Assessment of Sport Fish Abundance in the Upper North Saskatchewan River 2001

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Abstract

Electrofishing and sample angling were used to obtain sport fish relative abundance data in the upper North Saskatchewan River upstream of Abraham Lake during the spring of 2001. A bull trout mark-recapture population estimate was obtained for a 10.4 km reach immediately downstream of the Banff Park boundary (Alberta reach), a catch-per-unit-effort (CUE) survey was performed upstream (Banff reach). Average electrofishing CUE of bull trout was 0.34 fish/100 s and 0.23 fish/100 s in the Banff and Alberta reaches respectively. Sample angling bull trout CUE was 1.18 and 0.69 fish/h in the Banff and Alberta reaches respectively. Estimated bull trout abundance was 16.64 fish/km, more than double abundance estimates for comparable Alberta populations however data are limited. The sample angling catch of bull trout was biased toward larger fish relative to the electrofishing catch.

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Table of Contents

List of Figures

List of Tables

Appendices

1.0 Introduction

This study was performed to gather baseline information on the distribution, abundance, and life history characteristics of sport fish, particularly bull trout, inhabiting the North Saskatchewan River (NSR), upstream of Abraham Lake. Existing information regarding the upper NSR sport fishery is limited, primarily incidental in nature, and largely outdated. In recognition of this lack of information provincial fisheries management staff identified the upper NSR as the top priority for a co-operative inventory program (Appendix A) delivered by the Alberta Conservation Association (ACA). To this end, a fish inventory of tributaries to the upper NSR, and reconnaissance survey of the upper NSR main stem were performed in 2000 (summarised by Gardiner et al. 2001). In 2001 a co-operative effort between the ACA, Parks Canada, and Trout Unlimited was performed in May to survey sport fish distribution and relative abundance in the NSR within Banff National Park, downstream of highway 93 (Gardiner 2001). A mark-recapture, bull trout population estimate was also performed on the upper NSR April-May 2001 by ACA and Alberta Sustainable Resource Development (ASRD) staff. Results of the 2001 catch-per-unit-effort (CUE) survey within Banff National Park and the upper NSR bull trout population estimate are summarised in this report.

2.0 Background

Since the completion of the Bighorn Dam and formation of Abraham Lake in 1972, the only documented fishery survey in the upper NSR is the limited work done on the river upstream of the lake by Tebby (1974). Sampling efforts in the study focused largely upon the newly formed lake, sampling of the river above the lake consisted of a limited number of seine hauls and angler reports (Tebby 1974). Qualitative samples may have also been collected from the river using dip nets and rotenone (Tebby 1974). The following fish species were documented within the river upstream of the reservoir: mountain whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), longnose dace (*Rhinichthys cataractae*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), mountain sucker (*Catostomus platyrhynchus*), and spoonhead sculpin (*Cottus ricei*) (Tebby 1974). Lake trout (*Salvelinus namaycush*), cutthroat trout (*Oncorhynchus clarki*), and rainbow trout (*Oncorhynchus mykiss*) were not collected from the river during the study but were known to occur in the study area (Tebby 1974).

More recently, results of backpack electrofishing inventory work conducted by the ACA in 2000 confirmed the presence of bull, brook, cutthroat, and rainbow trout, and mountain whitefish in tributaries to the NSR upstream of Abraham Lake (Gardiner et al. 2001). Catch from a 2000 reconnaissance angling and float electrofishing survey on the river from the Banff Park boundary to the lake's inlet included those species, except cutthroat trout, and also included longnose sucker (Gardiner et al. 2001).

Of the fish species present, bull trout dominate the sport fish catch in the upper NSR (Tebby 1974, Gardiner et al. 2001) and, along with mountain whitefish, are the only sport fish species native to the upper NSR (Tebby 1974). Lake trout are considered native to the system (Tebby 1974) however lake trout from eastern Canada have been stocked into several lakes within the Rocky Mountain national parks (Donald and Alger 1993) and the origin of the lake trout now occurring within and upstream of the reservoir is unclear.

Bull trout are listed as a 'Species of Special Concern' in Alberta, largely in response to an observed reduction in distribution and numbers (Post and Johnston 2002). The provincial recovery plan for bull trout identifies site-specific population status information as fundamental to the recovery of the species (Berry 1994). Currently there is a province-wide zero limit for bull trout (Post and Johnston 2002) although a limited-harvest fishery in specific areas may be considered if there is sufficient evidence that the population can sustain harvest (Berry 1994).

The status of the upper NSR bull trout population and its ability to support harvest by anglers is largely unknown.

Throughout much of the study area the river flows in close proximity to the David Thompson Highway (highway 11), one of only four major roadways linking Alberta to the Rocky Mountain parks and British Columbia beyond. The area, known as the David Thompson Corridor, is particularly popular for its diverse array of outdoor recreational opportunities including hiking, sight-seeing, rock climbing, canoeing, kayaking and other water sports, helicopter touring, angling and hunting. Camping is also a popular recreational pursuit and several maintained campgrounds are located in the area. Resource development in the upper NSR catchment is relatively light at present but the potential for resource and, in particular, commercial development in the area is considerable. It is expected that both direct and indirect pressures upon the upper NSR system and its fish populations will only increase in the future.

The ACA initiated an inventory of the upper NSR fishery through the Co-operative Fisheries Inventory Program (CFIP) in 2000. Preliminary work included a fish inventory to document species distribution and relative abundance in low-order streams within the drainage. Sample angling and float electrofishing were used to survey sport fish populations in the river (Gardiner et al. 2001). In addition to species distribution information for the area (summarised above) 16 bull trout over >300 mm fork length (FL) captured in the river were tagged with Floy™ tags (Gardiner et al. 2001) in anticipation of more intensive collection efforts in the future. From observations made during fieldwork in 2000 it was decided that a population estimate for bull trout on the upper NSR should be performed in 2001. Arrangements were also made to conduct a single pass electrofishing CUE survey of sport fish in Banff National Park from the highway 93 crossing downstream to the park boundary.

2.1 Management

A majority of the upper NSR watershed falls within the Prime Protection Zone as defined by the Alberta Government's Resource Management Policy for the Eastern Slopes region (Government of Alberta 1984). The purpose of this zone is to preserve environmentally sensitive terrain and valuable ecological and aesthetic resources. Compatible regional objectives include watershed, fisheries, and wildlife management and extensive recreational activities (Government of Alberta 1984).

Currently (2003) the upper NSR outside of Banff National Park is closed to angling from November 1-March 31. From April 1-August 31 the trout limit is two with a zero catch limit on bull trout. Cutthroat and rainbow trout must be over 30 cm; the mountain whitefish limit is five over 30 cm. From September 1-October 31 the trout and mountain whitefish limit is zero. Fishing with bait is banned (Alberta Sustainable Resource Development 2003). Within Banff National Park the upper NSR is closed to angling from November 3-June 30, from July 1-November 2 the mountain whitefish, rainbow, lake, and brook trout limit is two, with a zero catch limit on bull and cutthroat trout. It is unlawful to possess more than two game fish at one time. A bait ban is in effect and no lead tackle under 50 grams is allowed when angling (Banff National Park of Canada Visitor Information Fishing Regulations Summary).

2.2 Climactic and Ecological Conditions

Climactic and ecological conditions of the upper NSR valley are characteristic of the Montane ecoregion. These areas are largely limited to the foothills and major valleys of the Rocky Mountains and influenced by warm winds channelled from British Columbia (Strong and Leggatt 1992). Characteristic vegetation includes the Douglas-fir, limber pine, lodgepole pine and aspen stands with secondary succession to white spruce. Total precipitation is variable typically peaking in July. Summer monthly temperatures average 11.9°C with a July maximum. Freezing temperatures can occur during any month. The Montane has the warmest winter temperatures of

any forested ecoregion in Alberta and can support a greater than average wildlife diversity (Strong and Leggatt 1992). Monthly mean temperature and total precipitation data collected near the study area at the Kootenay Plains weather station in 2001 are summarised in Figure 2.1. A more detailed summary of weather station data collected in 2001 is contained in Appendix B.

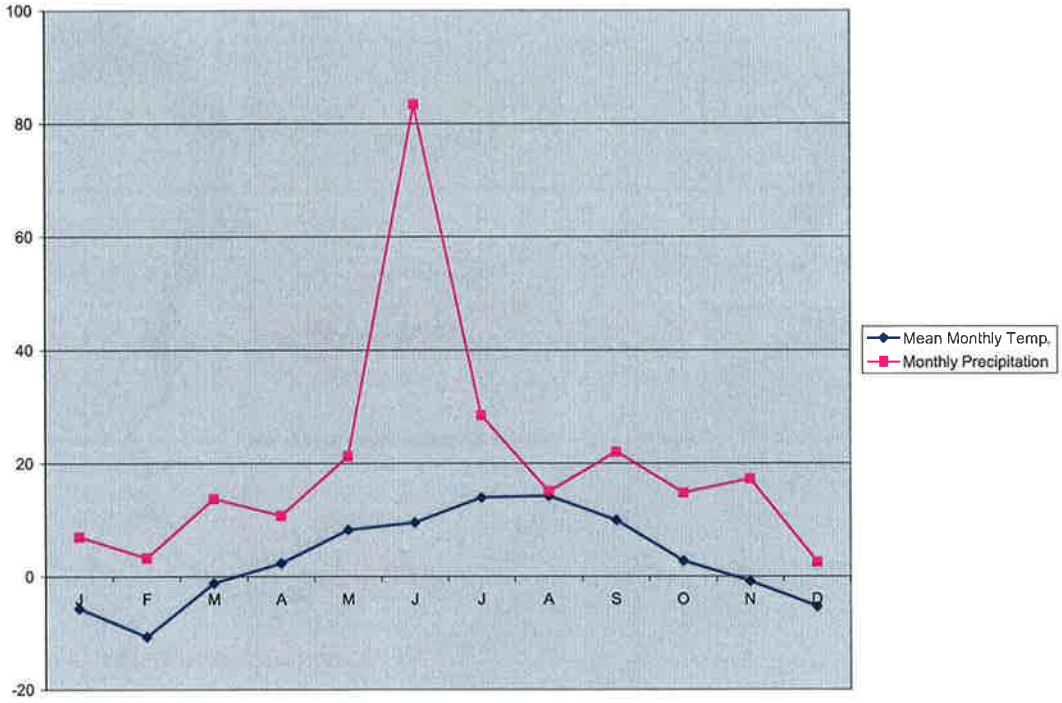

Figure 2.1 Mean monthly precipitation and temperature recorded at the Kootney Plains weather station, 2001.

2.3 Geography

The upper NSR and its major tributaries are of glacial origin. Steep slopes and a short but intense melting period make the watercourses subject to flash floods (Tebby 1974). Much of the NSR valley consists of glacial debris, reworked by the river and its tributaries into a complex of fans, side channels, and temporary flood plains (Tebby 1974). Regionally, the basin's fish fauna is the most depauperate of Alberta's major watersheds, probably as a result of glaciation and post-glacial events that limited colonisation (Tebby 1974). Locally, the steep gradient of many tributary streams appears to limit fish distribution to the lower reaches within the drainage from areas that appear to have otherwise suitable habitat (Gardiner et al. 2001). For a more detailed description of the area's geography see Tebby (1974).

2.4 Study Location

For the upper NSR bull trout population estimate a subsection of the approximately 29 kilometres of river occurring upstream of Abraham Lake to the Banff Park boundary was selected. The reach began at the park boundary and ended 10.4 km downstream at a pull out easily accessible from highway 11. A shorter reach within Banff National Park, from highway 93 to the park boundary was used for the sport fish CUE survey (Figure 2.2). Coordinates delimiting the bounds of each reach are contained in Appendix C.

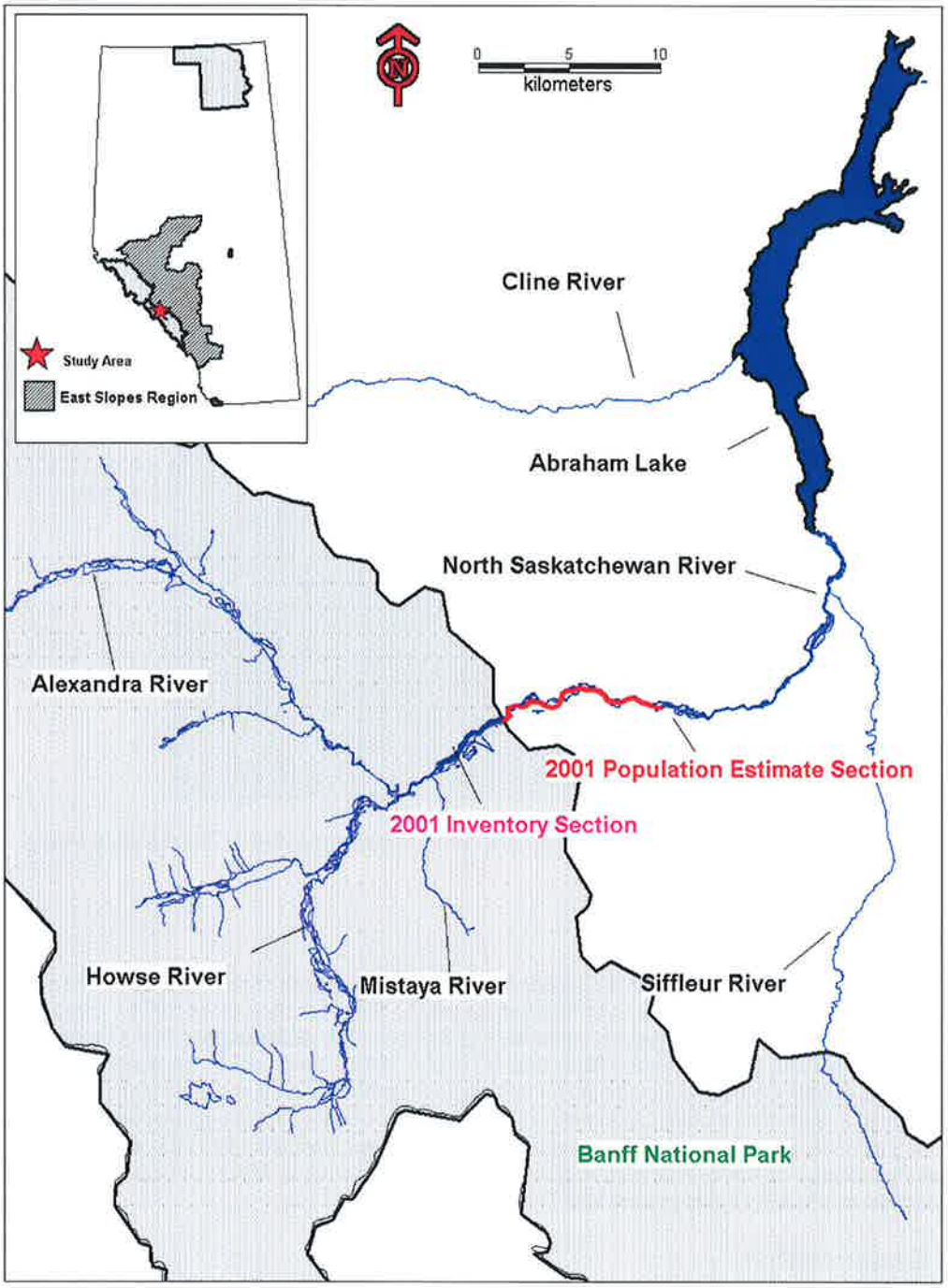

Figure 2.2 Location of the bull trout population estimate reach and sport fish CUE survey reach, upper North Saskatchewan River, April-May 2001.

3.0 Methods

3.1 Site Selection

Bull Trout Population Estimate Reach

The bull trout population estimate reach was selected based on the results of preliminary surveys performed in 2000 and a reconnaissance float performed April 23-24, 2001. In 2000, sample angling (May 17-18) and single-pass, float electrofishing (May 23-24) were used to assess river conditions, fish densities, and identify suitable habitat, within the upper NSR downstream of the park boundary (Gardiner et al. 2001). During the 2001 reconnaissance float the reach was surveyed again, river access points were evaluated, potential safety hazards were noted, and a limited amount of sample angling was performed. The reach selected for the bull trout population estimate contained much of the best bull trout habitat observed downstream of the park boundary.

Sport Fish CUE Survey Reach

Access considerations largely dictated the location of the sport fish CUE survey reach. A reconnaissance float of the NSR within Banff Park downstream of highway 93 was performed on May 17, 2001 to assess the feasibility of an electrofishing survey. During the float access points, potential safety hazards, and river conditions were noted. A limited amount of sample angling was performed.

3.2 Fish Collection

Bull Trout Population Estimate

A mark-recapture strategy was used to obtain a bull trout population estimate in the upper NSR. The first marking run was conducted on April 30, 2001. As only moderate numbers of fish were marked during the first run, a second marking run was performed on May 1 (Kraft et al. 1982). The recapture run was performed on May 8.

Results of preliminary work in 2000 suggested that bull trout numbers in the river were low and conditions suitable for electrofishing only occurred during a narrow window of opportunity in early spring before significant meltwater entered the river, severely reducing visibility and reducing electrofishing efficientcy. The range of habitat present within the river also suggested no single sampling method would be effective throughout the reach. Typically large, deep (>4 m) pools were separated by shallow, braided sections of river. Runs of intermediate depth with coarse cobble and boulder substrates were also present. With these challenges in mind three complimentary sampling methods were used in an effort to increase sampling efficiency during the population estimate.

1. Sample Angling

A 13ft (4.0 m), oar-propelled, Avon inflatable raft was used by the angling crew. The crew included one rower and one or two anglers. Anglers would fish shallow riffle and run habitat from the raft; everyone angled deeper run and pool habitats from shore. Generally anglers used large, flashy spoons and similar types of unbaited lures to target bull trout. Fishing effort, location of capture, and fish life history information (see Fish Sampling below) were recorded by the angling crew during each pass of the estimate.

2. Raft-Mounted Electrofisher

The first of two electrofishing systems was a 14ft (4.3 m), oar-propelled Avon™ raft (Figure 3.1). Mounted on the raft was a Smith-Root Type 5 GPP electrofisher. Pulsed direct current at 120 mhtz, set at high range, generating approximately two output amps was used. A ring style anode was operated by a crewmember from the bow of the raft and a trailing cathode array was fixed to the sides of the raft. A second crewmember netted fish from the bow while the crewleader manned the oars and monitored the electrofisher. Captured fish were placed in a livewell onboard and periodically transferred to the sampling crew (see Fish Sampling below).

Figure 3.1 Raft-mounted electrofisher used by staff from the Alberta Conservation Association.

3. Boat-Mounted Electrofisher

The second electrofishing system was a 14ft (4.3 m) Glascon boat, powered by a 15 horsepower Evinrude outboard motor with external prop (Figure 3.2). Mounted on the boat was a Smith-Root Type 6A GPP. Pulsed direct current with a three millisecond pulse width and 120 mhtz cycling speed set to 336 output volts, resulting in approximately 4-5 output amps of electricity was used. An 'eggbeater' style throwing annode was operated by a crewmember in the bow of the boat while another netted fish. The cathode consisted of a metal plate attached to the bottom of the boat. The crewleader navigated from the stern and monitored the electrofisher. Captured fish were placed in a livewell onboard and periodically transferred to the sampling crew (see Fish Sampling below).

Figure 3.2 Boat-mounted electrofisher used by staff from Alberta Sustainable Resource Development.

The angling crew worked through the sample reach first, followed by the crew manning the raft-mounted electrofisher, and finally the boat-mounted electrofishing crew. Using this combination of methods enabled the sampling of a range of sport fish habitats in the river including deep pools

where electrofishing alone may not have been effective. For a more thorough discussion of combining electrofishing and angling results to derive a sport fish population estimate, including a test of mark-recapture assumptions, see Ripley (1997).

A fish sampling crew (see below) followed the electrofishing boats and sampled all electrofishing captures. Fish were transferred from the electrofishing boats to the sampling crew at short intervals to reduce fish stress and displacement within the sample reach.

Sport Fish CUE Survey

The primary goal of sampling efforts within Banff National Park was to determine if any large (>300 mm FL) bull trout occurred upstream of the park boundary as a pre-planning tool for an anticipated bull trout telemetry project. Sample angling in conjunction with a single-pass, sport fish, CUE electrofishing survey were used to determine the distribution of bull trout in the reach.

A 14ft (4.3 m) Avon raft was used during the initial reconnaissance survey. Equipment and methods used during the survey were comparable to those used by the sample angling crew during the population estimate (see above) except that anglers focused their effort on the best bull trout habitat within the reach. For the electrofishing CUE survey the same equipment and procedures were used as those outlined for the electrofishing raft during the population estimate (see above).

3.3 Fish Sampling

All captured fish were identified to species according to keys in Nelson and Paetz (1992) and Scott and Crossman (1973). Fork length (nearest mm) was measured for all fish; weight (nearest 10 g) was measured for sport species only. Sex and maturity information were recorded when discernible by external observation.

All bull trout, rainbow trout, and lake trout captured >300mm FL were tagged with red coloured Floy™ -anchor/spaghetti tags. All salmonids captured within the upper NSR were marked with an adipose fin clip. Clips taken from bull and lake trout during the population estimate were stored in the ACA's Rocky Mountain House office, samples collected within Banff National Park and directly downstream of the boundary were provided to Parks Canada.

During the population estimate the caudal fin of all fish captured by the angling crew was marked using a hole-punch during the recapture run. This ensured that fish captured while electrofishing, previously captured that day by the angling crew were not counted twice as recaptures. Capture location and tag number were recorded for tagged fish. A crew dedicated to fish handling sampled fish captured while electrofishing during the population estimate; the respective collection crew sampled all other fish.

3.4 Data Entry

Field data was entered into Excel spreadsheets and forwarded to ASRD database managers for inclusion into the Fisheries Management Information System (FMIS), the provincial government fisheries database. Field data associated with work on the upper NSR entered into FMIS included data collected during the population estimate (Inventory Project 1189) and within Banff National Park during the sport fish CUE survey (Inventory Project 2819). Inventory Project 1189 was originally created in 1999 to catalogue data collected within the upper NSR drainage through a partnership between the ACA and ASRD. Project 2819 was created to house data collected through a partnership between the ACA – Rocky Mountain House office, and Banff National Parks. Field notes are stored in the ACA's – East Slopes Regional office in Rocky Mountain House.

3.5 Data Analysis

The mark-recapture population estimate was derived using the Peterson formula as outlined by Kraft et al. (1982). Calculations were performed using the POP-EST program, a BASIC program available through Alberta Sustainable Resource Development, according to the procedure outlined in Kraft et al. (1982). Electrofishing CUE was calculated using the number of seconds (s) the system was activated, meters (m) of stream sampled, and number of fish captured. Hours (h) spent angling and number of fish captured was used to determine angling CUE.

The data analysed in this report were queried from FMIS using Oracle Discoverer™, histograms were created using Microsoft Excel™, and maps were prepared using MapInfo Professional™. A two-tailed Mann-Whitney *U* test was used for comparison of the size composition of bull trout comprising electrofishing and sample angling catches using SPSS™ software with alpha set at 0.05.

4.0 Results and Discussion

4.1 Species Composition

Catch composition of the 2001 bull trout population estimate downstream of the Banff Park boundary (Alberta reach hereafter), and sport fish CUE survey upstream of the park boundary (Banff reach hereafter) from the upper NSR are outlined in Table 4.1 below. Bull trout captured while angling during the reconnaissance float of the CUE survey reach are included in the catch.

Table 4.1 Catch composition of the 2001 population estimate and sport fish CUE survey from the upper NSR May-June 2001.

	Cutthroat Trout	Lake Trout	Longnose Dace	Longnose Sucker	Mountain Whitefish	Rainbow Trout
27.7% (n = 113)	0.25% (n = 1)	1.5% (n = 6)	0.5% (n = 2)	19.1% (n = 76)	49.5% (n = 193)	1.3% (n = 5)
24.6% (n = 15)			1.6% (n = 1)	27.9% (n = 17)	44.3% (n = 27)	1.6% (n = 1)

a. Total includes catch for angling reconnaissance trip and CUE survey.

Catch composition was remarkably similar between reaches. Both catches were dominated by mountain whitefish, with lower numbers of bull trout and longnose sucker. Lake and cutthroat trout were not captured upstream of the park boundary, while longnose dace and rainbow trout were captured in both reaches. In combination, these last four species, accounted for less than five percent of the total catch in either reach. It should be noted that non-sport species were not marked and recaptures, if any, during the population estimate could not be identified.

Species captured in the river during Tebby's (1974) study not captured in 2001 include brook trout, mountain sucker, spoonhead sculpin, and lake chub. Both brook trout and mountain sucker were rarely captured in the river during the 1972-1974 study and there is some evidence to suggest that brook trout may avoid the river during the June-August flood season (Tebby 1974). These factors may account for the species absence in the 2001 catch. Tebby (1974) found spoonhead sculpin and lake chub throughout the upper NSR however sampling methods included seining and rotenone use. Arguably those methods more effectively target smaller cottid and cyprinid species while current methods were designed to target larger, sport species.

Lake trout were not documented within the river or newly formed reservoir during Tebby's study although they occurred within the headwaters area (Tebby 1974). Their appearance in the 2001 catch may be cause for concern as there is some evidence to suggest that lake trout may displace or exclude bull trout from lake environments (Fredenberg 2002, Donald and Alger 1993). Angler misidentification of bull trout in their catch may further confound bull trout recovery efforts

based on zero bag limits while harvest of other salmonids, particularly the similarly looking lake trout, is allowed (Schmetterling and Long 1999).

4.2 Relative Abundance

Bull trout angling, electrofishing, and combined CUE; recaptures included, during the 2001 population estimate on the upper NSR is outlined in Table 4.2 below.

Table 4.2 Bull trout CUE during the population estimate on the upper NSR May-June 2001.

	Run	Capture Method	Effort	Number of Fish Caught	CUE[a]
Marking Run	First Marking Run	Electrofishing	20300 (s)	57	.28 fish/100 s
	Second Marking Run	Electrofishing	17733 (s)	34	.19 fish/100 s
	First Marking Run	Angling	15.82 (h)	8	.51 fish/h
	Second Marking Run	Angling	14.34 (h)	11	.77 fish/h
Recapture Run		Electrofishing	19123 (s)	41	.21 fish/100 s
		Angling	21.66 (h)	17	.78 fish/h
Grand Total		Electrofishing	57156 (s)	132	.23 fish/100 s
		Angling	51.82 (h)	36	.69 fish/h

a. Several bull trout were captured more than once during the population estimate; CUE calculations include all capture events.

During the population estimate bull trout CUE declined between marking runs while electrofishing and increased while angling. During the recapture run CUE for both sampling methods were comparable to those observed during the second marking run. Water clarity, which might partially account for changes in CUE, improved slightly between marking and recapture runs but was generally excellent during every run of the estimate. Table 4.3 summarizes CUE information for the other sport fish captured during the population estimate.

Table 4.3 Lake trout, rainbow trout, and mountain whitefish CUE during the population estimate on the upper NSR May-June 2001.

	Run	Species	Effort	Number of Fish Caught	CUE[a]
Marking Run	First Marking Run	LKTR	20300 s	3	.01 fish/100 s
	Second Marking Run	LKTR	17733 s	2	.01 fish/100 s
	First Marking Run	MNWH	20300 s	63	.31 fish/100 s
	Second Marking Run	MNWH	17733 s	51	.29 fish/100 s
	First Marking Run	RNTR	20300 s	3	.01 fish/100 s
	Second Marking Run	RNTR	17733 s	0	0
Recapture Run		LKTR	19123 s	3	.02 fish/100 s
		MNWH	19123 s	80	.42 fish/100 s
		RNTR	19123 s	2	.01 fish/100 s
Grand Total		LKTR	57156 s	8	.01 fish/100 s
		MNWH	57156 s	194	.34 fish/100 s
		RNTR	57156 s	5	.01 fish/100 s

a. Two lake trout were captured more than once during the population estimate; CUE calculations include all capture events.

Only a single cutthroat trout was captured during the population estimate (0.002 fish/100 s). Lake trout and rainbow trout CUE's were consistently low during every run of the population estimate while the mountain whitefish CUE was higher on the recapture run. Mark-recapture sport fish population estimate results for the Alberta reach of the upper NSR are summarized in Table 4.4 below. Bull trout population estimates obtained by electrofishing, angling, and both methods combined are included for comparison.

Table 4.4 Mark-recapture sport fish population estimate results from the upper NSR. Marking runs performed April 30th and May 1st, recapture run May 8th.

Species	Capture Method	Number Marked	Number Caught Recapture Run	Number of Recaptures	n	Estimate	95 % Confidence Interval	Fish/Km
BLTR	Combined	90	48	25	113	173	133<=N<=213	16.64
	Electrofishing	78	41	18	101	178	124<=N<=232	17.13
	Angling	20	17	12	25	28	23<=N<=34[a]	2.69
LKTR	Electrofishing	5	3	2	6	Not Valid	N/A	N/A
RNTR	Electrofishing	3	2	0	5	Not Valid	N/A	N/A
MNWH	Electrofishing	115	81	1	195	Not Valid	N/A	N/A

a. Calculated using the hypergeometiric distribution (Kraft et al. 1982).

Estimates of bull trout abundance in the upper NSR using only those results obtained by electrofishing, and results obtained by a combination of electrofishing and sample angling are similar although the combined estimate is more precise. The population estimate obtained by sample angling alone underestimates the observed abundance of bull trout in the upper NSR. Using similar methods Tchir (2000) found sample angling to underestimate the population size of bull trout and Ripley (1997) arctic grayling in the Kakwa River.

Comparable population estimates performed on other Alberta bull trout rivers are rare. In a 32-kilometer reach of the upper Kakwa River Hvenegaard and Fairless (1998) estimated 7.28 bull trout per kilometre. The estimate was repeated in 2000 resulting in an estimated 9.19 bull trout per kilometre however fish spawning in tributary streams may have been missed as the estimate was performed in late September.

Table 4.5 summarizes CUE information for all fish captured during the sport fish CUE survey of the upper NSR within Banff National Park. Both reconnaissance, and single-pass electrofishing results are included; catch data adapted from Gardiner (2001).

Table 4.5 Sport fish CUE during the survey of the Banff reach in the upper NSR, May 17-18th, 2001.

Capture Method	Species	Effort	Number of Fish Caught	CUE
Electrofishing	BLTR	3139 (s)	11	.34 fish/100 s
	MNWH	3139 (s)	27	.85 fish/100 s
	RNTR	3139 (s)	1	.03/100 s
Angling	BLTR	3.4 (h)	4	1.18 fish/h

A comparison of Table 4.5 with tables 4.2-3 indicates similar electrofishing CUE of bull and rainbow trout between reaches. Considerably greater CUE's were observed for mountain whitefish and angled bull trout within Banff. Differences in angling CUE between reaches may be attributable to a difference in sampling methods. During the CUE survey sample anglers targeted only those habitats considered to provide the best habitat for adult bull trout, during the population estimate anglers fished throughout the reach. Only bull trout were captured while sample angling.

4.3 Size Distribution

Size distributions of sport fish captured during the population estimate in the upper NSR are summarized in Table 4.6 below. Length-frequency histograms of bull trout and mountain whitefish captured during the 2001 population estimate (recaptures removed) are contained in figures 4.1 and 4.2 respectively.

Table 4.6 Size distributions of sport fish captured during a mark-recapture population estimate on the upper NSR. Marking runs performed April 30th and May 1st, recapture run May 8th. Sample size indicated parenthetically.

Species	Fork Length (mm)		Weight (g)	
	Mean	Range	Mean	Range
BLTR	372.0 (111)	58-718	855.0 (83)	20-4410
CTTR	N/A	382	N/A	610
LKTR	359.8 (6)	262-443	490 (6)	120-790
MNWH	145.9 (194)	50-253	59.5 (95)	10-250
RNTR	136.8 (5)	126-152	26.7 (3)	20-30

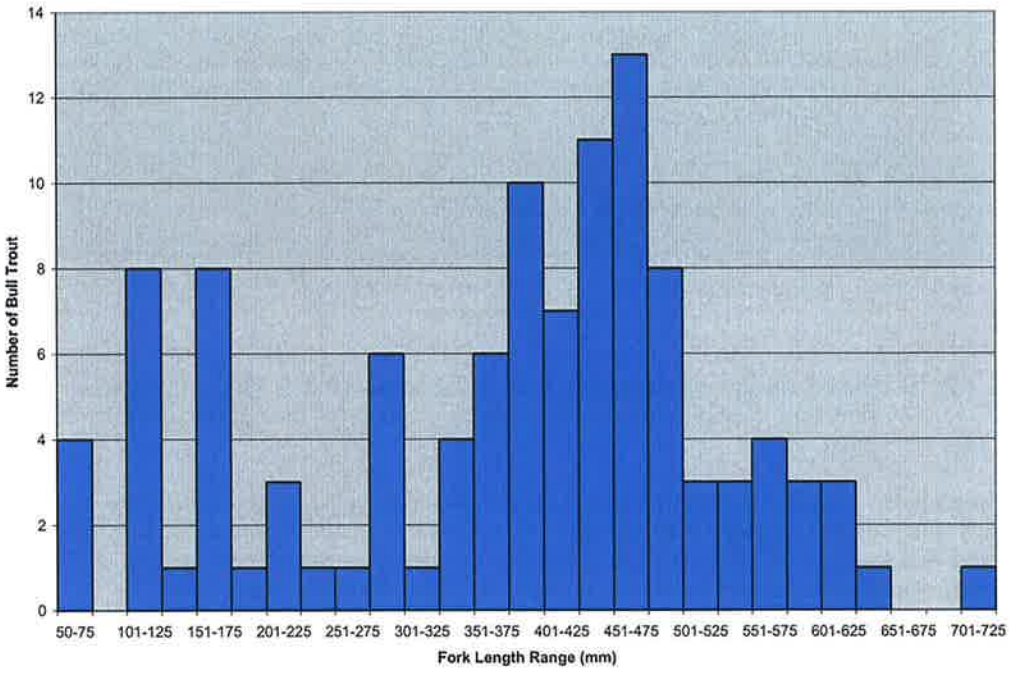

Figure 4.1 Length-frequency histogram of bull trout (n = 111), recaptures removed, captured during a population estimate on the upper NSR May-June 2001.

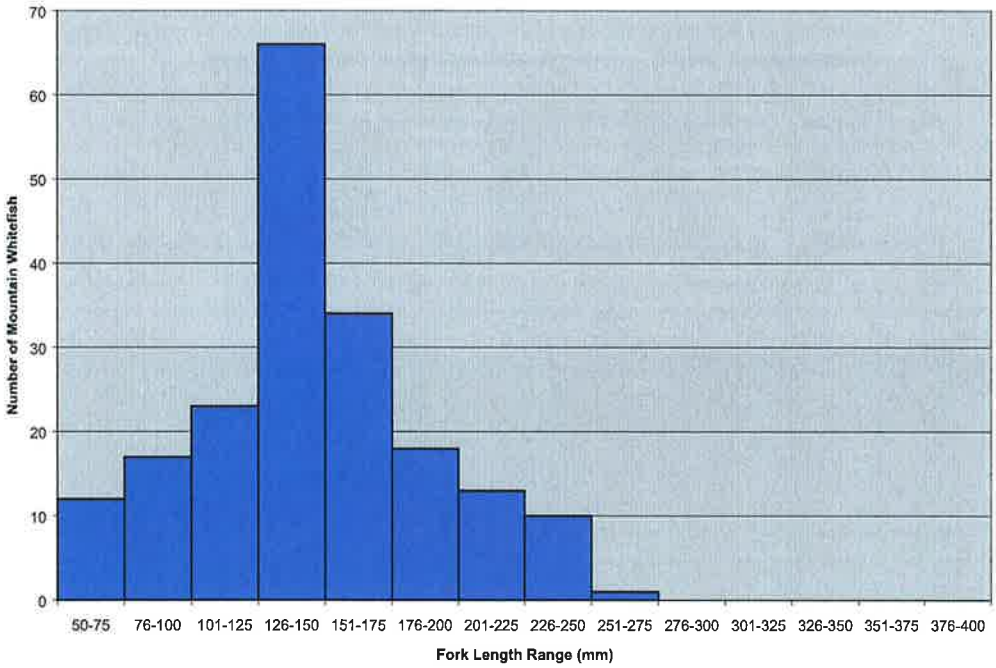

Figure 4.2 Length-frequency histogram of mountain whitefish (n = 194), recaptures removed, captured during a population estimate on the upper NSR May-June 2001.

Size distributions of sport fish captured in the Banff reach during the CUE survey in the upper NSR are summarized in Table 4.7 below. A combined bull trout and mountain whitefish length-frequency histogram is contained in Figure 4.3. Both reconnaissance sample angling, and single-pass electrofishing results are included; catch data adapted from Gardiner (2001).

Table 4.7 Size distributions of sport fish captured in the Banff reach during a CUE survey of the upper NSR upstream of the Banff Park boundary performed May 17-18th 2001.

Species	Fork Length (mm)		Weight (g)	
	Mean	Range	Mean	Range
BLTR	405.6 (15)	68-548	960 (9)	490-1500
MNWH	182.1 (27)	59-294	89.2 (26)	10-260
RNTR	390 (1)	NA	630 (1)	NA

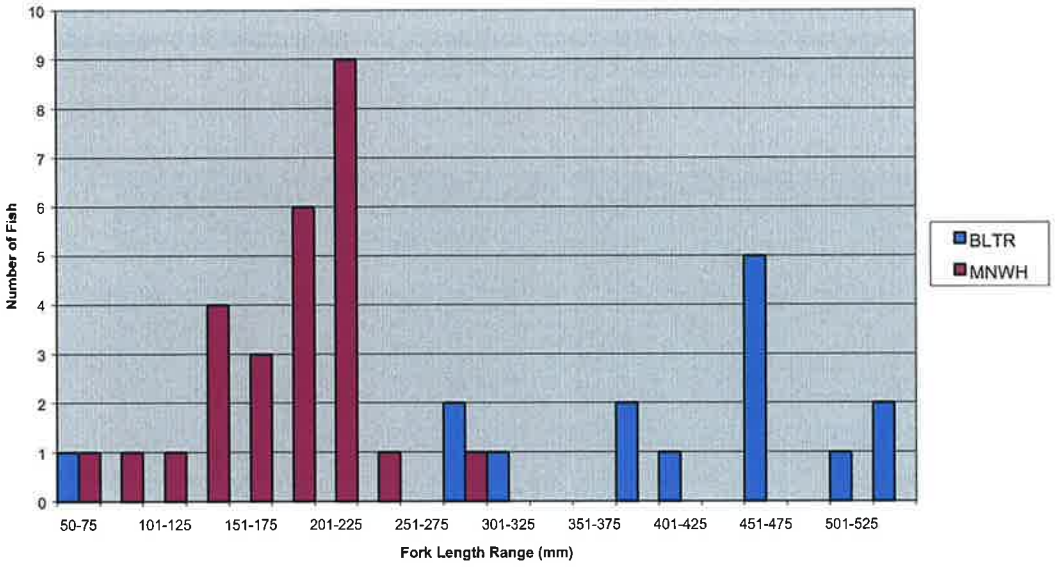

Figure 4.3 Length-frequency histogram bull trout (n = 15) and mountain whitefish (n = 27) captured during a sport fish CUE survey on the upper NSR May 17-18th, 2001.

The observed mean size of bull trout and mountain whitefish captured in the Banff reach is higher than that of fish captured in the Alberta reach. However, the size range of bull trout and mountain whitefish, species comprising the majority of the sport fish catch in each reach, include sizes corresponding to probable juvenile and adult fish of both species (Nelson and Paetz 1992, Scott and Crossman 1973).

4.4 Growth

Four out of 16 bull trout tagged during a reconnaissance angling and float electrofishing survey on the upper NSR in May 2000 were recaptured in 2001 during the population estimate. Growth data for these individuals are summarised in Table 4.8 initial capture data are from Gardiner et al. (2001).

Table 4.8 Change in fork length of bull trout tagged in 2000 recaptured in 2001 in the upper NSR.

Initial Capture		Recapture		Fork Length Change (mm)	Percent Increase	Tag Number
Date	Fork Length (mm)	Date	Fork Length (mm)			
May 23, 2000	335	May 8, 2001	363	+28	8.4	827
May 23, 2000	558	May 1, 2001	580	+22	3.9	824
May 23, 2000	475	May 8, 2001	475	0	0	823
May 24, 2000	456	May 8, 2001	505	+49	10.7	830

Mean growth of the tagged bull trout, was approximately 25 mm/year. Hvenegaard and Fairless (1998) calculated a mean growth rate for Kakwa River bull trout of a similar size based on recapture of tagged fish of 30 mm/year.

4.5 Sampling Method Comparisons

Figure 4.4 summarizes the number of bull trout, recaptures included, captured by each sample method during the population estimate on the upper NSR 2001.

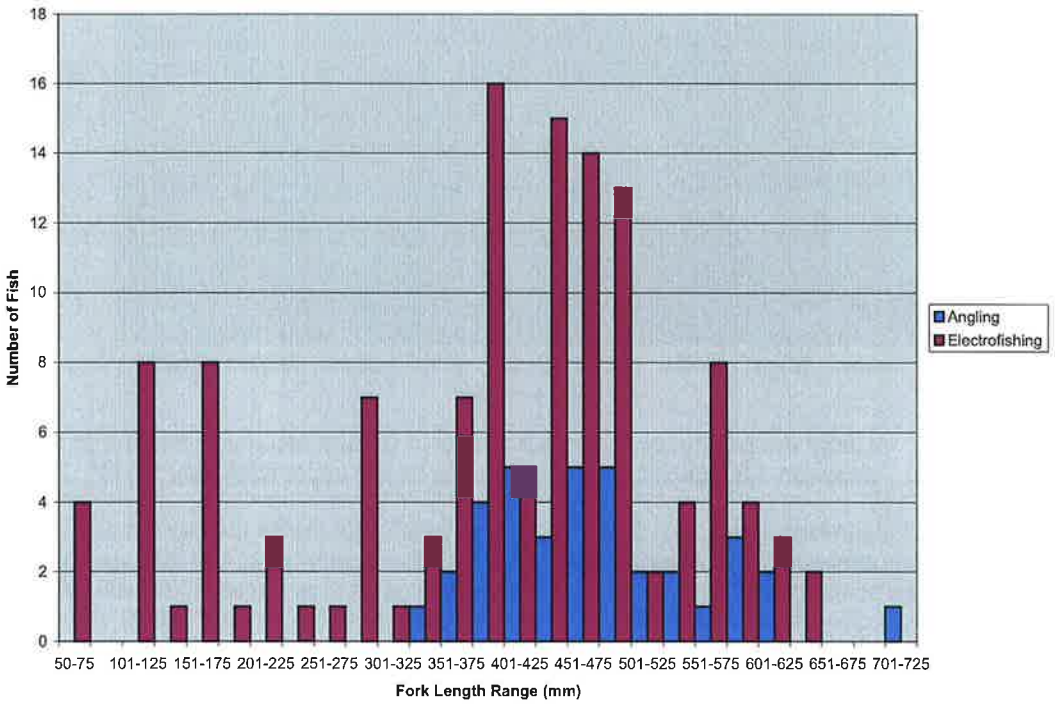

Figure 4.4 Length-frequency histogram of bull trout captured during the population estimate on the upper NSR 2001 by angling (n = 36) and electrofishing (n = 131), recaptures included.

As Figure 4.4 illustrates the angling gear employed during the population estimate clearly targeted the larger size classes of bull trout present in the catch. Length of bull trout captured while angling was significantly greater than the length of bull trout captured by electrofishing (U = 1564.00, P = 0.002). Tchir (2000) observed a similar bias in angler catch of bull trout during a population estimate on the upper Kakwa River, where bull trout entered the angling catch at approximately 280 mm FL while bull trout near 150 mm FL were captured electrofishing. These results are in contrast to Ripley's (1997) study of Kakwa River arctic grayling in which no significant difference in mean size of arctic grayling captured by electrofishing or angling was detected.

Of those fish captured over 300 mm FL, the minimum size class at which bull trout entered the angling catch; electrofishing captures were equal to or greater than angling captures at every size class except the largest in which a single fish (718 mm FL) was angled. Relative trends in catch between size classes of larger bull trout appear fairly consistent between methods. This suggests that angling catch, while underestimating actual numbers, may reflect relative abundance between size classes of bull trout.

During the population estimate it was possible for an individual bull trout to be handled by samplers several times over the course of the three days. Figure 4.5 summarizes the frequency

of tagged bull trout (i.e. >300 mm FL) handled up to the observed maximum of four times during the population estimate and contribution, by sampling method, of recaptures.

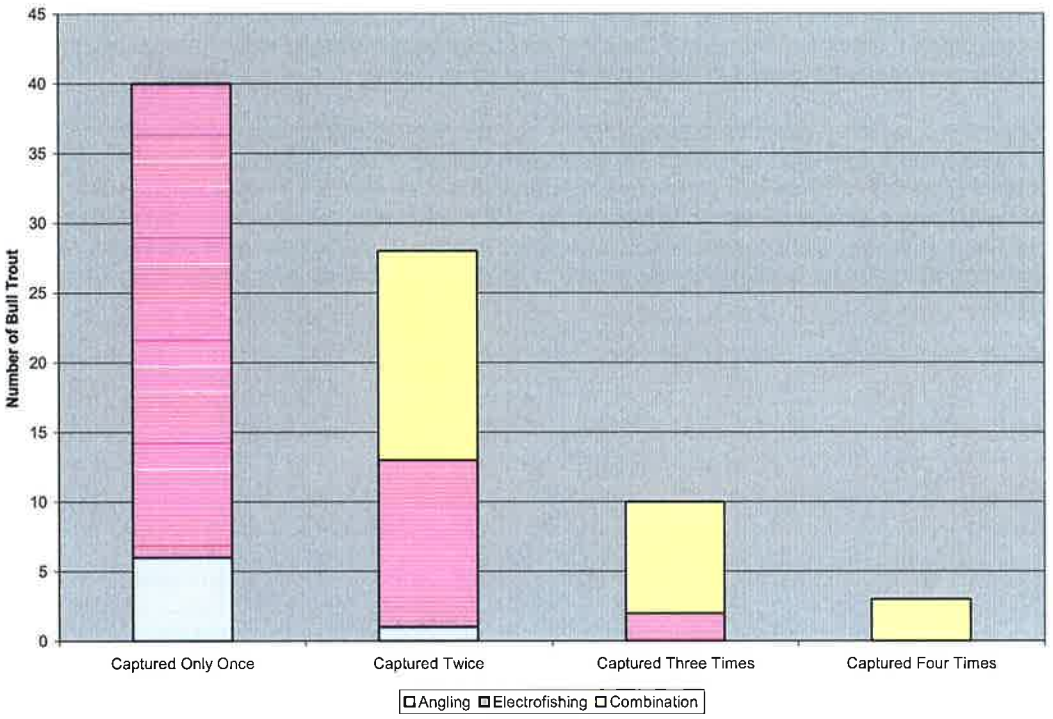

Figure 4.5 Frequency of tagged bull trout captures by sampling method during the population estimate on the upper NSR, May-June 2001.

As figure 4.5 illustrates a combination of electrofishing and sample angling was able to target bull trout and provide recaptures that either method performed individually would not have. The benefits of a sampling design similar to that used for this study need to be weighed against the detrimental effects on fish health associated with multiple capture and handling events possible in a study design of this nature. No immediate fish mortalities were observed during the population estimate.

5.0 Conclusion

Electrofishing and sample angling were used to obtain sport fish relative abundance data in the upper NSR, upstream of Abraham Lake; including a reach within Banff National Park April-May, 2001. Methods were designed to target bull trout in the varied habitats available within the river and maximize sampling efficiency. A bull trout mark-recapture population estimate was obtained for the 10.4 km of river immediately downstream of the Banff Park boundary, a CUE survey was performed upstream of the boundary. Mountain whitefish dominated the sport fish catch numerically followed by bull trout. Low numbers of rainbow, lake, and cutthroat trout were also captured. Longnose sucker and longnose dace were the only non-sport species observed.

Average CUE of bull trout while electrofishing was 0.34 fish/100 s and 0.23 fish/100 s in the Banff and Alberta reaches respectively. Bull trout CUE while sample angling was 1.18 and 0.69 fish/h in the Banff and Alberta reaches respectively. Estimated bull trout abundance downstream of the park boundary was 16.64 fish/km. This abundance estimate is more then double then those

reported else where in Alberta on large rivers, however only three other studies suitable for comparison were located, despite considerable effort spent researching by the authors.

Fork length ranges of bull trout and mountain whitefish captured at both sample reaches suggest juvenile and adult life stages both occur in the river, including large (>600 mm) bull trout. Recapture of a small number of bull trout that had been tagged the previous year allowed estimation of bull trout growth in the upper NSR at 25 mm/year.

During the population estimate bull trout in the sample angling catch were significantly larger than bull trout captured by electrofishing. Although size-biased when compared to the electrofishing catch, the sample angling catch included individual bull trout and bull trout recaptures that would not have been captured by electrofishing alone. Although some bull trout were handled up to four times during the population estimate no immediate injuries or mortalities were observed. The increased potential for handling stress needs to be considered when planning a study of this nature.

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Appendix A

Rocky Mountain House area-priority bull trout survey drainages as selected by Natural Resources Service

Alberta
ENVIRONMENT
Natural Resources
Fisheries Management Br.

Memorandum

FROM D.G.Christiansen
Rocky Mtn Hse

OUR REFERENCE 4602-6-1

TO Cal McLeod
Alberta Conservation Association

DATE May 1, 2000

TELEPHONE 845-8269
FAX 844-4216

SUBJECT **Rocky Area Bull Trout Inventory Priorities- 2000**

Based on a review of the Bull Trout Operational Plan for FMA #3, we have identified the following list of priorities for the co-operative bull trout inventory program in the North Saskatchewan and Red Deer River drainages:

1. Upper North Saskatchewan River
   A. Main stem and tributaries above Abraham Reservoir to park boundary
   B. Haven/Gonika Creeks
   C. Other tributaries dam to trunk road (Bighorn below falls, Black Canyon etc.)
   D. Tributaries to Abraham Reservoir (including Cline River system)
2. Upper Blackstone River and tributaries (above the Gap)
3. Upper Brazeau and unsurveyed tributaries above Trunk Road.
4. Lower Ram River (NSR to first falls) and unsurveyed tributaries
5. Upper Prairie Creek (above Strachan) and tributaries
6. Upper Red Deer River
   A. Upper Bighorn Creek
   B. Bull Creek
   C. Cartier Creek
   D. Coal Camp Creek
   E. Helmer Creek
   F. Nitchi Creek
   G. Upper Bearberry Creek
      (a) Barry Creek
      (b) Walton Creek
      (c) Smith Creek
   H. Upper Red Deer River mainstem, trunk road to Sundre (were possible)

Our preference for the co-operative bull trout inventory program with ACA in 2000 would be to work progressively down through the list, as far as time and resources permit. However, if due to weather and planned work in other locations, it is

reasonable to inventory lower priority waters, then that is something that could be considered.

As indicated earlier, we have $25K to contribute to the project this year, as well as some "in-kind support" (the details of which we need to sit down and sort out). As soon as we can meet, I will start working on an contract to outline work to be completed and the dollar transfer arrangements.

D.G.Christiansen

cc: S.Herman
R.Konynenbelt
K.Gardiner

Table B 1. Summary of temperature and precipitation data collected at the Kootney Plains weather station, 2001.

Month	Minimum Temperature °C (average)	Maximum Temperature °C (average)	Total Precipitation (mm)	Average Temperature (°C)
January	-11.5 (-22.2)	-0.3 (4.7)	7.00	-5.7
February	-19.3 (-32.9)	-2.8 (4.8)	3.25	-10.7
March	-8.6 (-20.9)	5.5 (13.2)	13.75	-1.2
April	-4.5 (-15.1)	9.0 (18.9)	10.75	2.3
May	1.6 (-5.4)	15.1 (26.5)	21.25	8.2
June	2.5 (-1.5)	17.6 (25.1)	83.50	9.5
July	6.6 (0.5)	22.6 (30.6)	28.50	13.9
August	4.8 (0.3)	24.6 (31.5)	15.00	14.2
September	1.3 (-3.6)	18.5 (27.7)	22.00	9.9
October	-3.6 (-12.5)	8.3 (18.9)	14.75	2.7
November	-6.1 (-23.1)	3.7 (12.9)	17.25	-0.9
December	-11.2 (-24.7)	-2.2 (6.4)	2.50	-5.4

Appendix C

Location of population estimate and CUE sport fish survey reaches, upper NSR drainage, 2001.

Table C 1. UTM coordinates (Map Datum NAD 83) of lower and upper boundaries of sample reaches in the upper NSR, 2001.

Location	Downstream Easting	Downstream Northing	Upstream Easting	Upstream Northing
Alberta Reach	523000	5760460	519197	5757930
Banff Reach	531783	5761347	523000	5760460