany et al. 2000), and with the provision for no harvest of bull trout as of 1999, we had addressed a major factor that could potentially have led to population decline in the Salmo River watershed. 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). It is encouraging to see that 2003 marks the year of the highest estimate of escapement within the Salmo River, five years after the regulation change was implemented. As the typical life cycle of a bull trout is maturity at five years of age, we may be seeing the initial response of the population to catch and release. It is important however to continue this monitoring over several more years to determine if the trend for increase is maintained, and to monitor the potential expansion of bull trout spawning activity into previously unused habitats.

One other issue that will be addressed through the continued monitoring is the effect of the recent Regional District of Central Kootenay decision to allow motor vehicle access along the old Burlington Northern right of way between Nelson and Salmo. I have concerns that this decision will promote access to major spawning areas and could impact the population through increased angler activity, movement of motorized vehicles through the stream/riparian corridor and ultimately lead to potential poaching.

In summary, this project continues to provide a reliable and cost-effective 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 for one more year in 2004. In addition, options to explore incorporating variability into the escapement estimate should be considered. This might include a more extensive monitoring of the number of bull trout per redd over the spawning period.

REFERENCES

Anonymous. 1977. Historical streamflow summary, British Columbia. Inland Waters Directorate, Water Survey of Canada, Ottawa, Canada, 758 p.

Baxter, J.S. 1999. Bull trout studies in the Salmo River watershed: 1998 and 1999. Report to BC Hydro, Castlegar, B.C. Report by Baxter Environmental, Nelson, B.C.

Baxter, J.S. 2001a. Bull trout studies in the Salmo River watershed: 2000. Report to BC Hydro, Castlegar, B.C. Report by Baxter Environmental, Nelson, B.C.

Baxter, J.S. 2001b. Aspects of the biology of bull trout (*Salvelinus confluentus*) in the Salmo River watershed as identified through radio telemetry (2000 and 2001 data) and a watershed management plan for the species. Report to Columbia-Kootenay Fisheries Renewal Partnership, Cranbrook, B.C, and BC Hydro, Burnaby and Castlegar, B.C. Report by Baxter Environmental, Nelson, B.C.

Baxter, J.S. 2002. Bull trout studies in the Salmo River watershed: 2001. Report to BC Hydro, Castlegar, B.C. Report by Baxter Environmental, Nelson, B.C.

Baxter, J.S., and G. Nellestijn. 2000. Aspects of the biology of bull trout (*Salvelinus confluentus*) in the Salmo River watershed as identified through radio telemetry. Report to Columbia-Kootenay Fisheries Renewal Partnership and Columbia Basin Trust, Cranbrook, B.C. Report by Salmo Watershed Streamkeepers Society, Salmo, B.C. and Baxter Environmental, Nelson, B.C

Baxter, J.S., and J.T.A. Baxter. 2003. Bull trout studies in the Salmo River watershed: 2002. Report to BC Hydro, Castlegar, B.C. Report by Baxter Environmental, Nelson, B.C. and Mountain Water Research, Winlaw, B.C.

Baxter, J.S., Coughlin, W.D., Pennington, B.M., and G.G. Oliver. 1998. Synoptic bioreconnaissance of bull trout distribution and abundance in the Salmo River watershed. Report to BC Hydro, Environmental Department, Castlegar, B.C. Report by Interior Reforestation Co. Ltd., Cranbrook, B.C.

Braumandl, T.F. and M.P. Curran [*eds.*]. 1992. A field guide for site identification and interpretation for the Nelson Forest Region. British Columbia, Ministry of Forests, Land Management handbook No. 20.

Decker, S., D. Quamme, and J.S. Baxter. 2002. Pre-fertilization monitoring of the South Salmo River and Sheep Creek. Report to BC Hydro, Burnaby, B.C.

Sigma Engineering Ltd. 1996. Salmo River inventory and assessment. Report to Columbia Basin Fish and Wildlife Compensation Program, Nelson, B.C. Report by Sigma Engineering Ltd., Vancouver, B.C.

McElhany, P., M.H. Ruckelhaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionary significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 156 p.

Appendix I. Photographic Plates.

Plate A. Bull trout redd in the upper Salmo River.

Plate B. Bull trout hiding in cover.

Plate C. Bull trout observed in the upper South Salmo River.

Plate D. Barrier to bull trout migration on the upper South Salmo River.

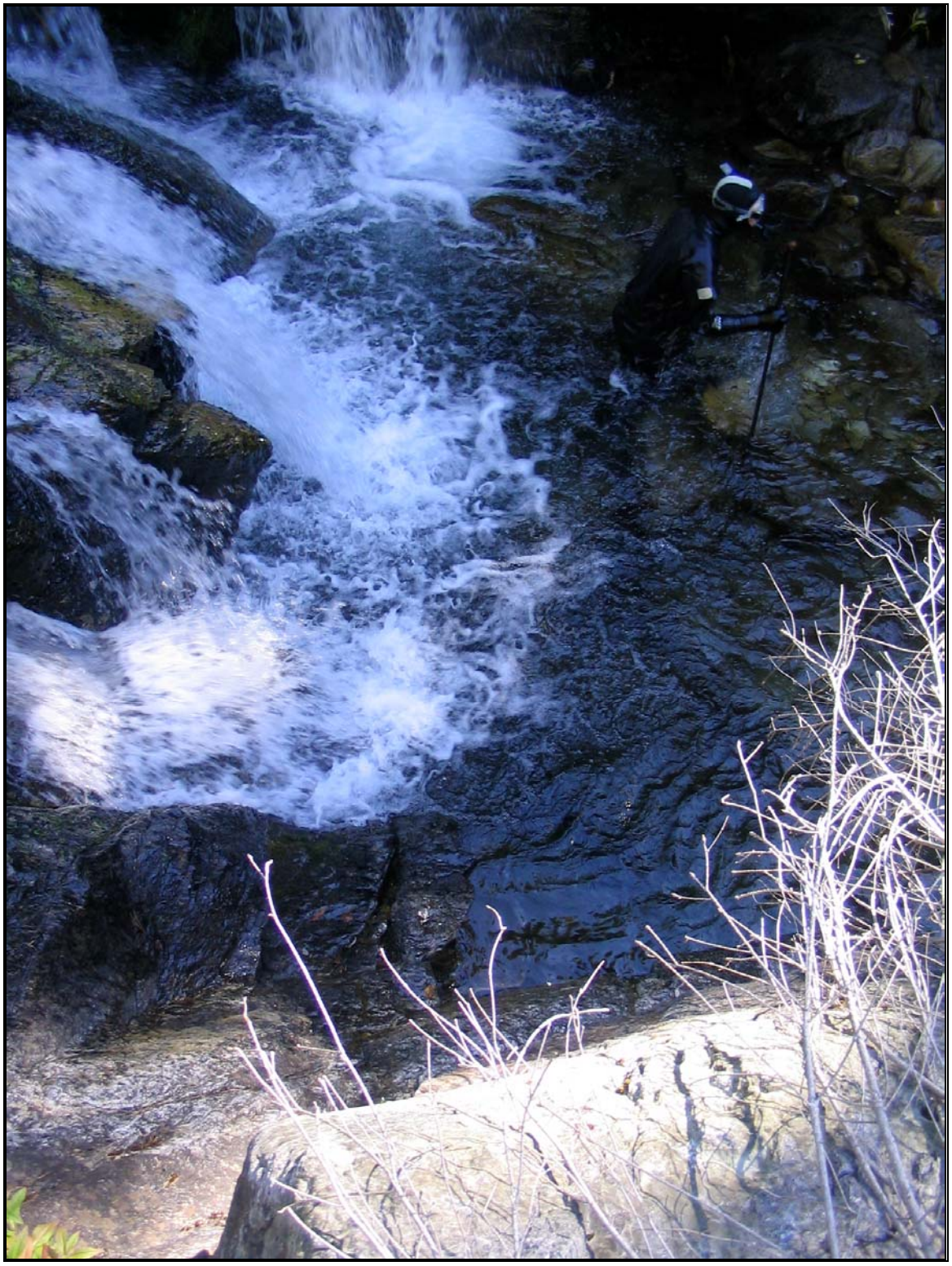

Plate E. Barrier to bull trout migration on the upper South Salmo River.

Appendix II. Summary data from bull trout redd counts conducted in the Salmo River watershed in 2003.

Clearwater Creek

Date	Location	Number of Redds	Number of Fish
October 2	Falls to mouth	22	3 Males (55-75 cm) 4 Females (70-75 cm)

upper Salmo River

Date	Location	Number of Redds	Number of Fish
September 29	Camp Busk to Barrett Creek	21	9 Males (55-75 cm) 8 Females (55-70 cm)

Sheep Creek

Date	Location	Number of Redds	Number of Fish
October 8	Log Jam to Aspen Creek	27	6 Males (60-70 cm) 4 Females (60-70 cm)
October 6	Curtis Creek to Log Jam	20	1 Males (65 cm) 0 Females

South Salmo River Watershed

Date	Location	Number of Redds	Number of Fish
October 3	South Salmo River-Stagleap Ck. confluence to 4 km d/s Stagleap Ck. confluence	6	0 Males 0 Females
October 3	Stagleap Creek-Powerlines to mouth	0	0 Males 0 Females
September 30	South Salmo River-5.6 km u/s US Border to US Border	3	2 Males (55-70 cm) 0 Females
	South Salmo River-US Border to Stagleap Ck. confluence	6	1 Males (50 cm) 0 Females

Appendix III. 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 2003 (DFS=Diver Fish Seen, WFS=Walker Fish Seen, DRS=Diver Redd Seen, WRS=Walker Redd Seen).

System	DFS	WFS	Dif	DRS	WRS	Dif
Stagleap Creek	0	0	0	0	0	0
	0	**0**	**0**	**0**	**0**	**0**
Clearwater Creek	0	0	0	1	1	0
	0	0	0	1	1	0
	1	1	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	1	1	0	1	1	0
	1	1	0	2	2	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
	0	0	0	1	1	0
	0	0	0	1	1	0
	3	3	0	1	1	0
	7	**7**	**0**	**22**	**20**	**2**
South Salmo River	3	2	1	9	9	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	3	**2**	**1**	**15**	**15**	**0**
Sheep Creek	0	0	0	2	2	0
	0	0	0	1	1	0
	0	0	0	2	2	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	2	2	0

System	DFS	WFS	Dif	DRS	WRS	Dif
Sheep Creek (continued)	0	0	0	1	1	0
	1	1	0	1	1	0
	0	0	0	2	2	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	1	1	0
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	3	3	0	2	2	0
	1	1	0	1	1	0
	0	0	0	2	2	0
	2	2	0	1	1	0
	11	**9**	**2**	**47**	**46**	**1**
Salmo River	0	0	0	1	1	0
	0	0	0	1	1	0
	0	0	0	3	3	0
	2	0	2	2	2	0
	0	0	0	1	1	0
	0	0	0	1	1	0
	1	1	0	0	0	0
	0	0	0	1	1	0
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	2	2	0	1	1	0
	3	0	3	1	0	1
	17	**5**	**12**	**21**	**19**	**2**