

Kakwa and Babette lakes Report 2025



fRI Research Water and Fish Program

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EXECUTIVE SUMMARY

The Kakwa watershed is home to one of Alberta's cold-water species at risk, bull trout (*Salvelinus confluentus*). Bull trout face many challenges to survival, one being competition with non-native trout species. Non-native rainbow trout (*Oncorhynchus mykiss*) have historically been stocked in the Kakwa headwaters (Kakwa, Babette and Cecilia Lakes). Upstream fish movement within the watershed is restricted by a waterfall, partially isolating populations of rainbow trout. However, there is a lack of information available on these stocked trout. If conservation efforts are to be taken for bull trout in the Kakwa watershed, knowledge on introduced non-native species should be increased. Therefore, this work aimed to: 1) sample Kakwa and Babette lakes to quantify the abundance and relative abundance of rainbow trout, 2) describe length distributions of fish collected, and 3) confirm rainbow trout are the only fish species present above the falls. Sampling occurred in August 2025 by the fRI Research Water and Fish Team and Alberta Environment and Protected Areas staff. Each lake was sampled for fish via angling and North American Standard Index Netting Sampling Protocol (NASIN) netting. Tributaries to Kakwa Lake were assessed with backpack electrofishing. Temperature and dissolved oxygen profiles were collected for both lakes. At Kakwa Lake, periphyton, and benthic and terrestrial invertebrates were collected for future stable isotope analysis. Results suggested both lakes were oligotrophic with cold water (~12-14 °C), no obvious stratification of temperature or oxygen, and limited aquatic vegetation and algae throughout. Catches were overall low but indicated rainbow trout were the only fish species present. Furthermore, it appears few rainbow trout persist in Babette Lake (~5% of total fish caught) while an established population with a range of size classes remain in Kakwa Lake and its connected tributaries. All fish caught via angling in Babette Lake occurred near the inlet despite angling the entire perimeter of the lake. Large mature rainbow trout were captured predominantly in Kakwa Lake while fry and juveniles were documented in the connected tributaries and near tributary outflows indicating recruitment is present. Due to low marks and recapture rates, a population estimate could not be completed but relative abundance suggests low catches for both netting (Kakwa Lake = 1.4 fish / net-night, Babette = 0.4 fish / net-night) and angling (Kakwa Lake = 0.7 fish / angler-h, Babette 0.4 fish / angler-h). Backpack electrofishing had moderate to high catches relative to those observed below the waterfall with 31 fish / 300 m in Kakwa River and 46 fish / 300 m in Babette Creek. Both tributaries had high numbers (100s) of young of year (yoy), that were unable to be captured due to their small size. Overall, the results suggest that rainbow trout have established a natural reproducing population with a subset that have grown to large sizes (typically found in the lakes). Both net catches and angling suggest that the two lakes currently hold low densities of fish that could be a result of low productivity or the lakes have yet to reach carrying capacity. The observations of large numbers of yoy suggest that recruitment is present and spawning habitat exists for spring spawning salmonids.



INTRODUCTION

The Kakwa River drainage originates in British Columbia’s Kakwa Provincial Park and flows into Alberta’s Kakwa Wildlands Provincial Park. The headwaters of the Kakwa drainage include three alpine lakes (Kakwa, Babette and Cecilia) that are separated from the rest of the watershed by Kakwa Falls. This barrier has historically kept the headwaters fishless, preventing up stream movement of fish like bull trout, one of Alberta’s cold-water Species-at-Risk (Figure 1).

Bull trout within the Kakwa drainage face a suite of threats including the introduction of non-native species. Stocking of non-native rainbow trout has occurred in the Kakwa watershed since the 1970s from both the Alberta and British Columbia Provincial Governments. In Alberta, 3,223,281 rainbow trout were stocked in Musreau Lake over 39 events and 152,997 in Long Lake over 10 events. In BC, records suggest that 93,000 rainbow trout were stocked between 1981 -1983 in the three lakes with Kakwa Lake receiving the larger number (56,500). Past (data from Ripley et al. 2004) and recent (2023 and 2024) records as part of watershed assessments suggest that rainbow trout have expanded outside of this historic stocking events (Figure 1). Despite the presence of robust data below Kakwa Falls, limited information on the status of stocked trout in the headwaters of the Kakwa River drainage is present. Capture of rainbow trout has occurred above Kakwa Falls both by anglers and backpack electrofishing but sampling is dated and sporadic. Also, catches of rainbow trout have been documented immediately downstream of Kakwa Falls suggesting populations above the falls may be seeding populations below the falls (FWMIS, 2025). In total, it is not well understood what the abundance of rainbow trout are above the falls.

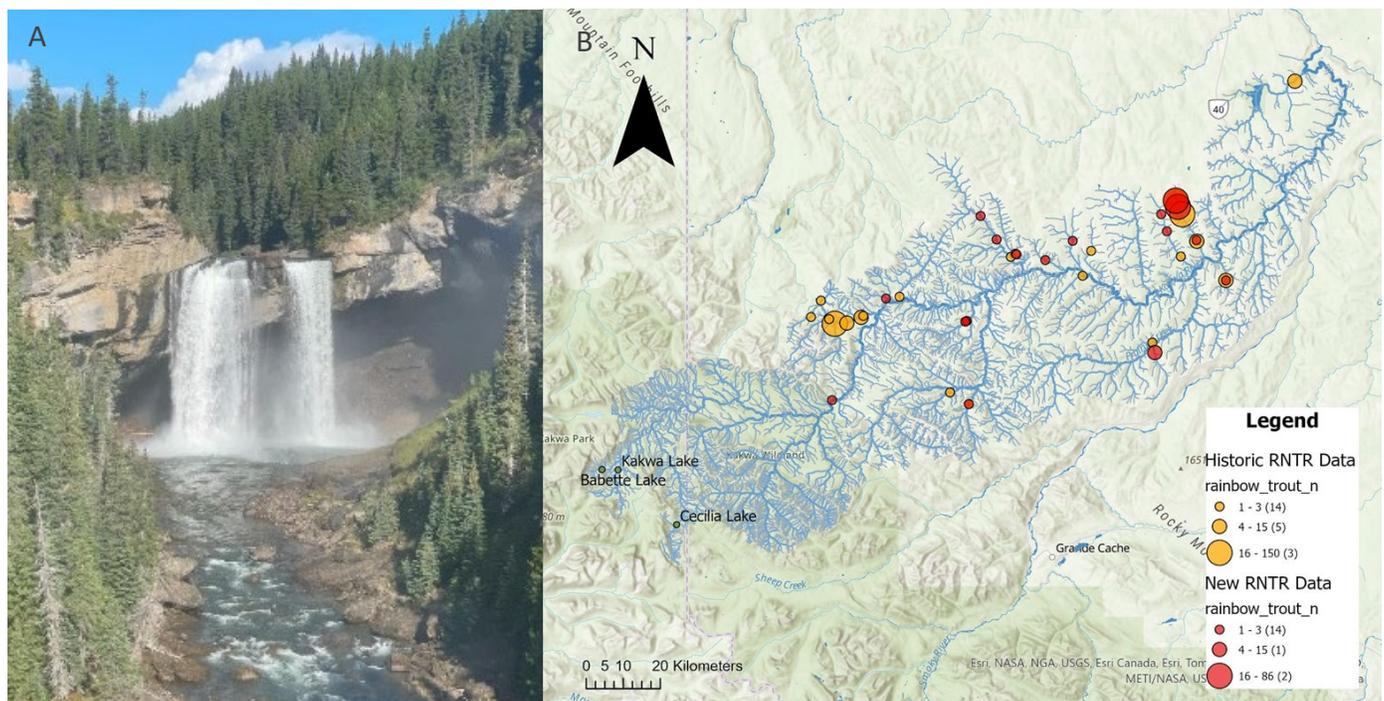


Figure 1. A) Kakwa Falls in August 2025, B) site specific rainbow trout CPUE for historic (1994-2001) and new (2023-2024) sampling within the Kakwa Watershed downstream of the Kakwa Falls.



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Conservation translocations may be a powerful tool in recovering and maintaining bull trout populations in the Kakwa River drainage (Galloway et al. 2016, Kissinger et al. 2024). Introduction of bull trout into lakes above Kakwa falls may be an option for establishing a viable population, however these actions would require considerable assessment of the recipient location to understand risks (Galloway et al. 2016). For example, competition between bull trout and rainbow trout is believed to be low, however, both species consume similar food at various stages of life and occupy cold water habitats (Nelson and Paetz 1992). Additionally, few studies have assessed competition between these species, especially in introduced populations so conclusions are limited (Kissinger et al. 2025). Understanding the abundance of introduced non-native species is crucial if any attempts to conserve bull trout are to be made within the Kakwa drainage.

Considering the lack of information on stocked rainbow trout in the Kakwa watershed along with the potential for bull trout conservation efforts, three main objectives were outlined for this project:

1. Quantify the abundance and relative abundance of rainbow trout above Kakwa falls by sampling Kakwa Lake, Babette Lake and connected tributaries.
2. Describe length distributions of fish within Kakwa Lake, Babette Lake and connected tributaries.
3. Confirm species presence and absence above Kakwa Falls (i.e., no native species present).



METHODS

STUDY AREA

Geographic location

Kakwa, Babette and Cecilia Lakes are sub-alpine oligotrophic lakes located within Kakwa Provincial Park between 54°04'N and 53°92'N latitude and 120°22' W and 120°00' W longitude (Figure 3). These lakes represent the headwaters of the Kakwa drainage that spans across the British Columbia and Alberta border (Kakwa Provincial Park in British Columbia, Kakwa Wildlands Provincial Park in Alberta). Based on logistics this work focused solely on Kakwa Lake and Babette Lake along with two Kakwa Lake tributaries, one feeding into Kakwa (Kakwa River) and one connecting Babette and Kakwa (Babette Creek, Figure 3).

The Lakes are located ~80 km north of McBride in BC or 70 km West of Grande Cache Alberta and can only be accessed via helicopter, float plane, horse, snowmobile or foot.

Table 1. Parameters of each lake sampled (B.C. Conservation Data Centre, 2025)

Lake	Max depth (m)	Perimeter (m)	Surface area (Ha)	Littoral area (Ha)
Kakwa Lake	24	13,260	353.9	91.9
Babette Lake	11	3,600	40.3	22.3

FIELD SAMPLING

Kakwa and Babette Lakes were sampled from August 6th - 13th by the fRI Research Water and Fish Team and Alberta Environment and Protected Areas staff. Each lake was sampled for fish via angling and North American Standard Index Netting Sampling Protocol (NASIN) netting. Temperature and dissolved oxygen profiles (DO) recorded at 1 m intervals from surface to bottom of Babette (n = 3) and Kakwa Lakes (n = 2, YSI – ProQuatro Multiparameter Meter). Tributaries to Kakwa Lake were assessed with single-pass backpack electrofishing. Single-pass electrofishing was conducted for 300 m.

Angling

In total 6 staff fished Kakwa (5 days) and Babette (1 day) lakes. All fish caught were measured for length and marked with a fin clip. The left pelvic fin was clipped in Kakwa and the adipose fin was clipped in Babette. Methods for angling included shore fishing, trolling and boat fishing. Five hook types were used (spinner, treble, spoon, wet fly and dry fly) and both fly and reel rods.



NASIN netting

Netting for the recapture of the mark-recapture survey followed NASIN protocols (Bonar et al., 2009; Government of Alberta 2018). Each net was 1.8 m in height, set with small buoys (~20 cm diameter), and consisted of eight 3.1 m long panels of 38 mm, 51 mm, 64 mm, 76 mm, 89 mm, 102 mm, 114 mm and 127 mm monofilament stretched mesh (Bonar et al. 2009). Nets were deployed via boat and set on bottom for ~19 hours and anchored perpendicular to shore with all locations randomly generated in ArcGIS (Table 2). Additional short-set gill nets (n = 12) were set in Kakwa Lake for ~1 hour in areas suspected to have fish in hopes of increasing marks while minimizing mortality. CPUE for short-sets was not included in the overnight set estimates.

For all nets, date, set and lift time, and location were recorded. All fish caught in overnight nets (n = 21) had fork length (mm), weight (g), sex, maturity, and stomach contents recorded. Otoliths were taken to age fish. Pelvic fins were clipped for genetics and caudal fins were clipped for stable isotope analysis. Additionally, an approximate 3 x 3 cm cube of muscle tissue was taken for mercury analysis. Genetics, isotope, otoliths, and mercury samples were archived for later analysis.

Table 2. Estimates of required gill nets per lake and strata based off the Government of Alberta, 2018 recommendations.

Lake	1.8-5 m	5-12m	12-20 m	20-35 m	35-50 m	Total
Babette Lake	5	3	N/A	N/A	N/A	8
Kakwa Lake	6	2	2	2	N/A	12

Electrofishing

Two Kakwa Lake tributaries were sampled via electrofishing (Kakwa River and Babette Creek). Each site was 300 m long as per the GOA Standard Protocol for Sampling of Small Streams in Alberta (Alberta Fisheries Management Branch, 2013). Sites were sampled in teams of two with a Smith-Root LR-24 backpack; all staff present were experienced backpack electrofishers. Electrofisher settings were set to the lowest minimum setting required to immobilize fish and were only increased when fish were not sufficiently immobilized for capture. Frequency remained at 38 Hz and volts ranged from 300 - 325 V.

Data collection for each site included temperature and conductivity measured with a probe (Hanna instruments EC / TDS / Temperature Tester), wetted and rooted width, max depth, clarity, substrate composition, date, time and location. Fork length was recorded on all captured fish. For the Babette Creek site a subset of fish (n = 20) under 160 mm were sampled for stable isotope analysis, otolith collection and mercury analysis. This subset of fish was not represented by angling or netting techniques and will provide an increased accuracy when assessing foodwebs and growth rates.



Stable Isotope Collection

Stable isotopes were collected exclusively from Kakwa Lake by four staff. All macroinvertebrates (~45 ml) were collected by handheld netting, NASIN nets castoffs, rock flipping and hand collecting. Terrestrial invertebrates (~15 ml) were collected via netting and hand collection. Periphyton was scraped of 10 randomly selected rocks by a toothbrush, rinsed with lake water, then placed in a 15 ml falcon tube. All aquatic vegetation was collected from castoffs of NASIN nets.

Temperature

During the summer of 2024, two temperature loggers were deployed above the Kakwa Falls via helicopter (Figure 2). Temperature was logged on HOBO Tidbit loggers at hourly intervals from June 2024 to August 2025.

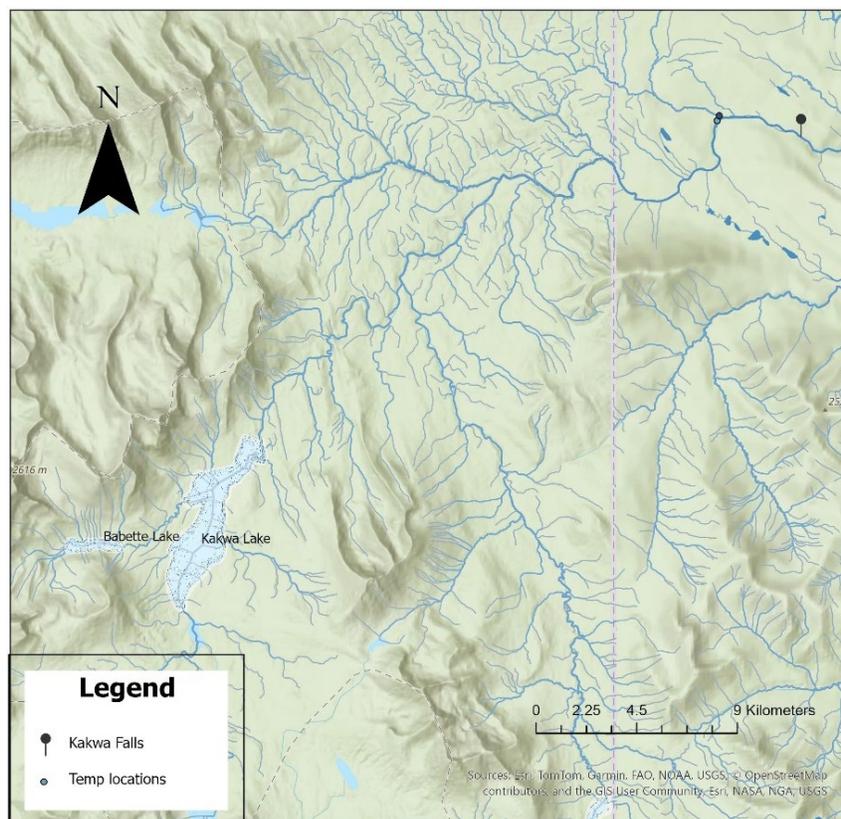


Figure 2. Kakwa Falls and two temperature loggers (Temp locations) downstream of Kakwa and Babette Lake.

DATA ANALYSIS

Catch Per Unit Effort (CPUE)

CPUE was used to determine relative abundance of fish. Different CPUEs were calculated based on sample location (lake or tributary) and technique. For angling, CPUEs were estimated as counts of fish



per person per hour. Gill netting CPUEs were estimated as counts of fish per experimental net – night (a net night is 18 h). Finally, electrofishing CPUEs were estimated as counts of fish per 300 m.

Biological metrics

Fish lengths were compared among locations and sampling techniques via frequency and density distributions. Length-weight relationships were collected for fish from the long-set gill nets. Fish length, weight, sex and maturity data were compared via average, min and max. Diet was assessed in all lethally sampled fish.

Fulton's condition factor was calculated based on methods from Barnham and Baxter (1998) where:

$$K = 100 \times W/L^3$$

Here K = Condition factor, W = fish weight in (g) and L= fish length in (cm).

Statistical Analysis

Statistical analysis was completed using R (2025.05.0). Data was considered significant when $\alpha < 0.05$. CPUE, mean, min and max calculations were completed in Excel.

RESULTS

LAKES

Temperature and dissolved oxygen profiles from both lakes were consistent and did not display a thermocline or hypoxia and remained in an ideal range for cold-water trout (Figure 7). Kakwa Lake profiles of oxygen and temperature ranged from 12 - 14 °C and DO = 8.76 - 9.97 mg / l while Babette sustained slightly cooler temperatures with higher oxygen (12 - 13 °C, DO = 9.0 - 9.5 mg / l, Figure 7). Both lakes appeared to be oligotrophic with minimal plants and high clarity similar to average summer stream temperature ranges seen directly above Kakwa Falls (average 11.6 ± 2.6 °C for Kakwa River, 8.93 ± 2.1 °C for Kakwa River tributary) (10 - 16 °C, Figure 2, Figure 4). The shoreline and tributaries were marked by large amounts of small gravel and cobble that would be ideal for spawning. In addition, groundwater was observed seeping out of the shore at numerous locations around Babette and Kakwa Lakes and it is suspected that the tributaries also possessed similar groundwater upwellings. Point measurements of temperature within tributaries were 12.5 °C in Babette Creek and 17.2 °C in Kakwa River inlet.

CPUE

Average CPUE for angling was less than one fish per hour for both Kakwa (0.70 fish / h) and Babette Lakes (0.44 fish / h, Table 3). Total CPUE was low with both long and short-set gill nets yielding < 1.5 fish per net hour for both Kakwa Lake and Babette Lake. Results were variable and ranged from 0-8 fish per net.



Overall, Kakwa had higher CPUE for both long-set gill nets and angling when compared to Babette. CPUE for electrofishing resulted in 11 fish and ~20 yoy caught (yoy were not measured due to their small size and fragility) for the Kakwa River tributary and 46 fish for Babette Creek tributary (Table 3). Due to poor CPUE in both angling and netting from Babette Lake only half the nets were set as available time was limited. Additionally, staff frequently observed fry along the shore of Kakwa Lake but did not observe fry along the shores of Babette Lake.

Table 3. Fish relative abundance as CPUE defined as: number of fish per net-night (18 h), number of fish / hour of angling, or number of fish / 300 m of electrofishing. In Kakwa and Babette Lakes and connected tributaries.

Location	Gear type	Effort	Total Fish Caught	CPUE (mean \pm SD)	Fulton's condition factor (K)
Kakwa Lake	gill net	12	19	1.43 \pm 1.78	1.02 \pm 0.13
	short-set gill net	12	5	0.20 \pm 0.25	
	angling	92.75 h	51	0.70 \pm 1.177	
Babette Lake	gill net	4	2	0.44 \pm 0.87	1.01 \pm 0.01
	angling	17.75 h	7	0.41 \pm 0.577	
Kakwa River	electrofishing	300	11 with ~20 yoy	31	
Babette Creek	electrofishing	300	46	46	

Mark recapture

A total of 56 fish were marked in Kakwa and 7 in Babette Lakes but none were recaptured and thus a population estimate could not be completed. It became apparent that the number of necessary marks for a population estimate would not be reached due to low catch numbers via angling, thus a lack of recaptures was not unexpected. Additionally, no fish were recaptured while angling further suggesting mark numbers were too low to generate a population estimate.

Biological Metrics

Total fish length varied between sample location and method used (Figure 5). With Kakwa Lake consistently having larger fish, averaging 433 mm and ranging from 188 - 542 mm. Electrofishing had the smallest fish, averaging 62 mm for Kakwa River and 77 mm for Babette Creek. Babette Lake had the smallest sample collected, yielding 9 fish that averaged 238 mm and ranged from 185 - 342 mm.

Length and weight relationships indicated all but two fish from Kakwa were larger than fish from Babette despite using similar sampling methods (Figure 6). Condition factor for all gill netted fish was considered poor on average (Table 3) with some fish considered in fair condition (Barnham and Baxter 1998). Additionally, rainbow trout collected from both lakes were often female (60%) and mature (65%). Stomach contents for 20 fish included invertebrates such as scuds (*Gammaridae*), caddisflies (*Trichoptera*), leeches (subclass Hirudinea) and in one case a mussel (*Unionidae*). During electrofishing,



one juvenile fish was observed to be eating a small fry.

CONCLUSIONS

Preliminary results from this project indicate that Kakwa Lake and its associated tributaries have an established rainbow trout population with a range of size classes and life stages. True to historic records, no other fish species including bull trout were observed during sampling. Data and observations indicate

large mature rainbow trout thrive in Kakwa Lake with ample fry and juveniles in the connected tributaries. In contrast, the few trout collected in Babette Lake were significantly smaller than 95% of fish caught in Kakwa Lake. Although population size could not be determined from the mark recapture efforts, a wealth of knowledge was collected on the populations of stocked rainbow trout in the Kakwa headwaters.

Relative abundance appeared to be low in both lakes based on netting and angling data. Angling catch rates of < 1 fish / angler – h were lower than expected for lakes that receive limited pressure. Overall, these catches are low relative to other alpine lakes where average rates for stocked rainbow trout consisted of 4.9 - 4.3 fish / angler - h (Koenig et al., 2011) and catch rates for introduced brook trout in Gran Paradiso National Park lakes reached 12.8 fish / angler - h (Tiberti et al., 2017). Low angling rates could partially be due to the high clarity of both Babette and Kakwa Lakes causing fish to be low in the water column or to be spooked by anglers.

Unlike angling and gill netting, electrofishing CPUE was relatively high and caught predominantly juveniles and fry. Catch rates were higher (> 30 fish / 300 m) compared to native bull trout CPUE (average 0.84 fish / 300 m) below the falls. While rainbow trout electrofishing catch rates were higher than those for bull trout in the Kakwa, catches of non-native rainbow below Long Lake were higher than tributaries here (46 – 89 fish / 300 m vs. 31 - 46 fish / 300 m).

Kakwa and Babette Lakes appear to be oligotrophic with no thermocline and a thorough mixing of oxygen throughout all depths. It should be noted temperature and oxygen were sampled in the summer and likely changes depending on season. Of the two lakes, Kakwa appeared to have higher productivity with an greater observed presence of aquatic vegetation, fish and macroinvertebrates. Additionally, Kakwa Lake has access to two tributaries that, based on the electrofishing results, appear to be ideal habitat for spawning and early rearing. This study indicates that Kakwa Lake is an ideal habitat for cold-water trout species.

Overall, rainbow trout have managed to establish a population within Kakwa Lake since their initial stocking in the early 1980's. This is not surprising given the ideal cold-water temperatures, presence of groundwater, gravel substrate for spawning, highly oxygenated water and tributaries supporting fry and juveniles. While catches were low in both lakes, there appeared to be good recruitment. Lower CPUE could be a product of a number of factors including: 1) rainbow trout are still establishing in these



systems and have not reached carrying capacity as this is only 42 years since initial stocking, or, 2) the system has lower productivity and temperatures than this strain of rainbow trout is adapted for.

The results of this study fill an important data gap in the waters above Kakwa Falls and help understand the presence and distribution of non-native rainbow trout below Kakwa Falls. These data also aid in filling out decision frameworks for the possible introduction of native species below the falls (i.e., bull trout, Galloway et al. 2016). Data from this work is publicly accessible through Alberta's Fish and Wildlife Management System (FWMIS) and British Columbia's Fish and Fish Habitat Database.

ACKNOWLEDGMENTS

This project was funded by FRIAA (FRI-24-04) with associated support from Canfor, Weyerhaeuser and West Fraser. Samples were collected under a Parks Use Permit from the Ministry of Environment and Parks Conservation and Recreation Division BC Parks No. 112560 and a fish collection permit from the BC Recreational Fisheries & Wildlife Program No. FJ25-951364.

Special thanks to Heather Gauthier and Cody Knack from Alberta Environment and Protected Areas staff, along with Parker Makkreel, Sam Chevalier, Benjamin Kissinger and Claire Allore for planning and execution of field work. Adam Shular at Gemini Heli for flights. Additional thanks to Kakwa camp hosts (Paul and Kim). Special thanks to Reece Legault, Desirae McMurray, James Morgan, and Adrian Batho from BC Ministry of Environment and Parks for assistance with logistics and permits.



FIGURES

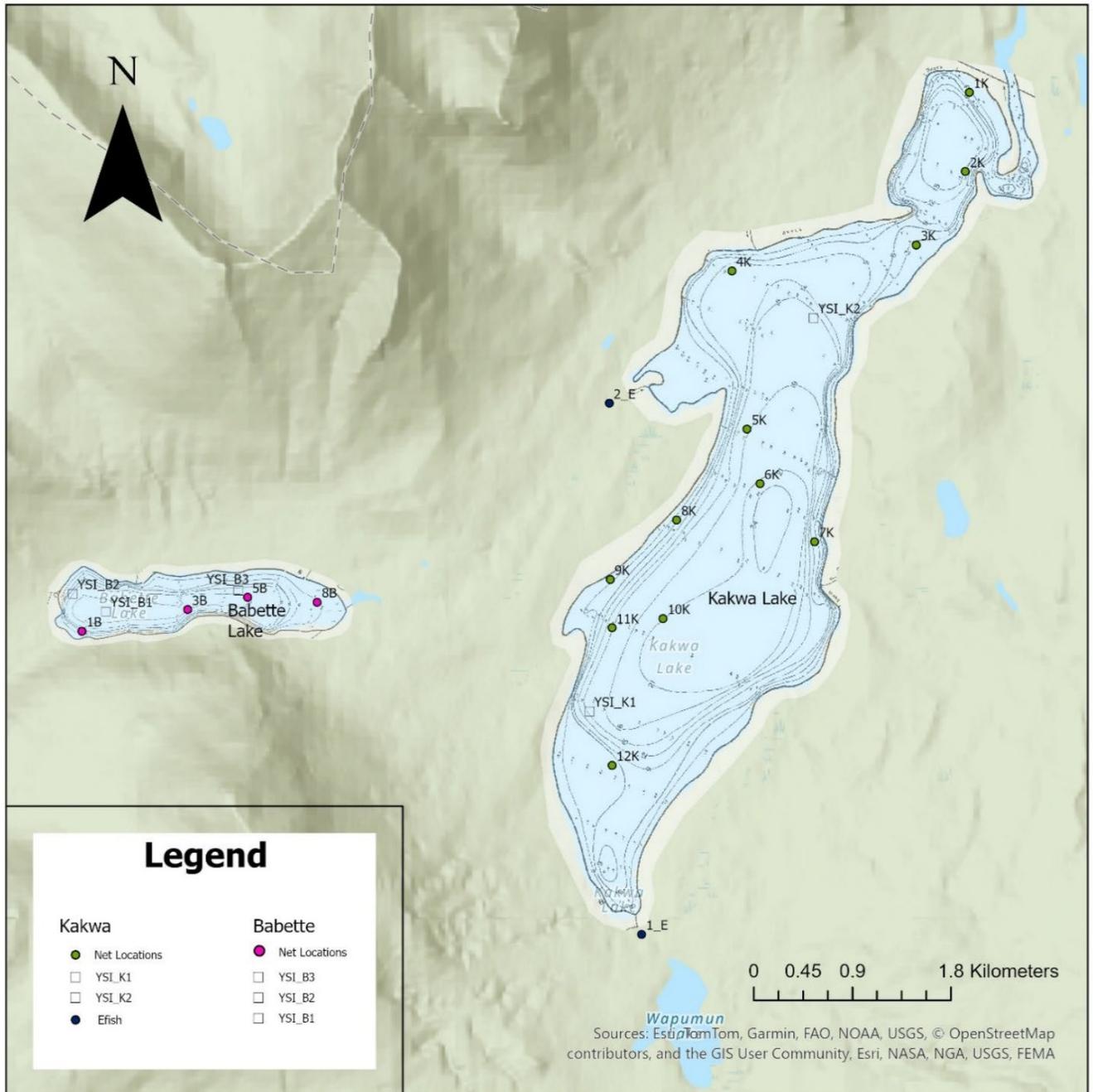


Figure 3. Net locations and electrofishing sites in Kakwa and Babette Lakes.



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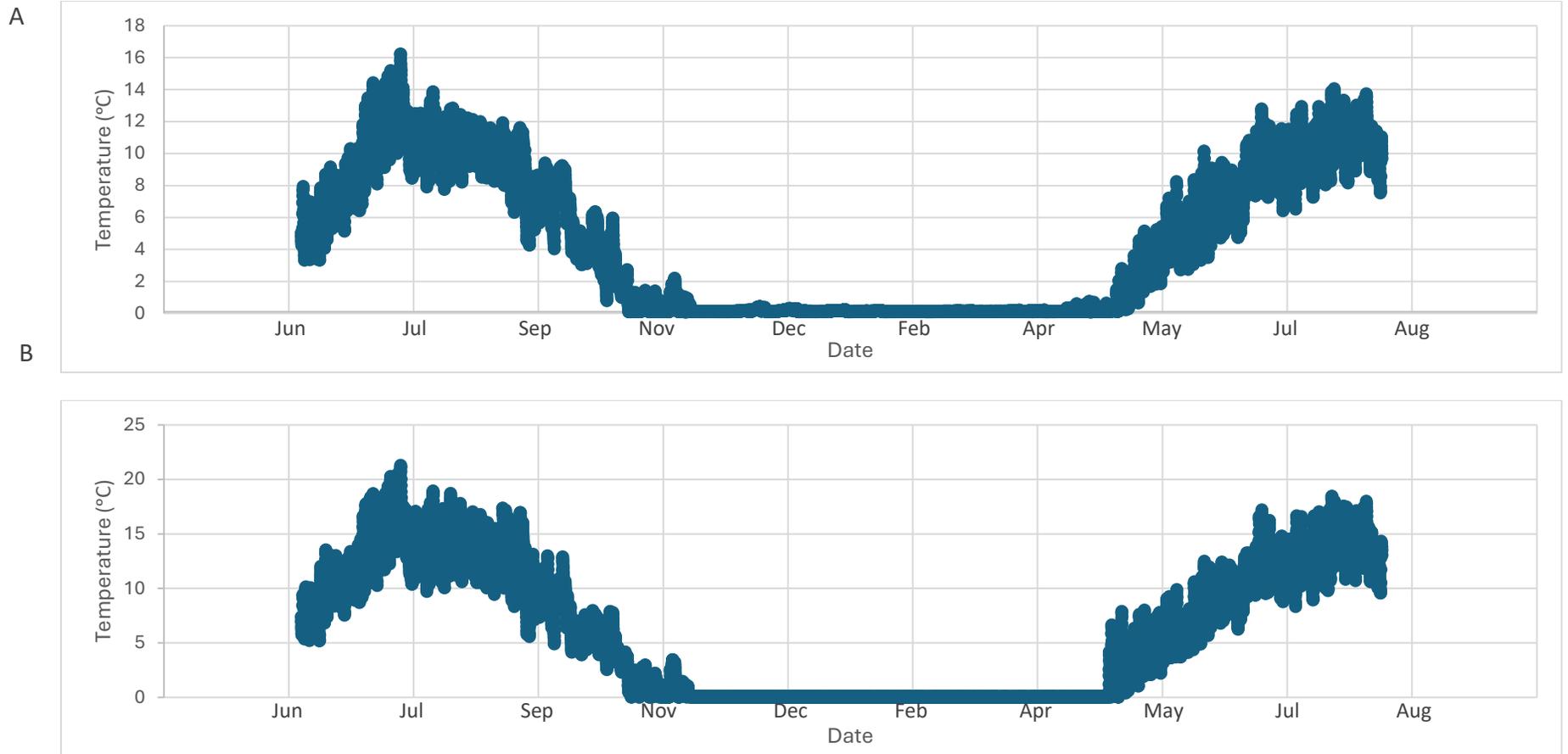


Figure 4. Hourly temperature profiles for water upstream of Kakwa Falls from June 2024 to August 2025 a) site 124 on a Kakwa River tributary b) site 125 directly on Kakwa River



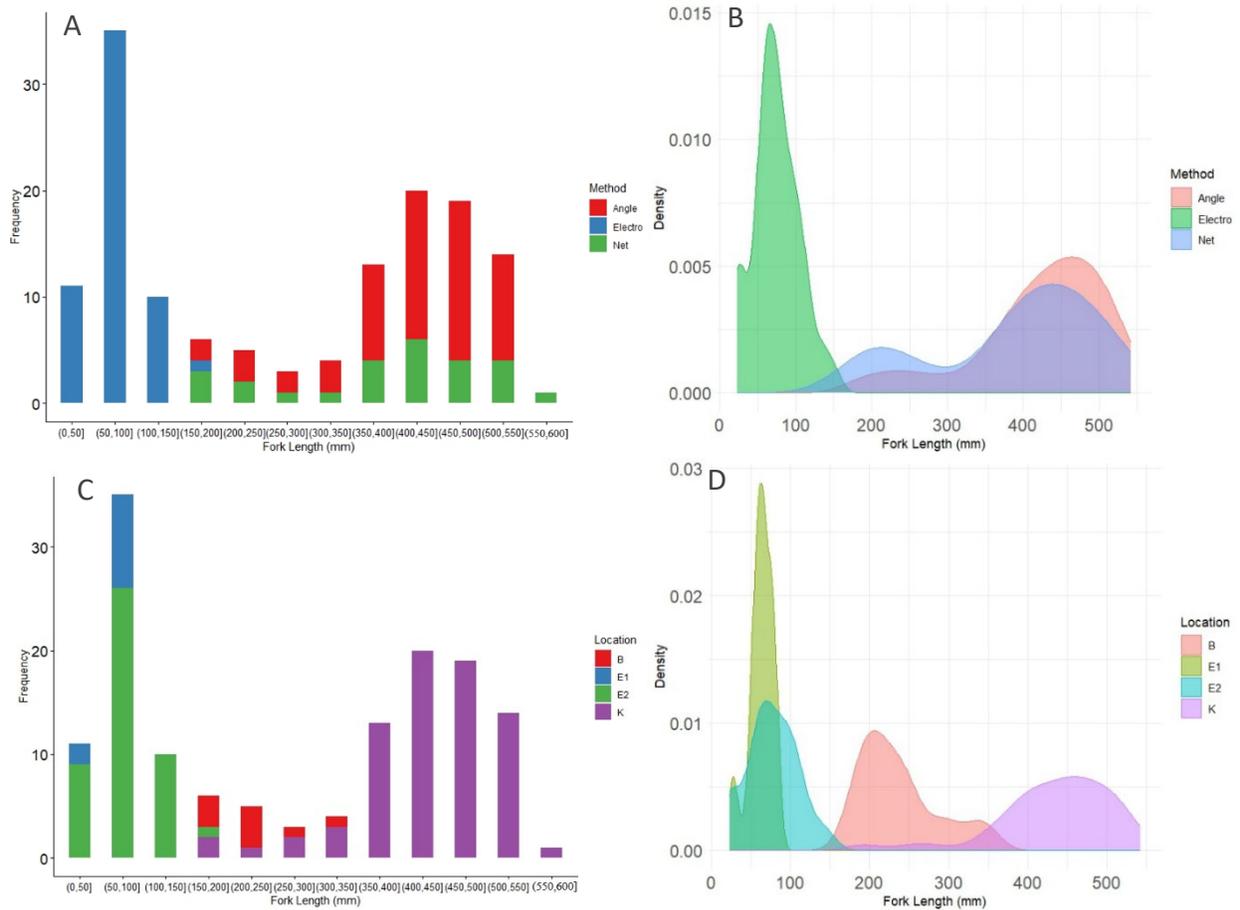


Figure 5. Frequency and density of rainbow trout fork lengths (mm) based on method and location. A) frequency distribution (binned by 50 mm increments) of fork lengths for three methods :angling, electrofishing and gill netting, B) fork length density distribution for three fishing methods, C) frequency distribution (binned by 50 mm increments) of fish fork lengths for four locations: Babette Lake (B), Kakwa River tributary (E1), Babette Creek tributary (E2), and Kakwa Lake (K), and D) fork length density distribution for four locations.



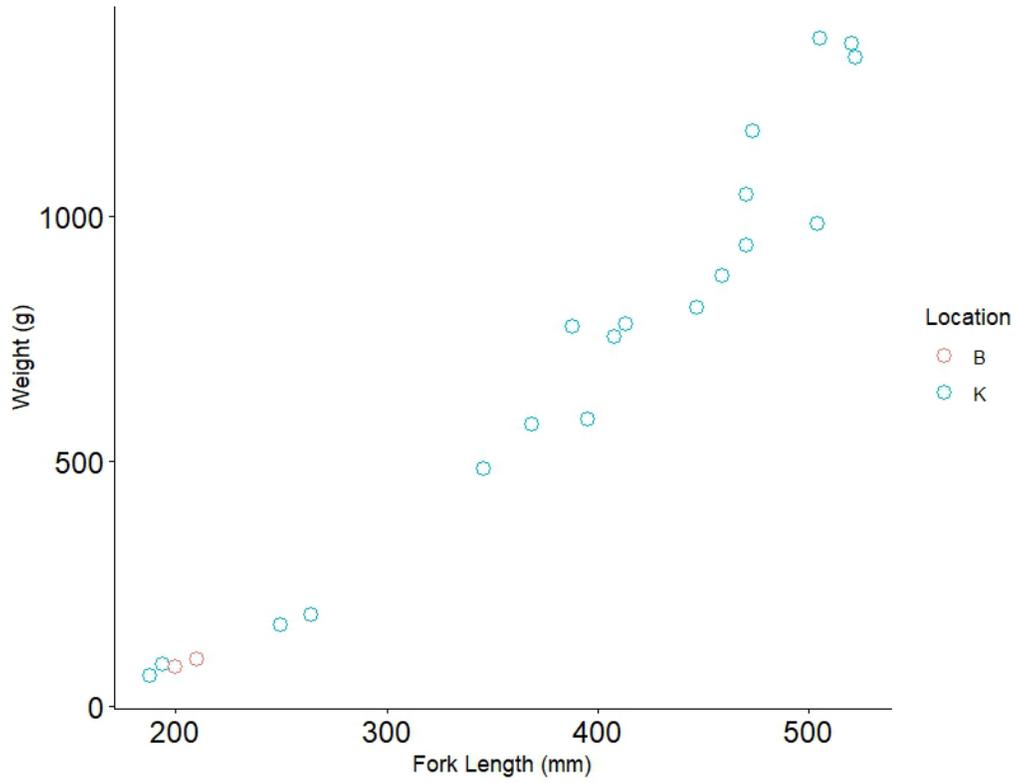


Figure 6. Weight (g) and fork length (mm) of rainbow trout caught via gill net in Babette (B) and Kakwa (K) lakes.



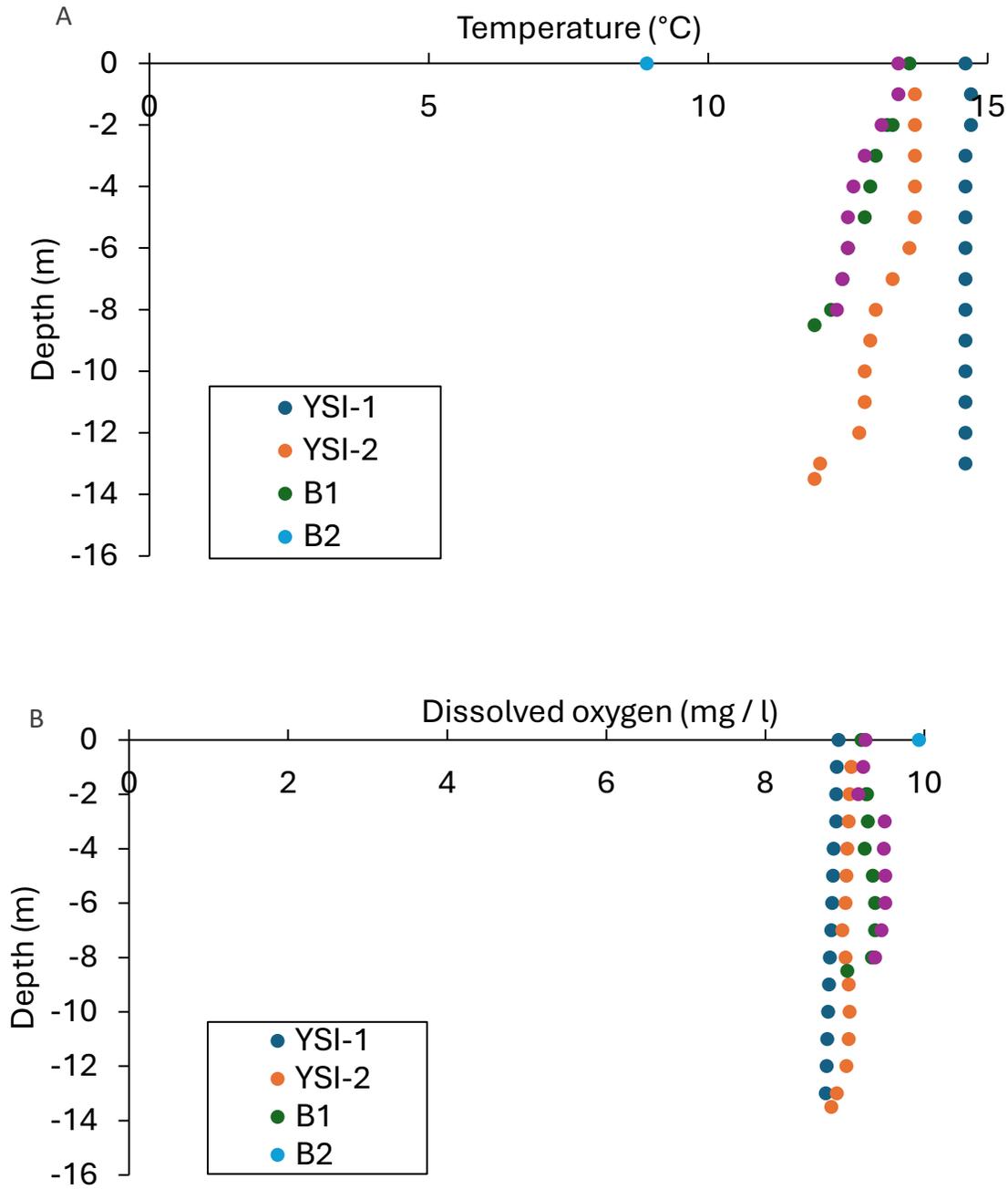


Figure 7. Water profile of A) temperature (°C) and B) dissolved oxygen (mg/L) for Babette Lake (B1, B2, B3) and Kakwa Lake (YSI-1, YSI-1).



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