

Monitor and Protect Wigwam River Bull Trout for Koocanusa Reservoir

White River Bull Trout Enumeration Project Summary

Progress Report
2003



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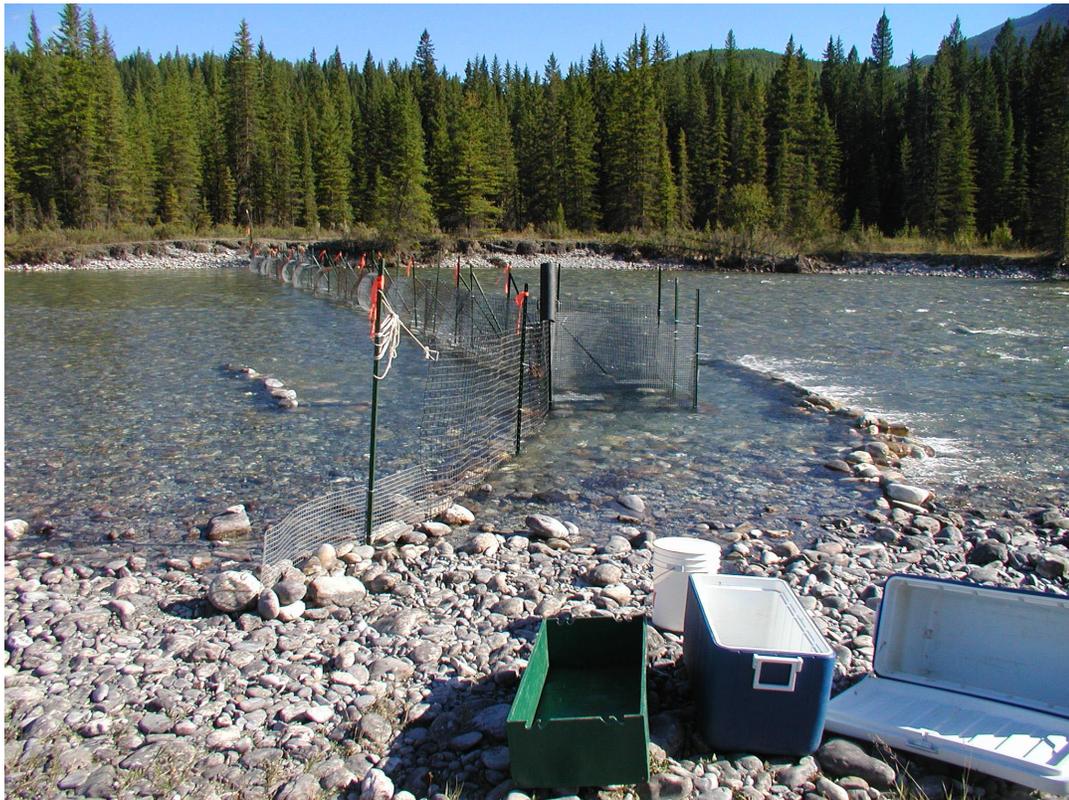
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Summary of the White River Bull Trout Enumeration Project (2003)



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Executive Summary

This report summarizes the first year of a three-year bull trout (*Salvelinus confluentus*) enumeration project on the White River and is a co-operative initiative of the British Columbia Ministry of Water, Land, and Air Protection and Bonneville Power Administration. The White River has been identified as an important bull trout spawning tributary of the upper Kootenay River in southeastern British Columbia. The objective was to collect information on the returning adult spawning population to the White River through the use of a fish fence and traps, and to conduct redd surveys at the conclusion of spawning to provide an index of spawning escapement and distribution.

The fence was installed on September 9th, 2003 and was operated continuously (*i.e.* no high-water or breaching events) until the fence was removed on October 9th, 2003. Estimation of the spawning population of White River bull trout was incomplete. This was due to a larger and more protracted out-migration than expected. As a result, the bull trout spawning population of the White River was estimated to be somewhere above 899 fish. In comparison, this represents approximately one third the population estimate of the 2003 Wigwam River bull trout spawning population.

Based on redd index data, the number of bull trout per redd was over twice that of the Wigwam River or Skookumchuck Creek. This was expected as the index sites on the Wigwam River and Skookumchuck Creek cover the majority of the spawning area. This is not true on the White River. From previous redd counts, it is known that there are approximately twice as many redds in Blackfoot Creek as there are in the index site. Additionally, given the large size of the White River watershed and in particular, the large number of tributaries, there is a high likelihood that important bull trout spawning areas remain unidentified.

Both floy tag and radio-telemetry data for the White River bull trout have identified extensive life history migrations. Similar data for the Wigwam River and Skookumchuck Creek populations illustrate there is considerable overlap and mixing among these three local populations within their over-wintering and feeding habitat. The upper Kootenay River, Lake Koocanusa and the lower Bull River provide overwintering and feeding habitat for the White River, Skookumchuck Creek and Wigwam River bull trout.

Recommendations to improve escapement estimates and spawning distribution are provided. An accurate population estimate is especially important to provide baseline for any potential impacts due to wildfire and subsequent salvage logging that is currently underway immediately

adjacent to and upstream of important spawning and rearing habitat in the Middlefork of the White River. Identification of important spawning habitat is important to meet management objectives for the White River.

Acknowledgements

The White River bull trout enumeration project is a trans-boundary initiative implemented by the British Columbia Ministry of Water, Land, and Air Protection (MWLAP), in cooperation with Bonneville Power Administration (BPA). Funding was provided by BPA under the umbrella project "Monitor and Protect Bull Trout for Koochanusa Reservoir", BPA project Number 2000-004-00. Bill Westover, Herb Tepper and Kevin Heidt (MWLAP) were responsible for project funding and development, as well as fence set-up and removal. Their contribution was greatly appreciated. Kerry Morris, Angela Prince (Westslope Fisheries Ltd.) and Jim Clarricoates (Columbia River Inter-Tribal Fisheries Commission) contributed to data collection.

Table of Contents

EXECUTIVE SUMMARY	I
ACKNOWLEDGEMENTS.....	II
TABLE OF CONTENTS.....	III
LIST OF TABLES.....	IV
LIST OF FIGURES.....	IV
1 INTRODUCTION	1
1.1 OBJECTIVES	3
1.2 STUDY AREA	3
2 METHODS.....	5
2.1 TRAPPING.....	5
2.2 ENUMERATION AND BIOLOGICAL SAMPLING.....	5
2.3 REDD COUNTS	6
2.4 WATER TEMPERATURE MONITORING	6
3 RESULTS.....	7
3.1 TRAPPING.....	7
3.2 ENUMERATION AND BIOLOGICAL SAMPLING.....	7
3.2.1 <i>Bull Trout</i>	7
3.2.2 <i>Other Species</i>	10
3.3 REDD COUNTS	12
3.4 WATER TEMPERATURE MONITORING	13
4 DISCUSSION.....	14
5 RECOMMENDATIONS	17
6 REFERENCES	18

List of Tables

Table 1. Catch composition (excluding recaptures) of the 2003 White River enumeration program.	7
Table 2. Summary of fork length and weight for bull trout captured at the White River fence, 2003.....	9
Table 3. Characteristics of bull trout populations of the upper Kootenay River core area as summarized from data collected at enumeration fences. Note: Wigwam River data from Baxter and Westover (2000) and Skookumchuck River data from Baxter and Baxter (2002).....	15

List of Figures

Figure 1. White River enumeration fence location.....	2
Figure 2. Mean, minimum, and maximum monthly discharge for the White River near Canal Flats, 1940-1948 (WSC Stn No. 08NF003).....	4
Figure 3. Frequency and timing of bull trout out-migration through the White River enumeration fence, 2003. Note that recaptures (n=1) and upstream migrants (n=2) are not included.	8
Figure 4. Length frequency distribution of bull trout captured at the White River fish fence in 2003.	9
Figure 5. Length frequency distribution of kokanee captured at the White River enumeration fence, 2003.	11
Figure 6. Length frequency distribution of mountain whitefish captured at the White River enumeration fence, 2003.....	12
Figure 7. Total number of bull trout redds enumerated within the Middlefork White River index section in 2003 compared to previous surveys.....	12
Figure 8. Total number of bull trout redds enumerated within the Blackfoot Creek index section in 2003 compared to previous surveys.....	13
Figure 9. Daily spot water temperatures for the period of fence operations, White River, 2003.	13
Figure 10. Summary of annual bull trout redd surveys conducted on the three most important upper Kootenay River spawning tributaries identified using radio-telemetry.....	16

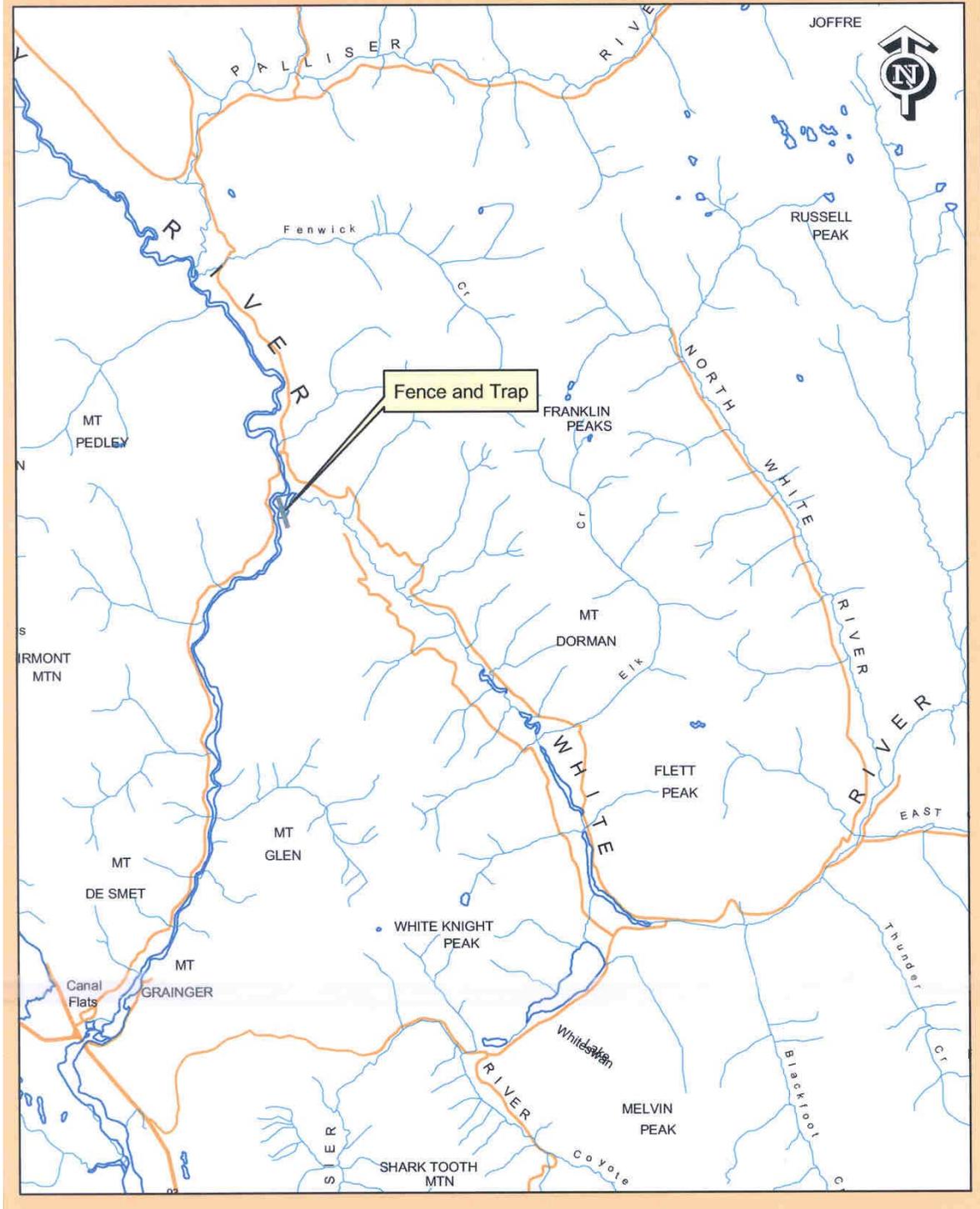
1 Introduction

This report summarizes the first year of a three-year bull trout (*Salvelinus confluentus*) enumeration project on the White River in the East Kootenay region of British Columbia (Figure 1). The White River is a regionally significant sportfish stream located in southeastern British Columbia that supports healthy populations of both bull trout and Westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Biotelemetry investigations have identified the White River watershed as a major spawning area for the upper Kootenay River bull trout population (B. Westover, MWLAP, Cranbrook, B.C., *pers. Comm.*), and as such is an important watershed for the maintenance of healthy populations of bull trout within the upper Kootenay River.

Bull trout populations have declined in many areas of their range within the Pacific Northwest including British Columbia. Bull trout were blue listed as vulnerable in British Columbia by the B.C. Conservation Data Center (Cannings 1993) and although there are many healthy populations of bull trout in the East Kootenay they remain a species of special concern. Bull trout in the United States portion of the Columbia River were listed as threatened in 1998 under the Endangered Species Act by the U.S. Fish and Wildlife Service. The upper Kootenay River watershed (above Libby Dam) is within the Kootenai sub-basin of the Mountain Columbia Province, one of eleven eco-provinces that make up the Columbia River basin and has become a primary focus of research for bull trout in both Canada and the United States. Under the U.S. Recovery Plan for bull trout, Lake Kootenusa (and the Kootenay River watershed above Libby Dam) was considered a core area (USFWS 2002). Using this core area approach, recovery criteria require that at least 5 local populations with 100 or more individuals exist, and that the area should contain 1,000 or more adult bull trout. To achieve this requirement, population monitoring was required within this core area.

In response to these concerns, the British Columbia Ministry of Water, Land and Air Protection (MWLAP) applied for and received funding from the Bonneville Power Administration (BPA) to assess and monitor the status of wild, native stocks of bull trout in tributaries to Lake Kootenusa (Libby Reservoir) and the upper Kootenay River. This task is one of many that were undertaken to "Monitor and Protect Bull Trout for Kootenusa Reservoir" (BPA Project Number 2000-04-00). These include adult enumeration projects on the Wigwam River (Baxter and Westover 2000) and Skookumchuck Creek (Baxter and

Figure 1: White River Enumeration Fence Location



Baxter 2002), juvenile bull trout and fish habitat studies in the Wigwam River (Cope 2003), Skookumchuck Creek (Cope 2003) and Middle Fork of the White River (Cope and Morris 2003) and an upper Kootenay River basin-wide radio telemetry project that is currently in its final stages (B. Westover, MWLAP, Cranbrook, B.C., *pers. Comm.*).

1.1 Objectives

The focus of this component of the study program was to collect information on the returning adult spawning population to the White River through the use of a fish fence and traps, and to conduct redd surveys at the conclusion of spawning to provide an index of spawning escapement and distribution. The data collected will contribute to the development of a long-term stock assessment program for the upper Kootenay River bull trout population that should ensure impacts from increased development and angling pressure are minimized.

Specific objectives for the first year of the 3-year enumeration project were:

- Capture and tag post-spawning bull trout at an enumeration fence in order to estimate run size and be able to determine subsequent recaptures;
- Capture other fish species at the enumeration fence; and,
- Collect biological data from all sampled fish.

1.2 Study Area

The White River originates in the Height of the Rockies Wilderness Area (HOTR), located along the western edge of the continental divide between the Park and Front Ranges of the southern Rocky Mountains in southeastern British Columbia. The upper basin of the White River is divided into three large forks. The North Fork White River and the Middle Fork White River flow south approximately 40 km until they join the East Fork of the White River (Figure 1). At this junction, the White River flows west for approximately 10 km. At Whiteswan Provincial Park the river turns north for its final 34 km until it empties into the upper Kootenay River, approximately 30 km north of the village of Canal Flats (Figure 1). The headwaters of the White River drainage originate from glacier fed alpine lakes at an elevation of approximately 2,440 m and declines to 910 m.

Provincial management objectives for the White River are protection of bull trout and Westslope cutthroat trout spawning areas and angler use of wild fish. Bull trout and Westslope cutthroat trout are the primary management species and are highly sought after

by local, regional and international anglers. A local commercial guiding industry caters to recreational fishermen targeting these fish.

The White River is characterized by long, narrow and forested valleys running through the rugged Rocky Mountains. Elevated layers of limestone dominate the geology. Three biogeoclimatic zones dominate the valleys. Montane Spruce at lower elevations, Engelmann Spruce and Sub alpine fir at middle elevations are the most common and alpine tundra at higher elevations (above approximately 2300 m). In 1936, a forest fire burned much of the HOTR and the upper Middle Fork White River watershed. Historic forest fire salvage logging was extensive in these reaches. In 2003, a wildfire again burned the upper Middle Fork White River and the HOTR. Currently, aggressive salvage logging is being undertaken within the upper reaches of the Middle Fork White River watershed below the HOTR.

The White River has a total watershed area of 987 km². The flow regime is comparable to most interior streams with high annual run-off reaching it's peak in June or July and expected low flows in late fall and winter (Figure 2).

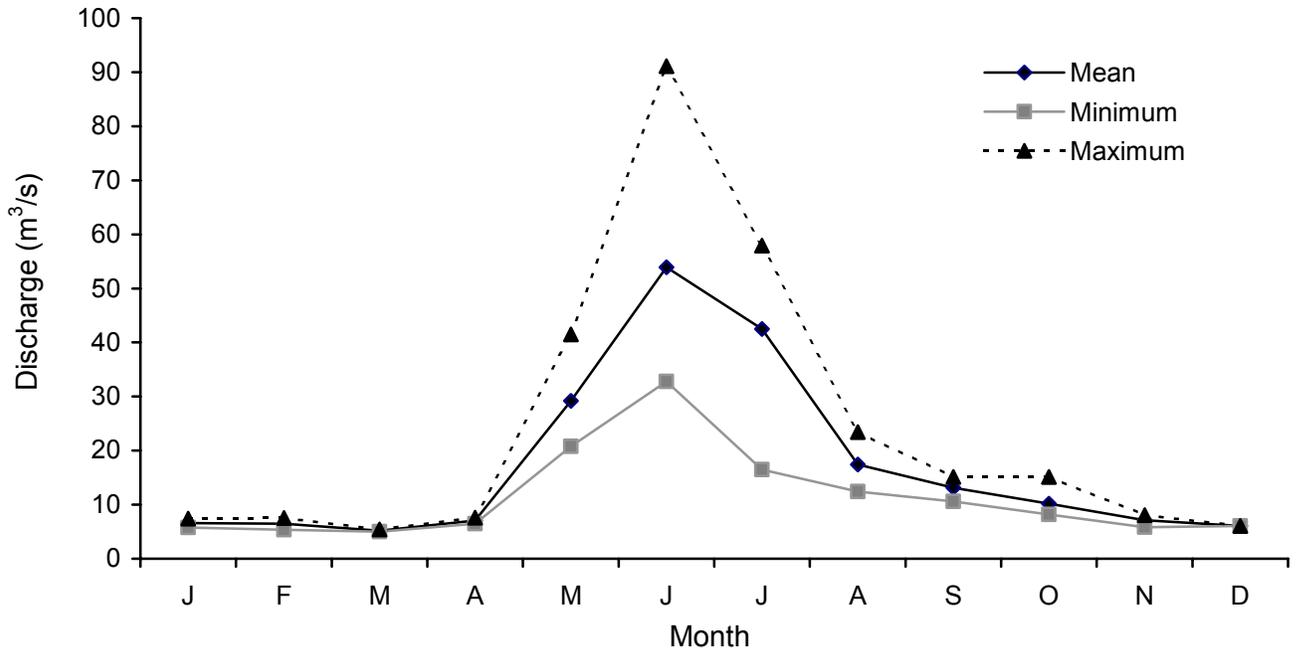


Figure 2. Mean, minimum, and maximum monthly discharge for the White River near Canal Flats, 1940-1948 (WSC Stn No. 08NF003).

2 Methods

2.1 Trapping

A 5.0 cm square coated wire mesh fish fence supported by T-bar fence posts was installed across the White River on 9 September, 2003, immediately upstream of the confluence with the Kootenay River (see cover photo). Upstream and downstream traps constructed of 2.5 cm wire mesh were used in conjunction with the fence to capture and hold the fish until processing. River rock and wire skirting were used on the upstream side of the fence to seal the bottom of the structure where the fence came into contact with the streambed. Finally, moveable 2.5 cm mesh wire panels were hinged to the upstream side of the fence in order to allow debris to be removed quickly by flipping the panels and any accumulated debris to the downstream side of the fence. The enumeration fence was installed at this time of year primarily to capture downstream migrating bull trout kelts and minimize the effect the fence might have on the reproductive biology of the fish.

Traps were fished continuously, and periodically the fence was cleaned of debris and the traps were emptied of fish. Frequency of trap and fence maintenance was determined by flow and debris conditions as well as catch frequency; however, the fence was cleaned and traps checked a minimum of three times nightly (20:00, 01:00, 6:00) and during mid-day.

Immediately prior to the fence being removed, bull trout remaining within 600 m upstream of the fence were enumerated by snorkeling.

2.2 Enumeration and Biological Sampling

All captured fish were transferred to an insulated 40-L bath of river water containing 2.0 ml clove oil yielding bath concentrations of 50 mg/l. The lowest effective dose of clove oil is recommended, as time to recovery of equilibrium and fear response in salmonids has been shown to increase exponentially with exposure time (Keene *et. al.* 1998). Because of its low solubility in water, the clove oil was first dissolved in 10-ml of ethanol (95%) before being added to the river water. Clove oil is a safe, inexpensive, and effective anaesthetic suitable for food fish in the field (Prince and Powell 2000, Anderson *et. al.* 1997).

Once anaesthetized, the fish were examined for the presence of previous tags and condition. Fish were subsequently measured for fork length (cm), weight (g), sexed, and tagged with a Floy tag placed at the base of the dorsal fin. Bull trout Floy tags were purple in colour, Westslope cutthroat trout were yellow in colour, and all other species were released without tags. Floy tags used for this study were Floy FD-94 T-Bar anchor tags,

with 1 inch bare monofilament below the tubing. Tags were inserted with a Mark II super heavy duty tagging gun having a one inch insertion using Mark II long, regular needles (outside diameter = 0.22 cm). After recovery the fish were released in the direction they were migrating.

2.3 Redd Counts

Bull trout redds were visually enumerated by two-person crews that traversed index sites located in the high density spawning reaches of the mainstem Middlefork of the White River and Blackfoot Creek. The Middlefork White River site extends from the bridge at kilometer 70 of the White River Middlefork Forest Service Road (FSR) downstream to the bridge at kilometer 60. The Blackfoot Creek site extends from the bridge at kilometer 48 of the Blackfoot FSR downstream to the bridge at approximately kilometer 45. Surveys were conducted October 3 (Middlefork) and October 6, 2003 (Blackfoot).

2.4 Water Temperature Monitoring

Spot water temperatures were taken at the fence location each day at 18:00. A water temperature monitoring program was established during fence operations, and two Optic StowAway™ temperature thermographs were installed at the fence (12 September, 2003) and at the Middlefork spawning grounds (21 September, 2003). Thermistors were programmed to record instantaneous temperatures every 15 minutes and the hourly average was logged. Thermistors will be downloaded in the summer of 2004.

3 Results

3.1 Trapping

The fence was installed on September 9, 2003, and then remained operational throughout the duration of the study period (*i.e.* no high-water or breaching events occurred). The fence was removed on October 9th, 2003. As a result, daily out-migration estimates were generated for 30 consecutive days.

3.2 Enumeration and Biological Sampling

3.2.1 Bull Trout

The 2003 catch and relative contribution of each fish species to the total catch are presented in Table 1.

Table 1. Catch composition (excluding recaptures) of the 2003 White River enumeration program.

Common Name	Catch	% Composition
Bull Trout	776	59.3
Kokanee	328	25.0
Mountain Whitefish	196	15.0
Westslope Cutthroat Trout	5	0.4
Rainbow Trout	2	0.2
Burbot	1	0.1
Total	1,308	100.0

A total of 776 bull trout were sampled through the enumeration fence. Two bull trout were juveniles less than 24 cm in fork length and were not tagged. In addition, eight bull trout had a floy tag present from previous sampling in the Bull River and Kootenay River; only one of these fish was tagged with a purple tag due to tag damage. The remaining 767 captured bull trout were tagged with a purple Floy Tag.

Of the 776 bull trout that were processed, 774 were downstream out-migrants (Figure 3) and two were upstream migrants. Estimation of the spawning population of White River bull trout was most certainly negatively biased. Bull trout were caught immediately upon fence installation, and increasing daily catches from 2 October to 8 October indicate a significant proportion of the out-migrant population remained within the White River after removal

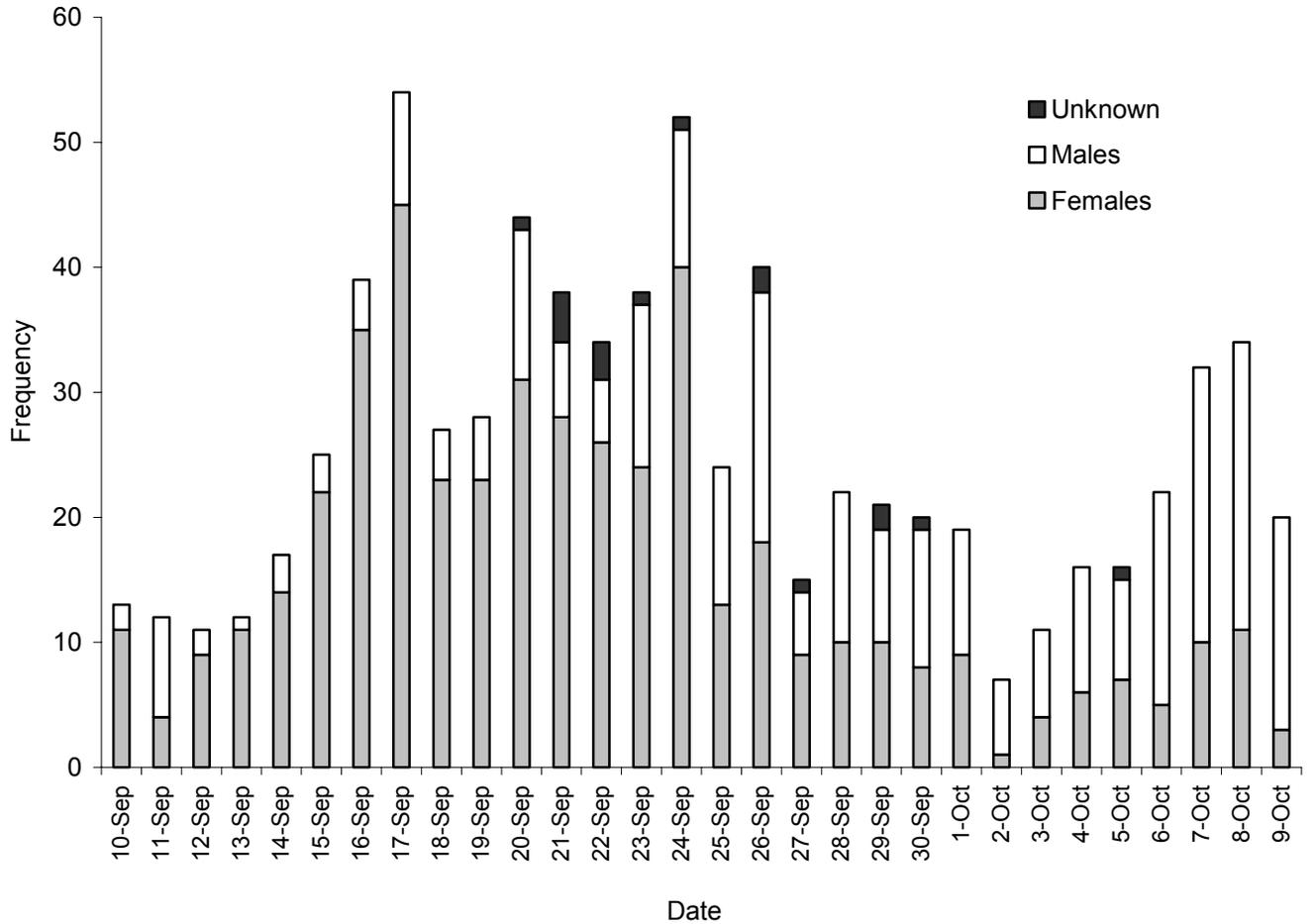


Figure 3. Frequency and timing of bull trout out-migration through the White River enumeration fence, 2003. Note that recaptures (n=1) and upstream migrants (n=2) are not included.

of the fence. In addition, 123 bull trout were observed immediately upstream of the fence during the snorkel survey, prior to the fence being removed on October 9. With the addition of this snorkel count, the total bull trout count was 899 fish. Fence operations should be extended in future years to more accurately estimate the spawning escapement within the White River.

Of the 776 bull trout, 289 were males, 470 were females and the sex could not be determined for 17 fish. Of the 759 bull trout where sex could be determined, the sex ratio was 1.63:1 females to males. The mean length and weight of a post-spawning White River out-migrant was 66 cm and 3,013 g (Table 2). Captured bull trout ranged from 22.4 cm to 89.5 cm in length and the length frequency distribution of all captures, including unknown sex, is illustrated in Figure 4.

Table 2. Summary of fork length (cm) and weight (g) for bull trout captured at the White River fence, 2003.

	<u>Males</u>		<u>Females</u>		<u>Combined</u> ¹	
	Length	Weight	Length	Weight	Length	Weight
Mean	66.3	3232	65.9	2942	65.7	3013
Minimum	40.0	450	43.1	500	22.4	150
Maximum	89.0	6900	89.5	7250	89.5	7250
N	289	289	470	469	776	775
Std error	0.64	85	0.38	48	0.35	45

1 – includes unidentified sex.

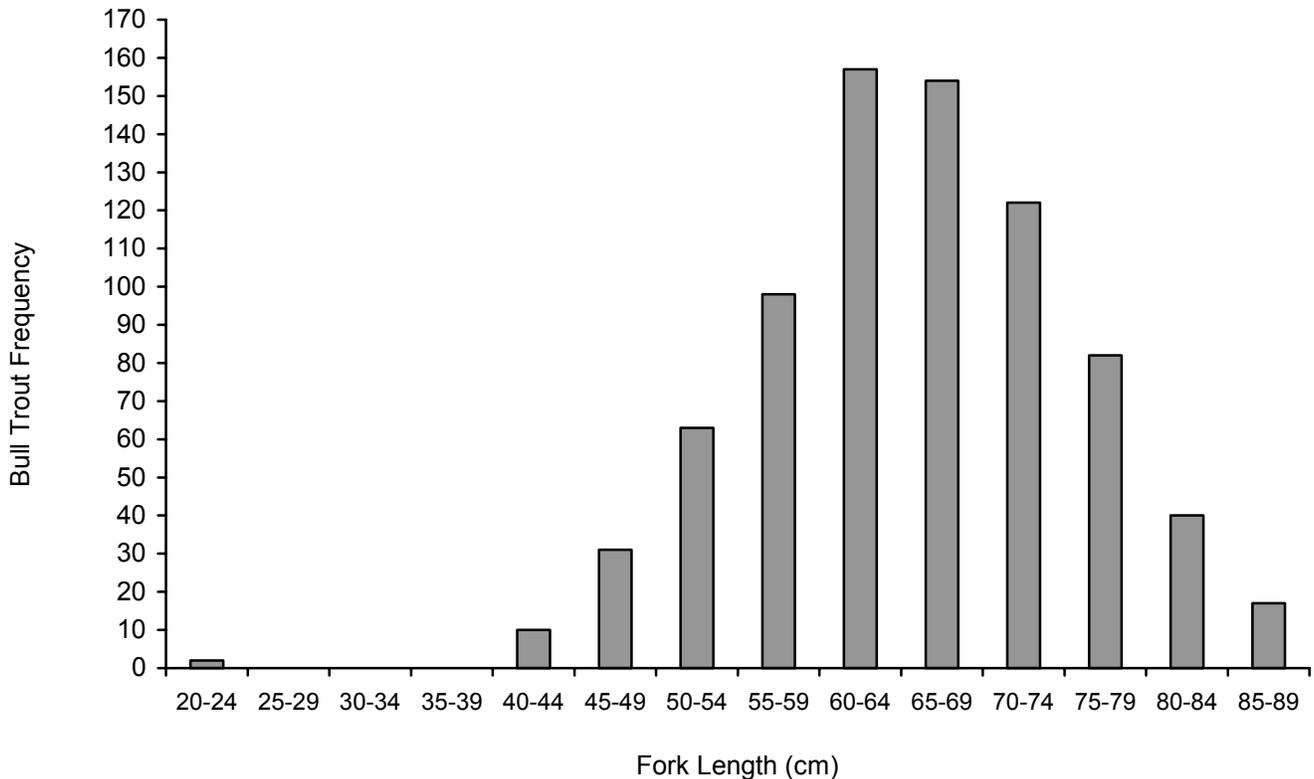


Figure 4. Length frequency distribution of bull trout captured at the White River fish fence in 2003.

There were eight recaptures from previous bull trout tagging programs within the upper Kootenay watershed. Two bull trout were previously tagged in the Bull River, five were tagged in the Kootenay River and one was tagged in the White River. Seven of these recaptures were originally tagged in 2000 for the upper Kootenay River radio telemetry project and movement data for six of the previously radio-tagged fish was available (B. Westover, MWLAP, Cranbrook, B.C., *file data*). Of the six movement histories one was limited to only three observations; the remaining five fish that are discussed here had a minimum of sixteen observations over 2 years. All five recaptures were post-spawning bull trout that had previously spawned in the White River in 2000, 2001 or both 2000 and 2001. These fish migrate from over-wintering habitat within the upper Kootenay River as far downstream as Lake Kooconusa, to spawning habitat within the upper White River watershed. This migration was on average 134.4 km (range 84 km to 174 km). Life histories for these fish were relatively consistent, in that they generally spent November through May in over-winter habitat within the upper Kootenay River, located between Skookumchuck and Lake Kooconusa. In June through August these mature fish migrated to spawning habitat located in the upper White River watershed. The majority of spawning occurs in September and out-migration occurs during September and October. Post spawners were actively feeding on mountain whitefish and kokanee in late September through November, as they migrated downstream to over-wintering habitat.

At the time of this report, recreational fisherman in the Kootenay had harvested two bull trout tagged at the White River fence, both at the Skookumchuck Creek confluence (approximately 60 km downstream of the White River). A third fish was captured and released 127 km downstream of the White River, at the confluence of Norbury Creek.

3.2.2 Other Species

In addition to bull trout, kokanee, mountain whitefish, Westslope cutthroat trout, rainbow trout and burbot were captured during the 2003 enumeration program. Incidental captures represent regionally important sportfish and are the primary food source for bull trout.

There were 328 kokanee captured representing 25% of the enumeration catch. The majority of kokanee captures were downstream out-migrants (n= 322). Kokanee ranged in length from 20.0 cm to 33.5 cm (mean = 25.5; n=275) and the length frequency distribution is illustrated in Figure 5. Kokanee ranged in weight from 75 g to 375 g (mean = 240.7; n=135). As the project progressed their condition factor decreased, and near the projects end, captures represented mortalities that were decomposing and stuck to the fence as debris. For this reason there were very few weights collected.

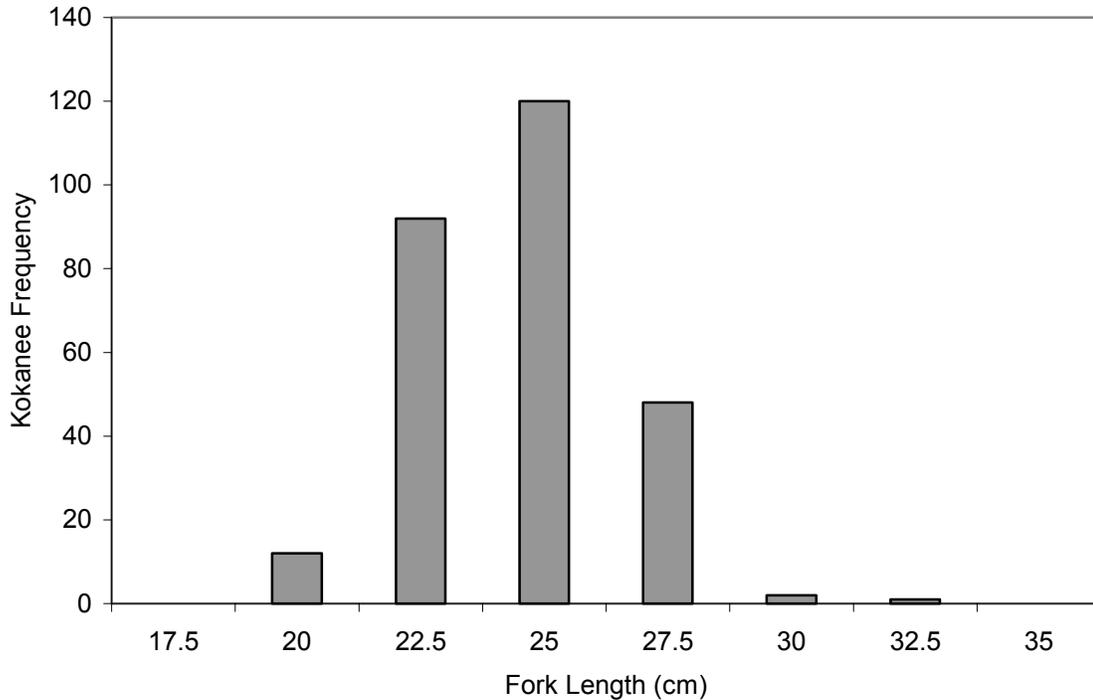


Figure 5. Length frequency distribution of kokanee captured at the White River enumeration fence, 2003.

There were 196 rocky mountain whitefish captured representing 15% of the catch. All 196 whitefish captures were downstream out-migrants. Whitefish ranged in length from 14.0 cm to 41.0 cm (mean = 23.7; n=187) and the length frequency distribution is illustrated in Figure 6. Whitefish ranged in weight from 50 g to 800 g (mean = 226.1; n=135).

There were five Westslope cutthroat trout captured; one was migrating upstream and four were migrating downstream. Only two of these fish were floy tagged as two were found dead in the fence and a third was released badly injured. Cutthroat trout ranged in fork length from 18.0 cm to 37.3 cm.

Two rainbow trout were captured migrating downstream. These fish were 34.5 cm and 46.4 cm in length. Rainbow trout were released unmarked.

One burbot 67 cm in total length was captured migrating downstream and released unmarked.

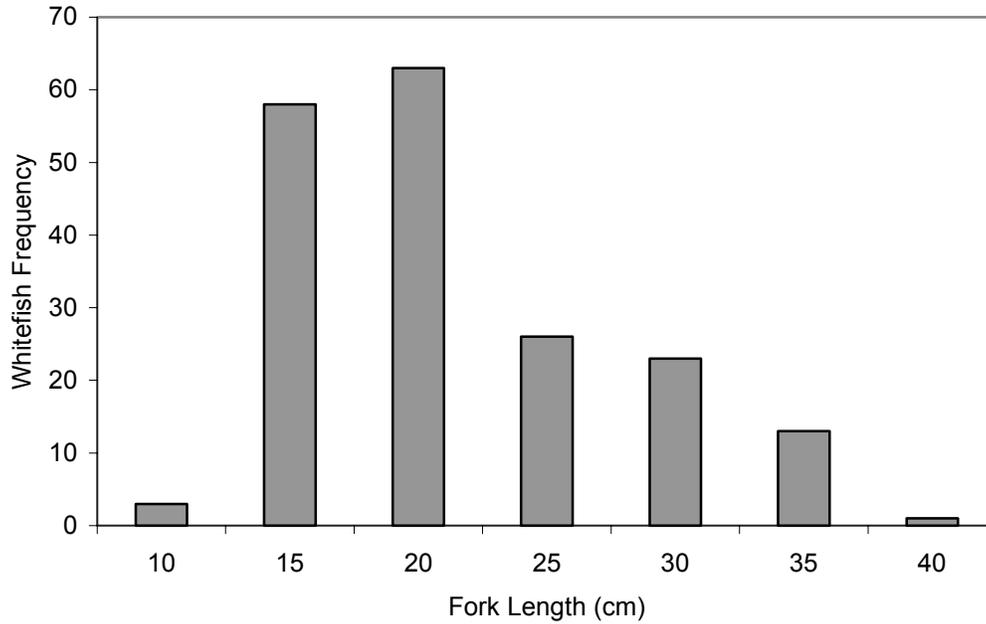


Figure 6. Length frequency distribution of mountain whitefish captured at the White River enumeration fence, 2003.

3.3 Redd Counts

A total of 239 bull trout redds were enumerated at the index sites. There were 143 redds enumerated at the Middlefork White River index site and 96 redds enumerated at the Blackfoot Creek index site. Bull trout redds have decreased marginally from previous surveys in 2001 and 2002 (Figures 7 and 8).

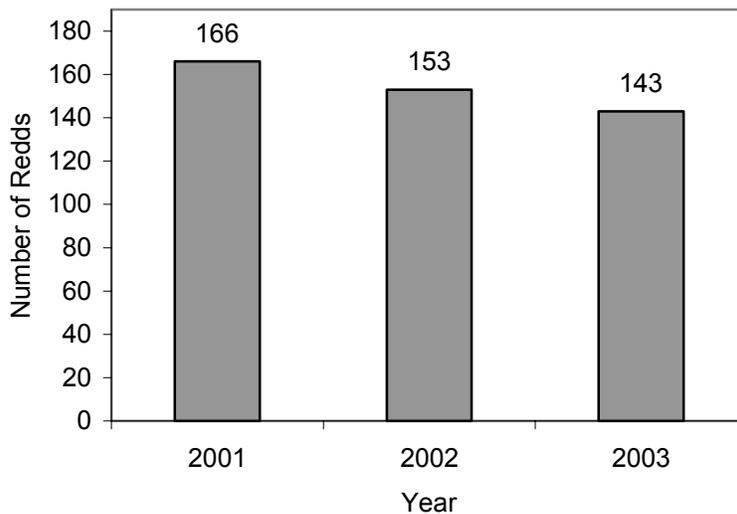


Figure 7. Total number of bull trout redds enumerated within the Middlefork White River index section in 2003 compared to previous surveys.

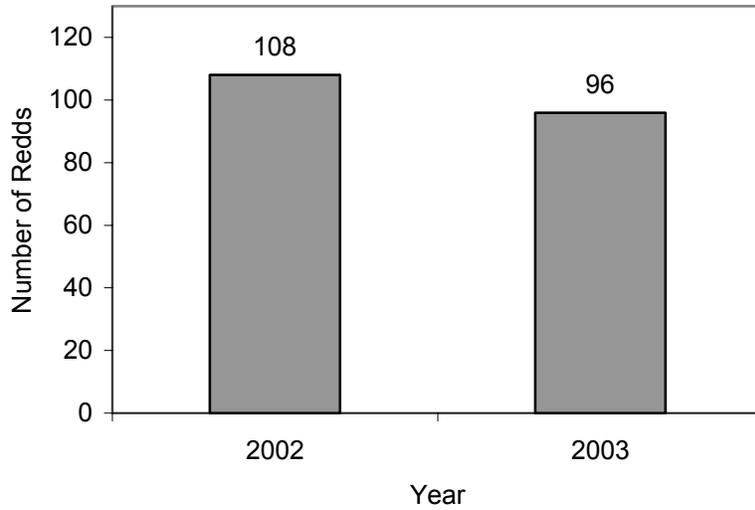


Figure 8. Total number of bull trout redds enumerated within the Blackfoot Creek index section in 2003 compared to previous surveys.

3.4 Water Temperature Monitoring

Daily spot water temperatures ranged from 11.5 °C to 7.4 °C (Figure 9). These temperatures were well within the range preferred by bull trout, and were consistent with expectations. Daily mean temperatures will be downloaded from thermographs in the summer of 2004.

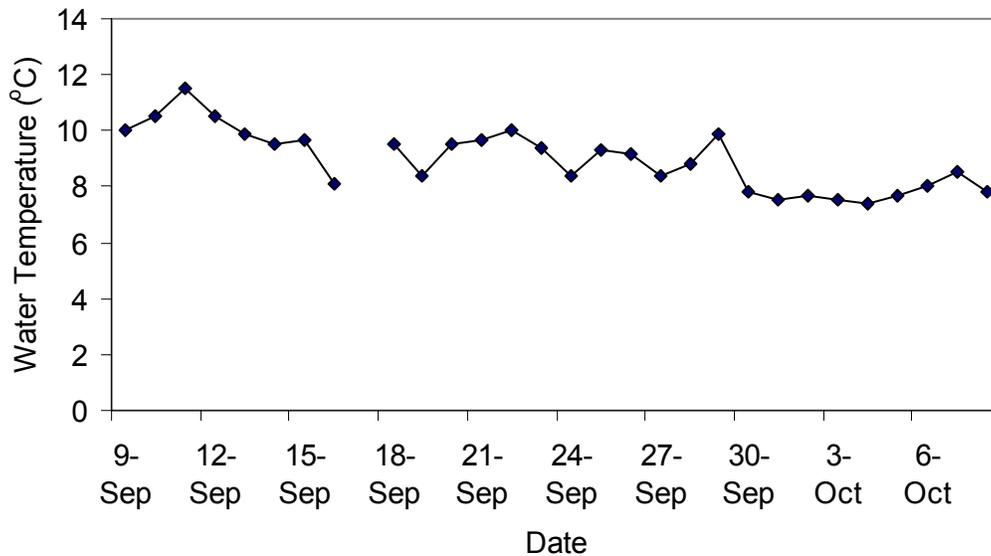


Figure 9. Daily spot water temperatures for the period of fence operations, White River, 2003.

4 Discussion

The use of the enumeration fence in the upper Kootenay River tributaries, over the past eight years, has provided an extensive database on the biological characteristics for three of the sub-populations (Wigwam River, Skookumchuck Creek and White River) within the upper Kootenay River core area (Table 3). Enumeration data from the Wigwam River and Skookumchuck Creek have served as valuable indexes of population size within the time frame of operation. However, estimation of the spawning population of White River bull trout was negatively biased, as the enumeration data for the present study was incomplete. As a result, the bull trout spawning population of the White River was estimated to be somewhere above 899 fish.

There was strong evidence to support this conclusion from the following:

- Out-migrant bull trout were captured immediately upon fence installation;
- The significant pulse of out-migrants from 2 to 9 October suggests the out-migration was not completed at the time of fence removal;
- Bull trout were observed on the spawning grounds during the redd surveys of 3 and 6 October; and,
- 123 bull trout were observed in the 600 m immediately upstream of the fence at the time of removal.

Based on redd enumeration data, the 2003 spawning population of Wigwam River bull trout was probably in excess of 3,000 adults (Figure 10; B. Westover, MWLAP, Cranbrook, B.C., *pers. Comm.*). When compared to other bull trout systems, it can be argued that the Wigwam River may be the most prolific bull trout population in the species distribution range. The current estimate for the White River population was in excess of 899 fish, approximately one-third of the Wigwam River population. The presence of two such populations within the upper Kootenay River, in conjunction with the U.S. Fish and Wildlife listing of the Columbia River population of bull trout as a threatened species, has international significance and places the status of the upper Kootenay River core area as a high priority for government, public and First Nations agencies.

Based on redd index data, the number of bull trout per redd (*i.e.* 3.8; Table 3) was over twice that of the Wigwam River or Skookumchuck Creek. This was expected as the index sites on the Wigwam River and Skookumchuck Creek cover the majority of the spawning

Table 3. Characteristics of bull trout populations of the upper Kootenay River core area as summarized from data collected at enumeration fences. Note: Wigwam River data from Baxter and Westover (2000) and Skookumchuck River data from Baxter and Baxter (2002).

Variable	<u>Wigwam River (730.6 km²)</u>				<u>Skookumchuck River (641 km²)</u>			<u>White River (987 km²)</u>
	1996	1997	1998	1999	2000	2001	2002	2003
Total Bull Trout Through Fence	862	616	821	978	252	273	309	776
No. Observed (snorkel count prior to fence removal)	n/a	n/a	n/a	n/a	67	19	41	123
Sex Ratio (Females:Males)	1.9:1	2.5:1	2.5:1	2.2:1	3.0:1	2.8:1	1.6:1	1.6:1
Total Redds Enumerated	512	598	679	849	197	143	149	239
Estimated No. Bull Trout per Redd	2.1	1.2	1.5	1.4	1.6	2.0	2.1	3.8 ^a
Total Length (cm)								
Mean	67	65	66	67	69	64	68	66
Range	43-86	38-87	34-91	37-91	40-92	40-92	42-90	22-90
Male Length (cm)								
Mean	71	71	72	72	79	74	75	66
Range	52-86	38-87	34-91	44-91	51-92	52-92	60-90	40-89
Female Length (cm)								
Mean	65	63	63	65	66	65	65	66
Range	43-86	46-85	42-85	37-85	40-86	50-88	42-86	43-90
Timing Through Fence								
Peak	Sept 30	Oct 1	Sept 24	Sept 20	Sept 20	Sept 19	Sept 26	Sept 24
Start	Sept 11	Sept 13	Sept 9	Sept 9	Sept 7	Sept 6	Sept 7	Sept 9
End	Oct 14	Oct 14	Oct 14	Oct 14	Oct 16	Oct 12	Oct 10	Oct 9

a – note that based on redds in index sites only and is known to be high. Index Sites for the White River encompass a much lower proportion of the known spawning habitat as compared to the Wigwam River and Skookumchuck Creek.

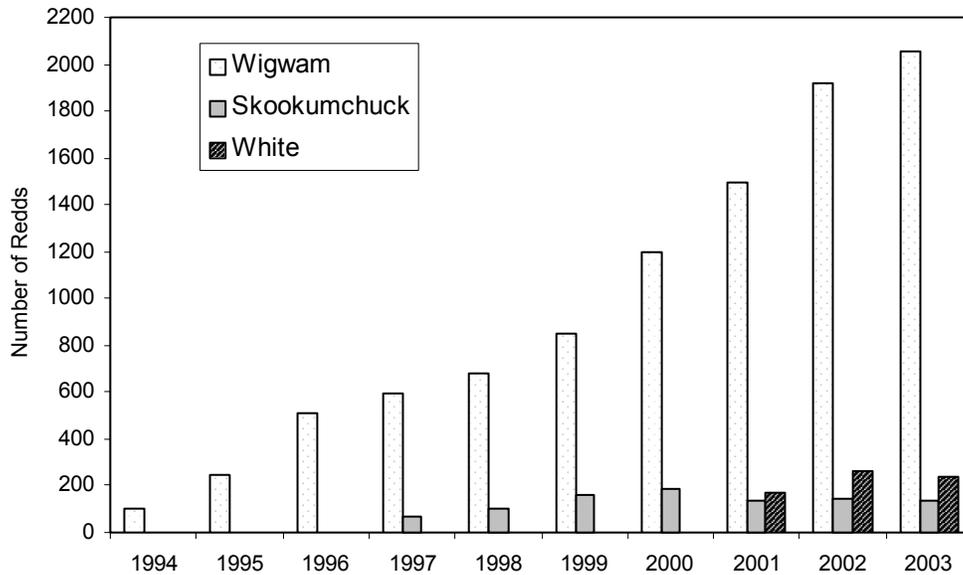


Figure 10. Summary of annual bull trout redd surveys conducted on the three most important upper Kootenay River spawning tributaries identified using radio-telemetry.

area. This is not true on the White River. From previous redd counts, it is known that there are approximately twice as many redds in Blackfoot Creek as there are in the index site. Additionally, given the large size of the White River watershed and in particular, the large number of tributaries (*i.e.* NorthFork and EastFork White River) there is a high likelihood that there are additional important bull trout spawning areas that remain unidentified. Since previous aerial surveys have been unable to identify additional redds in the mainstem North Fork or Eastfork White River, it was suspected they spawn in small tributaries that are not seen from the air.

Both floy tag and radio-telemetry data for the White River bull trout have identified extensive life history migrations (mean home range = 134.4 km; range 84 km to 174 km; $n = 5$). Similar data for the Wigwam River and Skookumchuck Creek populations illustrate that there is considerable overlap and mixing among these three local populations within their over-wintering and feeding habitat. The upper Kootenay River, Lake Kooconusa and the lower Bull River provide overwintering and feeding habitat for the White River, Skookumchuck Creek and Wigwam River bull trout. Although bull trout in the upper Kootenay River watershed show some genetic uniqueness between individual watersheds (Taylor *et. al.* 1999), management of these populations based on the upper Kootenay River as a core area is the correct stance (Baxter and Baxter 2002).

Bull trout populations have been shown to be extremely susceptible to habitat degradation and over harvest (McPhail and Baxter 1996, Ratliff *et. al.* 1996) and are ecologically important as an indicator of watershed health (Ford *et. al.* 1995). When compared to other watersheds within the species distribution range, a strong case can be made that the large spawning escapement of bull trout within the White River represents a large and stable population that is a positive indicator of ecological watershed health. Alternatively, a strong case can be made that due to the susceptibility of bull trout to habitat perturbation, this population is currently threatened by aggressive salvage logging that is presently underway within the wildfire area of the Middlefork of the White River. The salvage logging is taking place immediately adjacent to and upstream of extremely important bull trout spawning and rearing habitat. Aggressive salvage logging with exemptions and/or amendments to Provincial standards designed to protect and mitigate for forest harvesting impacts on resident fish species, would appear to be in conflict with Provincial fisheries management objectives to protect spawning habitat. Continued annual population and habitat monitoring of this population is required to insure stability and immediately identify any potential impacts. This is particularly important given the sensitivity of bull trout to habitat perturbation and the significance of this population on an international, regional and local scale.

5 Recommendations

In order to more accurately estimate the spawning escapement of bull trout within the White River, the maintenance of the enumeration fence should be extended for approximately 10 days. It is recommended that the 2004 program run from approximately 6 September through 18 October. An accurate population estimate is especially important to provide baseline for any potential impacts due to wildfire and subsequent salvage logging.

Given that there is a high likelihood of important bull trout spawning areas that remain unaccounted for, a basin wide aerial survey and ground count was recommended. A total redd count would also provide an alternate means of estimating the spawning escapement of bull trout in the White River. It was recommended that the entire watershed be flown, in detail, using a helicopter, to identify concentrations of redds. Ground surveys should then be used to enumerate redds on a basin-wide scale. A basin wide redd enumeration program every five years is recommended.

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