Upper Kootenay River Bull Trout Radio Telemetry Project

Monitor and Protect Wigwam River Bull Trout for Koocanusa Reservoir

Summary Report
2000 - 2003

DOE/BP-00005672-10

March 2004

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Upper Kootenay River Bull Trout Radio Telemetry Project (2000-2003)

Prepared by:
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March 2004

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EXECUTIVE SUMMARY

A bull trout radio telemetry project was carried out over approximately two and a half years (April 2000 – September 2002) in the upper Kootenay River watershed. A total of seventy-one bull trout were implanted with radio tags (30 females, 24 males and 17 unidentified). Tagged fish ranged in length from 47 cm to 88 cm and weighed between 1.10 kg and 7.25 kg. Of the seventy-one fish, thirty-nine were tagged in the upper Kootenay River, fourteen in Skookumchuck Creek, ten in the Bull River, seven in the White River and one in the Palliser River.

In total, 133 hours were spent tracking bull trout (81 hours in a fix wing airplane and 52 hours in a helicopter). A total of 1,127 separate bull trout locations were recorded for the seventy-one radio tagged fish (mean = 15.9 times per fish). Fourty-seven of the radio tagged bull trout spawned at least once. The project confirmed major bull trout spawning locations on the Wigwam River and Skookumchuck Creek, but more importantly it identified previously unknown spawning concentrations of bull trout in the White River, Blackfoot Creek and Verdant Creek.

The timing and location of bull trout over-wintering as well as the timing of spawning migrations through the sport fishery were determined. Bull trout began their pre-spawning migration from over-wintering locations in the Kootenay River and/or Lake Koocanusa between mid-May and mid-June during ascending and peak discharge levels. Bull trout leave the Kootenay River and enter their spawning tributary streams throughout July, directly corresponding with decreasing discharge rates. Spawning occurred throughout September and early October. After spawning, most radio tagged bull trout returned immediately to the Kootenay River. The only exception to this finding were bull trout tracked to the Bull River, which did not return to the Kootenay River until mid-October to mid-November. By early November, bull trout were in their over wintering habitats and remained there until the following May/June.

Although all bull trout were radio tagged in the Kootenay River or its' tributaries, it was estimated from radio telemetry data that 20% of the radio tagged fish were adfluvial and over-wintered in Lake Koocanusa. The remaining 80% of the tagged bull trout displayed a fluvial life history form and over-wintered in the Kootenay River upstream of Lake Koocanusa or in the Kootenay River within the drawdown portion of the reservoir. Both life history forms spawned in many of the same systems, but clearly utilized different areas for over-wintering. The use of similar spawning areas suggests a degree of genetic mixing occurs between the adfluvial and fluvial bull trout populations found in the upper Kootenay watershed.

Due to the sensitive nature of information related to bull trout spawning, staging and over-wintering locations, site specific data are not included in this general report; however, they are available from the Ministry of Water, Land and Air Protection once permission has been obtained from the Regional Manager or his designate.

ACKNOWLEDGEMENTS

The authors would like to acknowledge several organizations for providing funding for this project. The project began in April, 2000, with funding from the Habitat Conservation Trust Fund, Bonneville Power Administration, Columbia Basin Fish and Wildlife Compensation Program and Columbia Basin Trust. The original objective was to radio tag forty bull trout in the Kootenay River between Wardner and Canal Flats. In the summer of 2000, Fisheries Renewal B.C. and B.C. Hydro became partners and provided ten additional radio tags for Bull River bull trout. The scope of this project expanded even further during the fall of 2000, when an additional twenty tags were made available by Slocan Forest Products (Radium Division) for bull trout in the Kootenay River between Canal Flats and Kootenay National Park.

Habitat Conservation Trust Fund

Bonneville Power Administration

Columbia Basin Fish and Wildlife Compensation Program

Columbia Basin Trust

Fisheries Renewal B.C.

B.C. Hydro

Slocan Forest Products (Radium Division)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Although bull trout (*Salvelinus confluentus)* are still widely distributed throughout the north-western United States and western Canada (Rieman and McIntyre 1993), they have dramatically declined throughout many areas of their native range, particularly in the southern and eastern parts (Cannings and Ptolemy 1998). Various factors have contributed to this decline, including altered or loss of habitat, introduction of non-native fish species and over-fishing.

In 1994, bull trout were blue listed as vulnerable in British Columbia by the B.C. Conservation Data Center and although there are several healthy populations of bull trout in the Kootenay region of B.C., they remain a species of special concern. In June 1998, the U.S. Fish and Wildlife Service listed bull trout as threatened under the Endangered Species Act of 1973 in the U.S. portion of the Columbia River system and on November 1, 1999 they were listed as threatened in the coterminous United States (64 FR 58910) (U.S. Fish and Wildlife Service 2002).

Until recently, the biology and life history of bull trout in the upper Kootenay River system were poorly understood. Although some preliminary work was done on Wigwam River bull trout in 1978 (Oliver 1979), it wasn't until 1994 that fisheries staff from B.C. and Montana began to develop a real understanding of bull trout life history in the Kootenay River drainage upstream of the Libby Dam (Baxter and Oliver 1997; Westover 1999; Olmsted and Dean den Biesen 2001; Baxter and Westover 2000; Baxter and Baxter 2002[2]; Cope 2003[1]; Cope 2003[2]; Cope and Morris 2003).

This report summarizes a two and a half year (April 2000 – September 2002) radio telemetry project on bull trout in the upper Kootenay River. It also includes bull trout migration data from floy tagging studies on the Bull River, Wigwam River, White River and Skookumchuck Creek over the last eight years. The objectives of this project were threefold: to assess and monitor the status of wild, native populations of bull trout in tributaries to Lake Koocanusa and the upper Kootenay River; to identify critical spawning, summer, and over-wintering habitats and to document migration timing through a rapidly developing sport fishery.

2.0 BACKGROUND

Prior to construction of the Libby Dam in Montana, British Columbia and Montana shared a fluvial stock of bull trout which spent their adult life in the mainstem of the Kootenay River and spawned in its' tributary streams. Historically, few anglers fished the upper Kootenay River for bull trout, although some were captured incidentally during a late summer (August to October) cutthroat fishery and a late winter (January to March) whitefish fishery (Anon 1966). Most Kootenay River bull trout were angled during their spawning migration in tributary streams (Fred Canning and John Bell pers. comm.). Today, there is a rapidly developing bull trout sport fishery on the mainstem of the upper Kootenay River and several of its larger tributaries.

3.0 STUDY AREA

3.1 Rivers and Streams

The upper Kootenay River is located in the southeast corner of B.C. in Fish and Wildlife Management Region 4 (Figure 1). It originates in the Rocky Mountains near the northwest corner of Kootenay National Park, and flows south through the Rocky Mountain Trench. It enters Lake Koocanusa (a reservoir formed by the Libby Dam in Montana) near Wardner, and crosses the international border into Montana near Newgate. Several major tributary streams enter the upper Kootenay River along its' length, including the Elk, Bull, St. Mary, Lussier, White, Palliser and Vermilion rivers as well as Skookumchuck and Findlay creeks. A number of smaller tributary streams also enter the upper Kootenay River and/or Lake Koocanusa (Figure 1).

The Kootenay River (upstream of the B.C. Montana border) is approximately 275 km in length and has a drainage area of approximately 20,000 km^2. Water Survey of Canada (WSC) maintains an active hydrometric gauging station (WSC Station No. 08NG065) on the Kootenay River at Fort Steele and data is available from an inactive station at Newgate (WSC Station No. 08NG042) near the international border. Mean annual discharge in the Kootenay River at Fort Steele (1963-present) is 174 m^3/s, with mean minimum and maximum values of 19.5 m^3/s and 1,820 m^3/s respectively. Mean annual

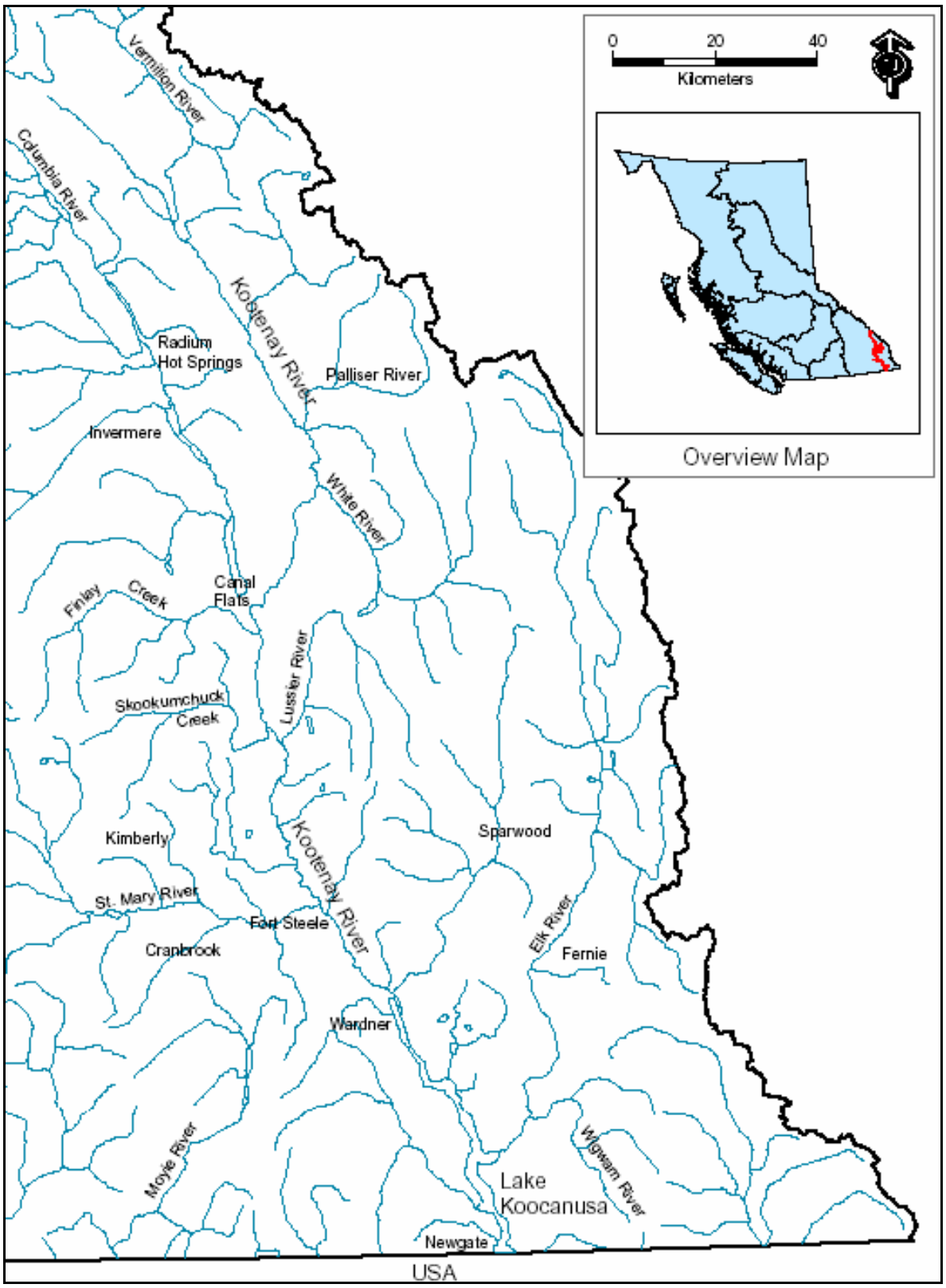

Figure 1. Location of study area.

discharge at Newgate (1930-1972) was 296 m³/s, with mean minimum and maximum values of 32.3 m³/s and 2,770 m³/s respectively (Table 1). Runoff reaches a peak in June with the highest flows between mid-May and mid-July each year (Figure 2).

Major tributaries directly relevant to this study are the Bull, White and Wigwam rivers and Skookumchuck Creek. WSC also has data from Hydrometric Stations on these systems (except the Wigwam River) (Table 1; Figures 3, 4 and 5). A hydrometric station was established by Westslope Fisheries at the Wigwam River bridge upstream of Bighorn Creek in July, 1999. Data from this station for 2000, 2001 and 2002 (excluding the winter months) are shown in Figure 6. Mean annual discharge is not available for the Wigwam River; however, mean daily minimum discharge was calculated at 2.16 m^3/s in April of 2001 and mean daily maximum discharge was calculated at 80.37 m^3/s in May of 2002 (Prince and Morris 2003) (Table 1). Discharge rates vary based on hydrometric station locations on these systems. For example, the Wigwam River station is located in the upper portion of the watershed, thereby recording lower discharge rates than those in lower portions of similar sized systems.

Table 1. Water Survey of Canada hydrometric data for the Kootenay, Bull, White and Wigwam rivers and Skookumchuck Creek.

System	Station Number	Length[3] (km)	Drainage Area (km^2)	Mean Annual Discharge (m^3/s)	Minimum Discharge (m^3/s)	Maximum Discharge (m^3/s)
Kootenay River[1]	08NG065	195	11,400	174	19.50	1,820
Kootenay River[2]	08NG042	275	20,000	296	32.30	2,770
Bull River	08NG002	107	1,530	32.9	2.40	388
Skookumchuck Ck.	08NG051	65	637	10.3	0.99	146
White River	08NF003	98	987[4]	23.3	4.25	170
Wigwam River[5]	N/A	57	835	N/A	2.16	80

[1]Kootenay River at Fort Steele
[2]Kootenay River at Newgate
[3]River lengths taken from B.C. Fisheries Inventory Data.
[4]Upstream of Hydrometric Station----total drainage area for the White River is 1,443 km²
[5]From Prince and Morris 2003

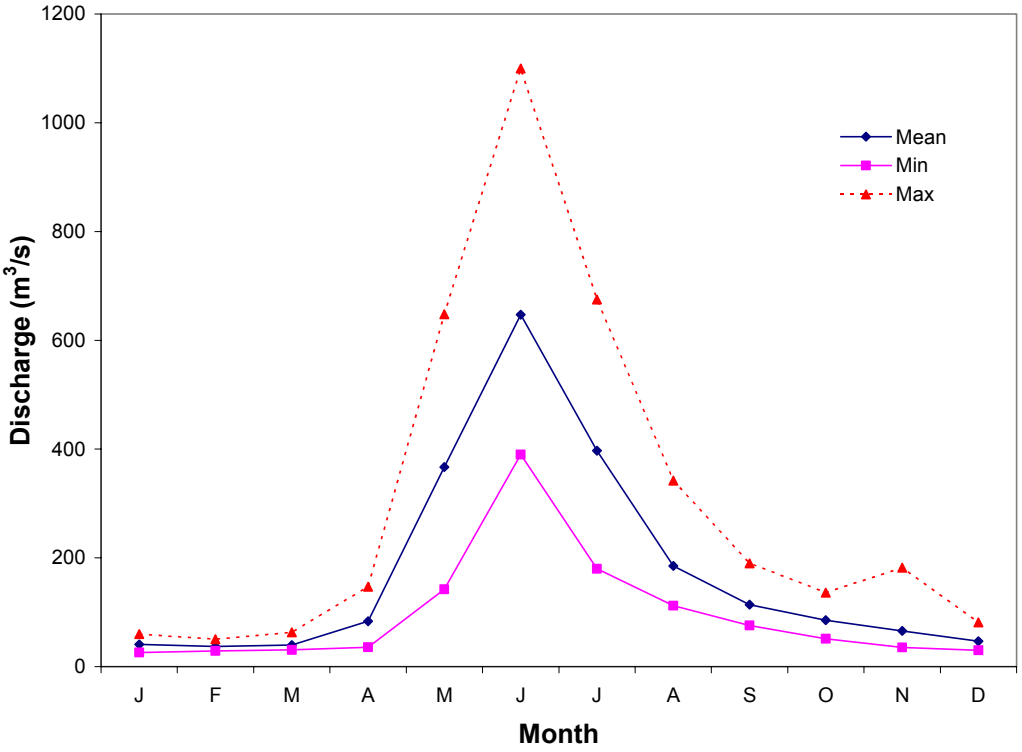

Figure 2. Mean, minimum and maximum monthly discharge for the Kootenay River at Fort Steele (1964-2000); WSC Station No. 08NG065.

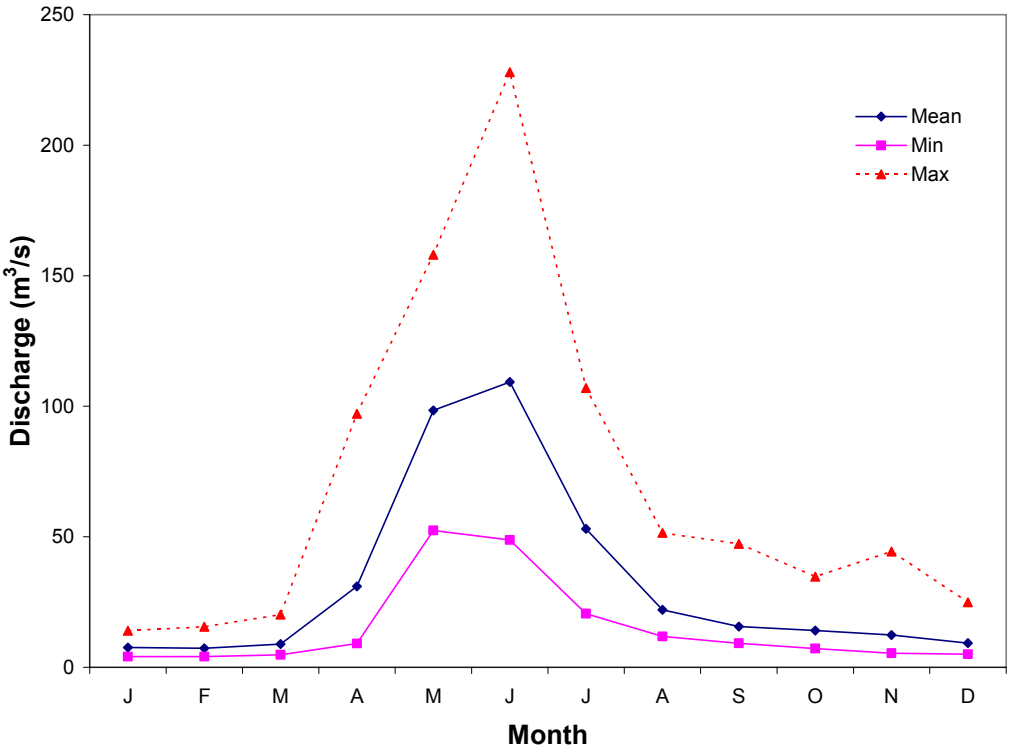

Figure 3. Mean, minimum and maximum monthly discharge for the Bull River (1914 to 2000); WSC Station No. 08NG002.

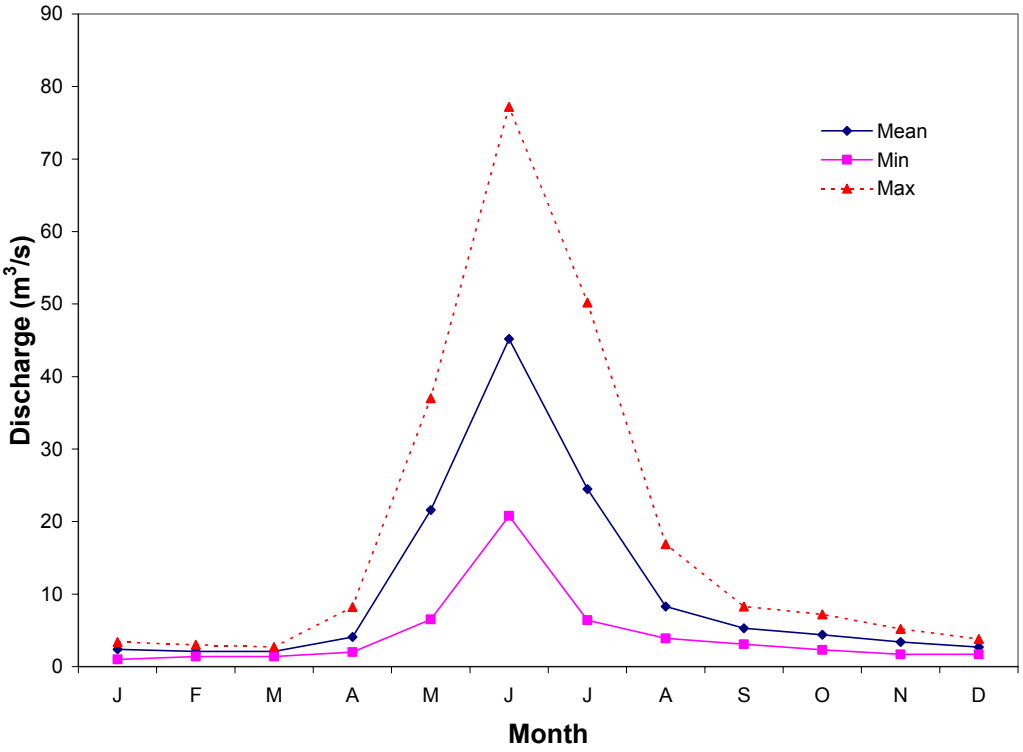

Figure 4. Mean, minimum and maximum monthly discharge for Skookumchuck Creek near Skookumchuck (1949-1955, 1963-1984); WSC Station No. 08NG051.

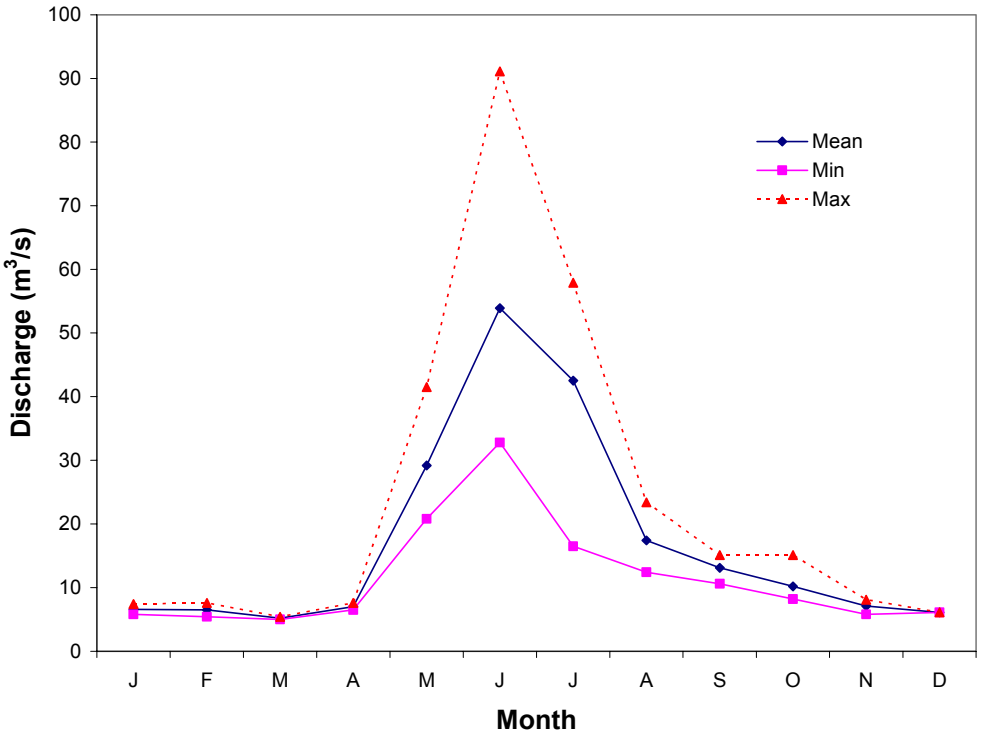

Figure 5. Mean, minimum and maximum monthly discharge for White River (1940-1948); WSC Station No. 08NF003.

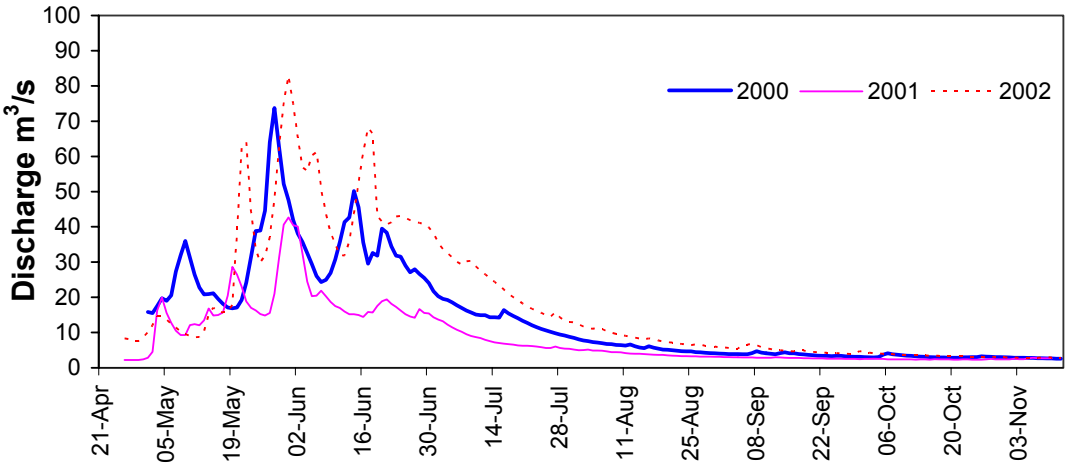

Figure 6. Mean daily discharge for the upper Wigwam River (2000-2002) (Prince and Morris 2003).

3.2 Lake Koocanusa

The Libby Dam is located on the Kootenay River approximately 27 km upstream from Libby, Montana, and was created as part of the Columbia River Treaty (Chisholm and Fraley 1985). Construction of the Libby Dam began in 1969 and impoundment was first achieved in March, 1972. The reservoir (Lake Koocanusa) reached full pool for the first time in July, 1974 (Shepard 1984). The main purpose of this dam was to generate hydro-electric power and assist with flood control. More recently, Lake Koocanusa water levels have also been manipulated to influence downstream flows for sturgeon and burbot in the Kootenay River and salmon in the lower Columbia River.

At full pool, Lake Koocanusa is 145 km long, with 68 km of its length located in B.C. It has a surface area of 18,801 hectares and a mean and maximum water depth of 38.5 m and 107 m respectively (Chisholm and Hamlin 1987). Average annual drawdown on Lake Koocanusa exceeds 30 m and has ranged as deep as 46 m. Construction of the Libby dam altered fish species composition and fish habitat in the upper Kootenay River. The river now supports adfluvial stocks of bull trout that over-winter in Lake Koocanusa and fluvial stocks which remain in the Kootenay River, upstream of the reservoir. These populations of bull trout both spawn in Kootenay River/Lake Koocanusa tributary streams. The Libby Dam is an upstream barrier to fish migration (including bull trout); however, a number of floy tagged adult bull trout are known to have successfully passed downstream through the dam.

4.0 INTERNATIONAL SIGNIFICANCE

Populations of upper Kootenay River bull trout live in a system which extends into Montana and Idaho therefore species management strategies have international significance. Bull trout are listed as threatened in the U.S. under the Endangered Species Act of 1973, however, the jurisdiction of this legislation does not extend into B.C. The recovery of bull trout populations in the U.S. portion of the upper Kootenay system depend largely on the protection and growth of populations in the B.C. portion of the watershed. Cooperation between both Montana Department of Fish Wildlife and Parks (MDFWP) and BC Ministry of Water, Land and Air Protection (WLAP) and their funding partners are key in this endeavour.

As a result of bull trout being listed under the Endangered Species Act in 1998, a Kootenay (spelled Kootenai in the U.S.) River Recovery Unit was identified (one of 22 recovery units established for bull trout in the Columbia River basin), and a Recovery Plan initiated. Four core areas were established within the Recovery Unit, with Lake Koocanusa (upstream of Libby Dam) being a primary core area (U.S. Fish and Wildlife Service 2002). Although Canadian portions of Lake Koocanusa and the upper Kootenay River are not officially included, they are considered essential to bull trout recovery in this core area. The majority of bull trout spawning and rearing habitat in the Lake Koocanusa core area is known to be within B.C. If bull trout populations within this area of B.C. are not maintained, recovery on the U.S. side of this system cannot occur.

The U.S. Bull Trout Recovery Plan measures recovery according to four criteria: distribution, abundance, population trends and connectivity in the watershed. Distribution criteria will be met when the total number of identified local populations is maintained or increased and are broadly distributed. Abundance criteria will be met when each of the primary core areas have at least 1,000 adult bull trout and are scientifically documented to host at least five local populations. Trend criteria will be met when the overall bull trout population in the unit is accepted as stable or increasing for at least 10 years. Connectivity criteria will be met when existing passage barriers identified as inhibiting bull trout migration in smaller streams within the unit have been remedied (U.S. Fish and Wildlife Service 2002).

5.0 METHODS

5.1 Radio Tags

Radio tags used in this study were digitally coded and manufactured by LOTEK Engineering Inc. in Newmarket, Ontario. The tags (Model MCFT-3A) were 16 mm in diameter, 51 mm in length and weighed 16.1 g in air and 6.2 g in water. These tags were programmed to transmit for 8 hours on and 16 hours off, which extended their operational life to approximately 791 days. Radio tags transmitted on six different frequencies (149.320, 149.340, 149.460, 149.540, 149.560 and 149.740 Mhz), with 10 to 12 codes on each frequency.

5.2 Tracking

A LOTEK SRX-400 scanning telemetry receiver with a three element Yagi antenna was used for tracking radio tagged fish. Both a Bell 206 Jet Ranger helicopter and a fixed-wing Cessna 182 aircraft were used in aerial monitoring of tagged fish. Tracking by fixed-wing aircraft was carried out by a contractor, while fisheries staff from WLAP carried out the tracking by helicopter. Fixed-wing flights were generally conducted monthly between November and June and bi-weekly during July and August. Helicopter flights occurred on approximately a weekly basis during September and October. Once a frequency lock was established and the transmitter code verified, the aircrafts GPS unit was used to reference coordinates of each radio tagged fish. This data was subsequently transferred to maps at a scale of 1:125,000, which were marked out in 5 km increments. Distances were measured upstream (+) or downstream (-) of the Wardner Bridge near the top end of Lake Koocanusa, which was arbitrarily set at km 0. Final map locations for radio tagged bull trout are within +/- 0.5 km of actual locations. Figures 7, 8 and 9 illustrate the kilometre designations used throughout the study. Timing of pre and post-spawning migration, as well as location of spawning, over wintering and summer habitats were determined; however, in some cases the dates had to be inferred from the closest tracking receptions immediately upstream and downstream. Bull trout showing similar migration behaviour were grouped together in order to simplify data analysis.

5.3 Fish Capture and Tagging

Angling was the principal method used in capturing fish for this study, although seven bull trout were captured and radio tagged at the Skookumchuck fish fence. Bull trout were primarily captured in the mainstem of the upper Kootenay River; however, some fish were also tagged in major tributary streams (Bull River, Skookumchuck Creek, White River and Palliser River drainages). A variety of angling techniques and terminal tackle were employed throughout the study including: spoons, jigs, flies and bait. River access was gained by drift boat, jet boat, pontoon boat and on foot.

Only bull trout greater than 47 cm in fork length and weighing more than 1.0 kg were radio tagged. Operating exclusively on this size of bull trout ensured that the weight of the transmitter (in air) did not exceed 2% of the body weight of the fish as recommended by LOTEK. Captured bull trout were held in flow-through cylindrical holding tubes until ready for surgery. Biologists maintained sterile conditions at the site by wearing sterile gloves, and sterilizing operating instruments and radio tags in a container of ethanol or germiphene.

Prior to surgery, fish were immersed in a 20 L anaesthetic bath of river water and clove oil (2 ml of clove oil per 20 L of water for a concentration of 100 ppm). Adequate anaesthesia was achieved within approximately 3-5 minutes of immersion (loss of motor function). The fish was then removed from the bath and placed on its back in a foam-lined V-shaped operating trough to facilitate the surgery. The gills were continually irrigated with a fresh supply of water and the fish was frequently bathed. A 2-3 cm long incision was then made in the abdominal cavity. Surgeries were carried out by Bill Westover, Regional Fisheries Biologist (WLAP) and James Baxter, who was contracted by B.C. Hydro and WLAP to perform approximately twenty of the surgeries (Note: Baxter made the incision on the left hand body side wall about 3 to 5 cm anterior of the pelvic fins. Westover located the incision in generally the same area except on the ventral side of the fish).

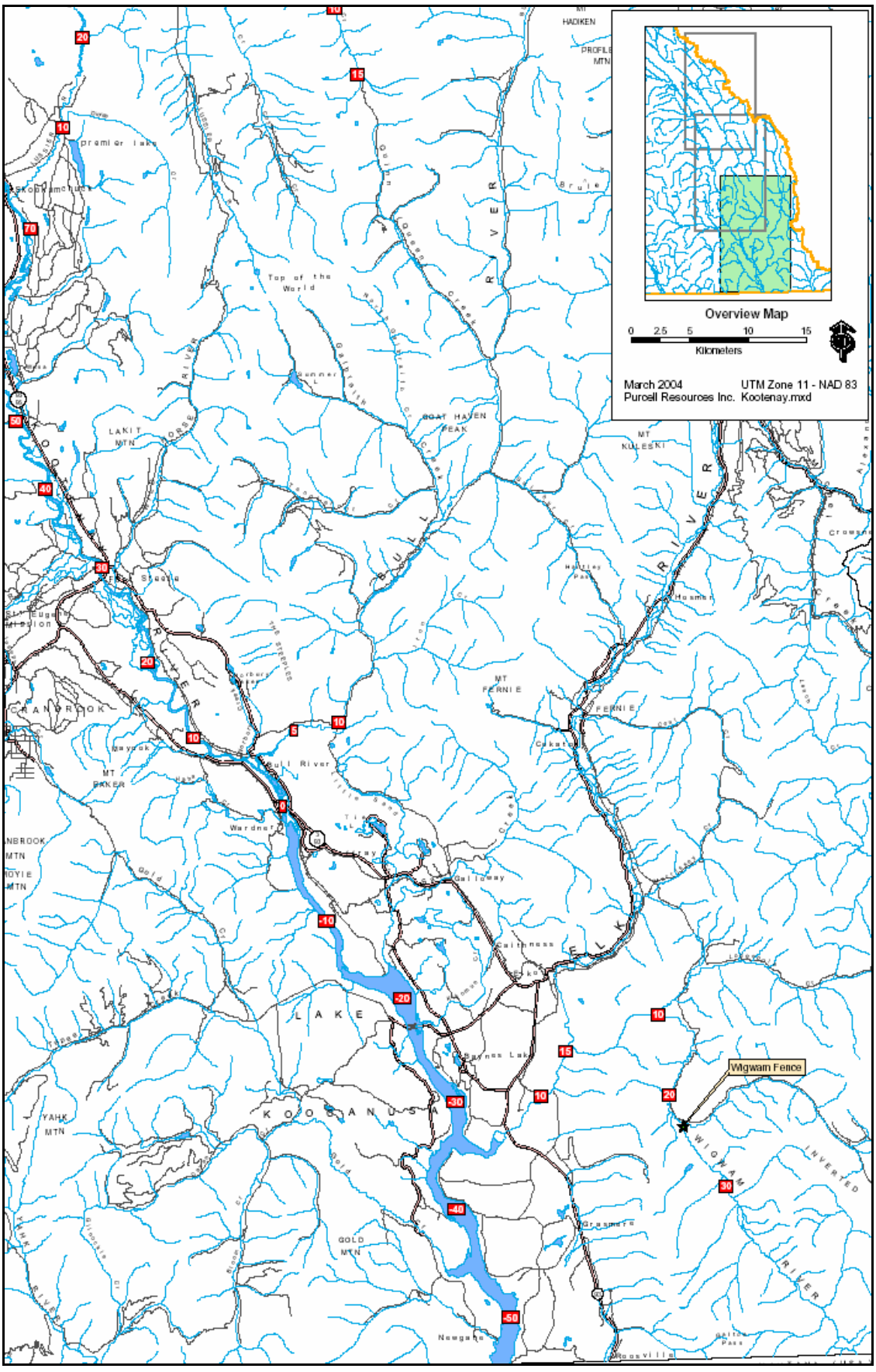

Figure 7. Upper Kootenay River bull trout radio telemetry locations.

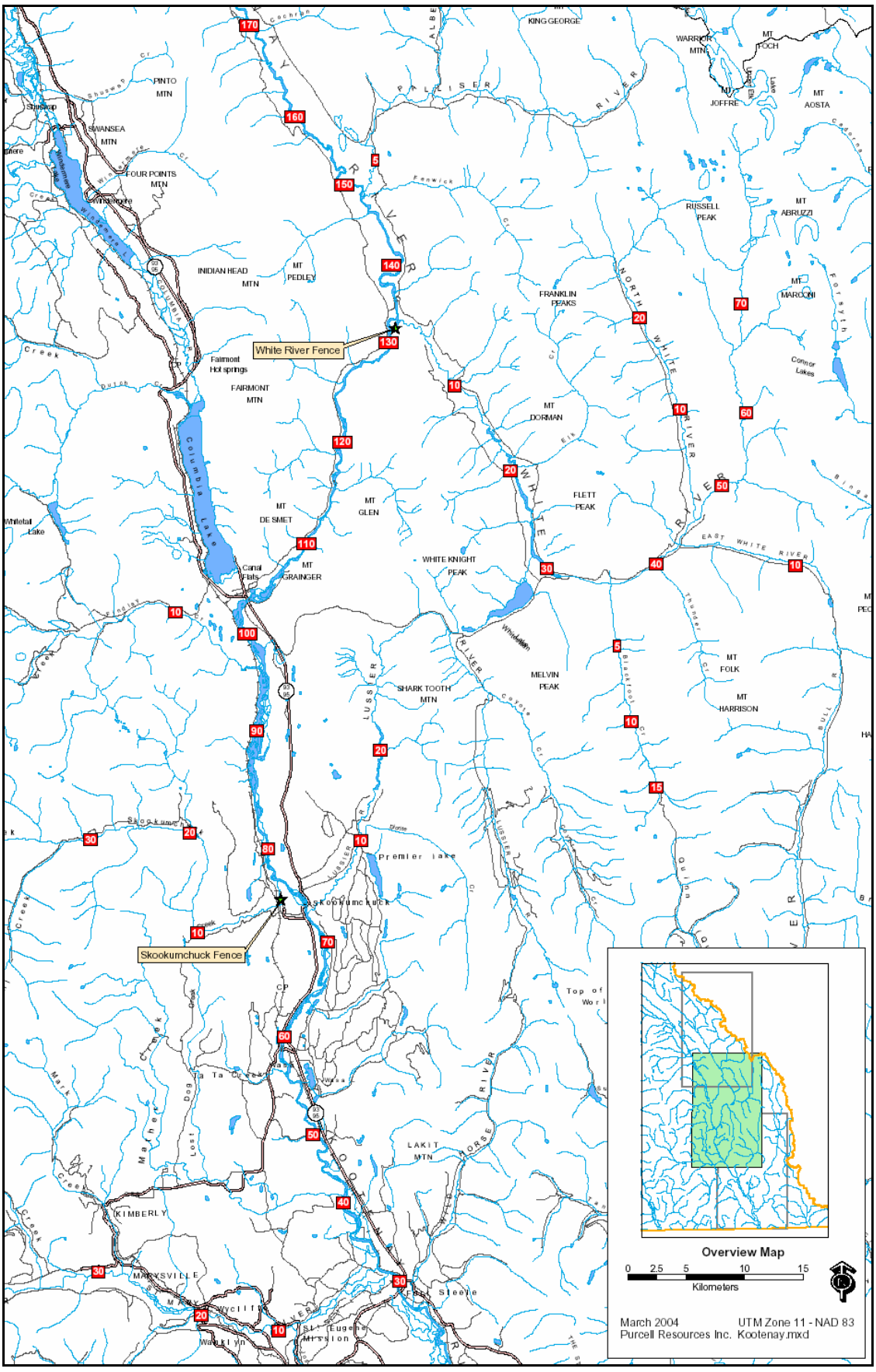

Figure 8. Upper Kootenay River bull trout radio telemetry locations.

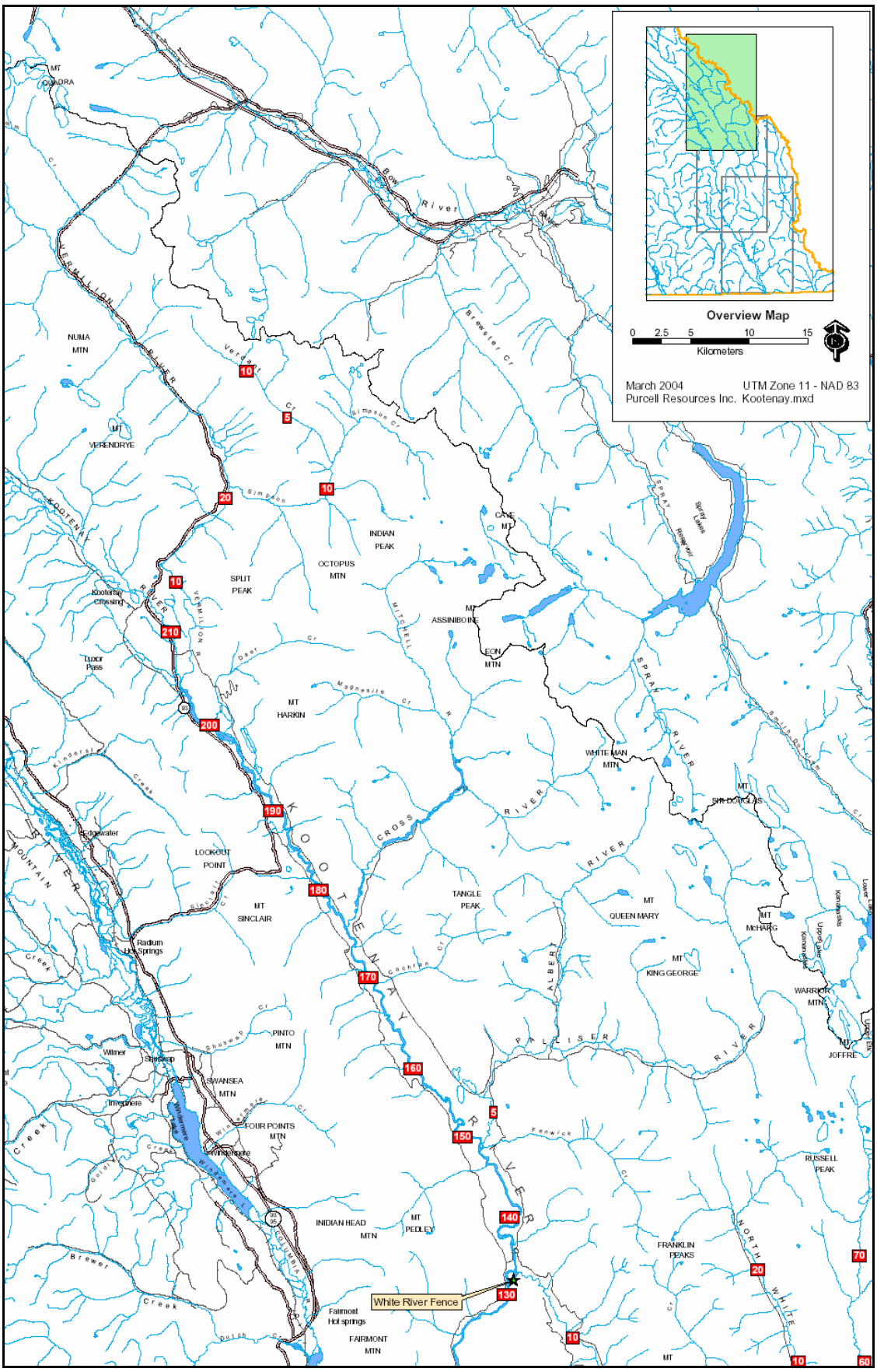

Figure 9. Upper Kootenay River bull trout radio telemetry locations.

Once the incision was complete, the radio tag was inserted into the abdominal cavity and the antennae of the radio tag was placed through the body wall with the aid of a hollow veterinary needle. When the antennae was pulled through the hollow needle and emerged out the body wall, the needle was removed. The incision was then closed with three sutures and Betadine was applied to the wound. (For a more detailed description of the surgical procedures, the reader is referred to Baxter and Nellestijn 2000). After surgery, bull trout were tagged with a coded PIT tag in the left cheek and with a numbered floy tag at the base of the dorsal fin, weighed to the nearest 0.25 kg, measured for fork length (nearest 0.5 cm) and sexed (when possible). For nine of the bull trout tagged by Baxter, weight was estimated from their length and girth using the formula: weight (lbs) = length (in) x girth² (in) / 800 (James Baxter pers. comm.). After tagging, bull trout were placed back in the holding tube until sufficiently recovered, and then released. The complete surgical procedure took about 4-5 minutes, with the individual fish allowed approximately 20 minutes for recovery.

5.4 Temperature and Discharge

To evaluate bull trout migration patterns in relation to environmental variables, data were collected on both water temperature and discharge at various locations in the study area. In October, 2001, five thermographs were placed in the mainstem of the Kootenay River and one located near the mouth of the White River. Three of the six thermographs were subsequently recovered in October, 2002 and temperature data is available for the mainstem Kootenay River at the Cross River (km 174), Wasa (km 58) and Wardner (km 0) bridges (Figures 7, 8 and 9). The remaining thermographs were not found and likely washed away during spring freshet. Annual discharge data for the upper Kootenay River and three of its major tributaries (Bull, Skookumchuck and White Rivers) were available from WSC hydrometric stations (Figures 2, 3, 4 and 5).

6.0 OTHER STUDIES

Additional bull trout spawning and migration data in the upper Kootenay River were available from four other studies. Approximately 2,100 bull trout spawners were floy tagged, 26 radio tagged and another 10 sonic tagged over a four year period (1996-1999), at a fish fence on the Wigwam River (Baxter and Westover 2000). Another 717 bull trout were floy tagged at a similar fence and trap over a three year period (2000-2002) on Skookumchuck Creek (Baxter and Baxter 2002[2]) and 103 bull trout were floy tagged on the Bull River over a three year period (1998-2000) (Olmstead and den Biesen 2001). Most recently, during the fall of 2003, 767 bull trout were floy tagged at a fence and trap at the mouth of the White River (Cope and Morris 2003) (Figures 7, 8 and 9). Angler reports of floy tagged bull trout recaptures from these studies assisted in determining migration patterns, over-wintering areas and straying from one system to another.

7.0 RESULTS

7.1 Fish Capture and Tagging

A total of seventy-one bull trout were implanted with radio tags during the study. Fifty-eight of the bull trout were tagged between April 25 and October 26, 2000. The remaining thirteen bull trout were tagged between April 1 and September 25, 2001. Fish were captured and radio tagged in the upper Kootenay River (39), Skookumchuck Creek (14), Bull River (10), White River (7) and the Palliser River (1) (Figure 1). Capture and tagging information were recorded for each bull trout including: date and location of capture, sex, length (cm), weight (kg), radio tag channel, frequency and code information, PIT tag number and floy tag number (Table 2).

Sixty-four of the bull trout were captured by angling and the remaining seven fish were captured at the Skookumchuck fish fence. Initial post-surgery mortality for these fish was estimated to be 0% as all tagged fish made significant migrations following surgery (determined by radio tracking). Two fish that were radio tagged in the lower reaches of Skookumchuck Creek on August 10, 2000 moved downstream approximately 40 km and did not move for the duration of the study. If these two fish were in fact dead, then post-

surgery mortality was less than 3%. Other fish however, spent up to one year at the same location before making a spawning migration. During the course of the project, two radio tagged bull trout were harvested by anglers and two were found dead in Skookumchuck Creek, four and sixteen months after tagging. The latter two fish were in areas known to be frequented by fisherman and it is suspected they were recaptured and released by anglers and died from post-hooking mortality.

Of the seventy-one bull trout implanted with radio tags, thirty were identified as females, twenty-four were males and seventeen were of unidentified sex. Female bull trout ranged in length from 50.0 cm to 83.0 cm with an average of 61.8 cm, and their weights ranged from 1.10 kg to 6.25 kg with an average of 2.62 kg. Male bull trout lengths ranged from 49.0 cm to 88.0 cm with an average of 66.0 cm, and their weights ranged from 1.20 kg to 7.25 kg with an average of 3.28 kg. The seventeen bull trout whose sex were not identified ranged in length from 47.0 cm to 71.0 cm with an average of 56.9 cm, and their weights ranged from 1.20 kg to 5.25 kg with an average of 2.21 kg. Overall, tagged bull trout ranged from 47.0 cm to 88.0 cm with an average length of 62.0 cm, and weighed from 1.10 kg to 7.25 kg with an average weight of 2.74 kg (Figures 10 and 11, Table 3).

Table 2. Information recorded for each radio tagged bull trout.

Radio Tag ID #	1	**Channel**	1
Frequency	149.320	**Code**	2
Date of Tagging	April 21, 2000	**Location**	Kootenay R. @ km 69
Length (cm)	54.0	**Weight (kg)**	1.75
Sex	Unidentified	**PIT Tag #**	4117310517
Floy Tag Colour	Yellow	**Floy Tag #**	205
DNA #	4	**Comments**	……

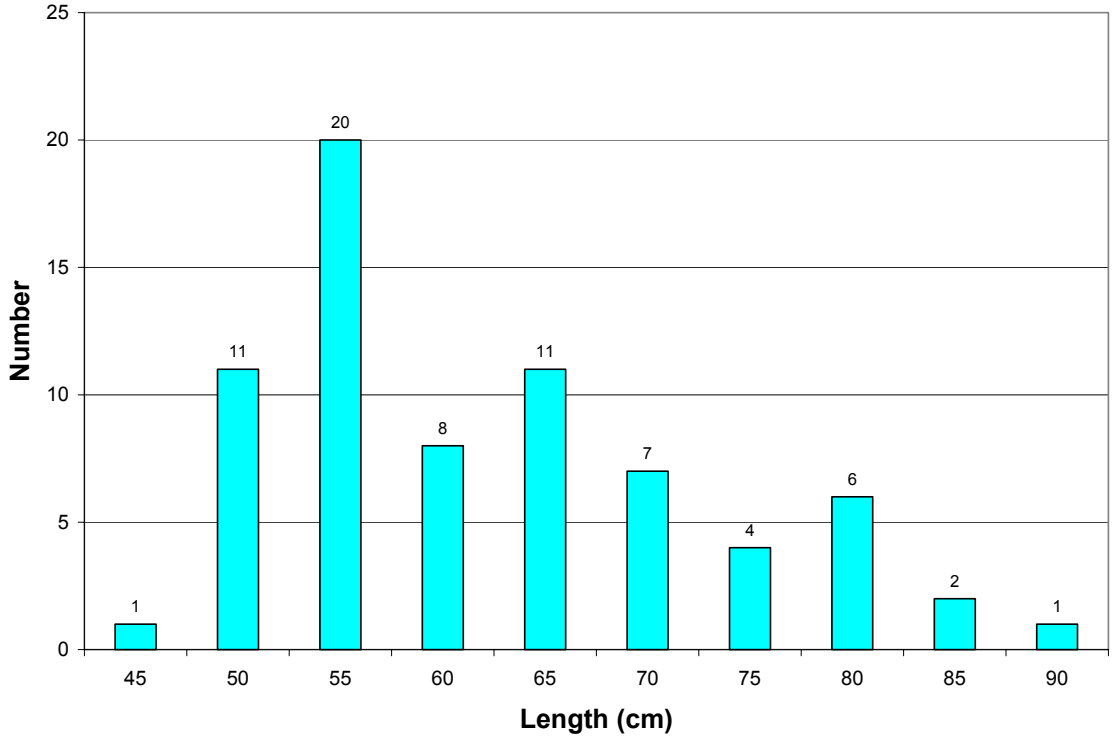

Figure 10. Length frequency distribution of radio tagged bull trout in the upper Kootenay River (2000 – 2001).

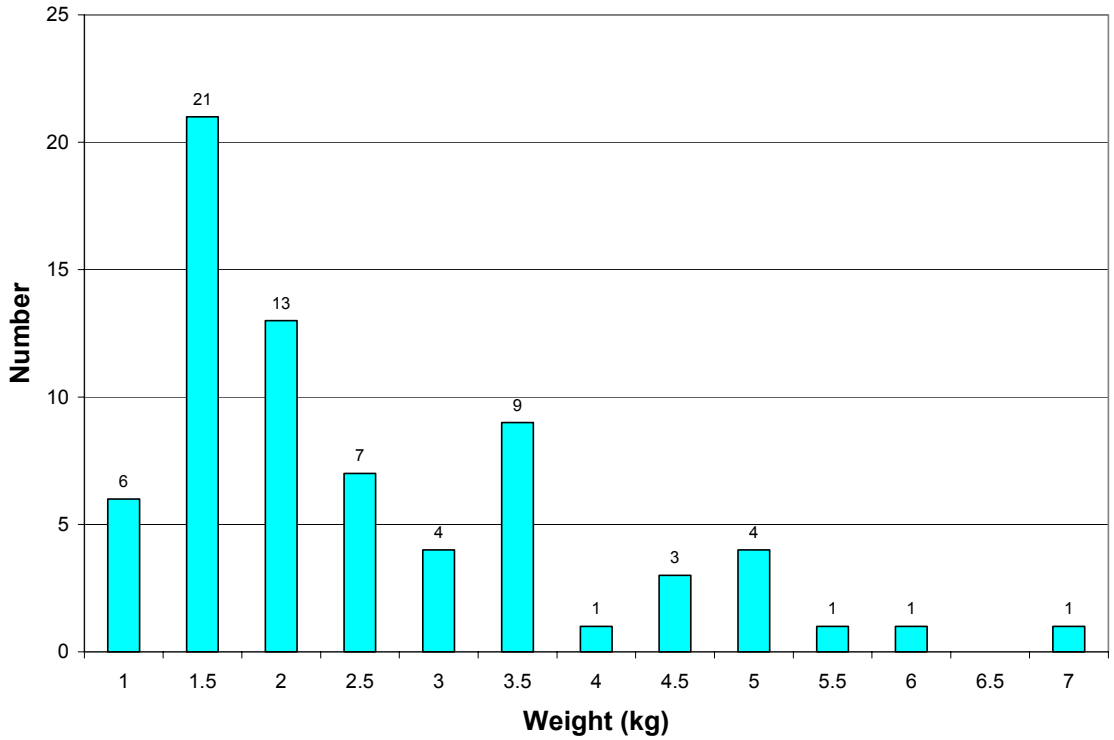

Figure 11. Weight frequency distribution of radio tagged bull trout in the upper Kootenay River (2000 – 2001).

Table 3. Length and weight of radio tagged bull trout (2000 – 2001).

Sex	Number of fish	Minimum length (cm)	Maximum length (cm)	Average length (cm)	Minimum weight (kg)	Maximum weight (kg)	Average weight (kg)
F*	30	50.0	83.0	61.8	1.10	6.25	2.62
M*	24	49.0	88.0	66.0	1.20	7.25	3.28
U*	17	47.0	71.0	56.9	1.20	5.25	2.21
Total	**71**	**47.0**	**88.0**	**62.0**	**1.10**	**7.25**	**2.74**

*F = Female, M = Male, U = Unidentified

7.2 Tracking

Tracking occurred over a period of approximately two and a half years. Initial tagging took place in April 2000 in the mainstem of the upper Kootenay River, with the last tags implanted in September 2001 at the Skookumchuck fish fence. Initial tracking flights began in May 2000 with final flights taking place in September 2002. In total, 133 hours were spent tracking bull trout (81 hours in a fix wing airplane and 52 hours in a helicopter). A total of 1,127 separate bull trout locations were recorded for the seventy-one radio tagged fish. The number of times that individual radio tagged bull trout were located ranged from 1 to 31 times (mean = 15.9 times per fish). Tracking was successful for most fish throughout the study, but limited by the life of the radio tag battery. Tracking was often limited for adfluvial fish over-wintering in deep portions of Lake Koocanusa and occasionally for fluvial fish over-wintering in deep pools in the mainstem of the Kootenay River. To test the readability of tags in deep water a radio tag was lowered into Lake Koocanusa and the radio signal was lost at 7 metres.

7.3 Timing of bull trout migration in relation to Temperature and Discharge

Fourty-seven of the seventy-one tagged bull trout spawned at least once. The remaining twenty-four fish did not spawn. Generally, bull trout began their pre-spawning migration from their over-wintering locations in the Kootenay River and/or Lake Koocanusa between mid-May and mid-June during ascending and peak discharge levels with mean daily water temperatures ranging between 6 and 10 ºC. Bull trout left the Kootenay River

and entered their spawning tributary streams throughout July corresponding with decreasing discharge rates and with water temperatures in the Kootenay River approaching seasonal highs (Figures 2, 12, 13 and 14). Spawning occurred throughout September and early October. After spawning, most radio tagged bull trout returned immediately to the Kootenay River, and by early November tagged fish were back in their over-wintering habitats, remaining there until the following May/June.

Some bull trout made extensive pre and post-spawning migrations; for example, one bull trout migrated 204 km upstream from its over-wintering location in Lake Koocanusa to reach its spawning grounds in the White River. After spawning, this same fish made a post-spawning migration of 208 km downstream to over-winter in Lake Koocanusa. The majority of radio tagged fish utilized the White River and Skookumchuck Creek systems for spawning, however they also spawned in Verdant Creek and the Palliser, Lussier and Wigwam rivers.

7.4 Tributaries utilized by radio tagged bull trout.

7.4.1 White River

Twenty-four radio tagged bull trout spawned in the White River system, (twelve in the middle fork of the White River, one in the East White River, one in the North White River and three in Blackfoot Creek). Seven other bull trout migrated into the White River drainage, but could not be located during the September spawning period. It is suspected these fish spawned in smaller tributary streams of the North White River. Of the twenty-four radio tagged bull trout that spawned in the White River system, seven were initially tagged in the White River, one was tagged in the Bull River, ten were tagged in the Kootenay River downstream of the White River and the remaining six were tagged in the Kootenay River upstream of the White River.

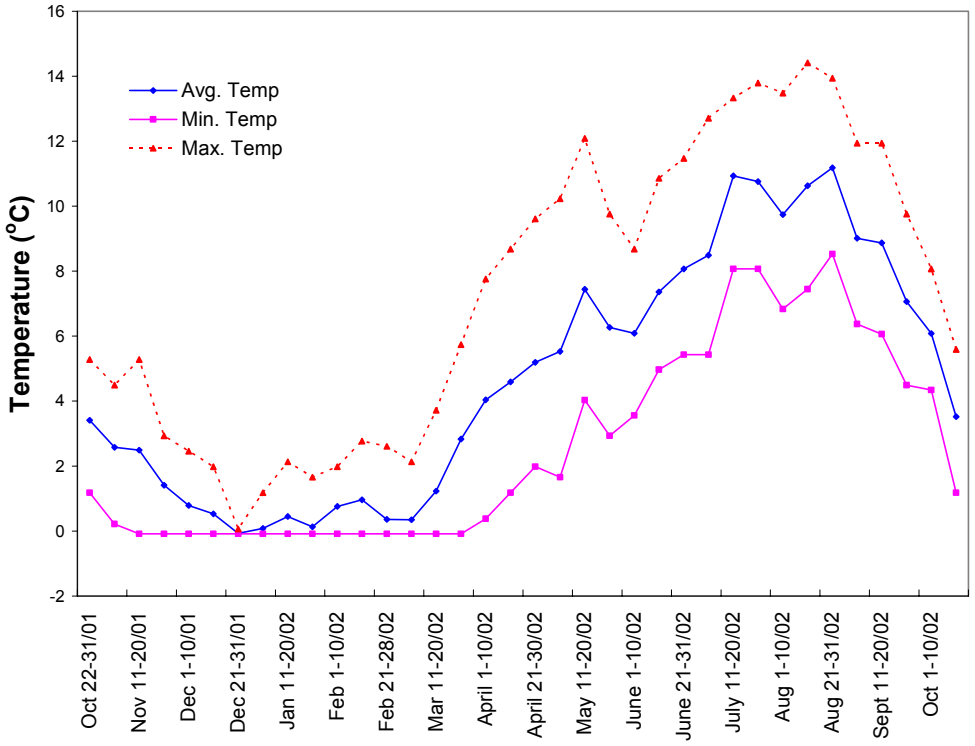

Figure 12. Mean, minimum and maximum daily water temperatures for the Kootenay River at the Cross River Bridge (km 173).

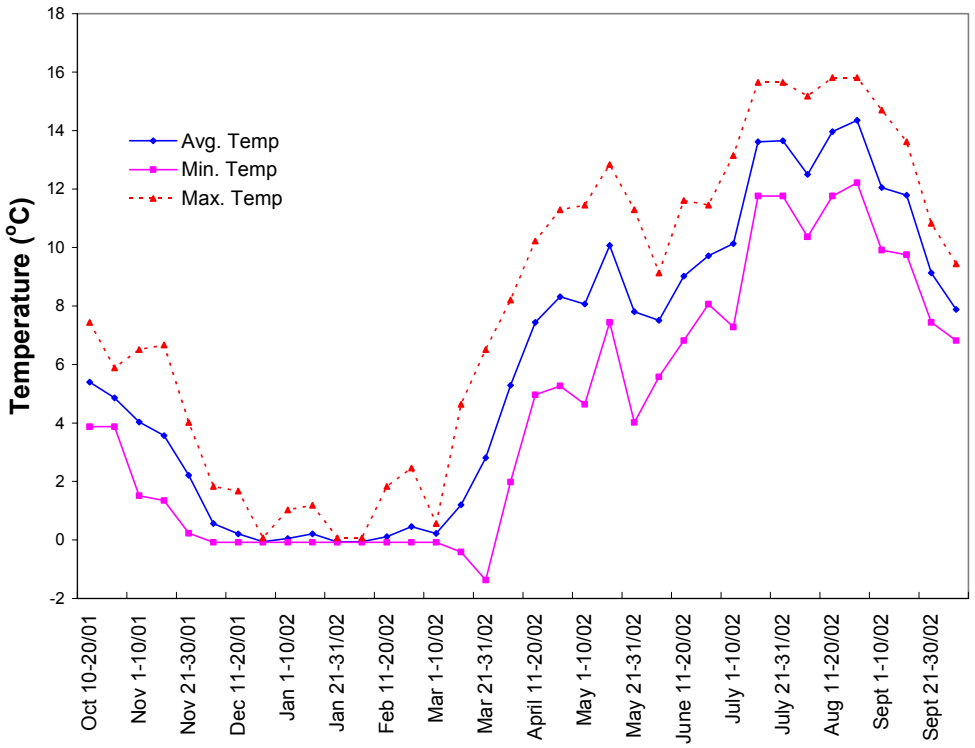

Figure 13. Mean, minimum and maximum daily water temperatures for the Kootenay River at the Wasa Bridge (km 58).

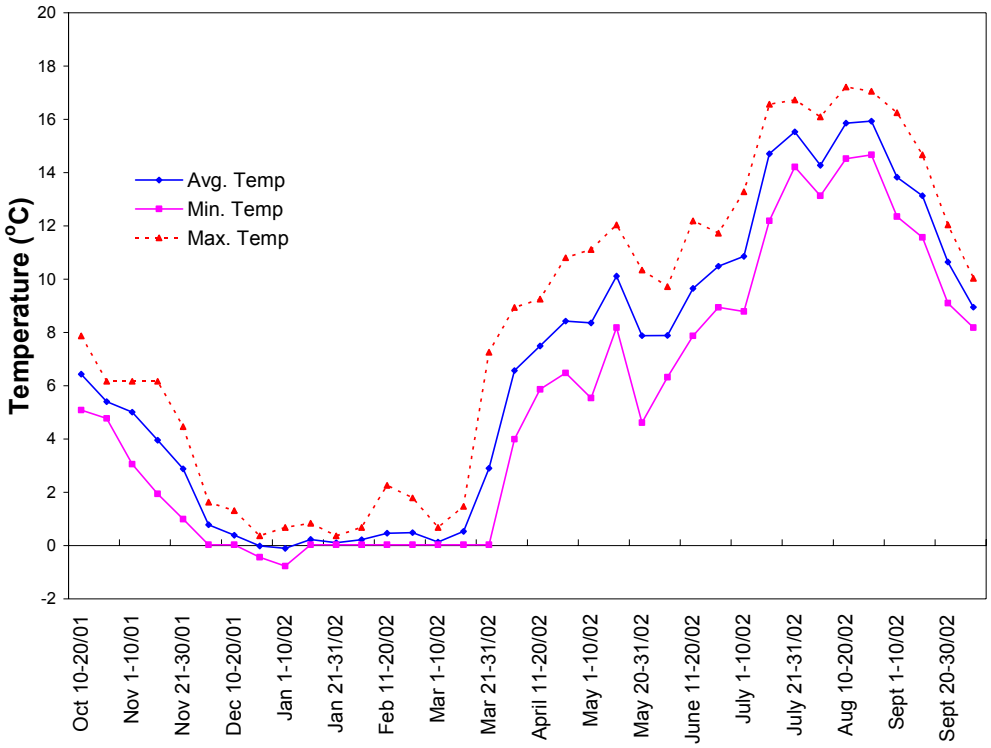

Figure 14. Mean, minimum and maximum daily water temperatures for the Kootenay River at the Wardner Bridge (km 0).

Five of the ten fish that were tagged in the Kootenay River downstream of the White River were radio tagged near the Wardner Bridge and traveled approximately 200 km upstream to their spawning grounds. Two of the six bull trout that were tagged in the Kootenay River upstream of the White River were tagged near Cochran Creek. These fish moved downstream approximately 38 km to the White River and then travelled 62 km upstream in the White River to spawn (100 km in total). The bull trout that was tagged in the Bull River spent the fall of 2000 in the Bull River, but during 2001 it migrated 200+ km to the White River to spawn. Mean home range for the radio tagged bull trout using the White River was 127 km (range 21 km to 218 km) (Table 4). Of the seventeen radio tagged bull trout that spawned in the White River during their first year, seven (41%) returned to the White River as repeat spawners in year two and three (17.6%) were alternate year spawners. One of the repeat year spawners spawned three consecutive years in a row.

Table 4. Mean, minimum and maximum home range for bull trout using the Bull, Lussier, Palliser, White and Wigwam rivers and Skookumchuck and Verdant creeks.

		Home range		
System	**Number of fish**	**Minimum (km)**	**Maximum (km)**	**Mean (km)**
Bull River[1]	18	16	218	95
Lussier River	1	78	78	78
Palliser River	2	16	65	40
White River	24	21	218	127
Wigwam River	3	59	68	62
Skookumchuck[1]	12	27	141	103
Verdant Creek	3	68	75	72

[1]Home range could not be determined for all bull trout using these systems.

A fence and trap were operated on the White River near it's confluence with the Kootenay River from September 9 to October 9, 2003 to capture emigrating post-spawning bull trout. A total of 776 bull trout were sampled at the fence, of which seven were radio tagged fish from this study and one was a floy tagged fish from the Bull River (Cope and Morris 2003). Growth rates for six of the radio tagged fish, time of passing through the fence and years in which they spawned are shown in Table 5. Even allowing for the 6 months difference in initial tagging, bull trout that over-wintered lower in the Kootenay system had better growth rates than bull trout over-wintering higher up in the Kootenay drainage (Table 5).

At the time of this report, anglers had reported catching three bull trout floy tagged at the White River fence during the fall of 2003. Two of these fish were tagged on September 15 and 16 and harvested on the Kootenay River at Skookumchuck on October 23, 2003. The third bull trout was tagged at the fence on September 22 and caught and released in the Kootenay River at the confluence of Norbury Creek (127 km downstream of the White River) on November 15, 2003 (Scott Cope pers. comm.).

Table 5. Growth and spawning years for radio tagged bull trout recaptured at the White River fence (2003).

Tagging Date (2000)	Tagging Location	Tagging Length (mm)	Recapture Date (2003)	Recapture Length (mm)	Growth (mm)	Spawning Years 00	01	02	03
April 21	Skookumchuck	540	Sept 24	675	135	N[2]	N	S[3]	S
April 25	Skookumchuck	695	Sept 16	790	95	N	S	S	S
July 13	Wardner	630	Sept 28	725	95	N	S	N	S
July 24	Bull River	590	Oct 1	762	172	N	S	N	S
Aug 23	White River	830	Sept 21	895	65	S	S	N	S
Oct 25	White River[1]	670	Oct 4	687	17	N	N	N	S

[1]Over-wintered in the Kootenay River upstream of the White River (km 140). The remaining fish over-wintered in the Kootenay River downstream of the White River (km 30 – 70).
[2]Did not spawn
[3]Spawned

7.4.2 Skookumchuck Creek

A total of nineteen radio tagged bull trout were present in Skookumchuck Creek; however, only fourteen of these fish migrated upstream to the main spawning area between km 25 and km 30 and are considered to have subsequently spawned. The remaining five bull trout restricted their movements to the lower 5 km of stream in areas where no redds were observed, and based on the timing (August) of these fish exiting the tributary, it appears these fish utilized this system for other purposes (i.e. feeding). One of these fish spent the first summer and fall in the lower reaches of Skookumchuck Creek, the second summer and fall in the Bull River and eventually spawned in the White River during the fall of 2003. Of the fourteen radio tagged bull trout that spawned in Skookumchuck Creek, twelve were radio tagged in Skookumchuck Creek and two were tagged in the Kootenay River near the mouth of the Lussier River. Of the twelve bull trout that spawned in Skookumchuck Creek during their first year, one (8%) returned as a repeat spawner in year two. Baxter and Baxter (2001[1] and 2002[2]) found that 13.5% of the 2001 spawning run and 9.1% of the 2002 spawning run in Skookumchuck Creek were repeat spawners. Mean home range for the radio tagged bull trout using Skookumchuck Creek was 103 km (range 27 km to 141 km) (Table 4).

Of the 717 bull trout floy tagged at the Skookumchuck fence and trap over a three year period (2000-2002) (Baxter and Baxter 2002[2]), eight have been reported recaptured by anglers and one was found dead in Lake Koocanusa. All angler-caught bull trout were in the Kootenay River between Fort Steele and Skookumchuck. Two of the angler-caught bull trout were harvested and the rest were released. One harvested bull trout was caught three times (March 28, April 7 and again on May 14, 2001 when it was killed).

7.4.3 Verdant Creek, Vermilion and Palliser rivers

A total of twenty bull trout were radio tagged in the Kootenay River upstream of the White River. As mentioned earlier, six of these fish migrated downstream and spawned in the White River, while seven of these fish moved up to 35 km from their initial tagging locations, but did not appear to make a spawning migration. Three fish spawned in Verdant Creek within Kootenay National and Mount Assiniboine parks, two spawned in the lower 6 km of the Palliser River and two were located in the Vermilion River. It is not known if the two fish in the Vermilion River actually spawned at that location. The Vermilion River is quite glacial and not typical of other bull trout spawning streams located during this study. Of the three fish that spawned in Verdant Creek during their first year, one (33%) returned to Verdant Creek as a repeat spawner in year two. Mean home range for the radio tagged bull trout using Verdant Creek was 72 km (range 68 km to 75 km) and mean home range for the two radio tagged bull trout using the Palliser River was 40 km (range 16 km to 65 km) (Table 4).

7.4.4 Findlay Creek, Lussier and St. Mary rivers

One bull trout that was radio tagged in the Kootenay River near the mouth of the Lussier River spawned in the Lussier. The home range for the lone radio tagged bull trout using this system was 78 km (Table 4). Another bull trout entered the Lussier River for a two month period (June and July), but left the system in August and spawned in Skookumchuck Creek. A bull trout that was tagged near the mouth of the Lussier River entered the St. Mary River for a short period of time (mid-May to mid-July), but did not spawn over the course of the study. Lastly, a bull trout floy tagged in the Bull River in September 2000 was caught and killed in the lower 15 km of Findlay Creek during the summer of 2002.

7.4.5 Bull River

Although many bull trout spent a significant amount of time in the Bull River there is little evidence of spawning in this system. On October 20, 2000 boat, shore and diver surveys conducted in the lower Bull River, below B.C. Hydro's Aberfeldie Generating Station, identified what were thought to be nine bull trout redds (Olmsted and den Biesen, 2001); however no juvenile bull trout were found during electrofishing sampling (Baxter and Hagen, 2002). During the three year period of this study, eight helicopter flights were made up the lower Bull River during September and October and no bull trout redds were seen. (Note: bull trout redds on the Wigwam, Skookumchuck, White, Blackfoot and Verdant Creek are easily visible from the air). These findings indicate little or no successful bull trout spawning occurs in this system. Despite these results, significant numbers of bull trout migrate into the Bull River during mid-summer and often remain until late October/early November. Olmsted and den Biesen (2001) estimated between 476 and 748 bull trout were present in the Bull River in October, 2000.

A total of nineteen radio tagged bull trout used the Bull River, but not necessarily for spawning. Ten of these bull trout were radio tagged in the Bull River by B.C. Hydro (Olmsted and den Biesen 2001) and nine were tagged in the Kootenay River near the Wardner Bridge. Bull trout tagged in the Kootenay River entered the Bull River in late July, similar to timing of bull trout entering other spawning tributaries; however, many of the Bull River tagged bull trout did not return to the Kootenay River until mid-October to mid-November. This emigration is two to six weeks later than spawning bull trout from other systems. Spawning kokanee from Lake Koocanusa also utilize the lower Bull River. They enter the Bull River in late August and peak spawning occurs the last week of September; however, post-spawning kokanee remain in the system to late October. Olmsted and den Biesen (2001) speculated that bull trout use the Bull River initially for staging, and then feeding, remaining in the system long enough for predation on spawning kokanee.

Radio tagged bull trout using the Bull River displayed the most unpredictable behaviour when compared to bull trout from other spawning streams identified in this study. Eight (42%) of the nineteen radio tagged bull trout that used the Bull River in their first year spawned in other systems in their second year (two in the Wigwam River and five in the

White River system). One fish that spent 2 months (August – September) in the lower Skookumchuck the first year, spent 3 months (July – September) in the Bull River the second year and spawned in the White River the third year. Four fish returned to the Bull River two years in a row after over-wintering below the high water mark of Lake Koocanusa and one of these fish spawned in the Wigwam River during its' third year. The remaining seven fish spent the first year in the Bull River and remained in the Kootenay River and/or Lake Koocanusa for the remainder of the study. Mean home range for the radio tagged bull trout using the Bull River was 95 km (range 16 km to 218 km) (Table 4).

Nineteen of the one hundred and three bull trout floy tagged in the Bull River between 1998 and 2000 have been reportedly recaptured. Of these, nine fish were caught at the Skookumchuck fish fence, eight were recaptured by anglers in the Bull River, one by an angler in Findlay Creek and one was recaptured at the White River fish fence.

7.4.6 Wigwam River

Three fish radio tagged in the Bull River spawned in the Wigwam River. All three of these fish over-wintered below the high water mark of Lake Koocanusa (one just south of the Wardner Bridge, another one near Kikomun Creek Park and the third one near the mouth of the Elk River). Mean home range for the radio tagged bull trout using the Wigwam River in this study was 62 km (range 59 km to 68 km) (Table 4).

More detailed migration information on Wigwam River bull trout is available from radio and sonic tagging studies carried out from 1996 - 1998 by MDFWP (Chirico and Westover 1998). Over the three year period of this previous study, twenty-six bull trout were radio tagged and ten sonic tagged at the Wigwam River fence. Subsequent tracking of both radio and sonic tagged fish was carried out by MDFWP. Results showed that these adult bull trout primarily over-winter in Lake Koocanusa on the Montana side of the international border. They stage in the Kootenay River off the mouth of the Elk River during late May and early June. Between mid-June and mid-July they are in the lower Elk River and by the end of July in the Wigwam River. Spawning peaks during the last week of September and adults are back in the Kootenay River by the end of October. All

radio tagged fish returned to Lake Koocanusa where they were lost to tracking over the winter due to depth (Baxter and Westover 2000).

Additional migration data for Wigwam River bull trout is available from approximately 2,100 bull trout floy-tagged at the Wigwam River fence between 1996 and 1999. To date, eighty-one of these bull trout have been reported caught and released or caught and harvested by anglers. Fish tagged in the Wigwam River were recaptured almost exclusively in lower reaches of Lake Koocanusa or its tributaries, primarily in the Elk and Wigwam Rivers. Fish were also captured on both Canadian and American portions of Lake Koocanusa. There were ten tagged fish captured in Montana by MDFWP gill nets. One tagged fish travelled through the Libby Dam alive and was recaptured in a fish trap on O'Brien Creek in Montana (tributary to the Kootenay River downstream of Kootenay Falls), and two tagged fish were found dead below the Libby Dam. Only eight of the reported Wigwam River recaptures migrated upstream beyond the Elk River confluence. Three floy tagged fish were caught near Kikomun Creek on Lake Koocanusa, one fish was caught at the Wardner Bridge and one fish was caught off the mouth of the Bull River. Three fish were reported caught beyond the Bull River: one at Fort Steele, one at Skookumchuck and one off the mouth of the White River.

7.5 Over-wintering

After spawning, all but three radio tagged fish returned to the Kootenay River and or Lake Koocanusa to over-winter. Most radio tagged bull trout were back in the Kootenay River by the first week of October. The only exceptions to this were bull trout in the Bull River which did not return to the Kootenay River until mid-October to mid-November. By early November, bull trout were in their over-wintering habitats and remained there until the following mid-May to mid-June. The three fish that remained in tributaries (Palliser River, Vermilion River and Skookumchuck Creek), over-wintered just above their confluences with the Kootenay River.

Bull trout that spawned in the White River over-wintered in the Kootenay River both upstream and downstream of the White River. White River bull trout over-wintered as far downstream as Lake Koocanusa and as far upstream as Cochran Creek. Radio tagged bull trout that entered Skookumchuck Creek over-wintered in two distinct locations:

Nine fish over-wintered in a 55 km section of the Kootenay River immediately downstream of Skookumchuck Creek, another nine over-wintered in the Kootenay River and/or Lake Koocanusa between the Wardner Bridge and the mouth of the Elk River, and one fish over-wintered in the latter location the first year and the former location the second year.

Bull trout spawning in Verdant Creek, Vermilion and Palliser rivers over-wintered in the Kootenay River from the mouth of the White River upstream to Cochran Creek, similar to White River bull trout that over-wintered in this same area. The one bull trout that spawned in the Lussier River over-wintered at Skookumchuck. Of the nineteen fish that used the Bull River, fifteen (79%) over-wintered below the high water mark of Lake Koocanusa and the remaining four (21%) over-wintered in the Kootenay River as far upstream as Skookumchuck.

Fish that remained in the Kootenay River or its tributaries utilized pool/glide habitats where depth and velocity were favourable for over-wintering. Five over-wintering locations in the Kootenay River were measured on October 28, 2002 (Table 6).

Table 6. Measurements of five upper Kootenay River bull trout over-wintering locations.

Length (m)	Width (m)	Maximum depth (m)	Residual depth (m)	Secchi reading	Substrate
154	57	5.5	0.9	5.5	Cobble/Bedrock
225	46	5.8	0.6	5.8	Gravel/Bedrock
193	62	3.1	1.2	2.0	Gravel/Boulders
287	103	2.1	1.2	2.1	Cobble
565	66	5.2	1.2	3.0	Clay

8.0 DISCUSSION

Radio telemetry proved to be an effective method for tracking bull trout over a large drainage area (20,000 km²), and combined with recapture data of floy tagged bull trout from the Wigwam, Skookumchuck and White river fence operations, provided a good overview of bull trout movement and seasonal habitat use within the upper Kootenay River system. The project confirmed major bull trout spawning locations on the Wigwam River and Skookumchuck Creek, and more importantly identified previously unknown spawning concentrations of bull trout in the White River, Blackfoot Creek and Verdant Creek. The timing and location of bull trout over-wintering as well as the timing of spawning migrations through the sport fishery were determined. This data, combined with annual bull trout redd counts, will result in effective monitoring and management strategies for this species in the upper Kootenay drainage.

Timing of bull trout spawning migrations in the upper Kootenay system appear to follow typical trends of other populations within B.C. (McPhail and Baxter 1996). Bull trout begin their pre-spawning migrations from over-wintering locations in the Kootenay River and/or Lake Koocanusa between mid-May and mid-June during ascending and peak discharge levels. Bull trout leave the Kootenay River and enter their spawning tributary streams throughout July corresponding with decreasing discharge rates. Spawning occurred throughout September and early October. After spawning, most radio tagged bull trout returned immediately to the Kootenay River. The only exception to this finding were the bull trout in the Bull River, which did not return to the Kootenay River until mid-October to mid-November. By early November, bull trout are in their over-wintering habitats and remained there until the following May/June.

Radio tracking identified distinct adfluvial and fluvial populations of bull trout within the upper Kootenay watershed. Although all seventy-one bull trout were tagged in the mainstem of the Kootenay River or its' tributaries, twenty-four (34%) over-wintered or spent some portion of their life history below the high water mark of Lake Koocanusa. However, not all of these fish were considered to be adfluvial fish, since ten of these bull trout over-wintered in the Kootenay River within the drawdown portion of Lake Koocanusa. The remaining fourteen fish (20% of the total radio tagged fish) were

considered to be adfluvial fish since they over-wintered in the reservoir portion of Lake Koocanusa. Fourty-seven fish over-wintered in the Kootenay River upstream of Lake Koocanusa, and when these bull trout are combined with the ten fish that over-wintered in the Kootenay River within the drawdown portion of Lake Koocanusa, a total of fifty-seven (80%) could be considered to have displayed a fluvial life history form.

Radio tagged bull trout displaying an adfluvial life history form spawned in Skookumchuck Creek, White River and the Wigwam River. Fluvial bull trout also spawned in Skookumchuck Creek and the White River as well as the Lussier and Palliser rivers and Verdant Creek. Both adfluvial and fluvial bull trout entered the Bull River; however, it is suspected that they were feeding on kokanee rather than spawning. Although eleven radio tagged bull trout entered more than one tributary during the study, there is no evidence that they spawned in these other tributaries. Eight of the eleven fish that entered more than one tributary entered the Bull River on at least one occasion.

Previous studies (Westover and Baxter 2000) and annual redd counts have shown the Wigwam River to be the most heavily used bull trout spawning stream in the upper Kootenay River drainage. Only three of the radio tagged fish entered the Wigwam River to spawn, which confirms data collected from previous studies on the Wigwam River that the majority of these adfluvial fish over-winter in the lower portions of Lake Koocanusa on the Montana side of the border.

The historical distribution of bull trout upstream of the Libby Dam (within the Lake Koocanusa primary core area of the Kootenay Recovery Unit) is considered to be relatively intact and migratory corridors connect over-wintering, feeding and staging areas to the spawning habitats identified in this study. Local populations of bull trout are broadly distributed and appear to be stable or increasing (Table 7). The 2,426 bull trout redds enumerated in 2003 equates to an approximate range of 2,900 to 5,100 spawners assuming a mean of 1.2 to 2.1 bull trout per redd which is what was found on the Wigwam River and Skookumchuck Creek upstream of the fish fences (Baxter and Westover 2000, Baxter and Baxter 2002[2]). This is considered to be a conservative estimate of the number of bull trout spawning in any given year in the upper Kootenay drainage since bull trout spawn outside of the index sections (particularly on the White

River) and in other systems that are know to support spawning bull trout but are not presently enumerated (Verdant Creek, St Mary River, Gold Creek etc).

Table 7. Bull trout redds enumerated in index sections of the Wigwam, Skookumchuck, White, and Blackfoot drainages (1994-2003).

System	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Wigwam River	105	247	512	598	679	849	1195	1496	1892	2053
Skookumchuck				66	105	161	189	132	149	134
White River								166	153	143
Blackfoot Cr.									108	96
Totals									**2302**	**2426**

Present angling regulations for trout and char on the upper Kootenay River between Lake Koocanusa and the confluence of the White River include:

- Trout/char daily quota = 1 (none under 30 cm) from April 1 to October 31;
- Trout/char release from November 1 to March 31;
- Single barbless hook;
- Bait ban from June 15 to October 31.

Similar regulations apply to trout and char in the Kootenay River upstream of the White River except that section of the Kootenay River is closed to all fishing from April 1 to June 15. The trout/char release regulation from November 1 to March 31 protects over-wintering bull trout from being harvested, particularly during mild winters when the Kootenay River does not freeze and anglers are able to fish the river throughout much of this time period. Anglers are permitted to harvest one bull trout (over 30 cm) per day between April 1 and October 31. This regulation permits the harvest of bull trout, particularly during April and the early part of May when water levels in the Kootenay River are still fairly low and clear. Bull trout are also harvested from mid-September to the end of October after they have returned to the Kootenay River from their spawning streams. Although immature bull trout are present in the Kootenay River throughout the year, few are harvested during the summer (June to August) due to high turbid freshet flows and because most mature adults targeted by anglers are in their spawning streams. It is interesting to note that the volunteer reporting of angler caught floy tagged bull trout

is low. Only 112 (3%) of the 3,687 floy tagged bull trout at the Wigwam, Skookumchuck and White River fences over the last eight years were reported recaptured. During creel surveys on the Wigwam River in 1998 and 1999 many anglers admitted to catching floy tagged bull trout but never recorded the tag number or colour and therefore did not report their catch.

Spawning migrations of both adfluvial and fluvial bull trout populations into the same tributaries suggests some degree of genetic exchange may be occurring but the degree to which such mixing is occurring is poorly understood. Health of the population as a whole, and survival from specific environmental disasters depend on this diversity. Populations in systems with substantial diversity are likely to be more stable because there are more refuges from extreme events and greater capacity to buffer effects of environmental change (Spruell, Rieman, Knudsen, Utter, Allendorf 1999). The existence of this metapopulation and likely genetic exchange between local populations ensures the diversity, stability and persistence of the population as a whole (Riemen & McIntyre 1993). A large-scale genetic study would be necessary to better understand the diversity and genetic divergence or similarities between the local populations identified in this study.

9.0 RECOMENDATIONS

- Continue to enumerate bull trout redds on index sections in the Wigwam and White rivers and on Skookumchuck and Blackfoot creeks.

- Spawning locations were not determined for seven (29%) of the twenty-four bull trout that entered the White River. Ground and perhaps aerial surveys of tributaries to the North White River should be carried out during September to determine additional spawning concentrations of bull trout in this system.

- Establish a bull trout redd enumeration index section on Verdant Creek in Kootenay National Park.

- Large adfluvial and/or fluvial bull trout are known to spawn in the St Mary River system (Mathew and Redding creeks) and it is surprising that only one of the radio tagged bull trout entered this system and only for a short period of time (mid-May to mid-July). There may be an opportunity to establish bull trout redd enumeration index section in Redding Creek if spawning concentrations can be found.

- Verdant Creek appears to be major bull trout spawning stream in the upper Kootenay drainage and they may spawn in other tributaries to the Simpson River as well. Federal and Provincial Parks (Kootenay National and Mount Assiniboine parks) should consider running a fence and trap preferably on the Simpson River downstream of Verdant Creek to capture emigrating post-spawning bull trout. Documenting the distribution and relative abundance of bull trout spawning in the upper Simpson drainage would provide valuable information for protection and management of this blue listed species.

- MDFWP are considering a limited (annual limit of two bull trout per angler) recreational bull trout fishery on Lake Koocanusa beginning in 2004. In addition, angling effort for bull trout is expected to increase on the upper Kootenay River and its' spawning tributaries in B.C. Fishing regulation adjustments (annual limits, bait bans, catch and release sections on the Kootenay River) may have to be considered if bull trout redds decline to undesirable levels.

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