



Columbia River Project Water Use Plan

Kinbasket Reservoir Fish and Wildlife Information Plan

Kinbasket Reservoir Juvenile Bull Trout Life History and Habitat Use Assessment

Implementation Year 2

Reference: CLBMON-06

WLR Monitoring Study No. CLBMON-06 (Year 2) Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment

Study Period: March – November 2016

**Canadian Columbia River Inter-Tribal Fisheries Commission.
7468 Mission Rd, Cranbrook, BC, V1C 7E5**

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WLR Monitoring Study No. CLBMON-06 (Year 2)

Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment



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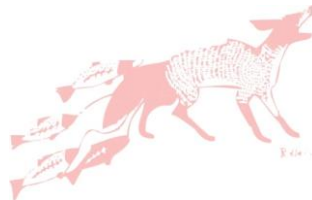
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Executive Summary

Bull Trout (*Salvelinus confluentus*) were identified by the Columbia River Water Use Plan Consultative Committee (WUP CC) as a key fish species of concern in Kinbasket Reservoir because of their importance as a sport fish and the potential for links between reservoir operations and Bull Trout population productivity. This three-year study was designed to answer management questions related to i) basic life history and habitat use characteristics of juvenile Bull Trout in Kinbasket Reservoir; ii) potential effects of reservoir operation on juvenile Bull Trout; iii) identification of modifications to the operation of Kinbasket Reservoir to protect or enhance juvenile Bull Trout populations.

Fyke nets were set overnight along the nearshore zone of Kinbasket reservoir at 35 sites to assess shoreline use by Bull Trout from April 23 to August 18, 2016. A total of 16 juvenile Bull Trout were captured in fyke nets set at 9 locations throughout Kinbasket Reservoir. Habitat assessments indicated that nearshore areas of Kinbasket Reservoir likely provide sub-optimal temperature and substrate conditions for juvenile Bull Trout. Temperatures in summer ranged near the maximum water temperature of 15°C tolerated by Bull Trout. Cover was lacking in most areas as fine/sand substrate made up 63% of sites, while gravel and cobble substrates made up only 15% and 21 % of sites

Bull Trout capture was conducted for a second year in Packsaddle Creek due to the lack of suitably sized spawning tributaries suitable for antenna installation. A total of 23 Bull Trout were collected using electrofishing techniques (September 20-22, 2016) and 14 juvenile Bull Trout were implanted with passive integrated transponder (PIT) tags. Juvenile/sub-adult Bull Trout ranged in size from 46 to 279 mm (mean length \pm SD = 99.4 \pm 53.18 mm) and ranged in weight from 0 to 230 g (mean weight \pm SD = 19.6 \pm 47.41 g).

A total of 18 juvenile Bull Trout were detected by the fixed antenna reader installed near the confluence of Packsaddle Creek with Kinbasket Reservoir (operated from March 31 and downloaded on September 23, 2016). Mean length at tagging of detected Bull Trout was 126.1 \pm 55.53 mm and mean weight at tagging of detected Bull Trout was 37.7 \pm 93.82 g. Inclusion of Bull Trout detection data from additional individuals in Packsaddle Creek over an extended study period (to include spring, summer, and fall 2017), as well as information collected from a large spanning tributary from the Columbia Reach will provide useful information on the assessment of outmigration.

Management Question	Hypotheses	Status
What are the basic life history and habitat use characteristics of juvenile Bull Trout in Kinbasket Reservoir (e.g., distribution, age structure)?		Basic life history and habitat use characteristics are discussed in this Year 2 report and will be further assessed in Year 3.
What are the potential effects of reservoir operation on juvenile Bull Trout, given the seasonal	H ₀ : Operation of Kinbasket Reservoir has no effect on juvenile Bull Trout, given the	To be addressed in Year 3.

<p>timing, age, and size of juveniles emigrating to the reservoir?</p>	<p>seasonal timing and size/age of juveniles emigrating to the reservoir.</p> <p>H₁: Operation of Kinbasket Reservoir affects emigration of juvenile Bull Trout.</p>	
<p>Can modifications be made to the operation of Kinbasket Reservoir to protect or enhance juvenile Bull Trout populations?</p>		<p>To be addressed in year 3.</p>

Acknowledgements

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1 Introduction

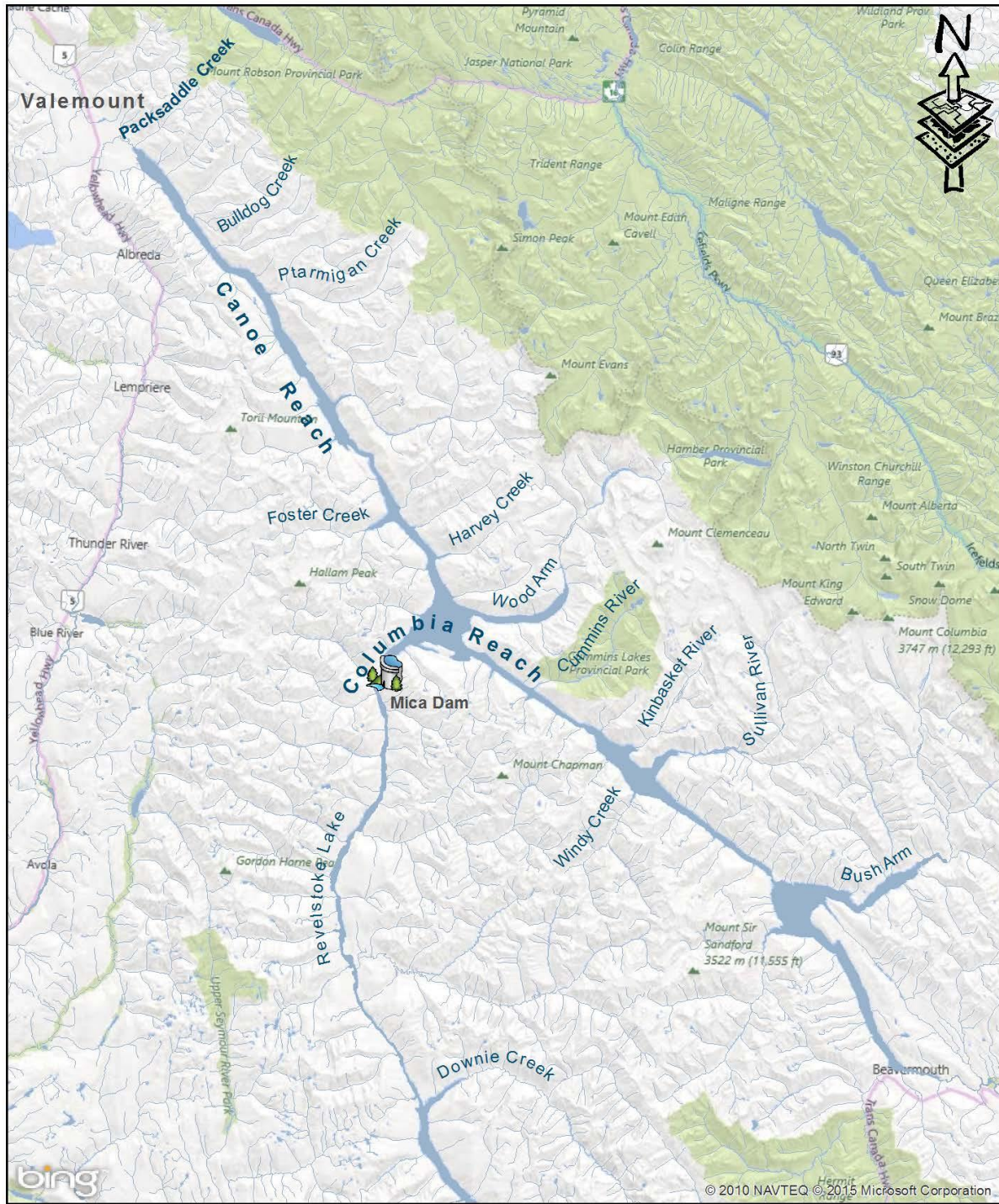
1.1 Monitoring Program Rationale

1.1.1 Background

Kinbasket Reservoir (Figure 1) was created by the construction of Mica Dam in 1973, under the terms of the Columbia River Treaty. The purposes of the creation of this earthfill, high head dam and reservoir were for optimized, coordinated power generation between Columbia River mainstem dams in the US and Canada and for downstream flood control. The reservoir inundated 216 km of the length of the Columbia River between Mica and Donald, and is among the largest reservoirs in British Columbia, with a maximum surface area of 43,200 ha and mean depth of 57 m. Prior to dam construction, the majority of this habitat was free flowing, with the exception of a lacustrine portion known as Kinbasket Lake that was 13 km long and had a surface area of 2,250 ha (Prince, 2011). The reservoir can be coarsely segregated into two main reaches, Columbia and Canoe, at the historic confluence of the Canoe and Columbia rivers, where the Columbia River turns southward approximately where Mica Dam is located. The reaches of the reservoir are typically bounded by steep valleys and are narrow, with stretches becoming riverine at low pool. Three large lacustrine portions of the reservoir occur at the confluence of the Canoe and Columbia reaches, at the historic location of Kinbasket Lake near the confluence with the Sullivan River, and at the confluence with the Bush River. Stream inputs are largely glacial, draining the high elevation northern tips of the Selkirk and Monashee mountains from the West, and the extensively glaciated West slopes of the Canadian Rockies from the East.

Operations of Mica dam result in large annual fluctuations of the reservoir levels. Kinbasket reservoir elevations may vary between a maximum of 754.38 m and a minimum 707.41 m, and may occasionally be brought up to a maximum elevation of 754.68 m if there is a high probability of spill. Normal operating level for the 2008-2012 period was between a mean maximum of 753.26 m and a mean minimum level of 718.12 m, with a normal operating range of 35.14 m. Drawdown from full pool normally begins slowly in September, and draft rate increases through the winter, with a levelling off of drafting and normal low pool occurring in mid-late April. During the spring period, discharge from Mica dam decreases, which coincides with the normal spring freshet, which rapidly refills the reservoir through the spring and early summer.

Bull Trout (*Salvelinus confluentus*) were identified by the Columbia River Water Use Plan Consultative Committee (WUP CC) as a key fish species of concern in Kinbasket Reservoir because of their importance as a sport fish and the potential for links between reservoir operations and Bull Trout population productivity. Bull Trout are also blue listed (Species of Special Concern) by the BC Conservation Data Centre due to their sensitivity to habitat loss or degradation, over-exploitation, and competition from other salmonids (CDC, 2006). However, adfluvial Bull Trout populations are presently considered to be doing well in Kinbasket Reservoir (RL&L, 2001), where they form a major component of the reservoir's sport fishery (Pole, 1996; RL&L, 2001).



Kinbasket Reservoir Study Area

0 10 20 40 60 Kilometers

1:750,000

Figure 1: Kinbasket Reservoir study area.

1.1.2 Bull Trout Biology

Bull Trout are native of western North America and are distributed in cool waters throughout the interior of British Columbia and in large west-flowing rivers of the Coast Mountains (McPhail, 2007). In British Columbia, Bull Trout commonly exhibit three life-history patterns: fluvial, adfluvial, and stream-resident. A fourth anadromous form is restricted to the southwestern portion of the province. Regardless of life-history type, most Bull Trout rear in streams for 2 to 4 years, with seasonal and diel shifts in microhabitats (McPhail, 2007). Juvenile Bull Trout are strongly associated with pools and deep side-channels in streams (McPhail, 2007).

Previous research suggests that an extended stream rearing period of at least 2 to 3 years is essential for Bull Trout reproductive success; sexual maturity is usually reached at age 4+ or 5+ (McPhail and Baxter, 1996; Fraley and Shepard, 1989; Mogen and Kaeding, 2005). Recent work in Arrow Lakes Reservoir has shown that some Bull Trout in the Columbia do not reach maturity until 8+ or more (Bray and Mylechreest, in preparation). For adfluvial populations, age at outmigration can vary. McPhail and Murray (1979) found that the majority of adult Bull Trout caught in Arrow Lakes emigrated at age 2. Emigrants into Lake Billy Chinook, Oregon were primarily of ages 2 and 3 (Ratliff, 1992). In Kananaskis Lake, Alberta, adult Bull Trout had emigrated from their natal tributary primarily at age 3 (Stelfox, 1997), and successful adult spawners had emigrated at ages 3 and 4 in Lake Pend D'Oreille (Downs et al., 2006). This is despite the fact that a large pulse of juvenile outmigrants occurs for fry, at age 0 (McPhail and Murray, 1979; Downs et al., 2006). Fry account for the majority of outmigrants because they are displaced by freshet flows and streams rapidly reach carrying capacity, although the lack of adult fish or spawners displaying short stream residence periods implies that fry outmigrants have poor survival and fitness (McPhail and Baxter, 1996; Downs et al., 2006).

Timing of outmigration is often associated with peak streamflow, with outmigration peaks mirroring freshet flows in spring, and in areas with more maritime or warmer climates, associated with a second peak occurring with fall rains or drops in temperature (Downs et al., 2006; McPhail and Murray, 1979; Bellerud et al., 1997; Hemmingsen et al 2001). In other areas, a single peak migration time is present and associated with spring freshet flows (Riehle et al., 1997; Moore et al., 2005; Zimmerman and Kinsel, 2010). A year-round study recently conducted in northeastern Oregon demonstrated that juvenile Bull Trout (>120mm) migrated downstream throughout the year with two migration pulses, an initial pulse in the spring, followed by a peak pulse in August (Hommel and Budy, 2008). In the same area, Bowerman (2013) reported that age-1 juvenile Bull Trout (<120mm) emigrated throughout the year, with peak emigration between July and October, which is a period of low discharge in that particular river system.

Although McPhail (2007) suggests that juvenile Bull Trout rarely occupy the littoral zone of lakes and that they move into deep water when they initially enter lakes, this has not been rigorously assessed by many studies. Shoreline habitats may be important to juvenile Bull Trout if they occupy shallow habitats for foraging, holding, or for refuge, or if they are dependent on resources that are primarily derived from littoral or near-shore habitats. Meeuwig and Guy (2007) reported that juvenile Bull Trout occupy shallow, shoreline habitat and that they may have high affinity to substrate cover in lacustrine environments. Juvenile (<250 mm) Bull Trout were spatially segregated from larger Bull Trout inhabiting

shallow areas (<1 m) in a small lake in Alberta and were dependent on both pelagic and littoral food web items within these habitats (Wilhelm et al. 1999).

While rearing in nursery streams, Bull Trout have a fairly consistent growth rate and almost exclusively forage on invertebrates (Warnock, 2012). Outmigration from spawning streams at age 2-4 years is associated with rapid increases in growth in adfluvial systems, and is probably associated with a shift to piscivory soon upon lake entry (McPhail and Murray, 1979). In Kinbasket Reservoir, the dominant prey item is likely to be subyearling or yearling Kokanee (*Oncorhynchus nerka*) if Bull Trout are piscivorous and of sufficient size to overcome gape limitations. Piscivorous Bull Trout may forage on prey fish 50% of their body length (Beauchamp and Van Tassel, 2001). If Bull Trout emigrate into Kinbasket Reservoir primarily at ages >1+, Kokanee should be within their gape limit. Small size classes (75-200 mm) of Bull Trout in Lake Billy Chinook were generally not strongly piscivorous in winter, but piscivory in other seasons could not be satisfactorily assessed (Beauchamp and Van Tassel, 2001). Bull Trout were increasingly piscivorous with size in size classes above 200 mm (Beauchamp and Van Tassel, 2001). Determination of the dominant food source utilized upon outmigration is important for assessing impacts of dam operations on juvenile Bull Trout populations. Suitability of nearshore habitats for littoral macroinvertebrates and littoral production is impacted by winter drawdown operations in reservoirs in cold climates, with winter freezing and ice scour, desiccation and low water residence times (Stockner et al., 2005; Aroviita and Hamalainen, 2008). Although littoral productivity is assumed to be small in Kinbasket Reservoir (Bray et al. 2013), the diet preferences of Kinbasket Reservoir juvenile Bull Trout are unknown, as are their affinity for near shore habitats that may be impacted by reservoir operations.

The WUP CC hypothesized that the greatest potential impact of reservoir operations on the productivity of Bull Trout populations is entrainment of immature Bull Trout through Mica Dam. While juvenile Bull Trout have not been recorded or noted in fish salvage operations at Mica Dam, and entrainment will be addressed separately by BC Hydro's Fish Entrainment Strategy, there is a data gap with respect to stream emigration and reservoir habitat use by juvenile Bull Trout. To address this data gap, the WUP CC recommended that a Bull Trout life history and habitat use assessment be undertaken in Kinbasket Reservoir. The objectives of the monitoring program are to examine the early life history and habitat use of juvenile Bull Trout to infer potential effects of reservoir operations. The program is to include monitoring the size, age, and seasonal timing of juvenile emigration to the reservoir and assessment of nearshore habitat at time of outmigration to determine use of these habitats over a three year study period.

1.1.3 Management Questions

The fundamental management questions (MQs) to be addressed through the Bull Trout life history and habitat use assessment (BC Hydro, 2007) are:

- 1) What are the basic life history and habitat use characteristics of juvenile Bull Trout in Kinbasket Reservoir (e.g., distribution, age structure)?

- 2) What are the potential effects of reservoir operation on juvenile Bull Trout, given the seasonal timing, age, and size of juveniles emigrating to the reservoir?
- 3) Can modifications be made to the operation of Kinbasket Reservoir to protect or enhance juvenile Bull Trout populations?

1.1.4 Management Hypothesis

The primary management hypothesis to be evaluated by the monitoring program is:

H0: Operation of Kinbasket Reservoir has no effect on juvenile Bull Trout, given the seasonal timing and size/age of juveniles emigrating to the reservoir.

1.1.5 Key Water Use Decision Affected

The proposed monitoring program will provide information required to support more informed decision-making with respect to the need to balance storage in Kinbasket Reservoir with impacts on fish populations in the reservoir. Specifically, it will provide the information that is required to support future decisions around maintaining the current operating regime or modifying operations through adjusting the drawdown schedule or minimum elevation to protect juvenile Bull Trout populations.

2 Project Methodology and Management

2.1 Overview, study objectives and limitations

The approach of this study is to make observations of juvenile Bull Trout life history and habitat use through passive detection of outmigration from rearing streams and by ground surveys in nearshore areas of Kinbasket Reservoir. Capture of fish in rearing streams occurred in 2015 and 2016 and fish were tracked using passive integrated transponder (PIT) tags and a fixed antenna. Fish were tracked year-round by a fixed antenna to identify timing of outmigration from a rearing tributary to the reservoir. A complementary program of ground surveys during the spring/summer period during reservoir refilling took place in 2016 and will continue in 2017 to assess the use of shoreline habitats by juvenile and subadult Bull Trout. This ground survey program additionally consists of habitat assessments and inventory of benthic invertebrates in nearshore areas and within the drawdown zone at tributaries that may provide foraging resources for juvenile and subadult Bull Trout.

The objectives of this study are to i) understand basic life history and habitat use characteristics of juvenile Bull Trout of Kinbasket Reservoir; ii) identify the timing of juvenile Bull Trout emigration to Kinbasket Reservoir by detecting outmigration of juveniles using PIT tag antennae at the mouths of rearing tributaries; iii) confirm habitat use of juvenile and subadult Bull Trout at nearshore littoral areas of Kinbasket Reservoir through ground surveys; iv) assess the presence of barriers to outmigration from rearing tributaries and access to nearshore littoral habitats in the drawdown zone due to dam operations; and iv) identify potential modifications to Kinbasket Reservoir operations to protect or enhance juvenile Bull Trout populations based on findings from i) to iv).

Although the study is designed to discern whether current operations affect the juvenile Bull Trout population in Kinbasket Reservoir, there are some potential limitations in the study design. The study can only assess whether there may be effects on juvenile Bull Trout in three years of observation. Kinbasket operations vary from year to year, so the full range of potential impacts given different reservoir operations will not be captured. In addition, the study program identifies habitat associations based on fish presence but it cannot identify suitable habitat based on fish absence. Fish absence does not necessarily imply that habitats are unsuitable or could be suitable if reservoir operations were modified.

2.1.1 Nearshore fish and habitat surveys

To answer MQ1, fish and habitat surveys were conducted monthly over 3 to 4 days from April to August to characterize habitat use of the nearshore area and changes with increasing reservoir elevation. Fish surveys were conducted to detect nearshore habitat use by juvenile/subadult fish, detect PIT tagged fish, and collect growth rate information (i.e., size, scale and fin samples). Surveys were conducted using fyke nets (0.9 x 1.2 m frame with 6.4 mm mesh and 9.1 m lead/wings) set overnight in a perpendicular orientation with the cod end away from shore to encounter fish moving from either direction along the shoreline. However, due to the steep gradient in many areas of the reservoir, some fyke nets were set parallel to shore. Sites were selected based on gradient for installation of fyke nets, usually in water depths of < 1 m.

Basic life history information (i.e., fork length and weight) was collected from Bull Trout, as well as other sport fish such as Rainbow Trout (*Oncorhynchus mykiss*), Burbot (*Lota lota*), Kokanee, and Mountain Whitefish (*Prosopium williamsoni*). Ages of individuals were classified based on the following thresholds: young-of-year (YOY) <70 mm, juveniles/sub-adults 70-400 mm, and adults >400 mm (McPhail and Baxter, 1996; Warnock and Rasmussen, 2013).

Habitat assessments were conducted at sampled sites to answer MQ2 that included measurement of latitudinal gradients along the shoreline of sampled sites, depth, substrate material, vegetation, and water quality parameters (temperature, pH, conductivity, total dissolved solids, and dissolved oxygen). Habitat characteristics were also documented with photographs.

Reservoir elevation information collected during the study will be used to associate reservoir operations with the accessibility of nearshore habitats of the reservoir by juvenile Bull Trout in the Year 3 report.

2.1.2 Capture, tagging, and detection

A list of candidate streams to assess juvenile Bull Trout emigration via PIT tag antenna detection was developed based on previous sampling that detected either Bull Trout spawning (Oliver, 2001), presence of juvenile fish (Fielden et al., 1992; Golder, 2003), and physical characteristics appropriate for antenna installation (i.e., stream width < 6.1 m, substrate suitable for driving antenna anchors, flows that would not result in loss of equipment). Several tributaries were identified throughout the reservoir, but few could be accessed by road. An antenna was installed at Packsaddle Creek, located in the north-western side of the reservoir, in Year 1 of the study. Carrol Creek, located on the south-western side of the

reservoir, was identified as a potential site to supplement information collected at Packsaddle Creek, but electrofishing efforts did not uncover any fish, likely due to a recent blow-out of the stream.

More juvenile Bull Trout were tagged in Packsaddle Creek to supplement information collected in the previous year. Capture of juvenile Bull Trout occurred in Packsaddle Creek (Stream Code: 300-8326; Figure 2) from September 20 to 23, 2016, using standard backpack electrofishing techniques. Electrofishing was conducted using a battery operated Smith-Root LR-24 backpack electrofishing unit. Settings on the unit ranged from 245 to 250 volts at 40 to 45 Hz. The electrofishing crew consisted of three certified electrofishers (one electrofisher operator and two netters). The crew scanned for fish by moving upstream from the mouth of the stream in a zig-zag pattern to span both banks. The fishes captured during each sweep were identified to species and measured for weight (g) and fork length (mm). Scale and fin samples were collected from each fish, and scale samples will be used to determine age of tagged fish. Bull Trout of adequate size (>65 mm fork length as recommended by PIT Tag Steering Committee; CBFWA, 2014) and in good condition were anaesthetized in a 60 L bath of stream water, with a 100 mg/L concentration of clove oil. Clove oil was first dissolved in ethanol before being added to water to ensure proper mixture of anaesthetic. Once fish reached level four anaesthesia (i.e., total loss of movement and weak opercular motion; Cope, 2009), they were implanted with a full-duplex PIT tag (Biomark HPT 12) in the ventral area of the abdominal cavity posterior to the pyloric ceca using an implant gun (Biomark MK25). Fish were then placed in a recovery enclosure with mesh panels that was placed in the stream in the direction of stream flow to allow for movement of fresh stream water over the gills of the fish. Once the fish were fully recovered they were released in a backwater eddy with slow moving water in proximity to their location of capture.

The antenna was operated from March 31 to December 4, 2016.

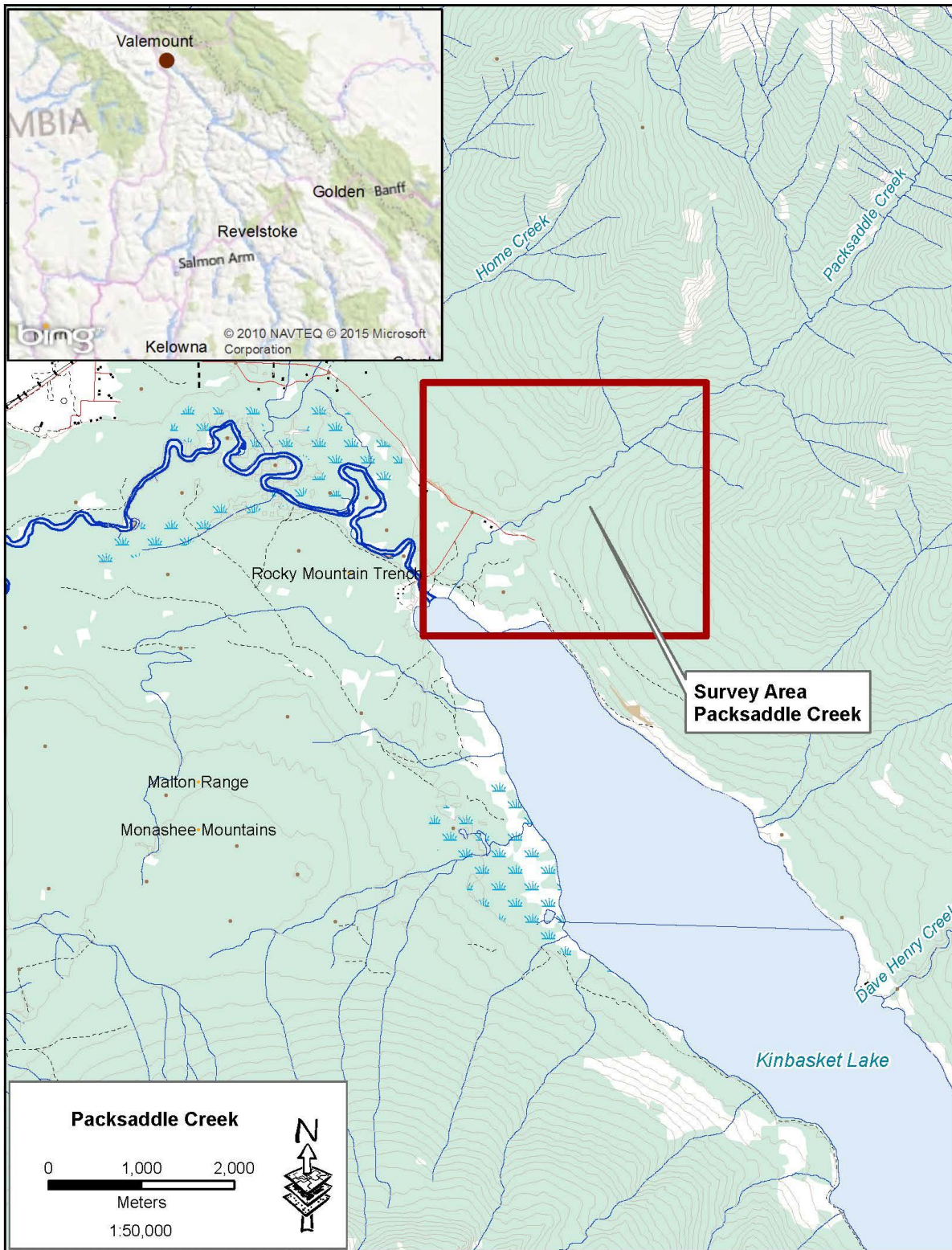


Figure 2: Map of electrofishing area on Pack saddle Creek.

3 Results

3.1 Nearshore Fish and Habitat Assessment

Fyke nets were set overnight along the nearshore zone of Kinbasket reservoir at 35 sites to assess shoreline use by Bull Trout in monthly sampling sessions from April 23 to August 18, 2016 (Figure 3). Site and water quality characteristics for all sampling sites are provided in Appendix 1.

A total of 16 Bull Trout (15 juvenile/sub-adult and 1 adult) were captured in fyke nets set at 9 locations throughout Kinbasket Reservoir (Figure 3; Table 1). Bull Trout ranged in size from 85 to 470 mm (mean length \pm SD = 214.4 \pm 88.60 mm; Figure 4; Table 1) and weighed 14 to 421 g (mean weight \pm SD = 107.25 \pm 121.60 g; Figure 5; Table 1). Other sportfish captured in fyke nets included 7 Burbot captured during April sampling session near the north end of reservoir; 2 Kokanee (May, June); 11 Mountain Whitefish (Apr, Jun, Aug); 54 Mountain Whitefish fry (Apr); and 3 Rainbow Trout (Apr, June, Aug) (Table 1). Redside Shiner (*Richardsonius balteatus*), Northern Pikeminnow (*Ptychocheilus oregonensis*), and Peamouth Chub (*Mylocheilus caurinus*) were the most abundant species in order of decreasing abundance (Appendix 2). Information on all fish captured in fyke nets are listed in Appendix 2.

The maximum water temperature observed at Kinbasket Reservoir sites where Bull Trout were present was 18.2 °C (mean water temperature at fyke net sites was 14.4 \pm 3.26 °C). In general, all Bull Trout (regardless of life stage or life history strategy) are cold water specialists and are seldom found in systems where water temperature exceeds 15°C for prolonged periods (McPhail and Baxter 1996). Stomach contents were examined in 10 Bull Trout, which contained larval fishes, invertebrates or were empty. One juvenile Bull Trout consumed a Redside Shiner that was likely inadvertently brought in by the enclosure of the fyke net.

Mean water temperature recorded in the shallow margins near the north end of the reservoir from August 16 -17 was 18.2 \pm 0.51 °C. The maximum water temperature of 19.1°C was recorded at Canoe River. These temperatures were recorded approximately one month before the generalized spawning period for Bull Trout in the Kootenays and well above the preferred pre-spawn and rearing temperatures observed for the species (McPhail and Murray 1979; Weaver and White 1985).

Habitat assessments indicated that shoreline sites occupied by Bull Trout ranged in gradient from 0% to >30 % (mean gradient = 8.6 \pm 6.61 %). Dominant and subdominant substrate of Bull Trout sites ranged from fines, gravel, and cobbles. Juvenile Bull Trout are often associated with abundant cover in the form of cobbles, large woody debris, and/or vegetation (Hammond, 2004). Of all 35 sampled sites, fines/sand was the dominant substrate at 63% of sites sampled, while substrates dominated by gravel and cobble made up only 15% and 21 % of sites, respectively. During the low pool period in early spring, substrates were predominantly fines, and Bull Trout sites had very little vegetation cover; however, during high pool, vegetation cover increased and included the presence of grasses, horsetail, sedges, willows, and clovers at sampling sites. All information collected during habitat assessments are detailed in Appendix 3. Statistics examining the associations between Bull Trout presence and various habitat features will be presented in the final report, when larger sample sizes are available.

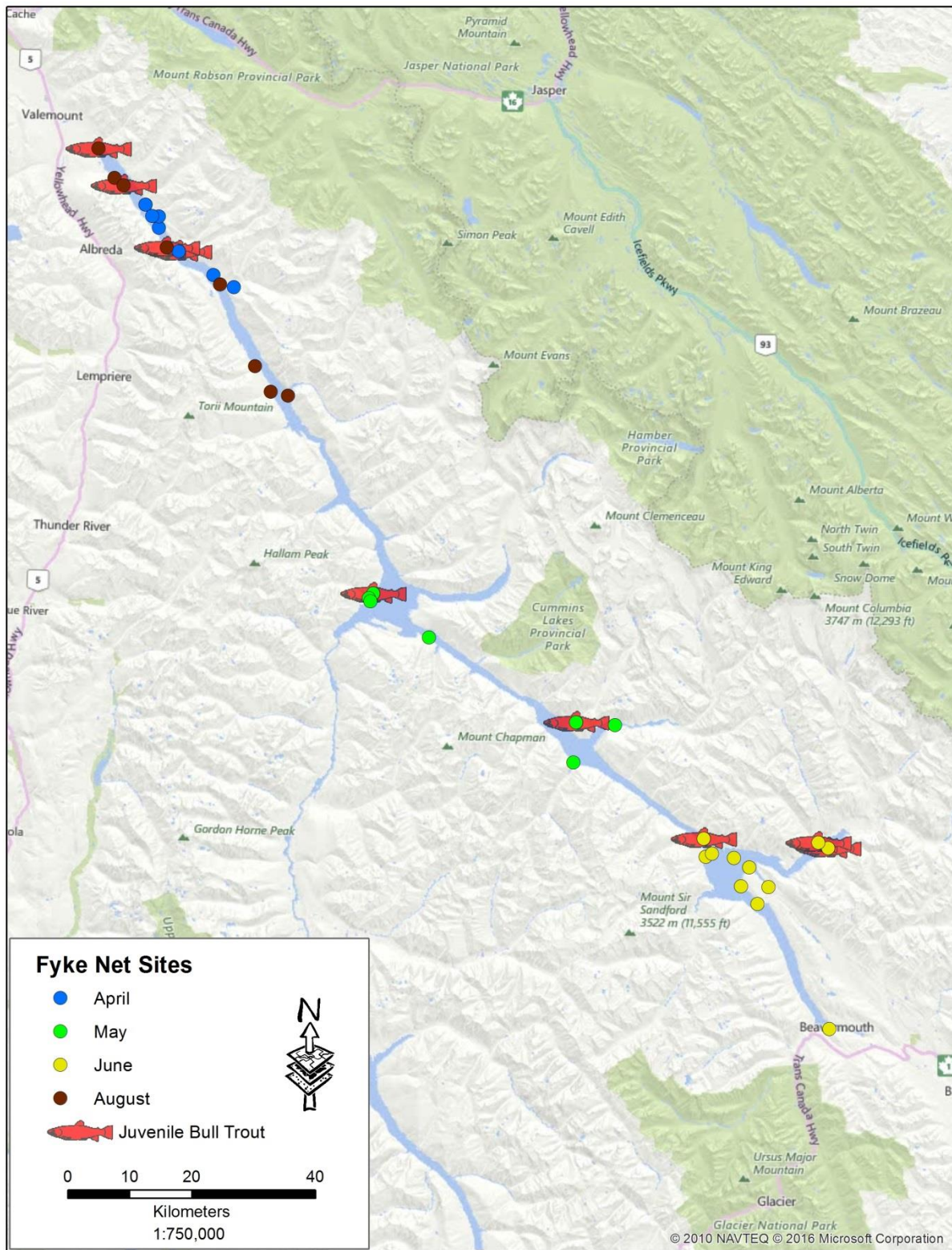


Figure 3: Locations of fyke net sampling sites and observations of Bull Trout in Kinbasket Reservoir (April 23 to August 18, 2016).

Table 1: Summary of sport fishes captured in fyke nets (n=35) set overnight along the nearshore zone of Kinbasket Reservoir from April 23 to August 18, 2016. Species abbreviations are: 'BT' - Bull Trout; 'BB' – Burbot; 'KO' – Kokanee; 'MW' - Mountain Whitefish; 'RB' - Rainbow Trout. Sizes of MW were not recorded.

Date	Location	Fyke Net #	UTM E	UTM N	Species	Count	Length (mm)	Weight (g)
26-Apr-16	Bulldog	FN1			BT	1	161	40
26-Apr-16	Bulldog	FN1			BT	1	162	42
26-Apr-16	Bulldog	FN1			BT	1	222	105
27-May-16	Kinbasket	FN3	431123	5757239	BT	1	156	30
28-May-16	Encampment Creek NW side	FN5	398305	5778053	BT	1	176	52
28-May-16	Encampment Creek NW side	FN5	398305	5778053	BT	1	210	62
28-May-16	Encampment Creek NW side	FN5	398305	5778053	BT	1	470	399
Jun-21-16	Good Fellow	FN1	471899	5736880	BT	1	179	52
Jun-21-16	Chatter	FN2	470311	5737782	BT	1	195	63
Jun-22-16	Surprise Rapids	FN2	451802	5738430	BT	1	214	95
Jun-22-16	Surprise Rapids	FN2	451802	5738430	BT	1	226	112
Jun-23-16	Surprise Rapids	FN1	451802	5738430	BT	1	235	104
Aug-18-16	Blackmore	FN1	364934	5833944	BT	1	85	14
Aug-18-16	Blackmore	FN1	364934	5833944	BT	1	174	47
Aug-18-16	Packsaddle	FN2	353843	5849907	BT	1	205	78
Aug-18-16	Unnamed tributary	FN4	357924	5843955	BT	1	360	421
25-Apr-16	Yellowjacket	FN2			BB	1	508	660
25-Apr-16	Yellowjacket	FN2			BB	1	541	793
25-Apr-16	Yellowjacket	FN1			BB	1	545	807
25-Apr-16	Griffin	FN1			BB	1	571	899
25-Apr-16	Yellowjacket	FN2			BB	1	599	1126
25-Apr-16	Yellowjacket	FN2			BB	1	639	1147
25-Apr-16	Yellowjacket	FN2			BB	1	662	1618
27-May-16	Mica Area	FN1	407305	5770914	KO	1	85	94
Jun-23-16	Surprise Rapids	FN1	451802	5738430	KO	2		
24-Apr-16	Horse Creek	FN2			MW	5		
25-Apr-16	Yellowjacket	FN2			MW	19		
25-Apr-16	Yellowjacket	FN1			MW	3		
25-Apr-16	Griffin	FN1			MW	1		
26-Apr-16	Km 35	FN1			MW	1		
Jun-20-16	Mayville	FN1	462256	5730614	MW	2		
Jun-21-16	Good Fellow	FN1	471899	5736880	MW	1		
Aug-17-16	North Ptarmigan	FN4	373540	5827973	MW	9		
Aug-18-16	Blackmore	FN1	364934	5833944	MW	1		
Aug-18-16	Canoe	FN3	356458	5845200	MW	1		
Aug-18-16	Unnamed tributary	FN4	357924	5843955	MW	23		
25-Apr-16	Yellowjacket	FN2			MW (fry)	54		
25-Apr-16	Yellowjacket	FN1			RB	1	135	46
Jun-20-16	Mayville	FN1	462256	5730614	RB	1		
Aug-18-16	Packsaddle	FN2	353843	5849907	RB	1	131	26

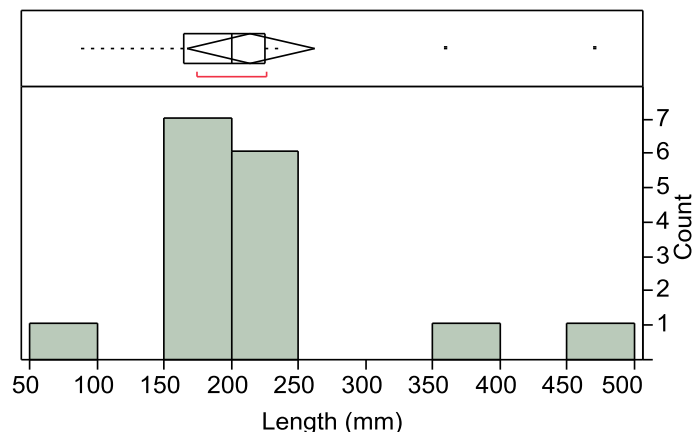


Figure 4: Distribution (histogram and box plot) of lengths (mm) of Bull Trout in Kinbasket Reservoir (captured April 23 to August 18, 2016). Boxes represent interquartile range, diamonds represent the sample mean and 95% confidence interval, while the middle line in the box is the median sample value. Whiskers represent observations outside of the interquartile range, with outlier data points. The red line indicates the densest 50% of the observations.

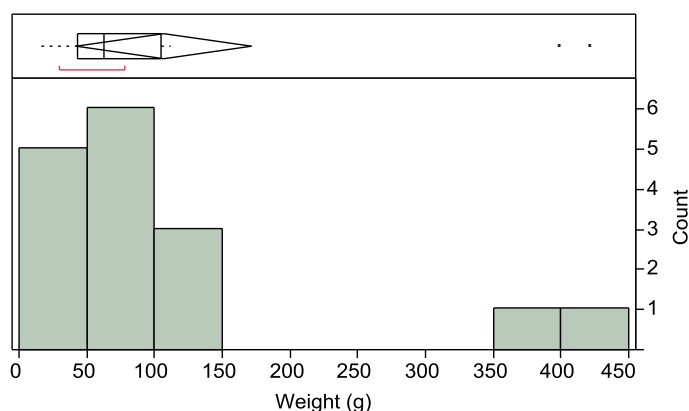


Figure 5: Distribution (histogram and box plot) of weights (g) of Bull Trout in Kinbasket Reservoir (captured April 23 to August 18, 2016). Boxes represent interquartile range, diamonds represent the sample mean and 95% confidence interval, while the middle line in the box is the median sample value. Whiskers represent observations outside of the interquartile range, with outlier data points. The red line indicates the densest 50% of the observations.

3.2 Juvenile Bull Trout capture, tagging and detection

A total of 23 Bull Trout were captured using electrofishing techniques (Table 2). Nine of the individuals were young-of-year. A total of 14 juvenile Bull Trout were implanted with PIT tags (Table 2). Along with Bull Trout, 8 Rainbow Trout (*Oncorhynchus mykiss*) and 1 Mountain Whitefish (*Prosopium williamsoni*) were captured (Table 2). Seven of the 8 Rainbow Trout captured were implanted with PIT tags to provide supplementary information to CLBMON-7. Electrofishing was halted when a spawning Bull Trout pair was observed in the tributary on Sept. 22, 2016. Although Sculpin were observed, they were not recorded.

Table 2: Summary information of fish captured by electrofishing in Packsaddle Creek (Sept. 20-22, 2016). Species abbreviations are: 'BT' - Bull Trout; 'MW' - Mountain Whitefish; 'RB' - Rainbow Trout. Sizes of MW were not recorded.

Date	Species	Length (mm)	Weight (g)	Count	Tag #
21-Sep-16	BT	46	0	1	
21-Sep-16	BT	50	0	1	
21-Sep-16	BT	50	1	1	
21-Sep-16	BT	53	0	1	
20-Sep-16	BT	55	1	1	
21-Sep-16	BT	55	1	1	
21-Sep-16	BT	55	1	1	
21-Sep-16	BT	60	0	1	
21-Sep-16	BT	61	0	1	
21-Sep-16	BT	86	6	1	989001006037226
20-Sep-16	BT	93	6	1	989001006037274
20-Sep-16	BT	96	3	1	989001006037281
21-Sep-16	BT	99	10	1	989001006037233
20-Sep-16	BT	100	12	1	989001006037209
21-Sep-16	BT	109	10	1	989001006037234
21-Sep-16	BT	110	10	1	989001006037225
20-Sep-16	BT	113	11	1	989001006037241
21-Sep-16	BT	124	17	1	989001006037290
21-Sep-16	BT	137	25	1	989001006037248
20-Sep-16	BT	145	35	1	989001006037266
21-Sep-16	BT	148	31	1	989001006037244
21-Sep-16	BT	163	40	1	989001006037292
20-Sep-16	BT	279	230	1	989001006037215
20-Sep-16	MW			1	
20-Sep-16	RB	63	2	1	
20-Sep-16	RB	85	7	1	989001006037214
20-Sep-16	RB	91	7	1	989001006037269
20-Sep-16	RB	93	9	1	989001006037245
20-Sep-16	RB	94	12	1	989001006037270
20-Sep-16	RB	98	9	1	989001006037196
20-Sep-16	RB	101	11	1	989001006037236
21-Sep-16	RB	223	124	1	989001006037291

Juvenile/sub-adult Bull Trout ranged in size from 46 to 279 mm (mean length \pm SD = 99.4 ± 53.18 mm; Table 2). Juvenile/sub-adult Bull Trout weighed 0 to 230 g (mean weight \pm SD = 19.6 ± 47.41 g; Table 2).

Data download from the antenna reader indicated that 21 fish passed the antenna between Mar. 31 and Sept. 23 (Table 3). Of those fish that were detected, 18 were juvenile Bull Trout and 3 were Rainbow

Trout (Table 3). One Bull Trout and one Rainbow Trout had been tagged just the few days before data download. Only single logs of the fish were recorded, which we assumed indicated unidirectional movement from the tributary to the reservoir. Details on the time and date of detections were unavailable during drafting of the report due to a malfunction with the internal clock of the antenna reader. Those data will be available in the Year 3 report. Mean length at tagging of detected Bull Trout was 126.1 ± 55.53 mm and mean weight at tagging of detected Bull Trout was 37.7 ± 93.82 g (Table 3).

Table 3: Summary of fish detected by antenna installed in Packsaddle Creek. Antenna was operated from Mar. 31 to Sept. 23, 2016. Species abbreviations are: 'BT' - Bull Trout; 'RB' - Rainbow Trout.

Species	Tag ID	Length (mm)	Weight (g)
BT	989001004470-239	120	19
BT	989001004470-252	88	8
BT	989001004470-256	129	17
BT	989001004470-259	135	23
BT	989001004470-264	121	15
RB	989001004470-279	128	22
BT	989001004470-281	81	5
BT	989001004470-287	115	15
BT	989001004470-295	94	9
RB	989001004470-296	159	47
BT	989001004470-298	122	16
BT	989001004470-311	116	13
BT	989001004470-312	79	6
BT	989001004470-320	330	412
BT	989001004470-326	131	17
BT	989001004470-327	139	31
BT	989001004470-330	88	8
BT	989001004470-334	101	11
BT	989001004470-335	117	14
RB	989001006037-236	101	11
BT	989001006037-292	163	40

4 Discussion and Recommendations

The fyke net surveys of fish use of the nearshore habitat indicated the presence of juvenile Bull Trout at 26% of sampled sites. Suboptimal conditions related to temperatures $> 15^{\circ}\text{C}$ (McPhail, 2007) and fine substrate may limit the seasonal use of juvenile Bull Trout in these areas. Furthermore, if water levels are kept very low over vegetated shallow margins of the reservoir during summer, increasing water temperatures and suboptimal substrate further reduces the habitat available to juvenile Bull Trout. Negative effects may theoretically extend to later life stages as well, if extensive epilimnetic shallow areas created by the reservoir are impassable by adult bull trout due to thermal barriers to passage. We suggest conducting a comprehensive assessment of water temperatures in Kinbasket Reservoir using inexpensive temperature loggers to more fully evaluate the thermal suitability for various life cycle stages of Bull Trout, and determine the link of thermal regimes to reservoir operations.

Detection of juvenile Bull Trout during the antenna operation period in the Fall 2015 indicated that outmigration might occur during low flow months towards the end of the growth season (Homel and Budy, 2008; Bowerman, 2013). Information from the 2016 antenna operation will provide further elucidation of movements associated with outmigration as part of their life history or observations of escape behaviour in response to handling. Given that the majority of juveniles have not yet been

detected, we suggest that the antenna in Packsaddle Creek operate for an additional year (spring to fall 2017) to ensure that outmigration of the maximum number of surviving tagged juvenile Bull Trout is recorded.

Given the constraints discussed in identifying candidate tributaries for determining Bull Trout outmigration using PIT tags and antenna, we suggest tagging more juvenile Bull Trout in the upper reaches of Packsaddle Creek by accessing the tributary by helicopter. This is an especially ideal approach if the study period can be extended to capture the spring to fall seasons of 2018. Additionally, we suggest the purchase of an additional antenna for installation of 2 antennae in a larger Bull Trout spawning tributary.

5 References

- Aroviita, J., and H. Hämäläinen. 2008. The impact of water-level regulation on littoral macroinvertebrate assemblages in boreal lakes. In *Ecological Effects of Water-Level Fluctuations in Lakes* (pp. 45-56). Springer Netherlands.
- BC Conservation Data Centre (CDC). 2016. Species Summary: *Salvelinus confluentus*. BC Conservation Data Centre, Ministry of the Environment, Victoria, BC. Available: <http://a100.gov.bc.ca/pub/eswp/speciesSummary.do?id=28551> (accessed Jan. 5, 2016).
- BC Hydro. 2007. Columbia River Project Water Use Plan Monitoring Program Terms of Reference. Kinbasket Reservoir Fish and Wildlife Information Plan - CLBMON-6 Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment. BC Hydro, Castlegar, BC, pp. 9.
- Beauchamp, D.J. and J.J. Van Tassel. 2001. Modeling seasonal trophic interactions of adfluvial Bull Trout in Lake Billy Chinook, Oregon. *Transactions of the American Fisheries Society*, 130:204-216.
- Bellerud, B.L., S. Gunckel, A.R. Hemmingsen, D.V. Buchanan and P.J. Howell. 1997. Bull trout life history, genetics, habitat needs and limiting factors in central and northeast Oregon, 1996 annual report. Bonneville Power Administration, Portland, Oregon.
- Bowerman, T. 2013. A multi-scale investigation of factors limiting bull trout viability [online]. Ph.D. thesis, Utah State University, Logan, Utah. Available from <http://digitalcommons.usu.edu/etd/1524/>
- Bray, K. and P. Mylechreest. In prep. Spawning and migratory movements of bull trout (*Salvelinus confluentus*) in Arrow Lakes Reservoir. Columbia Basin Fish and Wildlife Compensation Program, Revelstoke, BC.
- Bray, K., D. Sebastian, T. Weir, R. Pieters, S. Harris, D. Brandt and L. Vidmanic. 2013. Kinbasket and Revelstoke Reservoirs Ecological Productivity and Kokanee Population Monitoring. CLBMON-2 and CLBMON-3. 2008-2011 synthesis report.
- Columbia Basin Fish and Wildlife Authority. 2014. PIT Tag Marking Procedures Manual, Version 3.0. Prepared by: PIT Tag Steering Committee. <http://www.ptagis.org/resources/document-library>
- Cope, R.S. 2009. Duncan Reservoir burbot monitoring annual report: 2008-2009. prepared for BC Hydro. Westslope Fisheries Ltd. Cranbrook, B.C., pp. 35

- Downs, C.C., D. Horan, E. Morgan-Harris and R. Jakubowski. 2006. Spawning demographics and juvenile dispersal of an adfluvial Bull Trout population in Trestle Creek, Idaho. *North American Journal of Fisheries Management* 26:190-200.
- Fielden, R.J., T.L. Slaney and A.W. Wood. 1992. Survey of tributaries to Kinbasket Reservoir. Report prepared by Aquatic Resources Ltd., Vancouver, BC, for the Mica Compensation Program, Nelson, BC.
- Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology, and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and river system, Montana. *Northwest Science* 63: 133-143.
- Golder. 2003. Kinbasket Reservoir tributary fish passage improvement 2002-2003 – Phase 1. Report prepared by Golder Associates Ltd. for the Columbia Basin Fish and Wildlife Compensation Program, Revelstoke, BC.
- Hemmingsen, A.R., S.M. Gunckel, P.M. Sankovich and P.J. Howell. 2001. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon. Annual Report, Bonneville Power Administration, Project No. 199405400, Portland Oregon.
- Hemel, K. and P. Budy. 2008. Temporal and spatial variability in the migration patterns of juvenile and subadult bull trout in northeastern Oregon. *Transactions of the American Fisheries Society* 137:869–880.
- McPhail, J.D. 2007. The freshwater fishes of British Columbia. The University of Alberta Press, Edmonton, AB.
- McPhail, J.D. and C.B. Murray. 1979. The early life history and ecology of Dolly Varden (*Salvelinus malma*) in the upper Arrow Lakes. Submitted to BC Hydro and Power Authority and Kootenay Region Fish and Wildlife. 113 p.
- McPhail, J.D. and J.S. Baxter. 1996. A review of bull trout (*Salvelinus confluentus*) life history and habitat use in relation to compensation and improvement opportunities. Fisheries management report No. 104. Department of Zoology, University of British Columbia. Vancouver, BC.
- Meeuwig, M.H. and C.S. Guy. 2007. Evaluation and action plan for protection of 15 threatened adfluvial populations of bull trout in Glacier National Park, Montana. Final scientific report of US Geological Survey to US Fish and Wildlife Service, Kalispell, Montana.
- Mogen, J.T. and L.R. Kaeding. 2005. Identification and characterization of migratory and non-migratory bull trout populations in the St. Mary River drainage, Montana. *Transactions of the American Fisheries Society* 134: 841-852.
- Moore, T.L., S.J. Starcevich, S. Jacobs and P.J. Howell. 2005. Migratory patterns, structure, abundance, and status of bull trout populations from subbasins in the Columbia Plateau. 2004 Annual Report. Project 199405400. Bonneville Power Administration, Portland, OR
- Oliver, G.G. 2001. Kinbasket Reservoir bull trout radio telemetry study; 2000 tributary use summary. Report prepared by G.G. Oliver and Associates Environmental Science, Cranbrook, BC, for BC Hydro, Castlegar, BC.
- Pole, M. 1996. Kinbasket Reservoir creel surveys, 1995. Report prepared for Columbia Basin Fish and Wildlife Compensation Program, BC Hydro and BC Environment, Nelson, BC.

- Prince, A. 2011. Kinbasket Reservoir white sturgeon inventory and habitat use assessment (final report). prepared for BC Hydro. Canadian Columbia River Inter-tribal Fisheries Commission. Cranbrook, B.C., pp. 20
- Ratliff, D.E. 1992. Bull trout investigations in the Metolius River-Lake Billy Chinook system. In: Howell, P. J.; Buchanan, D. V., eds. Proceedings of the Gearhart Mountain bull trout workshop; 1992 August; Gearhart Mountain, OR. Corvallis, OR: Oregon Chapter of the American Fisheries Society: 37-44.
- Riehle, M., W. Weber, A.M. Stuart, S.L. Thiesfeld and D.E. Ratliff. 1997. Progress report of the multi-agency study of bull trout in the Metolius River system, Oregon. Pages 137- 144 in W.C. Mackay, M.K. Brewin, and M. Monita, editors. Friends of the bull trout conference proceedings. Trout Unlimited Canada, Bull Trout Task Force (Alberta), Calgary.
- RL&L. 2001. Environmental information review and data gap analysis volume 1: Upper Columbia, Mica and Revelstoke projects. Report prepared by RL&L Environmental Services Ltd., Castlegar, BC, for BC Hydro, Burnaby, BC.
- Stockner, J., A. Langston, D. Sebastian and G. Wilson. 2005. The limnology of Williston Reservoir: British Columbia's largest lacustrine ecosystem. Water quality research journal of Canada 40: 28-50.
- Stelfox, J.D. 1997. Seasonal movements, growth, survival and population status of the adfluvial bull trout population in lower Kananaskis Lake, Alberta. Pp. 309-316 *In* Friends of the Bull Trout Conference Proceedings (Mackay. W.C., M.K. Brewin, and M. Monita, eds.). Bull Trout Task Force (Alberta), c/o Trout Unlimited Canada, Calgary, AB.
- Warnock, W. 2012. Examining brook trout invasion into bull trout streams of the Canadian Rockies. Ph.D. Thesis, University of Lethbridge, Alberta, Canada. 184 pp.
- Warnock, W.G. and J.B. Rasmussen. 2013. Abiotic and biotic factors associated with brook trout invasiveness into bull trout streams of the Canadian Rockies. Can. J. Fish. Aquat. Sci. 70: 905-914
- Wilhelm, F.M., B.R. Parker, D.W. Schindler and D.B. Donald. 1999. Seasonal food habits of bull trout from a small alpine lake in the Canadian Rocky Mountains. Transactions of the American Fisheries Society 128:1176-1192.
- Zimmerman, M.S. and C. Kinsel. 2010. Migration of anadromous juvenile bull trout in the Skagit River, 1990-2009, FPT 11-02. Washington Department of Fish and Wildlife, Olympia, Washington.

Appendix 1: Summary of location, fyke net, and water quality details for sites along the nearshore zone of Kinbasket Reservoir sampled from April 23 to August 18, 2016.

Date	Location	UTM E	UTM N	Fyke Net #	Orientation	FN Set Time	FN Set Water Depth (cm)	FN Set Water Temp (°C)	Secchi (cm)	FN Check Time	FN Check Depth (cm)	FN Check Water Temp (°C)	DO %	pH	Cond (µS/cm)	TDS (mg/L)	Weather	Comments
23-Apr-16	Horse Creek	363616	5837126	FN1	Parallel	19:19	72.0		5	10:43	87.0						Partly cloudy, windy (day 2), turbid water	Reservoir drawn down to ~Yellowjacket; good access to Horse rec site and driving on DDZ; Horse fans from rec site to reservoir; FN set SE side of Horse Cr; marina located ~1km SE of site
23-Apr-16	Horse Creek	363668	5838957	FN2	Perpendicular	19:19	78.0		5	10:43	91.0						Partly cloudy, windy (day 2), turbid water	Reservoir drawn down to ~Yellowjacket; good access to Horse rec site and driving on DDZ; Horse fans from rec site to reservoir; FN set SE side of Horse Cr;
24-Apr-16	Yellowjacket	361467	5840876	FN1	Perpendicular	15:00	78.0		5	10:01	86.0						Partly cloudy, windy, turbid water	
24-Apr-16	Griffin	362543	5838995	FN1	Perpendicular	18:30	48.0			11:22	59.0						Partly cloudy, windy, turbid water	FN set in area less affected by wind; lots of wood debris collected in nets
24-Apr-16	Yellowjacket	361467	5840874	FN2	Perpendicular	16:00	82.0		5	09:47	91.0						Partly cloudy, windy, turbid water	
25-Apr-16	Km 35	372439	5829459	FN1	Perpendicular	14:45	44.0	8.00	46	09:32	59.0	7.0					Sunny, some clouds, less windy than set time	Site between Ptarmigan and Bulldog beside gravel pile
25-Apr-16	Ptarmigan	375776	5827501	FN1	Perpendicular	16:22	52.0		bottom	11:32	75.0	4.0					Sunny, some clouds, less windy than set time	Past km 39; FN set in quasi embayment to Ptarmigan; very steep slopes to road access so had to walk ~500 m along sand dunes created by reservoir; lots of woody debris collected on shore; wildlife tracks (suspect lynx)
25-Apr-16	Bulldog	366893	5833315	FN1	Perpendicular	18:34	55.0		bottom	13:45	74.0	8.0					Sunny, some clouds, less windy than set time	Near km 27 marker; saw ducks at site before setting up; set up SE side of Bulldog (E of bridge); evidence of upwelling along shore adjacent to FN site
26-May-16	Mica area	407305	5770914	FN1	Parallel	09:40	76.0	12.00	Bottom	20:33	105.0	11.0					Cloudy, rainy	observed dead KO, RB, MW on water surface; observed wolf on shoreline while traveling by boat and tracks near FN
26-May-16	Sullivan	437405	5756758	FN2	Parallel	12:16	30.0	12.00	Bottom	11:19	59.0	12.0					Raining	Observed wolf tracks on shore, and observed wolves on shore while travelling to next site
26-May-16	Across from Sullivan	430716	5750717	FN3	Parallel	13:15	74.5	13.00	Bottom	09:46	109.0	13.0					clouds, some rain, wind	Hunkered down after net check due to waves on open water.

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26-May-16	Kinbasket River	431123	5757239	FN4	Parallel	14:06	65.0	13.00	Bottom	12:13		12.0						Cloudy, Partially Rainy	
27-May-16	Encampment creek, NW side	398305	5778053	FN5	Parallel	15:12	67.0	10.00	Bottom	08:39	86.0	11.0						Cloudy with sunny breaks	
27-May-16	Encampment creek, SE side	397596	5777272	FN6	Parallel	15:36	33.0	10.00	Bottom	09:29	49.0	11.0						Cloudy with sunny breaks	
27-May-16	Embayment by encampment and boat launch	397889	5776785	FN7	Parallel	16:26	51.0	10.00	Bottom	10:01	71.0	11.0						Cloudy with sunny breaks	
19-Jun-16	Mayville creek	462256	5730614	FN1	Parallel	17:21	42.0	13.00	Bottom	08:38	51.0	11.2	94.39	7.45	130.7	115.05		sunny with clouds, calm evening	
19-Jun-16	Quartz creek	472100	5707650	FN2	Parallel	18:00	27.0	8.00	Bottom	07:54	33.0	6.4	106.89	5.97	141.1	142.35		sunny with clouds, calm evening	
20-Jun-16	Good Fellow creek	471899	5736880	FN1	Perpendicular	10:28	71.0	14.00	Bottom	08:37	86.0	15.5	55.80	8.40	165.5	131.30		cloudy, good conditions on water	
20-Jun-16	Chatter creek	470311	5737782	FN2	Perpendicular	11:31	55.5	15.00	Bottom	09:51	66.0	14.3	71.25	7.78	170.5	139.10		cloudy, good conditions on water	
20-Jun-16	Adj. Succour creek	456697	5735280	FN3	Perpendicular	12:24	63.0	16.00	Bottom	14:42	73.0	17.6	63.15	7.43	164.6	124.80		cloudy, good conditions on water	dead KO with lesions on dorsal side sample collected
20-Jun-16	Succour creek	459184	5733751	FN4	Perpendicular	12:53	73.0	16.00	Bottom	11:30	84.5	15.8	83.91	7.93	156.2	122.85		cloudy, good conditions on water	
21-Jun-16	West side of Succour creek	457821	5730703	FN1	Parallel	13:27	76.0	16.00	Bottom	08:16	86.0	14.0	70.41	8.00	145.5	119.60		Cloudy with sun and wind in afternoon	
21-Jun-16	Surprise Rapids reset	451802	5738430	FN1	Perpendicular	11:20	65.0	14.90	Bottom	08:38	78.0	14.6	70.98	7.19	161.0	168.40		Cloudy with some rain	
21-Jun-16	Surprise Rapids	451802	5738430	FN2	Perpendicular	15:56	66.0	11.00	Bottom	10:19	82.0	14.9	80.17	7.82	154.6	124.80		Cloudy with sun and wind in afternoon	
21-Jun-16	S of Surprise Rapids	452111	5735498	FN3	Parallel	16:25	24.0	11.00	Bottom	09:26	83.0	15.6	74.76	7.96	156.0	123.50		Cloudy with sun and wind in afternoon	
21-Jun-16	Esplanade Bay	460516	5727880	FN4	Perpendicular	17:03	70.0	11.00	Bottom	13:21	84.0	13.9	89.27	7.77	141.9	117.00		Cloudy with sun and wind in afternoon	
22-Jun-16	West side of Bear Island	453149	5735997	FN2	Perpendicular	12:03	27.0	17.00	Bottom	09:34	41.0	15.7	74.41	8.14	156.8	124.12		Cloudy with some rain	

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16-Aug-16	Hugh Allan Creek	384541	5810004	FN1	Perpendicular	10:03	65.0	18.00	Bottom	09:36		17.8	90.20	8.29	113.8	85.80	Overcast with wind	net collapsed
16-Aug-16	Windfall Creek	381752	5810622	FN2	Perpendicular	10:52	42.0	18.00	Bottom	10:14	43.0	18.1	88.70	8.33	105.4	78.65	Overcast with wind	
16-Aug-16	Grouse Creek	379190	5814764	FN3	Perpendicular	11:56	65.0	19.00	Bottom	10:59	70.0	18.3	90.80	8.15	108.5	80.60	Overcast with wind	
16-Aug-16	North Ptarmigan Creek	373540	5827973	FN4	Perpendicular	13:34	73.0	19.00	Bottom	12:38	65.0	18.6	87.50	7.95	103.0	76.05	Overcast with wind	
17-Aug-16	Blackmore Creek	364934	5833944	FN1	Perpendicular	13:42	51.0	18.20	Bottom	08:35	49.0	17.8	89.30	8.16	90.8	68.25	Partly cloudy with sun	
17-Aug-16	Packsaddle Creek	353843	5849907	FN2	Perpendicular	14:29	53.0	18.20	Bottom	12:03	55.0	17.5	85.80	8.07	95.0	72.15	Partly cloudy with sun	
17-Aug-16	Canoe Creek	356458	5845200	FN3	Perpendicular	15:15	64.0	20.50	Bottom	13:09	68.0	19.1	74.30	7.61	88.8	65.00	Partly cloudy with sun	
17-Aug-16	Unnamed tributary	357924	5843955	FN4	Perpendicular	15:41	51.0	11.50	Bottom	10:01	49.0	18.2	88.00	8.14	89.9	66.95	Partly cloudy with sun	

CLBMON-6: Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment (Year 2)

Appendix 2: Summary of all fishes captured with fyke nets (n=35) set overnight along the nearshore zone of Kinbasket Reservoir from April 23 to August 18, 2016. Species abbreviations are: 'BB' – Burbot (*Lota lota*); 'BT' - Bull Trout (*Salvelinus confluentus*); 'CAS' - Prickly Sculpin (*Cottus asper*); 'CC' – Sculpin spp. (*Cottus* spp.); 'CRH' – Torrent Sculpin (*Cottus rhotheus*); 'CSU' - Largescale Sucker (*Catostomus macrocheilus*); 'KO' – Kokanee (*Oncorhynchus nerka*); 'LNC' – Longnose Dace (*Rhinichthys cataractae*); 'LSU' – Longnose Sucker (*Catostomus catostomus*); 'MW' - Mountain Whitefish (*Prosopium williamsoni*); 'NSC' – Northern Pikeminnow (*Ptychocheilus oregonensis*); 'PCC' – Peamouth Chub (*Mylocheilus caurinus*); 'PMB' – Pumpkinseed Sunfish (*Lepomis gibbosus*); 'RB' - Rainbow Trout (*Oncorhynchus mykiss*); 'RSC' – Redside Shiner (*Richardsonius balteatus*).

Date	Location	Fyke Net #	Species	Count	Length (mm)	Weight (g)	Comments
25-Apr-16	Yellowjacket	FN2	BB	1	508	660	lesions
25-Apr-16	Yellowjacket	FN2	BB	1	541	793	
25-Apr-16	Yellowjacket	FN1	BB	1	545	807	
25-Apr-16	Griffin	FN1	BB	1	571	899	
25-Apr-16	Yellowjacket	FN2	BB	1	599	1126	
25-Apr-16	Yellowjacket	FN2	BB	1	639	1147	post spawn condition
25-Apr-16	Yellowjacket	FN2	BB	1	662	1618	full of fish
26-Apr-16	Bulldog	FN1	BT	1	161	40	No tag; no spawning at Bulldog so samples from Blackmore across Kinbasket or adjacent tribs? Bt present possibly bc of better cover and substrate; Stomach empty
26-Apr-16	Bulldog	FN1	BT	1	162	42	No tag; no spawning at Bulldog so samples from Blackmore across Kinbasket or adjacent tribs? Bt present possibly bc of better cover and substrate; Stomach contained caddisfly
26-Apr-16	Bulldog	FN1	BT	1	222	105	No tag; no spawning at Bulldog so samples from Blackmore across Kinbasket or adjacent tribs? Bt present possibly bc of better cover and substrate; Stomach contained larval fish likely NSC
27-May-16	Kinbasket	FN4	BT	1	156	30	Stomach empty
28-May-16	Encampment Creek NW side	FN5	BT	1	176	52	Tapeworm, Larval fish, and invertebrate in stomach
28-May-16	Embayment by encampment and boat launch	FN7	BT	1	210	62	Stomach empty
28-May-16	Encampment Creek NW side	FN5	BT	1	470	399	
21-Jun-16	Good Fellow Creek	FN1	BT	1	179	52	Samples collected from BT: Otolith, scales, fin rays; Stomach contents of BT: 2 larval fish - too digested to identify
21-Jun-16	Chatter Creek	FN2	BT	1	195	63	Collected fin, otolith, scales; stomach with digested larval fish
22-Jun-16	Surprise Rapids	FN2	BT	1	214	95	
22-Jun-16	Surprise Rapids	FN2	BT	1	226	112	
23-Jun-16	Surprise Rapids	FN1	BT	1	235	104	
18-Aug-16	Blackmore Creek	FN1	BT	1	85	14	
18-Aug-16	Blackmore Creek	FN1	BT	1	174	47	Collected fin ray, otolith, scales and noted stomach contents (empty)
18-Aug-16	Packsaddle Creek	FN2	BT	1	205	78	Collected fin ray, otolith, scales and noted stomach contents (Contained RSC from fyke net 1/3 size of BT)
18-Aug-16	Unnamed tributary	FN4	BT	1	360	421	Adult bull trout
26-Apr-16	Ptarmigan	FN1	CAS	3			
27-May-16	Sullivan	FN2	CAS	1			
27-May-16	Across from Sullivan	FN3	CAS	2			
28-May-16	Encampment Creek NW side	FN5	CAS	2			
28-May-16	Encampment Creek SE side	FN6	CAS	1			
28-May-16	Embayment by encampment and boat launch	FN7	CAS	3			
21-Jun-16	Chatter Creek	FN2	CAS	1			Stomach contents of BT: 1 larval fish - too digested to identify
21-Jun-16	Adj Succour Creek	FN3	CAS				
22-Jun-16	West of Succour Creek	FN1	CAS	1			
22-Jun-16	Surprise Rapids	FN2	CAS	21			

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22-Jun-16	Esplanade Bay	FN4	CAS	4			
23-Jun-16	Surprise Rapids	FN1	CAS	24			Very large 62g CAS
17-Aug-16	Windfall Creek	FN2	CAS	1			
17-Aug-16	Grouse Creek	FN3	CAS	1			
17-Aug-16	North Ptarmigan	FN4	CAS	2			
18-Aug-16	Canoe Creek	FN3	CAS	1			
18-Aug-16	Unnamed tributary	FN4	CAS	1			
24-Apr-16	Horse Creek	FN1	CC	28			
24-Apr-16	Horse Creek	FN2	CC	3			
25-Apr-16	Yellowjacket	FN2	CC	25			
25-Apr-16	Yellowjacket	FN1	CC	2			
25-Apr-16	Griffin	FN1	CC	24			
26-Apr-16	Bulldog	FN1	CC	1			
26-Apr-16	Ptarmigan	FN1	CRH	1			
27-May-16	Sullivan	FN2	CSU	1			
27-May-16	Kinbasket	FN4	CSU	1			
21-Jun-16	Chatter Creek	FN2	CSU	2			
21-Jun-16	Good Fellow Creek	FN1	CSU	26			
22-Jun-16	West of Succour Creek	FN1	CSU	3			
22-Jun-16	Esplanade Bay	FN4	CSU	3			
22-Jun-16	South of Surprise Rapids	FN3	CSU	5			
23-Jun-16	North side of Bear Island	FN2	CSU	1			
17-Aug-16	Grouse Creek	FN3	CSU	2			
27-May-16	Mica Area	FN1	KO	1	85	94	
23-Jun-16	Surprise Rapids	FN1	KO	2			
18-Aug-16	Canoe Creek	FN3	LNC	2			
21-Jun-16	Adj Succour Creek	FN3	LSU				
21-Jun-16	Succour Creek	FN4	LSU	2			
22-Jun-16	Surprise Rapids	FN2	LSU	1			
22-Jun-16	Esplanade Bay	FN4	LSU	7			
23-Jun-16	North side of Bear Island	FN2	LSU	1			
17-Aug-16	Windfall Creek	FN2	LSU	2			
17-Aug-16	Grouse Creek	FN3	LSU	1			
18-Aug-16	Canoe Creek	FN3	LSU	1			
24-Apr-16	Horse Creek	FN2	MW	5			
25-Apr-16	Yellowjacket	FN2	MW	19			
25-Apr-16	Yellowjacket	FN1	MW	3			
25-Apr-16	Griffin	FN1	MW	1			
26-Apr-16	Km 35	FN1	MW	1			
20-Jun-16	Mayville Creek	FN1	MW	2			
21-Jun-16	Good Fellow Creek	FN1	MW	1			
17-Aug-16	North Ptarmigan	FN4	MW	9			
18-Aug-16	Blackmore Creek	FN1	MW	1			
18-Aug-16	Canoe Creek	FN3	MW	1			
18-Aug-16	Unnamed tributary	FN4	MW	23			

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25-Apr-16	Yellowjacket	FN2	MW (fry)	54			
24-Apr-16	Horse Creek	FN1	NSC	68			
24-Apr-16	Horse Creek	FN2	NSC	46			
25-Apr-16	Yellowjacket	FN2	NSC	7			
25-Apr-16	Griffin	FN1	NSC	5			
26-Apr-16	Km 35	FN1	NSC	1			
26-Apr-16	Ptarmigan	FN1	NSC	44			2 size classes collected (larval and >20mm)
26-Apr-16	Bulldog	FN1	NSC	5			
27-May-16	Kinbasket	FN4	NSC	7			
28-May-16	Encampment Creek NW side	FN5	NSC	1			RCS in mouth
20-Jun-16	Mayville Creek	FN1	NSC	1			
21-Jun-16	Good Fellow Creek	FN1	NSC	32			
21-Jun-16	Chatter Creek	FN2	NSC	29			
21-Jun-16	Adj Succour Creek	FN3	NSC				
21-Jun-16	Succour Creek	FN4	NSC	13			
22-Jun-16	West of Succour Creek	FN1	NSC	17			
22-Jun-16	Surprise Rapids	FN2	NSC	52			Stomach contents of BT: Larval RSC, 3 larval fish - too digested to identify, 1 large PCC
22-Jun-16	South of Surprise Rapids	FN3	NSC	30			
22-Jun-16	Esplanade Bay	FN4	NSC	151			Large scale sucker caught with large tumour
23-Jun-16	North side of Bear Island	FN2	NSC	15			
23-Jun-16	Surprise Rapids	FN1	NSC	31			
18-Aug-16	Packsaddle Creek	FN2	NSC	1			
27-May-16	Mica Area	FN1	PCC	25			
27-May-16	Sullivan	FN2	PCC	3			
27-May-16	Kinbasket	FN4	PCC	4			
27-May-16	Across from Sullivan	FN3	PCC	19			Net collapsed, all fish in net were dead, all PCC in net infected with tapeworms
28-May-16	Encampment Creek NW side	FN5	PCC	9			
28-May-16	Embayment by encampment and boat launch	FN7	PCC	2			
20-Jun-16	Mayville Creek	FN1	PCC	4			
21-Jun-16	Good Fellow Creek	FN1	PCC	32			Lesions on peamouth
21-Jun-16	Chatter Creek	FN2	PCC	38			
22-Jun-16	West of Succour Creek	FN1	PCC	6			
22-Jun-16	Surprise Rapids	FN2	PCC	27			
22-Jun-16	South of Surprise Rapids	FN3	PCC	4			
22-Jun-16	Esplanade Bay	FN4	PCC	10			
23-Jun-16	North side of Bear Island	FN2	PCC	9			
23-Jun-16	Surprise Rapids	FN1	PCC	5			
17-Aug-16	North Ptarmigan	FN4	PCC	2			
18-Aug-16	Unnamed tributary	FN4	PCC	1			
22-Jun-16	Esplanade Bay	FN4	PMB	1			
25-Apr-16	Yellowjacket	FN1	RB	1	135	46	
20-Jun-16	Mayville Creek	FN1	RB	1			
18-Aug-16	Packsaddle Creek	FN2	RB	1	131	26	

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27-May-16	Kinbasket	FN4	RCS	7			
24-Apr-16	Horse Creek	FN1	RSC	133			
24-Apr-16	Horse Creek	FN2	RSC	9			
25-Apr-16	Yellowjacket	FN2	RSC	7			
25-Apr-16	Griffin	FN1	RSC	122			
26-Apr-16	Km 35	FN1	RSC	46			
26-Apr-16	Ptarmigan	FN1	RSC	14			
26-Apr-16	Bulldog	FN1	RSC	2			
27-May-16	Mica Area	FN1	RSC	40			
27-May-16	Sullivan	FN2	RSC	72			
27-May-16	Across from Sullivan	FN3	RSC	1			
28-May-16	Encampment Creek NW side	FN5	RSC	15			
28-May-16	Encampment Creek SE side	FN6	RSC	28			
28-May-16	Embayment by encampment and boat launch	FN7	RSC	84			
20-Jun-16	Mayville Creek	FN1	RSC	7			Unusual markings on Pikeminnow
21-Jun-16	Good Fellow Creek	FN1	RSC	96			
21-Jun-16	Chatter Creek	FN2	RSC	476			Samples collected from BT: Otolith, scales, fin rays.
21-Jun-16	Adj Succour Creek	FN3	RSC				Too many fish to process
21-Jun-16	Succour Creek	FN4	RSC	144			
22-Jun-16	West of Succour Creek	FN1	RSC	52			
22-Jun-16	Surprise Rapids	FN2	RSC	186			Samples collected from BT: Otolith, scales, fin rays.
22-Jun-16	South of Surprise Rapids	FN3	RSC	79			
22-Jun-16	Esplanade Bay	FN4	RSC	235			
23-Jun-16	North side of Bear Island	FN2	RSC	137			
23-Jun-16	Surprise Rapids	FN1	RSC	80			
17-Aug-16	Hugh Allan creek	FN1	RSC	1			Net collapsed - shiner dead, free tapeworm in net
17-Aug-16	Windfall Creek	FN2	RSC	230			
17-Aug-16	Grouse Creek	FN3	RSC	7			
17-Aug-16	North Ptarmigan	FN4	RSC	121			
18-Aug-16	Blackmore Creek	FN1	RSC	2			
18-Aug-16	Packsaddle Creek	FN2	RSC	210			
18-Aug-16	Canoe Creek	FN3	RSC	79			
18-Aug-16	Unnamed tributary	FN4	RSC	3			
20-Jun-16	Quartz Creek	FN2					No fish caught in net

Appendix 3: Summary of habitat assessments of sites along the nearshore zone of Kinbasket Reservoir sampled from April 23 to August 18, 2016.

Date	Location	UTM E	UTM N	Fyke Net #	Transect 1					Transect 2					Vegetation cover	Upland vegetation cover	Dominant Substrate	Subdominant Substrate	Comments		
					Location relative to FN	Slope T1	Slope T2	Slope T3	Slope T4	Slope T5	Location relative to FN	Slope T1	Slope T2	Slope T3						Slope T4	Slope T5
24-Apr-16	Horse Creek	363616	5837126	FN1	SE	4	4	3	2	4	NW	7	4	4	4	5	None		Fines	Cobble	
24-Apr-16	Horse Creek	363668	5838957	FN2	SE	9	4	5	4	4	NW	6	4	4	3	3	None		Fines	Cobble	
25-Apr-16	Yellowjacket	361467	5840874	FN2	SE	2	3	5	5	4	NW	4	4	3	2	3	None		Fines		
25-Apr-16	Yellowjacket	362543	5838995	FN1	SE	2	4	4	1	8	NW						None		Fines		
25-Apr-16	Griffin	361467	5840876	FN1	SE	3	3	4	4	4	NW	8	9	9	13	15	None		Fines		
26-Apr-16	KM 35	372439	5829459	FN1	SE	12	11	10	11	9	NW	13	11	10	9	8	None	cottonwood, trembling aspen (and cottonwood x aspen), birch, spruce	Fines	large cobble; boulder/cobble/fines at higher elevation	Steep slope to truck but more gradual to FN1; slope measured in % not degrees
26-Apr-16	Ptarmigan	375776	5827501	FN1	SE	4	4	4	4	3	NW	29	64	>30	>30	>30	None		Fines		NW transects 3 to 5 >30% to treeline too dangerous to measure; SE transect towards Ptarmigan; slope in %
26-Apr-16	Bulldog	366893	5833315	FN1	SE	5	12	5	10	>30	NW	9	4	2.5	3	9	None		Fines	boulder and cobble at confluence	Slope in %; areas beyond SE T5 have slope >30%
26-May-16	Mica area	407305	5770914	FN1	NW	9	12	14	17	16	SE	10	12	18	6	19	None	Fd, At, Se, Cw, Hw	Cobble	Sand	
26-May-16	Sullivan	437405	5756758	FN2	SE	33	22	20	19	29	NW	>30	>30	>30	>30	>30	None	Fd, At, Se, Cw, Hw	Sand	Gravel	No slope measurements to NW >30%
26-May-16	Across from Sullivan	430716	5750717	FN3	NW	12	25	>30	>30	>30	SE	12	16	23	>30	>30	None	Hw, Fd	Cobble	Sand	
26-May-16	Kinbasket River	431123	5757239	FN4	SE	10	12	11	12	12	NW	10	>30	>30	>30	>30	None		Sand	Gravel	
28-May-16	Encampment NW side	398305	5778053	FN5	NE	6	9	10	9	11	SW	8	9	7	9	9	None	Alnus spp.	Cobble	Sand	
28-May-16	Encampment SE side	397596	5777272	FN6	SW	0	0	11	17	16	NE	3	19	20	9	6	None		Sand	Gravel	
28-May-	Encampment	397889	5776785	FN7	NE	11	11	13	9	10	SE	11	12	12	4	7	None		Sand	Gravel	

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16	West Bay																				
20-Jun-16	Mayville Creek	462256	5730614	FN1	West	4	6	6	5	12	East	6	14	11	13	7	grasses (gramineae spp.), horsetail (Equisetum arvense)	Trembling aspen (Populus tremuloides), Paper birch (Betula papyrifera), Western red cedar (Thuja plicata), Western white pine (Pinus monticola), Douglas fir (Pseudotsuga menziesii)	Gravel	Cobble	
20-Jun-16	Quartz Creek	472100	5707650	FN2	West	6	4	3	5	4	East	1	7	7	13	16	None	None	Fines	Gravel	
21-Jun-16	Good Fellow	471899	5736880	FN1	North	4	4	4	3	4	South	3	1	2	3	4	Grasses (gramineae spp.), Horsetail (Equisetum arvense)	Fd, Ep, Cw, Pw, At	Gravel	Cobble	
21-Jun-16	Chatter Creek	470311	5737782	FN2	West	2	1	0	1	0	East	2	2	3	1	0	Horsetail	Grasses (Gramineae spp.), Trembling aspen (Populus tremuloides), Douglas fir (Pseudotsuga menziesii), Western white pine (Pinus monticola)	Fines	Sands	
21-Jun-16	Across from Succour Creek	456697	5735280	FN3	East	9	20	25	25	19	West	9	8	10	9	10	None	Grasses Gramineae spp.), Trembling aspen (Populus tremuloides), Paper birch (Betula papyrifera)	Fines	Sands	
21-Jun-16	Succour Creek	459184	5733751	FN4	South	4	10	10	12	16	North	2	6	7	9	4	Grasses, Pineapple weed	Trembling aspen (Populus tremuloides), Douglas fir (Pseudotsuga menziesii), Paper birch (Betula papyrifera), Western white pine (Pinus monticola)	Gravel	Cobble	
22-Jun-16	West side of Succour Creek	457821	5730703	FN1	North	3	5	5	4	1	South	6	7	4	2	3	Horsetail	Douglas fir (Pseudotsuga menziesii), Paper birch (Betula	Fines	Gravel	

																		papyrifera),Western red cedar (Thuja plicata),Western white pine (Pinus monticola),Trembling aspen (Populus tremuloides)			
22-Jun-16	Surprise Rapids	451802	5738430	FN2	South	7	28	25	29	30	North	11	14	10	11	13	Sedges	Trembling aspen (Populus tremuloides),Paper birch (Betula papyrifera, Western white pine (Pinus monticola)	Cobble	Gravel	
22-Jun-16	South side of Surprise Rapids	452111	5735498	FN3	North	6	5	4	6	2	South	6	4	4	6	7	Horsetail, Pineapple weed, Sedges, Clovers	Trembling aspen (Populus tremuloides),Paper birch (Betula papyrifera),Western white pine (Pinus monticola)	Fines	Sands	
22-Jun-16	Pt of Esplanade Bay	460516	5727880	FN4	East	4	12	23	25	27	West	21	30	>30	>30	>30	Grasses, Horsetail	Western red cedar (Thuja plicata), Western white pine (Pinus monticola), paper birch (Betula papyrifera),Trembling aspen (Populus tremuloides)	Sands	Gravel	
17-Aug-16	Hugh Allan Creek	384541	5810004	FN1	East	4	5	9	12	30	West	4	3	4	6	4	Common horsetail (Equisetum arvense), grasses (Gramineae spp.)	Reed canary grass (Phalaris arundinacea), bunchgrass (Gramineae spp.), foxtail (Hordeum murinum, clover (Trifolium spp), horsetail (Equisetum arvense), trembling aspen (Populus tremuloides), Lodgepole pine (Pinus Contorta)	Sands	Gravel	
17-Aug-16	Windfall Creek	381752	5810622	FN2	North	12	8	10	13	11	South	10	9	10	10	11	Horsetail (Equisetum arvense),	Horsetail (Equisetum arvense), Reed	Sands	Gravel	

																	Clover (trifolium spp.), Reed canary grass (Phalaris arundinacea)	canary grass (Phalaris arundinacea), Clover (Trifolium spp.), Alder (Alnus spp.), Trembling aspen (Populus tremuloides), Lodgepole pine (Pinus contorta), Grand fir (Abies grandis)			
17-Aug-16	Grouse Creek	379190	5814764	FN3	North	12	9	8	30	30	South	11	9	8	8	10	Clover (Trifolium spp.), Bunchgrass (Gramineae spp.), Reed canary grass (Phalaris arundinacea)	Willows (Salix spp.), Yellow hawkweed (Hieracium caespitosum), Horsetail (Equisetum arvense), reed canary grass (Phalaris arundinacea), Pearly everlasting (Anaphalis margaritacea, Alder (Alnus spp.), Clover (Trifolium spp.), Trembling aspen (Populus tremuloides), lodgepole pine (Pinus contorta)	Cobbles	Sands	
17-Aug-16	North Ptarmigan Creek	373540	5827973	FN4	East	3	3	2	1	1	West	1	2	2	3	2	Bunchgrass (Gramineae spp), Clovers(Trifolium spp.), Macrophytes, Reed canary grass (Phalaris arundinacea), horsetail (Equisetum arvense)	Trembling aspen (Populus tremuloides), Lodgepole pine (Pinus contorta), Grand fir (Abies grandis), Willows (Salix spp.), Alder (Alnus spp.)	Cobbles	Sands	
18-Aug-16	Blackmore Creek	364934	5833944	FN1	East	12	8	25	13	11	West	13	12	16	13	30	Clovers (Trifolium	Horsetail (Equisetum	Cobbles	Gravels	

																	spp.), Grasses (Gramineae spp.)	arvense), Willows (Salix spp.), Yellow hawkweed (Hieracium caespitosum), Black cottonwood (Populus trichocarpa), Trembling aspen (Populus tremuloides), Pearly everlasting (Anaphalis margaritacea), Engelmann spruce (Picea engelmannii), Grand fir (Abies grandis).			
18-Aug-16	Packsaddle Creek	353843	5849907	FN2	North	6	7	3	2	4	South	6	6	8	7	4	Grasses (Gramineae spp), Horsetail (Equisetum arvense), Willows (Salix spp.) Clovers (Trifolium spp.)	Grasses (Gramineae spp.), Cottonwood (Populus trichocarpa), Trembling aspen (Populus tremuloides), Lodgepole pine (Pinus contorta)	Sands	Cobbles	Mechanical site disturbance on south portion
18-Aug-16	Canoe Creek	356458	5845200	FN3	North	7	9	8	10	10	South	6	0	0	0	0	Horsetail (Equisetum arvense), Reed canary grass (Phalaris arundinacea)	Cottonwood (Populus trichocarpa), Trembling aspen (Populus tremuloides), Engelmann spruce (Picea engelmannii), Red cedar (Thuja plicata), Western hemlock (Tsuga heterophylla) Grasses (Gramineae spp.)	Gravels	Fines/Organics	
18-Aug-16	Unnamed tributary	357924	5843955	FN4	North	10	7	8	9	9	South	7	11	11	8	11	Willows (Salix spp.), Grasses (Gramineae	Foxtails (Hordeum murinum), Grasses (Gramineae spp.),	Gravels	Cobbles	Stream gradient under

																	spp.)	Horsetail (Equisetum arvense), Cottonwood (Populus trichocarpa), Alder (Alnus spp.) Willows (Salix spp.), Trembling aspen (Populus tremuloides)			reservoir influence, Patches of green filamentous algae on shore and trace amounts in water
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