Abundance and Distribution of Bull Trout in Elk Creek, Alberta, 2010

Alberta Conservation Association

Conserving Alberta's Wild Side

The Alberta Conservation Association is a Delegated Administrative Organization under Alberta's Wildlife Act.

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Conservation Report Series Type
Data

ISBN printed: 978-0-7785-9388-1
ISBN online: 978-0-7785-9389-8
Publication No.: T/242

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Suggested Citation:
Judd, C., and M. Rodtka. 2011. Abundance and distribution of bull trout in Elk Creek, Alberta, 2010. Data Report, D-2011-004, produced by the Alberta Conservation Association, Rocky Mountain House, Alberta, Canada. 13 pp + App.

Cover photo credit: David Fairless

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EXECUTIVE SUMMARY

The majority of Alberta's bull trout (*Salvelinus confluentus*) populations, according to Alberta Sustainable Resource Development, are classified as being '*At Risk*' or at '*High Risk*' of extirpation and therefore require updated abundance information for managers to monitor population trends. The Clearwater River core area bull trout population is classified as being at '*High Risk'* of extirpation. We used single pass electrofishing capture data from inventory sites, as well as capture-mark-recapture estimates, to quantify the spatial distribution and abundance of bull trout in Elk Creek, a tributary to the Clearwater River. From 14 April to 6 May 2010, we electrofished 15 systematically distributed sample sites, for a total sample distance of approximately 3.7 km of Elk Creek. Bull trout were captured at 14 of the 15 inventory sites and were the dominant species in the headwaters. Brown trout were the dominant species in the lower half of Elk Creek. We captured 135 bull trout that ranged in size from 59 – 326 mm fork length (FL) but our catch was dominated by juvenile and sub-adult fish and did not include enough adults (≥250 mm FL; n=6) for valid adult abundance estimates. Estimated abundance of bull trout (≥70 mm FL) in Elk Creek is 1,031 (95% CI = 827 – 1,327). Bull trout density was greatest 23 km upstream from the mouth. We used size-at-maturity information for bull trout from the Clearwater River to determine the approximate size of adult fish in Elk Creek. Size-at-maturity data from Elk Creek would enable a more accurate description of adult bull trout abundance in the stream. Our study will provide resource managers with data required to update the status of Elk Creek's bull trout population in the Clearwater River core area.

Key words: Alberta, Elk Creek, bull trout, abundance, status

ACKNOWLEDGEMENTS

We thank Alberta Conservation Association (ACA) employees Ariane Cantin and Kevin Fitzsimmons for assistance in data collection; Kevin Fitzsimmons also assisted with study design and statistical analysis. Editorial reviews by Steve Herman (Alberta Sustainable Resource Development), Kevin Fitzsimmons and Peter Aku (ACA) greatly improved the final report.

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1.0 INTRODUCTION

1.1 Background

Alberta Sustainable Resource Development (ASRD), in review of their bull trout (*Salvelinus confluentus*) management plan, used a modification of the Natural Heritage Network ranking system to rank bull trout population trends in the province (ASRD and Alberta Conservation Association (ACA) 2009). This ranking system divides watersheds into core areas that provide habitat and the necessary requirements for long-term survival of bull trout. Core areas are ranked according to adult population size, area of occupancy, short-term trends and threats to the core area (Fredenberg et al. 2005; U.S. Fish and Wildlife Services (USFWS) 2008). The majority of core areas in Alberta have bull trout populations that are considered '*At Risk*' or at '*High Risk*' of extirpation.

The Clearwater River core area is composed of four identified sub-populations: Clearwater River, Elk Creek, Prairie Creek, and Tay River. The Clearwater River core area was given a '*High Risk*' ranking even though the Elk Creek sub-population may be increasing (ASRD and ACA 2009). Bull trout abundance at an ASRD index reach used to monitor this sub-population was as low as 13 fish/km in 1979 but increased to 150 fish/km in 1998; the increase may be related to the province-wide harvest closure implemented in 1995 (ASRD and ACA 2009). However, along with angling pressure, the Elk Creek bull trout population encounters threats common to other bull trout populations including poor land management practices, habitat fragmentation, and exotic species introductions (ASRD and ACA 2009).

The Clearwater drainage is one of the few drainages in Alberta where bull trout population status has been monitored for decades. However, changes in study design and long intervals between studies make it difficult to draw any but the most conservative conclusions about the population (Rodtka 2005). Our study provides fisheries managers with an update on the abundance and distribution of bull trout in Elk Creek, information which can be used when determining species status within the Clearwater River core area.

1.2 Objectives

The objectives for this study are to:

1. Estimate abundance and spatial distribution of adult bull trout in Elk Creek.

2. Determine the size structure of bull trout in Elk Creek.

2.0 STUDY AREA

Elk Creek is a fifth-order tributary to the Clearwater River within the Rocky Mountain and Foothills Natural Regions of Alberta (Natural Regions Committee 2006). Located approximately 61 km southwest of the town of Rocky Mountain House, Elk Creek is 35 km in length and drains an area of approximately 95 km^2 (Figure 1). It is paralleled much of its length by Secondary Highway 734, including six bridged crossings, and is easily accessed by anglers. The headwaters of the creek flow through the Kiska Wilson Forest Land Use Zone (FLUZ) where off-highway vehicle (OHV) use is restricted to designated trails. Land use activities in the area include equestrian and OHV use, livestock grazing, oil and gas exploration and forestry. Grazing has impacted the lower section of Elk Creek by reducing riparian vegetation and increasing bank shear. Elk Creek meanders through meadow habitat and historically, beaver dams have limited fish movement and migration (Rhude and Rhem 1995), although few dams currently exist (Judd and Rodtka unpublished data). Sport fish species in Elk Creek include bull trout, brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and mountain whitefish (*Prosopium williamsoni*).

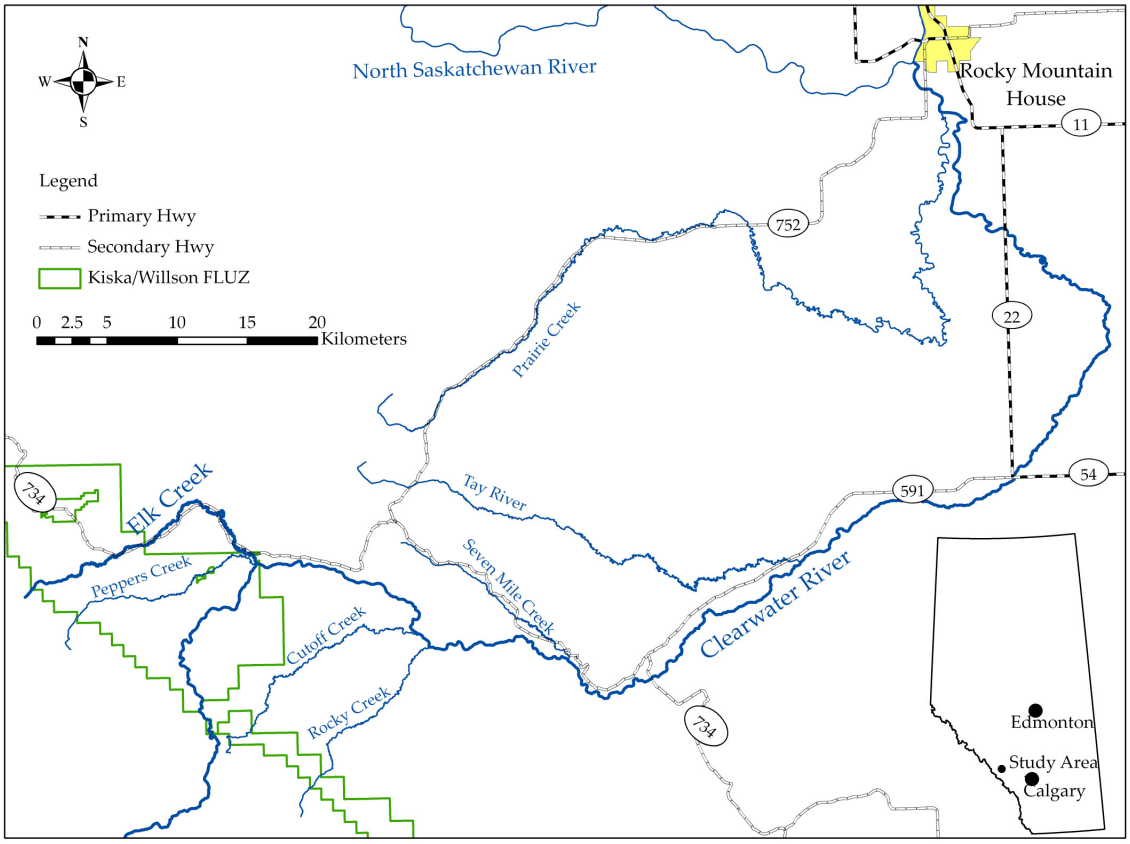

Figure 1. Location of Elk Creek relative to the Clearwater River and the town of Rocky Mountain House.

3.0 MATERIALS AND METHODS

3.1 General sampling methods

With a random start, we distributed inventory sites along Elk Creek systematically (1,500 m interval) using GIS and the Government of Alberta Resource Management Information Branch 2005 data layers (Figure 2). A handheld GPS was used to locate sites in the field (±250 m). Inventory sites were 250 m in length (measured with a hip chain) or 50 times the mean wetted width (whichever was greater; Fitzsimmons and Rodtka 2008) and began in a riffle area. Exceptions to sample length include site E0, where equipment malfunction, and site E20, where ice cover, prevented us from completing the sites.

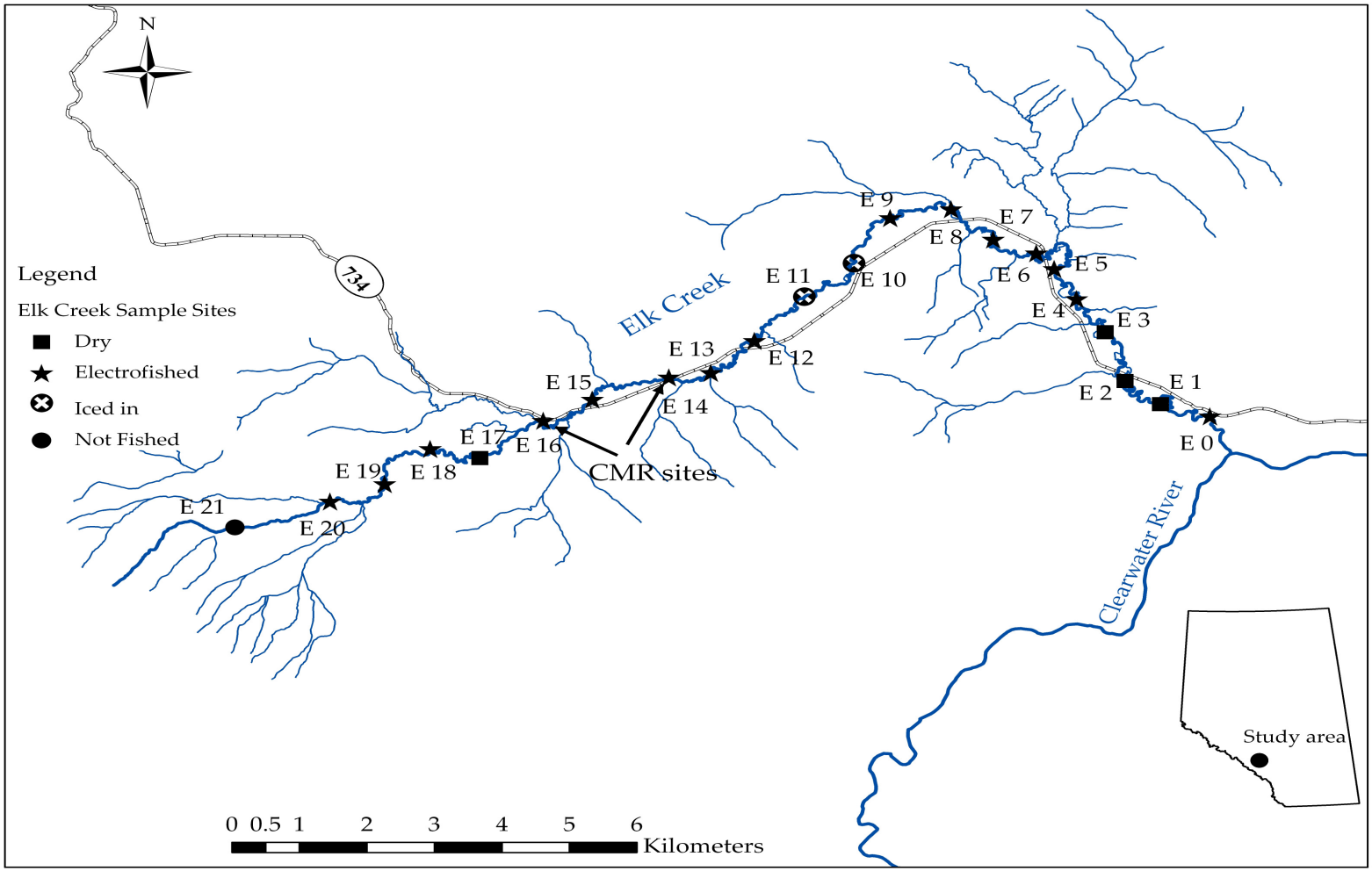

Figure 2. Location of backpack electrofishing inventory and capture-mark-recapture (CMR) sites in Elk Creek, 2010.

A total of 22 inventory sites were selected, 15 of which were electrofished, 4 (E1-E3, E17) were dry, 2 (E10, E11) were covered in ice, and 1 site (E21) in the headwaters was too narrow and shallow to effectively electrofish (Figure 2). Dry and iced-in sites were periodically checked to observe any change in condition. Sampling was conducted in early spring (14 April to 6 May 2010) when bull trout movement is minimal (ASRD and ACA 2009) in order to reduce the effects of bull trout migration on our results. This timing also allowed us to document habitat use by resident fish before the spring freshet. Sample sites were electrofished using a Smith-Root LR-20 or 12-B backpack electrofisher (voltage 250–600 V, frequency 30–35 Hz and duration 4–8.6 ms). We electrofished with a two-person crew (one dipnetter and one electrofisher operator) working in an upstream direction. At each site, fish were identified to species according to Nelson and Paetz (1992). Bull trout x brook trout hybrids were identified using external characteristics, including faint or incomplete vermiculation on the dorsal surface and faint spotting on the dorsal fin (Earle et al. 2007). All fish were measured (fork length FL, mm), fish (≥70 mm FL) were weighed (g) and all fish were released at 50 m intervals. We collected adipose fin clips for future DNA analysis from suspected hybrids and bull trout (≥250 mm FL).

We selected two sites (E14 and E16) for adult bull trout abundance estimates using capture-mark-recapture (CMR) techniques. Size-at-maturity of bull trout in Elk Creek is unknown so we based our classification of adults (≥250 mm FL) on approximate values reported for the Clearwater River (Rhude and Rhem 1995). Site E14 was part of a larger ASRD index reach used to monitor the population and was selected as a CMR site to allow comparison of our results to previous work by ASRD. Site E16 was selected following our inventory sampling effort because its habitat was generally representative of the headwaters and, based on our catch, we were confident of marking enough fish (≥70 mm FL), to ensure sufficient recaptures to calculate an abundance estimate. Fish captured during the CMR marking run at site E14 were included with the inventory site capture data, whereas fish at site E16 were not. At CMR sites, we marked fish (≥70 mm FL) on the marking run by clipping their adipose fin. A single recapture run was performed the next day where we recorded the number of previously marked and unmarked fish. Fish emigration and immigration was assumed to be eliminated by placing block nets at the top and bottom of both CMR sites before commencing with the marking run.

At all sites, we measured water temperature (0.1°C) and conductivity (0.1 μS/cm) prior to electrofishing. Stream wetted widths (0.1 m) and depths (0.01 m) were measured, and the dominant substrate was visually assessed along transects spaced every 25 m. Intensive habitat measurements were taken every 10 m at sites E0, E7 and E16 to be used for an additional study. Depth and substrate composition measurements were taken at three stations per transect; ¼, ½, and ¾ stream wetted width. The dominant substrate was visually assessed at each station using a modified Wentworth scale where fines are particles less than 2 mm, small gravel 2 – 16 mm, large gravel 17 – 64 mm, cobble 65 – 256 mm and boulders are greater than 256 mm (Bain et al. 1985). A summary of site habitat measurements is presented in Appendix 1.

All fish and habitat information was submitted for inclusion into the ASRD Fisheries and Wildlife Management Information System database.

3.2 Population modeling

We used methods described by Paul and Dormer (2005) and Fitzsimmons (2008) to estimate bull trout abundance and distribution in Elk Creek. The model adjusts the observed catch data at each site by incorporating the uncertainty in capture efficiency and fish captures given a constant capture efficiency by using the beta and negative binomial distributions, respectively. Electrofishing capture efficiency (q) was estimated for bull trout at the two adult abundance estimate sites (CMR sites) using the MARK software package (Cooch and White 1998). Uncertainty in estimation of q was then modeled with the beta distribution. We corrected the catch data at the 15 inventory sites using electrofishing capture efficiencies picked at random from the beta distribution. The beta distribution ranges in values from zero to one, which lends itself to describing proportions, and its parameters (α and β) are defined by the mean and the standard deviation of the values of q derived from CMR estimates. The parameters of the beta distribution are defined as:

$$\alpha = \bar{x}\left(\frac{\bar{x}(1-\bar{x})}{v} - 1\right)$$

$$\beta = (1-\bar{x})\left(\frac{\bar{x}(1-\bar{x})}{v} - 1\right)$$

where $\bar{x}$ and v are the mean and variance, respectively, of the capture efficiency estimates.

Bull trout abundance at each inventory site was estimated using the observed catch at each site, a value of q drawn at random from the modeled distribution of capture efficiencies, and the negative binomial distribution. We estimated the number of fish expected to have been missed at each inventory site while electrofishing with a fixed q. Bull trout abundance at each inventory site is then expressed as the observed catch plus the number of fish expected to have been missed. As the negative binomial distribution cannot compute zero values, the catch was set to 0.1 fish at sites where no fish were captured, and trials were then conducted on the adjusted values.

Finally, fish abundance over the entire length of Elk Creek was estimated using a nonparametric generalized additive model with estimated fish abundance from each inventory site and each site's distance upstream as model input data. This model estimated fish abundance in 250 m increments along Elk Creek and also provided one estimate of fish abundance over the entire stream. Ten thousand replicates were performed to obtain a mean population estimate and 95% confidence intervals. Modeling was performed using the software program R (R Development Core Team 2008).

4.0 RESULTS

4.1 Inventory data

In total, we captured 319 fish throughout the 3.7 km sampled on Elk Creek. Fish species composition consisted of 50% brown trout (n=159), 42% bull trout (n=135), 7% mountain whitefish (n=21) and 1% bull trout x brook trout hybrids (n=4). Brown trout dominated the catch in the lower reaches (Sites E0-E12) of the creek while bull trout was the dominant species in the upper reaches (Sites E13-E20) (Figure 3). Bull trout were present in 14 of the 15 inventory sites surveyed. A summary of fish capture data is presented in Appendix 2.

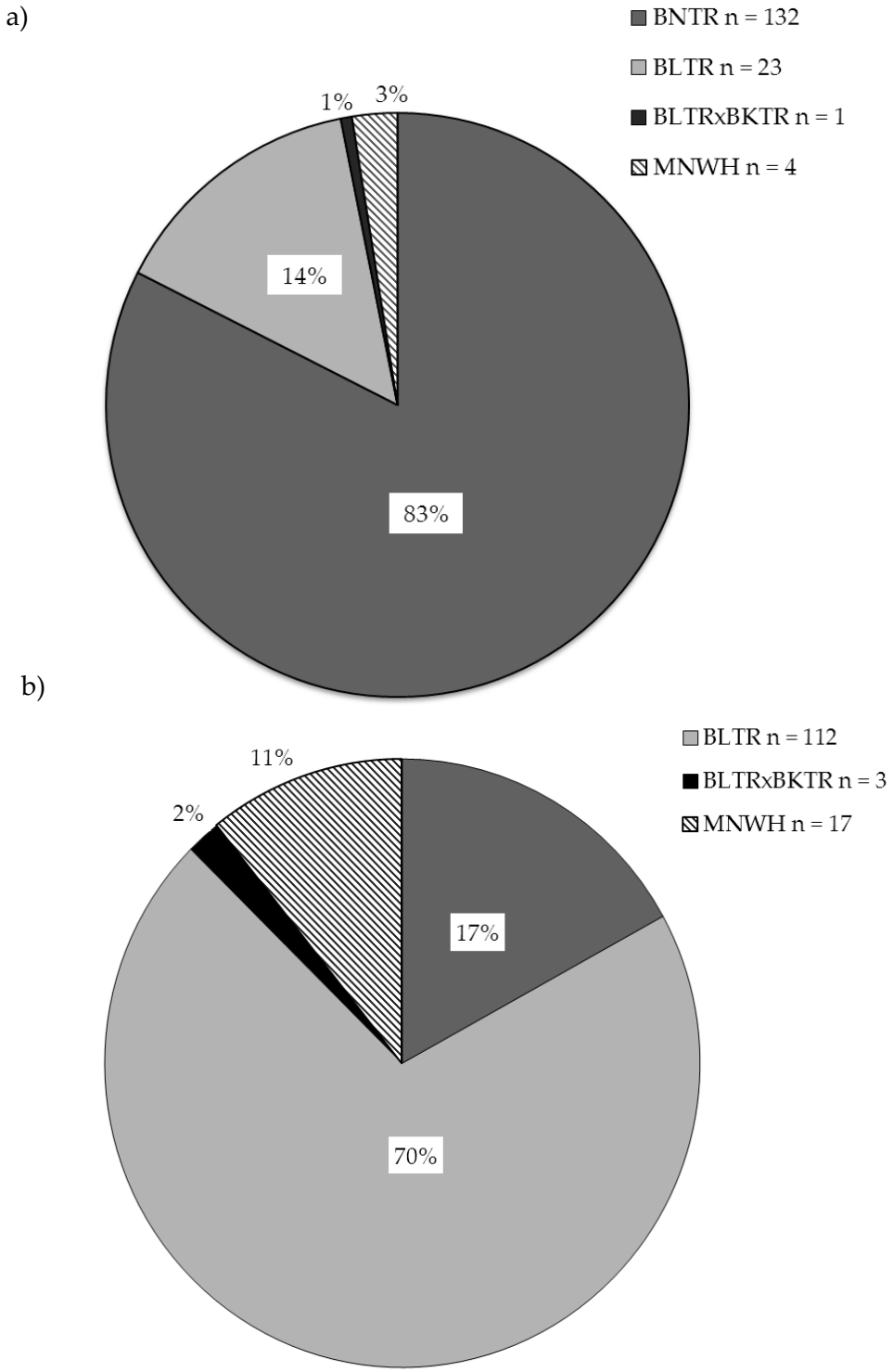

Figure 3. Fish species composition in Elk Creek at backpack electrofishing inventory sites; a) E0 to E12 and, b) E13 to E20. Species codes: BNTR = brown trout, BLTR = bull trout, BLTRxBKTR = hybrid, MNWH = mountain whitefish.

4.2 Population modeling

We did not capture enough adult bull trout (≥250 mm FL) at our two CMR sites for a valid adult abundance estimate; therefore we estimated backpack electrofishing capture efficiencies and abundance using smaller bull trout (≥70 mm FL). Capture efficiencies for sites E14 and E16 were 0.7216 and 0.7913 respectively (Table 1). The estimated mean abundance of bull trout in Elk Creek was 1,031 (95% CI = 827 – 1,327) (Figure 4). Bull trout density was greatest 23 km upstream from the mouth, near site E14.

Table 1. Summary of bull trout (≥70 mm FL) captured by backpack electrofishing at Elk Creek capture-mark-recapture sites, 2010.

	Site E14	Site E16
Marked time 1	31	30
Captured time 2	20	17
Captured time 2 and marked at time 1	14	13
Capture efficiency (q)	0.7216	0.7913

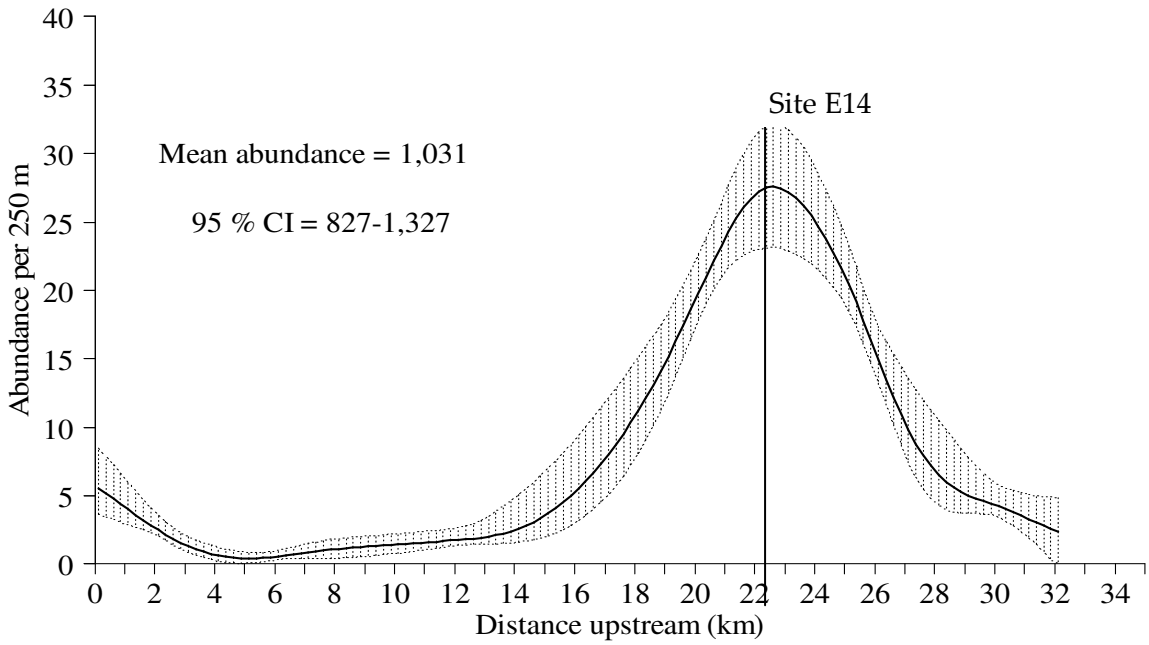

Figure 4. Estimated abundance of bull trout per 250 m in Elk Creek using fish capture data from backpack electrofishing inventory sites with capture efficiencies from capture-mark-recapture techniques. Band indicates the upper and lower 95% confidence intervals. Site E14 is an index site used to monitor bull trout population abundance.

4.3 Size structure

Bull trout captured in Elk Creek ranged from 59 – 326 mm FL with a mean (± SD) of 153 ± 56 mm FL (Figure 5). Few adult bull trout were captured; the majority of the catch was juvenile fish (≤149 mm FL; n=60) or sub-adult fish (150–249 mm FL; n=69). Although typically much larger, mature bull trout as small as 150 mm FL have been documented in Alberta (ASRD and ACA 2009), so it is possible that some of the fish we classify as sub-adults may be adults.

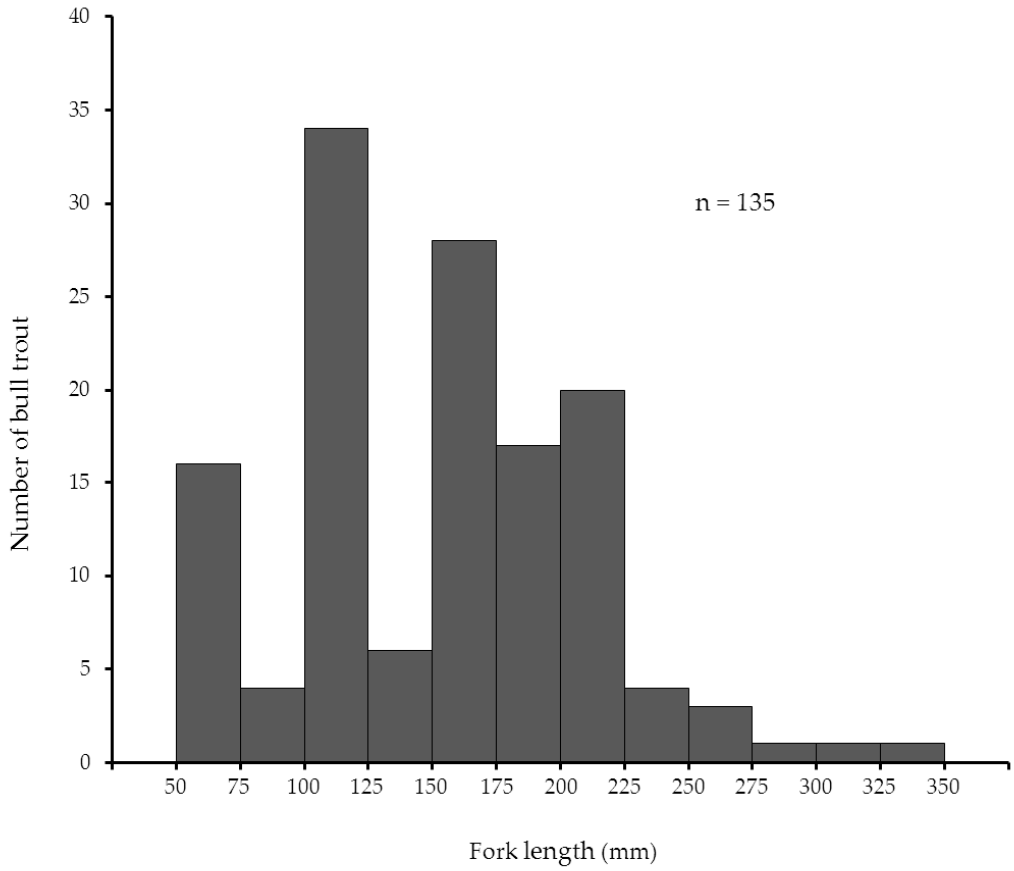

Figure 5. Length-frequency distribution for bull trout captured at backpack electrofishing inventory sites in Elk Creek, 2010.

4.4 Summary

We electrofished 15 of 22 sample sites distributed throughout Elk Creek. The remaining sites were either dry (n=4), covered in ice (n=2) or too small to effectively electrofish (n=1). At the electrofishing sites, we captured 319 sport fish including 135 bull trout. From our estimates of bull trout catchability, using electrofishing gear and inventory catch data, the mean abundance of bull trout (≥70 mm FL) in Elk Creek is 1,031 (95% CI = 827 – 1,327). Based on size-at-maturity information for bull trout from the Clearwater River the majority of bull trout in Elk Creek appear to be juveniles and sub-adults with only 4% (n=6) of our bull trout catch classified as adults (≥250 mm FL). Size-at-maturity data from Elk Creek would enable a more accurate description of adult bull trout abundance in the stream. Our study will provide resource managers with an update on the abundance and distribution of bull trout in Elk Creek, information which can be used when determining species status within the Clearwater River core area.

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6.0 APPENDICES

Appendix 1. Summary of habitat measurements at inventory sites on Elk Creek, 2010. Intensive habitat measurements were taken every 10 m at sites E0, E7, and E16. Geographic coordinates are UTM, NAD 83, Zone 11.

Location ID	Date	Easting	Northing	Mean wetted width ± SD (m)	Mean depth ± SD (m)	Dominant substrate	Comments
E0	14-Apr-10	592515	5768084	4.4 ± 2.2	0.15 ± 0.09	Cobble	-
E1	23-Apr-10	591780	5768304	-	-	-	Dry
E2	23-Apr-10	591257	5768726	-	-	-	Dry
E3	23-Apr-10	590961	5769611	-	-	-	Dry
E4	26-Apr-10	590539	5770214	3.8 ± 1.2	0.28 ± 0.18	Cobble	Thin layer of ice covering some corner pools.
E5	22-Apr-10	590209	5770760	4.6 ± 1.2	0.18 ± 0.12	Large gravel	Parts of reach ice covered.
E6	25-Apr-10	589942	5771045	3.1 ± 1.1	0.24 ± 0.09	Large gravel	Possible redds observed in reach.
E7	21-Apr-10	589304	5771296	5.0 ± 1.6	0.28 ± 0.12	Cobble	-
E8	24-Apr-10	588681	5771847	4.3 ± 1.7	0.22 ± 0.08	Cobble	Undercut in the form of ice ledges.
E9	27-Apr-10	587777	5771685	3.8 ± 1.1	0.25 ± 0.14	Large gravel	-
E10	6-May-10	587242	5770864	-	-	-	Ice covered
E11	25-Apr-10	586505	5770254	-	-	-	Ice covered
E12	22-Apr-10	585767	5769454	3.8 ± 1.2	0.24 ± 0.15	Cobble	-
E13	23-Apr-10	585118	5768874	5.1 ± 1.6	0.38 ± 0.18	Large gravel	-
E14	24-Apr-10	584501	5768792	4.0 ± 1.4	0.16 ± 0.06	Large gravel	Possible redds observed in reach.
E15	27-Apr-10	583367	5768391	2.8 ± 0.6	0.29 ± 0.14	Large gravel	-
E16	14-Apr-10	582638	5768005	2.5 ± 1.1	0.16 ± 0.07	Large gravel	-

Appendix 1. Continued.

Location ID	Date	Easting	Northing	Mean wetted width ± SD (m)	Mean depth ± SD (m)	Dominant substrate	Comments
E17	15-Apr-10	581697	5767323	-	-	-	Dry
E18	28-Apr-10	580965	5767492	1.1 ± 0.5	0.17 ± 0.08	Fines	Small (0.3m) waterfall barriers.
E19	25-Apr-10	580291	5766854	2.5 ± 0.9	0.14 ± 0.07	Large gravel	-
E20	25-Apr-10	579481	5766535	1.9 ± 0.5	0.07 ± 0.08	Cobble	Creek ice covered upstream of 200 m.
E21	25-Apr-10	578076	5766066	-	-	-	Too small to sample.

Appendix 2. Fish capture, listed by species, at inventory and CMR sites backpack electrofished in Elk Creek, 2010. Site E14 pass 1 catch was included in inventory site capture data. Species codes: BLTR = bull trout, BNTR = brown trout, BKTR = brook trout, MNWH = mountain whitefish.

Location ID	Distance (m)	Effort (s)	BLTR	BNTR	BKTR	BLTR x BKTR	MNWH
E0	209	505	4	6	0	0	0
E1	-	-	-	-	-	-	-
E2	-	-	-	-	-	-	-
E3	-	-	-	-	-	-	-
E4	250	599	2	2	0	0	0
E5	250	611	1	2	0	0	0
E6	250	762	1	16	0	0	1
E7	250	899	3	70	0	0	1
E8	250	809	1	7	0	1	1
E9	250	712	2	6	0	0	1
E10	-	-	-	-	-	-	-
E11	-	-	-	-	-	-	-
E12	250	1,116	9	23	0	0	0
E13	250	1,026	20	6	0	1	10
E14							
Pass 1	250	1,293	36	6	0	1	7
Pass 2	250	1,262	22	6	0	1	10
E15	250	841	19	7	0	0	0
E16							
Inventory	250	863	25	8	0	1	0
Pass 1	300	1,158	37	11	1	1	0
Pass 2	300	1,010	25	11	1	0	0
E17	-	-	-	-	-	-	-
E18	250	388	0	0	0	0	0
E19	250	No effort recorded	10	0	0	0	0
E20	200	293	2	0	0	0	0
E21	-	-	-	-	-	-	-

The Alberta Conservation Association acknowledges the following partner for their generous support of this project

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