Site C Clean Energy Project

Peace River Fish Community Monitoring Program (Mon-2)

Task 2a – Peace River Large Fish Indexing Survey

Construction Year 5 (2019)

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REPORT

Peace River Large Fish Indexing Survey

2019 Investigations (Mon-2, Task 2a)

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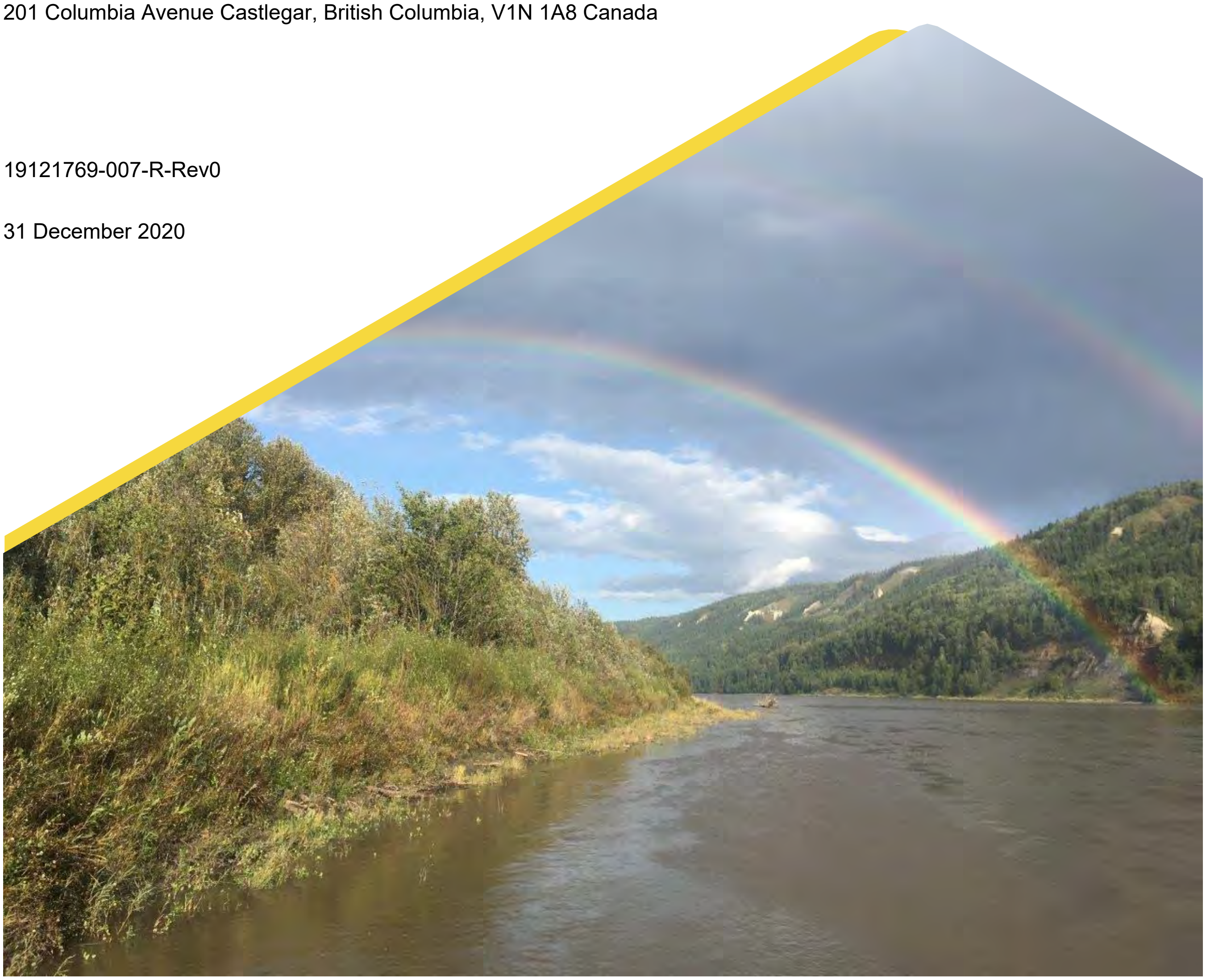

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Executive Summary

The Site C Clean Energy Project (the Project), including Project construction, reservoir filling, and operation, could affect fish and fish habitat via three key pathways: changes to fish habitat (including nutrient concentrations and lower trophic biota), changes to fish health and fish survival, and changes to fish movement. These pathways are examined in detail in Volume 2 of the Project's Environmental Impact Statement (EIS; BC Hydro 2013). The EIS makes both qualitative and quantitative predictions of fish production in the Peace River downstream of the Project.

Quantitative predictions of fish biomass downstream of the Project were generated as part of the EIS. For these predictions, each fish species was assigned to one of four groups: Group 1 consisted of large-bodied fish typically targeted by anglers (i.e., Burbot [*Lota lota*], Goldeye [*Hiodon alosoides*], Lake Trout [*Salvelinus namaycush*], Northern Pike [*Esox lucius*], Rainbow Trout [*Oncorhynchus mykiss*], and Walleye [*Sander vitreus*]); Group 2 included species considered "passage sensitive" (i.e., Arctic Grayling [*Thymallus arcticus*], Bull Trout [*Salvelinus confluentus*], and Mountain Whitefish [*Prosopium williamsoni*]); Group 3 included planktivorous species (i.e., Kokanee [*Oncorhynchus nerka*] and Lake Whitefish [*Coregonus clupeaformis*]); and Group 4 fish consisted of all remaining species (i.e., Northern Pikeminnow [*Ptychocheilus oregonensis*], sucker species, and small-bodied fish species). Relative to pre-Project estimates, the EIS predicted decreased biomass of Group 1 fishes over the short- (10 years) and long-term (greater than 30 years), increased biomass of Group 2 fishes over the short- and long-term, similar biomasses of Group 3 fishes over the short- and long-term, and decreased biomass of Group 4 fishes over the short- and long-term.

The objective of the Peace River Large Fish Indexing Survey (hereafter, Indexing Survey) is to validate EIS predictions and address uncertainties identified in the EIS regarding the Project's effects on fish in the Peace River. The status of the Indexing Survey's progress towards testing each of the applicable hypotheses listed in BC Hydro's Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP; BC Hydro 2015a) is presented in Table E1.

The Indexing Survey was initiated in 2015 and has been conducted annually (Golder and Gazey 2016, 2017, 2018, 2019). It is the continuation and expansion of two previous programs conducted using similar methods. These included BC Hydro's Large River Fish Indexing Program (2001–2007; P&E 2002; P&E and Gazey 2003; Mainstream and Gazey 2004–2008) and the Peace River Fish Index (2008–2014; Mainstream and Gazey 2009–2014; Golder and Gazey 2015).

In 2019, sampling for the Indexing Survey was conducted in six different sections of the Peace River mainstem: Section 1 near the town of Hudson's Hope, BC; Section 3 downstream of the Halfway River's confluence with the Peace River; Section 5 immediately downstream of the Site C dam site area; Section 6 downstream of the Pine River's confluence with the Peace River; Section 7 downstream of the Beatton River's confluence with the Peace River; and Section 9 in the Many Islands area in Alberta. Section 2 (the Farrell Creek area), Section 4 (the Wilder Creek area), and Section 8 (the Pouce Coupe River area) were not sampled as part of the Indexing Survey; however, small portions of Section 8 were sampled during the Goldeye and Walleye Survey detailed below. All large-bodied fishes were monitored; however, the monitoring program focused on seven indicator species of most interest to regulatory agencies, comprising the following: Arctic Grayling, Bull Trout, Burbot, Goldeye, Mountain Whitefish, Rainbow Trout, and Walleye. Fish were captured by boat electroshocking and measured for length and weight. Ageing structures were collected from most fish, and indicator species were marked with half-duplex (HDX) passive integrated transponder (PIT) tags. For species with sufficient capture-recapture data, population abundance was estimated using a Bayes sequential model (conducted by W.J. Gazey Research). Catch rates were used to assess changes in relative abundance for all species. Other fish population metrics analyzed included length-at-age, body condition, and relative weight. These metrics were compared to results from 2002 to 2018 and to select environmental parameters. In 2019, these parameters were limited to Peace River discharge and water temperature values; however, the list of parameters tested could be expanded during subsequent study years to include those deemed most likely to influence local fish populations (e.g., primary or secondary productivity, recreational angling pressure, water quality).

In response to low Goldeye catch during the Indexing Surveys from 2015 to 2017, the Goldeye and Walleye Survey was implemented in the spring and summer of 2018 to increase Goldeye catch. The Goldeye and Walleye Survey was repeated in 2019. While initially intended to target both Goldeye and Walleye, the survey was implemented specifically to increase Goldeye catch; Walleye catch during the preceding Indexing Surveys was sufficient to adequately monitor this species. The Goldeye and Walleye Survey consisted of boat electroshocking surveys near the confluences of select Peace River tributaries (Six Mile and Eight Mile creeks, and the Alces, Beatton, Clear, Kiskatinaw, and Pouce Coupe rivers) that were known or suspected feeding areas for Goldeye. Goldeye are seasonal residents that migrate upstream into the study area in the early spring to spawn. After spawning, Goldeye remain near the confluences of select tributaries to feed until water clarity increases, at which time, they migrate downstream to more turbid locations. The objective of the Goldeye and Walleye Survey was to catch these fish prior to their downstream migration. In 2019, the Goldeye and Walleye Survey was conducted in June and July.

Overall, results from 2019 indicated a stable fish population in the Peace River, with most species metrics falling within the ranges of values recorded during previous study years. Key results from the 2019 survey, which was conducted between 14 June and 4 July (Goldeye and Walleye Survey) and between 20 August and 14 October (Indexing Survey), as well as key trends observed over the 18-year monitoring period are summarized as follows:

- In 2019, water levels in the Peace River were within historical bounds (2002–2018) for most of the year but were substantially below average values from approximately mid-March to mid-October. Discharge was variable between mid-July and mid-September and increased from near historic lows to near historic highs during the latter half of the 2019 study period.
- In 2019, water temperatures in the Peace River were similar to historical averages for most of the year in most sections.
- Arctic Grayling abundance in Section 3 was estimated at 75 individuals and substantially below the 2018 estimate for this section (*n* = 998); however, the 2018 estimate had wide credible intervals. The 2019 estimate was similar to estimates generated in 2016 and 2017 for this species. Abundance in other sections could not be determined due to a lack of recaptured individuals. Overall, Arctic Grayling abundance is much lower than historical highs (i.e., approximately 3500 individuals in 2009). Catch rate data track closely with abundance estimates and suggest stable Arctic Grayling abundance in recent (i.e., 2012 to 2019) study years. Catch included increased numbers of age-0 and age-1 fish, particularly in Sections 6 and 7.

- Overall, neither population abundance estimates nor catch-per-unit-effort suggested substantial or sustained changes in the abundance of Bull Trout between 2002 and 2019. Bull Trout population abundance estimates could only be generated for Sections 1 and 3 in 2019; however, the overall pattern of distribution among sections was consistent with previous study years.
- Age-related analyses for Bull Trout were limited to fish whose ages could be assigned based exclusively on fork length (i.e., individuals less than 240 mm FL) and recaptured during subsequent years. The dataset was supplemented with length-at-age data collected under other FAHMFP components and Site C baseline studies where possible. Age analyses for these known-aged fish indicate a substantial change in Bull Trout growth rate at age-3, which aligns with their migration from rearing tributaries to the Peace River mainstem. The number of older individuals in the dataset is expected to grow as more inter-year recaptured fish are encountered and as more immature fish, initially tagged in Peace River tributaries, migrate to the Peace River mainstem.
- High Bull Trout condition noted in 2018 (K = 1.02) was not apparent in 2019 (K = 0.99). The 2019 estimate was similar to values recorded in 2015 and 2016 (average K = 0.99). During most study years, body condition estimates were greater for Section 1 (approximately 1.02 to 1.15) than the other sections (approximately 0.95 to 1.08).
- Between 2002 and 2019, Burbot catch ranged between 0 and 47 individuals. Burbot catch was substantially higher in 2016 (n = 37) and 2019 (n = 47). Burbot favour turbid water and the anomalously higher catch in 2016 and 2019 may have been due, in part, to higher water turbidity levels in the downstream sections during the 2016 (33 cm average Secchi depth for Sections 6, 7, and 9 combined) and 2019 (36 cm average Secchi depth for Sections 6, 7, and 9 combined) study periods compared to other study years when sampling was conducted in these sections (90 cm average Secchi depth for 2015, 2017, and 2018 combined).
- Population abundance estimates and catch rate data for Largescale Sucker (*Catostomus macrocheilus*) in 2019 were similar to previous study years, suggesting a stable population over the long-term. All estimates (years and sections) were uncertain due to wide credible intervals. Largescale Sucker were only PIT-tagged from 2015 to 2019.
- Longnose Sucker (*Catostomus catostomus*) population abundance estimates and catch rate data both suggest a declining population between 2015 and 2019. Reasons for the apparent decline are not known.
- Fourteen Goldeye were captured during the 2019 Indexing Survey, more than all previous surveys combined. Goldeye were not recorded prior to the 2015 Indexing Survey. All Goldeye were captured in Section 9.
- Overall (all sections combined), the population abundance of Mountain Whitefish in 2019 was estimated at 62,742 individuals and was similar to 2017 estimates for all sections (n = 55,113 individuals). Estimates from 2018 were higher in all sections (n = 81,862 individuals). There was some overlap in credible intervals between estimates. Overall (all years combined), the Mountain Whitefish population in the Peace River has been generally stable since 2002, with the exception of a notable increase in 2010 that was due to strong recruitment from the 2007 brood year (i.e., spawning in fall 2006).

- Results indicate that changes to electroshocker settings first implemented in 2014 have resulted in differences in selectivity for Mountain Whitefish, with relatively more small fish (i.e., fish less than 250 mm FL) and fewer large fish being caught from 2014 to 2019.
- The Rainbow Trout catch in 2019 (*n* = 157) was within the range of catches recorded between 2015 and 2018 (range = 122 to 186). Rainbow Trout are more common (i.e., higher catch rates and represent a higher portion of the catch) in upstream sections, and are rarely recorded in downstream sections, which have only been sampled since 2015. Additional years of data are required to adequately identify long-term trends for this species.
- In 2019, Walleye abundance was estimated only for Section 7 (*n* = 2028). In the three years that abundance has been estimated for Walleye in Section 7, values have ranged from a low of 1299 individuals (in 2017) to a high of 2028 individuals in 2019. Insufficient data prevented the generation of abundance estimates for Walleye for most sections during most study years. Catch rate data suggest increasing Walleye abundance between 2015 and 2018, and declining abundance between 2018 and 2019.
- In its current form, the Indexing Survey is unlikely to yield high enough catches to produce reliable estimates of absolute abundance that are precise enough to detect changes over time for Burbot, Goldeye, Northern Pike, Rainbow Trout, Walleye, and White Sucker (*Catostomus commersonii*). For these species, catch rate data will be used to identify effects of the Project.
- In total, 261 radio telemetry tags were deployed into Arctic Grayling (n = 38), Bull Trout (n = 85), Burbot (n = 18), Rainbow Trout (n = 56), and Walleye (n = 64) in support of the FAHMFP. These tags were deployed into fish captured throughout the study area.

Data collected from 2002 to 2020 will represent the baseline, pre-Project state of the Peace River fish community. Management hypotheses will be statistically tested after the river diversion phase of construction (i.e., after 2020).

Table E1: Status of Peace River Large Fish Indexing Survey hypotheses after 2019 (Mon-2, Task 2a).

Mon-2 Management Question	Management Hypotheses Relevant to Task 2a	2019 Status
How does the Project affect fish in the Peace River between the Project and the Many Islands area in Alberta during the short (10 years after Project operations begin) and longer (30 years after Project operations begin) term?	**H_1:** Post-Project total fish biomass in the Peace River between the Project and the Many Islands area in Alberta will be less than pre-Project conditions (current = 37.42 t; at 10 years of operations = 30.78 t; >30 years of operations = 30.79 t).	The hypothesis has not been tested. Methodologies employed under Task 2a have been similar to those employed during pre-Project baseline studies. Data collected to date are consistent with baseline data and should allow comparisons between pre-Project data and data collected during construction and operation. Higher statistical certainty occurs with species with higher catch rates.
	H_2: Post-Project harvestable fish biomass in the Peace River between the Project and the Many Islands area in Alberta will be greater than pre-Project estimates of harvestable fish biomass (current = 13.93 t; at 10 years of operations = 18.77 t; >30 years of operations = 18.78 t).	The hypothesis has not been tested. Methodologies employed under Task 2a have been similar to those employed during pre-Project baseline studies. Data collected to date are consistent with baseline data and should allow comparisons between pre-Project data and data collected during construction and operation.
	H_3: Post-Project biomass of each fish species in the Peace River between the Project and the Many Islands area in Alberta will be consistent with biomass estimates in the EIS.	The hypothesis has not been tested. Methodologies employed under Task 2a have been similar to those employed during pre-Project baseline studies. Data collected to date are consistent with baseline data and should allow comparisons between pre-Project data and data collected during construction and operation for most fish species. For less common indicator species, most notably Burbot and Goldeye, it is likely that detecting changes in abundance or biomass will rely on indices such catch rate, as the survey in its current format is unlikely to generate precise abundance estimates from capture-recapture data.

Mon-2 Management Question	Management Hypotheses Relevant to Task 2a	2019 Status
	H_4: Changes in post-Project fish community composition in the Peace River between the Project and the Many Islands area in Alberta will be consistent with EIS predictions.	The hypothesis has not been tested. To date, diversity profiles show distinct differences in fish community structure between sample sections and in its current format, the survey is expected to provide data capable of testing this hypothesis.
	H_5: The fish community can support angling effort that is similar to baseline conditions.	The hypothesis has not been tested. The survey, in its current format, is expected to generate species abundance estimates of most harvestable fish species. These estimates, in conjunction with angling pressure data generated by the Peace River Creel Survey (Mon-2, Task 2c), will be used to test the hypothesis.

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
ADMB	AD Model Builder
AIC	Akaike's Information Criterion
CJS	Cormack-Jolly-Seber
DELT	Deformities, Erosion, Lesions, and Tumor
EAC	Environmental Assessment Certificate
EIS	Environmental Impact Statement
FAHMFP	Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program
FDS	Federal Decision Statement
FDX	Full-Duplex
GPP	Generator Powered Pulsator
HDX	Half-Duplex
HPD	Highest Probability Density
HSD	Honest Significant Difference
Indexing Survey	Peace River Large Fish Indexing Survey
Mon-2	Peace River Fish Community Monitoring Program
PCD	Peace Canyon Dam
PIT	Passive Integrated Transponder
Project	Site C Clean Energy Project
PUP	Park Use Permit
SIA	Stable Isotope Analysis
WLR	Water License Requirements

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1.0 INTRODUCTION

Potential effects of the Site C Clean Energy Project (the Project) on fish[1] and fish habitat[2] are described in Volume 2 of the Project's Environmental Impact Statement (EIS) as follows[3]:

> The Project has the potential to affect fish habitat in two ways. The Project may destroy fish habitat by placing a permanent physical structure on that habitat, or the Project may alter fish habitat by changing the physical or chemical characteristics of that habitat in such a way as to make it unusable by fish. Destruction or alteration of important habitats may be critical to the sustainability of a species population.
>
> The Project may affect fish health and survival. It may cause direct mortality of fish or indirect mortality of fish by changing system productivity, food resource type and abundance, and environmental conditions on which fish depend (e.g., water temperature).
>
> The Project may affect fish movement by physically blocking upstream and downstream migration of fish or by causing water velocities that exceed the swimming capabilities of fish, which results in hindered or blocked upstream migration of fish. Blocked or hindered fish movement has consequences to the species population. Fish may not be able to access important habitats in a timely manner or not at all (e.g., spawning habitats). Blocked fish movement may result in genetic fragmentation of the population.

Condition No. 7 of the Project's Provincial Environmental Assessment Certificate (EAC), Schedule B states the following:

> The EAC Holder must develop a Fisheries and Aquatic Habitat Monitoring and Follow-up Program [FAHMFP] to assess the effectiveness of measures to mitigate Project effects on healthy fish populations in the Peace River and tributaries, and, if recommended by a QEP [Qualified Environmental Professional] or FLNRO [BC Ministry of Forests, Lands and Natural Resource Operations], to assess the need to adjust those measures to adequately mitigate the Project's effects.

Furthermore, the Project's Federal Decision Statement (FDS) states that a plan should be developed that addresses the following:

> Condition No. 8.4.3: an approach to monitor changes to fish and fish habitat baseline conditions in the Local Assessment Area (LAA); and
>
> Condition No. 8.4.4: an approach to monitor and evaluate the effectiveness of mitigation or offsetting measures and to verify the accuracy of the predictions made during the environmental assessment on fish and fish habitat.

The Peace River Large Fish Indexing Survey (hereafter Indexing Survey) is designed to provide supporting data to address the EAC and FDS conditions detailed above. Specifically, the Indexing Survey represents Task 2a of the Peace River Fish Community Monitoring Program (Mon-2) within the FAHMFP (BC Hydro 2015a). The intent of the Indexing Survey is to "monitor the response of large-bodied fish species in the Peace River to the Project" (BC Hydro 2015a).

For the EIS, each large-bodied fish species was assigned to one of three groups (Golder et al. 2012): Group 1 fishes included species typically targeted by anglers (i.e., Burbot [*Lota lota*], Goldeye [*Hiodon alosoides*], Lake Trout [*Salvelinus namaycush*], Northern Pike [*Esox lucius*], Rainbow Trout [*Oncorhynchus mykiss*]), Group 2 fishes included species considered "passage sensitive" (i.e., Arctic Grayling [*Thymallus arcticus*], Bull Trout [*Salvelinus confluentus*], Mountain Whitefish [*Prosopium williamsoni*]), and Group 3 fishes included planktivorous species (i.e., Kokanee [*Oncorhynchus nerka*] and Lake Whitefish [*Coregonus clupeaformis*]). The three Peace

[1] Fish includes fish abundance, biomass, composition, health, and survival.
[2] Fish habitat includes water quality, sediment quality, lower trophic levels (periphyton and benthic invertebrates), and physical habitat.
[3] EIS, Volume 2, Section 12.1.2 (BC Hydro 2013).

River sucker species (i.e., Largescale Sucker [*Catostomus macrocheilus*], Longnose Sucker [*Catostomus catostomus*], and White Sucker [*Catostomus commersonii*]), Northern Pikeminnow[4] [*Ptychocheilus oregonensis*], and all small-bodied fish species were considered Group 4.

The Indexing Survey will monitor the response of all large-bodied fish species to the Project over the short term (10 years after Project operations begin) and longer term (30 years after the Project operations begin), but focuses on collecting data that quantify the relative and absolute abundances and spatial distribution of seven indicator species. The seven indicator species include Arctic Grayling, Bull Trout, Burbot, Goldeye (*Hiodon alosoides*), Mountain Whitefish, Rainbow Trout, and Walleye (*Sander vitreus*). These species were identified in local provincial management objectives (BC Ministry of Environment 2009; BC Government 2011) as species of interest to recreational anglers and harvested by Aboriginal groups, and were the focus of the Project's EIS effects assessment (BC Hydro 2013).

In 2008, BC Hydro implemented the Peace River Fish Index (GMSMON-2), an annual program designed to monitor Arctic Grayling, Bull Trout, and Mountain Whitefish populations in the Peace River downstream of Peace Canyon Dam (PCD) and their responses to instream physical works designed to improve fish habitat in select side channel areas (Mainstream and Gazey 2009–2014; Golder and Gazey 2015). Data collected under GMSMON-2 and its predecessor, the Peace River Fish Community Indexing Program (P&E 2002; P&E and Gazey 2003; Mainstream and Gazey 2004–2008), provide a continuous dataset for the fish community within the study area beginning in 2001 that can be compared to data collected during the current monitoring program (Golder and Gazey 2016–2019). Changes in methodologies, objectives, and study areas over 18 years of sampling limits the compatibility of some aspects of the dataset.

In 2019, the program collected various biological samples from select fish for potential analysis. These included tissue samples for stable isotope analysis (SIA), genetic, and mercury analyses, and hard structure samples (i.e., fin rays or otoliths) for microchemistry analysis. All samples were provided to BC Hydro and will be used to further characterize Peace River fish populations by other components of the FAHMFP. The analysis and interpretation of these samples is not discussed in this report.

Field crews implanted radio telemetry tags into some Arctic Grayling, Bull Trout, Burbot, Rainbow Trout, and Walleye captured during the Indexing Survey. These fish were implanted with radio telemetry tags to support the FAHMFP; however, the analysis and interpretation of telemetry data is not discussed in this report.

Field crews collected additional data at some sites to support offset effectiveness monitoring (Mon-2, Task 2d of the FAHMFP) related to the Project (BC Hydro 2015b, 2015c). Results associated with offset effectiveness monitoring are not presented or discussed in this report but are available under separate cover (Golder 2020).

[4] EIS, Volume 2, Section 12.3.2.2 (BC Hydro 2013).

1.1 Key Management Question

The overarching management question for the Peace River Fish Community Monitoring Program is as follows:

1) How does the Project affect fish in the Peace River between the Project and the Many Islands area in Alberta during the short (10 years after Project operations begin) and longer (30 years after Project operations begin) term?

1.2 Management Hypotheses

The Peace River Fish Community Monitoring Program's overarching management question will be addressed by testing a series of management hypotheses using predictions made in the Project's EIS. These predictions are summarized in Mon-2 of the FAHMFP as presented in the Table 1.

Table 1: Short and longer term predictions of fish biomass (metric tonnes - t) for pre- and post-Project conditions for the Peace River from the Project to the Many Islands area in Alberta. Fish biomass is presented for the "Most Likely" scenario (plus a minimum to maximum range). Data were summarized from Mon-2 of the FAHMFP (BC Hydro 2015a).

Species Group	Species Name	Pre-Project Biomass (t)	Post-Project Biomass (t)			
			Short Term (in 10 Years)		Longer Term (> 30 Years)	
			Most Likely	Range	Most Likely	Range
1	Walleye	3.38	1.69	0.34–1.69	1.69	0.34–1.69
	Lake Trout	0.00	0.00	0.00–0.01	0.00	0.00–0.01
	Rainbow Trout	0.17	0.35	0.17–0.35	0.35	0.17–0.35
	Northern Pike	0.74	0.37	0.37–0.74	0.37	0.37–0.74
	Burbot	0.10	0.05	0.01–0.05	0.05	0.01–0.05
Group 1 Subtotal		**4.39**	**2.46**	**0.89–2.83**	**2.46**	**0.89–2.83**
2	Bull Trout	1.49	1.23	1.23–2.54	1.23	1.23–2.54
	Arctic Grayling	0.64	0.32	0.06–0.64	0.32	0.06–0.64
	Mountain Whitefish	7.38	14.74	14.74–14.74	14.74	14.74–14.74
Group 2 Subtotal		**9.50**	**16.29**	**16.03–17.91**	**16.29**	**16.03–17.91**
3	Kokanee	0.03	0.01	0.00–0.02	0.03	0.01–0.04
	Lake Whitefish	0.00	0.01	0.00–0.01	0.00	0.00–0.01
Group 3 Subtotal		**0.03**	**0.02**	**0.01–0.03**	**0.03**	**0.01–0.04**
Total Harvestable Fish Biomass		**13.93**	**18.77**	**16.94–20.78**	**18.78**	**16.94–20.79**
4	Sucker Species	21.74	10.87	10.87–10.87	10.87	10.87–10.87
	Small-bodied Fish	0.87	0.70	0.43–0.87	0.70	0.43–0.87
	Northern Pikeminnow	0.87	0.44	0.26–0.52	0.44	0.26–0.52
Group 4 Subtotal		**23.49**	**12.01**	**11.57–12.27**	**12.01**	**11.57–12.27**
Total Fish Biomass		**37.42**	**30.78**	**28.50–33.05**	**30.79**	**28.50–33.06**

Management hypotheses detailed within the Peace River Fish Community Monitoring Program that will be tested using data collected during the Indexing Survey are as follows:

H_1: Post-Project total fish biomass in the Peace River between the Project and the Many Islands area in Alberta will be less than pre-Project conditions (current = 37.42 t; at 10 years of operations = 30.78 t; >30 years of operations = 30.79 t).

H_2: Post-Project harvestable fish biomass in the Peace River between the Project and the Many Islands area in Alberta will be greater than pre-Project estimates of harvestable fish biomass (current = 13.93 t; at 10 years of operations = 18.77 t; >30 years of operations = 18.78 t).

H_3: Post-Project biomass of each fish species in the Peace River between the Project and the Many Islands area in Alberta will be consistent with biomass estimates in the EIS.

H_4: Changes in post-Project fish community composition in the Peace River between the Project and the Many Islands area in Alberta will be consistent with EIS predictions.

H_5: The fish community can support angling effort that is similar to baseline conditions.

1.3 Study Objectives

The objective of the Indexing Survey is to validate predictions and address uncertainties identified in the EIS regarding the Project's effects on fish in the Peace River and to assess the effectiveness of fish and fish habitat mitigation measures. The purpose of the Indexing Survey is to monitor the response of large-bodied fish species in the Peace River to the construction and operation of the Project. The Indexing Survey will incorporate data previously collected during BC Hydro's WLR (Water License Requirements) Peace River Fish Index (GMSMON-2) and its predecessor, the Peace River Fish Community Indexing Program.

Field work for the Indexing Survey was conducted from late summer to early fall (i.e., mid-August to early October). Sampling was conducted during this time period for several reasons, including ensuring compatibility with historical datasets (e.g., Golder and Gazey 2018), increasing sampling efficiency by sampling when turbidity is typically low, and reducing potential sampling effects to Bull Trout by sampling when spawning Bull Trout are not present in the Peace River mainstem (i.e., when they are spawning in select tributaries). The mid-August to early October study period for the Indexing Survey occurs after most Goldeye and Walleye migrate downstream out of the study area. As such, Mon-2 included contingent sampling for these species as follows:

> If catch data from [2016] and [2017] suggest that the mid-August to late September time period will not yield sufficient data to monitor the Peace River Goldeye and Walleye populations (i.e., if less than 20 Goldeye or Walleye are captured during either study year), an additional field program will be implemented beginning in [2018] that focuses on these species. This contingent assessment will consist of boat electroshocking in the spring (i.e., mid-May to early June) near the confluences of major Peace River tributaries in Sections 7 and 8 (Mainstream 2012) as data indicate high Goldeye and Walleye catch-rates surrounding most tributary confluences in these sections during the spring season (Mainstream 2013a).

Between 2015 (i.e., the initial study year for the Indexing Survey) and 2018, Walleye catch during all sessions and sections combined averaged 276 individuals and ranged from a low of 116 individuals in 2015 to a high of 389 individuals in 2017. As such, the contingent assessment was not required for this species. However, over the same time period, average Goldeye catch was three individuals and ranged from a low of no catch in 2018 to a high of eight individuals in 2016. Due to the low number of Goldeye encountered between 2015 and 2018, the contingent assessment was implemented in 2019.

1.4 Study Area and Study Period

1.4.1 Indexing Survey

The study area for the Indexing Survey includes an approximately 205 km section of the Peace River from near the outlet of PCD (river kilometre [River Km] 25 as measured downstream from WAC Bennett Dam) downstream to the Many Islands area in Alberta (River Km 230; Figure 1). The spatial extent of the program is consistent with the spatial boundaries for the effects assessment in the EIS, which was guided by physical modelling and fisheries studies.

The mainstem of the Peace River between PCD and the Many Islands area in Alberta was delineated into various sections (Table 2) using information provided by Mainstream (2012). The upstream extent of Section 5 was moved approximately 5 km downstream relative to Mainstream's classification to more closely align with the location of the Project, as described below. The most downstream approximately 2 km of the Pine River was included in the study area and sampled as part of Section 6. The most downstream approximately 0.5 km of the Beatton and Kiskatinaw rivers were included in the study area and sampled as part of Section 7. A summary of historical datasets by section, year, study period, and effort (number of days of sampling) is provided in Appendix B, Table B1.

Table 2: Location and distance from WAC Bennett Dam of Peace River sample sections as delineated by Mainstream (2012) with the exception of Section 5.

Section Number	Location	River Kilometre[a]		Number of Sites Sampled in 2019[c]
		Upstream	Downstream	
1a	Peace River Canyon area	20.4	25.0	0
1	Downstream end of Peace River Canyon to the Lynx Creek confluence area	25.0	34.0	15
2	Lynx Creek confluence area downstream to the Halfway River confluence area	34.0	65.8	0
3	Halfway River confluence area downstream to the Cache Creek confluence area	65.8	82.1	15
4	Cache Creek Confluence area downstream to the Moberly River confluence area	82.1	105.0	0
5[b]	Moberly River confluence area downstream to near the Canadian National Railway bridge	105.0	117.7	15
6	Pine River confluence area downstream to the Six Mile Creek confluence area	121.5	134.0	18
7	Beatton River confluence area downstream to the Kiskatinaw River confluence area	140.0	158.0	19
8	Pouce Coupe River confluence area downstream to the Clear River confluence area	174.0	187.7	0
9	Dunvegan West Wildland Provincial Park boundary downstream to Many Islands Park	217.5	231.0	16

[a] River Km values as measured from the base of WAC Bennett Dam (River Km 0.0).
[b] The upstream delineation of Section 5 was moved approximately 5 km downstream to more closely align with the location of the Site C damsite.
[c] Includes only fall sampling (20 August to 14 October) not the contingent assessment for Walleye and Goldeye in June and July.

As detailed in the FAHMFP, only Sections 1, 3, 5, 6, 7, and 9 (Appendix A, Figures A1 to A6, Table A1) were selected for long-term monitoring under the Indexing Survey. Sections 1 and 3 are situated upstream of the Project and are scheduled to be sampled during the current program until the reservoir filling stage of the Project's development in 2023. These sections will be sampled to monitor potential effects of construction (i.e., creation of the diversion headpond and river diversion) on the Peace River fish community. Sections 5, 6, 7, and 9 are scheduled to be sampled annually as part of the Indexing Survey until 2053.

Similar to study years 2015 to 2018, Sections 1a, 2, 4, and 8 were excluded from the 2019 Indexing Survey for several reasons, including the following: the limited amount of historical data available for these sections, the short lineal length of river they represent (Section 1a only), low historical catch rates (e.g., Mainstream 2010, 2011, 2013), and the similarity of their habitats relative to adjacent sections. Small portions of Section 8 near the Clear River and Pouce Coupe River confluences were sampled as part of the Goldeye and Walleye Survey (Section 1.4.1). During most historical study years, the same sites were sampled within each section. Sites sampled in 2019 were identical to sites sampled in 2018 (Golder and Gazey 2019).

For the Indexing Survey, 98 sites were sampled within the six sections of the Peace River in 2019 (Appendix A, Figures A1 to A6). The length of sites varied from 40 to 1900 m and consisted of the nearshore area along a bank of the river. The two sites in the Pine River were 1000 and 1500 m in length, the two sites in the Beatton River were 430 and 600 m in length, and the one site in the Kiskatinaw River was 1240 m in length. Site descriptions and UTM locations for all 98 sites are included in Appendix A, Table A1. A sample is defined as a single pass through a site while boat electroshocking (see Section 2.1.4). Field crews attempted to sample each site six times (i.e., six sessions) over the study period (Table 3); however, due to poor weather, permit conditions limiting sampling to water temperatures above 5°C, and equipment issues, a sixth session could not be completed in Sections 5 and 9 in 2019.

Each sample session took between 8 and 13 days to complete. Each section within each session was sampled over one to five days (Table 3).

Table 3: Summary of boat electroshocking sample sessions conducted in the Peace River, 2019.

Session	Start Date	End Date	Section					
			1	3	5	6	7	9
1	20 Aug	1 Sep	22-27 Aug	27-29 Aug	24-31 Aug, 1 Sep	20-27 Aug	27-30 Aug	24-25 Aug
2	1 Sep	12 Sep	1-3 Sep	4-9 Sep	7-11 Sep	1-8 Sep	8-12 Sep	10-11 Sep
3	13 Sep	20 Sep	13-15 Sep	15-18 Sep	16-20 Sep	13-15 Sep	17-19 Sep	19-20 Sep
4	21 Sep	1 Oct	21-22 Sep	23-26 Sep	25-29 Sep	22-24 Sep	24-30 Sep, 1 Oct	27-28 Sep
5	30 Sep	8 Oct	30 Sep	1-3 Oct	4-7 Oct	2-3 Oct	5-8 Oct	4-5 Oct
6	9 Oct	14 Oct	9 Oct	12-Oct	14-Oct[a]	10-11 Oct	11-13 Oct	-

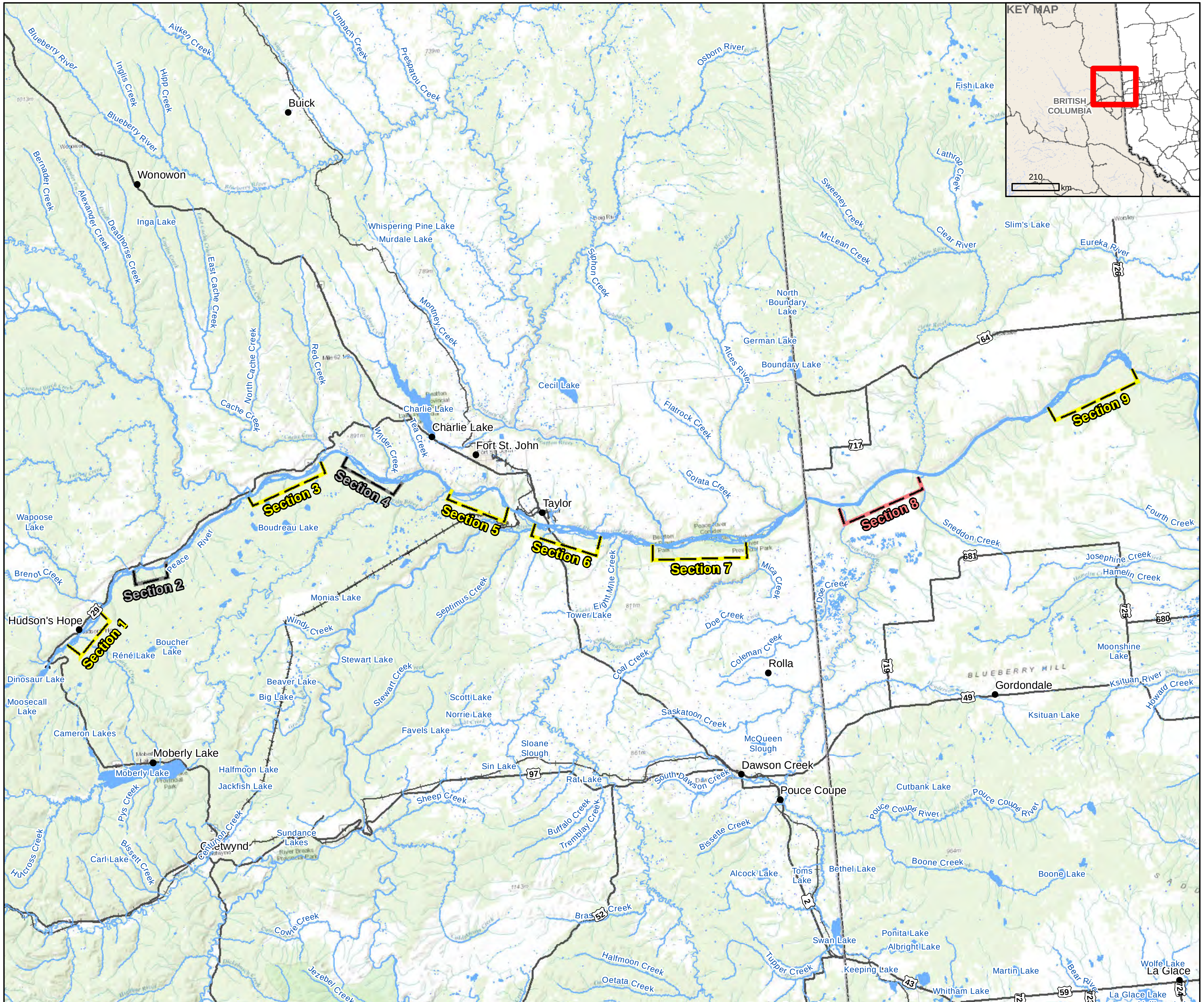
[a] Partial session.

1.4.2 Goldeye and Walleye Survey

Two sessions were conducted as part of the Goldeye and Walleye Survey. Session 1 was conducted on 14 and 15 June and Session 2 was conducted on 3 and 4 July (Table 4). This survey was limited to the confluence areas of major tributaries in Sections 7 and 8, including Six Mile Creek, Eight Mile Creek, the Beatton River (split into two sites), the Kiskatinaw River, the Alces River, the Pouce Coupe River, and the Clear River (Appendix A, Figures A7 to A9; Table A2).

Table 4: Summary of boat electroshocking sample sessions conducted in the Peace River as part of the contingent Goldeye and Walleye Survey, 2019.

Session	Tributary						
	Section 7				Section 8		
	Six Mile Creek	Eight Mile Creek	Beatton River	Kiskatinaw River	Alces River	Pouce Coupe River	Clear River
1	14 June	14 June	14 June	14 June	15 June	15 June	15 June
2	4 July	4 July	3 July	3 July	4 July	4 July	4 July



LEGEND

- PLACE NAME
- DAM SECTION
- PROVINCIAL BOUNDARY
- WATERCOURSE
- WATERBODY
- RAILWAY
- ROAD

SAMPLING SECTIONS

- 1; 3; 5; 6; 7; 9
- 2; 4
- 8

0 10 20

1:625,000 METRES

REFERENCES
1. TRANSPORTATION, RAILWAY, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. DAM SITE OBTAINED FROM FROM GEOBASE®.
3.SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
OVERVIEW OF THE PEACE RIVER LARGE FISH INDEXING SURVEY (MON-2, TASK 2A) STUDY AREA, 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2020-07-08
DESIGNED	DF
PREPARED	CD
REVIEWED	PG
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

2.0 METHODS

2.1 Data Collection

2.1.1 Discharge

Hourly and five-minute discharge data were obtained from several different Water Survey of Canada[5] gauging stations. Discharge values for Sections 1 and 3 prior to 2019 were calculated using data collected at the Water Survey of Canada Gauging Station 07EF001 (Peace River at Hudson Hope). In 2019, Station 07EF001 was decommissioned and releases from PCD were used to calculate discharge values in Sections 1 and 3. No major tributaries flow into the Peace River between PCD and the former 07EF001 station location. As such, the two datasets are similar.

Releases from PCD were used to represent discharge in Section 1. Release data from PCD were combined with data from Station 07FA006 (Halfway River Near Farrell Creek) to represent discharge in Section 3. Data from Station 07FA004 (Peace River Above Pine River) were used to represent discharge in Section 5. Data from Station 07FD002 (Peace River Near Taylor) were used to represent discharge in Section 6. Data from Station 07FD010 (Peace River Above Alces River) were used to represent discharge in Section 7.
Accurate discharge data for Section 9 were not available due to the locations of the nearest Peace River gauging stations relative to the inflow points of several large unmonitored tributaries.

2.1.2 Water Temperature

Hourly water temperatures in the Peace River for 2019 were obtained from the Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9) using Onset Tidbit™ temperature data loggers (Model #UTBI-001; accuracy ± 0.2°C; Onset Computer Corporation; Cape Code, MA, USA). In this report, water temperature data from 2008 to 2019 from three different Peace River stations were used: Section 1 downstream of PCD (station pcnDN1); Section 3 downstream of the Halfway River's confluence with the Peace River (station halfDN2), and Section 5 downstream of the Moberly River's confluence with the Peace River (station mobDN1). Water temperature data were summarized to provide daily average temperatures.
Spot measurements of water temperature were obtained using a handheld OAKTON ECTestr 11 meter (resolution 0.1°C; accuracy ± 0.5°C; OAKTON Instruments; Vernon Hills, IL, USA) at all sample sites at the time of sampling.

2.1.3 Habitat Conditions

Habitat parameters recorded at each site (Table 5) included variables recorded during previous study years (Golder and Gazey 2015–2019) and variables recorded as part of other, similar BC Hydro programs on the Columbia River (i.e., CLBMON-16 [e.g., Golder et al. 2018a] and CLBMON-45 [e.g., Golder et al. 2018b]). These data were collected to provide a means of detecting changes in habitat availability or suitability in sample sites over time. Collected data were not intended to quantify habitat availability or imply habitat preferences.

The type and amount of instream cover for fish were qualitatively estimated at all sites. Water velocities were visually estimated and categorized at each site as low (less than 0.5 m/s), medium (0.5 to 1.0 m/s), or high (greater than 1.0 m/s). Water clarity was visually estimated and categorized at each site as low (less than 1.0 m

[5] Available for download at https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html.

depth), medium (1.0 to 3.0 m depth), or high (greater than 3.0 m depth). Where water depths were sufficient, water clarity was also estimated using a “Secchi Bar” that was manufactured based on the description provided by Mainstream and Gazey (2014). Mean and maximum sample depths were estimated by the boat operator based on the boat’s sonar depth display.

Table 5: Habitat variables and boat electroshocker settings recorded at each site during each sample session during the Peace River Large Fish Indexing Survey, 2019.

Variable	Description
Date	The date the site was sampled
Time	The time the site was sampled
Estimated Flow Category	A categorical ranking of PCD discharge (high; low; transitional) at the time of sampling
Air Temp	Air temperature at the time of sampling (to the nearest 1°C)
Water Temp	Water temperature at the time of sampling (to the nearest 0.1°C)
Conductivity	Water conductivity at the time of sampling (to the nearest 10 µS/cm)
Secchi Bar Depth	The Secchi Bar depth recorded at the time of sampling (to the nearest 0.1 m)
Cloud Cover	A categorical ranking of cloud cover (Clear = 0-10% cloud cover; Partly Cloudy = 10-50% cloud cover; Mostly Cloudy = 50-90% cloud cover; Overcast = 90-100% cloud cover)
Weather	A general description of the weather at the time of sampling (e.g., comments regarding wind, rain, smoke, or fog)
Water Surface Visibility	A categorical ranking of water surface visibility (low = waves; medium = small ripples; high = flat surface)
Boat Model	The model of boat used during sampling
Range	The range of voltage used during sampling (high or low)
Percent	The estimated duty cycle (as a percent) used during sampling
Amperes	The average amperes used during sampling
Mode	The mode (AC or DC) and frequency (in Hz) of current used during sampling
Length Sampled	The length of shoreline sampled (to the nearest 1 m)
Time Sampled	The duration of electroshocker operation (to the nearest 1 s)
Netter Skill	A categorical ranking of each netter’s skill level (1 = few misses; 2 = misses common for difficult fish; 3 = misses are common for difficult and easy fish; 4 = most fish are missed)
Netter Observation Skill	A categorical ranking of each netter’s observation skill level (1 = few misses; 2 = misses common for difficult fish; 3 = misses are common for difficult and easy fish; 4 = most fish are missed)
Mean Depth	The mean water depth sampled (to the nearest 0.1 m)
Maximum Depth	The maximum water depth sampled (to the nearest 0.1 m)
Water Clarity	A categorical ranking of water clarity (High = greater than 3.0 m visibility; Medium = 1.0 to 3.0 m visibility; Low = less than 1 m visibility)
Instream Velocity	A categorical ranking of water velocity (High = greater than 1.0 m/s; Medium = 0.5 to 1.0 m/s; Low = less than 0.5 m/s)
Instream Cover	The type (i.e., Interstices; Woody Debris; Cutbank; Turbulence; Flooded Terrestrial Vegetation; Aquatic Vegetation; Shallow Water; Deep Water) and amount (as a percent) of available instream cover
Crew	The field crew that conducted the sample
Sample Comments	Any additional comments regarding the sample

2.1.4 Fish Capture

Boat electroshocking was conducted at all sites along the channel margin, typically within a range of 0.5 to 2.0 m water depth. Each crew used Smith-Root high-output Generator Powered Pulsator (GPP 5.0) electroshockers (Smith-Root; Vancouver, WA, USA) operated from outboard jet-drive riverboats. The electroshocking procedure consisted of manoeuvring the boat downstream along the shoreline of each sample site. Field crews sampled large eddies (i.e., eddies longer than approximately two boat lengths) while travelling with the direction of water flow. Two crew members, positioned on netting platforms at the bow of each boat, netted stunned fish, while the third individual on each crew operated the boat and electroshocking unit. Netters attempted to capture all fish that were stunned by the electrical field. Captured fish were immediately placed into 175 L onboard live-wells equipped with freshwater pumps. Fish were netted one at a time and placed into the live-wells. Having more than one fish in a net at one time was avoided as much as possible. Fish that were positively identified but avoided capture were enumerated and recorded as “observed”. Netters attempted to collect a random sample of fish species and sizes; however, netters focused their effort on less common fish species (e.g., Arctic Grayling) or life stages (e.g., immature Bull Trout) when they were observed. This approach was employed during previous study years (Mainstream and Gazey 2014; Golder and Gazey 2015–2019) and may cause an overestimate of the catch of these species and life stages; however, by maintaining this approach, the bias remains constant among study years.

Both the time sampled (seconds of electroshocker operation) and length of shoreline sampled (metres; Table 6) were recorded for each sample. The start and end location of each site was established prior to the start of the field program; however, if a complete site could not be sampled, the difference in distance between what was sampled and the established site length was estimated and recorded on the site form. This revised site length was used for that session in subsequent analyses. Reasons for field crews not being able to sample an entire site’s length included public on shore, beavers swimming in a site, and shallow water depths preventing boat access.

Table 6: Number and lengths of sites sampled by boat electroshocking during the Peace River Large Fish Indexing Survey, 2019.[a]

Section	Number of Sites	Site Length (m)		
		Minimum	Average	Maximum
1	15	300	837	1200
3	15	950	1331	1900
5	15	350	867	1280
6	18	250	975	1500
7	19	220	923	1400
9	16	40	953	1200

[a] Sites established and surveyed as part of the Goldeye and Walleye survey were excluded from this table. These sites ranged between 400 and 900 m in length (average length = 648 m).

Each boat electroshocking unit was operated at a frequency of 30 Hz with pulsed direct current. Amperage was adjusted as needed to achieve the desired effect on fishes, which was the minimum level of immobilization that allowed efficient capture and did not cause undesired outcomes such as immediate tetany or visible hemorrhaging (Martinez and Kolz 2009). An amperage of 3.0 A typically produced the desired effect on fishes; however, amperage was set as low at 1.5 A and as high as 4.6 A at some sites based on local water conditions and the electroshocking unit employed.

The electroshocker settings used in 2014 to 2019 were different when compared to the settings employed during previous study years (Mainstream and Gazey 2004–2014). Prior to 2014 (i.e., the 2002–2013 epoch), higher frequencies and higher amperages were used. The settings used from 2014 to 2019 (i.e., the 2014–2019 epoch) resulted in less electroshocking-induced injuries on large-bodied Rainbow Trout in studies conducted on the Columbia River (Golder 2004, 2005) and align with recommendations by Snyder (2003) for pulsed direct current and low frequencies for adult salmonids. Reducing the impacts of sampling will help ensure the long-term sustainability of the monitoring program.

Although electrical output varies with water conductivity, water depth, and water temperature, field crews attempted to maintain electrical output at similar levels for all sites over all sessions.

2.1.5 Ageing

Scale samples were collected from all captured Arctic Grayling, Goldeye, Kokanee, Mountain Whitefish (with the exceptions detailed in Section 2.1.6), and Rainbow Trout. Fin ray samples were collected from all initially captured Bull Trout, Goldeye, Lake Trout, Northern Pike, and Walleye. Otoliths were collected opportunistically from fish that succumbed to sampling. Ageing structures (i.e., scales, fin rays, and/or otoliths) were collected in accordance with the methods outlined in Mackay et al. (1990). All ageing structure samples were stored in appropriately labelled coin envelopes and archived for long-term storage for BC Hydro.

Scales were assigned an age by counting the number of growth annuli present on the scale following procedures outlined by Mackay et al. (1990). Scales were temporarily mounted between two slides and examined using a microscope. Where possible, several scales were examined, and the highest quality scale was photographed using a 3.1-megapixel digital macro camera (Leica EC3, Wetzlar, Germany) and saved as a JPEG-type picture file. All scale images were linked to the Peace River Large Fish Indexing Database and provided to BC Hydro (referred to as Attachment A). All scales were examined independently by two experienced individuals, and ages were assigned. If the assigned ages differed between the two examiners, the sample was re-examined by a third examiner. If there was agreement between two of three examiners, then the consensus age was assigned to the fish. If there was not agreement between two of three examiners, then the fish was not assigned an age.

To continually increase the accuracy of ages assigned using fin rays, ageing methods are modified relative to previous study years based on lessons learned and literature reviews. These changes are described, where needed, in the following sections. Fin rays were coated in epoxy and allowed to dry. Once dried, a rotary sectioning saw with a diamond blade (Buehler IsoMet Low Speed Saw; Lake Bluff, IL, USA) was used to create multiple cross-sections of each fin ray sample. The rotary sectioning saw allowed the thickness of cross-sections to be set to a standard width of 0.5 mm. This width allowed for maximum reflected or transmitted light to pass through the sections, making annuli more apparent when observed under a microscope (Watkins and Spencer 2009). In addition, the use of the rotary sectioning saw resulted in cross-sections with more polished surfaces (which reduced sanding and preparation time) compared to the jeweler’s saw (Gesswein Canada;

Toronto, Canada) used prior to 2017. The cross-sections were permanently mounted on a microscope slide using a clear coat nail polish and examined using a Leica S6D imaging microscope (Leica Microsystems Inc.; Concord, Canada). Where possible, several fin ray cross-sections were examined, and the cross-section with the most visible annuli was photographed with the microscope's integrated 3.1-megapixel digital macro camera (Leica EC3, Wetzlar, Germany). All fin ray cross sections were imaged using the maximum zoom possible.

Fin rays (excluding Walleye) were examined independently by two experienced individuals, and ages were assigned. If the assigned ages differed between the two examiners, the sample was re-examined by a third examiner. If there was agreement between two of three examiners, then the consensus age was assigned to the fish. If there was not agreement between two of three examiners, then the fish was not assigned an age.

Based on length-at-age data collected from age-0 to age-2 Bull Trout in the Halfway River watershed (e.g., Golder 2018), ages assigned through fin ray analysis as part of the current project were underaged by one year. This result is likely because the fin ray cannot be collected close enough to the fish's body wall to capture the first annulus on the fin ray (i.e., the annulus closest to the focus of the fin ray). As such, one year was added to all assigned Bull Trout ages.

A further review of ages assigned to Bull Trout fin rays identified inconsistencies in annuli development for this species, supporting hypotheses first noted in 2018 (Golder and Gazey 2019). Average lengths of age-classes, as assigned using the above detailed methods, were inconsistent with anticipated lengths based on inter-year capture-recapture data. For this reason, Bull Trout ages, as assigned using fin rays, are not presented in this report. Instead, age-related analyses for Bull Trout are based on fork lengths (FL) at initial capture for immature individuals and inter-year recapture data as detailed below.

Immature Bull Trout encountered during the Site C Reservoir Tributary Fish Population Indexing Survey (Mon-1b, Task 2c; hereafter, Tributary Survey; Golder 2020) were accurately assigned age classes based largely on each fish's fork length due to limited overlap in lengths between age-0 to age-3 individuals. Age-4 and older Bull Trout were rarely encountered during the Tributary Survey because most immature Bull Trout migrate out of natal/rearing tributary by age-3. Data collected during the Tributary Survey indicate a maximum length for age-3 Bull Trout of approximately 240 mm FL. Between 2015 and 2019, the smallest Bull Trout recorded in the Peace River mainstem during the Indexing Survey was 153 mm FL, and 112 Bull Trout less than or equal to 240 mm FL were recorded in all five study years combined (Golder and Gazey 2016–2019). During historical surveys (2001 to 2014), the smallest Bull Trout recorded in the Peace River mainstem was 142 mm FL, and 306 Bull Trout less than or equal to 240 mm FL were recorded (P&E 2002; P&E and Gazey 2003; Mainstream and Gazey 2004–2008, Mainstream and Gazey 2009–2014; Golder and Gazey 2015). Bull Trout younger than age-3 are unlikely to be present in the Peace River mainstem and Bull Trout older than age-3 are expected to be larger than 240 mm FL based on data collected during the Tributary Survey (Golder 2020); therefore, the bulk of Bull Trout encountered in the Peace River mainstem that are less than 240 mm FL are likely age-3 individuals. For all study years combined (2001 to 2019), this represents a dataset of 418 age-3 Bull Trout from the Peace River mainstem. For the current study year, age-related analyses for Bull Trout were based on these length-based age-class assignments. Further, ages were assigned to subsequent inter-year recaptures of fish that were initially encountered as age-3 individuals (i.e., age-3 plus the number of years at-large). When possible, age-related analyses for Bull Trout were further supplemented by data collected during the Tributary Survey (Golder 2020) to help provide a more complete understanding of this species' growth and life history characteristics.

Ages assigned to Bull Trout through fin ray examination during previous study years and results from corresponding analyses should be interpreted with caution for the reasons detailed above and by Golder and Gazey (2018).

In 2015 and 2016, Walleye fin rays were aged using methods detailed by Mackay et al. (1990). However, Watkins and Spencer (2009) detailed methods for ageing Walleye fin rays that were shown to be more accurate than the methods detailed by Mackay et al. (1990) for northern Walleye populations. As such, the methods detailed by Watkins and Spencer (2009) were employed after 2016 and are briefly described below. For fin rays collected from Walleye, each fin ray photograph was imported into ImageJ software (www.imagej.net) equipped with the Fiji microscope measurement tool plugin. This software allows the user to take measurements on microscope images. Prior to examining cross-section images in ImageJ, a calibration slide with a known length (i.e., a 1 mm scale with 0.01 mm divisions) was measured to set the scale for future measurements. For each imaged cross-section, the pelvic fin ray radius (PFRR) was measured in µm and the distance was plotted and saved on the cross-section image. The PFRR is the distance from the focus of the ray (i.e., the center of fin ray) to the end of the largest lobe of the ray. This measurement was then used to determine the radius distance from the focus to the first annulus using the following formula from Watkins and Spencer (2009):

(1) $Sc = (PFRR \times L_1) / Lc$

where Sc is the distance from the focus to the first annulus (in µm), PFRR is the pelvic fin ray radius (in µm), L_1 is the average fork length of a fish at age 1 (in mm), and L_c is the fork length of the fish when caught (in mm). The value of 188 mm was used for L_1 for all Walleye cross-section calculations based on results provided by Golder and Gazey (2018). Once Sc was determined for each cross-section, the distance was measured out on the imaged cross-section in ImageJ. The Sc value was also plotted and saved on the cross-section image. The closest annulus visible to the measured Sc was considered the first annulus and the subsequent annuli moving outwards towards the end of the largest lobe of the fin ray were counted to determine age. All fin ray images with plotted PFRR and Sc were examined independently by two experienced individuals. If the assigned ages differed between the two examiners, the sample was re-examined by a third examiner. If there was agreement between two of three examiners, then the consensus age was assigned to the fish. If there was not agreement between two of three examiners, then the sample was rejected and the fish was not assigned an age.

While assigning ages, examiners were aware of the species of each sample but did not have other information about the fish, such as body size or capture history.

Ages were assigned to all Arctic Grayling, Bull Trout, Northern Pike, and Rainbow Trout that were captured, except in cases where ageing structures were too poor quality to assign an age. In total, 489 Mountain Whitefish scale samples and 95 Walleye fin rays were analyzed, which represented 4% of the total number of Mountain Whitefish captured and 31% of the total number of Walleye captured in 2019. Ageing structures from Mountain Whitefish and Walleye aged in 2019 were from randomly selected, first-time capture individuals. All Mountain Whitefish scale samples selected for ageing were collected during Session 1 of 2019 (20 August to 1 September). After Session 1, scale samples were only collected from Mountain Whitefish that also received a PIT tag. As a result, including scale samples collected after Session 1 in age related analyses would have resulted in larger (i.e., taggable) fish being overrepresented in the sample.

2.1.6 Fish Processing

A site form was completed at the end of each sampled site. Site habitat conditions and the number of fish observed were recorded before the start of fish processing for life history data (Table 7). All captured fish were enumerated and identified to species, and their physical condition and general health were recorded (i.e., any abnormalities were noted). For each captured fish, the severity of deformities, erosion, lesions, and tumor (DELT) were recorded based on the external anomalies' categories provided in Ohio EPA (1996). Data collected for each fish in 2019 were consistent with previous study years (e.g., Golder and Gazey 2019).

Table 7: Variables recorded for each fish captured during the Peace River Large Fish Indexing Survey, 2019.

Variable	Description
Species	The species of fish
Age-Class	A general size-class for the fish (e.g., YOY <120 mm FL, Immature <250 mm FL, and Adult ≥250 mm FL)
Length	The fork length of the fish to the nearest 1 mm (total lengths were recorded for Burbot)
Weight	The weight of the fish to the nearest 1 g
Sex and Maturity	The sex and maturity of the fish (determined where possible through external examination)
Ageing Method	The type of ageing structure collected if applicable (i.e., scale, fin ray, otolith)
Tag Colour/Type	The type (i.e., T-bar anchor or PIT tag) or colour (for T-bar anchor tags only) of tag applied or present at capture
Tag Number	The number of the applied tag or tag present at capture
Tag Scar	The presence of a scar from a previous tag application
Fin Clip	The presence of an adipose fin clip (only recorded if present without a tag)
Condition	The general condition of the fish (i.e., alive, dead, or unhealthy)
Preserve	Details regarding sample collection (if applicable)
Comments	Any additional comments regarding the fish

Fish were measured for fork length (FL) or total length (TL; for Burbot and sculpin species) to the nearest 1 mm and weighed to the nearest 1 g using an A&D Weighing™ (San Jose, CA, USA) digital scale (Model SK-5001WP; accuracy ±1 g). Data were entered directly into the Peace River Large Fish Indexing Database (provided to BC Hydro as Attachment A) using a laptop computer. All sampled fish were automatically assigned a unique identifying number by the database that provided a method of cataloguing associated ageing structures.

All Arctic Grayling, Bull Trout, Burbot, Goldeye, Rainbow Trout, and Walleye that were greater than 149 mm in length and all Lake Trout, Largescale Sucker, Longnose Sucker, Mountain Whitefish, Northern Pike, and White Sucker that were greater than 199 mm in length and in good condition following processing were marked with a half-duplex (HDX) PIT tag (ISO 11784/11785 compliant) (Oregon RFID, Portland, OR, USA). Tags were implanted within the left axial muscle below the dorsal fin origin and oriented parallel with the anteroposterior axis of the fish. All tags and tag applicators were immersed in an antiseptic (Super Germiphene™; Brantford, ON, Canada) and rinsed with distilled water prior to insertion. The size of PIT tag implanted was based on the length of the fish and was the same as other FAHMFP monitoring programs in the Peace River, such as the Tributary Survey (Golder 2019):

- Fish between 150 and 199 mm FL received 12 mm long PIT tags (12.0 mm x 2.12 mm HDX+).
- Fish between 200 and 299 mm FL received 23 mm long PIT tags (23.0 mm x 3.65 mm HDX+).
- Fish greater than 300 mm FL received 32 mm long HDX PIT tags (32.0 mm x 3.65 mm HDX+).

HDX PIT tags were applied from 2016 to 2019; full-duplex (FDX) PIT tags were applied prior to 2016. All HDX PIT tags that have been applied as part of this program are compatible with the PIT arrays installed in the Halfway River watershed as part of the Peace River Bull Trout Spawning Assessment (Mon-1b, Task 2b; Ramos-Espinoza et al. 2018, 2019). In 2019, all fish of the targeted species and size were implanted with a HDX tag, including recaptured fish that had previously been implanted with a FDX PIT tag. FDX and HDX tags are incompatible with each other (i.e., they do not interfere with each other); therefore, fish that are double-tagged with both tag types are readable by both the PIT arrays and handheld PIT tag readers.

PIT tags were read using a Datamars DataTracer FDX/HDX handheld reader (Oregon RFID, Portland, OR, USA). When fish that had both HDX and FDX tags were scanned, the HDX tag would most often be detected because of its longer read-range, but occasionally only the previous FDX tag was detected. In either case, the fish could be linked to their previous encounter histories in the Peace River Large Fish Indexing Database.

As was done during previous study years, a simplified processing method was used for the more common species during Sessions 5 and 6 as described in Section 1.4. During Sessions 5 and 6, fish that did not have a PIT tag at capture were assigned a size category based on fork length (i.e., less than 150 mm, 150–199 mm, 200-299 mm, greater than or equal to 300 mm) and were released without recording lengths or weights, collecting scale samples, or implanting PIT tags. This allowed field crews to conduct the sessions over a shorter time period by reducing fish handling and fish processing time. During Sessions 5 and 6, this simplified fish processing procedure was used for Mountain Whitefish and all sucker species (Largescale Sucker, Longnose Sucker, and White Sucker). All other fish species were sampled using the full processing procedure.

To reduce the possibility of capturing the same fish at multiple sites in a single session, fish were released near the middle of the site where they were captured.

2.1.7 Radio Telemetry Tag Deployment

Candidate fish selected for radio telemetry tag implantation were selected based on the health and vigor of the fish after the post-capture holding period. Fish that appeared stressed or unhealthy were excluded as potential candidates. The type and size of radio tag implanted was dependent on the weight of the fish. Field crews attempted to keep tag burden (i.e., the weight of the tag divided by the weight of the fish) to less than 2%; however, this limit was exceeded for 4 of the 261 tags deployed. Typically, NTF-3-2 tags, which weighed 0.57 g (in air), were implanted into fish that weighed more than 30 g, NFT-5-2 tags, which weighed 1.5 g, were implanted into fish that weighed more than 77 g, NFT-6-1 tags, which weighed 2.5 g, were implanted into fish that weighed more than 242 g, and NFT-6-2 tags, which weighed 4 g, were implanted into fish that weighed more than 209 g,

A standard surgical record and tag deployment datasheet was used to document the handling, tagging, and release processes for each telemetry tagged fish. Data collected included the following:

- fish sample number and species;
- telemetry tag information (tag code, tag frequency, model number, serial number, etc.);
- Corresponding HDX PIT tag number;
- site of capture;
- water temperature at capture;

- fork length measured to nearest millimetre;
- weight measured to nearest gram;
- initials of the surgeon and the assistant;
- date of surgery;
- start and end time of anaesthetic bath;
- start and end time of surgery; and
- comments on health and post-surgery condition.

Each tag was activated with the Lotek tag activator and the tag code was verified with a Lotek SRX800 MD-4 receiver that was used to detect and decode the tag signal. Tags and all surgical instruments were placed in a 10% disinfectant solution (Super Germiphene™) for 10 minutes and then transferred to a rinse tray filled with distilled water prior to surgery. The surgeon wore nitrile gloves and rinsed them with isopropyl alcohol prior to surgery. To maintain the integrity of the fish's mucous layer, handling of the fish was kept to a minimum and when required, was done using nitrile gloves and a soft-mesh transfer net. An anaesthetic bath of 30 L of water with 50 PPM of clove oil was used to sedate the fish. The clove oil was mixed with 70% ethyl alcohol to achieve a 9:1 alcohol to clove oil ratio, which facilitated mixing the clove oil with the water. Only one fish was anaesthetized at a time. The level of sedation was constantly assessed by checking the ability of the fish to remain vertical in the anaesthetic bath water, the frequency of opercular movements, and tail twitch reflex responses.
Once anaesthetized, the fish was removed from the anaesthetic bath, weighed and measured, and placed ventral side up in a sponge-lined surgery tray. During the surgical procedure, a water supply system was set up to continuously irrigate the gills with fresh river water.

The start of the incision location was anterior of the cloacal vent and slightly off the midline, posterior to the liver. Using #11 scalpel blade and rat-tooth forceps, an incision approximately 1.5 times the diameter of the radio telemetry tag was made through the abdominal wall. A catheter or stainless-steel cannula, appropriate for the radio telemetry tag's antenna diameter and the size of the fish, was inserted into the incision and directed along the body wall towards the fish's caudal fin. The cannula pierced the body wall approximately 3 cm away from the incision and the ventral surface and angled back so that the antenna was in line with the fish. The antenna was pulled through the cannula and the tag was inserted into body cavity, tip first. Once inserted, a combination of gently pushing on the tag and pulling on the antenna was used to position the tag in the appropriate location. The cannula was removed, and the incision was stitched closed with two to three simple surgeon 2-1-1 interrupted stitches using Ethicon Vicryl Plus 4-0 braid sutures (Ethicon Inc., Somerville, NJ, US) with a round taper-point needle.

After the surgery, the fish was placed in the livewell until they recovered and regained normal swimming behavior. During the recovery period, freshwater was continuously pumped into the livewell. Once recovered, the fish were released back into the mainstem of the river near to their capture location. At release, tagged fish were monitored to ensure they actively swam to depth and did not remain in shallow water.

All fish sampling and tagging data for radio tagged fish were provided to LGL in support of the Site C Fish Movement Assessment (Mon-1b, Task 2d; LGL 2020).

2.2 Data Analyses

2.2.1 Data Compilation and Validation

Data collected under the Indexing Survey were stored in the Peace River Large Fish Indexing Database, which contains historical data collected under the Large River Fish Indexing Program (P&E 2002; P&E and Gazey 2003; Mainstream and Gazey 2004–2008), the Peace River Fish Index (Mainstream and Gazey 2009–2014; Golder and Gazey 2015), and the Peace River Large Fish Indexing Survey (Golder and Gazey 2016–2019). The database is designed to allow most data to be entered directly by the crew while out in the field using Microsoft® Access 2010 software and contains several integrated features to ensure that data are entered correctly, consistently, and completely.

Various input validation rules programmed into the database checked each entry to verify that the data met specific criteria for that particular field. For example, all species codes were automatically checked upon entry against a list of accepted species codes that were saved as a reference table in the database; this feature forced the user to enter the correct species code for each species (e.g., Rainbow Trout had to be entered as "RB"; the database would not accept "RT"). Combo boxes were used to restrict data entry to a limited list of choices, which kept data consistent and decreased data entry time. For example, a combo box limited the choices for Cloud Cover to Clear, Partly Cloudy, Mostly Cloudy, or Overcast. The user had to select one of these choices, which decreased data entry time (e.g., by eliminating the need to type out "Partly Cloudy") and ensured consistency in the data (e.g., by forcing the user to select "Partly Cloudy" instead of typing "Part Cloud" or "P.C."). The database contained input masks that required the user to enter data in a pre-determined manner. For example, an input mask required the user to enter Sample Time in 24-hour short-time format (i.e., HH:mm:ss). Event procedures ensured data conformed to underlying data in the database. For example, after the user entered life history information for a particular fish, the database automatically calculated the body condition of that fish. If the body condition was outside a previously determined range for that species (based on the measurements of other fish in the database), a message box appeared on the screen informing the user of a possible data entry error. This allowed the user to double-check the species, length, and weight of the fish before it was released. The database also allowed a direct connection between the handheld PIT tag reader (Datamars DataTracer FDX/HDX reader) and the data entry form, which eliminated transcription errors associated with manually recording the 15-digit PIT tag numbers.

The database also included tools that allowed field crews to quickly query historical encounters of tagged fish while the fish was in-hand. This allowed the crew to determine if ageing structures, such as fin rays, had been previously collected from a fish or comment on the status of previously noted conditions (e.g., whether a damaged fin had properly healed). Quality Assurance/Quality Control (QA/QC) was conducted on the database before analyses. QA/QC included checks of capture codes and tag numbers for consistency and accuracy, checks of data ranges, visual inspection of plots, and removal of age-length and length-weight outliers, where applicable.

Various metrics were used to provide background information and descriptive summaries of fish populations. Although these summaries are important, not all of them are presented or specifically discussed in detail in this report. However, these metrics are provided in the appendices for reference purposes and are referred to when necessary to support or discount results of various analyses. Metrics presented in the appendices include the following:

- discharge and water temperature summaries (Appendix C, Figures C1 to C5)
- bank habitat classification types and site lengths by habitat type when applicable (Appendix D, Tables D1 and D2)
- habitat parameters recorded at each sample site (Appendix D, Table D3)
- percent composition of the catch by study year by section (Appendix E, Tables E1 and E2)
- catch rates for all species (Appendix E, Tables E3 and E4), 2019
- summary of captured and recaptured fish by species and session, 2019 (Appendix E, Table E5)
- length-frequency histograms, age-frequency histograms, length-weight regressions, body condition estimates, and catch curve estimates of mortality by year or section for Arctic Grayling, Bull Trout, Largescale Sucker, Longnose Sucker, Mountain Whitefish, Northern Pike, Rainbow Trout, Walleye, and White Sucker where applicable, 2002 to 2019 (Appendix F, Figures F1 to F37)

For all figures in this report, sites are ordered by increasing distance from WAC Bennett Dam (River Km 0.0) based on the upstream boundary of each site.

As detailed in Section 1.4 and Appendix B, Table B1, not all sections were sampled during all study years. For figures and statistics related to fish life history (i.e., length, weight, and age), analyses were supplemented, when feasible, with data collected in Sections 6, 7, and 9 under the Peace River Fish Inventory in 2009, 2010, and 2011 (Mainstream 2010, 2011, 2013). The Peace River Fish Inventory employed similar capture techniques during similar times of the year. Because effort differed between the Peace River Fish Inventory and the current program, these data were not included in figures or statistics related to effort or fish counts. As detailed in Section 2.1.5, age-related analyses for Bull Trout were supplemented with data collected during the Tributary Survey (Golder 2020), when possible.

2.2.2 Population Abundance Estimates

A capture-recapture program was conducted on Arctic Grayling, Bull Trout, Largescale Sucker, Longnose Sucker, Mountain Whitefish, Northern Pike, Rainbow Trout, Walleye, and White Sucker during the 2019 study period. Although Northern Pike were tagged with the intention of including them in the capture-recapture program, there were insufficient tagged fish captured to generate abundance estimates for this species.

Similar to 2015–2018, PIT tags were applied to all Mountain Whitefish greater than or equal to 200 mm FL during Sessions 1 through 4. Prior to 2015 (i.e., prior to the Peace River Large Fish Indexing Survey), only fish greater than or equal to 250 mm FL were tagged with either T-bar anchor or PIT tags, depending on the study year. The inclusion of fish between 200 and 249 mm FL since 2015 has increased the number of tags available for recapture, thereby increasing the precision of future growth, survival, and abundance estimates. Furthermore, Mountain Whitefish in the 200 to 249 mm FL size range are large enough to fully recruit to the electroshocking gear while still being young enough to estimate ages based on fork lengths. The majority of these fish are age-2. Including age-2 fish capture data in future capture-recapture studies could allow the generation of survival and abundance estimates for specific brood years (i.e., the fall during which spawning occurred), which could be used to test for correlations with environmental conditions during early life history and help test the management hypotheses. To maintain consistency with analyses conducted during previous study years, Mountain Whitefish tagged between 200 to 249 mm FL were excluded from the 2019 population abundance models.

In the text that follows, frequent reference is made to the terms “capture probability” and “catchability”. Capture probability is defined as the probability of detecting (i.e., encountering) an individual fish given that it is alive during a sampling event (Otis et al. 1978). For the current study, a sampling event is a sampling day or session within a section (one to five sampling days; Table 3), dependent on the estimation model used. Catchability is defined as the proportion of the population that is captured by a defined unit of effort (Ricker 1975). Under these classical definitions, the two terms are not synonymous. For example, if the number of fish sampled was directly related to the level of effort employed, then sessions with different levels of effort on the same population may have exhibited similar catchabilities but different capture probabilities.

During Sessions 1 through 4, PIT tags were applied to all captured fish of appropriate size and species. In the final two sessions (i.e., Sessions 5 and 6), simplified fish processing procedures were implemented, and PIT tags were not applied to untagged Mountain Whitefish, allowing additional capture effort and recapture of previously tagged fish, which improved the statistical confidence of the estimates. Overall, the program was successful in terms of the number of tags applied and recaptured for Mountain Whitefish but was less successful for all other species including Arctic Grayling, Bull Trout, Rainbow Trout, and sucker species. Therefore, the methods described (diagnostics, population estimation, catchability, and sampling power analyses) herein were comprehensively applied to Mountain Whitefish. Due to sparse data, only the closed population estimation methodologies without empirical diagnostics for model selection were applied for Arctic Grayling, Bull Trout, Rainbow Trout, Walleye, and the three sucker species.

2.2.2.1 Factors that Impact Population Abundance Estimates

The tagging program has some characteristics that must be considered with reference to the population estimation methodology and limitations of the subsequent estimates:

- Capture probability was likely heterogeneous (i.e., some fish were more likely to be caught than others) because of spatial distribution, reactions of the fish to the boat electroshocker, and netter experience (e.g., larger fish are generally easier to capture than small fish).
- Some fish may have been more or less prone to capture by the boat electroshocker because of their size (i.e., size selectivity). The larger the voltage gradient that the fish experiences across its body, the more susceptible it is to the electrical field. Therefore, a larger fish, with a corresponding larger voltage gradient, is more susceptible to capture than a smaller fish that experiences a relatively smaller voltage gradient.
- Tags were generally applied to fish greater than 250 mm; thus, estimates are only applicable to that portion of the population. For Arctic Grayling, individuals larger than 200 mm were tagged and estimates are for Arctic Grayling larger than 200 mm.
- Fish grew over the duration of the study such that fish recruited into the portion of the population greater than 250 mm while the study was being conducted. However, given the short duration of the study period (56 days), appreciable growth was not expected and would be similar among study years.

- Tagged fish could move to sections where capture probability may have been different because of possible differences in sample size (sampling effort), catchability, number of available tags for recapture, or the population size.
- Capture probability within a section could vary over time because of differences in catchability possibly generated by physical-biological interactions (e.g., varying water depths, water clarity).

To investigate these characteristics, capture behaviours of tagged Mountain Whitefish were examined. Length histograms of the fish tagged and recaptured were examined to reveal selectivity patterns generated by the presence of a tag. These patterns were further evaluated by comparing cumulative length distributions at release and recapture. Growth over the study period was examined by regressing the time at large (days) of a recaptured fish on the increment of growth (i.e., difference in length measured at release and recapture).

The movements of fish between sections during the 2019 study period were assessed through weighting the number of recaptured fish by sampling intensity. The distance travelled upstream or downstream between a fish's initial release and recapture was determined using the upstream River Km value for each of the 98 sample sites.

2.2.2.2 Empirical Model Selection

Apparent survival of Mountain Whitefish over the study period, which represents fish that survive and have not left the study area, was estimated with the Cormack-Jolly-Seber (CJS) model using MARK software (White 2006), consistent with previous study years. The CJS model allows for time-varying capture probability. Only tagged fish were used because their encounter histories were known. The encounter history for an individual fish was assigned to the section of first encounter regardless of the

location of subsequent encounters. The CJS analysis was applied to several aggregations of survival and capture probabilities over time and sections. The best fitting model for survival is reported here and applied to the population estimation models.

The large number of recaptured Mountain Whitefish also allowed for an empirical evaluation of the change in catchability over the study period. Two models (constant versus time-varying catchability) were compared using the delta Akaike's information criterion (ΔAIC) adjusted to account for the number of parameters following Burnham and Anderson (2002). If the catchability is held constant, then the probability that an encountered fish is marked at sequence *t* (p_t) depends only on the proportion of the population that is marked, as follows:

(1) $$p_t = \frac{M_t}{M_t + U_t} = \frac{M_t}{N}$$

where M_t is the cumulative tags applied that are available for recapture at time *t*, U_t is the number of untagged fish in the population at time *t*, and *N* is the population size that is to be estimated. The number of cumulative tags available at time *t* was adjusted (estimated) for mortality following procedures detailed below (see Equation 6). Note that if catchability varies over time, but equally for tagged and untagged fish, then p_t does not change and still reflects the proportion of the population that is tagged. This is the formulation that is used in the Bayes sequential model presented below. If the catchability of tagged and untagged fish varies over the study period, then the probability that an encountered fish is tagged can be characterized as follows:

(2) $$p_t = \frac{M_t}{N\exp(b_t)} \text{ with the constraint that } \sum_t b_t = 0$$

where b_t is the logarithmic population deviation and will provide a better fit to the data. In the remainder of this document, all reference to "time-varying catchability" is as characterized by Equation 2. Equation 2 is also consistent with a change in population size (population change and time-varying catchability are confounded). The negative log-likelihoods (*L*) were computed for these models with an assumed binomial sampling distribution as follows:

$$L \propto \sum_t \left[R_t \log_e(p_t) + (C_t - R_t)\log_e(1 - p_t) \right]$$

(3)

where R_t is the number of recovered tags in the sample of C_t fish taken at time *t*. Parameter estimates, standard deviations, and AIC values were calculated through the minimization of Equation 3 using AD Model Builder (Fournier et al. 2012) to implement the model. For these estimates, each sampling day after the first session was used as a sequence.

2.2.2.3 Bayes Sequential Model for a Closed Population

A Bayesian capture-recapture model for closed populations (Gazey and Staley 1986; Gazey 1994) was applied to the capture-recapture data. The Bayesian model was adapted to accommodate adjustments for apparent mortality, movement between sections, stratified capture probabilities, and sparse recaptures characteristic of Arctic Grayling and Bull Trout. The major assumptions of the model were as follows:

1) The population size in the study area did not change and was not subject to apparent mortality over the study period. Any apparent mortality was assumed to be constant over the study area and the study period and was specified (instantaneous daily mortality). Fish could move within the study area (i.e., to different sections); however, the movement was fully determined by the history of recaptured fish.
2) All fish in a stratum (day and section), whether tagged or untagged, had the same probability of being captured.
3) Fish did not lose their tags during the study period.
4) All tags were reported when encountered. If marks were not always detected, then a missed-tag detection rate could be specified in the model.

The following data were used by the Bayes sequential model to generate population abundance estimates:

- m_{ti} the number of tags applied in 2019, or tagged during a previous study year and encountered in 2019 during day *t* in section *i*
- c_{ti} the number of fish examined for tags during day *t* in section *i*
- r_{ti} the number of recaptured fish in the sample c_{ti}
- d_{ti} the number of fish removed or killed at recapture r_{ti}

A fish had to be greater than or equal to 250 mm FL (or 200 mm FL for Arctic Grayling) to be a member of m_{ti}. A fish was counted as examined (a member of c_{ti}) only if the fish was examined for the presence of a tag and met the length requirements outlined above. A fish was counted as a recapture (r_{ti}) only if it was a member of the sample (c_{ti}), was a member of tags applied (m_{ti}), and was recaptured in a session later than its release session. A fish was counted as removed (d_{ti}) if it was not returned to the river, its tag was removed, or if the fish was deemed to be unlikely to survive. To allow for mixing of tagged fish and recovery from capture, a fish was not available until τ days after mark application or first encounter in 2019. Recaptures with time-at-large less than τ days were ignored and the sample was not counted (i.e., as if the encounter did not happen). The minimum time-at-large was set to three days. Multiple recaptures within a session and section (three or more encounters) were also ignored (i.e., only the first recapture within a section-session was recorded).

The number of tags available for recapture, adjusted for movement, was determined by first estimating the proportion of tags released in section i moving to section j (p_{ij}), defined as follows:

$$\sum_j p_{ij} = 1$$

The movements of tagged fish were determined by their recapture histories corrected for sampling intensity as follows:

(4)
$$\hat{p}_{ij} = \frac{\dfrac{w_{ij}}{\sum_t c_{tj}}}{\sum_j \dfrac{w_{ij}}{\sum_t c_{tj}}}$$

where w_{ij} is the total number of recaptures that were released in section i and recaptured in section j over the entire study period. The maximum number of releases available for recapture during day t in section j (m^*_{tj}) is then as follows:

(5)
$$m^*_{tj} = \sum_i \hat{p}_{ij} m_{ti}$$

The typical closed population model assumptions (e.g., Gazey and Staley 1986) can be adjusted for mortality, emigration of fish from the study area, and the non-detection of a tag when a fish is recaptured. Thus, the number of tags available for recapture at the start of day t in section i (M_{ti}) consists of released tags in each section adjusted for removals (mortality and emigration) summed over time:

(6)
$$M_{ti} = \sum_{v=1}^{t-h} (m^*_{vi} - d_{vi}) \exp\{(v + h - t) Q_i\}$$

where Q_i is the instantaneous daily rate of apparent mortality in the i-th section and h is the number of lags or mixing days (set to three days).

The number of fish examined during day t in the i-th section (C_{ti}) does not require correction:

(7)
$$C_{ti} = c_{ti}$$

Recaptured fish (R_{ti}) in the sample C_{ti}, however, needed to be adjusted for the proportion of undetected tags (u) as follows:

(8) $$R_{ti} = (1+u)r_{ti}$$

The corrected number of tags available, sampled, and recaptured (Equations 6, 7, and 8) were used in the model (Gazey and Staley 1986) to form the population abundance estimates. If apparent mortality is assumed ($Q_i > 0$ in Equation 6), then the population abundance estimates represent the mean population size weighted by the information (likelihood of recapture) contained in each sampling event during the study period.

Population size was estimated using a Microsoft Excel© spreadsheet model with macros coded in Visual Basic. The model has two phases. First, capture-recapture data were assembled by section under the selection criteria of minimum time-at-large (i.e., days) and minimum fork length (mm) specified by the user. Second, the user specified the sections to be included in the estimate, an annual instantaneous mortality rate, the proportion of undetected tagged fish, and the confidence interval percentage desired for the output. The model then assembled the adjusted capture-recapture data (Equations 6, 7, and 8) and followed Gazey and Staley (1986) using the replacement model to compute the population abundance estimates. Output included posterior distributions, the Bayesian mean, standard deviation, median, mode, equal-tailed credible interval, and the highest probability density (HPD) interval. For plots of abundance by year and section, the Bayes mean was used as the point estimate and the HPD interval was used as the 95% credible interval. The interpretation is that the point estimate is the mean of the estimated distribution of true population size and there is a 95% chance (i.e., 95% posterior belief) that the true population size is within the credible interval, given the observed capture-recapture data.

Population abundance estimates were generated for the six sections using tags applied at a start-date of 20 August 2019, a minimum length of 250 mm FL (200 mm FL for Arctic Grayling), daily instantaneous removal rate (which represented natural mortality, unobserved removals, and emigration) estimated using the CJS model, and an undetected tag rate of 0%. The total population abundance estimate for the study area was obtained by summing the section estimates (mean values). Confidence intervals for the total study area estimates were calculated invoking a normal distribution under the central limit theorem with a variance equal to the sum of the variances for the sections where a population abundance estimate was feasible. For Arctic Grayling, all tagged fish were used to increase the size of the dataset; however, population abundance estimates were only produced for Section 3, which had 13 recaptures (all other sections combined had 2 recaptures). Minimal population abundance estimates (i.e., the probability of x that the population size is at least y) were computed for Arctic Grayling following Gazey and Staley (1986).

2.2.2.4 Mountain Whitefish Synthesis Model

The Mountain Whitefish age-structured stochastic model that was developed by Gazey and Korman (2016) was updated to include 2019 data in addition to historical data collected between 2002 and 2018. The model synthesised length-at-age, incremental growth from release-recapture occurrences, length-frequency, and capture-recapture data.

The synthesis model evaluates the consistency of assumed population dynamics with historical data. Demographic parameter estimates are expected to be more accurate and precise than separate analyses (e.g., separate analyses of growth and abundance) because appropriate population dynamics and all available information are used by the model. A synthesis model can also provide an effective mechanism for monitoring a population. New data may require alterations to the model to improve the fit to the data, which enhances knowledge of population dynamics. Additionally, a synthesis model can assist impact assessment through identification of quantities that can be reliably predicted or identify additional data required to obtain reliable predictions.

A detailed mathematical description of the synthesis model is provided by Gazey and Korman (2016). The model currently focuses on Mountain Whitefish captured in Sections 1, 3, and 5 with no movement of Mountain Whitefish between the sections modelled. Major assumptions required to enable predictions were as follows:

- Fish enter the population (recruitment) each year at age-0 before the start of sampling in August.
- Ages assigned to age-0 fish through scale analysis are without error.
- Trends in growth track a von Bertalanffy curve with an assumed measurement error of length, individual variation of length, and environmental annual variation in mean length.
- Age-dependent survival is a simple power function of the expected length.
- The lengths of fish belonging to an age-class are normally distributed around their mean length.
- The oldest age-class represents all older fish and is subject to the same mortality (i.e., an absorbing age-class where the fish remain but the number of fish belonging to a cohort diminishes over time).
- The initial population size (i.e., 2002 for Sections 1 and 3, and 2004 for Section 5) of each age-class is set from that year's age-specific survival scaled by the observed age structure relative to the initial recruitment (i.e., stationary equilibrium age structure for the initial year).
- Selectivity of fish captured using boat electroshocking follows a logistic curve as a function of size for each sample section. Also, because of different electroshocker settings among study years, separate selectivity curves were applied for the epochs 2002–2013 and 2014–2019.
- The age composition of newly tagged fish reflects the available age composition of the untagged population.
- The population in a sample section is closed to additions or mortality (or tag loss) during each year's study period (28–56 days).
- Within-year capture probabilities are related to across-year capture probabilities through a simple power function.
- All tags are reported on recovery and there is no loss of tags from fish. Tag loss between years is included in the estimate of apparent mortality.

Parameter estimation was achieved through minimization of the model objective function, which consisted of multiple negative log-likelihood data components. These components included length-at-age, incremental length, untagged length composition, tagged length composition, frequency of untagged binary bins (<250 mm FL and ≥250 mm FL), untagged captures, within year tag recaptures, across year tag recaptures, a recruitment prior, and two penalty functions to avoid the prediction of negative population values. Goodness of fit of the model to the data was examined graphically by plotting observed and predicted values.

2.2.3 Catchability

If catchability is constant across years and sample sections, then indices of abundance such as catch rate (number of fish sampled per unit effort, CPUE) would be comparable. Handling time to process a fish, gear saturation, size selectivity by the sampling gear, and other variations in physical conditions can cause systematic bias in the relationship between CPUE and abundance (Hilborn and Walters 1992). Catchability coefficients (parameters relating abundance indices to actual abundance; Ricker 1975) were calculated using closed population assumptions, possibly subject to apparent mortality. If an index of abundance is applicable, then the coefficients should remain constant over study years and sections.

An estimate for the catchability coefficient for the *i*-th section was calculated following Ricker (1975) as follows:

$$\hat{q}_i = \frac{\sum_t C_{ti}}{E_i \cdot N_i} \tag{9}$$

where C_{ti} is from Equation 7, E_i is electroshocking effort (measured as hours of electroshocking or distance traveled), and N_i is the Bayes population abundance estimate for Section *i*, as described in Section 2.2.2.3 above. Given the number of fish sampled and effort data, the variance of the catchability coefficient was defined as follows:

$$Var(\hat{q}_i) = \left(\frac{\sum_t C_{ti}}{E_i} \right)^2 Var\left(\frac{1}{N_i} \right) \tag{10}$$

where the reciprocal of estimated abundance is distributed normally and can be estimated using the following expression (Ricker 1975):

$$Var\left(\frac{1}{N_i} \right) = \frac{\sum_t R_{ti}}{\left(\sum_t M_{ti} C_{ti} \right)^2} \tag{11}$$

2.2.4 Catch and Life History Data

Catch rates for each site were expressed as the number of fish captured per kilometre of shoreline sampled per hour of electroshocker operation (CPUE = no. fish/km-h). The CPUE for each session at each site was the sum of the number of fish captured per kilometre of shoreline sampled per hour of electroshocker operation. The average CPUE was calculated by averaging the CPUE from all sites and sessions. The standard error of the average CPUE was calculated using the square root of the variance of the CPUE from all sites for all sessions divided by the number of sampling events. Prior to 2019, catch rates were calculated using both captured fish and observed fish (i.e., fish that were positively identified but avoided capture). A review of available data indicated that observed fish values could be influenced by water clarity as most of these fish are observed further away from the netter and are less visible in turbid conditions. As such, observed fish were not included in the metric in 2019 and catch rates from prior study years were recalculated. This change in calculation method should be considered when comparing CPUE values presented in this report to CPUE values presented in previous year's reports.

Length-frequencies were calculated using the statistical environment R, v. 3.6.1 (R Core Team 2019). Frequency plots were constructed for fork lengths by year, for all years combined (but plotted separately for each section), and by section within 2019. For all species, fork lengths were plotted using 10 mm bins. Similar to length-frequency, age-frequency plots were constructed by year, for all years combined (but plotted separately by section), and by section within 2019.

Fulton's body condition factor (*K*; Murphy and Willis 1996) was calculated as follows:

(12) $$K = (\frac{W_t}{L^3}) \times 100{,}000,$$

where W_t was a fish's weight (g) and *L* was a fish's fork length (mm). Body condition was plotted for all previous years by section. Mean condition values were estimated for each year and section combination, along with their respective 95% confidence intervals. These plots were constructed for most species.

For most species, relative weight (W_r) was calculated for each fish, providing a comparison of individual fish weight to that of a standard weight developed for each species. Relative weight was calculated as follows:

(13) $$W_r = (\frac{W}{W_s}) \times 100,$$

where *W* is the weight in grams of the individual fish and W_s is the standard weight for a fish of the same length. A relative weight of 100% would indicate a fish that is a physiological optimum. Values below 100% indicate fish that are below the optimum condition, while values above 100% would be considered more rotund. Mean relative weight values were estimated and plotted for each year and section combination, along with their respective 95% confidence intervals.

For Mountain Whitefish, a standard weight equation was proposed by Rogers et al. (1996) using the regression-line percentile technique based on measurements from 13,554 Mountain Whitefish (greater than 140 mm TL) collected from 36 populations across their geographic range as follows:

(14) $$Log_{10}W_s = 5.086 + 3.036Log_{10}TL,$$

where TL is the fish's total length in mm. Prior to calculating relative weight for Mountain Whitefish captured during the Indexing Survey, all measured fork lengths (FL) were converted to total length (TL) using the following formula:

(15) $$TL = 0.252 + 1.080FL.$$

This formula was established in Rogers et al. (1996) and derived from regressing TL on FL for a subset (n = 246) of the total Mountain Whitefish dataset (n = 13,554), where both TL and FL were available.

For Bull Trout, a standard weight equation was proposed by Hyatt and Hubert (2000) using the regression-line percentile technique based on measurements of Bull Trout with total lengths between 120 and 850 mm collected from 13 different populations as follows:

(16) $$Log_{10}W_s = 5.327 + 3.115Log_{10}TL,$$

Prior to calculating relative weight for Bull Trout, all measured fork lengths were converted to total length using the following formula as described by Hyatt and Hubert (2000):

(17) $$TL = 1.049FL.$$

For Rainbow Trout, a standard weight equation was proposed by Simpkins et al. (1996) using the regression-line percentile technique based on measurements of Rainbow Trout with total lengths greater than or equal to 120 mm collected from 81 different populations as follows:

(18) $$Log_{10}W_s = -5.023 + 3.024Log_{10}TL,$$

Prior to calculating relative weight for Rainbow Trout, all measured fork lengths were converted to total length using the following formula as described by Simpkins and Hubert (1996):

(19) $$TL = -0.027 + \ 1.072FL.$$

For Burbot, a standard weight equation was proposed by Fisher et al. (1995) using the regression-line percentile technique based on measurements of 10,293 Burbot with total lengths greater than or equal to 200 mm collected from 79 different North American populations as follows:

(20) $$Log_{10}W_s = -4.6886 + 2.898Log_{10}TL,$$

For Walleye, a standard weight equation was proposed by Murphy et al. (1990) using the regression-line percentile technique based on measurements of 42,487 Walleye as follows:

(21) $$Log_{10}W_s = -5.453 + 3.180Log_{10}TL,$$

Prior to calculating relative weight for Walleye, all measured fork lengths were converted to total length using the following formula:

(22) $$TL = 1.060FL.$$

Length-at-age data were used to construct three-parameter von Bertalanffy growth models (Quinn and Deriso 1999) for all species of interest:

(23) $$L(t) = L_\infty (1 - e^{-K(t-t0)})$$

where L_∞ is the asymptotic length of each species, *K* is the rate at which the fish approaches the asymptotic size (i.e., growth rate coefficient), and t_0 is the theoretical time when a fish has length zero. Non-linear modeling in R was used to estimate all three parameters of interest. Growth curves were estimated for each year (all sections combined) and separately for each section in 2019, where sample sizes were sufficient. For Rainbow Trout, a two-parameter von Bertalanffy curve (i.e. with the t_0 parameter) was used because the full model would not converge due to small sample sizes.

For each study year *i*, the mean fork length of all study years excluding Year *i* was estimated, and the estimated mean was subtracted from the individual fork lengths sampled in Year *i*. The mean and 95% confidence intervals of the estimated differences in fork lengths were then calculated for each year.

Length-weight regressions (Murphy and Willis 1996) were calculated for all species of interest as follows:

(24) $$W = a \times L^b$$

where *W* is weight (g), *L* is fork length (mm), *a* is a constant, and *b* is the regression coefficient.

Catch curves (Ricker 1975) were used to estimate mortality of Arctic Grayling, Mountain Whitefish, and Walleye using year-specific data. Sections 1, 3, 5 were combined into one curve for each species because these sections were consistently sampled between 2002 and 2019. Sections 6, 7, and 9 were combined into another curve for each species because these sections were only sampled from 2015 to 2019. In addition, 2019 data were used to construct section-specific catch curves; this was performed for Arctic Grayling, Mountain Whitefish, and Walleye only, due to scarce age data for other species. Instantaneous total mortality (*Z*) was estimated using ordinary least squares regression of natural logarithm-transformed counts of fish at age, performed on the descending arm of the age distribution:

(25) $$\ln(N_t) = \ln(N_0) - Z \times t$$

where N_0 is the number of fish at the first age-class included in the catch curve analysis, *Z* is instantaneous total mortality, and *t* is time in years. Annual survival was then estimated as $S = e^{-Z}$. Annual mortality (*A*) was calculated as 1-*S*. Confidence intervals (95%) around the annual mortality estimates were calculated using the confidence intervals estimated during regression around *Z*, converting it to confidence intervals around *A* as described above. The catch curves used counts of fish for age-5 and older age-classes. Abundances of age-0 to age-4 fish were not used in catch curves because they were under-represented in the study area, likely because many individuals rear in tributaries, and the smaller age-classes were not fully recruited to the sampling gear.

Recaptured fish that had previously been tagged with T-bar anchor tags in earlier years of the program (2002 to 2004) were included in catch rate analyses but were omitted from all length, weight, age, and growth analyses due to possible effects of the tag on growth. Within-year recaptures were also excluded from age, length, weight, and growth analyses but included in catch rates.

2.2.5 Diversity Profiles

Diversity profiles will eventually be used to monitor changes to the Peace River's fish community composition in response to the construction and operation of the Project. Specifically, profiles will be used to test hypothesis H_4 after the river diversion phase of construction.

Traditional indices of diversity, such as species richness, Shannon's index, or Simpson's index differ in how the relative abundance of species affects the index, which affects the degree to which less common versus common species are represented. A diversity profile is a method that plots the relationship between diversity and the degree to which relative abundance is represented (Leinster and Cobbold 2012). The response variable in a diversity profile is the "effective number of species", which is the number of equally common species required to get a particular value of an index (Jost 2006). Effective numbers are recommended for comparisons of diversity because they allow intuitive and straightforward comparison of the number of species, instead of individual indices, which are more difficult to interpret and can be misleading due to non-linearity (Jost 2006; Chao et al. 2014). For instance, a community of eight equally common species has a Shannon index of 2.1 (calculated using natural log) and 8 effective species, whereas a community of 16 equally common species has a Shannon index of 2.8 and 16 effective species. The second community is twice as diverse as the first but appears only 33% more diverse using the Shannon index (2.7 vs. 2.1).

Diversity profiles also can take into account similarity between species when calculating diversity. Most measures of diversity do not take into account similarity between species, such that the diversity of a community of three trout species is equal to that of a community with a sculpin species, a trout species, and Walleye. However, most people would intuitively consider the latter community more diverse. Diversity profiles can account for diversity among species by assigning a similarity value between 0 and 1 for each pair of species, where a value of 1 indicates an equivalent species and a value of 0 indicates no similarity (Leinster and Cobbold 2012). Similarity values could be assigned based on any biologically criteria desired, such as genetic or functional similarity.

Diversity profiles were calculated using the following equation:

(26) $$ {}^{q}D^{\mathbf{Z}}(\mathbf{p}) = \left(\sum p_i \, (\mathbf{Zp})_i^{q-1}\right)^{1/(1-q)} $$

where *D* is the effective number of species, *p* is the relative abundance of the species present, *q* is the parameter representing the relative contribution of relative abundance data, and *Z* is the similarity matrix among species (Leinster and Cobbold 2012). A value of $q = 0$ represents no importance of relative abundance and is equivalent to a count of the number of species, often referred to as species richness. A value of $q = 1$ is equivalent to the Shannon index. Values less than 1 result in less common species being over-represented, and values greater than 1 result in common species being over-represented. Values on the right of a diversity profile (highest values of *q*) are insensitive to changes in less common species and values on the left are sensitive to less common species. The shape of diversity profiles can be used to interpret the community composition and compare composition between datasets. For instance, a flat profile indicates near equal abundance among species, whereas a steeper profile indicates more unequal abundance among species. Diversity profiles allow comparison of the number of effective species across the entire range of importance of less common to common species, instead of requiring the assumptions of a single diversity index. Diversity profiles have previously been used in a power analysis to assess the likelihood of detecting significant differences in community composition in the Peace River before and after Project construction (Ma et al. 2015).

Diversity profiles were calculated separately for each section for all years with available data. The analysis used captured fish of all species but excluded fish not identified to the species level (e.g., fish recorded as sculpin species or sucker species). For the species similarity matrix (*Z*), values were set to 1 for all “small fish” and for all sucker species, which treated each of these groups as one species. Values in the matrix were set to 0 for all pairs of species with the interpretation that all these pairs of species were equally and completely different. This was the same approach for species similarity developed by Ma et al. (2015). Diversity was not statistically compared between each section (e.g., t-test). Instead, the effective number of species is shown graphically to allow the reader to decide what magnitude of difference is biologically meaningful.

3.0 RESULTS

3.1 Physical Parameters

3.1.1 Discharge

Discharge in the Peace River is regulated by the operations at WAC Bennett Dam and PCD. In most years, total river discharge gradually decreases from January to early June, increases from early June to mid-July, remains near stable from mid-July to early October, and increases from early October to late December. In 2019, mean daily discharge in the Peace River (i.e., discharge through PCD) was within the historical range of the 2002–2018 period, with the exception of a period of historically low flows in early January and historically high flows in mid-November (Figure 2; Appendix C, Figure C1). From mid-March to early October of 2019, discharge through PCD was substantially below the average discharge recorded during this same period from 2002 to 2018. During the 2019 study period, mean daily discharge was variable during Sessions 1 to 3, near historical lows during Session 4, and increased from near historical lows to near historical highs over Sessions 5 and 6 (Figure 2).

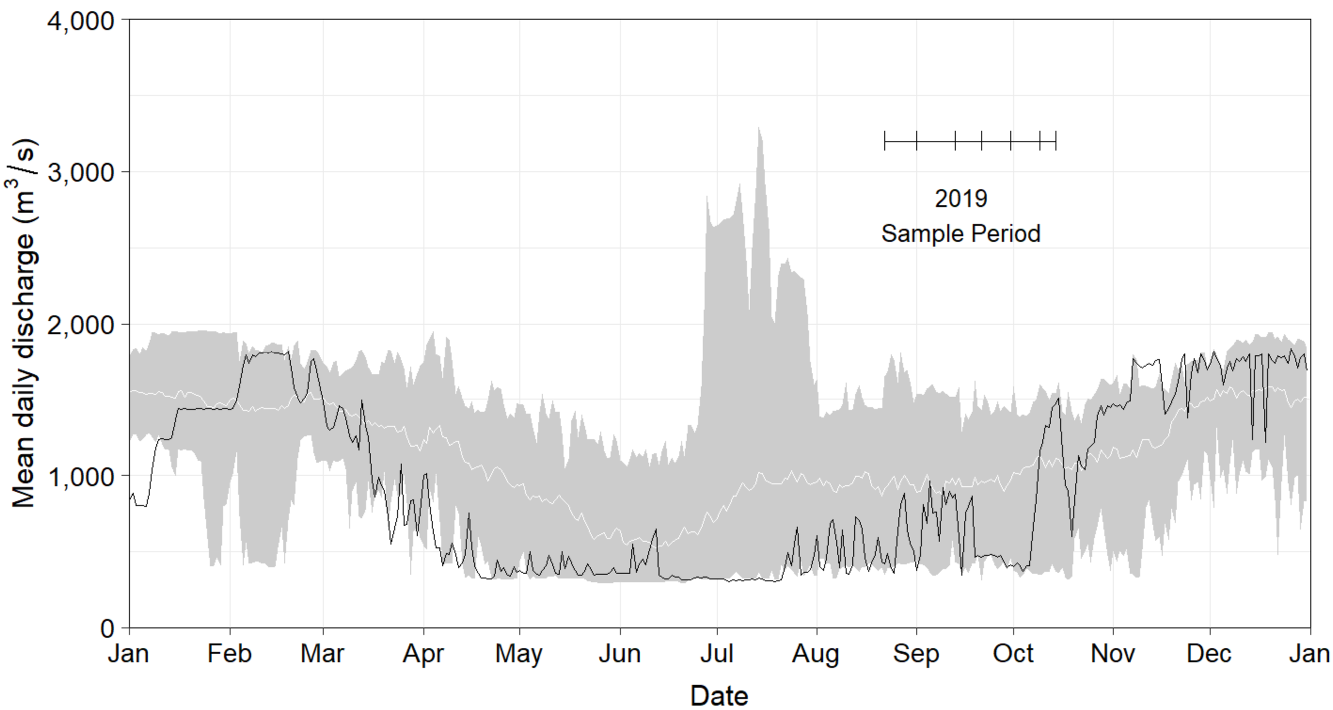


Figure 2: Mean daily discharge (m^3/s) for the Peace River at Peace Canyon Dam, 2019 (black line). The shaded area represents minimum and maximum mean daily discharge values recorded at the dam from 2002 to 2018. The white line represents average mean daily discharge values over the same time period. Vertical lines on the sample period bar represent the approximate start and end times of each sample session.

During the 2019 study period, mean hourly discharge in the Peace River was variable and ranged from a high of more than 2000 m³/s in Section 7 to a low of approximately 500 m^3/s in Section 1 (Figure 3). Hourly discharge throughout the day was more variable from mid-August to mid-September (approximately Sessions 1 to 3) than from mid-September to mid-October (approximately Sessions 4 to 6).

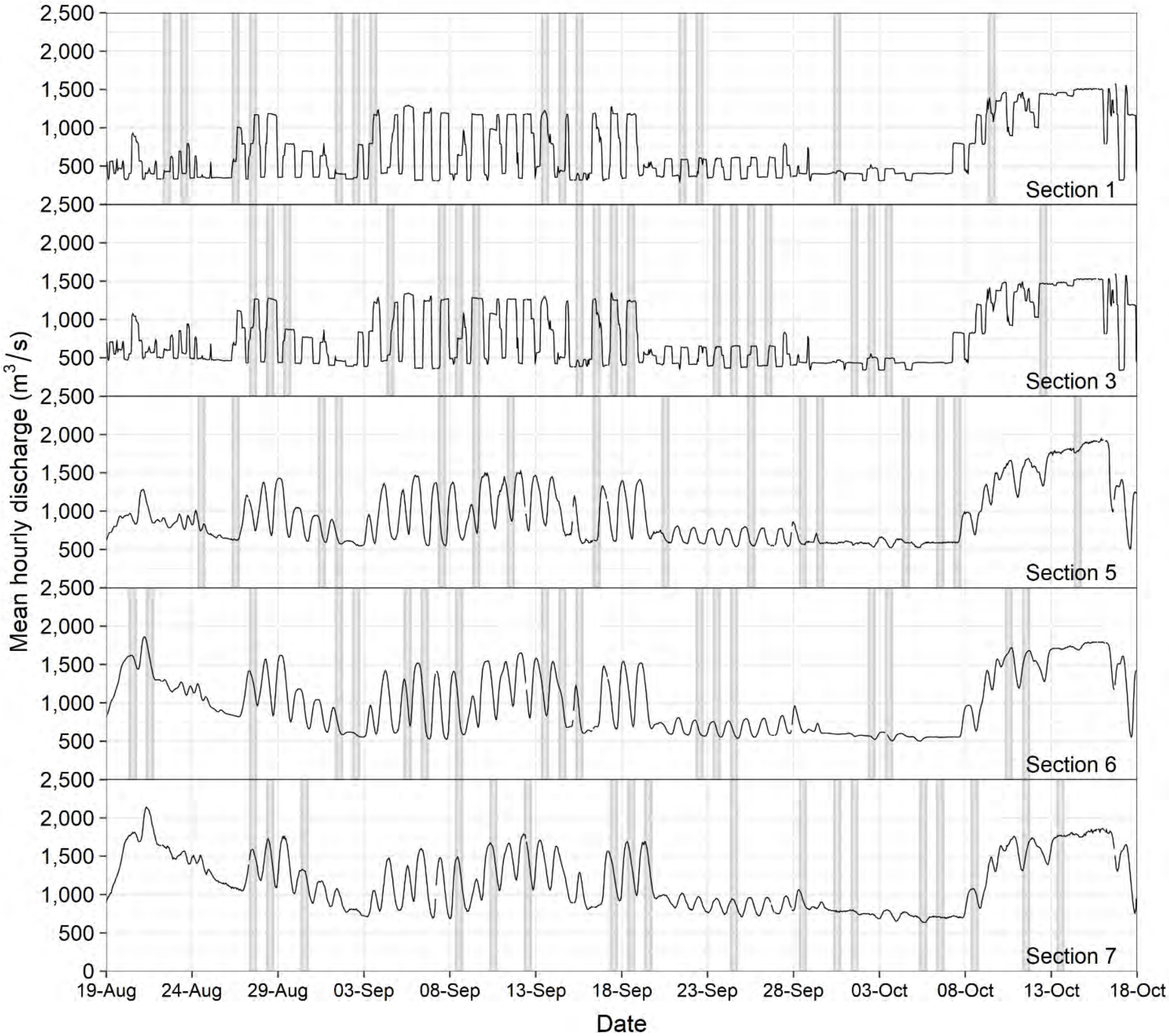


Figure 3: Sectional discharge in five-minute intervals for the Peace River, 9 June to 17 October 2019. The shaded areas represent the approximate timing of daily sampling (from 9:00 a.m. to 5:00 p.m.). Section 3 data represent approximate values as detailed in Section 2.1.1. Data for Section 9 are not available for the reasons provided in Section 2.1.1.

3.1.2 Water Temperature

During a typical study year, water temperatures are generally lower in Section 1 during the spring and summer and higher in Section 1 during the fall and winter compared to Sections 3 and 5 (Appendix C, Figure C2). During a typical year, Peace River water temperatures remain low (generally less than 2°C) from January to early April, gradually increase from early April to early August, and gradually decrease from early August to late December (Appendix C, Figures C3 to C5). In 2019, water temperatures remained low until early April and increased from early April to early September before declining from early September to the end of the year.

Mean water temperatures in the Peace River during the 2019 study period, as measured downstream of PCD and representative of water temperatures within Section 1, gradually declined while remaining within the historical range recorded between 2008 and 2018 (Figure 4).

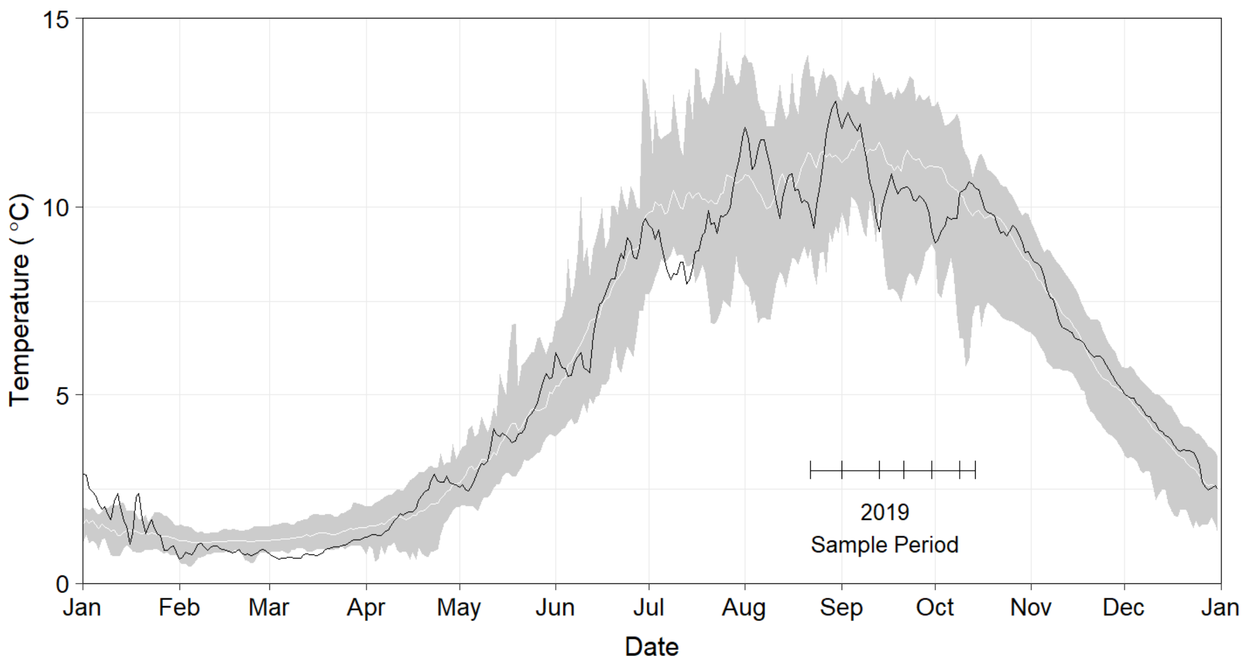


Figure 4: Mean daily water temperature (°C) for the Peace River recorded downstream of Peace Canyon Dam, 2019 (black line). The shaded area represents the minimum and maximum mean daily water temperature values recorded downstream of PCD between 2008 and 2018. The white line represents the average mean daily water temperature during the same time period.

Mean daily water temperature in the Peace River, as measured downstream of the confluence of the Peace and Halfway rivers, represents water temperatures in Section 3. In 2019, the datalogger was dislodged by debris and as a result, temperature data from approximately mid-March to early August are not available for this location (Figure 5). During the 2019 study period, water temperatures in Section 3 were extremely variable and near historical lows in mid-August and late September, and near historical averages in the middle of the study period. Over a one-week period in late September, water temperatures in Section 3 declined from 12.5°C to 4.2°C (Figure 5). This 8.3°C decline in temperature was not recorded by temperature loggers installed in Section 1 (Figure 4) and is likely due to colder Halfway River outflows.

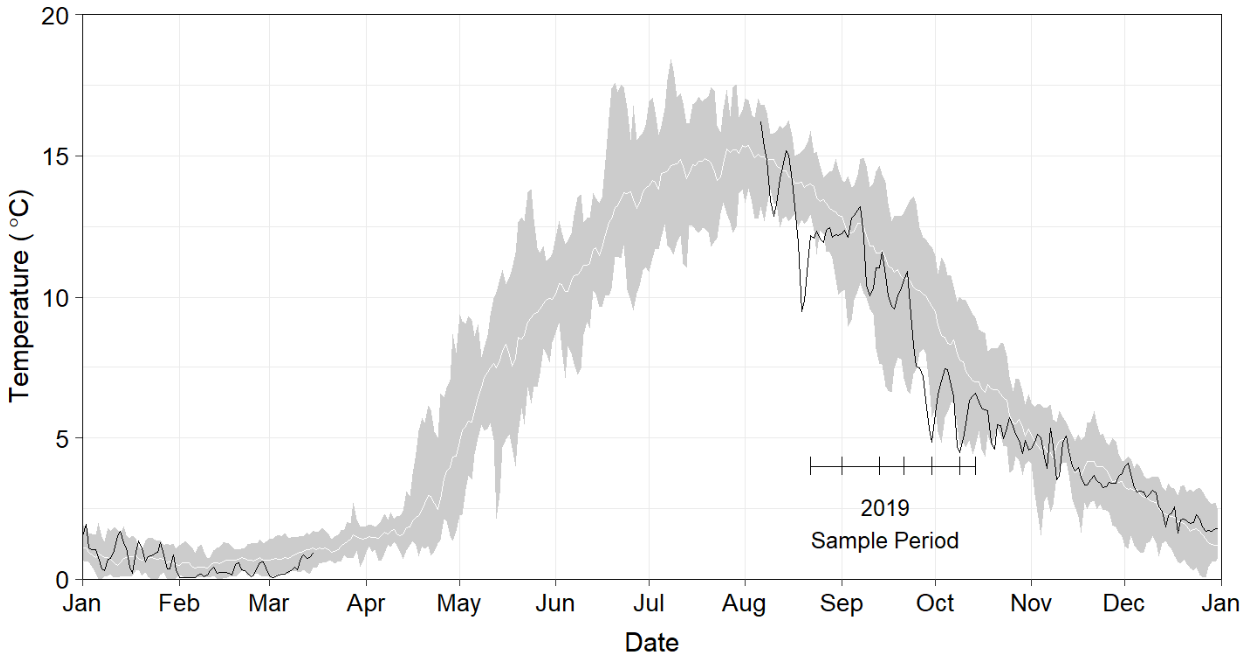


Figure 5: Mean daily water temperature (°C) for the Peace River recorded downstream of the Halfway River confluence, 2019 (black line). The shaded area represents the minimum and maximum mean daily water temperature values recorded at that location between 2008 and 2018. The white line represents the average mean daily water temperature during the same time period.

Mean daily water temperature in the Peace River, as measured below the confluence of the Peace and Moberly rivers, represents water temperatures in Section 5. Trends in water temperature in Section 5 are typically similar to those in Section 3 (Appendix C, Figure C2). In 2019, water temperatures generally inclined from early March to early August, generally declined from early August to late December, and remained within historical bounds for most of the year (Figure 6). During the 2019 study period, water temperatures in Section 5 gradually declined from a high of approximately 13.5°C during Session 1 to a low of 8.4°C during Session 6.

Continuous water temperature data are not available for the Peace River for Sections 6, 7, or 9. Water temperature measurements taken by the crew at the time of sampling during the 2019 study period generally declined from a high of 14.0°C to a low of approximately 6.5°C in Section 6, declined from a high of 14.4°C to a low of 5.2°C in Section 7, and declined from a high of 14.8°C to a low of 4.5°C in Section 9 (Appendix D, Table D3).

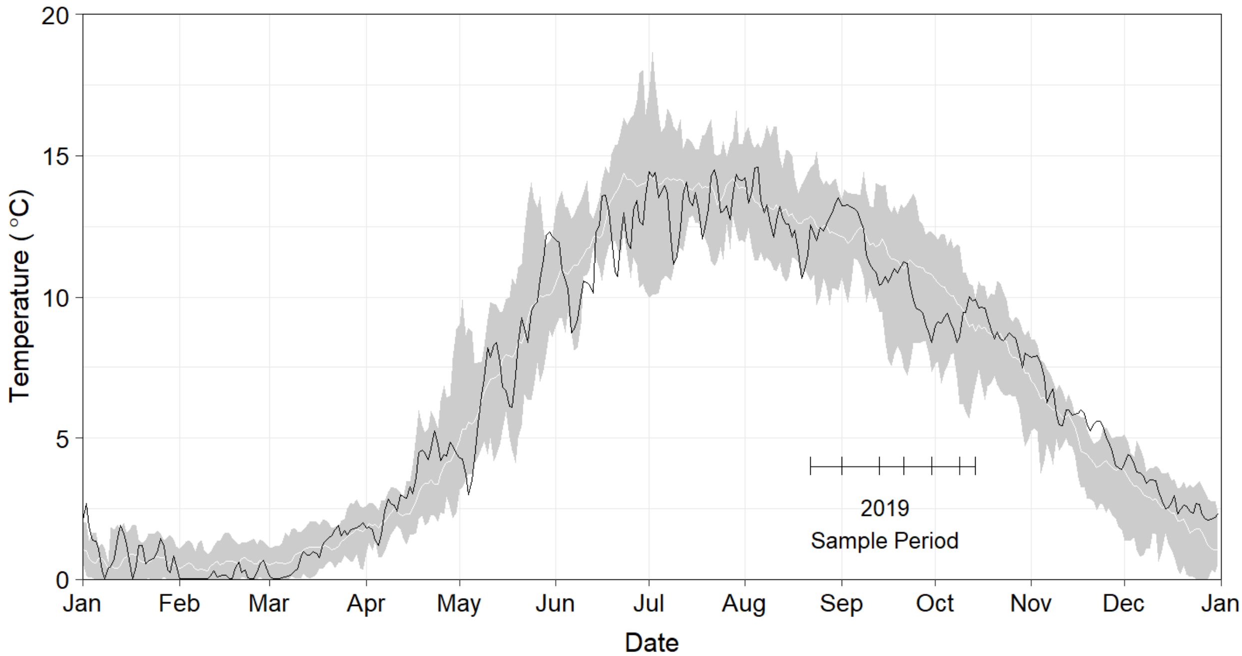


Figure 6: Mean daily water temperature (°C) for the Peace River recorded near the Moberly River confluence, 2019 (black line). The shaded area represents the minimum and maximum mean daily water temperature values recorded at that location between 2008 and 2018. The white line represents the average mean daily water temperature during the same time period.

3.1.3 Habitat Variables

Mainstream (2012) provides a description of fish habitat available in the study area. Habitat variables collected at each site during the present study are provided in Appendix D, Table D3 and are also included in the Peace River Large Fish Indexing Database (Attachment A). In Sections 1, 3, and 5, each site was categorized into various habitat types using their bank habitat type as assigned by R.L.&L. (2001). The Bank Habitat Type Classification System is summarized in Appendix D, Table D2. Bank habitat types have not been classified and are not available for Sections 6, 7, and 9. Locations sampled as part of the Indexing Survey and the Goldeye and Walleye Survey are detailed in Appendix A, Table A1 and A2, respectively and illustrated in Appendix A, Figures A1 to A8. Habitat classifications (when available) are illustrated in Appendix A, Figures A1 to A6. Overall, habitat data recorded during the 2019 Indexing Survey did not suggest any substantial changes to fish habitat in any sections when compared to 2018 data.

3.2 General Characteristics of the Fish Community

In 2019, 17,290 fish from 25 different species were captured in the Peace River and select tributary confluences (Table 8). These values do not include fish that were observed but avoided capture and do not include intra-year recaptured individuals. Catch was greatest in Section 3 (29% of the total catch) and lowest in Section 9 (5% of the total catch; Table 8). To align with classifications presented in the Site C EIS (Golder et al. 2012), each fish species was placed into one of four groups. Group 1 consisted of large-bodied fish typically targeted by anglers (i.e., Burbot, Goldeye, Lake Trout, Northern Pike, Rainbow Trout, Walleye), Group 2 included species considered "passage sensitive" (i.e., Arctic Grayling, Bull Trout, and Mountain Whitefish), Group 3 included planktivorous species (Kokanee and Lake Whitefish), and Group 4 fish consisted of all remaining species (i.e., Northern Pikeminnow, sucker species, and small-bodied fish species). Group 2 fish were most common and comprised 66% of the total catch, with Mountain Whitefish representing 97% of the overall group. Group 4 fish were the second most abundant group and comprised 31% of the total catch. The bulk of the Group 4 catch were sucker species (87%). Group 1 fish contributed 2% to the total catch and was dominated by Walleye (53% of the Group 1 catch) and Rainbow Trout (30% of the Group 1 catch). Group 2 fish were infrequently captured, with catch largely limited to the upstream sections of the study area. While encountered, the following species each comprised less than 1% of the total catch (in declining order of abundance): Slimy Sculpin (*Cottus cognatus*), Flathead Chub (*Platygobio gracilis*), Burbot, Trout-perch (*Percopsis omiscomaycus*), Northern Pikeminnow, Longnose Dace (*Rhinichthys cataractae*), Kokanee, Goldeye, Spottail Shiner (*Notropis hudsonius*), Prickly Sculpin (*Cottus asper*), Yellow Perch (*Perca flavescens*), Lake Trout, Spoonhead Sculpin (*Cottus ricei*), Lake Whitefish. In general, cold-water species (as defined by Mainstream 2012), such as Bull Trout, Mountain Whitefish, and Rainbow Trout, were more common in upstream sections of the study area and cool-water species (Mainstream 2012), such as Northern Pike and Walleye, were more common in the downstream sections of the study area (Table 8).

Table 8: Number of fish caught by boat electroshocking and their frequency of occurrence in sampled sections of the Peace River, 20 August to 14 October 2019.

Group[a]	Species	Section												All Sections		
		1		3		5		6		7		9				
		n[b]	%[c]	n[b]	%[c]	n[b]	%[c]	n[b]	%[c]	n[b]	%[c]	n[b]	%[c]	n[b]	%[c]	%[d]
1	Burbot			2	2	8	18	5	5	13	9	19	25	47	9	<1
	Goldeye											14	18	14	3	<1
	Lake Trout			3	4									3	1	<1
	Northern Pike					5	11	15	16	3	2	2	3	25	5	<1
	Rainbow Trout	75	100	67	79	9	20	3	3	2	1	1	1	157	30	1
	Walleye			13	15	22	50	70	75	128	88	41	53	274	53	2
Group 1 Subtotal		75	100	85	100	44	100	93	100	146	100	77	100	520	100	2
2	Arctic Grayling			38	1	14	1	35	2	13	1	1	<1	101	1	1
	Bull Trout	63	2	63	2	26	2	24	1	20	2	4	2	200	2	1
	Mountain Whitefish	3,514	98	3,637	97	1,114	97	1,591	96	972	97	232	98	11,060	97	64
Group 2 Subtotal		3,577	100	3,738	100	1,154	100	1,650	100	1,005	100	237	100	11,361	100	66
3	Kokanee	10	100	5	100	1	50	1	100					17	94	<1
	Lake Whitefish					1	50							1	6	<1
Group 3 Subtotal		10	100	5	100	2	100	1	100	0	0	0	0	18	100	0
4	Flathead Chub			1	<1	2	<1	1	<1	34	3	11	2	49	1	<1
	Lake Chub			23	2	3	<1	51	4	66	6	7	1	150	3	1
	Largescale Sucker	191	40	301	27	219	28	274	20	144	14	40	7	1,169	22	7
	Longnose Dace			4	<1	2	<1	5	<1	4	<1	3	<1	18	<1	<1
	Longnose Sucker	233	49	661	59	397	50	855	64	715	68	500	82	3,361	62	19
	Northern Pikeminnow	7	1	53	5	49	6	38	3	24	2	12	2	183	3	1
	Prickly Sculpin	1	<1	1	<1	6	1	3	<1	1	<1			12	<1	<1
	Redside Shiner	1	<1	31	3	43	5	47	4	10	1	1	<1	133	2	1
	Slimy Sculpin	6	1	29	3	16	2	10	1	7	1			68	1	<1
	Spoonhead Sculpin			1	<1					1	<1	1	<1	3	<1	<1
	Spottail Shiner					3	<1	8	1	1	<1	2	<1	14	<1	<1
	Trout-perch			2	<1	6	1	11	1	22	2	2	<1	43	1	<1
	White Sucker	33	7	19	2	47	6	35	3	20	2	22	4	176	3	1
	Yellow Perch					1	<1	1	<1			10	2	12	<1	<1
Group 4 Subtotal		472	100	1,126	99	794	99	1,339	99	1,049	99	611	99	5,391	99	30
All species		4,134	24	4,954	29	1,994	12	3,083	18	2,200	13	925	5	17,290	100	98

[a] Based on the groupings detailed in Golder et al. (2012)[6].

[b] Includes fish captured and identified to species; does not include fish that avoided capture or within-year recaptured fish.

[c] Percent composition within each fish group.

[d] Percent composition of the total catch.

[6] EIS, Volume 2, Appendix P Part 3 (BC Hydro 2013).

3.3 Arctic Grayling

During the 2019 survey, 101 Arctic Grayling were captured (i.e., excluding within-year recaptures). Arctic Grayling were captured in all sections except Section 1 (38 in Section 3, 14 in Section 5, 35 in Section 6, 13 in Section 7, and 1 in Section 9). An immature Arctic Grayling captured in Section 9 in 2019 was the third Arctic Grayling to be recorded in this section since 2016 (two YOY Arctic Grayling were captured in Section 9 in 2016). The distribution among sections differed between 2019 and 2018. In 2018, less than 1% of Arctic Grayling were recorded in Section 6 (*n* = 5; Golder and Gazey 2019), whereas in 2019, 35% of Arctic Grayling were captured in Section 6 (*n* = 35) (Table 8). With the exception of Section 6, the number of Arctic Grayling captured in each section were similar in 2018 and 2019; however, in 2019, substantially more age-0 (*n* = 22) and age-1 (*n* = 9) Arctic Grayling were recorded in Section 6 relative to 2018 (*n* = 2 age-0; *n* = 0 age-1).

3.3.1 Biological Characteristics

Fork lengths of Arctic Grayling ranged between 90 and 391 mm; weights ranged between 7 and 737 g.

Arctic Grayling captured in 2019 that were also captured during a previous study year (i.e., inter-year recaptured fish) were assigned ages using the youngest scale sample collected because older scale samples are typically less accurate for Arctic Grayling (Mackay 1997). Sixteen Arctic Grayling were assigned ages using scale samples collected during a previous study year plus the number of years the fish was at-large. An additional 57 Arctic Grayling were assigned ages using scale samples collected during the current study year. Assigned ages ranged between age-0 and age-5 (Table 9).

Table 9: Average fork length, weight, and body condition by age for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Age	Fork Length (mm)			Weight (g)			Body Condition (K)		
	Average ± SD	Range	*n*[a]	Average ± SD	Range	*n*[a]	Average ± SD	Range	*n*[a]
0	112 ± 10	90 – 130	24	15 ± 4	7 – 24	24	1.07 ± 0.13	0.90 – 1.47	24
1	180 ± 13	161 – 189	6	65 ± 15	44 – 81	6	1.10 ± 0.06	1.04 – 1.20	6
2	295 ± 8	280 – 305	6	295 ± 27	247 – 320	6	1.15 ± 0.04	1.10 – 1.22	6
3	334 ± 15	304 – 355	12	464 ± 80	304 – 606	12	1.23 ± 0.09	1.08 – 1.35	12
4	348 ± 17	320 – 386	16	519 ± 81	412 – 633	16	1.23 ± 0.10	1.05 – 1.41	16
5	360 ± 25	306 – 391	9	591 ± 106	354 – 729	9	1.26 ± 0.08	1.14 – 1.37	9

[a] Number of individuals sampled.

The number of Arctic Grayling by age-class (Table 9) and length-frequencies (Figure 7) indicate that both juvenile (age-0; < 130 mm FL) and older (age-2+) age-classes are present in the study area. Historical length-frequency data (Appendix F, Figure F1) showed a variety of length groupings during most study years. Length distributions did not overlap between age-0 to age-2 individuals but did overlap between age-3 and age-5 individuals, suggesting that Arctic Grayling reach sexual maturity in the Peace River at approximately age-3 (Table 9).

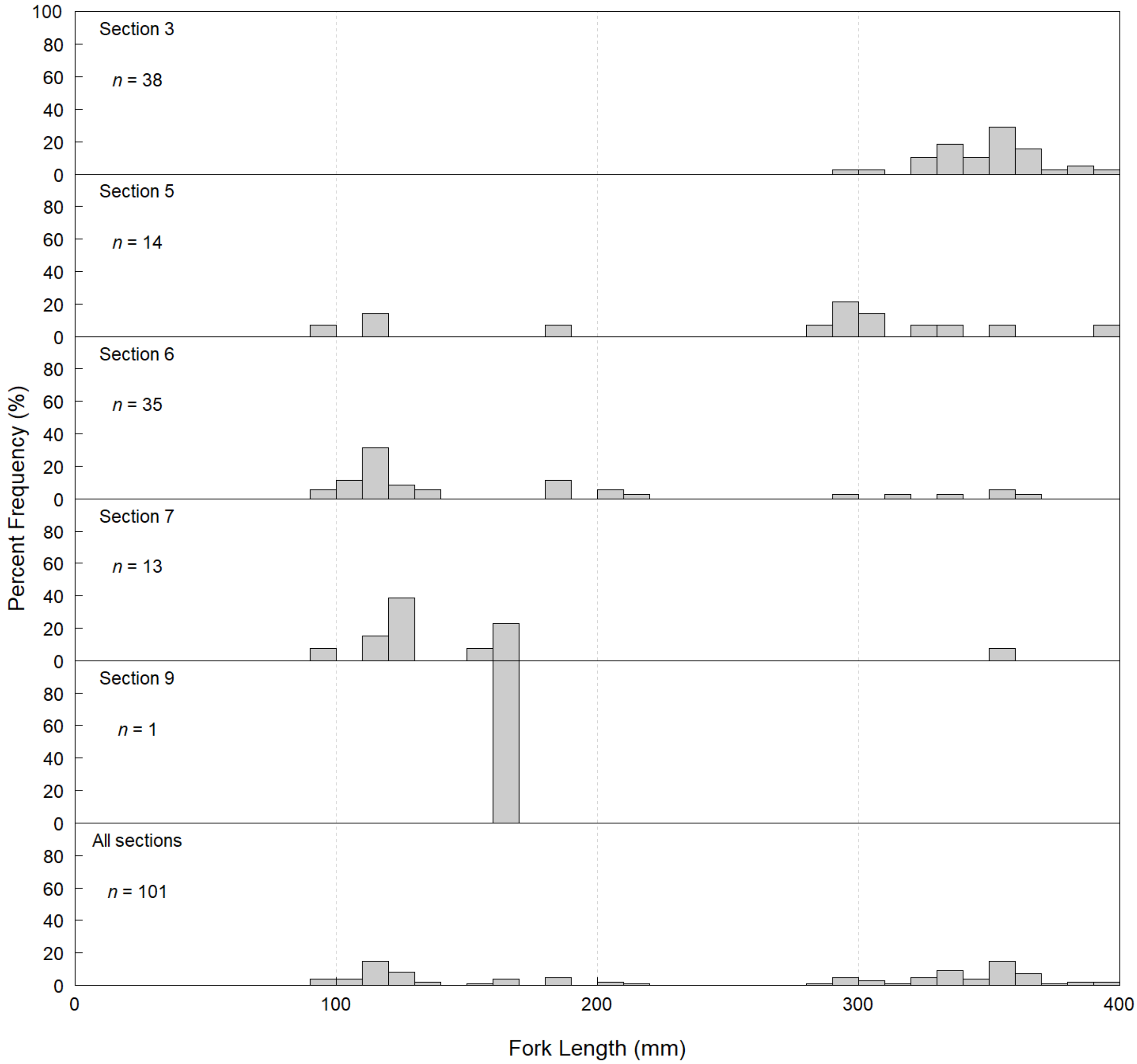


Figure 7: Length-frequency distribution for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

The interpretation of age-frequency distributions of Arctic Grayling by section was limited due to the low number of captured and aged individuals in most sections (Figure 8). Most of the Arctic Grayling were age-0, age-3, and age-4. Arctic Grayling considered to be age-0 based on fork length (<120 mm; Figure 7) or scale ageing (Figure 8) were captured in Sections 5, 6, and 7 but not in Sections 1, 3, or 9. Data suggest poor recruitment originating from the 2017 and 2018 brood years, which is indicated by a lower percentage of age-1 and age-2 individuals in the 2019 catch (Figure 8) and supported by data collected in 2017 and 2018 (Appendix F, Figure F3). The high number of age-0 Arctic Grayling recorded in Sections 5, 6, and 7 in 2019 (Figure 8) suggest strong recruitment from the 2019 brood year (i.e., fish that hatched earlier in 2019); however, additional years of data are required to confirm this premise.

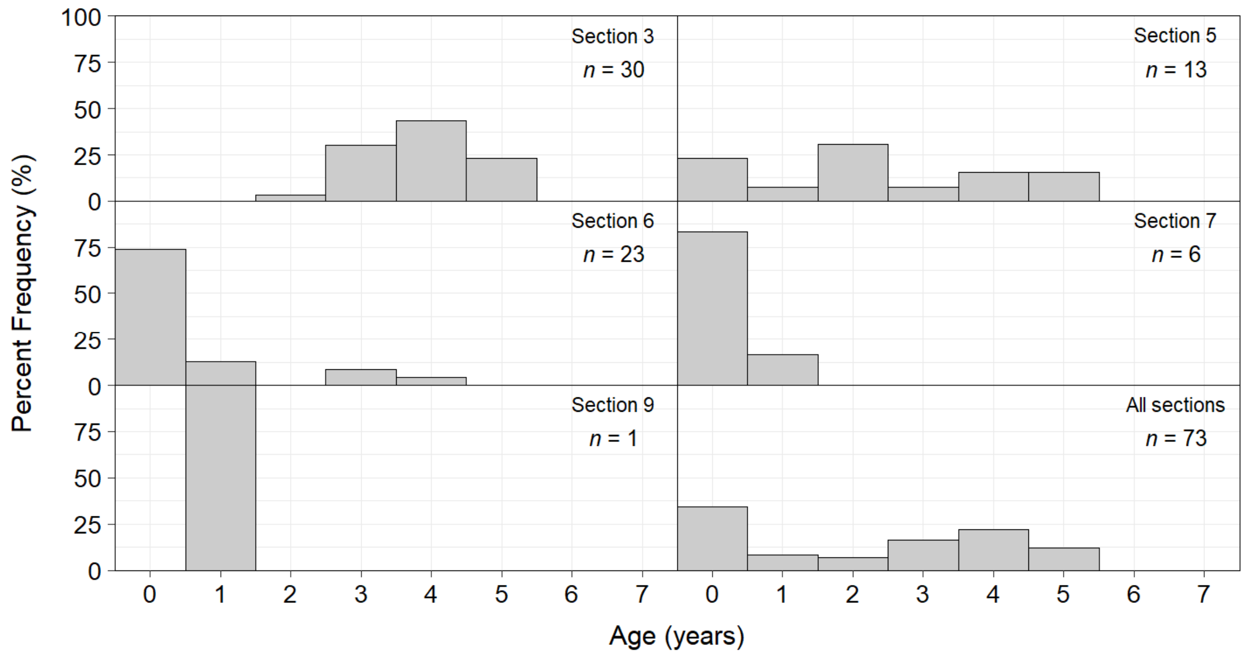


Figure 8: Age-frequency distributions for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019. Arctic Grayling were not captured in Section 1 in 2019.

Length-at-age and von Bertalanffy growth curves in 2019 showed that mean length-at-age and growth of Arctic Grayling were within the range of values observed in previous study years (Figure 9 and Figure 10). Greater predicted asymptotic length in some years, such as 2003 and 2006 (Figure 10), may have been related to small sample sizes, rather than real differences in growth among years. Length-at-age varied among years and showed no discernible trends among age classes or study years (Figure 11). The decline in mean length of age-2 Arctic Grayling noted between 2015 and 2018 (Golder and Gazey 2019) was not apparent in 2019; however, only six age-2 individuals were recorded in 2019, and captures were limited to two sections (Sections 3 and 5).

Length-weight regressions for Arctic Grayling had small sample sizes for most sections, which prevented meaningful comparisons among sections (Figure 12). There was little difference in length-weight regressions for Sections 1, 3, and 5 combined compared to Sections 6, 7, and 9 combined for years where data were available for all of these sections (2014 to 2019; Appendix F, Figure F5). The exponent of length-weight regressions was greater than 3.0 in most years indicating slightly positive allometric growth (i.e., increase in body weight with increase in length). Length-weight slopes and the predicted weight at mean length were not statistically compared in 2019 because 2019 results were very similar to 2017 results and statistical comparisons conducted in 2017 were uninformative due to the small sample sizes for many years and age-classes of Arctic Grayling (see Golder and Gazey 2018).

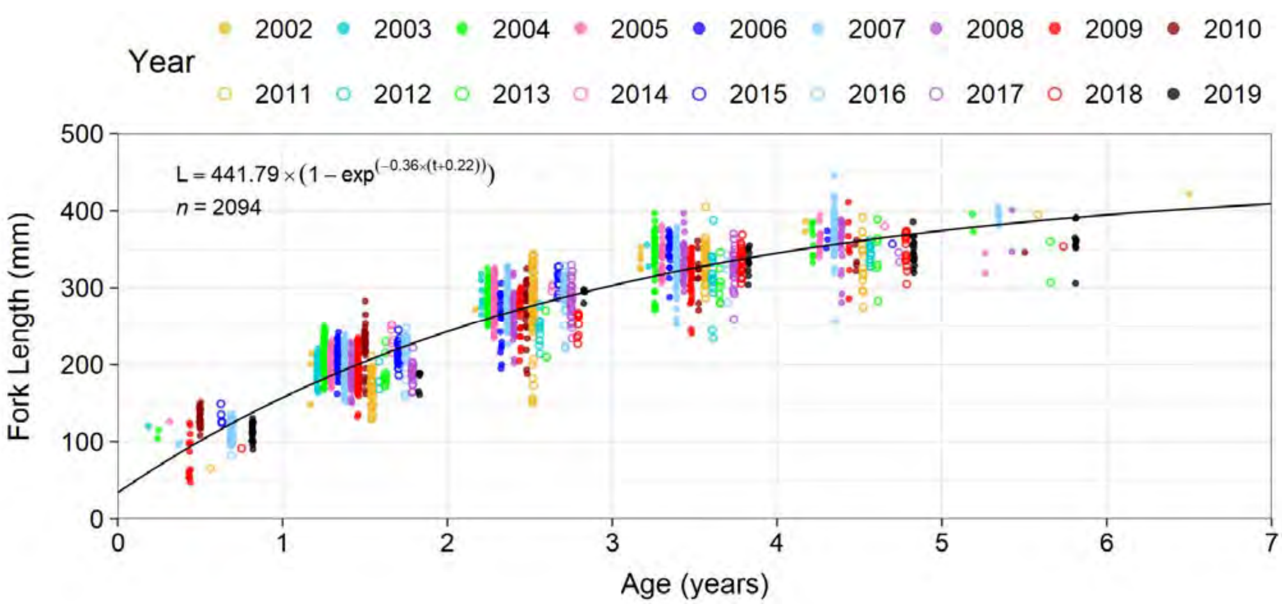


Figure 9: Length-at-age data for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. Data points from each year are offset to prevent overlap.

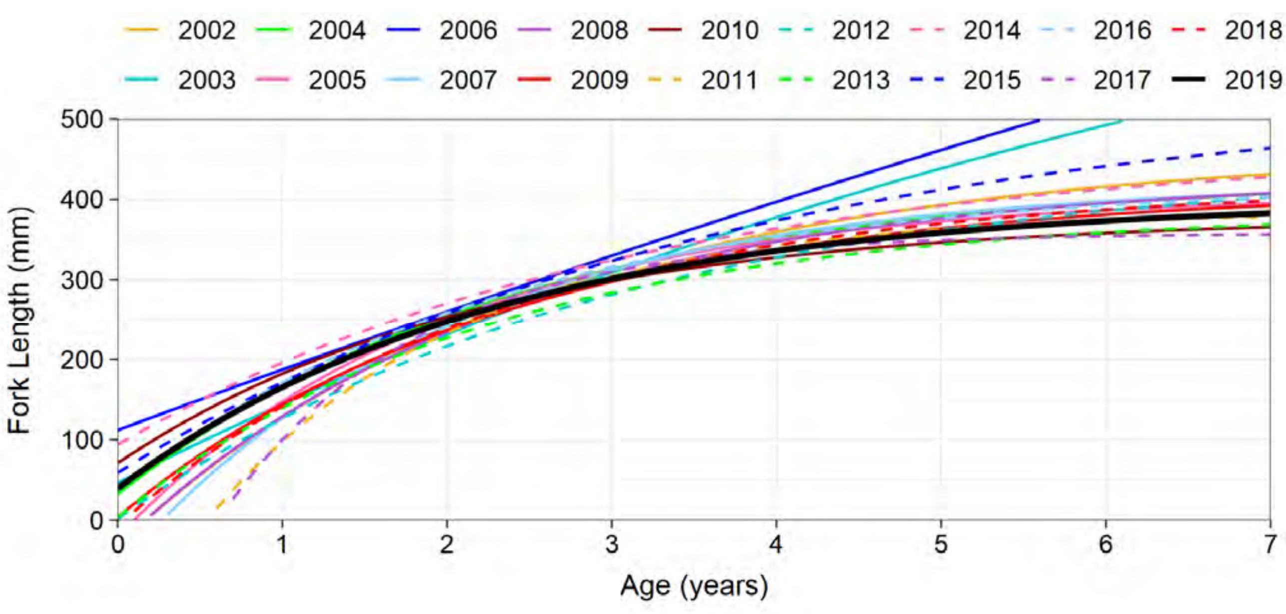


Figure 10: von Bertalanffy growth curves for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019.

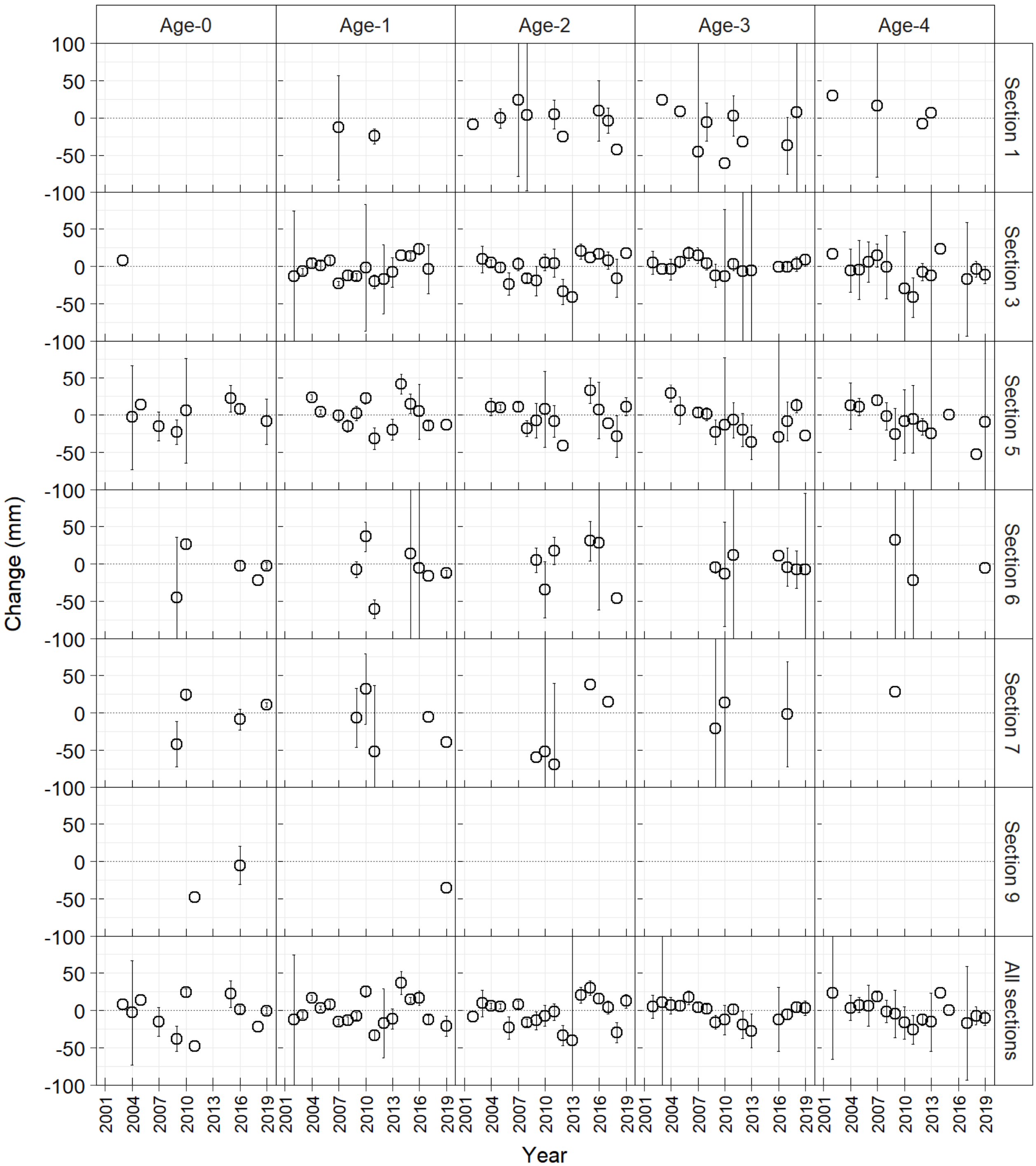


Figure 11: Change in mean length-at-age for Arctic Grayling captured by boat electroshocking in the Peace River, 2002 to 2019. Change is defined as the difference between the annual estimate and the estimate of all years combined. Error bars represent 95% confidence intervals. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

The body condition (*K*) of Arctic Grayling captured in 2019 ranged from 0.90 to 1.47 and was most variable for age-0 individuals (Table 9). In general, body condition increased with age. There was little variation in mean body condition between 2002 and 2019 in any sections (Figure 13).

Relative weights were not calculated for Arctic Grayling.

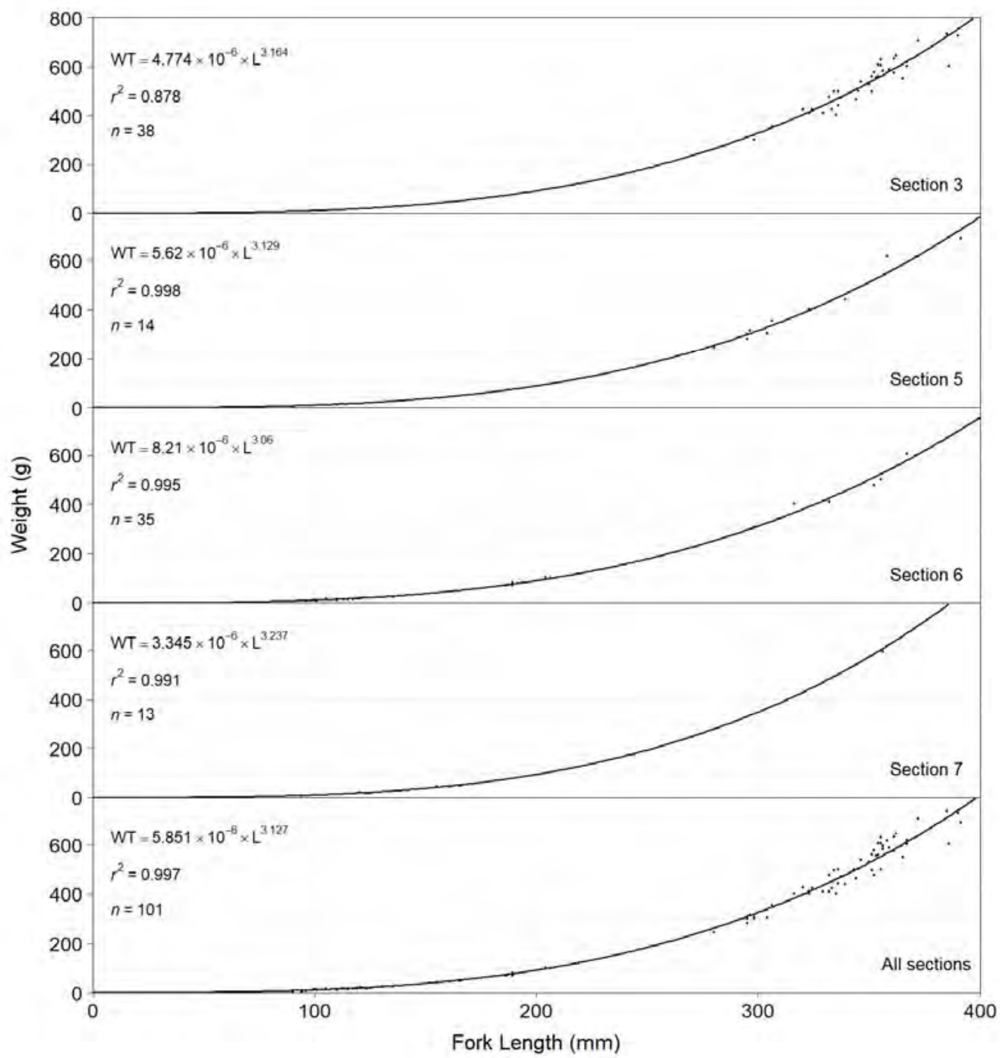


Figure 12: Length-weight regressions for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

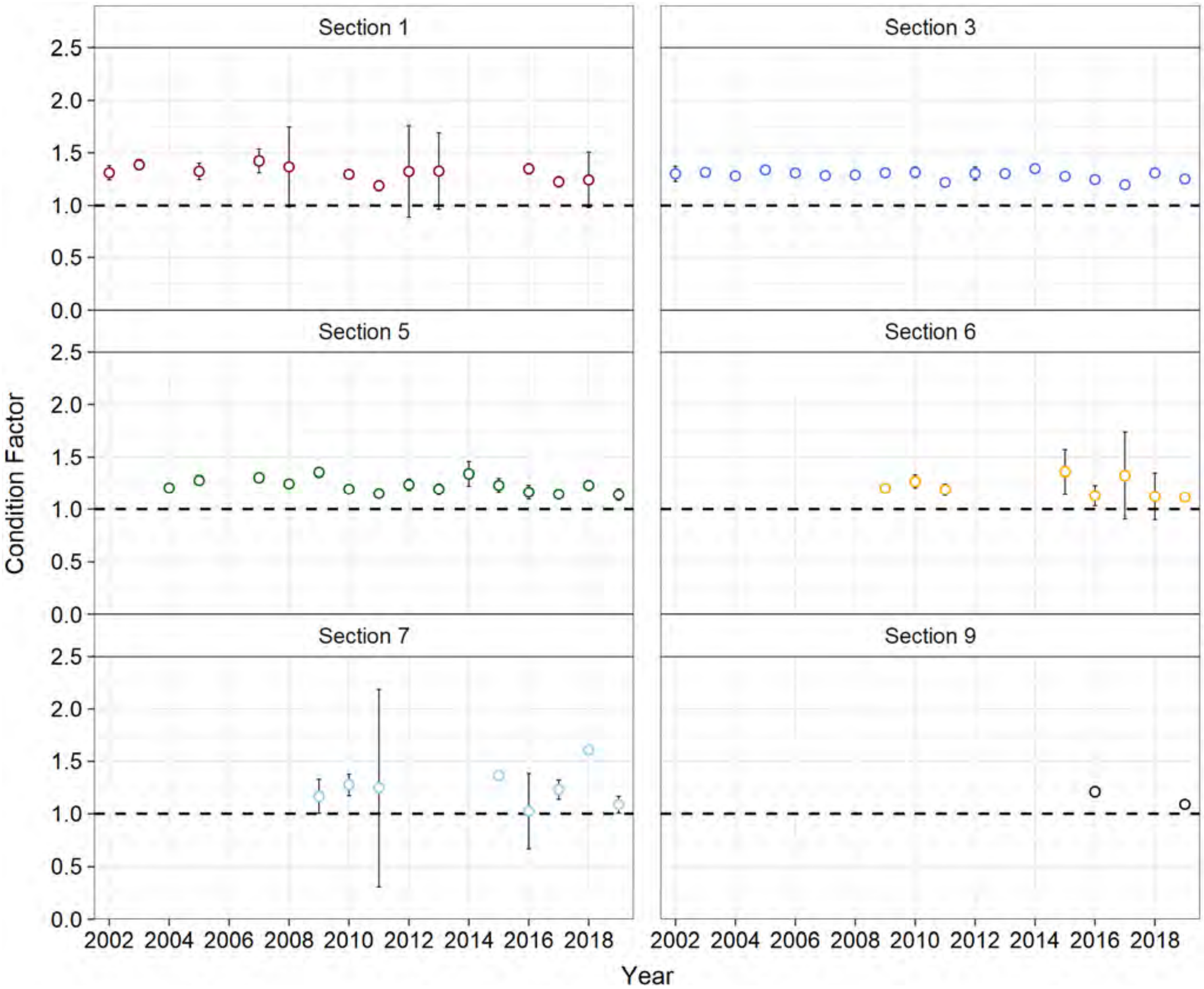


Figure 13: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) for Arctic Grayling captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6 and 7, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

3.3.2 Abundance

3.3.2.1 Catch-Per-Unit-Effort

Arctic Grayling were consistently captured between 2002 and 2019 in Sections 1, 3, and 5 and consistently captured between 2015 and 2019 in Sections 6, 7, and 9; therefore, changes in catch-rates over time were compared for this species using these section groupings (Figure 14). Arctic Grayling catch rates in Sections 1, 3, and 5 declined between 2011 and 2014, increased between 2014 and 2016, and was similar from 2016 to 2019. Confidence intervals overlapped for estimates generated between 2015 and 2019 for Sections 1, 3, and 5, suggesting a stable Arctic Grayling population over this time period. This result was supported by catch rate data from Sections 6, 7, and 9 between 2015 and 2018; however, the 2019 estimate was substantially higher for these sections, due largely to increased catch of age-0 and age-1 individuals in Section 6 (Figure 14). During most study years, Arctic Grayling were more commonly recorded in upstream sections than lower sections.

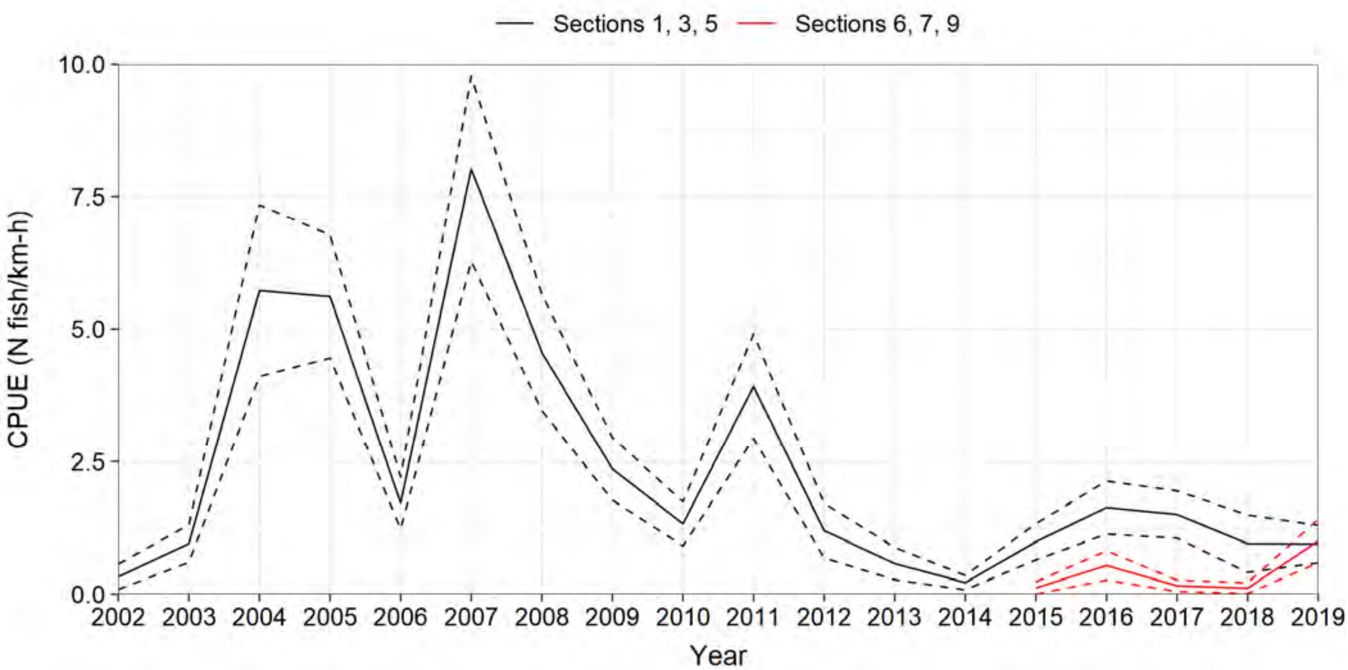


Figure 14: Mean annual catch rates (CPUE) for Arctic Grayling captured by boat electroshocking in Sections 1, 3, and 5 combined and Sections 6, 7, and 9 combined of the Peace River, 2002 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. Sections 6, 7, and 9 were not consistently sampled prior to 2015.

3.3.2.2 Capture-Recapture

A thorough description of the population abundance analysis conducted by W.J. Gazey Research is provided in Appendix G. The text below represents a summary of key findings and conclusions drawn from results provided in Appendix G.

Abundance estimates for Arctic Grayling were generated for Section 3 only, where the mean estimate was 75 individuals with a 95% credible interval of 44 to 113 individuals (Table 10). Abundance estimates were not generated for other sections due to the low number of tagged and recaptured individuals. For Section 3, the abundance estimates for Arctic Grayling were similar from 2016 to 2019. Estimates had large credible intervals, indicating a high level of uncertainty in the estimate (Figure 15). One less capture-recapture session was conducted in Sections 5 and 9 when compared to other sections, which reduced the quantity of data available for generating population abundance estimates for these sections.

Table 10: Population abundance estimates generated using the Bayes sequential model for Arctic Grayling captured by boat electroshocking in Section 3 of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
3	75	65	44	113	19	25.3

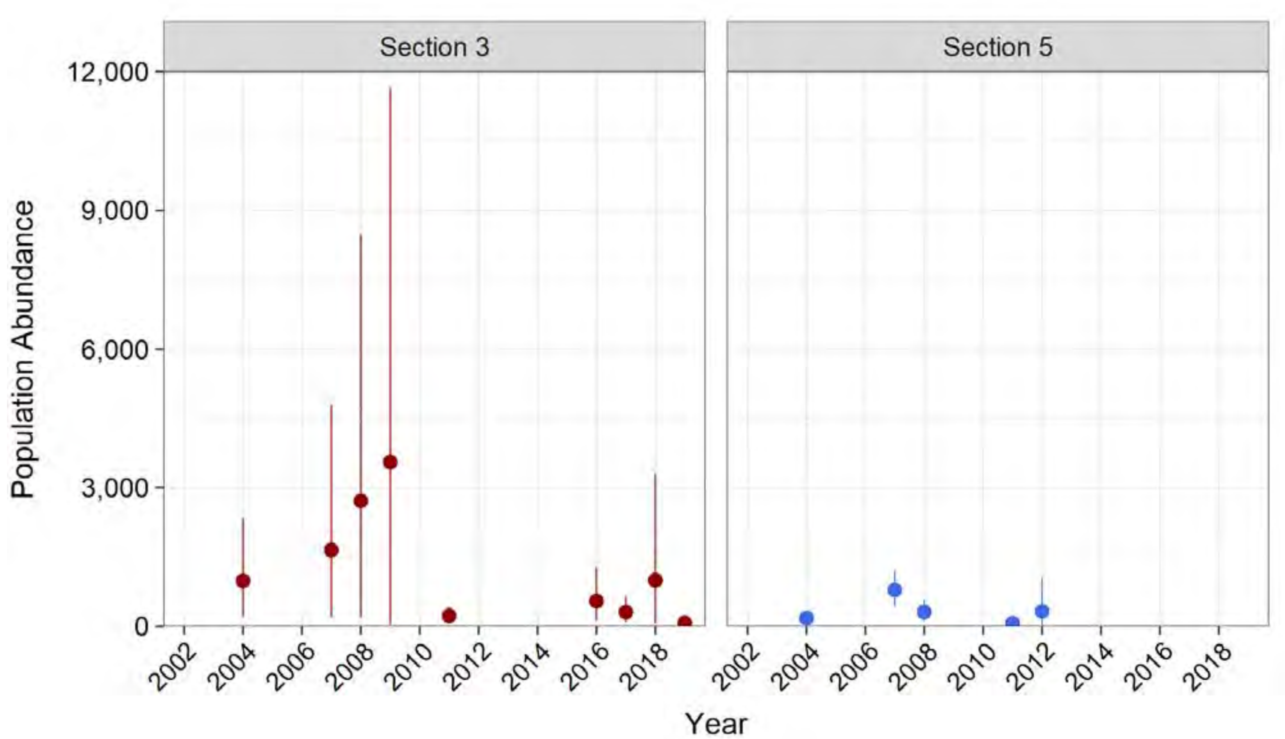


Figure 15: Population abundance estimates (mean and 95% credible intervals) for Arctic Grayling captured by boat electroshocking in Sections 3 and 5 of the Peace River, 2002–2019 (for years with sufficient data to enable population estimates).

Overall, capture data from all study years combined indicate that Arctic Grayling are common in Sections 3, 5, and 6 and present in small numbers in Sections 1, 7, and 9. Consistent with 2018 results, no recaptured Arctic Grayling were observed to move between sections in 2019.

3.4 Bull Trout

3.4.1 Biological Characteristics

During the 2019 survey, 200 Bull Trout were initially captured (i.e., excluding within-year recaptures; Table 8) and measured for length (n = 200) and weight (n = 197). Fewer Bull Trout were captured in Section 9 (n = 4) compared to Sections 1, 3, 5, 6 and 7 (range = 20 to 63 individuals). Fork lengths ranged between 153 and 860 mm, and weights ranged between 15 and 5386 g.

A preliminary review of ages assigned to Bull Trout through fin ray analysis showed high uncertainty in the estimates. As such, in 2019, the dataset for age-related Bull Trout analyses was limited to smaller individuals that could be accurately aged based on their fork length. These data were supplemented with length-at-age data collected between 2017 and 2019 as part of the Tributary Survey (Golder 2018, 2019; Golder 2020), data collected during Site C baseline studies (Mainstream 2010, 2011, 2013), and calculated ages based on the number of years that inter-year recaptured fish were at-large. Analyses include age-0 to age-3 Bull Trout captured in the Halfway River watershed between 2017 and 2019, and age-3 to age-7 individuals captured in the Peace River between 2002 and 2019 (Table 11), resulting in a combined dataset of 1751 ages.

Table 11: Average fork length, weight, and body condition by age for Bull Trout captured in the Peace River Watershed, 2002 to 2019. Table includes data from the current Indexing Survey and data collected during the Site C Reservoir Tributaries Fish Population Indexing Survey (Golder 2018, 2019; Golder 2020) and Site C baseline studies (Mainstream 2010, 2011, 2013).

Age	Fork Length (mm)			Weight (g)			Body Condition (K)		
	Average ± SD	Range	n^a	Average ± SD	Range	n^a	Average ± SD	Range	n^a
0	44 ± 6	29 – 65	281	1 ± 0.4	1 – 3	137	-[b]	-[b]	-[b]
1	92 ± 9	62 – 129	876	7 ± 3	3 – 26	871	1.10 ± 0.14	0.70 – 1.79	871
2	137 ± 11	121 – 177	117	28 ± 8	18 – 61	117	1.08 ± 0.14	0.89 – 2.31	117
3	197 ± 23	142 – 240	471	100 ± 31	28 – 224	420	1.03 ± 0.14	0.74 – 2.97	420
4	303 ± 1	303 – 304	2	270 ± 18	249 – 290	4	0.94 ± 0.04	0.90 – 0.99	4
5	428 ± 52	391 – 465	2	753 ± 226	609 – 1014	3	1.03 ± 0.03	1.01 – 1.07	3
6	484	-	1	1055	-	1	0.93	-	1
7	730	-	1	4399	-	1	1.13	-	1

[a] Number of individuals sampled.

[b] Body condition values were not calculated for age-0 individuals due to low precision of the weigh scale at lower weight ranges.

Length-frequency histograms suggest similar size distributions between Sections 1, 3, 5, 6, and 7 (Figure 16); only four Bull Trout were captured in Section 9 in 2019. Approximately half of the Bull Trout captured (52%) were between 200 and 400 mm FL, which is consistent with historical results (Appendix F, Figures F6 and F7) and indicative of the use of the area by subadults during the study period. All Bull Trout encountered in 2019 that were less than 240 mm FL (n = 33) were considered age-3 for the reasons detailed in Section 2.1.5. The smallest Bull Trout recorded in 2019 was 153 mm FL. Age-0 to age-2 Bull Trout, and some age-3 Bull Trout, rear in select Peace River tributaries (Mainstream 2012) and are rare in the mainstem of the Peace River. Fish larger than 500 mm FL represented 26% of the Bull Trout catch, which indicates that adult Bull Trout are also present in the study area during the late summer to fall. However, during the study period, large, sexually mature Bull Trout are less abundant than subadults in the Peace River mainstem because many adults are spawning in tributaries (mainly in the Halfway River watershed; Mainstream 2012). One large (822 mm FL) Bull Trout that succumbed to sampling on 3 October 2019 in Section 6 was classified as spent by field staff when small numbers of partially reabsorbed eggs were observed inside its abdominal cavity. The absence of distinct modes in length-frequency histograms suggest variable growth rates and overlapping size distributions for individual age-classes (Figure 16).

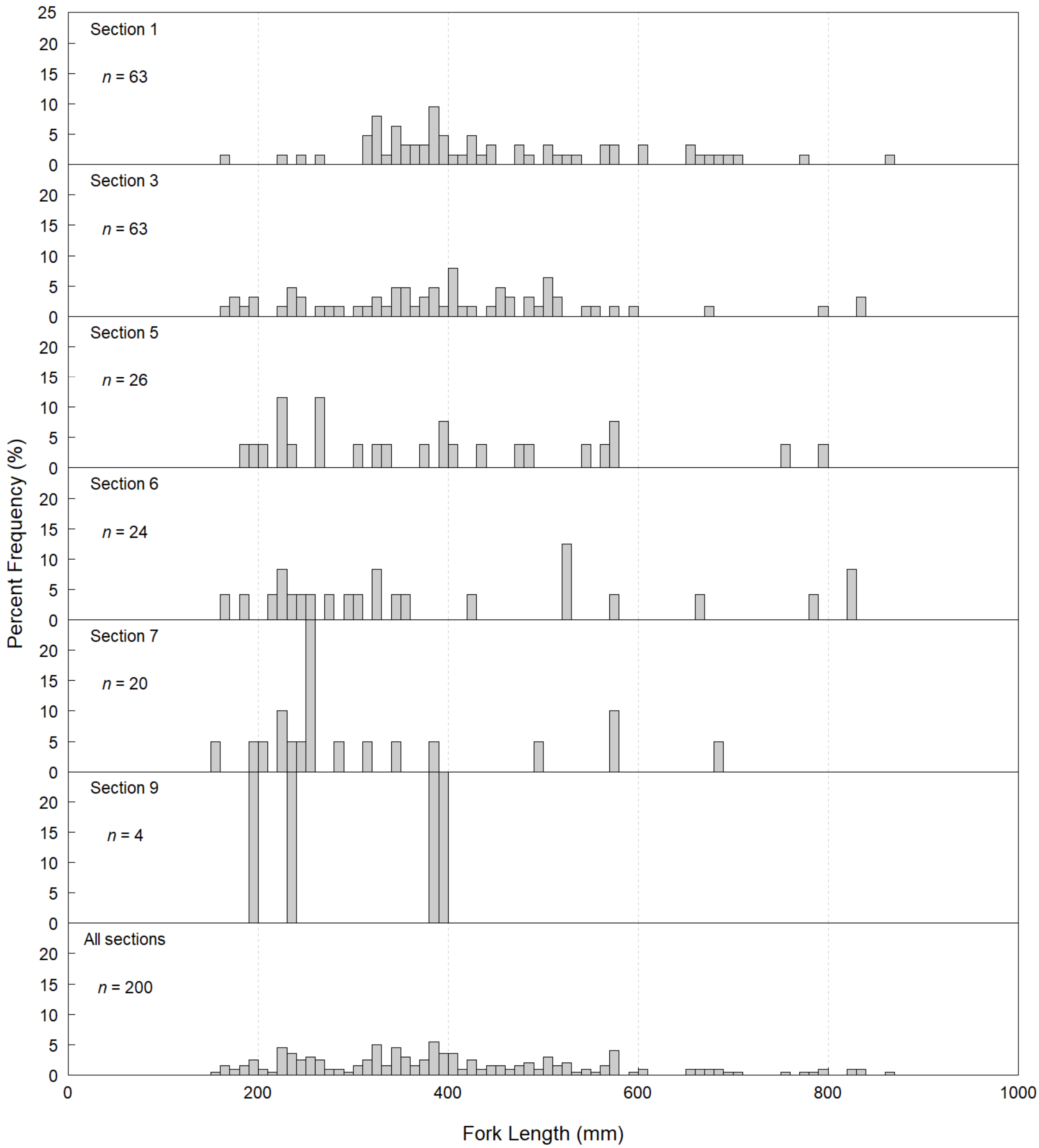


Figure 16: Length-frequency distributions for Bull Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Most juvenile Bull Trout do not enter the Peace River mainstem until age-3 (Golder 2018). Age-3 Bull Trout in the Peace River are large enough (minimum length = 143 mm FL) to be effectively sampled by the boat electroshocker, indicating that this age-class is not being missed by the sampling gear but is present in low numbers.

Length-at-age data indicate a change in Bull Trout growth rate at age-3, which is related to Bull Trout migrating into the Peace River from rearing tributaries at this age (Figure 17). Based on length-frequency data, age-0 Bull Trout in the Chowade River and Cypress and Fiddes creeks are approximately 44 mm FL in length by late July (Golder 2020). In these same systems, age-1 Bull Trout are approximately 92 mm FL, representing an annual growth rate in the first full growing season of 48 mm, and age-2 Bull Trout are 137 mm FL, representing an annual growth rate in the second full growing season of 45 mm (Table 11). Age-3 Bull Trout that remain in rearing tributaries have an average length of 177 mm FL (i.e., annual growth rate in the third full growing season of 40 mm; not presented), while Bull Trout that migrate to the Peace River at age-3 have an average length of 215 mm FL (i.e., an annual growth rate in the third full growing season of 78 mm; not presented). Growth data from known-aged inter-year recaptured fish in the Peace River (i.e., fish that were assumed to be age-3 at initial capture based on their fork length) are limited (*n* = 6), but averaged annual growth of approximately 93 mm (range = 72 to 116 mm). The largest known-aged Bull Trout encountered was 730 mm FL and was age-7.

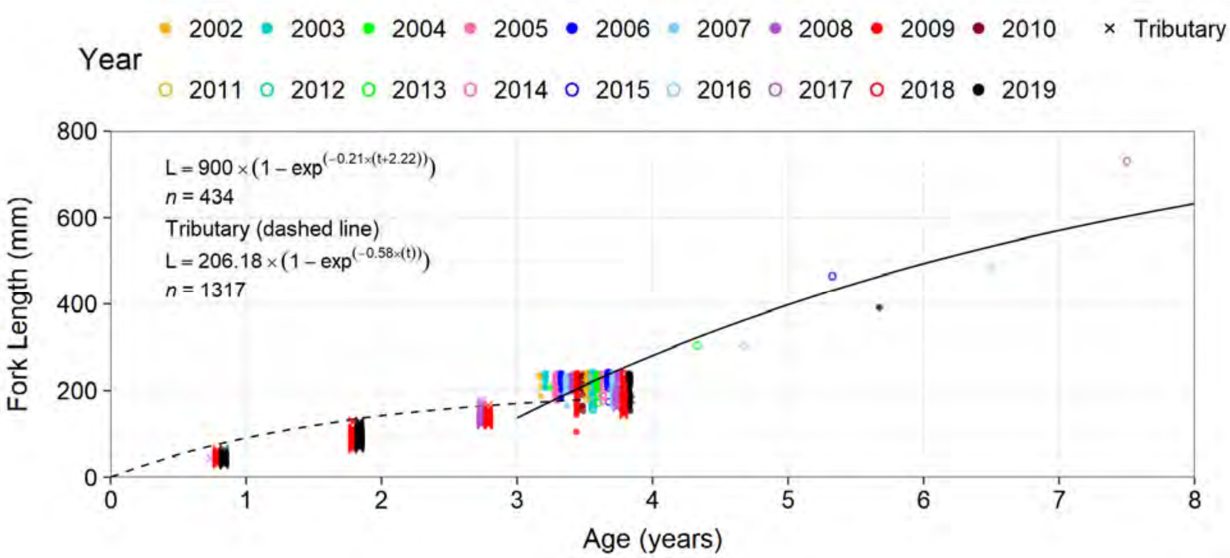


Figure 17: von Bertalanffy growth curve for Bull Trout captured in the Peace River watershed between 2002 and 2019. Figure includes data from the current Indexing Survey and data collected during the Site C Reservoir Tributaries Fish Population Indexing Survey (Golder 2018, 2019; Golder 2020) and Site C baseline studies (Mainstream 2010, 2011, 2013).

Growth data were available for inter-year recaptured fish of unknown age (*n* = 307) (i.e., fish that were assumed be age-4 or older at their initial capture based on their fork length). For these fish, annual average growth was 57 mm and ranged between 0 and 159 mm (Attachment A). The number of years these fish were at-large ranged between one and six years, suggesting ages of recapture between age-5 and age-10.

The dataset for known-aged Bull Trout in the Peace River is expected to increase during subsequent study years as immature Bull Trout initially captured and tagged in tributaries as age-1 to age-3 individuals under the Tributary Survey (Golder 2020) migrate into the study area and are captured.

For all sections, there was little change in mean Bull Trout body condition (*K*) between 2018 and 2019. Overall, body condition remained stable between 2002 and 2019, with slightly higher condition noted in 2010 and 2012 in most sections and slightly lower condition noted in Sections 1 and 3 in 2014–2015 and in 2019 in most sections (Figure 18). During most study years, body condition estimates were greater for Section 1 (approximately 1.02 to 1.15) than the other sections (approximately 0.95 to 1.08). Relative weight estimates tracked closely with body condition estimates for most sections and study years. In Section 1, relative weights were above 100% during most study years, indicating rotund fish.

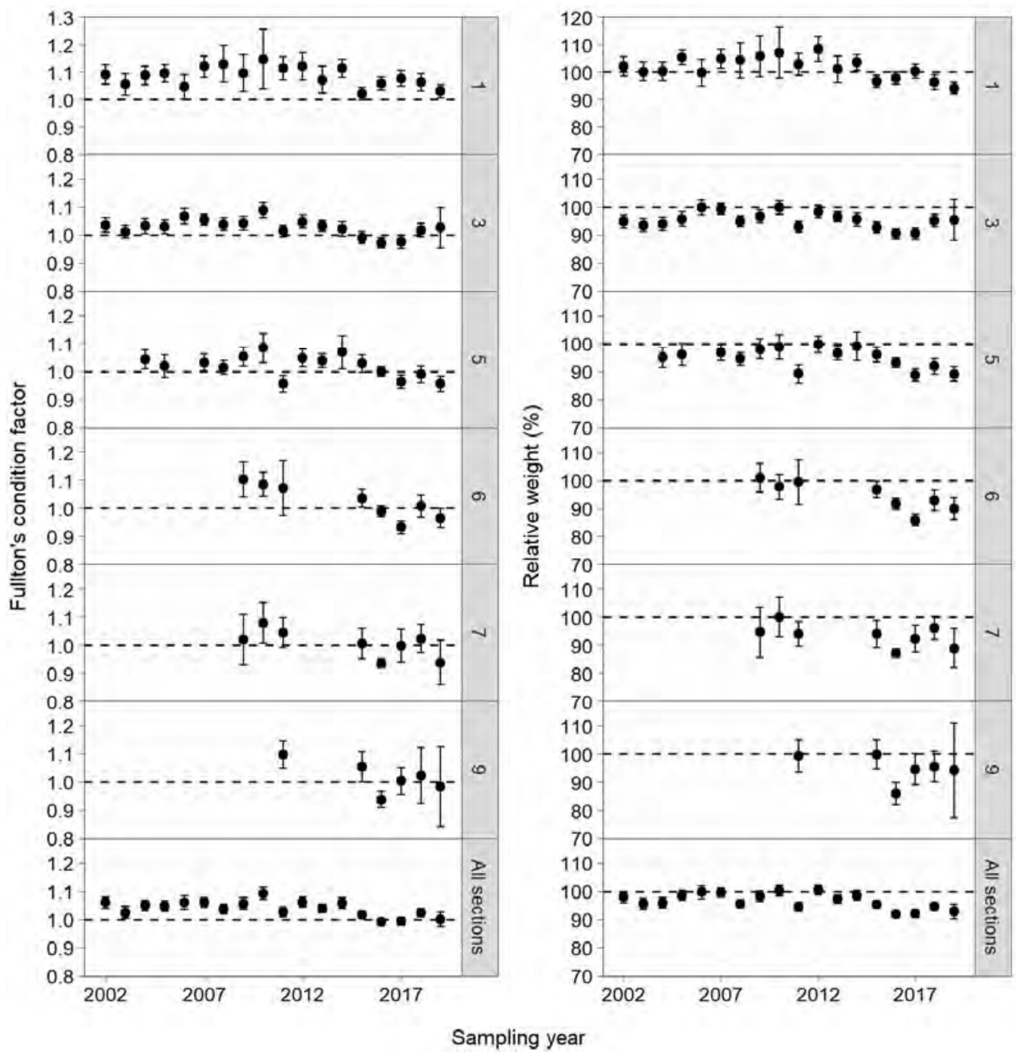


Figure 18: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) (left pane) and mean relative weight (%) values (right pane) for Bull Trout captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

In 2019, length-weight regressions were similar to historical study years (Appendix F, Figure F8) with typical values of b near 3.0; however, results were not statistically tested in 2019. Golder and Gazey (2018) conducted statistical comparisons on data collected between 2002 and 2017. The results also suggested similar length-weight relationships among sections (Figure 19).

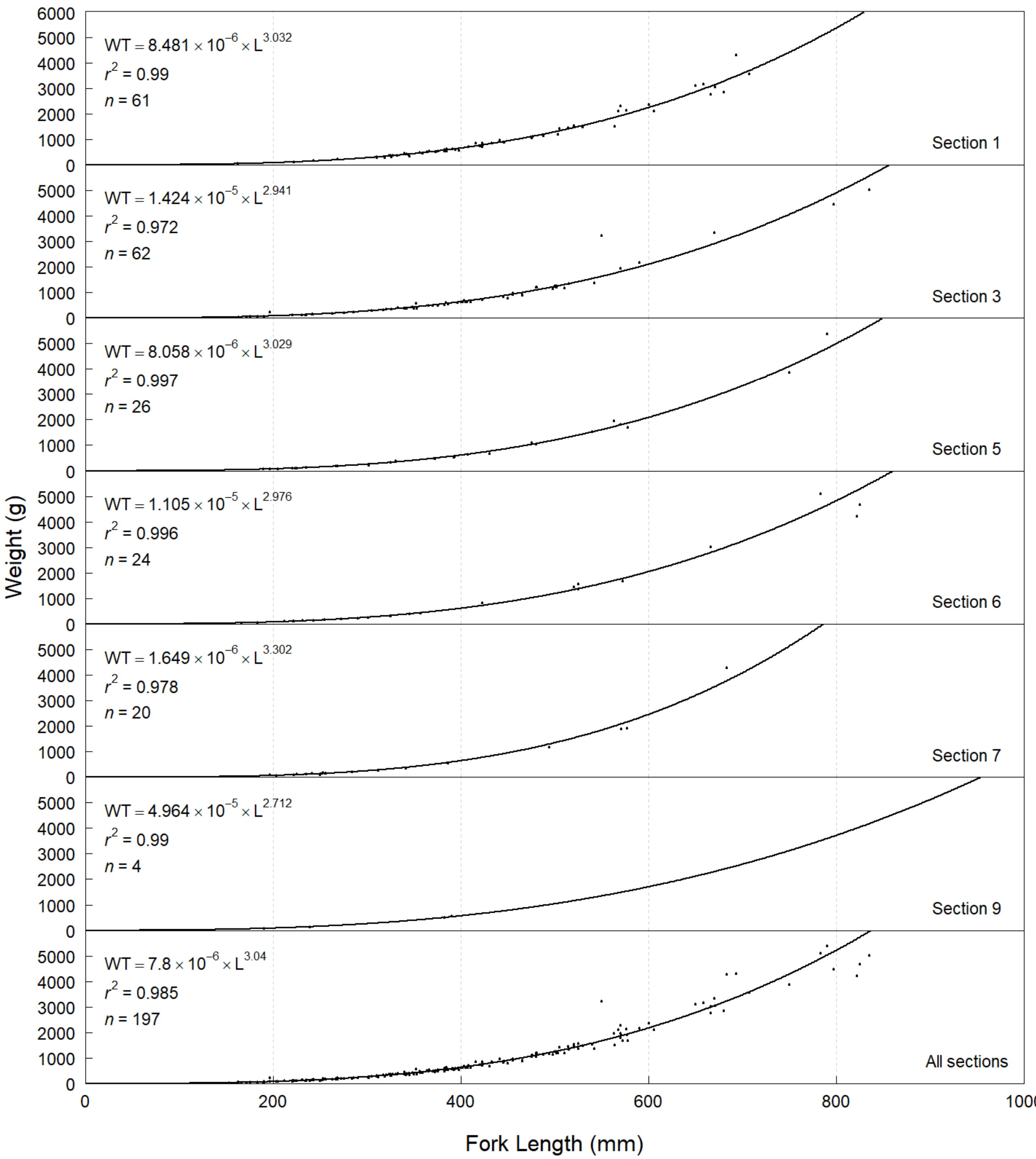


Figure 19: Length-weight regressions for Bull Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

3.4.2 Abundance

3.4.2.1 Catch-Per-Unit-Effort

Bull Trout were consistently captured between 2002 and 2019 in Sections 1, 3, and 5 and consistently captured between 2015 and 2019 in Sections 6, 7, and 9; therefore, changes in catch-rates over time were compared for this species using these section groupings (Figure 14). Bull Trout catch rates were relatively stable between 2002 and 2019, ranging from a low of approximately 2 fish/km-h in 2006 to a high of 6 fish/km-h in 2011. The catch rate of Bull Trout in 2019 (4 fish/km-h) was similar to the average catch rate recorded for this species over the previous 17 years.

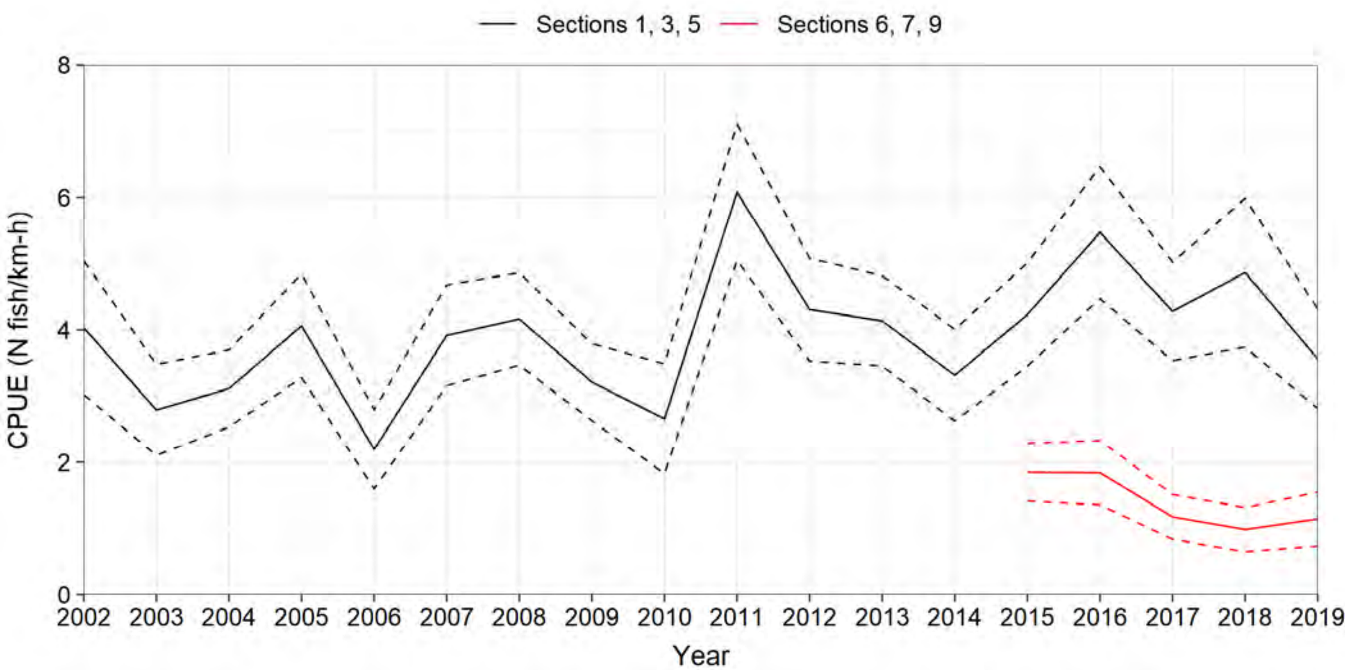


Figure 20: Mean annual catch rates (CPUE) for Bull Trout captured by boat electroshocking in Sections 1, 3, and 5 combined and Sections 6, 7, and 9 combined of the Peace River, 2002 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. Sections 6, 7, and 9 were not consistently sampled prior to 2015.

From 2015 to 2019, catch rates for Bull Trout were lower in Sections 6, 7, and 9 compared to catch rates recorded in Sections 1, 3, and 5 over the same time period. Catch rates for Sections 6, 7, and 9 indicate a gradual decline in Bull Trout abundance from 2016 to 2018.

3.4.2.2 Capture-Recapture

A thorough description of the population abundance analysis conducted by W.J. Gazey Research is provided in Appendix G. The text below represents a summary of key findings and conclusions drawn from results provided in Appendix G.

In 2019, abundance estimates of Bull Trout were generated for Sections 1 and 3 (Table 12) but could not be generated for the other sections. The estimate (mean with 95% credible interval) was greater in Section 1 (321 fish; 134–578 fish) than Section 3 (224 fish; 85–423 fish). Only a single individual was recaptured in Section 5 in 2019, preventing the generation of a precise abundance estimate for this section for Bull Trout. Abundance estimates were generated for Bull Trout in Section 5 each year from 2008 to 2018.

Table 12: Population abundance estimates generated using the Bayes sequential model for Bull Trout captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
1	321	247	134	578	128	39.7
3	224	164	85	423	104	46.5
Total[a]	545	**462**	**287**	**859**	**165**	**30.2**

[a] Calculated from the joint distribution of Sections 1 and 3.

There were 21 within-year recaptures of Bull Trout in 2019, and movement between sections was limited to a single individual that was released in Section 3 and recaptured in Section 1. All other Bull Trout were recaptured in the same section as their initial release.

Credible intervals surrounding Bull Trout abundance estimates overlapped for all sections and study years, and generally indicate a stable population. Overall (all study years combined), abundance estimates for Section 3 suggest a cyclical pattern, with higher values recorded in 2002, 2006, 2012, 2015, and 2017 and lower values recorded in all other years (Figure 21). One less capture-recapture session was conducted in Sections 5 and 9 when compared to other sections, which reduced the quantity of data available for generating population abundance estimates for these sections.

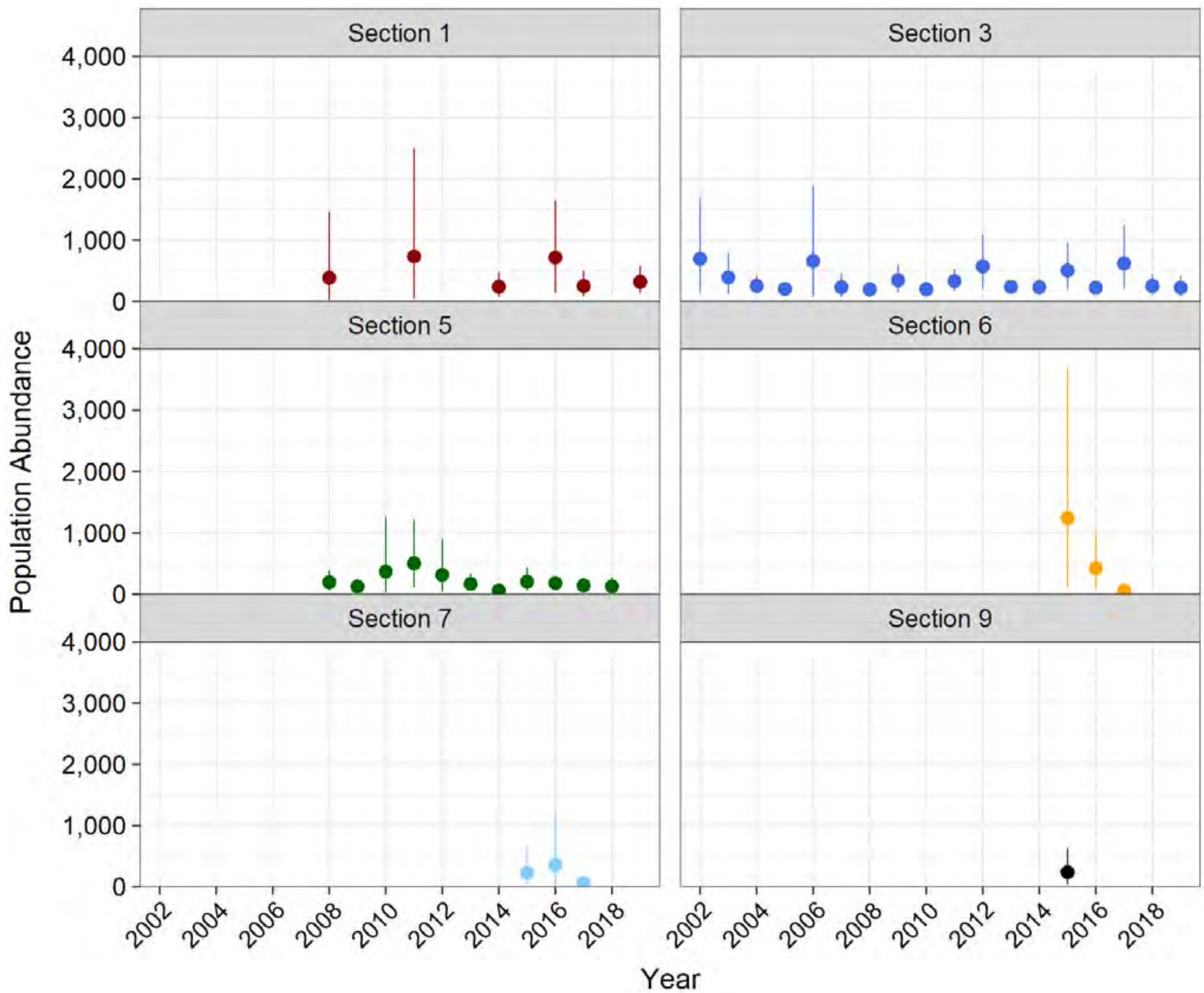


Figure 21: Population abundance estimates (means with 95% credible intervals) generated using the Bayes sequential model for Bull Trout captured by boat electroshocking in sampled sections of the Peace River, 2002–2019.

3.5 Burbot

In 2019, 47 Burbot were captured and an additional 11 Burbot were observed but avoided capture. Total lengths of Burbot ranged between 154 and 869 mm (Figure 22), and weights ranged between 24 and 3947 g. Ageing structures were not collected from Burbot.

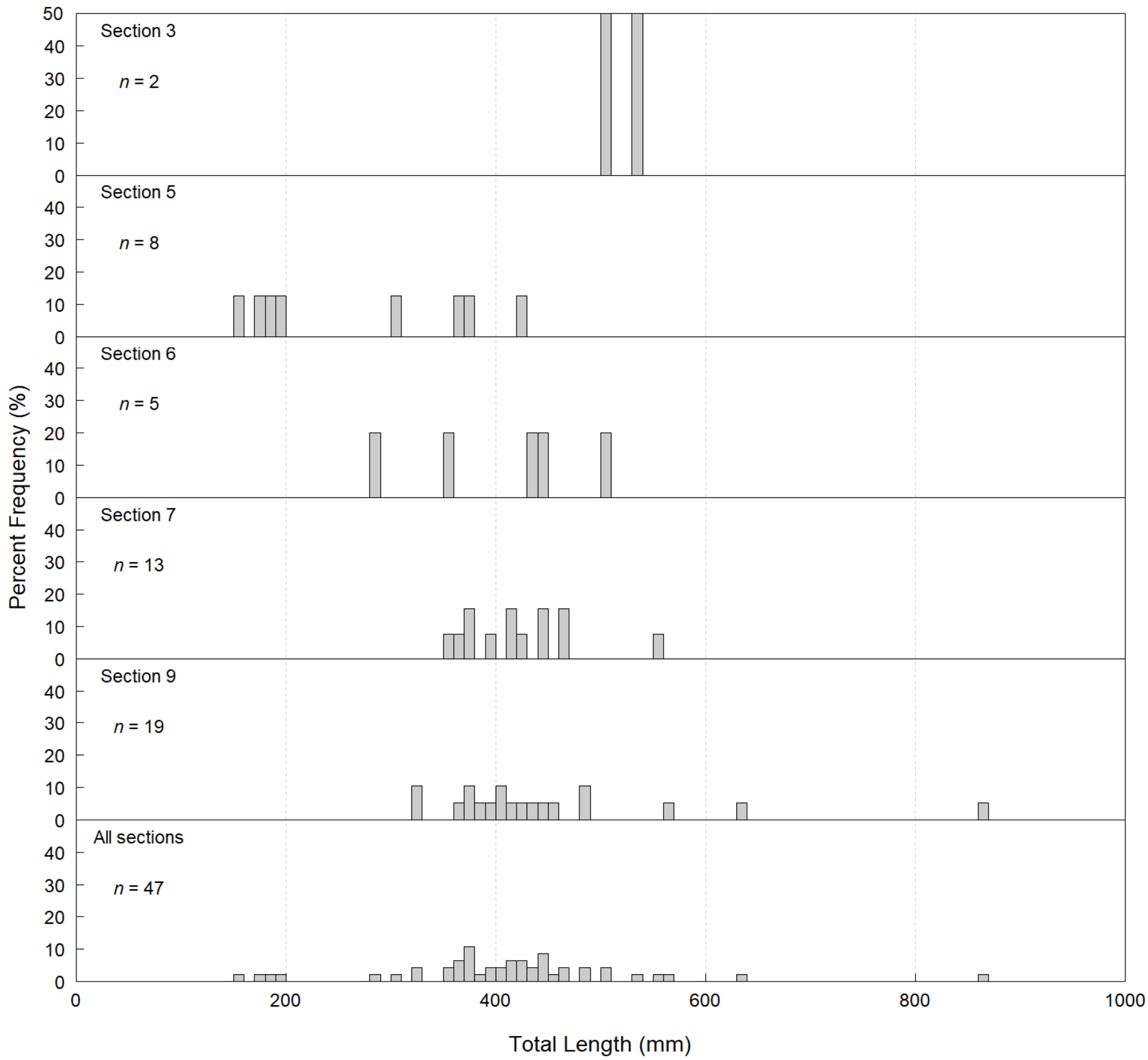


Figure 22: Length-frequency distributions for Burbot captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Most (90%) of the Burbot captured in 2019 were larger than 300 mm TL. Age-0 Burbot (i.e., fish less than approximately 150 mm TL) were not recorded in 2019 (Figure 22). The variable catch rates of adult Burbot each year coupled with frequently low age-0 encounter rates each year suggest that the area is primarily used by subadults and adults during the study period and that recorded densities may vary with habitat conditions. Average secchi depths were low in 2016 (64) and 2019 (54 cm) when compared to other study years between 2014 and 2018 (104 to 139 cm; Attachment A). Greater Burbot catch during turbid water years (2016 and 2019) is likely due to greater Burbot abundance in the mainsteam of the Peace River within the study area, but not greater Burbot abundance within the larger Peace River watershed.

3.5.1 Abundance

All of the Burbot captured during the 2019 survey were implanted with PIT tags; one was recaptured approximately one month later in the same section it was released in (Section 9). Population abundance estimates were not generated for Burbot due to the low number of tagged and recaptured fish.

3.5.1.1 Catch-Per-Unit-Effort

Overall encounters (i.e., captured plus observed fish) in 2019 (*n* = 58) were the second highest on record, after the 2016 study year (*n* = 60). In 2018, 23 Burbot were encountered. In all remaining study years, less than 10 Burbot were recorded each year (Appendix E, Tables E1 and E2). Burbot were encountered in all sections except Section 1 in 2019 (Table 8 and Figure 22), which is indicative of their preference for cool/turbid waters that are more commonly recorded in the downstream portions of the study area (Mainstream 2012). Low catches in years before 2015 is largely due to limited sampling in Sections 6 to 9 during these study years.

Between 2015 and 2019, Burbot catch rates were generally low and varied (all sections combined; Figure 23). Confidence intervals overlapped for most study years. Burbot were not consistently targeted prior to 2015; therefore, the 2002 to 2014 study years were excluded from the analysis.

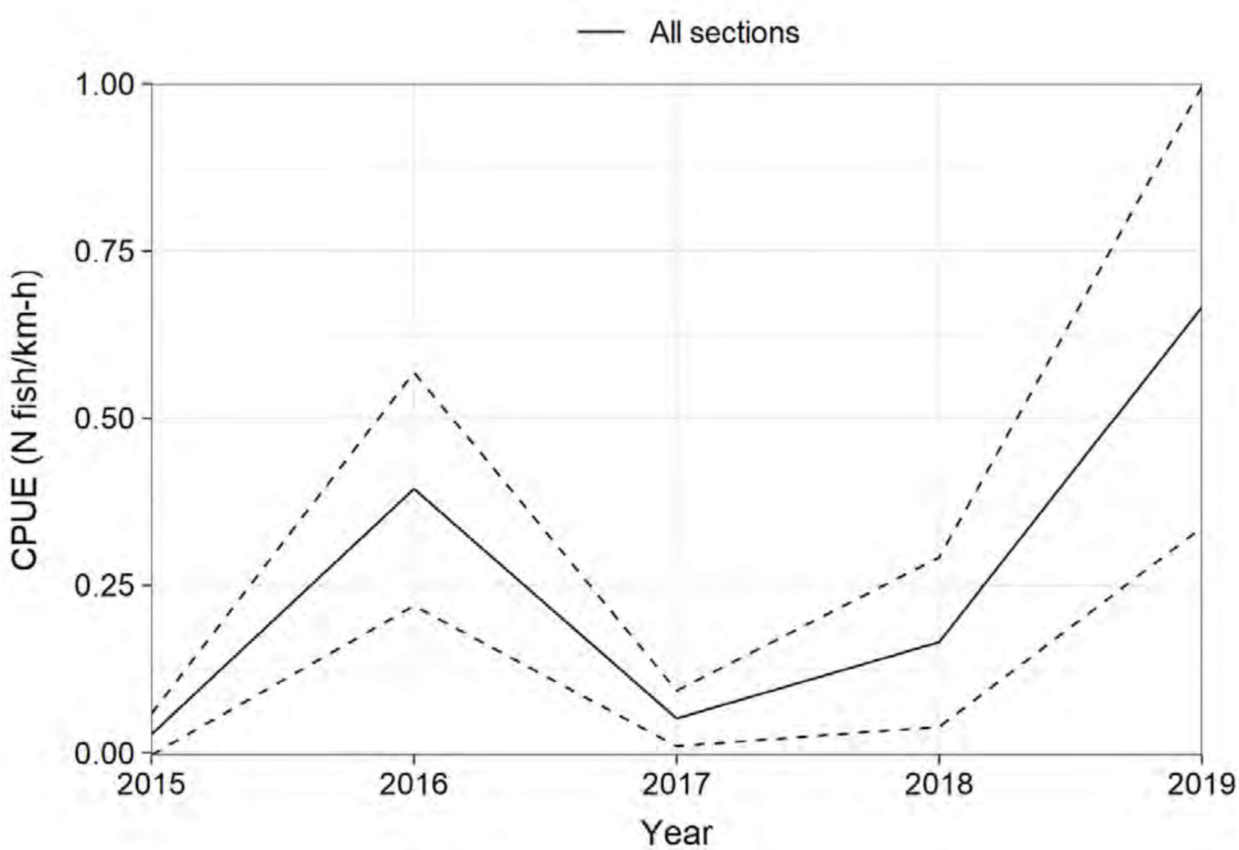


Figure 23: Mean annual catch rates (CPUE) for Burbot captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Burbot were not actively targeted during these study years.

3.6 Goldeye

Fourteen Goldeye were captured during the 2019 Indexing Survey—all in Section 9. An additional five Goldeye were captured during the 2019 Goldeye and Walleye Survey. Fork lengths for all captured Goldeye ranged between 366 and 426 mm, and weights ranged between 532 and 1036 g. Length-frequency histograms and body condition summaries were generated for this species in 2019 but are not presented because they were generally uninformative due to the low number of captured fish. Life history measurements for each individual fish are presented in Table 13.

Table 13: Life history measurements and capture information for all Goldeye captured in 2019 as part of the Peace River Large Fish Indexing Survey, 15 June to 14 October 2019.

Capture Date	Site Name	Fork Length (mm)	Weight (g)	Body Condition (*K*)	Age	Tag Number
14-Jun-19	07BEA02	426	696	0.90		900230000084260
15-Jun-19	08CLE01	384	532	0.94		900230000085414
15-Jun-19	08CLE01	406	618	0.92		900230000084559
03-Jul-19	07BEA01	382	630	1.13		900230000084648
03-Jul-19	07BEA02	415	729	1.02		900230000084536
24-Aug-19	903	383	770	1.37		900230000202524
10-Sep-19	902	385	700	1.23		900230000208604
10-Sep-19	902	385	721	1.26		900230000207818
10-Sep-19	903	405	898	1.35		900230000208713
10-Sep-19	902	420	898	1.21		900230000207297
19-Sep-19	910	366	645	1.32		900230000207670
19-Sep-19	910	370	538	1.06	11	900230000207430
19-Sep-19	910	396	726	1.17		900230000207365
19-Sep-19	902	405	798	1.20	13	900230000207422
19-Sep-19	910	405	883	1.33	14	900230000207155
19-Sep-19	902	417	1036	1.43		900230000207526
04-Oct-19	902	395	798	1.29		900230000209392
04-Oct-19	902	407	958	1.42		900230000207742
04-Oct-19	902	411	910	1.31		900230000208896

Fin ray samples were collected from 12 of the 19 Goldeye captured in 2019. These samples were provided to BC Hydro for potential microchemical analysis. Three Goldeye were assigned ages based on collected scales. Goldeye ranged between age-11 and age-14. Scales are not the preferred structure for assigning ages to older Goldeye (MacKay 1997), and these ages should be interpreted with caution. All Goldeye captured in 2019 were considered adults based on their fork length.

3.6.1 Abundance

All of the Goldeye encountered during the 2019 Indexing Survey were captured in Section 9. Over the 18-year Indexing Survey study period, Goldeye have not been recorded upstream of the Pine River confluence (i.e., upstream of Section 6); however, Mainstream Aquatics captured Goldeye in Section 5 during a Peace River Fish Inventory Study (Mainstream 2010).

3.6.1.1 Catch-Per-Unit-Effort

Goldeye were first encountered during the Indexing program in 2015. Between 2015 and 2018, Goldeye catch rates were low (Figure 24). Although still low and uncertain, the catch-rate for Goldeye in 2019 was more than three times the average rate recorded for this species between 2015 and 2018.

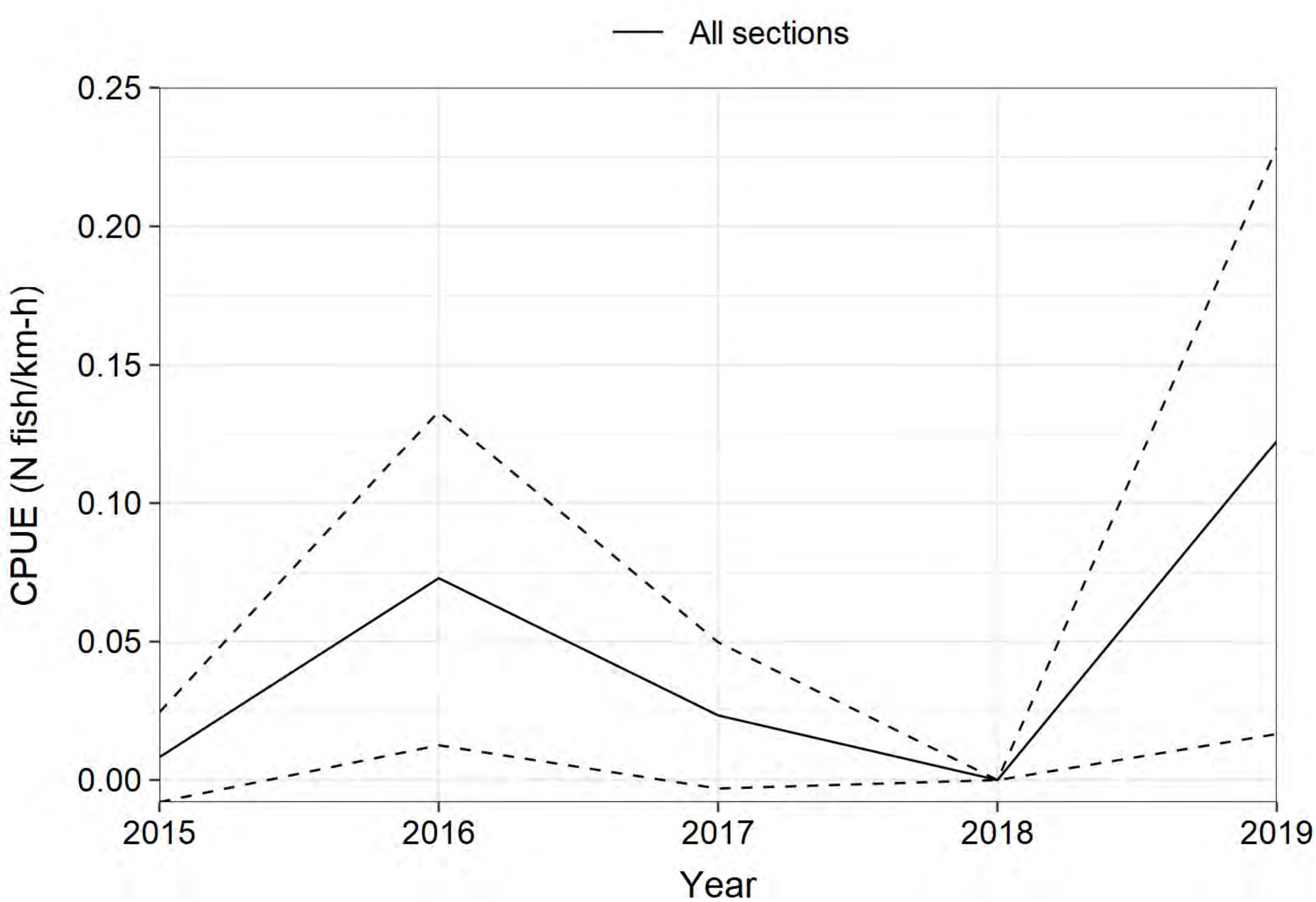


Figure 24: Mean annual catch rates (CPUE) for Goldeye captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Sections 6, 7, and 9 were not sampled during these years.

3.7 Largescale Sucker

3.7.1 Biological Characteristics

During the 2019 survey, 1169 Largescale Sucker were initially captured (i.e., excluding within-year recaptures; Table 8). Of these 1169 fish, 897 were measured for length and weight. Fork lengths ranged between 81 and 587 mm, and weights ranged between 5 and 2462 g.

Length-frequency histograms for Largescale Sucker suggest some differences in length distribution among sections (Figure 25). Small fish (i.e., 100–400 mm FL) comprised the greatest percentage of the catch in Sections 3 and 9, whereas large fish (i.e., 400–600 mm FL) were the greatest percentage of the catch in Sections 1, 5, 6, and 7. This finding is consistent with study results from 2015 to 2018 (Golder and Gazey 2016–2019).

In 2019, the length-weight regression for Largescale Sucker from all sections had an exponent of 3.06 (Figure 26) indicating slightly positive allometric growth. In 2019, the length-weight relationship was similar to previous study years (Appendix F, Figures F21); however, results were not statistically compared in 2019. Statistical results from 2017 (Golder and Gazey 2018) showed significant differences in length-weight regression slopes between some years but did not suggest any consistent or sustained trends over time.

Mean body condition (*K*) in 2019 was near the long-term average in Sections 1, 3, and 9 (Figure 27). In Sections 3, 5, 6, and 7, body condition was generally lower from 2016 to 2019 relative to earlier study years. As was observed for some other species (e.g., Figure 18), the mean body condition of Largescale Sucker was greater in Section 1 (*K* = 1.30) than all other sections downstream (*K* = 1.22 to 1.26). Relative weights were not calculated for Largescale Sucker.

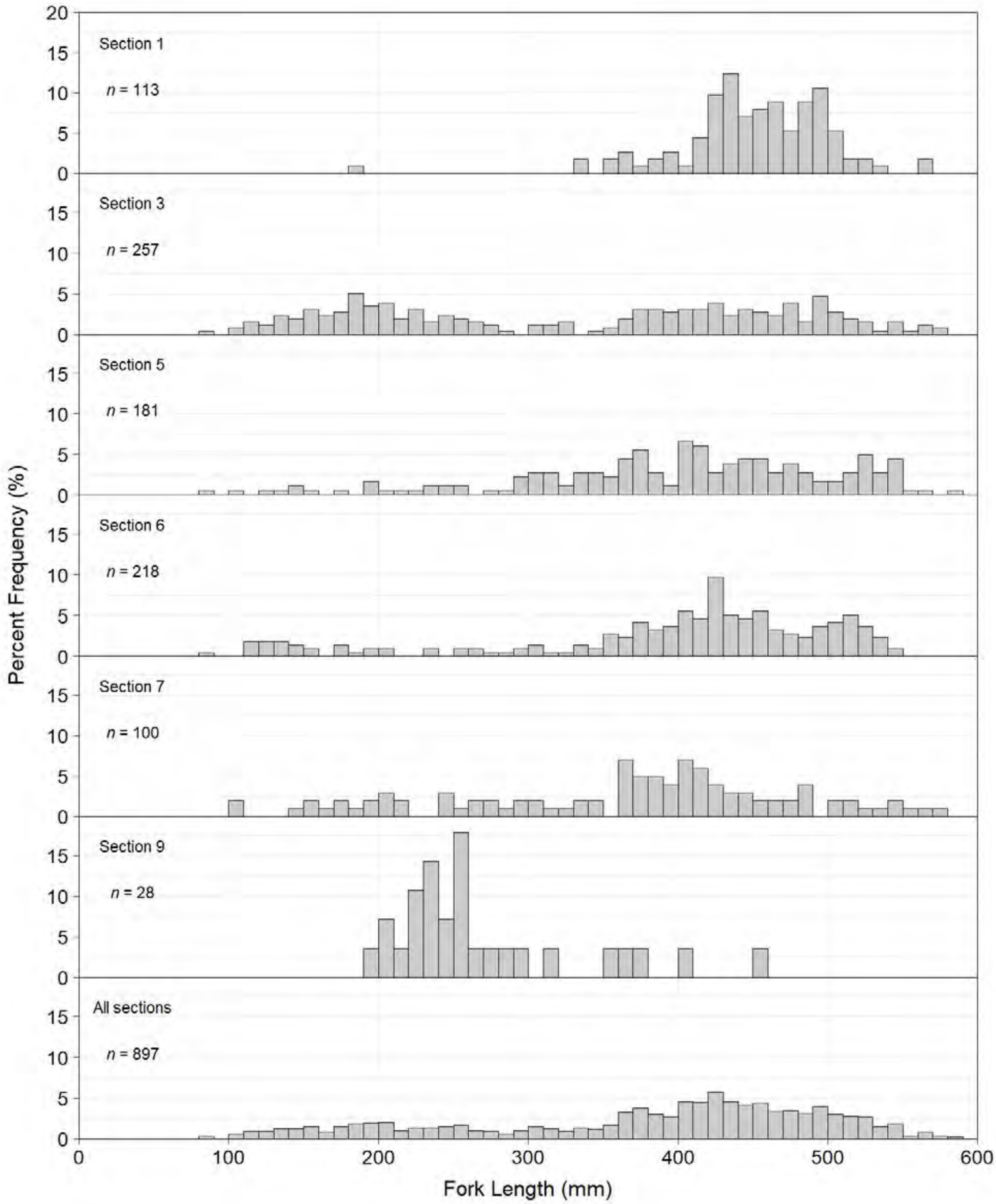


Figure 25: Length-frequency distributions for Largescale Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

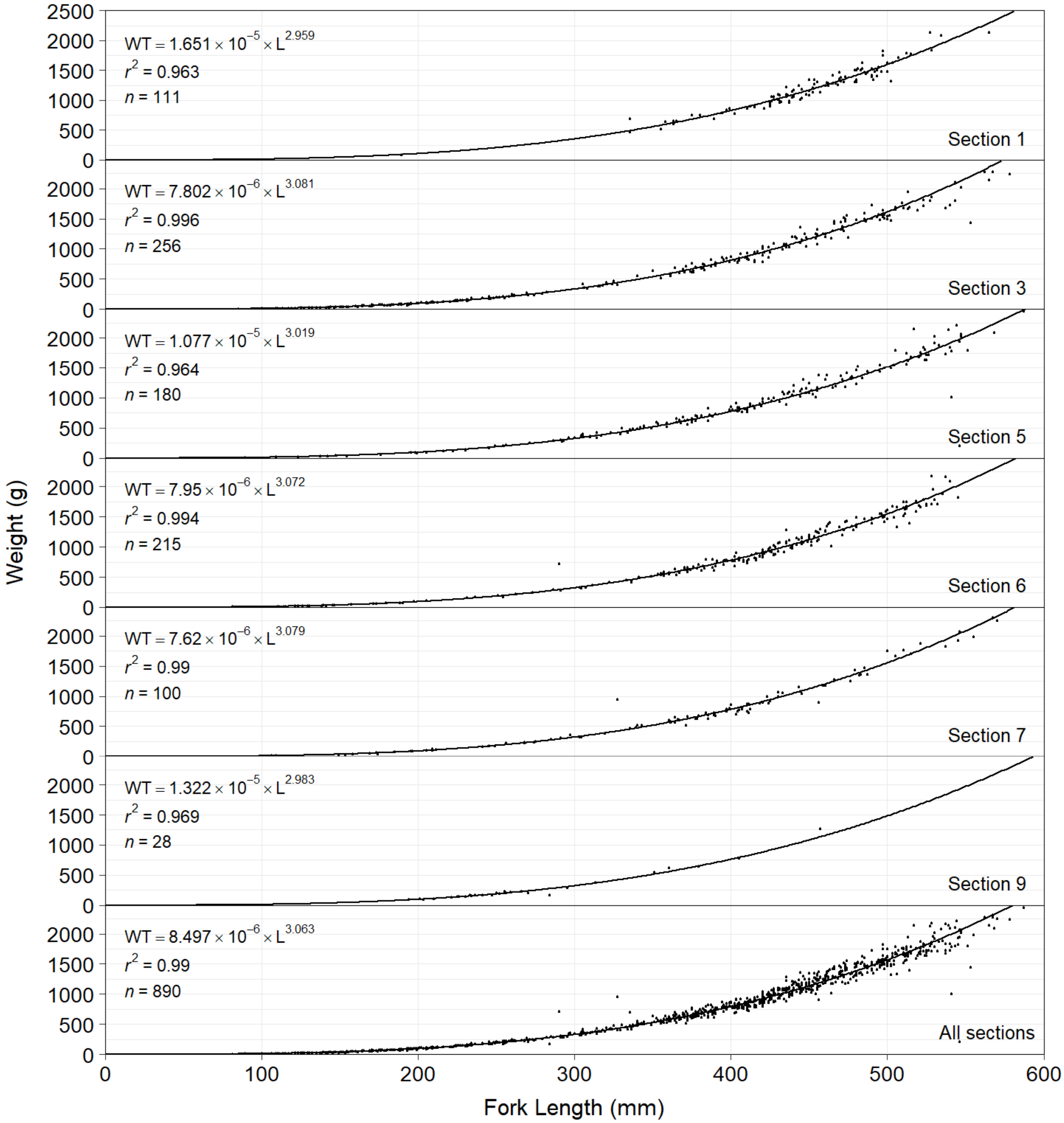


Figure 26: Length-weight regressions for Largescale Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

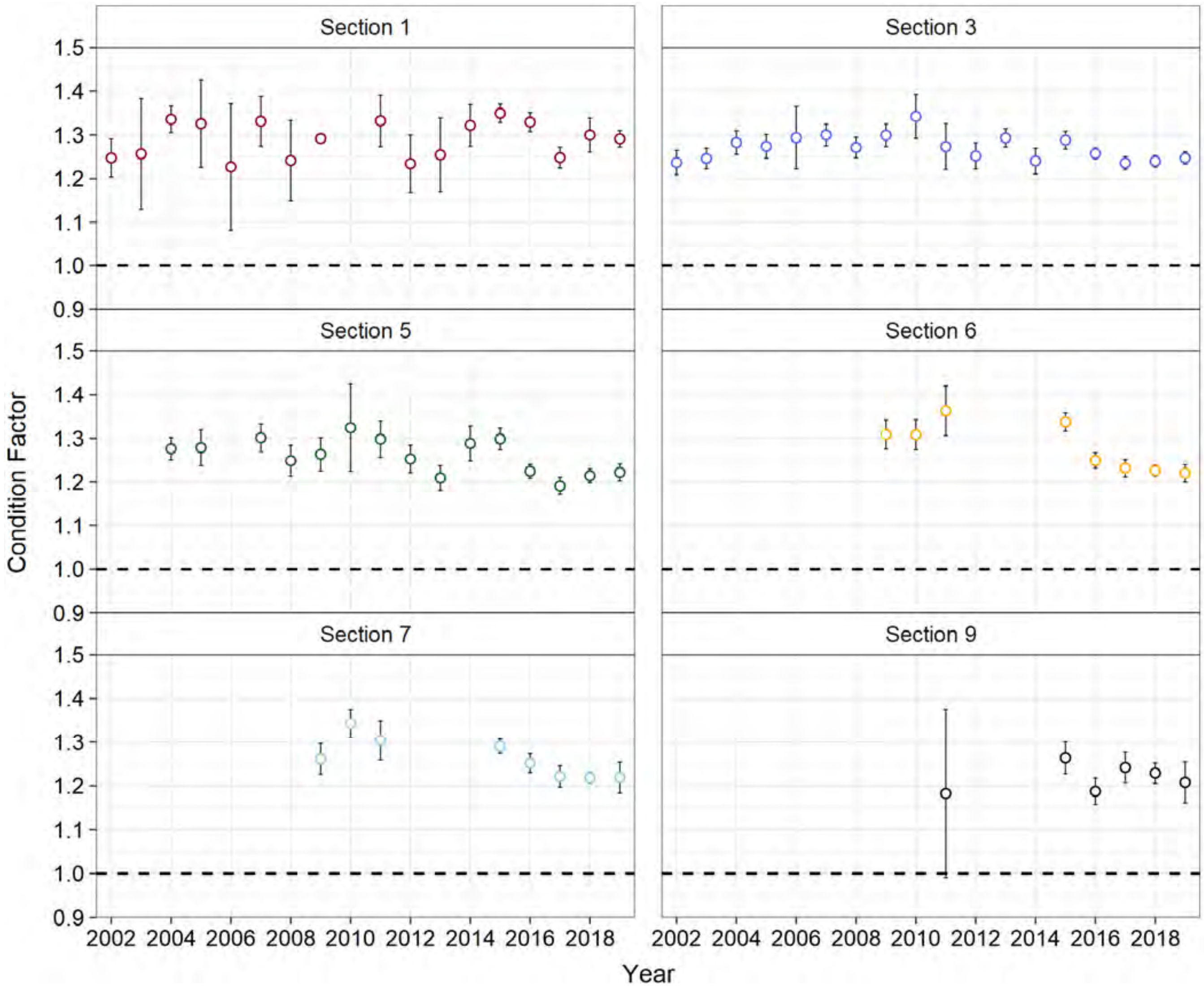


Figure 27: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) for Largescale Sucker captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

3.7.2 Abundance

3.7.2.1 Catch-Per-Unit-Effort

Catch-rates for Largescale Sucker were consistent from 2015 to 2019 and ranged between a low of 8 fish/km-h in 2018 and a high of 12.0 fish/km-h in 2016 (Figure 28). Largescale Sucker were not consistently targeted prior to 2015; therefore, the 2002 to 2014 study years were excluded from the analysis.

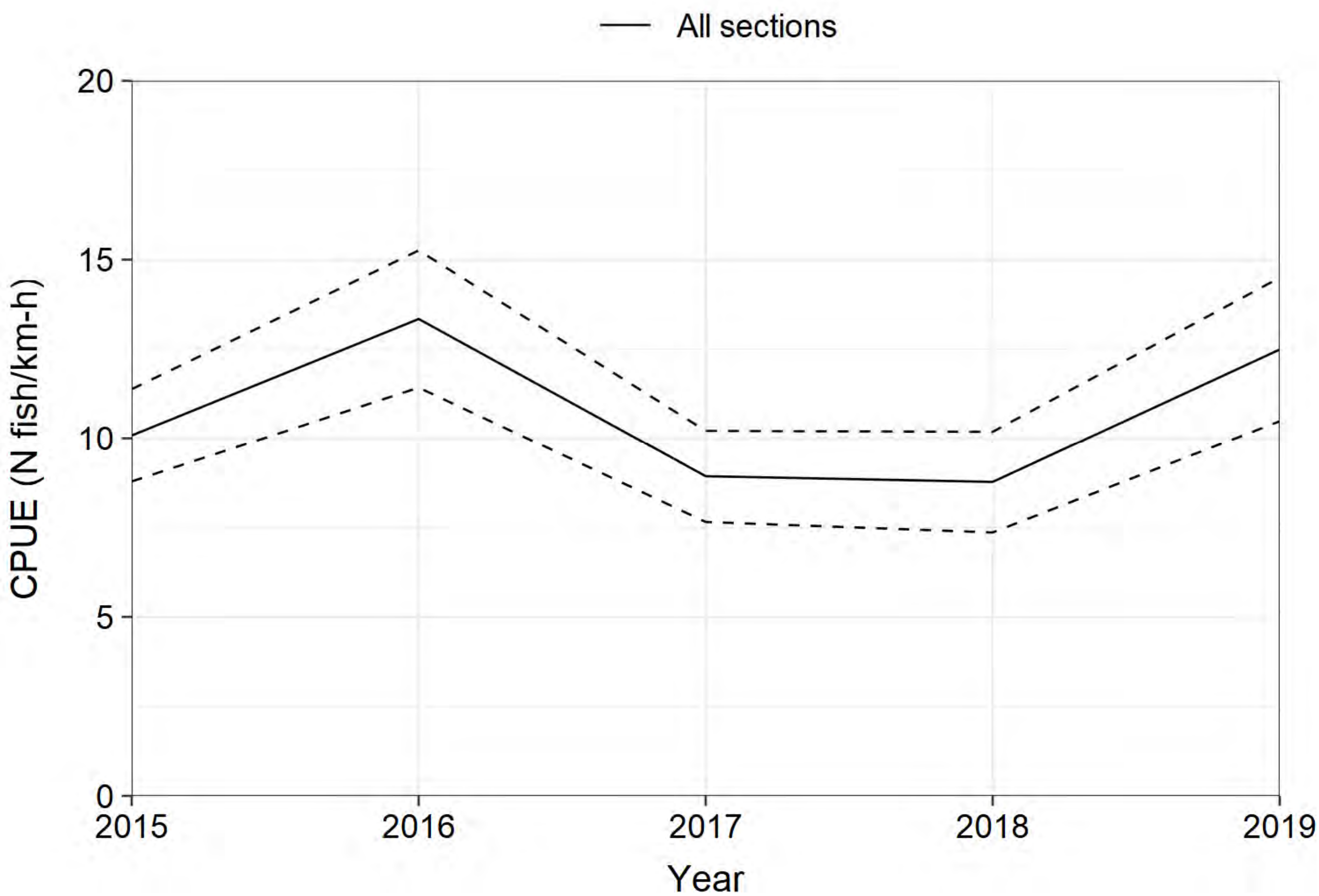


Figure 28: Mean annual catch rates (CPUE) for Largescale Sucker captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Sections 6, 7, and 9 were not sampled during these years.

3.7.2.2 Capture-Recapture

Population abundance estimates were generated for all six sections in 2019 (Table 14). The abundance estimate was low in Section 9 (554 individuals; range 30 to 2080 individuals) when compared to all other sections (average = 4585 individuals; range = 2111 to 6336 individuals). The 2019 study year was the first study year in which suitable numbers of recaptured fish allowed the generation of abundance estimates for Sections 1 and 9.

Table 14: Population abundance estimates generated using the Bayes sequential model for Largescale Sucker captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
1	6,336	3,400	1,260	15,420	4,356	68.9
3	2,111	1,600	810	3,890	922	43.7
5	5,872	3,610	1,500	12,970	3,580	61.0
6	4,165	3,140	1,590	7,690	1,824	43.8
7	4,443	1,750	540	12,900	4,151	93.4
9	554	110	30	2,080	672	121.4
Total[a]	23,481		**9,114**	**37,848**	**7,330**	31.2

[a] Calculated from the joint distribution of Sections 1 through 9.

In Sections 3, 5, 6, and 7, the population abundance estimates in 2019 overlapped estimates from previous years; however, 2019 results suggest lower abundance in Section 3 and higher abundance in Sections 5 and 7.
In Section 6, abundance remained stable at approximately 4000 individuals between 2015 and 2019 (Figure 29). Abundance estimates were not available for years prior to 2015 because this species was not marked prior to 2015. Only 2 of the 31 Largescale Sucker captured twice in 2019 were recaptured in a different section than they were initially tagged and released. One of these fish was initially tagged in Section 3 and was recaptured in Section 6. The other was initially tagged in Section 3 and was recaptured in Section 5.

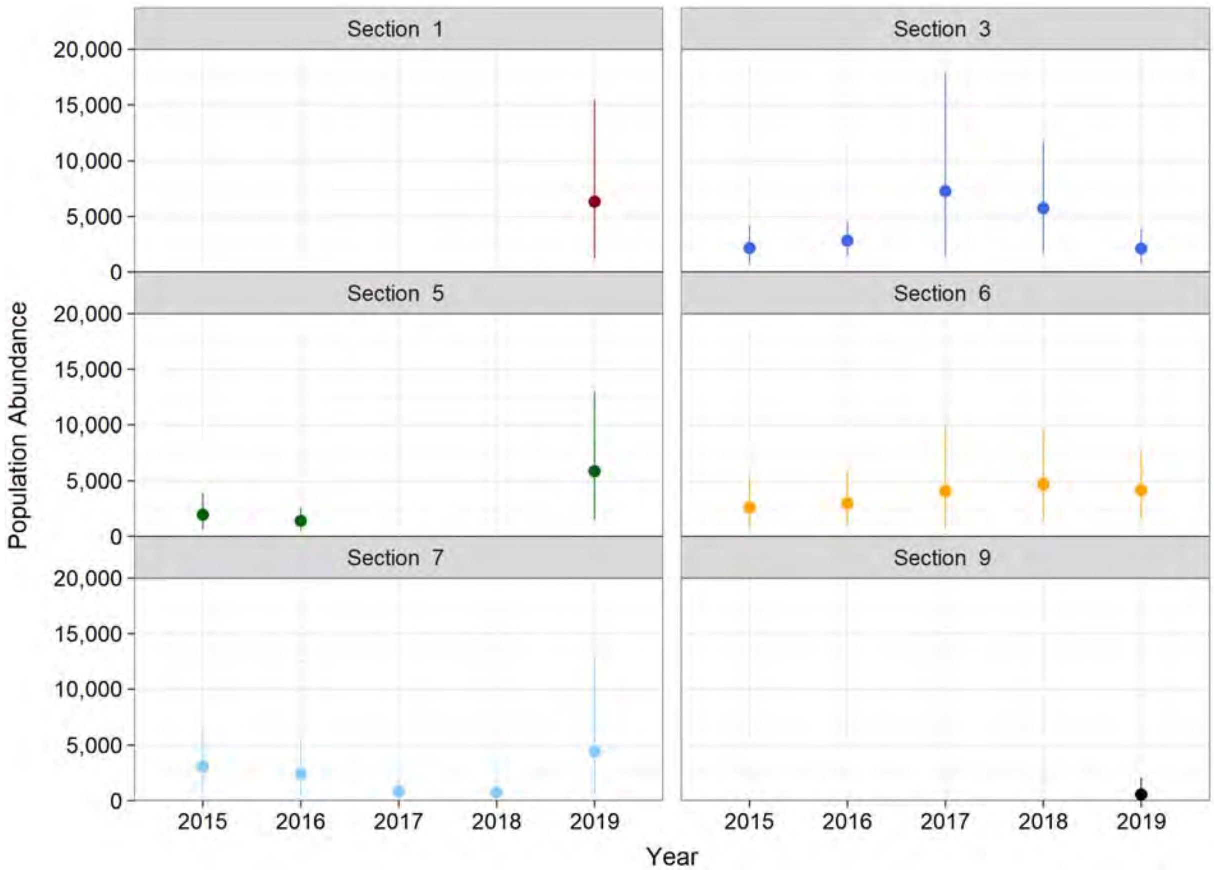


Figure 29: Population abundance estimates (with 95% credible intervals) generated using the Bayes sequential model for Largescale Sucker captured by boat electroshocking in sampled sections of the Peace River, 2015-2019.

3.8 Longnose Sucker

3.8.1 Biological Characteristics

During the 2019 survey, 3361 Longnose Sucker were initially captured (i.e., excluding within-year recaptures; Table 8). Of these 3361 fish, 2,672 were measured for length and weight. Fork lengths ranged between 62 and 745 mm, and weights ranged between 6 and 1675 g.

For Longnose Sucker, a lack of distinct modes in length-frequency histograms for most sections suggest that the sample comprised multiple age-classes with overlapping length distributions (Figure 30). Consistent with 2018 results (Appendix F, Figure F16 and F17), most Longnose Sucker captured in 2019 were between 350 and 450 mm FL in all sections. All age classes were present throughout the study area. Substantially more small (i.e., less than 200 mm FL) Longnose Sucker were recorded in Sections 5 and 6 in 2019 (Figure 30) when compared to 2018 (Golder and Gazey 2019).

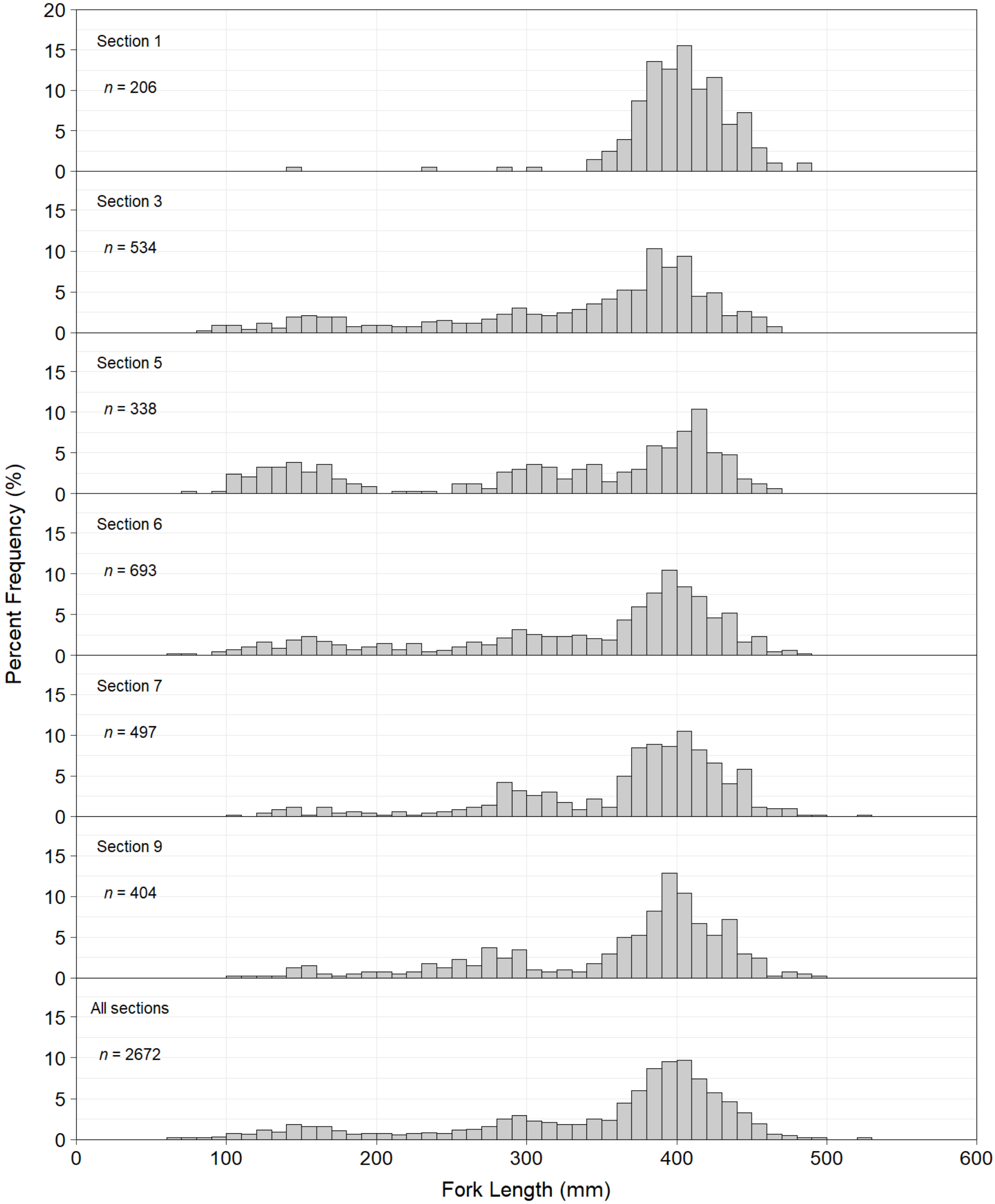


Figure 30: Length-frequency distributions for Longnose Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

The body condition of Longnose Sucker declined in most sections between 2015 and 2019 (Figure 31). The greatest declines over this time period were in Section 1 (K = 1.4 in 2015 and K = 1.25 in 2019) and Section 7 (K = 1.29 in 2015 and K = 1.19 in 2019) with minimal overlap in confidence intervals between study years. Body condition declined with increasing distance downstream of PCD from Section 1 (K = 1.25) to Section 6 (K = 1.18) and increased between Section 6 and Section 9 (K = 1.21). A similar trend was observed in Largescale Sucker (Figure 27). Relative weights were not calculated for Longnose Sucker.

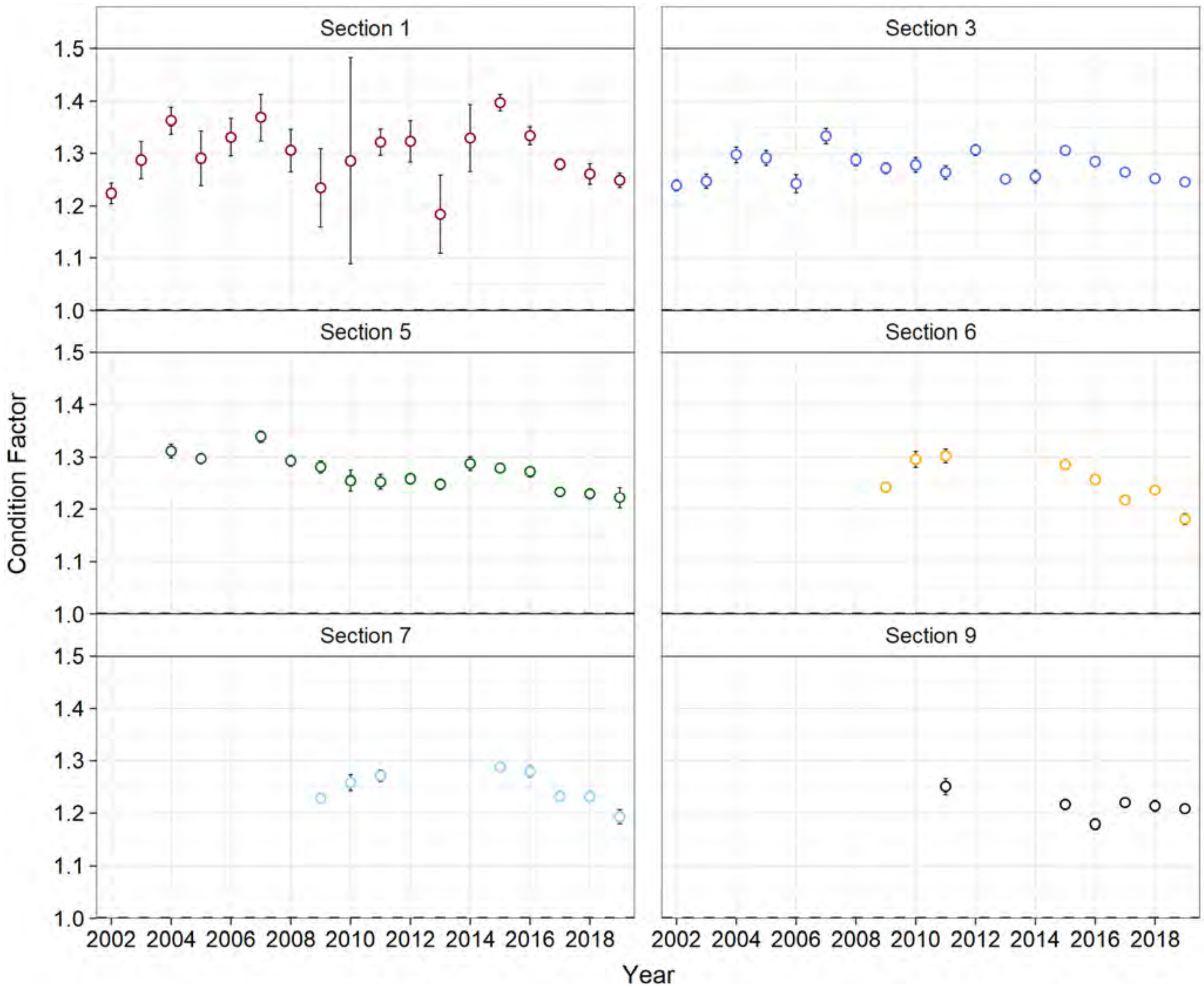


Figure 31: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) for Longnose Sucker captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

In 2019, the length-weight relationship for Longnose Sucker (Figure 32) was similar to historical study years (Appendix F, Figures F18). Statistical comparisons conducted in 2017 showed significant differences in length-weight regression slopes between some years (Golder and Gazey 2018); however, the results did not suggest any consistent or sustained trends over time.

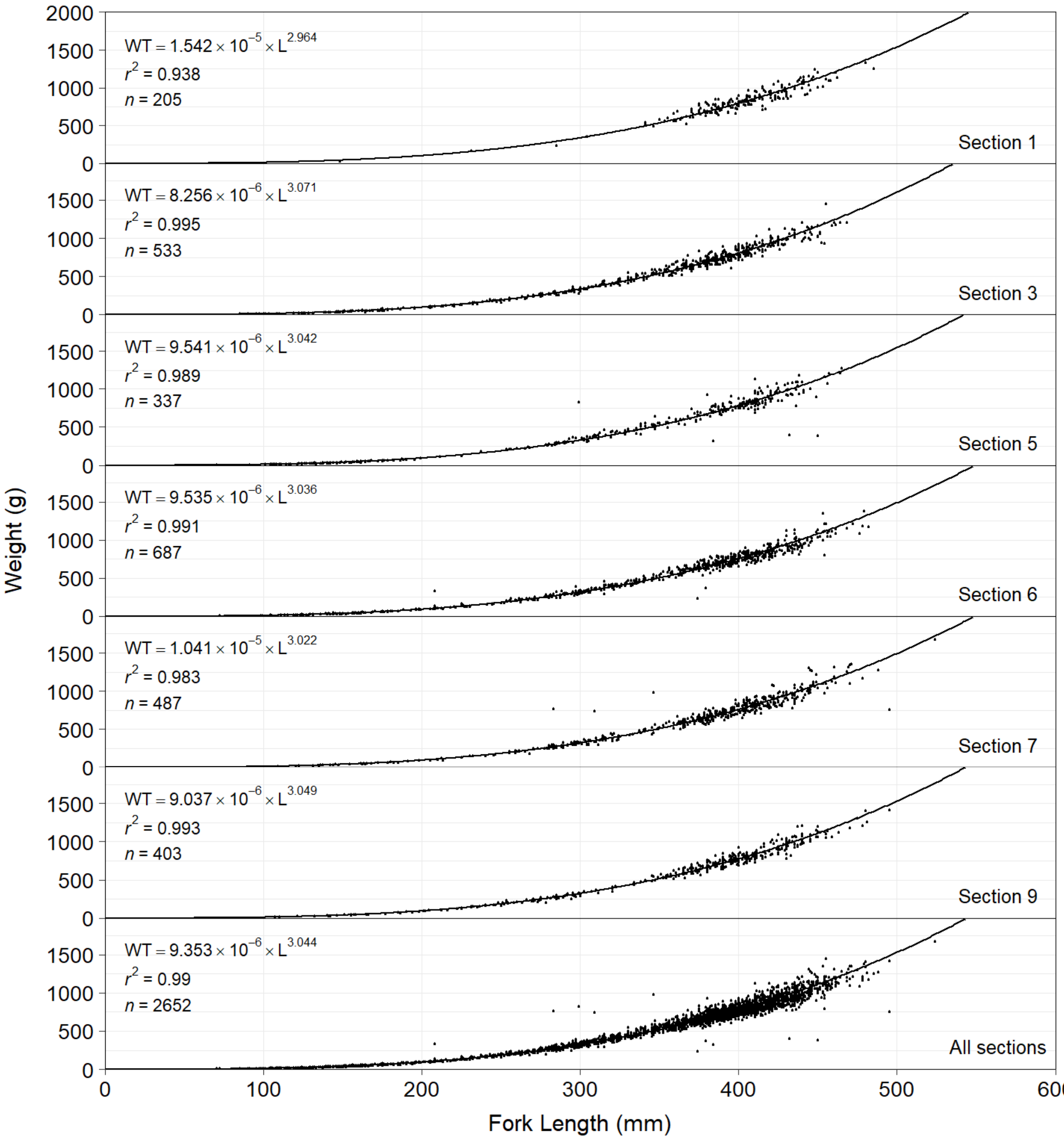


Figure 32: Length-weight regressions for Longnose Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

3.8.2 Abundance

3.8.2.1 Catch-Per-Unit-Effort

Between 2015 and 2019, catch-rates for Longnose Sucker generally declined from a high of approximately 55 fish/km-h in 2015 to a low of 35 fish/km-h in 2019 (Figure 33). Confidence intervals did not overlap between 2015 and 2019 estimates. Reasons for the decline are not known. Longnose Sucker were not consistently targeted prior to 2015; therefore, the 2002 to 2014 study years were excluded from the analysis.

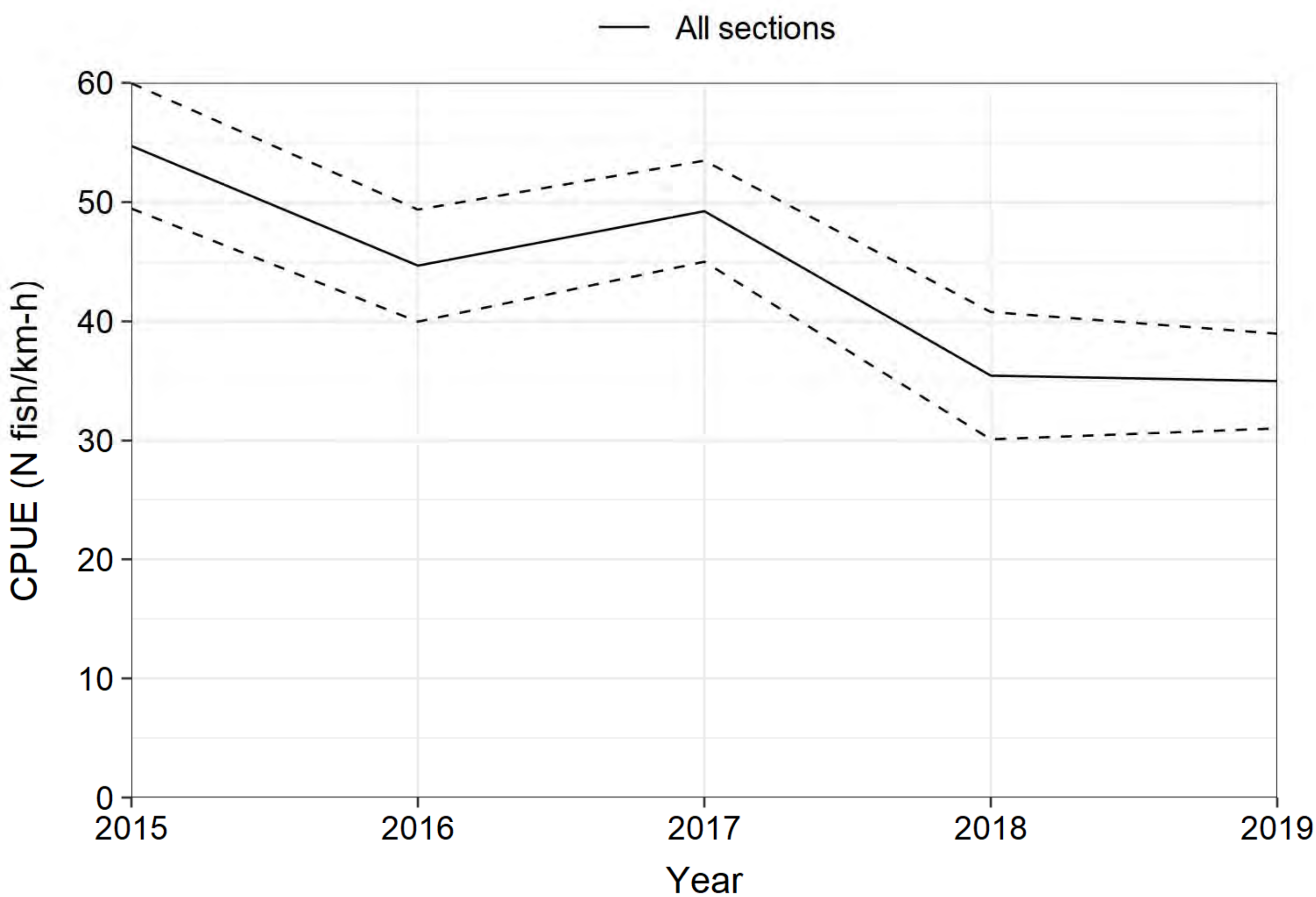


Figure 33: Mean annual catch rates (CPUE) for Longnose Sucker captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Sections 6, 7, and 9 were not sampled during these years.

3.8.2.2 Capture-Recapture

In 2019, abundance estimates of Longnose Sucker were generated for all sections (Table 15). The abundance estimates (mean with 95% credible interval) were similar in Sections 1, 3, and 7 (approximately 14,000 fish) and lower in Sections 5 and 9 (approximately 5000 fish). Credible intervals were wide surrounding the Section 1 estimate. This was due to the low number of recaptured fish in Section 1 (*n* = 5) compared to all other sections (average = 18 recaptures; range = 11 to 26 recaptures).

Table 15: Population abundance estimates generated using the Bayes sequential model for Longnose Sucker captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
1	14,409	6,340	2,080	38,580	10,826	75.1
3	13,168	10,560	5,760	22,840	4,901	37.2
5	5,041	4,140	2,340	8,500	1,745	34.6
6	10,651	9,660	6,420	15,600	2,462	23.1
7	14,165	12,420	7,740	21,900	3,870	27.3
9	5,308	4,660	2,920	8,180	1,428	26.9
Total[a]	**62,742**		**37,387**	**88,097**	**12,936**	**20.6**

[a] Calculated from the joint distribution of Sections 1 through 9.

Population abundance estimates for Longnose Sucker are available from 2015 to 2019 but not from prior years because this species was not marked before 2015. Estimates suggested declining abundance between 2015 and 2017 in Sections 5, 6, and 9; credible intervals overlapped for all years. The declining trend is supported by catch-rate data (Section 3.8.2.1 and Appendix E, Table E2).

Of the Longnose Sucker captured more than once in 2019, 6.5% (6 of 93 individuals) were recaptured in a different section than where they were initially tagged and released. Similar to 2018, in 2019, all of the individuals that were recaptured in a different section were recaptured in a downstream section. Of the six individuals that moved between sections, five were recaptured at the next section immediately downstream (i.e., captured in Section 3 and recaptured in Section 5, captured in Section 5 and recaptured in Section 6, or captured in Section 6 and recaptured in Section 7). The remaining individual was captured in Section 1 and recaptured in Section 6, travelling 93 km downstream between its initial capture on 3 September and its recapture on 2 October.

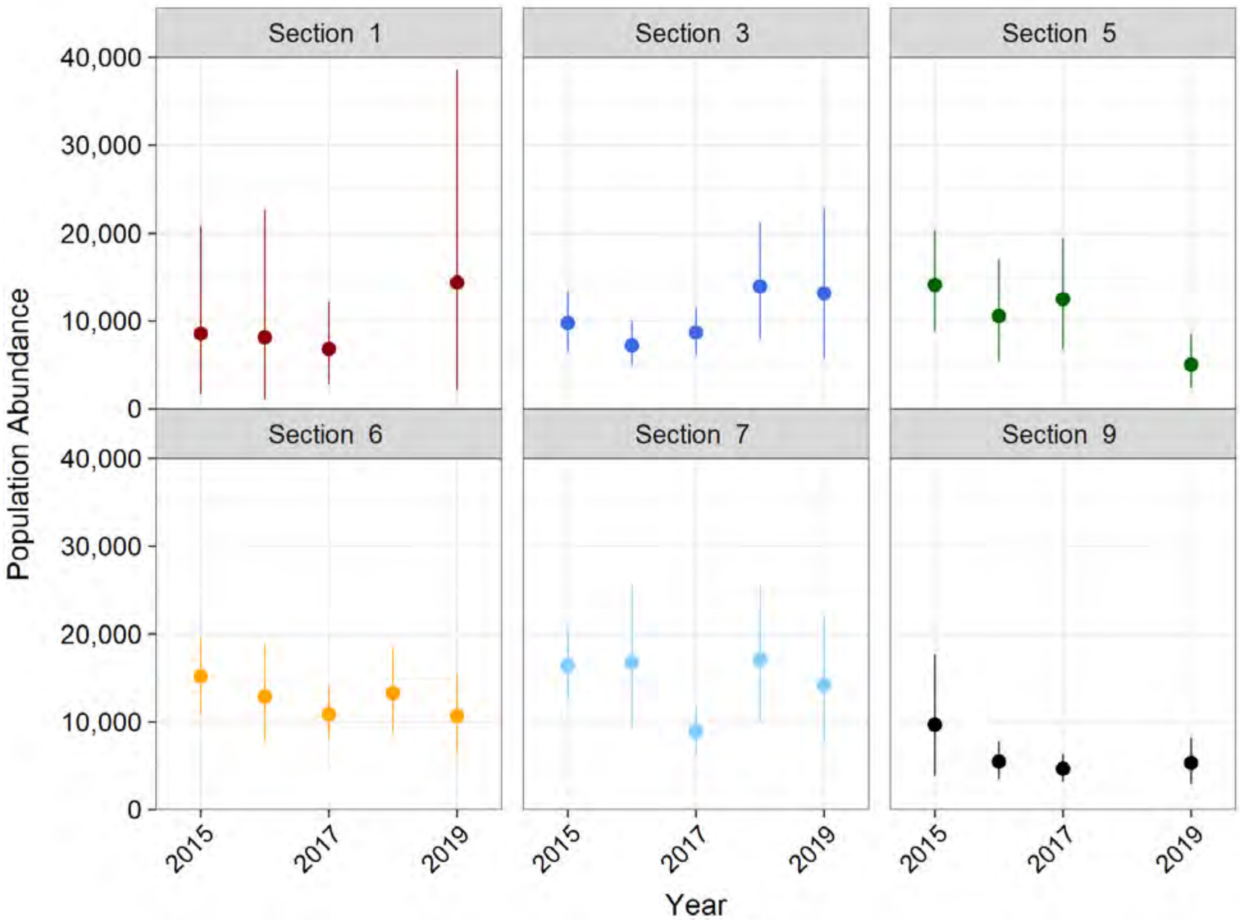


Figure 34: Population abundance estimates (with 95% credible intervals) generated using the Bayes sequential model for Longnose Sucker captured by boat electroshocking in sampled sections of the Peace River, 2015-2019.

3.9 Mountain Whitefish

3.9.1 Biological Characteristics

During the 2019 survey, 11,060 Mountain Whitefish were initially captured (i.e., excluding within-year recaptures) and 7715 of these were measured for length and weight. Lengths ranged between 59 and 544 mm FL, and weights ranged between 2 and 1394 g. Scale samples were analyzed from 489 individuals; ages ranged between age-0 and age-11. An additional 200 inter-year recaptured Mountain Whitefish were assigned ages based on a younger scale sample plus the number of years the fish was at-large. Length, weight, and body condition by age-class are summarized in Table 16.

Table 16: Average fork length, weight, and body condition by age for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 27 August to 10 October 2018.

Age	Fork Length (mm)			Weight (g)			Body Condition (K)		
	Average ± SD	Range	n^a	Average ± SD	Range	n^a	Average ± SD	Range	n^a
0	87 ± 7	74 - 99	24	6 ± 2	2 - 11	24	0.89 ± 0.23	0.31 - 1.46	24
1	152 ± 12	130 - 180	57	37 ± 12	17 - 67	57	1.03 ± 0.13	0.77 - 1.31	57
2	212 ± 9	199 - 240	37	106 ± 15	76 - 138	37	1.10 ± 0.09	0.86 - 1.28	37
3	266 ± 19	213 - 310	104	212 ± 45	98 - 321	104	1.12 ± 0.08	0.91 - 1.38	104
4	285 ± 22	240 - 343	129	258 ± 58	128 - 430	129	1.10 ± 0.10	0.77 - 1.46	129
5	306 ± 22	256 - 363	88	294 ± 51	177 - 415	88	1.03 ± 0.11	0.76 - 1.32	88
6	313 ± 22	268 - 355	78	314 ± 55	198 - 446	78	1.03 ± 0.11	0.71 - 1.30	78
7	330 ± 28	282 - 388	60	349 ± 74	228 - 541	60	0.97 ± 0.12	0.71 - 1.25	60
8	341 ± 27	300 - 391	30	391 ± 95	279 - 615	30	0.98 ± 0.12	0.71 - 1.14	30
9	352 ± 37	300 - 435	26	430 ± 134	268 - 780	26	0.96 ± 0.10	0.75 - 1.18	26
10	340 ± 41	304 - 421	14	408 ± 135	285 - 722	14	1.02 ± 0.09	0.82 - 1.15	14
11	348 ± 44	280 - 470	22	414 ± 189	246 - 1106	22	0.94 ± 0.10	0.76 - 1.12	22
12	342 ± 29	310 - 397	9	405 ± 102	295 - 637	9	1.01 ± 0.16	0.80 - 1.37	9
13	355 ± 39	327 - 382	2	393 ± 69	344 - 441	2	0.89 ± 0.14	0.79 - 0.98	2
14	333 ± 22	305 - 361	6	333 ± 43	280 - 388	6	0.91 ± 0.14	0.72 - 1.08	6
15	-	-	-	-	-	-	-	-	-
16	310	-	1	271	-	1	0.91	-	1
17	471	-	1	1056	-	1	1.01	-	1
18	465	-	1	1135	-	1	1.13	-	1

[a] Number of individuals sampled.

For Mountain Whitefish, the length-frequency histogram (Figure 35) showed discrete modes for age-0 (70-110 mm FL) and age-1 (150–200 mm FL) age-classes. All older age-classes appeared to have overlapping length distributions. Based on these and similar data from previous study years, growth slows considerably after approximately age-3 for this species, most likely due to fish reaching sexual maturity. In 2019, Sections 5, 6, and 7 had the greatest percentage of age-0 Mountain Whitefish, although this age-class was present in all sections. The length-frequency of each age class captured in upstream (Sections 1, 3, 5) and downstream (Sections 6, 7, and 9) sections of the study area overlapped and were essentially identical (Figure 36). Overall, high numbers of age-0 Mountain Whitefish (i.e., fish smaller than 100 mm FL) were captured in 2019 (n = 399; Figure 35), when compared to other study years where this size class was specifically targeted (i.e., 2014 to 2018; average = 222; range 88 to 352). The high number of age-0 fish recorded in 2019, particularly in Sections 5, 6, and 7 (Figure 37), suggests strong recruitment from the 2019 brood year (i.e., fish that hatched earlier in 2019. Age-0 Mountain Whitefish are too small to fully recruit to the boat electroshocker. Strong recruitment of the age-1 cohort in 2020 would support this finding.

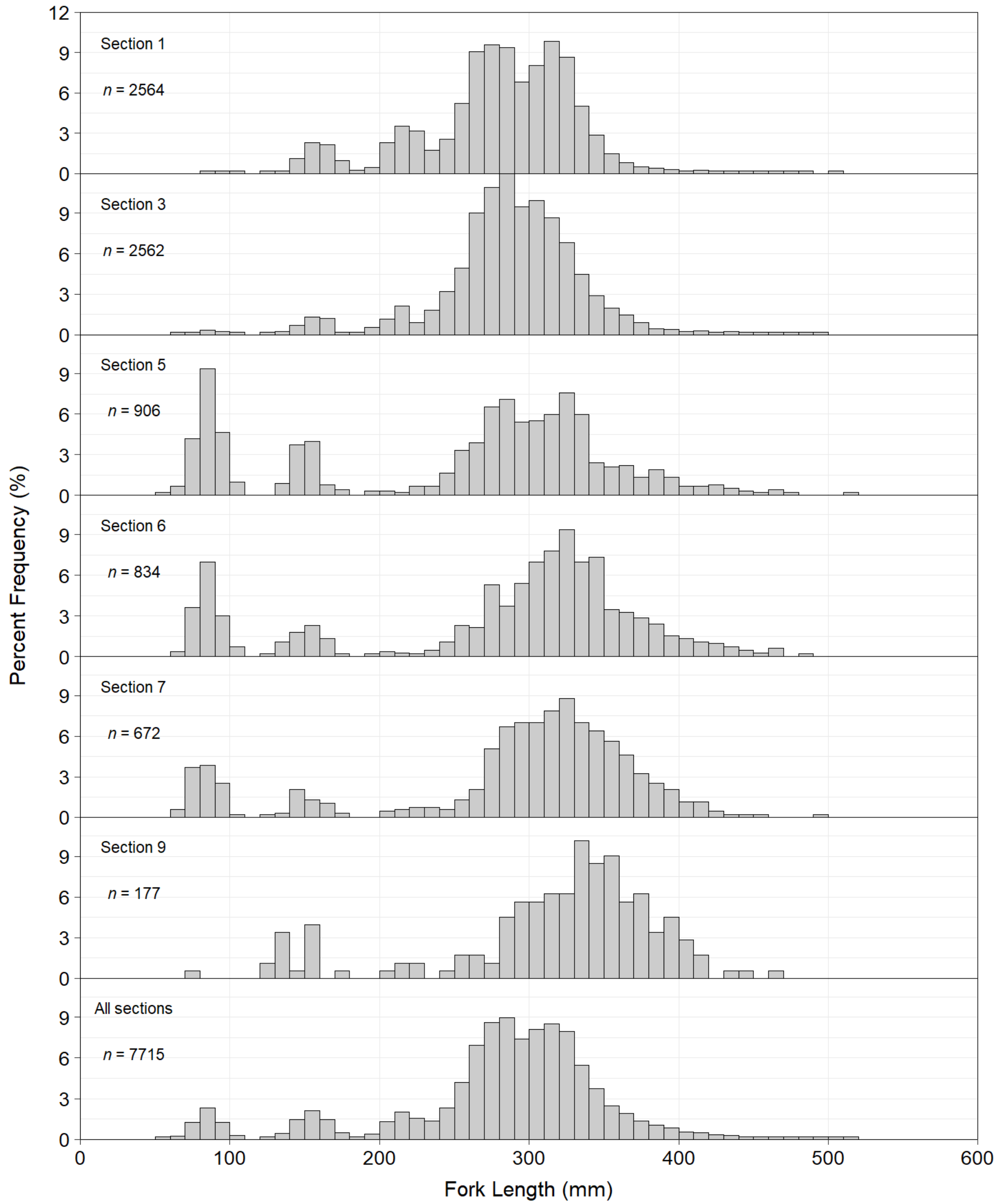


Figure 35: Length-frequency distributions for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

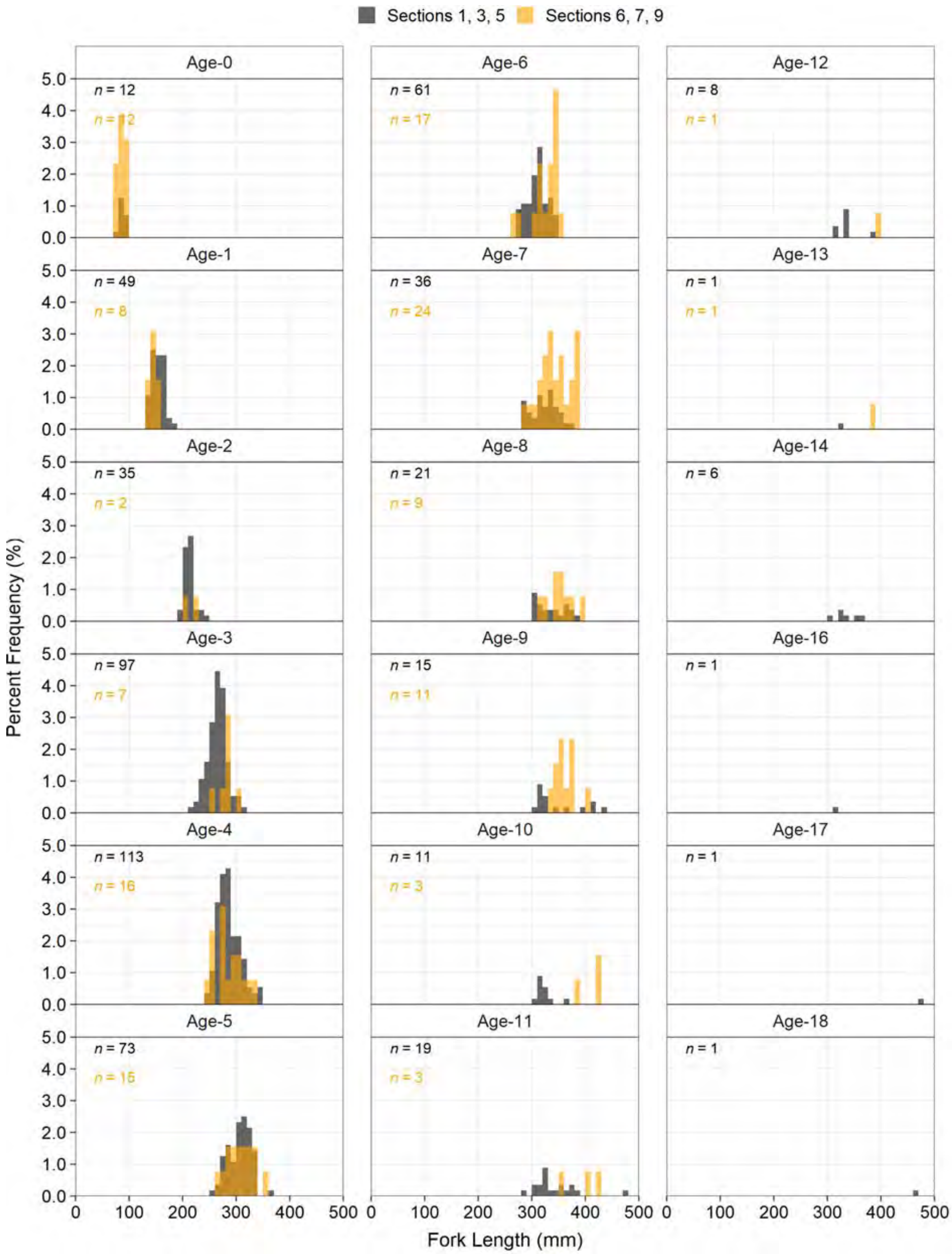


Figure 36: Length-at-age frequency distributions for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

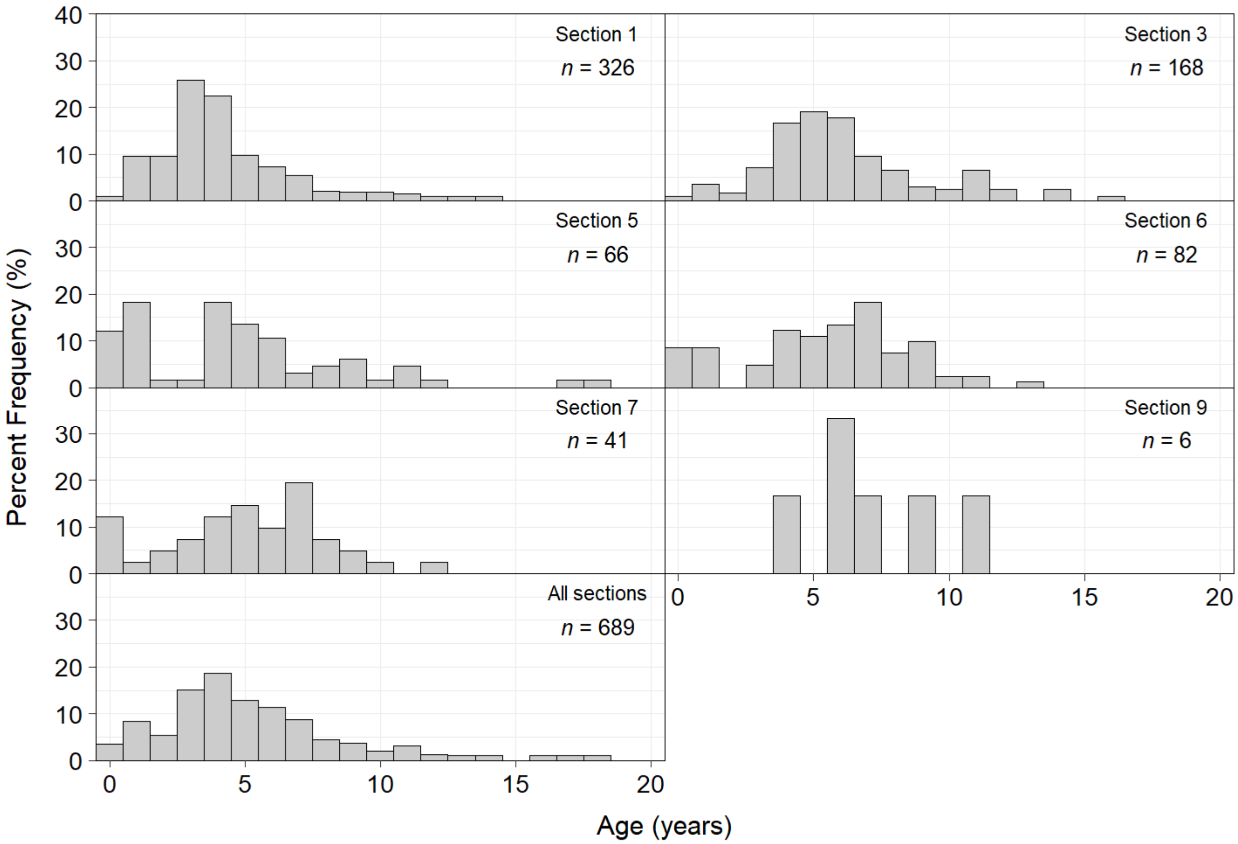


Figure 37: Age-frequency distributions for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

The annual growth of Mountain Whitefish in the study area, as assessed using the von Bertalanffy growth curve, varied among sections (Figure 38). The different curves for Sections 1 and 3 (i.e., lower asymptotic length and greater size of age-0) was likely related to the low number of young (age-0 and age-1) and old (greater than age-6) individuals captured in these sections, rather than a true difference in growth rate. The growth curve in 2019 suggested a similar growth rate to all other study years, albeit with a lower asymptotic length (Figure 39). Consistent among years, Mountain Whitefish in the study area exhibit rapid growth until approximately age-3; thereafter, growth slows considerably (Figure 38 and Figure 39).

The average change in length-at-age analysis for Mountain Whitefish (Figure 40) was limited to individuals younger than age-5 due to the slow growth, wide range of lengths recorded, and unknown precision of ages assigned to older individuals. Overall (all sections combined), the age-2 through age-4 age-classes grew to a larger size in 2014, 2015, and 2016 when compared to previous and later years, suggesting that these cohorts were approximately 10 to 20 mm larger in length, depending on the age group, relative to the 15-year average. Mean length-at-age of age-1 Mountain Whitefish was lower in 2019 relative to 2018 in all sections (Figure 40).

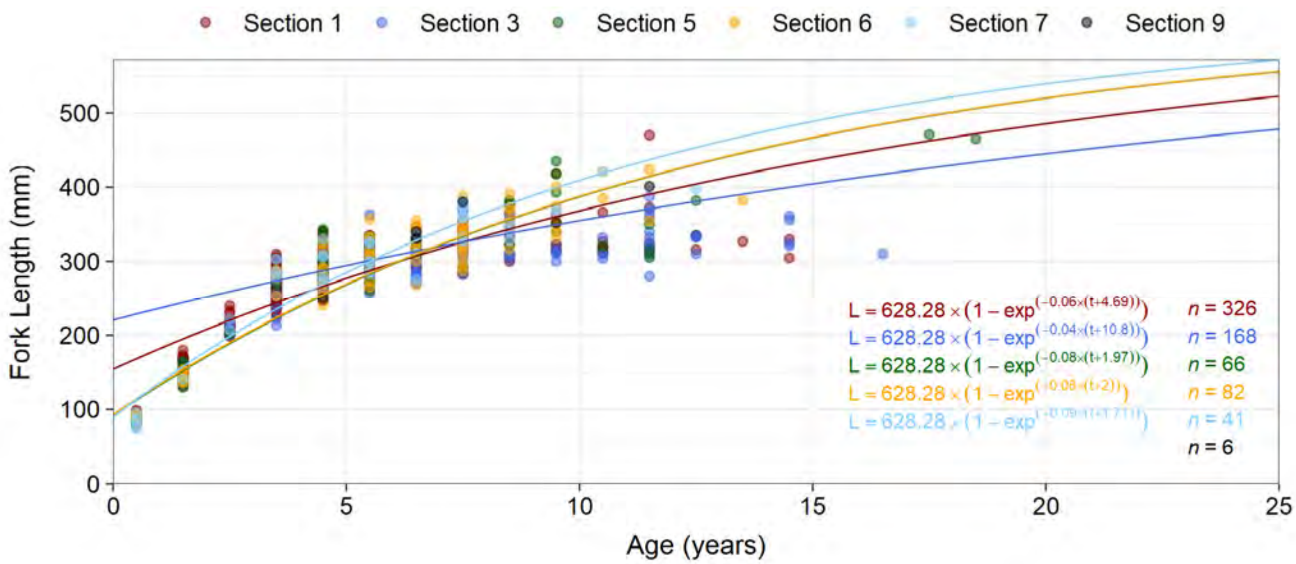


Figure 38: von Bertalanffy growth curve for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

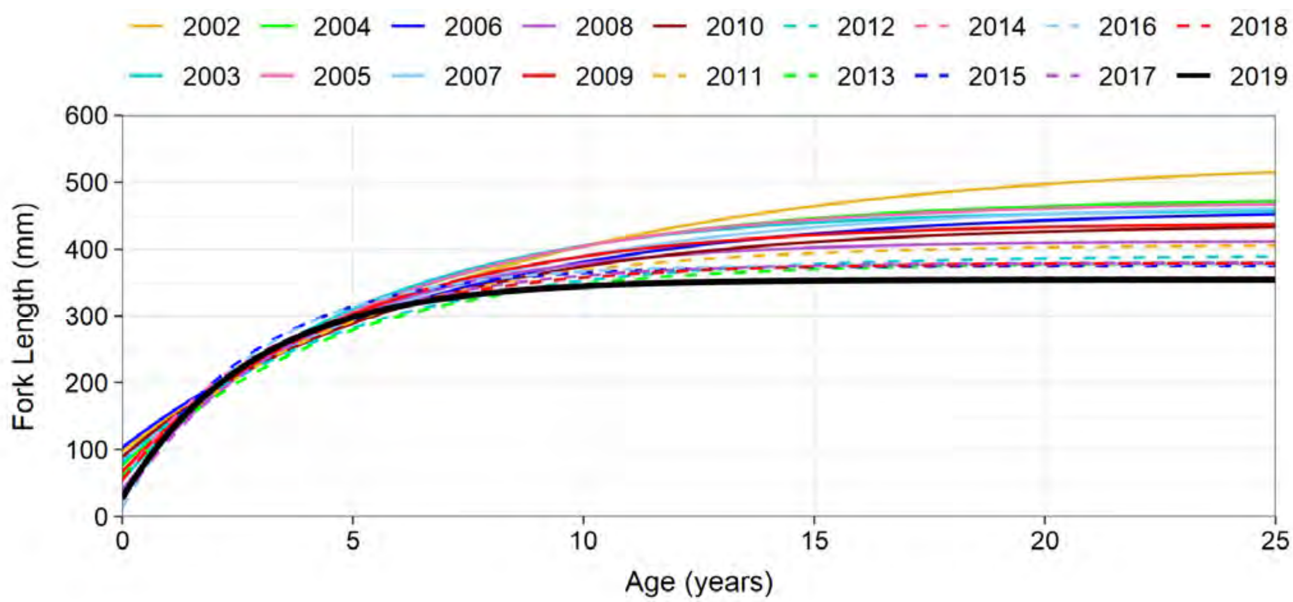


Figure 39: von Bertalanffy growth curve for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019.

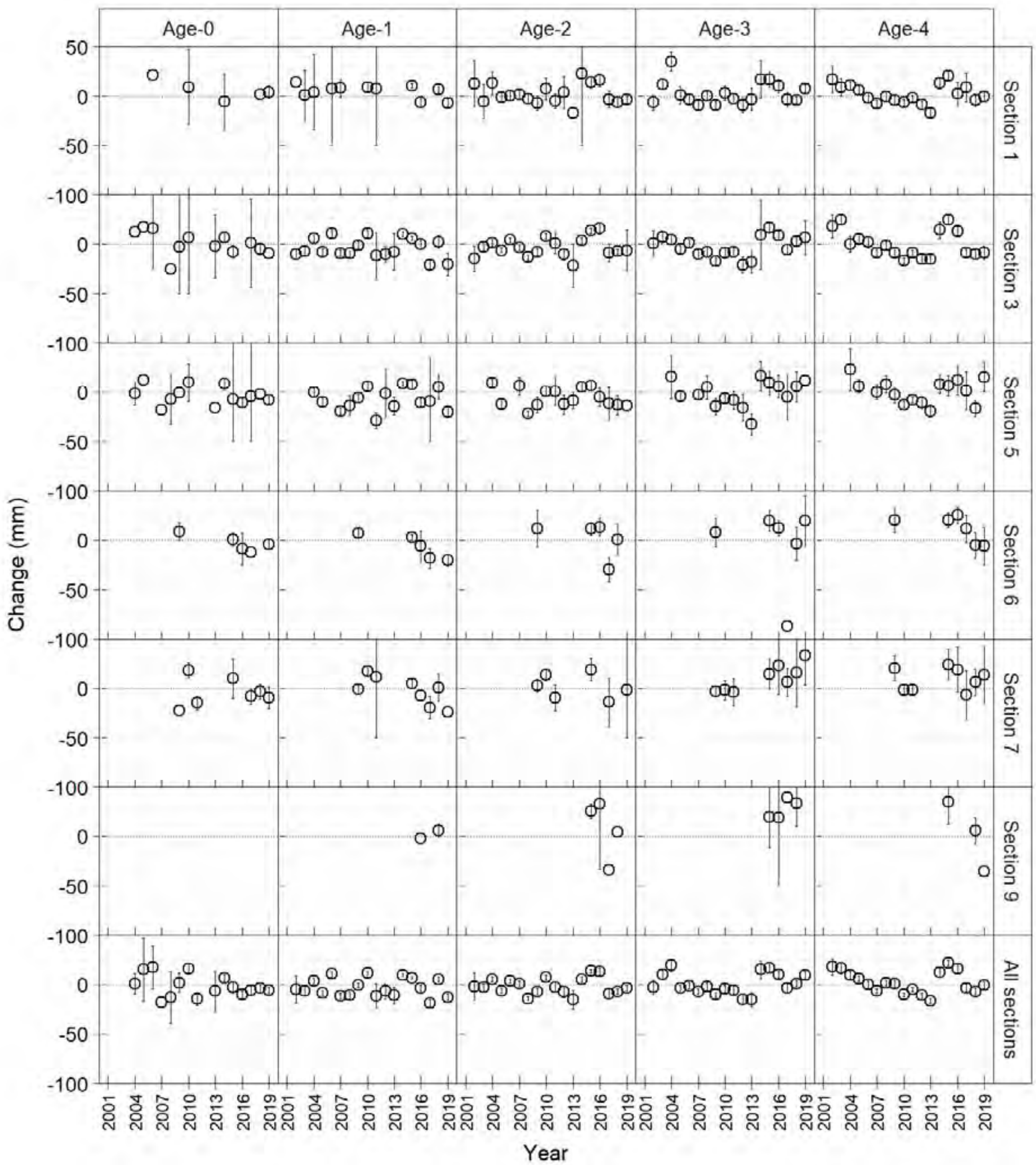


Figure 40: Change in mean length-at-age for Mountain Whitefish captured by boat electroshocking during the Peace River Fish Index, 2002 to 2019. Change is defined as the difference between the annual estimate and the estimate of all years and sections combined. Error bars represent 95% confidence intervals. For Sections 6 and 7, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

Historically, high mean body condition (*K*) was recorded for Mountain Whitefish from 2003 to 2010 and from 2014 to 2015, whereas lower mean body condition was recorded in 2002 and from 2011 to 2013. Body condition declined from 2015 to 2017 and remained relatively low from 2017 to 2019 (Figure 41). Mean body condition of Mountain Whitefish generally decreased from upstream to downstream, with the greatest mean body condition (*K*) in Section 1 (average approximately 1.15) and the lowest body condition in Section 9 (average approximately 1.07). Compared to Arctic Grayling (Figure 13) and Bull Trout (Figure 18), Mountain Whitefish body condition was typically more variable among study years (Figure 41).

Trends in relative weight estimates tracked closely with body condition estimates in all sections and study years (Figure 41). Relative weights were near optimal values (i.e., 100%) in Section 1 in 2014 and 2015, but generally ranged between 80% and 95% in most sections and study years. Overall, relative weight estimates were within the range of values recorded for this species in the Columbia River downstream of Revelstoke Dam (e.g., Golder et al. 2019a) and downstream of Hugh L. Keenleyside Dam (e.g., Golder et al. 2019b).

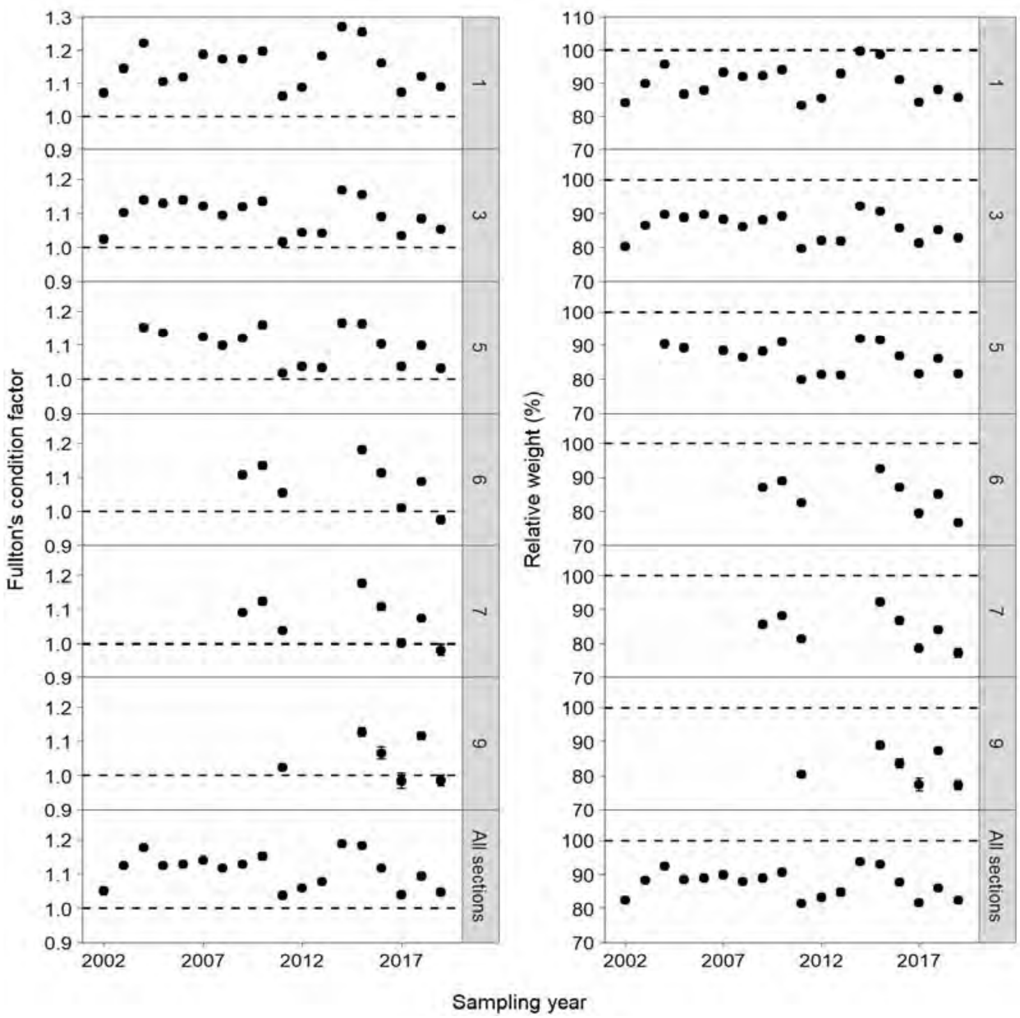


Figure 41: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) (left pane) and mean relative weight (%) values (right pane) for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

Length-weight regressions had exponents (i.e., exponentiated slopes from the log-log regression) close to 3.0 in most years (Figure 42; Appendix F, Figure F13), which suggests isometric growth and no changes in body shape with increasing size. Pairwise comparisons of length-weight regressions between years and sections were not conducted in 2019. Analyses conducted in 2017 (Golder and Gazey 2018) showed some statistically significant differences in the length-weight relationship among years and sections, but the differences were generally minor and did not indicate any long-term patterns or trends.

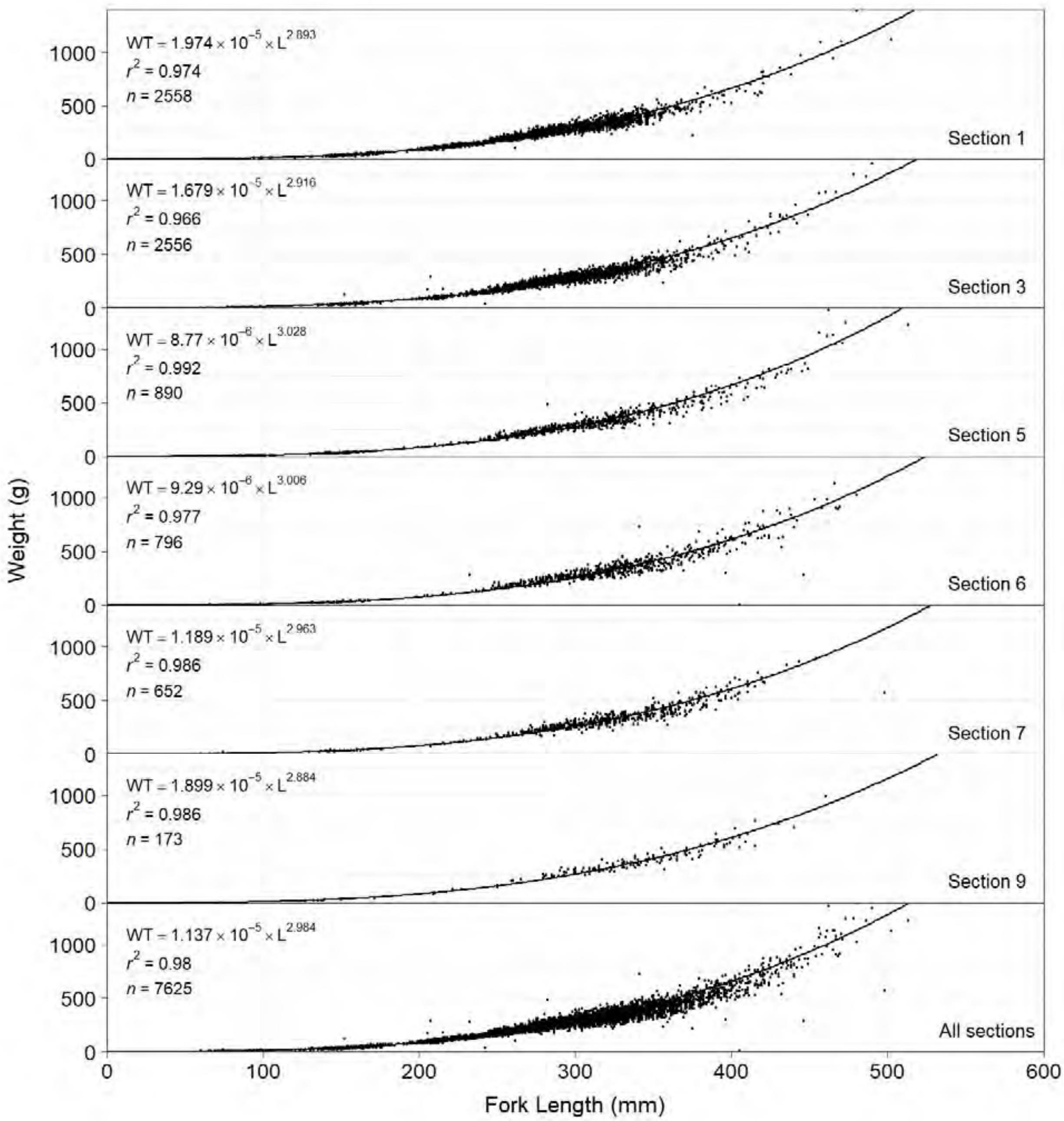


Figure 42: Length-weight regressions for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

3.9.2 Abundance

3.9.2.1 Catch-Per-Unit-Effort

Mountain Whitefish were consistently captured between 2002 and 2019 in Sections 1, 3, and 5 and consistently captured between 2015 and 2019 in Sections 6, 7, and 9; therefore, changes in catch-rates over time were compared for this species using these section groupings (Figure 43). Mountain Whitefish catch rates were stable between 2002 and 2010, increased by 48% between 2010 and 2011, and decreased by 64% between 2011 and 2014. Catch rates of Mountain Whitefish were lower but stable from 2014 to 2019, averaging approximately 200 fish/km-h over the six years combined.

Between 2015 and 2019, catch rates for Mountain Whitefish in Sections 6, 7, and 9 were, on average, 65% lower than catch rates recorded in Sections 1, 3, and 5 (Figure 43).

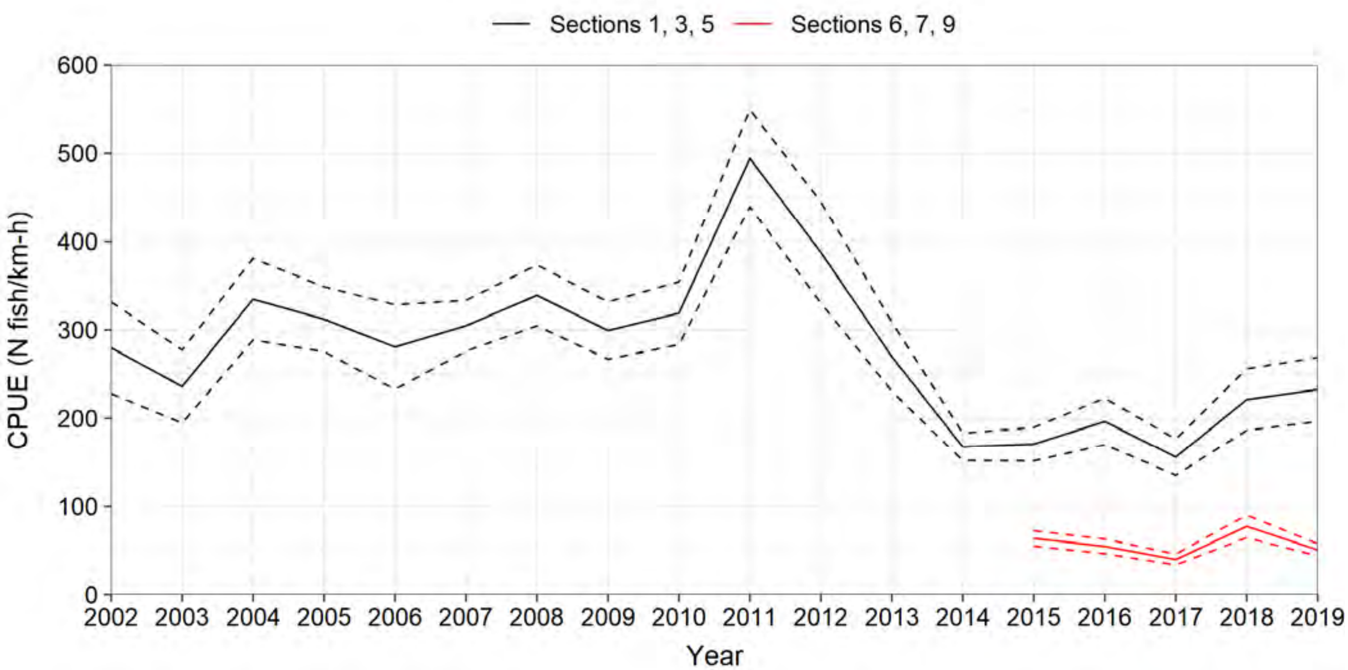


Figure 43: Mean annual catch rates (CPUE) for Mountain Whitefish captured by boat electroshocking in Sections 1, 3, and 5 combined and Sections 6, 7, and 9 combined of the Peace River, 2002 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. Sections 6, 7, and 9 were not consistently sampled prior to 2015.

3.9.2.2 Capture-Recapture

Appendix G provides a thorough description of the Mountain Whitefish population abundance analysis conducted by W.J. Gazey Research. The text below represents a summary of key findings and conclusions drawn from the results provided in Appendix G. Population estimates were restricted to data collected from fish implanted with PIT tags that were equal to or larger than 250 mm FL; capture-recapture data from fish between 200 and 249 mm FL were excluded from the population abundance analysis to maintain consistency with previous study years.

In 2019, mean population estimates of Mountain Whitefish were higher in Sections 1, 3, 6, and 7 and lower in Sections 5 and 9 (Table 17). In Section 1, the 2019 population estimate was similar to most study years with the exception of 2018. The population estimate in 2018 was greater than all other years but highly uncertain (Figure 44). Abundance estimates for Sections 3 and 5 were consistent between 2015 and 2019, with credible intervals overlapping among years. Between 2015 and 2019, average abundance in Section 3 was approximately 13,000 fish (range = 9,100 to 15,100 fish) and average abundance in Section 5 was approximately 10,500 fish (range = 7,500 to 14,300 fish). In Sections 6, 7 and 9, population estimates are only available from 2015 to 2019 and suggest relatively little variability in abundance during this period.

Table 17: Population abundance estimates generated using the Bayes sequential model for Mountain Whitefish captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
1	14,409	6,340	2,080	38,580	10,826	75.1
3	13,168	10,560	5,760	22,840	4,901	37.2
5	5,041	4,140	2,340	8,500	1,745	34.6
6	10,651	9,660	6,420	15,600	2,462	23.1
7	14,165	12,420	7,740	21,900	3,870	27.3
9	5,308	4,660	2,920	8,180	1,428	26.9
Total[a]	**62,742**		**37,387**	**88,097**	**12,936**	**20.6**

[a] Calculated from the joint distribution of Sections 1 through 9.

Abundance estimates in Figure 44 that were deemed to have substantive assumption violations are labelled in the figure as suspect (i.e., open circles instead of filled in circles). In 2004 the estimates appeared valid; however, very low water likely concentrated the fish from locations that were not sampled in other years. Similarly, the estimates for 2010 and 2011 are the largest on record (excluding the Section 1 estimate from 2018) and coincide with low water levels. In 2016, the abundance estimate for Section 1 was similarly high, and low water levels impeded sampling during Session 3. Results for 2014 were atypical in that water levels were low but population abundance estimates were near a historical low. The reliability of the 2019 population estimates is discussed in Section 4.3.2.

Comparison of Mountain Whitefish length distributions between length at initial capture and subsequent recapture in 2019 found that the recapture frequency of smaller fish (250–275 mm FL) was lower than that of larger fish (i.e., larger than 275 mm FL). This result is consistent with past studies and was not statistically significant in any of the sections (P>0.05).

Growth (i.e., the increment in length of recaptured fish as a function of time-at-large) was not statistically significant in 2019 (P=0.9); therefore, the number of unmarked fish that entered the population through growth during the study period (termed growth recruitment) was expected to be negligible.

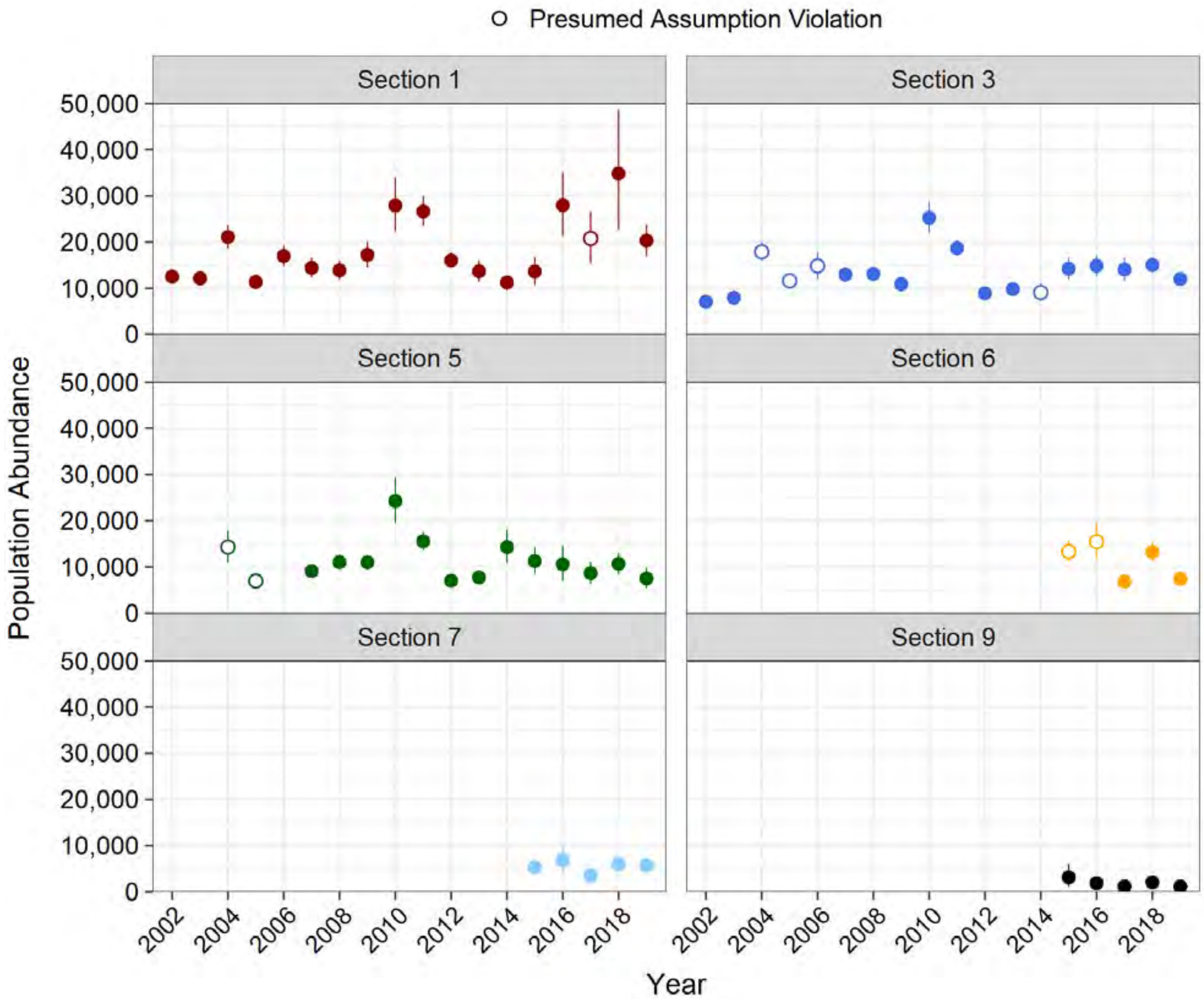


Figure 44: Population abundance estimates (with 95% credible intervals) generated using the Bayes sequential model for Mountain Whitefish captured by boat electroshocking in Sections 1, 3, 5, 6, 7 and 9 of the Peace River, 2002–2019. Estimates that are not coloured in denote suspect estimates due to assumption violations.

Mountain Whitefish exhibited some movement between sections in 2019 (overall, 6.8% of fish moved). In general, the fish exhibited high site fidelity within a section between release and recovery. The CJS analysis revealed no apparent mortality (survival not significantly different than 1.0) of tagged Mountain Whitefish during the 2019 study.

The test for time-varying catchability among sessions in 2019 resulted in substantially better fit for time-varying catchability in Sections 3 and 6, while constant catchability fit better or almost as well in all other sections (Appendix G, Table G.3). The logarithmic population deviation estimates displayed little trend over time except for Section 6, which trended upward over time.

If the assumptions of the population abundance model are valid, then the sequential posterior probability plots are expected to stabilize around a common mode. In 2019, these sequential probability plots revealed converged distributions for all sections except Section 6 (Appendix G, Figures G8 to G13). This suggests that one or more of the model assumptions was not valid for Section 6 in 2019. As a result, there is greater uncertainty associated with the Section 6 estimate relative to estimates for other sections. Between 2015 and 2019 (i.e., years when abundance estimates were generated for Sections 6), model assumptions were not valid for all years except 2017.

3.9.2.2.1 Mountain Whitefish Synthesis Model

Appendix H provides a summary of the data input into the Mountain Whitefish synthesis model, as well as the model results. The synthesis model fit to the data was generally good, based on plots of observed and predicted values (Appendix H, Figures H2 to H8). One exception was that across-year recaptures were underestimated for Section 5 for session-year observations greater than 25 recaptures. Fish less than 250 mm FL that were marked in Sections 1 and 3 between 2016 and 2019 displayed greater growth rates than predicted. Figure 45 compares synthesis model and Bayes sequential model estimates by section and year, and Table 18 presents the parameter estimates. Synthesis model and Bayes sequential model estimates were similar in most years, with the synthesis model typically yielding slightly higher estimates. However, in 2019, there was a substantial difference between the synthesis model result and the Bayes sequential model result for Section 1. Selectivity was flatter (i.e., more consistent selectivity across size classes) from 2014 to 2019 when compared to 2002 to 2013 (i.e., a higher preference for smaller fish; Appendix H, Figure H11), likely due to modifications to the boat electroshocker settings that were implemented in 2014. Recruitment estimates were imprecise and exhibited large variation among study years (Appendix H, Figure H14).

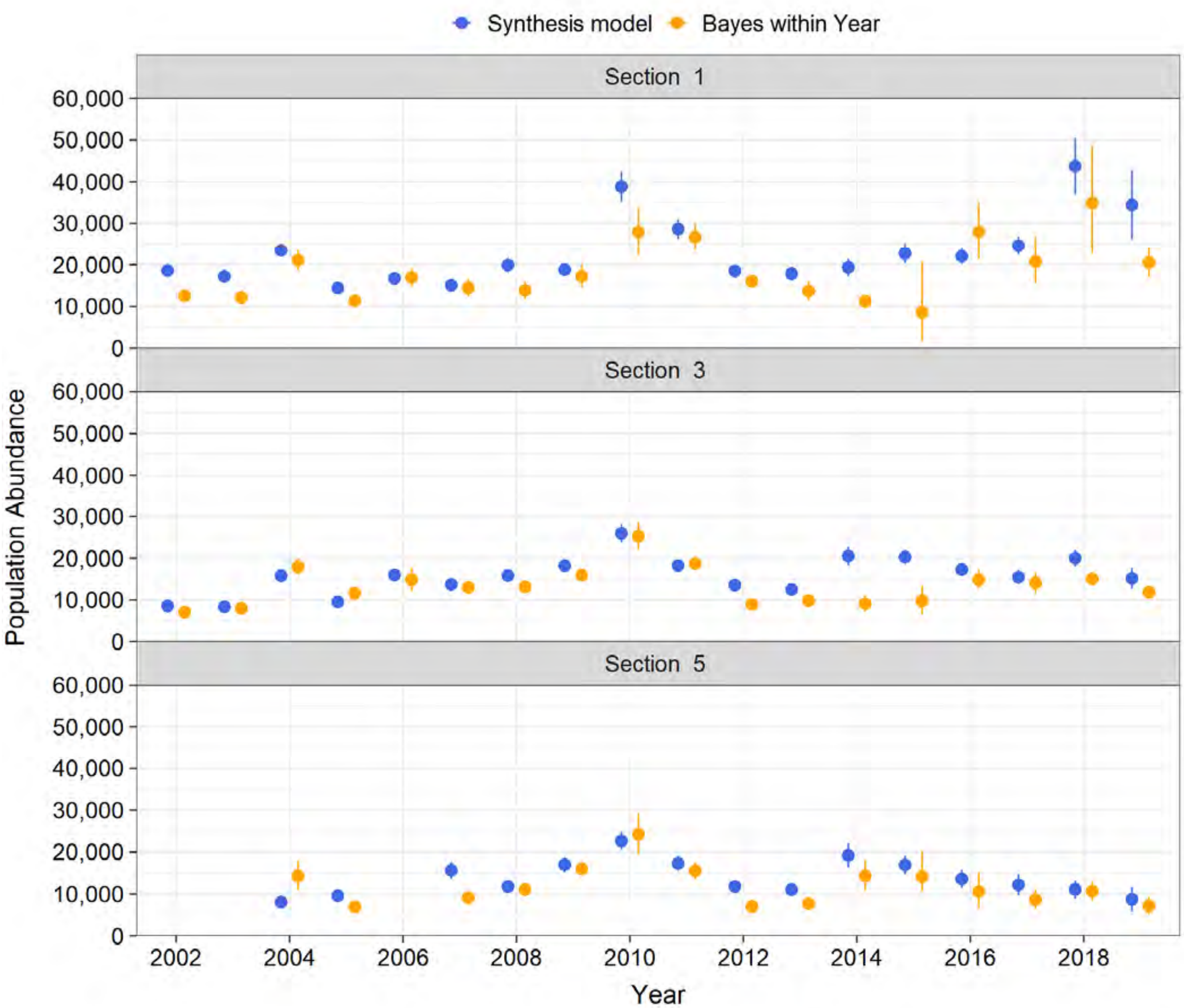


Figure 45: Comparison of Mountain Whitefish population abundance estimates based on the synthesis model and the Bayes sequential model by section and year. Bayesian error bars are the 95% highest probability density interval and the synthesis model error bars are ±2 standard errors.

Table 18: Synthesis model parameter estimates and associated standard errors, 2019.

Parameter	Year	Section 1		Section 3		Section 5	
		Estimate	SE	Estimate	SE	Estimate	SE
Nuisance length-at-age							
Length age-10 (mm)		323.0	3.9	321.1	2.6	354.5	6.1
Growth coefficient		0.391	0.017	0.378	0.010	0.275	0.013
Individual length SD (mm)		27.4	0.7	26.0	0.5	33.5	1.2
Growth							
Length age-0 (mm)		97.6	2.2	93.6	1.0	92.5	1.1
Growth coefficient		0.205	0.005	0.155	0.005	0.159	0.006
Individual length SD (mm)		25.9	0.5	41.7	1.1	41.3	1.4
Length age-10 (mm)	2003	295.5	2.1	296.8	2.8		
	2004	313.3	1.5	347.1	2.5		
	2005	283.9	1.6	301.1	2.6	314.3	3.3
	2006	295.6	1.8	340.5	2.5		
	2007	292.7	1.8	311.6	2.3	345.1	3.4
	2008	308.5	1.7	303.6	1.9	324.5	3.2
	2009	293.7	1.7	299.9	2.4	326.3	2.9
	2010	310.2	1.7	308.7	3.0	322.5	2.9
	2011	289.2	1.4	282.6	2.0	293.2	2.5
	2012	280.1	1.4	270.2	2.0	277.9	2.6
	2013	289.2	1.7	272.4	1.9	282.2	2.6
	2014	333.6	2.0	330.8	2.5	329.2	3.2
	2015	331.4	2.1	321.9	2.6	320.3	4.0
	2016	309.2	2.0	296.6	2.4	299.8	4.1
	2017	295.7	1.9	279.9	2.4	292.1	3.5
	2018	307.9	2.1	298.6	2.2	298.4	3.7
	2019	285.6	1.9	270.2	2.1	289.1	3.8
Selectivity							
Mid length bin (10 mm increments)	2002-13	28.7	0.28	30.7	0.56	35.3	0.68
	2014-19	30.3	0.78	31.5	2.53	490.0	
Slope	2002-13	1.8	0.05	2.9	0.09	3.7	0.15
	2014-19	2.2	0.14	6.0	1.14	13.3	1.86
Asymptotic Mortality (logit)	2002-04	-1.175	0.046	-1.264	0.032		
	2005-07	-0.895	0.057	-1.345	0.056	-0.896	0.045
	2008-10	-1.331	0.087	-1.164	0.055	-1.905	0.130
	2011-13	0.078	0.064	-0.606	0.061	-0.533	0.101
	2014-16	-33.565		-2.059	0.192	-1.696	0.243
	2017-18	-2.367	0.760	-1.910	0.409	-0.994	0.445
Recruitment ($\log_e$)	2002	11.54	0.14	11.26	0.13		
	2003	11.66	0.43	13.73	0.14		
	2004	13.17	0.29	10.55	0.63	13.02	0.20
	2005	13.65	0.24	13.43	0.29	14.34	0.29
	2006	12.47	0.49	13.21	0.39	13.54	0.34
	2007	12.22	0.50	10.30	0.58	10.82	0.68
	2008	12.53	0.34	10.15	0.53	10.50	0.50
	2009	11.43	0.51	9.93	0.53	10.12	0.55
	2010	11.40	0.53	10.49	0.61	10.62	0.57
	2011	11.92	0.60	13.16	0.23	10.76	0.68
	2012	13.88	0.31	11.50	0.51	12.65	0.33
	2013	12.63	0.37	9.91	0.49	10.35	0.58
	2014	11.00	0.44	9.62	0.37	10.02	0.47
	2015	11.44	0.53	9.05	0.42	9.83	0.44
	2016	13.39	0.62	9.04	0.46	9.44	0.45
	2017	14.76	0.62	8.99	0.51	9.01	0.50
	2018	12.89	0.90	10.25	0.48	9.37	0.51
	2019	12.55	0.77	10.50	0.51	9.98	0.46
Miscellaneous							
Capture probability coefficient		0.0451	0.0096	0.0465	0.0108	0.0795	0.0160
Negative binomial dispersion coefficient		1.74	0.10	2.83	0.16	2.68	0.17

3.10 Northern Pike

3.10.1 Biological Characteristics

During the 2019 survey, 25 Northern Pike were initially captured (i.e., excluding within-year recaptures) and all of these were measured for length and weight. Fork lengths ranged between 165 and 755 mm FL, weights ranged between 28 and 3330 g, and body condition (*K*) ranged between 0.61 and 0.77. Fin rays were collected from 24 fish; these samples were not analyzed but were provided to BC Hydro for long-term storage.

Length-frequency data suggest that all life stages of Northern Pike are present in the study area (Figure 46); however, their use is largely limited to the study area's lower sections. Northern Pike were not recorded in Sections 1 or 3 in 2019 (Table 8) but were recorded in these two sections in low numbers in 2017 (*n* = 2) and 2018 (*n* = 4) (Appendix E, Tables E1 and E2). Northern Pike were not consistently targeted prior to 2015. Between 2015 and 2019, the number of fish less than 250 mm FL (i.e., age-0 and age-1 individuals) has been low (range = 0 to 8 individuals; Appendix F, Figure F23).

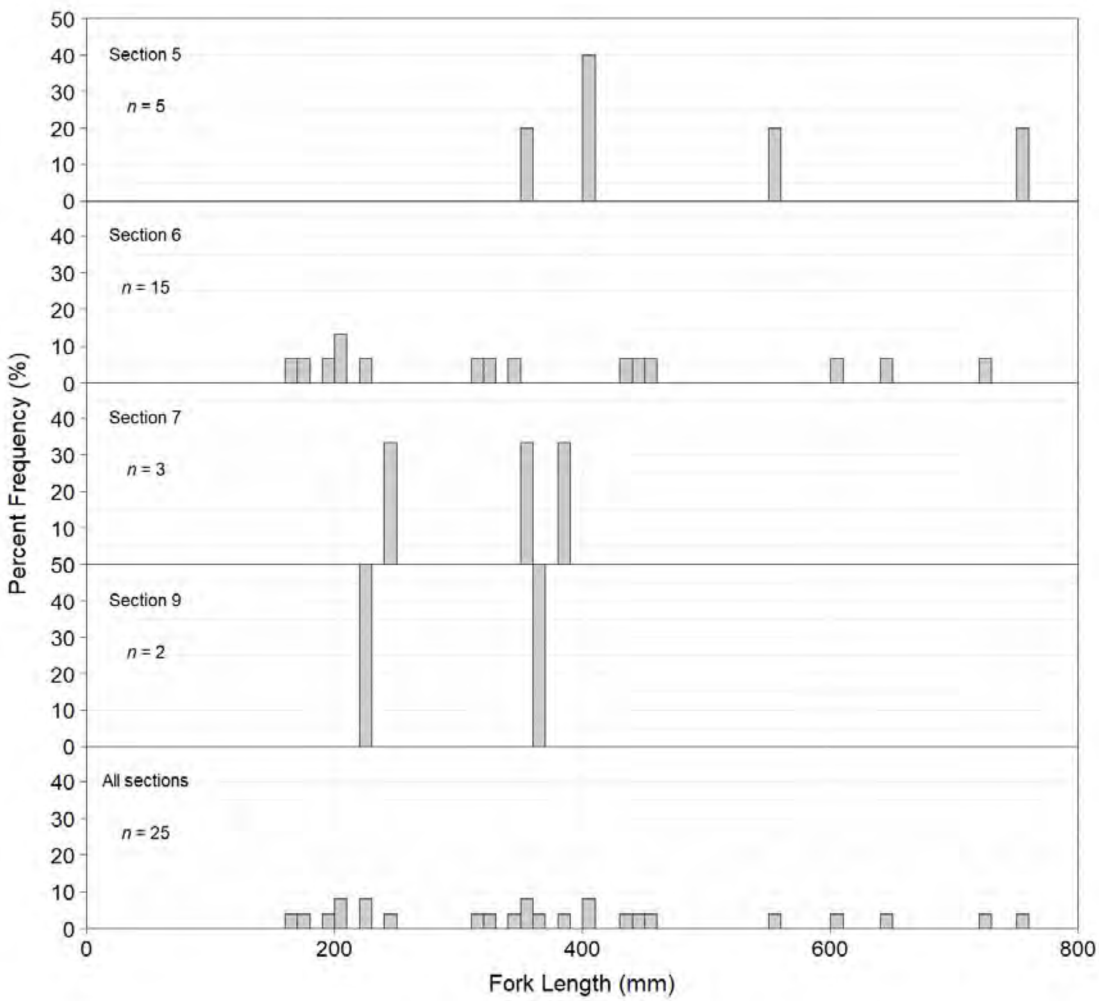


Figure 46: Length-frequency distributions for Northern Pike captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Length-weight relationships for Northern Pike in 2019 indicate positive allometric growth (b greater than 3.0), where fish become more rotund as they increase in length (Figure 47). Sample sizes were small and did not suggest any large differences in the length-weight relationship among sections (Figure 47) or years (Appendix F, Figure F24). The mean body condition (K) of Northern Pike in 2019 was consistent with mean body condition values recorded among recent study years and sections (Figure 48). Relative weight values were not estimated for Northern Pike in 2019.

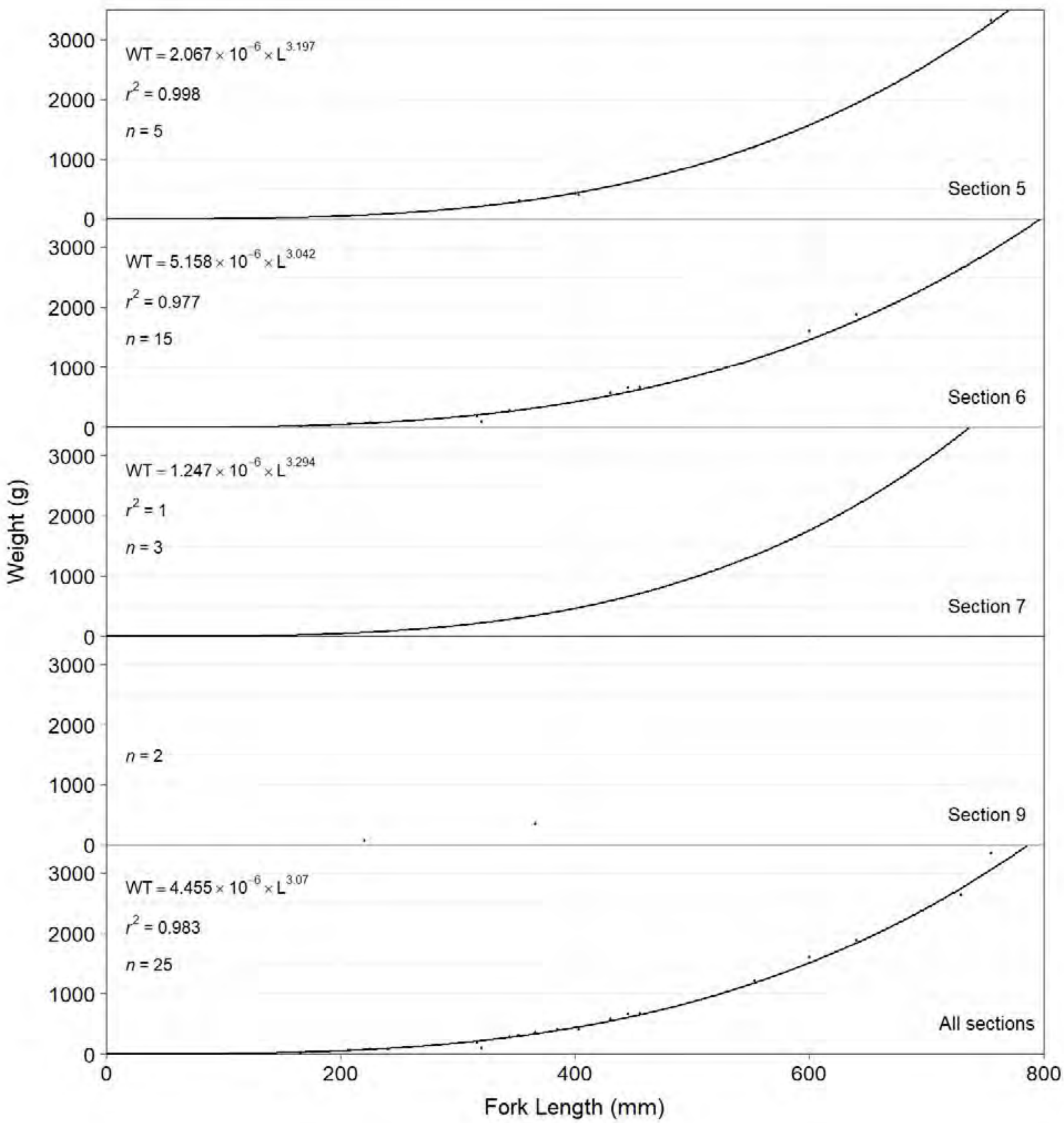


Figure 47: Length-weight regressions for Northern Pike captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

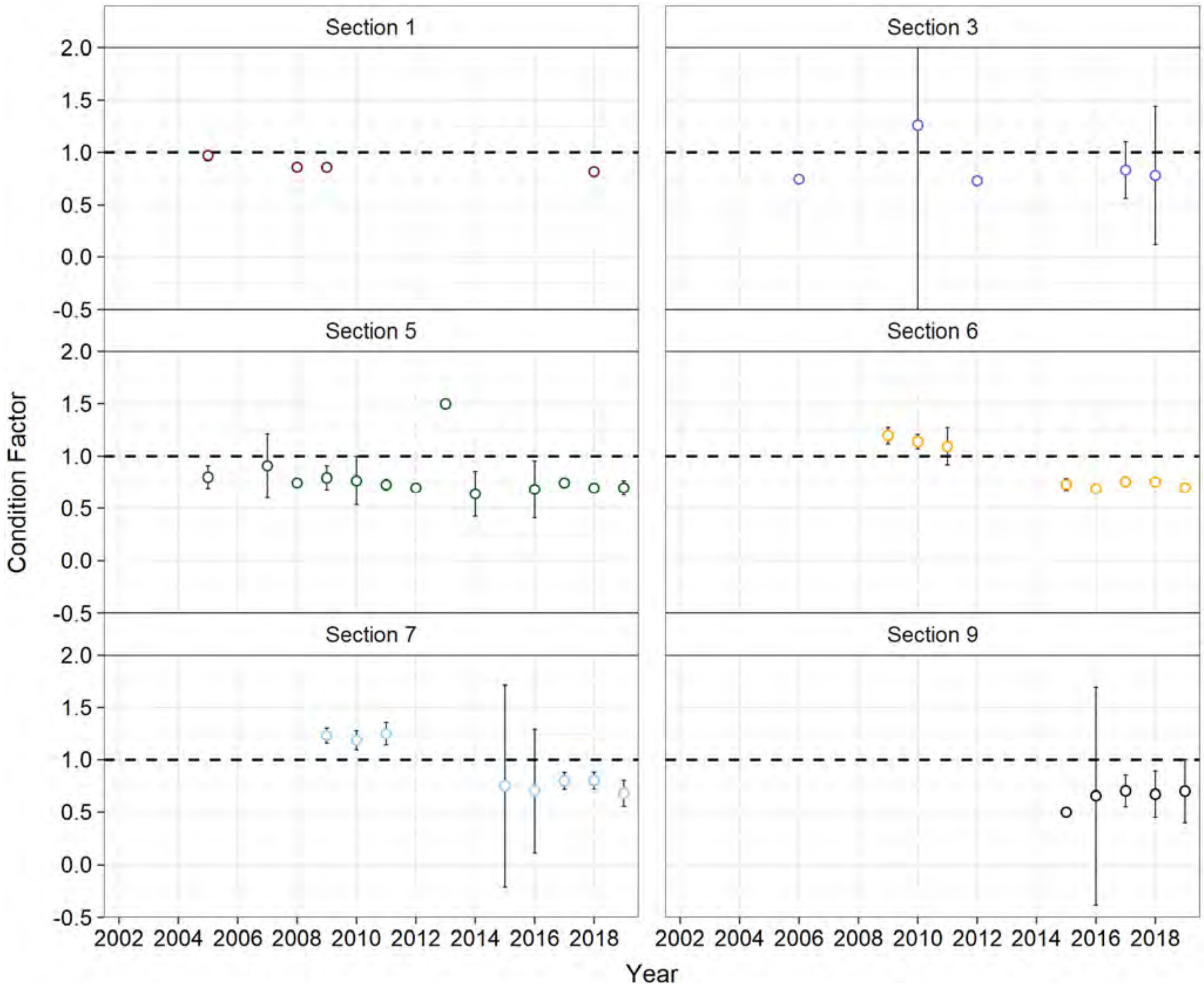


Figure 48: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) for Northern Pike captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013). The 95% CI of Section 3 values in 2010 extends from -1.14 to 3.66.

3.10.2 Abundance

3.10.2.1 Catch-Per-Unit-Effort

In total, 23 of the 25 Northern Pike captured during the 2019 survey were implanted with PIT tags; none of them were recaptured. Since 2015 (i.e., since sampling has been conducted in all six sections), 125 Northern Pike have been captured. Of those 125 fish, 54 (43%) were recorded in Section 6. The remaining fish were recorded in Section 5 (*n* = 32; 26%), Section 7 (*n* = 21; 17%), Section 9 (*n* = 12; 10%), Section 3 (*n* = 5; 4%), and Section 1 (*n* = 1; <1%) (Attachment A). These data suggest a preference for the downstream portions of the study area for this species. Small sample sizes and low numbers of recaptured individuals (one in the last five years combined) prevented the generation of absolute abundance estimates for this species. Catch rate data suggest stable to increasing Northern Pike abundance between 2015 and 2019 (all sections combined); confidence intervals overlapped for all estimates (Figure 49).

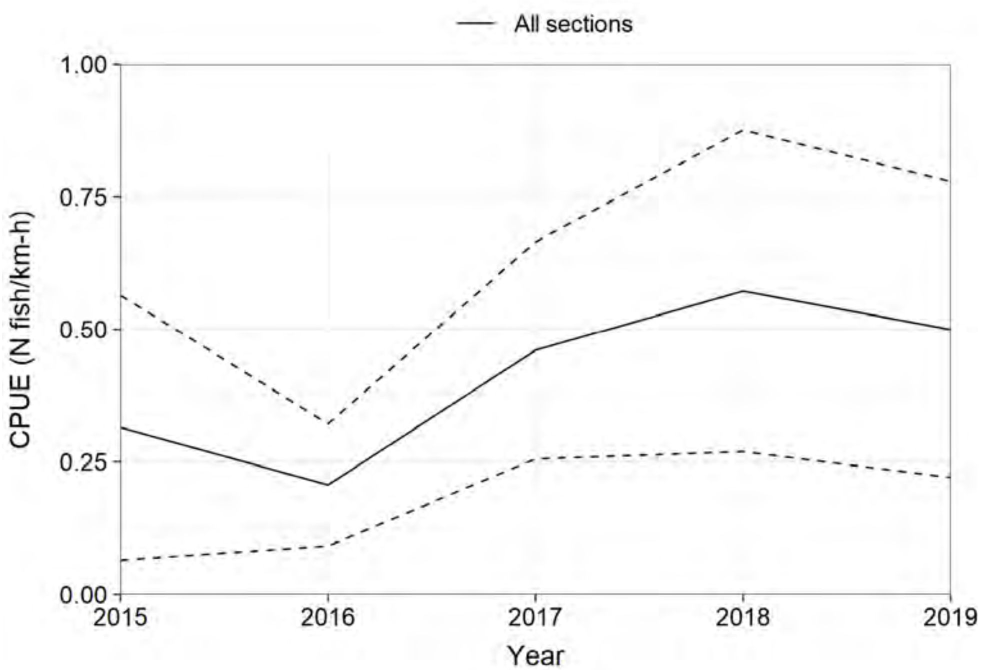


Figure 49: Mean annual catch rates (CPUE) for Northern Pike captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Northern Pike were not consistently targeted prior to 2015.

A single Northern Pike was captured near the Pouce Coupe River during the 2019 Goldeye and Walleye Survey. It had a fork length of 798 mm, weighed 3389 g, and was implanted with a PIT tag.

3.11 Rainbow Trout

3.11.1 Biological Characteristics

During the 2019 survey, 157 Rainbow Trout were initially captured (i.e., excluding within-year recaptures); all were measured for length and weight. Fork lengths ranged between 125 and 485 mm and weights ranged between 15 and 1498 g (Table 19). Body condition (*K*) ranged between 0.77 and 1.51.

Rainbow Trout captured in 2019 that were also captured during a previous study year (i.e., inter-year recaptured fish) were assigned ages using the youngest scale sample collected because older scale samples are typically less accurate for Rainbow Trout (Mackay et al.1997). Twelve Rainbow Trout were assigned ages using scale samples collected during a previous study year plus the number of years the fish was at-large. An additional 129 Rainbow Trout were assigned ages using scale samples collected during the current study year. Assigned ages ranged between age-0 and age-8 (Table 9).

Table 19: Average fork length, weight, and body condition by age for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Age	Fork Length (mm)			Weight (g)			Body Condition (K)		
	Average ± SD	Range	n[a]	Average ± SD	Range	n[a]	Average ± SD	Range	n[a]
0	84	-	1	5	-	1	0.84	-	1
1	182 ± 29	125 – 247	59	72 ± 33	15 – 159	59	1.10 ± 0.12	0.77 – 1.44	59
2	230 ± 22	196 – 269	28	141 ± 46	77 – 232	28	1.12 ± 0.07	0.99 – 1.26	28
3	320 ± 42	242 – 408	30	398 ± 168	164 – 829	30	1.15 ± 0.09	0.97 – 1.34	30
4	377 ± 36	309 – 420	12	621 ± 172	321 – 846	12	1.13 ± 0.05	1.06 – 1.20	12
5	398 ± 41	350 – 485	8	702 ± 345	446 – 1498	8	1.05 ± 0.14	0.84 – 1.31	8
6	402 ± 45	370 – 433	2	670 ± 56	630 – 709	2	1.06 ± 0.26	0.87 – 1.24	2
7	-	-	-	-	-	-	-	-	-
8	465	-	1	1167	-	1	1.16	-	1

[a] Number of individuals sampled.

Scale analyses indicate differences in growth of immature Rainbow Trout (i.e., fish less than approximately 250 mm FL) based on their location of capture. As examples, fork lengths of age-1 Rainbow Trout captured in Section 1 averaged 173 mm (range = 128 to 210 mm FL), whereas fork lengths of age-1 Rainbow Trout captured in Section 3 averaged 186 mm (range = 125 to 225 mm FL). The wide range of growth rates for young Rainbow Trout in the Peace River resulted in overlapping length distributions of individual age cohorts as young as between age-1 and age-2 (e.g., a large age-1 Rainbow Trout in Section 3 can be larger than a small age-2 Rainbow Trout in Section 1).

Most (60%) of the Rainbow Trout captured in 2019 were between 150 and 300 mm FL (Figure 50). The length-frequency histogram (Figure 50) support the findings of length-at-age data (Table 19) and indicate that the length distributions of age-1 and age-2 Rainbow Trout overlapped. A single age-0 Rainbow Trout (84 mm FL) was captured in Section 3 in 2019. An age-0 Rainbow Trout (72 mm FL) was also captured in Section 3 in 2018 (Golder and Gazey 2019). These two fish represent the only two Rainbow Trout less than 100 mm in fork length to be captured in the Peace River mainstem over the 18-year study period. Age-0 Rainbow Trout are likely rare because this age-class remains in natal streams for their first year and have not yet migrated into the Peace River mainstem at the time of sampling. Age-1 was the most common age-class of Rainbow Trout in the study area and age-2 fish were underrepresented in most sections (Figure 51).

The von Bertalanffy model suggests a slower growth rate in Section 1 relative to Sections 3 and 5. Growth curves could not be estimated for other sections because of small sample sizes (Figure 52). Comparison of von Bertalanffy curves among years suggested similar growth in 2019 when compared to most previous study years. Small sample sizes, especially for the youngest and oldest age classes, resulted in poor fits of the von Bertalanffy model during most study years, which may explain differences in annual growth curves rather than actual differences in growth rates.

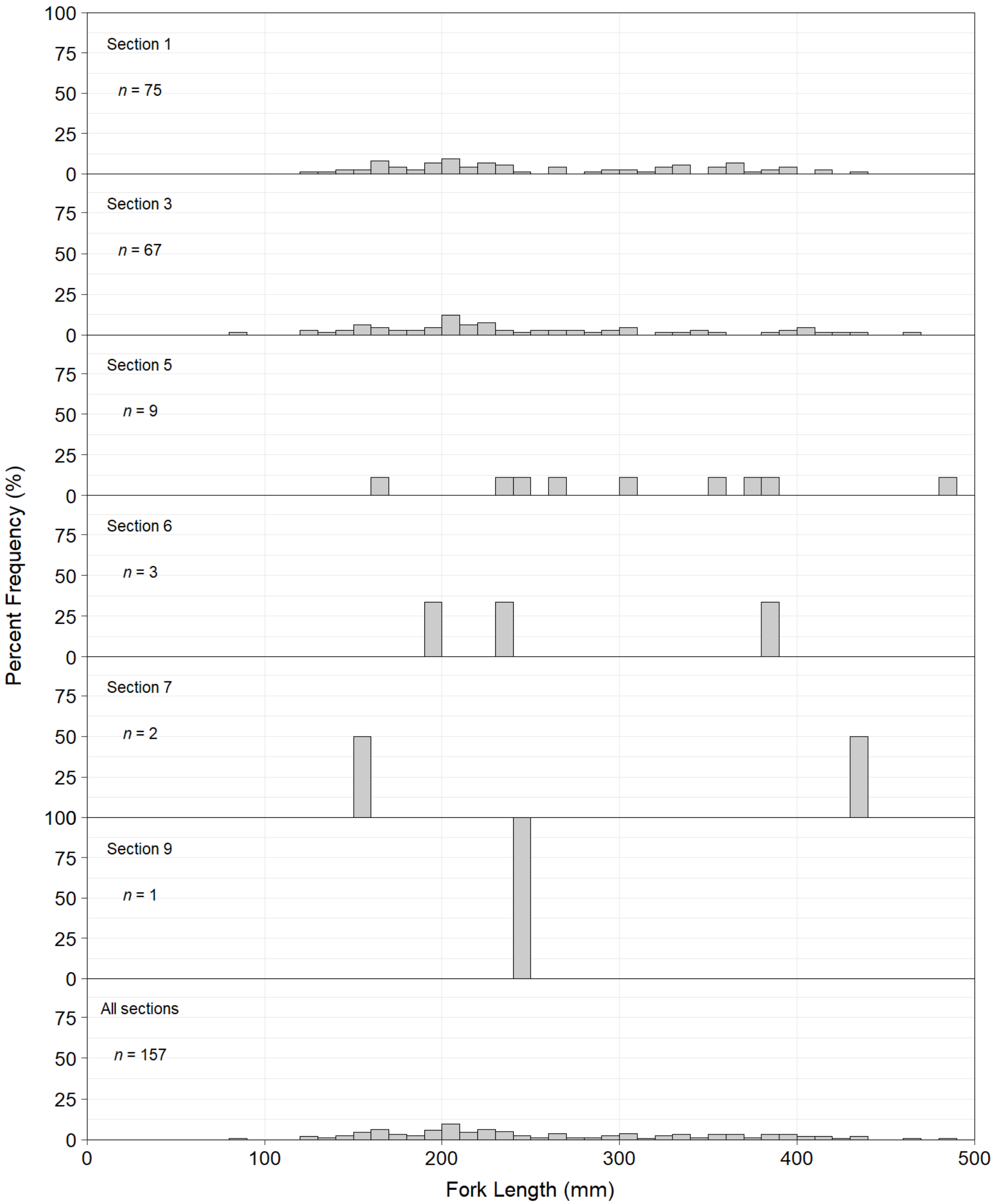


Figure 50: Length-frequency distributions for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

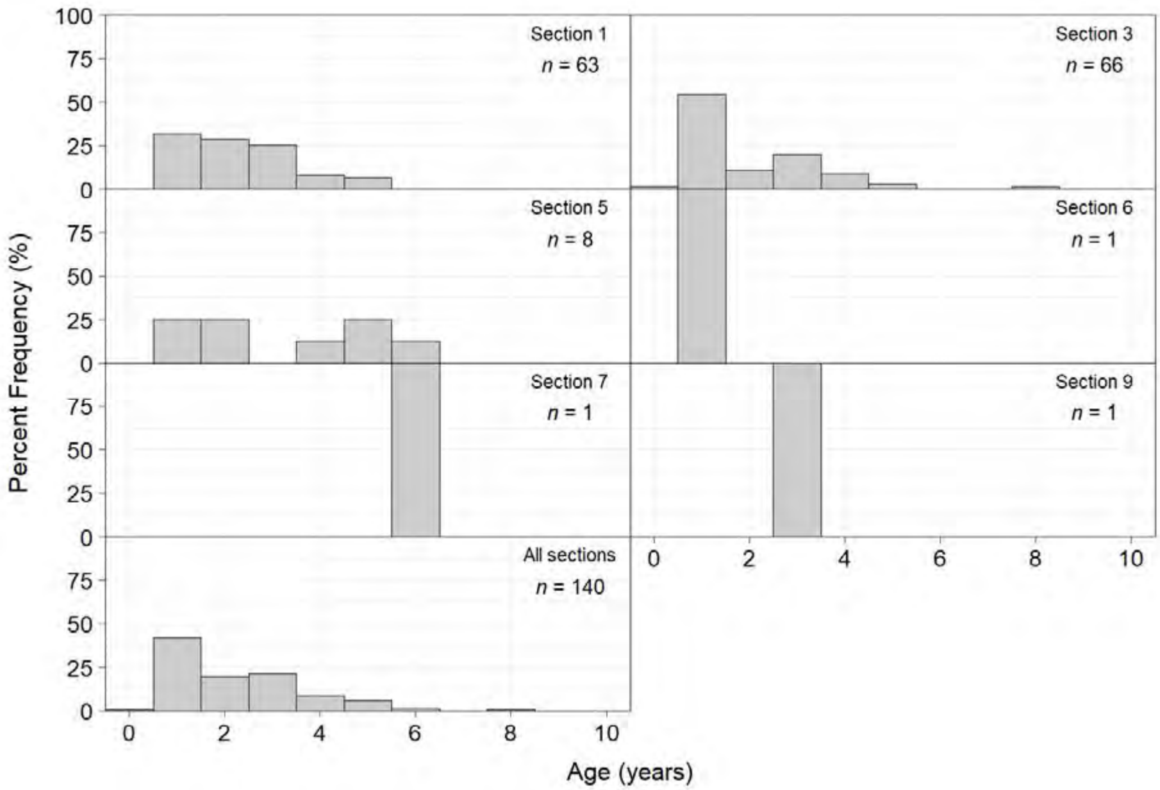


Figure 51: Age-frequency distributions for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

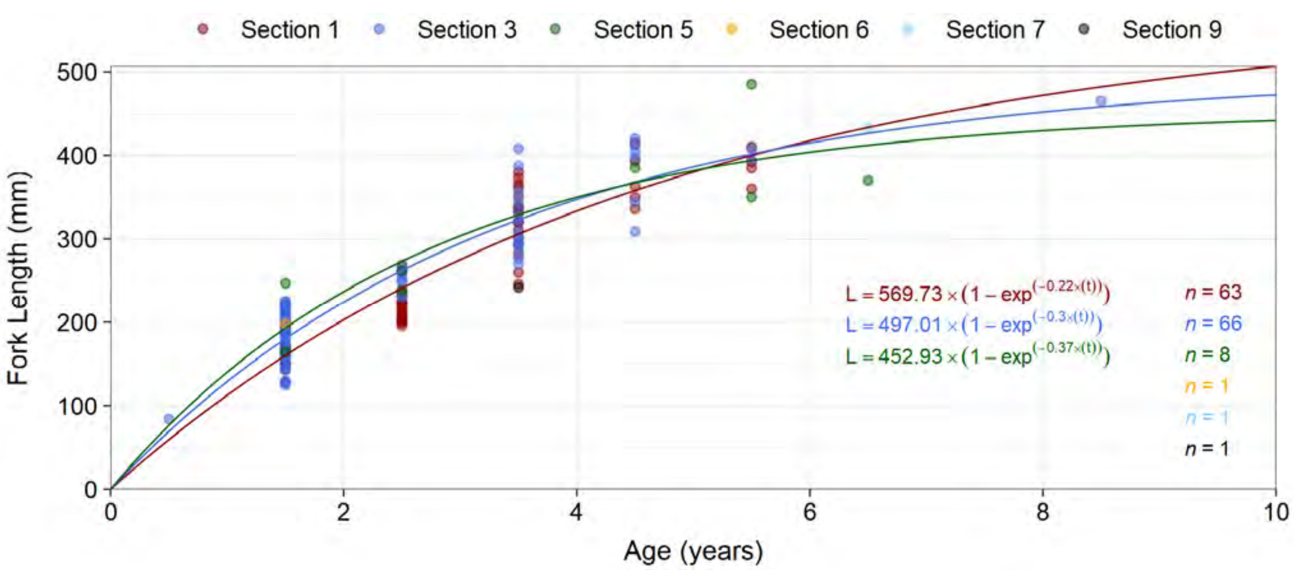


Figure 52: von Bertalanffy growth curve for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

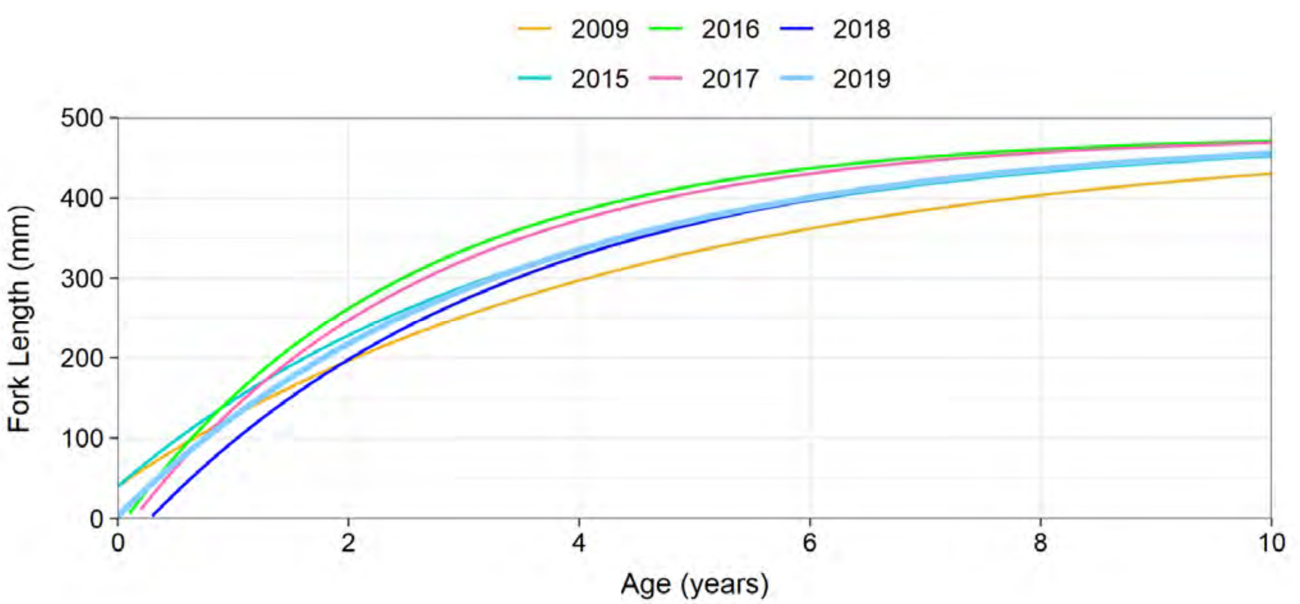


Figure 53: von Bertalanffy growth curve for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 2009 to 2019.

Trends in mean body condition and relative weight estimates for Sections 7 and 9 are based on limited data (i.e., 1 to 7 fish per year in each section) and should be interpreted with caution (Figure 54). For the remaining four sections, mean body condition and relative weight were similar among years and sections, with overlapping confidence intervals for most estimates (Figure 54). For all sections combined, relative weight was greater than 90% during most study years, indicating that Rainbow Trout are in good condition.

The length-weight relationship in 2019 (all sections combined) had a b value close to 3.0, suggesting isometric growth (Figure 55). Sample sizes were too small for meaningful comparisons of length-weight relationship among sections (Figure 55). Differences in the relationship were not statistically compared in 2019. Statistical results from 2017 (Golder and Gazey 2018) suggested little change in the length-weight relationship of Rainbow Trout over time or among sections.

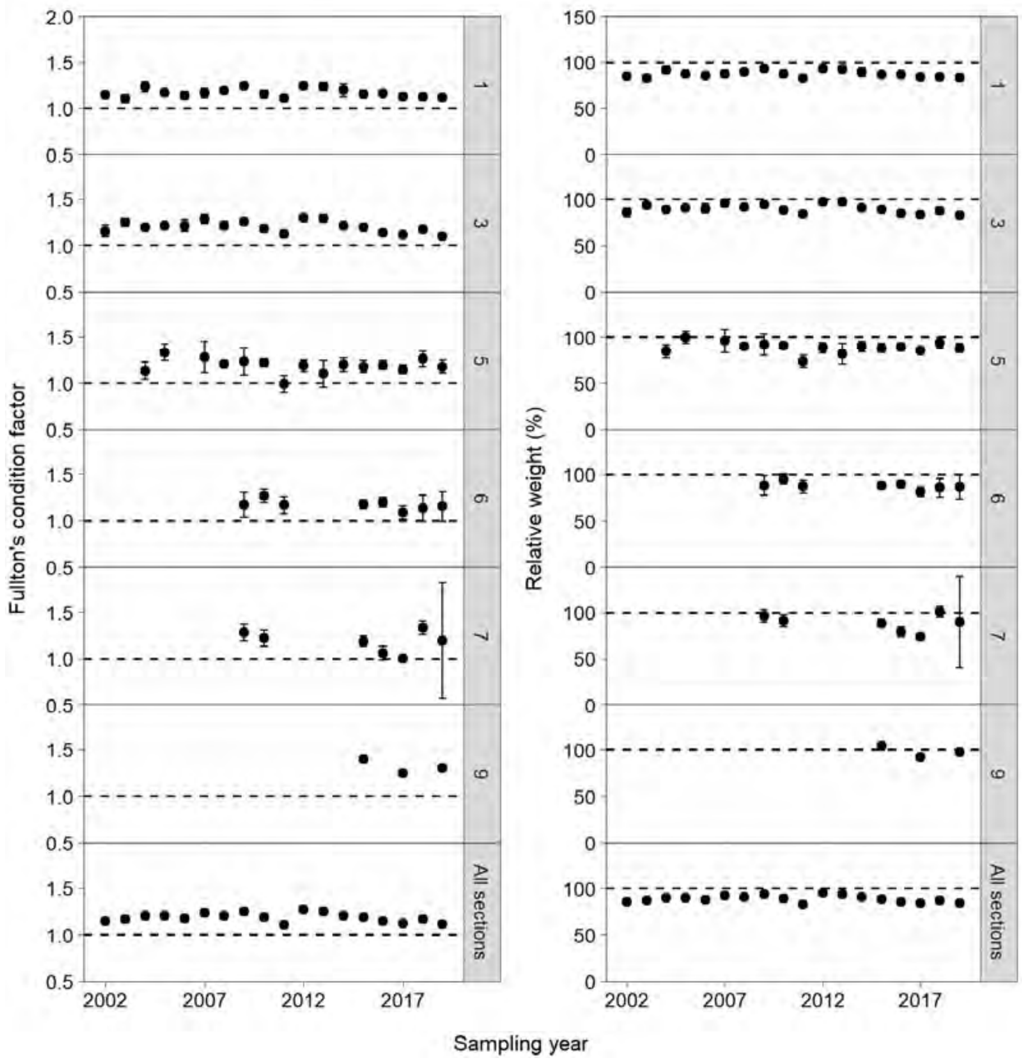


Figure 54: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) (left pane) and mean relative weight (%) values (right pane) for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

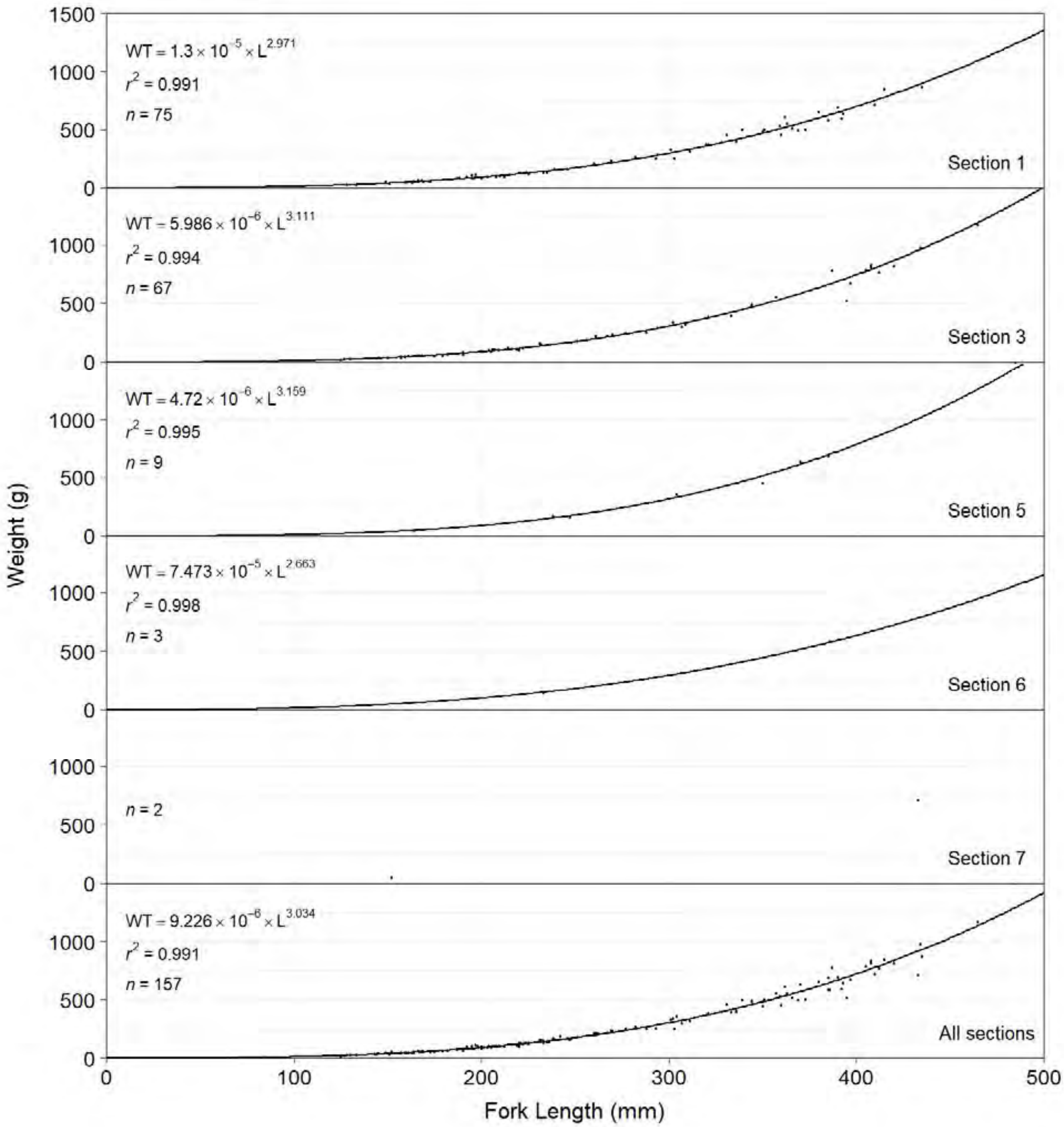


Figure 55: Length-weight regressions for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

3.11.2 Abundance

3.11.2.1 Catch-Per-Unit-Effort

Between 2002 and 2019, the total catch of Rainbow Trout has ranged from a low of 77 individuals in 2013 to a high of 210 individuals in 2016 (average = 135 individuals; Appendix E, Tables E1 and E2). Rainbow Trout are most commonly recorded in Section 3 (49% of the total Rainbow Trout catch), followed by Section 1 (34%), and Section 5 (10%). Rainbow Trout are less common downstream of Section 5, and their frequency declines with increased distance from Section 5 (5% in Section 6, 2% in Section 7, and less than 1% in Section 9).

Only three Rainbow Trout were captured in Section 9 between 2015 and 2019 combined (Attachment A). In 2019, 89% of the Rainbow Trout catch was recorded in the upstream two sections (44% in Section 1 and 45% in Section 3; Table 8). These data suggest a preference for the upstream portions of the study area for this species. Catch rate data suggest stable Rainbow Trout abundance between 2015 and 2019 (all sections combined). Confidence intervals overlapped for all estimates and were generally narrow for all years except 2018 (Figure 49).

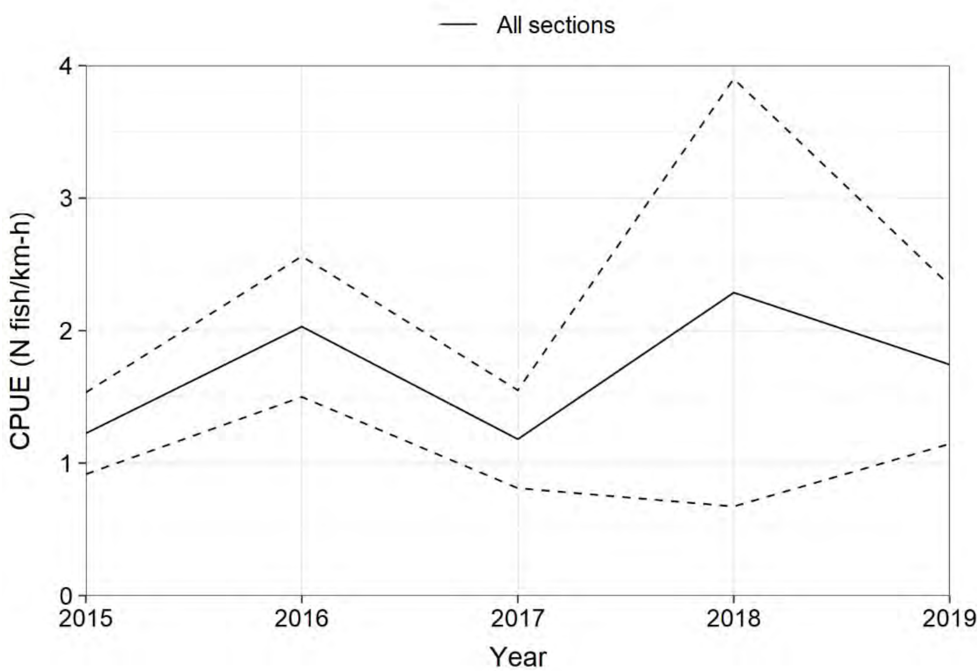


Figure 56: Mean annual catch rates (CPUE) for Rainbow Trout captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Rainbow Trout were not consistently targeted prior to 2015.

3.11.2.2 Capture-Recapture

Of the 178 Rainbow Trout captured during the 2019 survey, 174 were implanted with PIT tags. Of those 174 fish, 22 were subsequently recaptured. Four fish were recorded in each of Section 1 and Section 5. The remaining 14 recaptured fish were recorded in Section 3. Movement between sections was not observed in 2019.

There were sufficient recapture data to produce population abundance estimates for Sections 1, 3, and 5 only. The population estimate (mean with 95% credible interval) was greater in Section 1 (1384 fish; 56–1073 fish) than Section 3 (67 fish; 31–118 fish) and Section 5 (18 fish; 6–50 fish). The abundance of Rainbow Trout in Sections 3 and 5 varied among years between 2016 and 2019, and large and overlapping confidence intervals reflect uncertainty in the estimates due to small sample sizes (Figure 57).

Table 20: Population abundance estimates generated using the Bayes sequential model for Rainbow Trout captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
1	384	163	56	1,073	319	83.0
3	67	52	31	118	26	38.3
5	18	8	6	50	18	101.4
Total[a]	**469**	**255**	**122**	**1,162**	**320**	**68.3**

[a] Calculated from the joint distribution of Sections 1, 3, and 5.

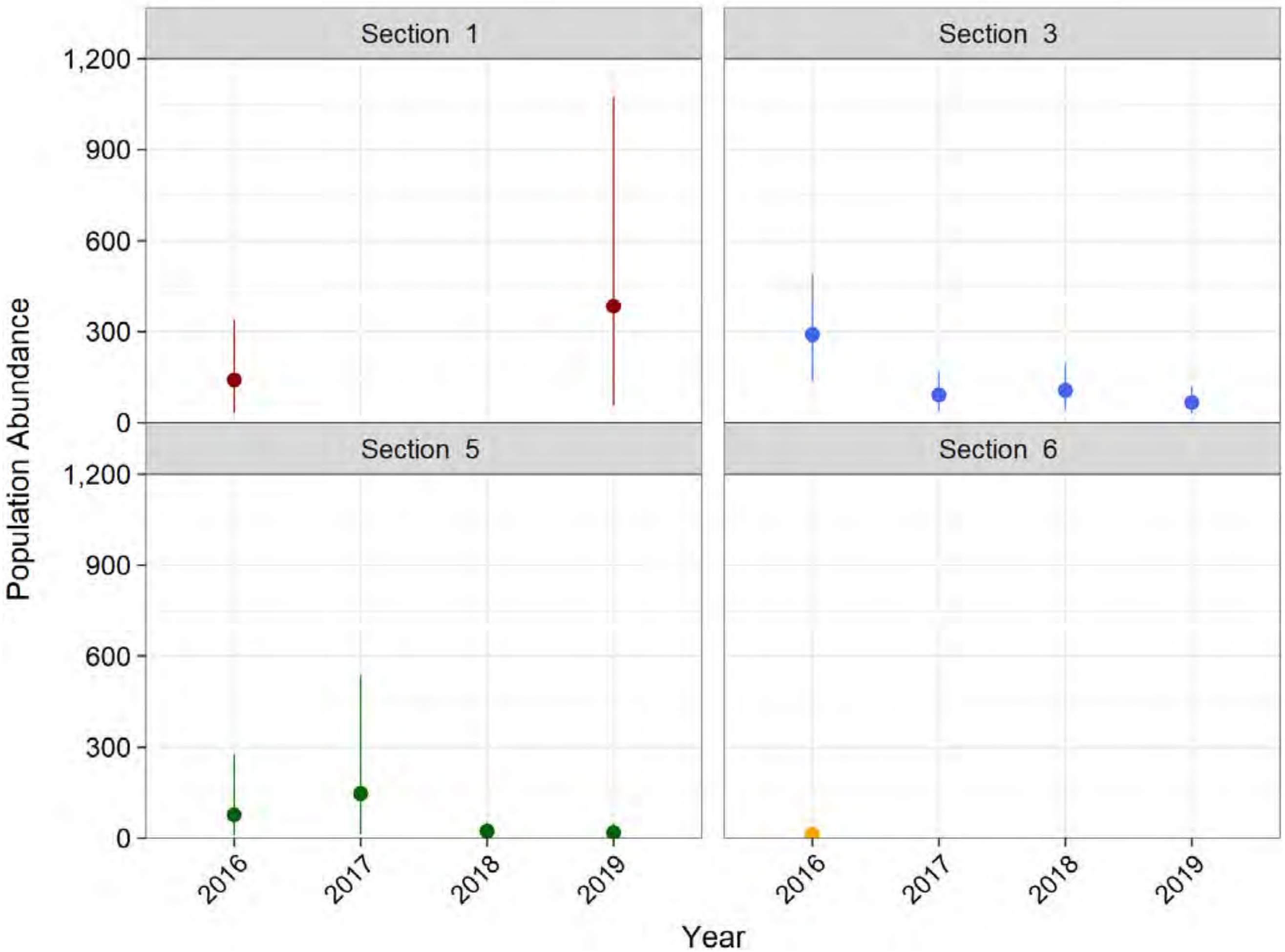


Figure 57: Population abundance estimates (with 95% credible intervals) generated using the Bayes sequential model for Rainbow Trout captured by boat electroshocking in Sections 1, 3, 5, and 6 of the Peace River, 2016–2019.

3.12 Walleye

3.12.1 Biological Characteristics

During the 2019 survey, 274 Walleye were initially captured (i.e., excluding within-year recaptures) and they were all measured for length and weight. Fork lengths ranged between 81 and 665 mm, weights ranged between 4 and 3849 g, and body condition (*K*) ranged between 0.53 and 1.93.

If Walleye captured in 2019 were also captured during a previous study year (i.e., inter-year recaptured fish) and assigned an age during that initial capture, the number of years that the fish was at-large was added to the initial age to provide a 2019 age estimate for the fish. Eleven Walleye were assigned ages using this method.
An additional 82 Walleye were assigned ages using fin ray samples collected during the current study year. Assigned ages ranged between age-0 and age-14 (Table 21).

Table 21: Average fork length, weight, and body condition by age for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Age	Fork Length (mm)			Weight (g)			Body Condition (K)		
	Average ± SD	Range	*n*[a]	Average ± SD	Range	*n*[a]	Average ± SD	Range	*n*[a]
0	120 ± 13	110 – 134	3	18 ± 9	12 – 28	3	0.97 ± 0.17	0.85 – 1.16	3
1	229 ± 23	180 – 252	9	126 ± 36	54 – 173	9	1.01 ± 0.06	0.93 – 1.08	9
2	290 ± 13	276 – 305	5	279 ± 49	234 – 347	5	1.13 ± 0.07	1.05 – 1.24	5
3	334 ± 14	311 – 357	9	424 ± 53	314 – 507	9	1.13 ± 0.10	0.99 – 1.25	9
4	375 ± 18	332 – 411	22	585 ± 93	444 – 829	22	1.10 ± 0.09	0.92 – 1.30	22
5	414 ± 19	389 – 449	11	826 ± 141	602 – 1089	11	1.15 ± 0.07	1.02 – 1.24	11
6	400 ± 22	366 – 433	10	755 ± 145	524 – 935	10	1.17 ± 0.08	1.07 – 1.34	10
7	435 ± 28	400 – 474	5	920 ± 180	715 – 1135	5	1.11 ± 0.10	0.99 – 1.22	5
8	488 ± 14	454 – 502	10	1412 ± 180	1011 – 1633	10	1.21 ± 0.11	1.08 – 1.43	10
9	454 ± 28	414 – 481	5	1172 ± 244	866 – 1423	5	1.24 ± 0.05	1.17 – 1.28	5
10	601	-	1	2509	-	1	1.16	-	1
11	535	-	1	1958	-	1	1.28	-	1
12	509	-	1	1344	-	1	1.02	-	1
13	-	-	-	-	-	-	-	-	-
14	589	-	1	2700	-	1	1.32	-	1

[a] Number of individuals sampled.

A mode representing the age-0 age-class (i.e., fish less than 150 mm FL) was evident in the length-frequency histogram in Sections 6, 7, and 9 (Figure 58). Between 2015 and 2019, the abundance of age-0 Walleye in the catch varied and was substantially higher in 2017 (n = 40) and 2019 (n = 44) relative to 2015 (n = 5), 2016 (n = 1), and 2018 (n = 4) (Appendix F, Figure F29).

After approximately age-2, length ranges overlapped adjacent age-classes (Figure 58; Figure 59).

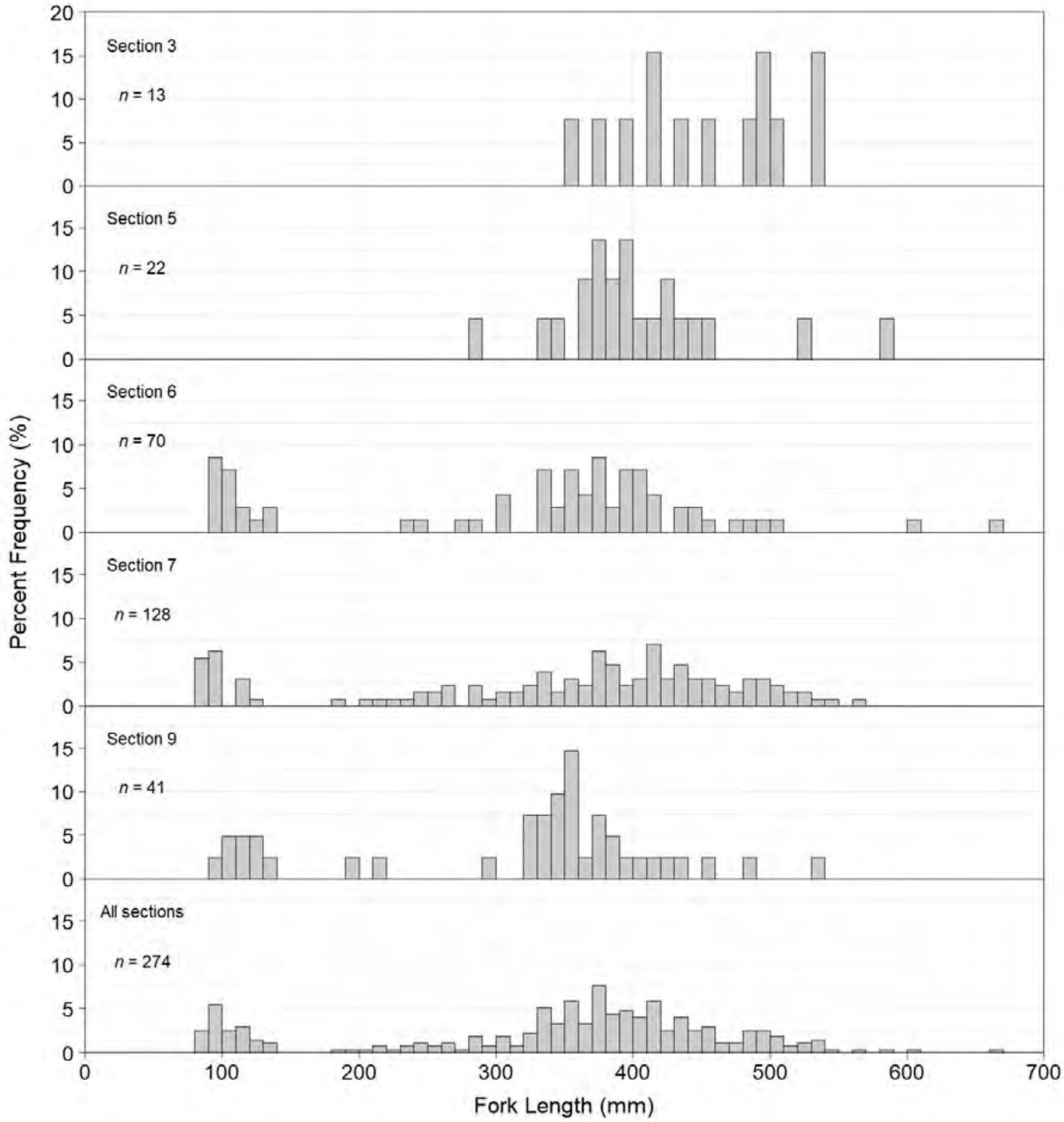


Figure 58: Length-frequency distributions for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

The majority of Walleye captured (206 out of 274 individuals; 75%) were longer than 300 mm FL, representing age-3 and older individuals (Figure 60). The high number of age-3 and older fish suggests that the study area is primarily used by adults during the sampling period. Consistent with previous study years, small Walleye (i.e., fish less than approximately 300 mm FL corresponding to age-2 and younger cohorts) were only encountered in downstream sections (Appendix F, Figures F30 and F31).

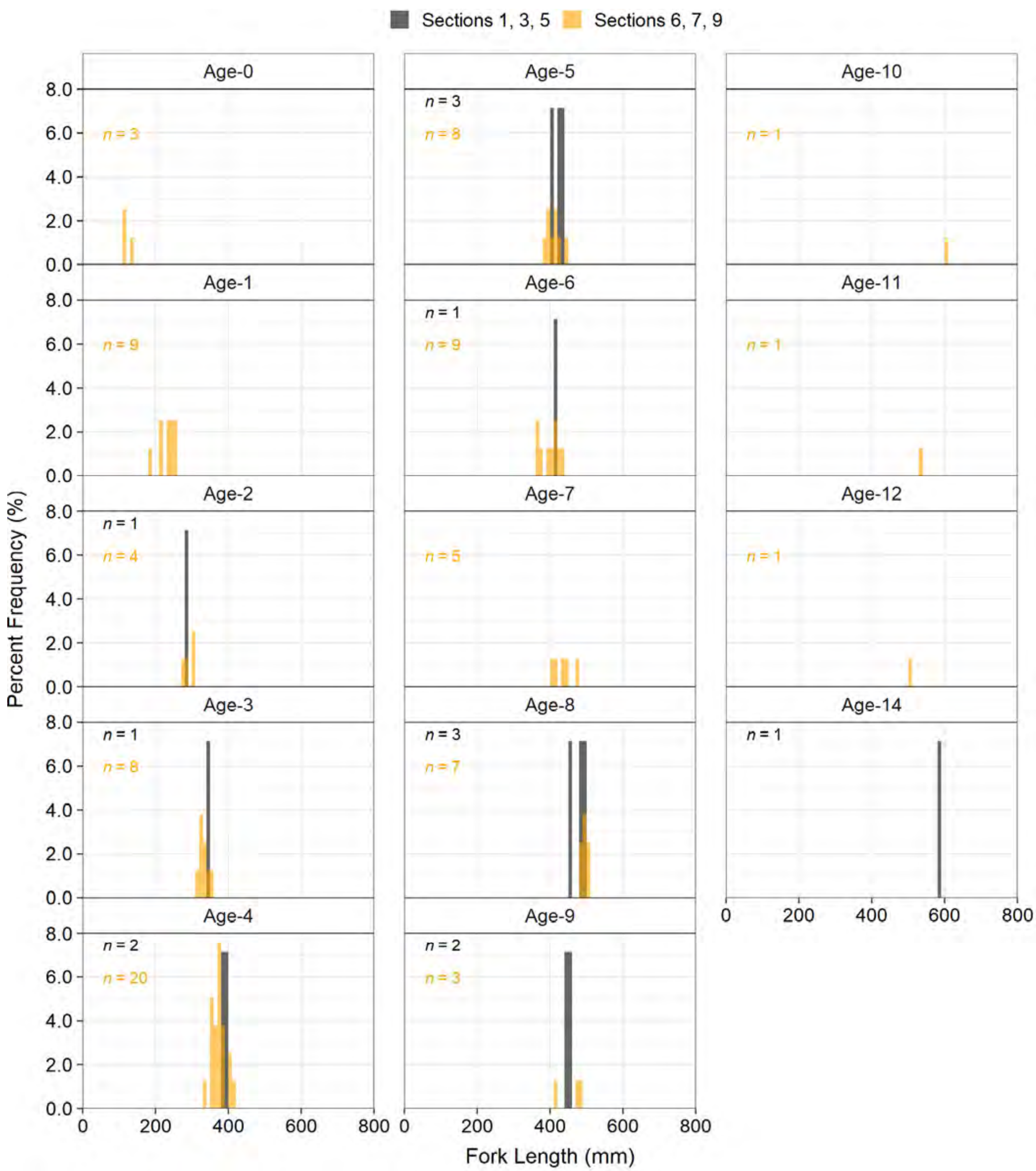


Figure 59: Length-at-age frequency distributions for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

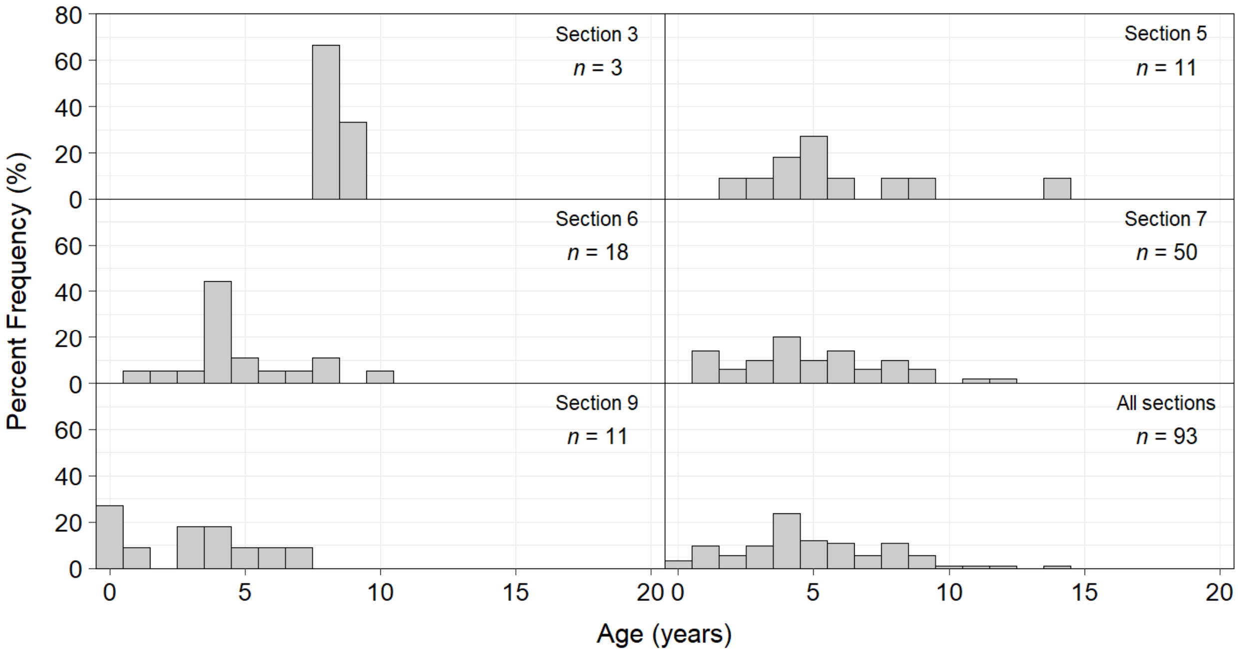


Figure 60: Age-frequency distributions for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

Growth curves estimated using the von Bertalanffy method suggest an asymptotic size of 561 mm FL for Peace River Walleye (Figure 61). This value appears low as Walleye up to 736 mm FL have been recorded in the Peace River as part of the current study. Ages assigned to fin rays collected from older individuals are less precise and the low number of very large Walleye in the length-at-age data likely biases estimates of mean asymptotic size. Comparison of growth curves among years suggest some differences; however, the 2019 estimate was within the range of estimates generated between 2009 and 2018 (Figure 62). Differences in growth rates among years could be explained by real changes in growth conditions, but are more likely due to imprecise ages, particularly for older individuals.

Mean body condition varied little among years and sections with confidence intervals overlapping for most estimates (Figure 63). Relative weight calculations tracked closely with body condition estimates and averaged approximately 95% for all sections combined over the 18-year study period. The length weight-relationship was also similar among sections (Figure 64) and years (Appendix F, Figure F32), with typical values of b of 3.1.

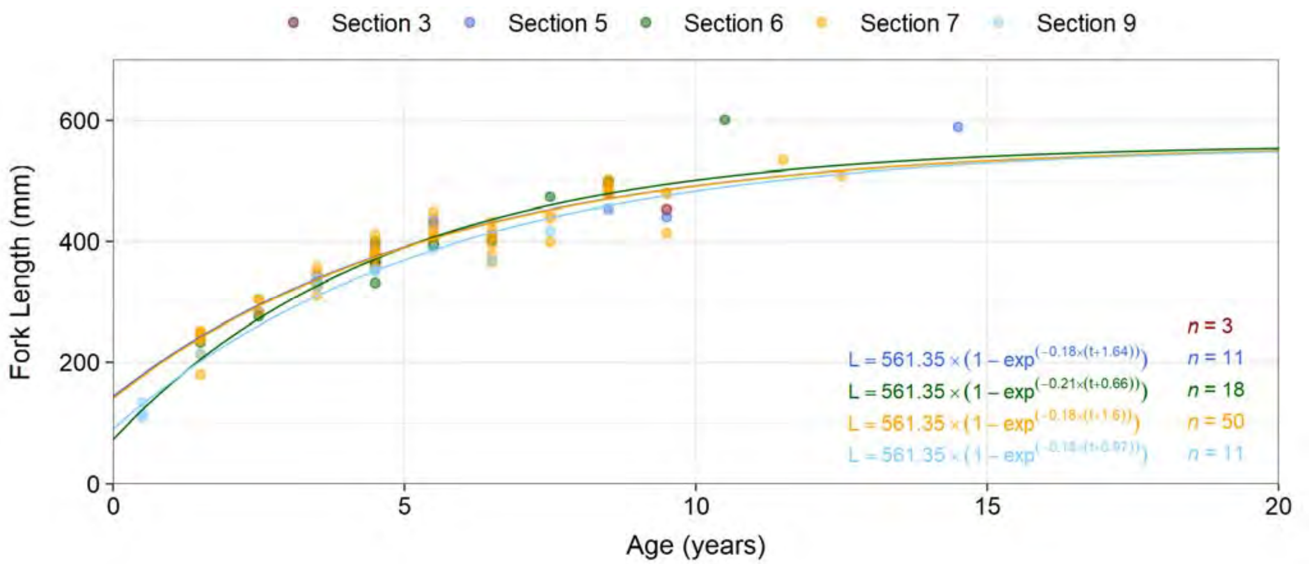


Figure 61: **von Bertalanffy growth curve for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.**

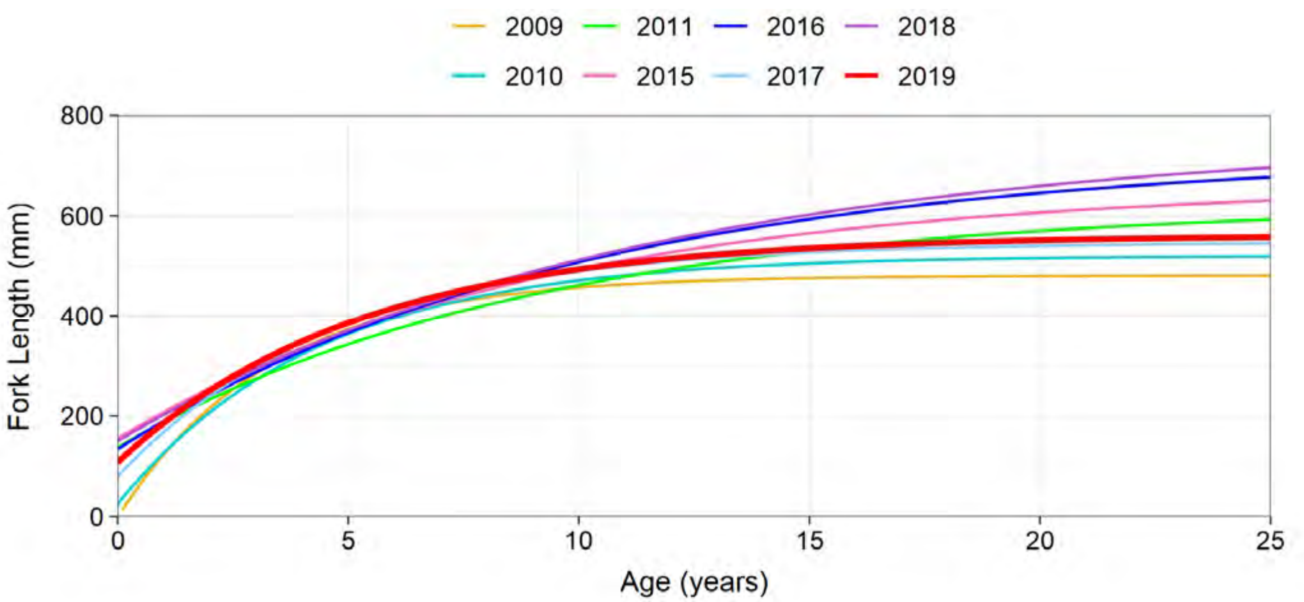


Figure 62: **von Bertalanffy growth curve for Walleye captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019.**

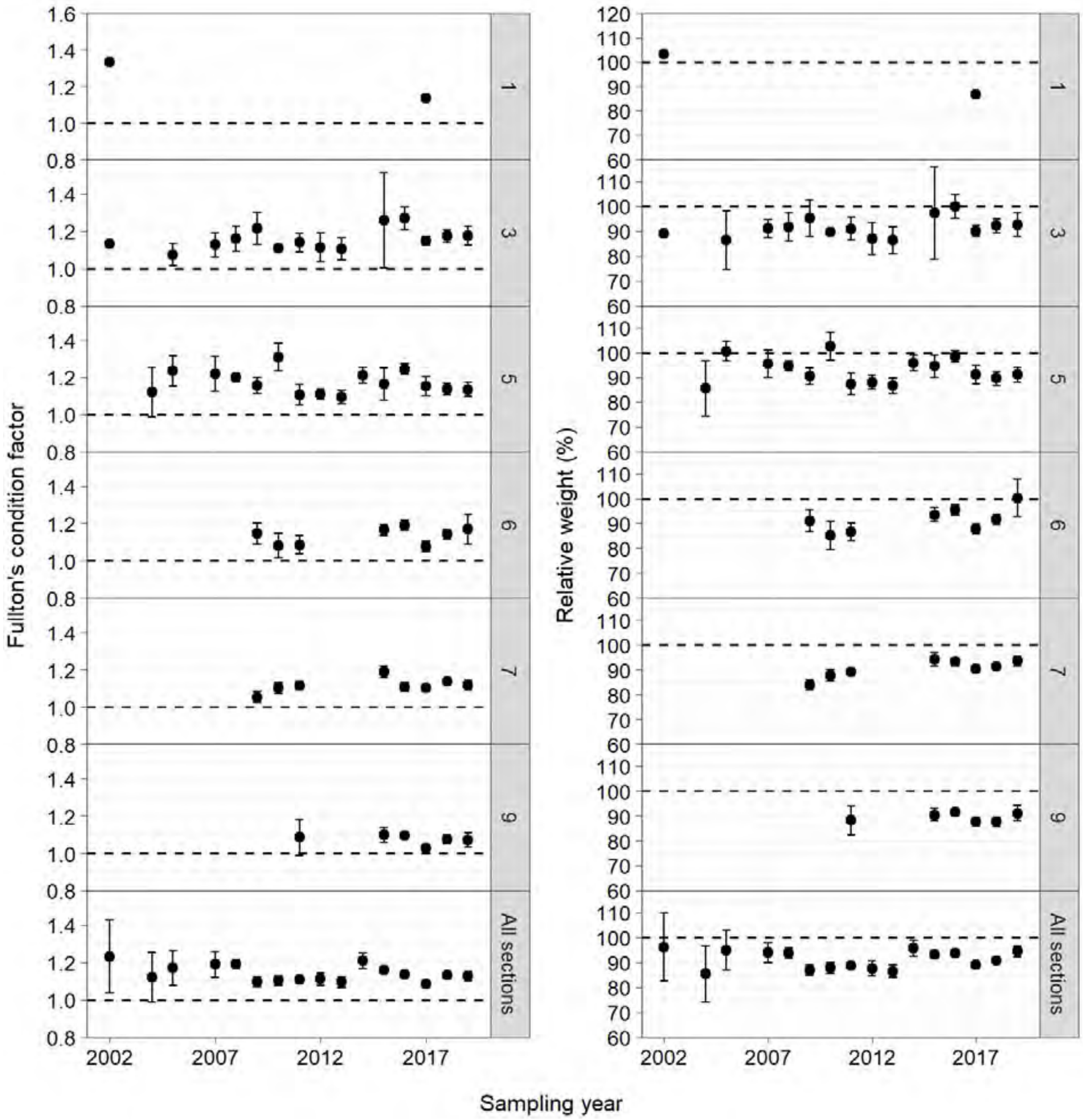


Figure 63: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) (left pane) and mean relative weight (%) values (right pane) for Walleye captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2019. For Sections 6, 7, and 9, the analysis was supplemented with data collected during boat electroshocking surveys conducted during the late summer to fall period of 2009, 2010, and 2011 by Mainstream (2010, 2011, 2013).

Overall, 24 Walleye were recorded during the Goldeye and Walleye Survey conducted in June and July 2019. These fish ranged between 310 and 598 mm FL and between 309 and 2318 g in weight. Of the 24 Walleye captured during the Goldeye and Walleye Survey, 14 were aged, ranging between age-2 and age-10. Length and age data indicate similar uses of the area by this species during the early to mid-summer season as the mid-summer to early fall season. Walleye spawn in the spring when water temperatures are around 5°C (Nelson and Paetz 1992). None of the Walleye captured during the Goldeye and Walleye Survey were in spawning condition. For all size classes combined, body condition (*K*) was lower for Walleye recorded during the Goldeye and Walleye Survey (average = 1.00; range: 0.83 to 1.13) when compared to those recorded during the Indexing Survey (average = 1.12; range: 0.53 to 1.93). This result is consistent with results from the 2018 Goldeye and Walleye Survey (Golder and Gazey 2019). Of the 24 Walleye tagged during the 2019 Goldeye and Walleye Survey, 1 was subsequently recaptured during the Indexing Survey. It was initially captured at the mouth of Six Mile Creek on 4 July and was recaptured approximately 10 km upstream in Section 6 on 22 September. Additional results from the Goldeye and Walleye Survey are provided in Section 3.14.

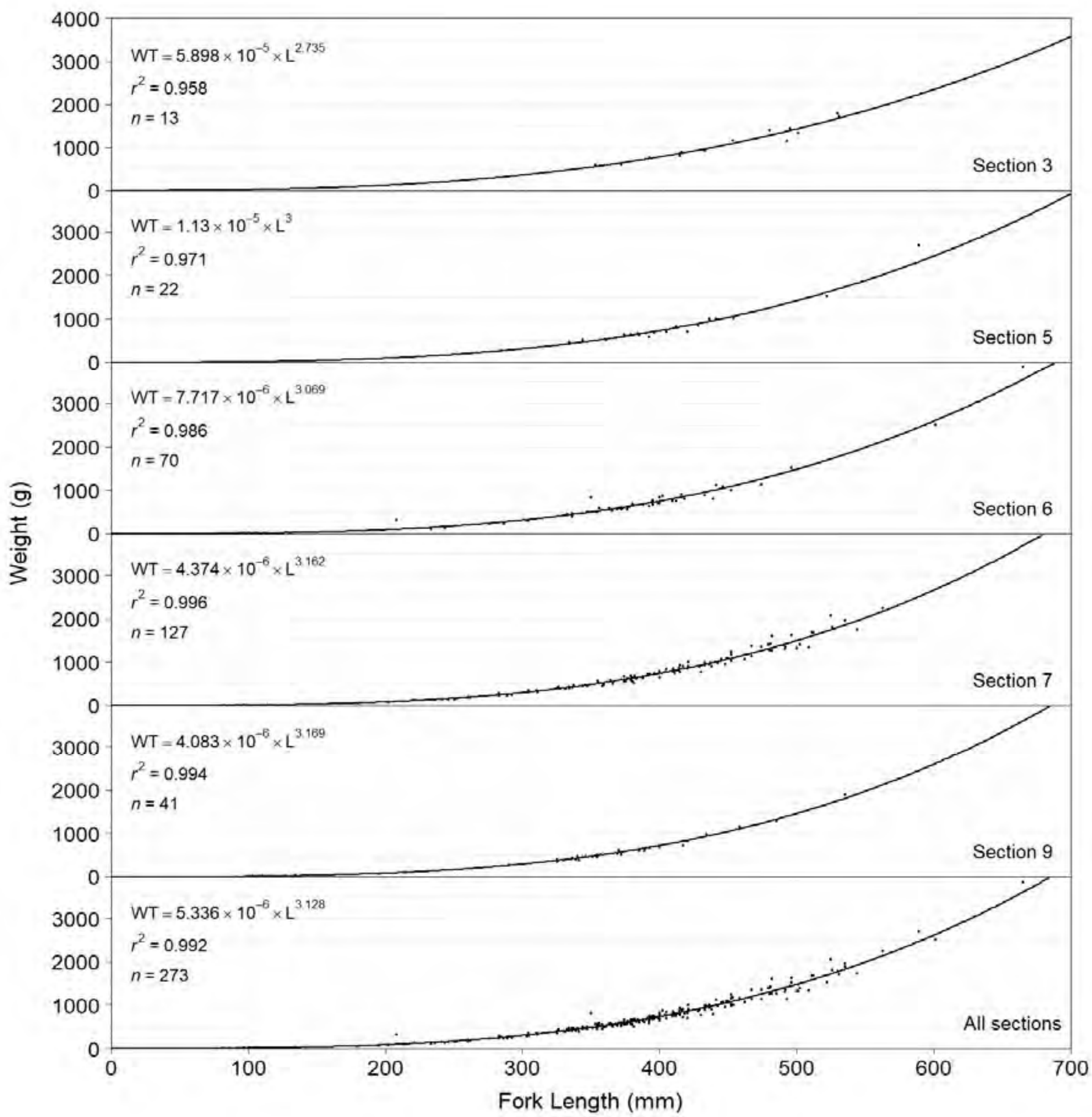


Figure 64: Length-weight regressions for Walleye captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

3.12.2 Abundance

3.12.2.1 Catch-Per-Unit-Effort

Between 2002 and 2014, Walleye were not consistently targeted. Total catch each year for this species ranged between 0 and 58 individuals (average = 21 fish/year; Appendix E, Tables E1 and E2). Years prior to 2015 were excluded from catch-rate analyses (Figure 65) because the species was not consistently targeted and because Walleye are not commonly recorded in Sections 1, 3, and 5, which were the only sections surveyed prior to 2015. Catch rate data suggest increasing Walleye abundance between 2015 and 2018 (all sections combined) and declining abundance between 2018 and 2019. Confidence intervals overlapped for most estimates and were generally narrow for all years except 2018 (Figure 49).

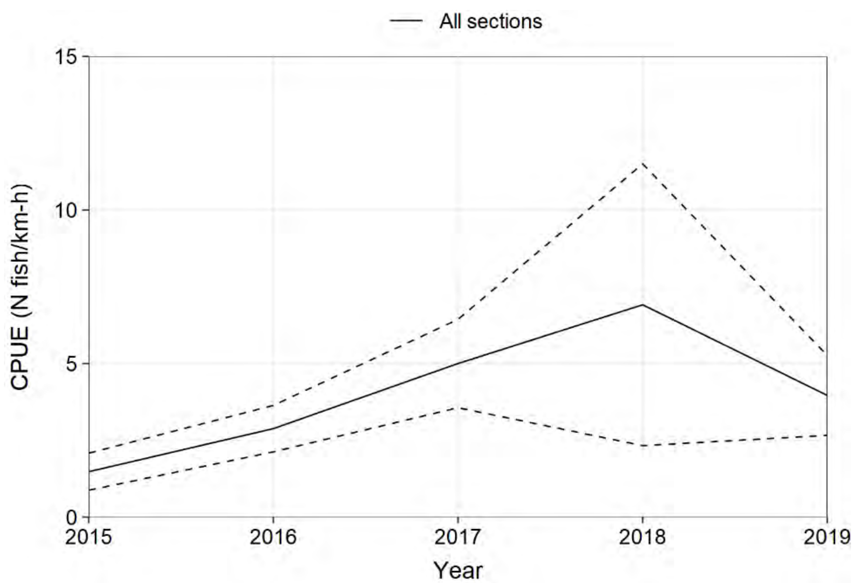


Figure 65: Mean annual catch rates (CPUE) for Walleye captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because Walleye were not consistently targeted prior to 2015.

In 2019, 13 Walleye were captured upstream of the Project. All 13 were recorded in Section 3. Only four Walleye have been recorded upstream of the Halfway River confluence since the program began in 2002. Catch data collected to date indicate a preference for the downstream portions of the study area for this species (Table 8).

3.12.2.2 Capture-Recapture

Of the 274 Walleye captured in 2019, 228 of these fish were implanted with PIT tags, and of those, 13 were recaptured in subsequent sessions. Two were recaptured in Section 6 and one was recaptured in Section 9. All remaining fish were recaptured in Section 7. Two fish were recaptured in a different section than they were initially tagged and released. One individual was initially captured in Section 6 and recaptured in Section 7 and one individual was initially captured in Section 7 and recaptured in Section 6.

In 2019, sufficient capture-recapture data were available to calculate Walleye abundance in Section 7 only (Table 22). This estimate was similar to estimates generated for Section 7 in 2017 and 2018 (Figure 66).

Table 22: Population abundance estimates generated using the Bayes sequential model for Walleye captured by boat electroshocking in sampled sections of the Peace River, 2019.

Section	Bayes Mean	Maximum Likelihood	95% Credible Intervals		Standard Deviation	Coefficient of Variation (%)
			Low	High		
7	2028	1390	640	4115	1030	50.8

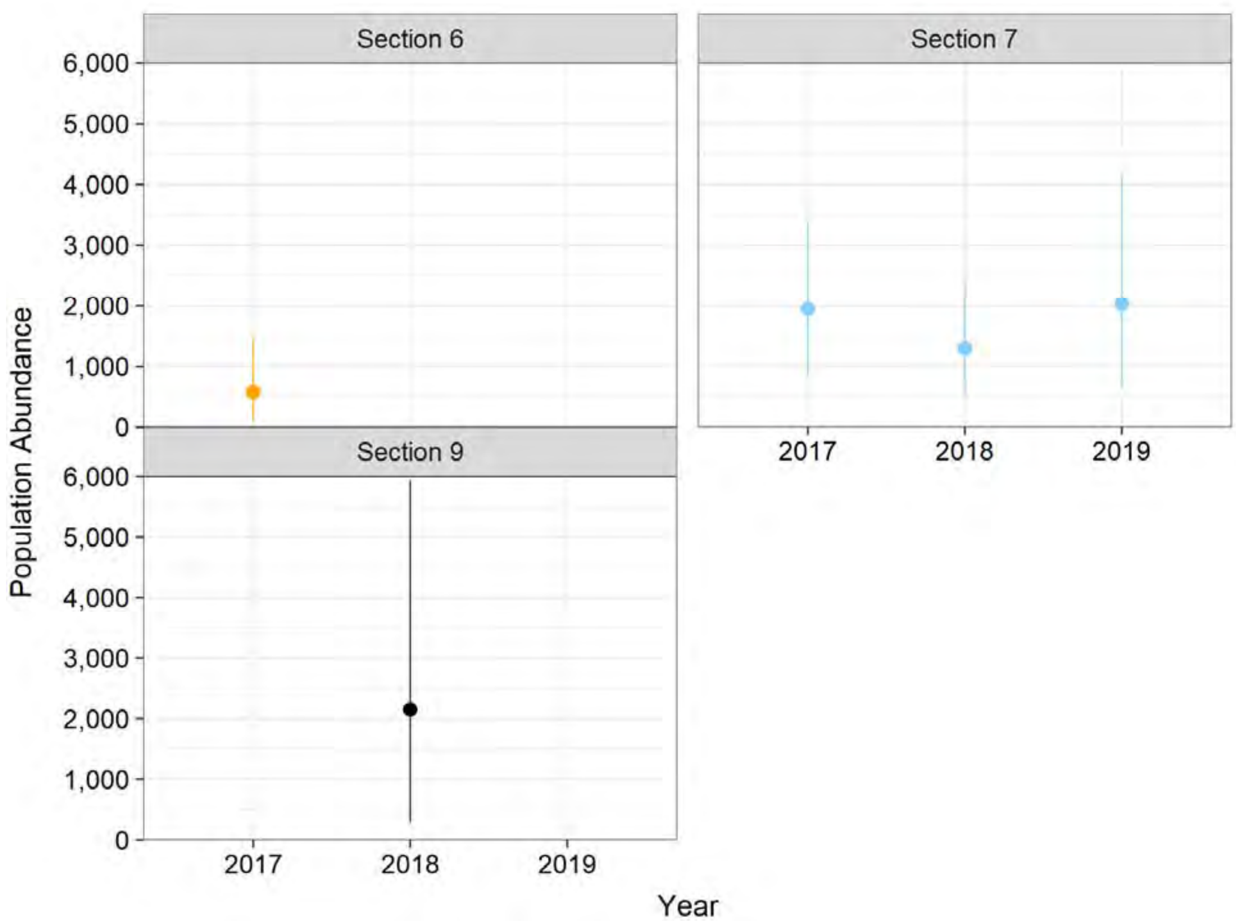


Figure 66: Population abundance estimates (with 95% credible intervals) generated using the Bayes sequential model for Walleye captured by boat electroshocking in Sections 6, 7, and 9 of the Peace River, 2017–2019.

3.13 White Sucker

3.13.1 Biological Characteristics

During the 2019 survey, 176 White Sucker were initially captured (i.e., excluding within-year recaptures; Table 8). Of these 176 fish, 130 were measured for length and weight. Fork lengths ranged between 135 and 464 mm and weights ranged between 27 and 1262 g.

Most (89%) of the White Sucker captured in 2019 were between 300 and 500 mm FL. Length-frequency histograms suggest similar length distributions among sections (Figure 67), except that White Sucker less than 300 mm FL were not captured in Section 1, but were captured in all other sections. This result is consistent with previous study years (Appendix F, Figure F35 and F36).

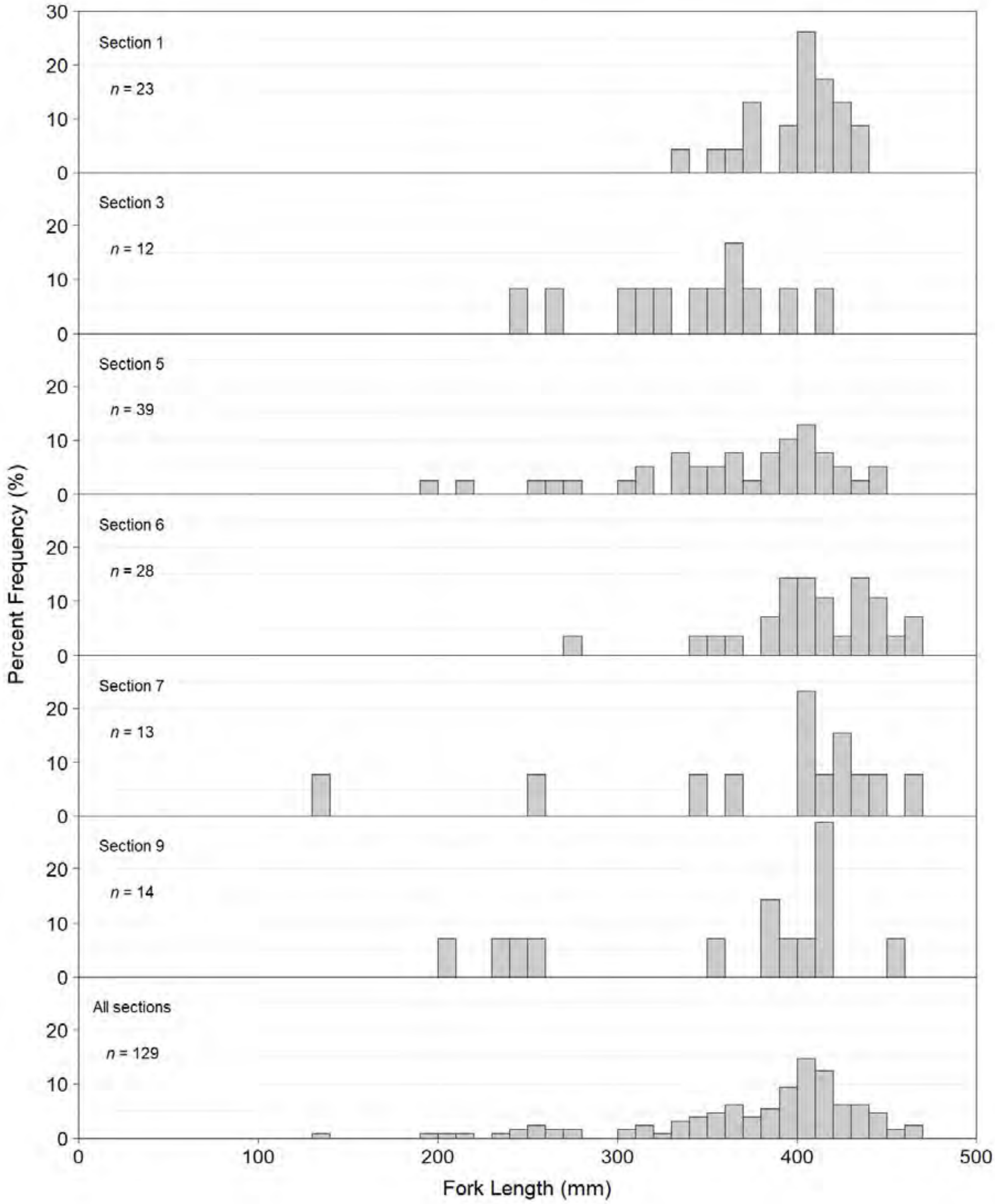


Figure 67: Length-frequency distributions for White Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

The length-weight relationship in 2019 was similar to previous years (Appendix F, Figure F37); however, the differences were not statistically compared. Analyses conducted in 2017 (Golder and Gazey 2018) indicated little significant difference in the length-weight relationship among years or sections. Small sample sizes hinder interpretation of length-weight relationships for White Sucker (Figure 68). The mean body condition (*K*) of White Sucker varied little among sections or years with typical values of 1.3 and a range of 1.2 to 1.5 (Figure 69). Relative weights were not calculated for White Sucker.

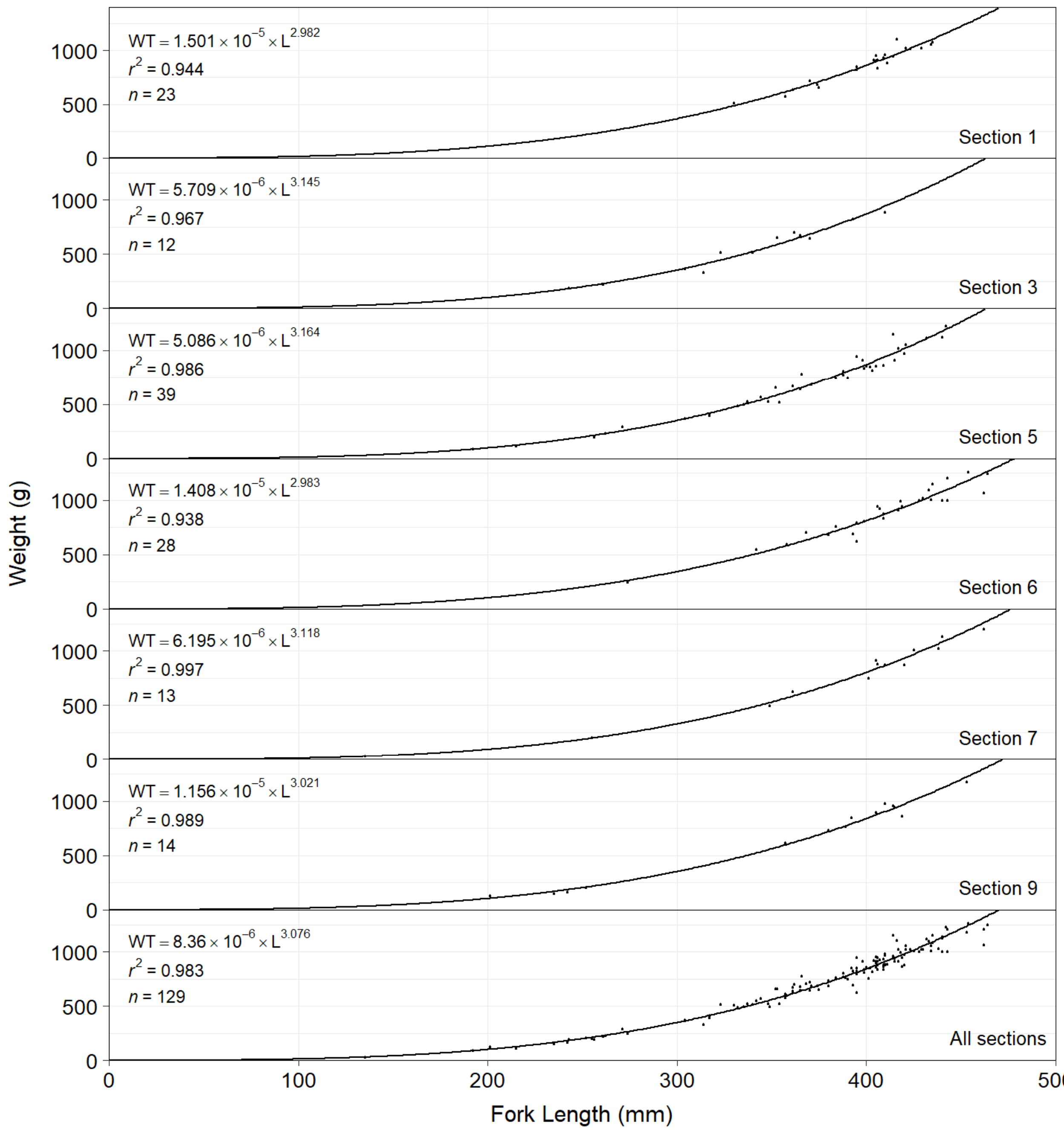


Figure 68: Length-weight regressions for White Sucker captured by boat electroshocking in sampled sections of the Peace River, 20 August to 14 October 2019.

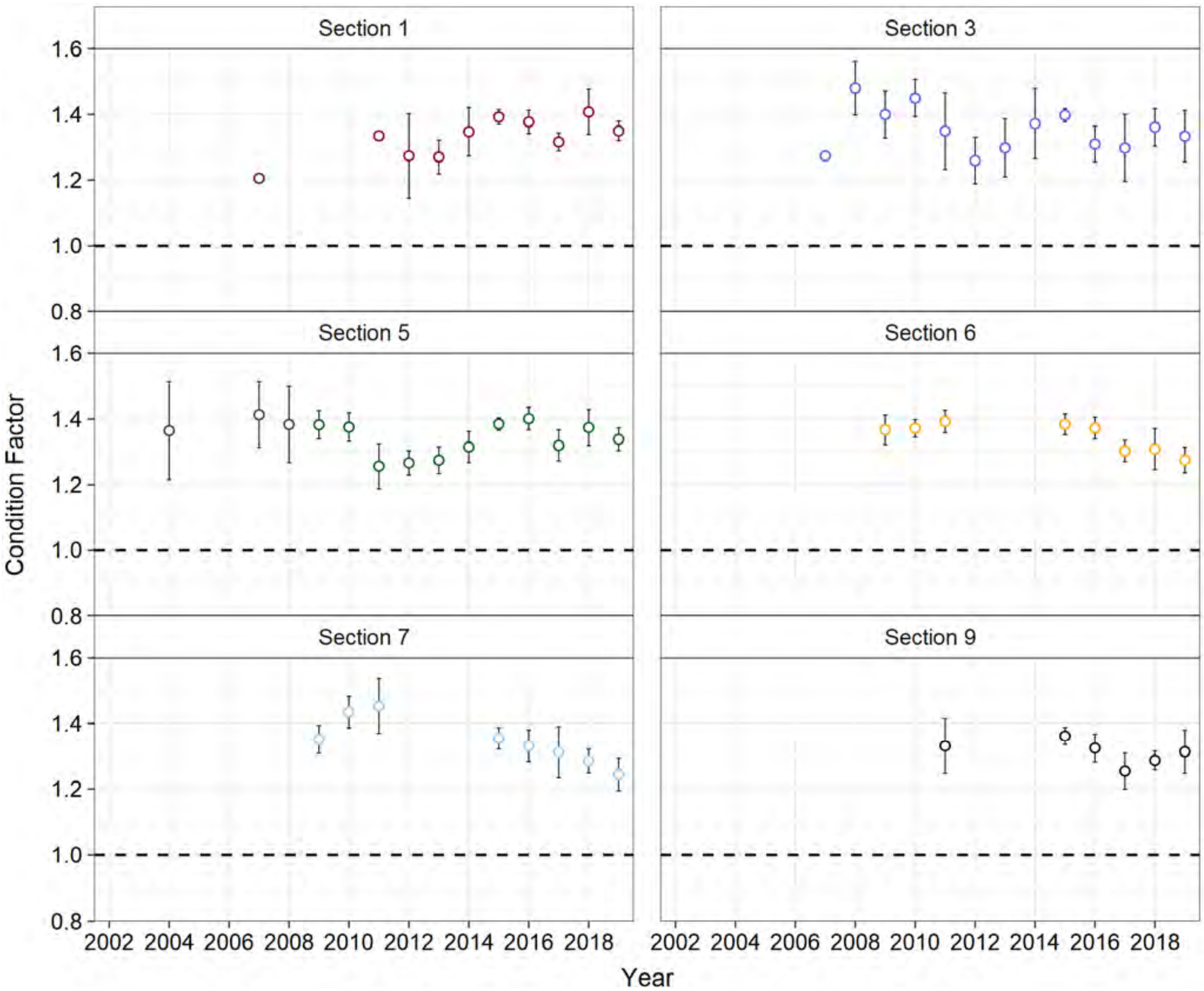


Figure 69: Mean Fulton's body condition factor (*K*) with 95% confidence intervals (CIs) for White Sucker captured by boat electroshocking in sampled sections of the Peace River, 2002 to 2018.

3.13.2 Abundance

3.13.2.1 Catch-Per-Unit-Effort

In total, 124 of the 176 White Sucker captured during the 2019 Indexing Survey were implanted with PIT tags; seven of them were recaptured, all in the same section they were initially released. One of the White Suckers was recaptured in Section 1, four were recaptured in Section 4, and one was recaptured in Section 9. Since 2015 (i.e., since sampling has been conducted in all six sections), 1248 White Sucker have been captured. Between 2015 and 2019, White Sucker were fairly evenly distributed through the study area, with 21% recorded in Section 5, 20% recorded in Section 1, 19% recorded in Section 6, 15% recorded in Section 9, 14% recorded in Section 3, and 11% recorded in Section 7 (Attachment A). Small sample sizes and low numbers of recaptured individuals prevented the generation of absolute abundance estimates for this species. Catch rate data suggest declining White Sucker abundance between 2015 and 2018 and an increase in abundance between 2018 and 2019 (all sections combined); confidence intervals overlapped for all estimates with the exception of the 2015 estimate (Figure 49).

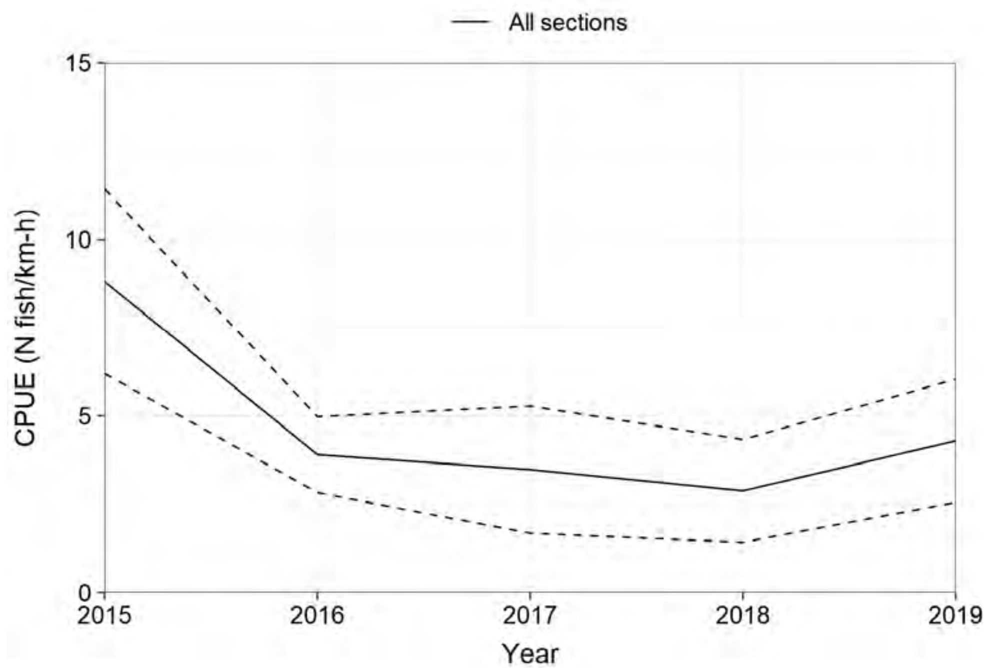


Figure 70: Mean annual catch rates (CPUE) for White Sucker captured by boat electroshocking in all sections of the Peace River combined, 2015 to 2019. The dashed lines denote 95% confidence intervals. Analysis included captured fish only and all size-cohorts combined. The 2002 to 2014 study years were excluded from the analysis because White Sucker were not consistently targeted prior to 2015.

3.14 Goldeye and Walleye Survey

During the 2019 Goldeye and Walleye Survey, 5 Goldeye and 24 Walleye were captured (Table 23). Field crews only targeted indicator species (Arctic Grayling, Bull Trout, Burbot, Goldeye, Mountain Whitefish, Rainbow Trout, and Walleye); however, a single Northern Pike was also captured. Lower capture numbers hindered detailed analysis of life history measurements recorded during the Goldeye and Walleye Survey; however, length measurements were similar to measurements recorded during the Indexing Survey for all species. For all three species encountered during the 2019 Goldeye and Walleye Survey, body condition (*K*) was lower when compared to values recorded during Indexing Surveys (all size classes combined).

None of the Walleye captured during the Goldeye and Walleye Survey were subsequently recaptured during the Goldeye and Walleye Survey; however, some of these fish were captured during previous and subsequent Indexing Surveys. Four Walleye were initially captured during prior Indexing Surveys, one on multiple occations, dating back to 2016. Movements of fish between capture events varied. Two were previously recorded in Section 3 before being recaptured in Section 7. One was previously recorded in Section 5 before being recaptured in Section 7, and one was both captured and recaptured in Section 7. A fifth Walleye, initially tagged in July during the 2019 Goldeye and Walleye Survey was recaptured in September approximately 10 km upstream during the Indexing Survey.

None of the Goldeye or Northern Pike recorded during the 2019 Goldeye and Walleye Survey were captured prior to the Goldeye and Walleye Survey or were recaptured during the subsequent Indexing Survey.

Table 23: Average fork length, weight, and body condition of fish captured by boat electroshocking during the Goldeye and Walleye survey, 14 June to 4 July 2019.

Species	Group[a]	Fork Length (mm)			Weight (g)			Body Condition (K)		
		Average ± SD	Range	*n*[b]	Average ± SD	Range	*n*[b]	Average ± SD	Range	*n*[b]
Goldeye	1	403 ± 19	382 – 426	5	641 ± 76	532 – 729	5	0.98 ± 0.09	0.90 – 1.13	5
Northern Pike	1	798	-	1	3389	-	1	0.67	-	1
Walleye	1	401 ± 70	310 – 598	24	711 ± 452	309 – 2318	24	1.01 ± 0.07	0.83 – 1.13	24

[a] As assigned by Golder et al. (2012).

[b] Number of individuals sampled.

3.15 Catchability

When catchability is near constant across study years or sections, indices of relative abundance, such as catch rate, are considered reliable indicators of true abundance and are comparable across years or sections. If catchability is constant, then for years or sections where poor capture-recapture data prevented the generation of population abundance estimates, catch rate data can be used as a reliable indicator of abundance. Greater differences in catchability across sections or years would suggest that catch was influenced by some external factor (e.g., physical conditions at the time of sampling, gear saturation, size selectivity), which would make catch rate a less reliable indicator of true abundance. For these reasons, catchability by year and section was assessed for Mountain Whitefish. Mountain Whitefish are the most common fish species captured during the Indexing Survey and were the only species with sufficient numbers of recaptures to compute catchability coefficients. It is unknown whether the trends in catchability in Mountain Whitefish also apply to other indicator species.

For Mountain Whitefish, catchability coefficients were computed based on the Bayesian sequential estimates. The catchability coefficients were calculated using effort as measured in the kilometres of shoreline sampled (top panel) and using effort as measured in the number of hours of electroshocking (bottom panel) for all sections sampled from 2015 to 2019 (Figure 71). Confidence limits overlapped for most sections and years. For both distance and effort measures, the 2019 Section 9 estimates were higher than all previous years for all sections; however, these estimates also had extremely wide confidence intervals. Only five sessions were conducted in Section 9 in 2019. During previous study years, six sessions were conducted in Section 9.

The 2019 catchability coefficients for Sections 1, 3, and 5 were higher than the low values recorded in 2017 but were still within the range of values recorded since boat electroshocker settings were modified in 2014. Since 2014, catchability has been lower but more consistent among years when compared to catchability estimates prior to 2014 (Figure 72).

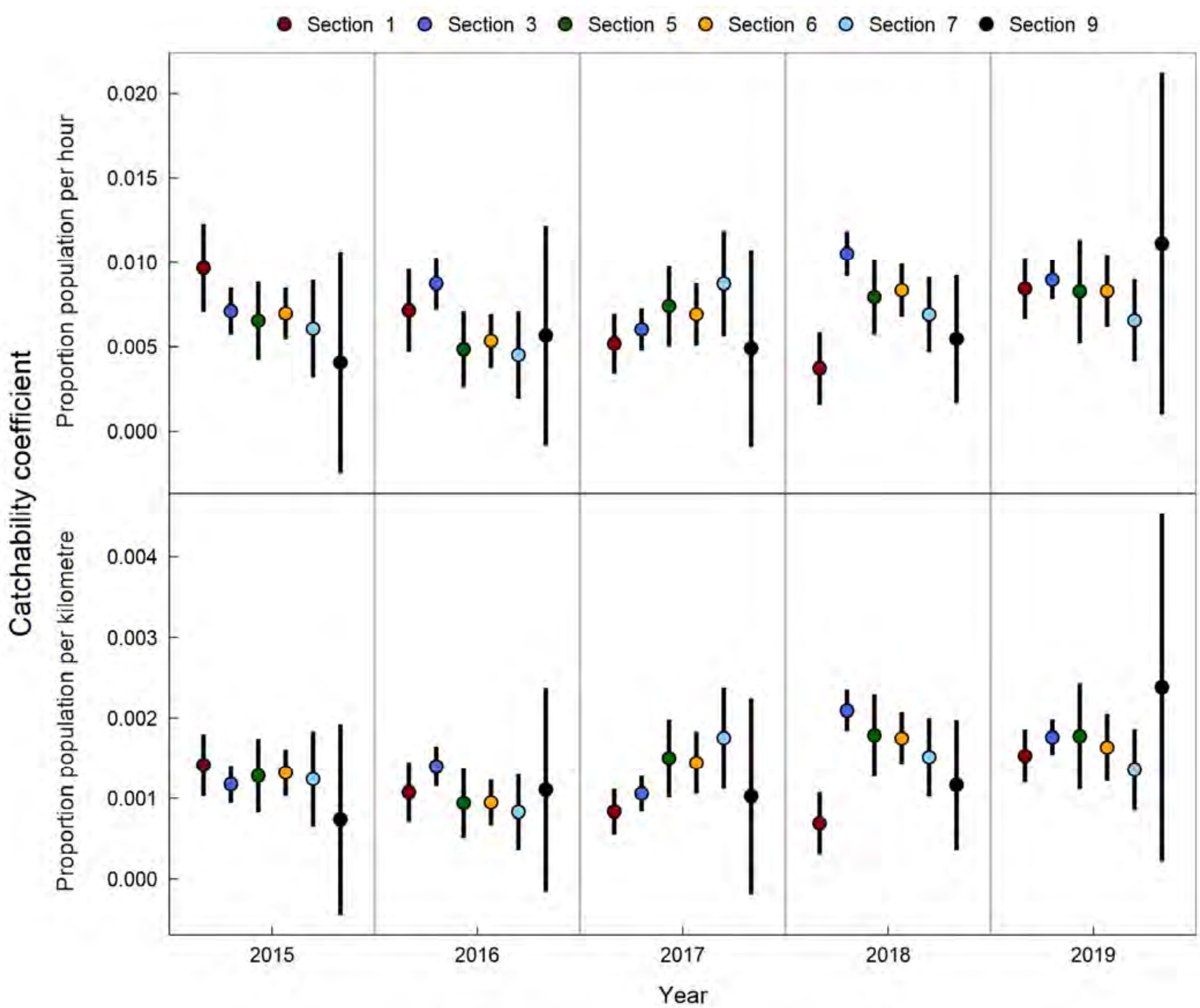


Figure 71: Catchability estimates by section for Mountain Whitefish captured by boat electroshocking based on sampling effort measured in time (top panel) and distance (bottom panel) in the Peace River, 2015–2019. Vertical bars represent 95% confidence intervals.

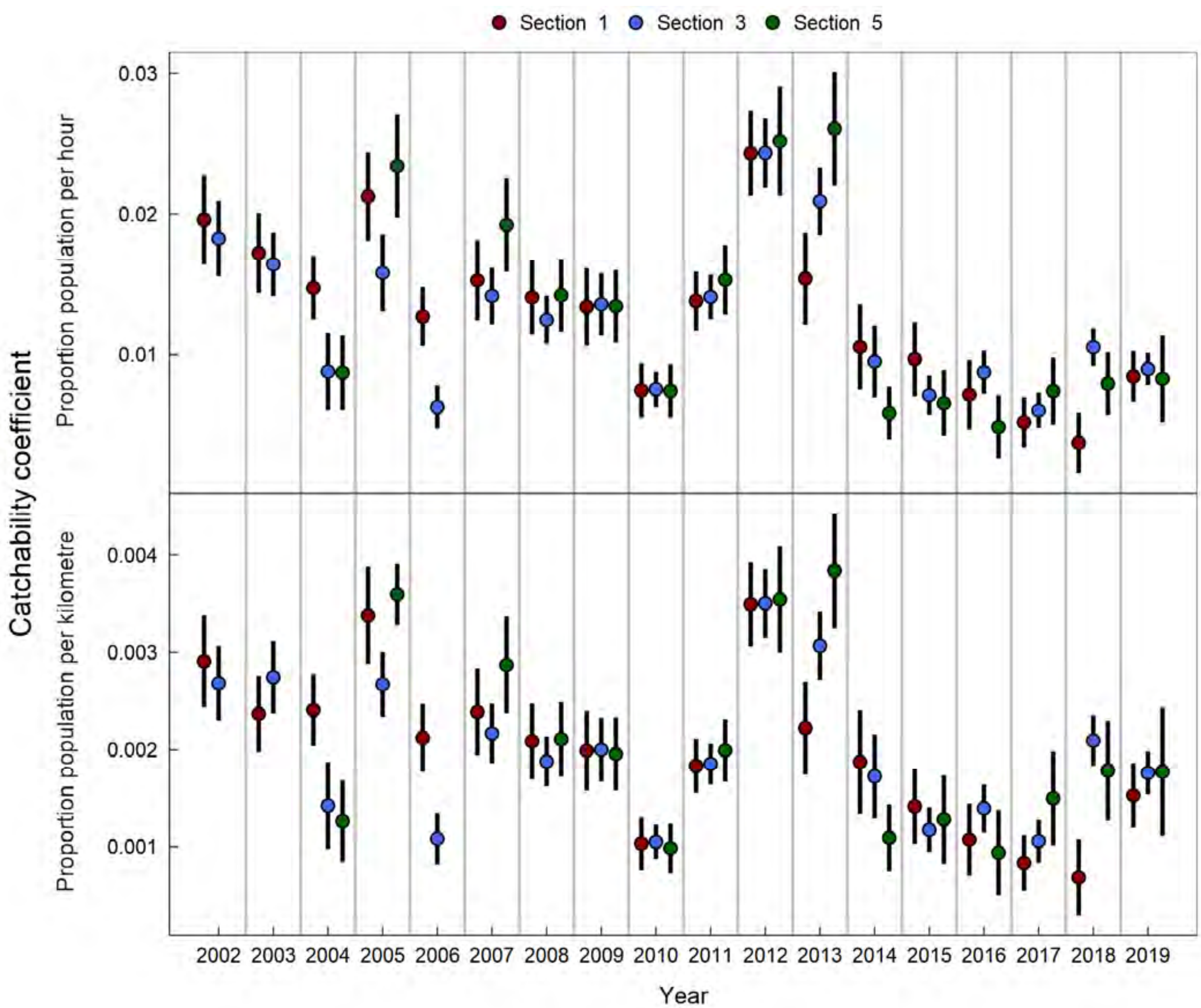


Figure 72: Catchability estimates by year and section (Sections 1, 3, and 5) for Mountain Whitefish captured by boat electroshocking based on sampling effort measured in time (top panel) or distance (bottom panel) in the Peace River, 2002–2019. Vertical bars represent 95% confidence intervals.

3.16 Diversity Profiles

In the diversity profiles, the effective number of species is used to indicate the diversity of fish taxa while varying the value of *q*, which represents the relative contribution of less common species to the diversity metric. The steep decline in the effective number of species with increasing values of *q* reflects the community composition in the study area, with a few species dominating the catch and low numbers of less common species (Figure 73). This community composition results in species richness ($q = 0$) of 8 to 12 effective species, but less than four effective species at values of *q* equal or greater than one in all sections. Consistent with 2017 (Golder and Gazey 2018) and 2018 (Golder and Gazey 2019), diversity was generally greater in downstream sections (Sections 6, 7, and 9) than in sections farther upstream (Sections 1, 3, and 5).

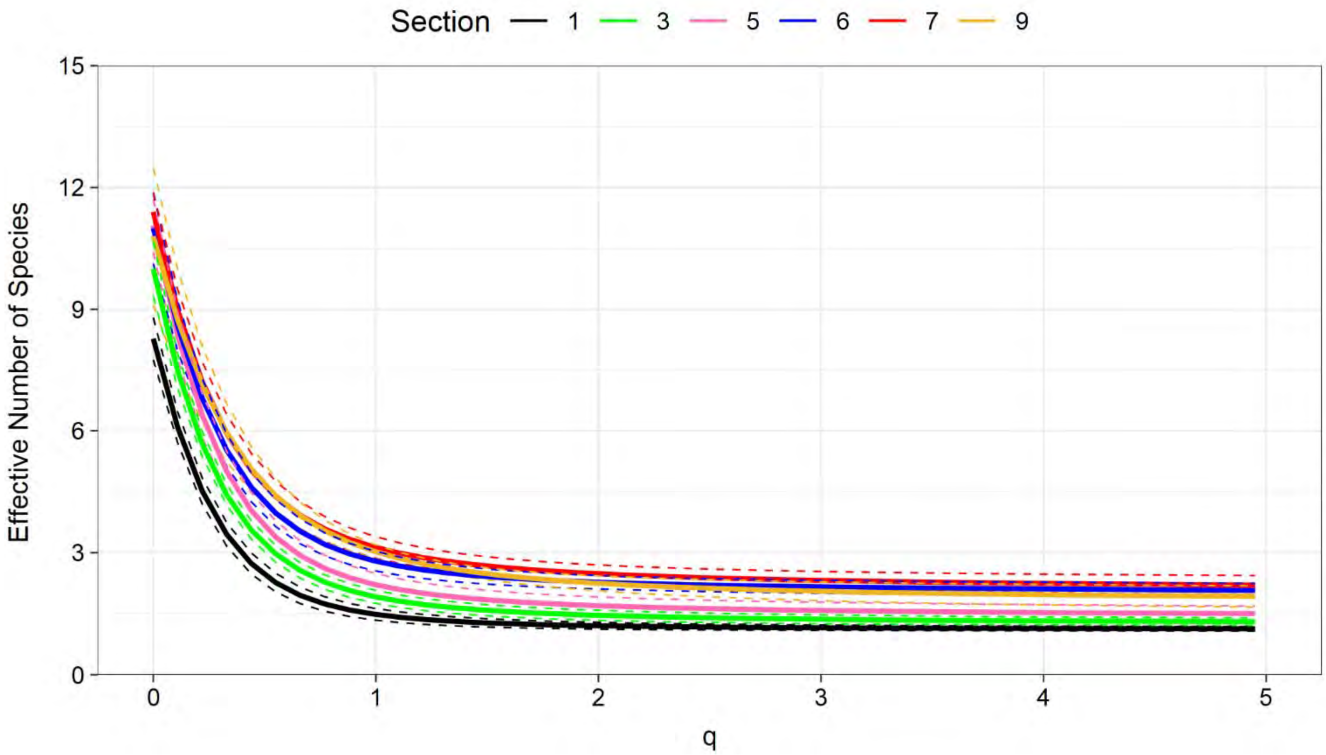


Figure 73: **Diversity profiles showing effective number of species versus the parameter (*q*) representing the importance of less common to common species in the calculation. Values are means (solid lines) with 95% confidence intervals (dashed lines) from annual diversity profiles from 2002 to 2019 combined for each section in the Peace River study area (Sections 6, 7, and 9 only include data from 2015 to 2019). A value of q = 0 corresponds to species richness while a value of q = 1 corresponds to the Shannon index.**

3.17 Radio Telemetry Tag Deployment

In 2019, 261 radio telemetry tags were implanted into Arctic Grayling (n = 38), Bull Trout (n = 85), Burbot (n = 18), Rainbow Trout (n = 56), and Walleye (n = 64) (Table 24). Of these 261 tags, 13 were NTF-3-2 radio telemetry tags, 11 were NTF-5-2 radio telemetry tags, 7 were NFT-6-1, and 230 were NTF-6-2.

Arctic Grayling implanted with NTF-3-2 radio telemetry tags (n = 5) had fork lengths that ranged between 155 and 189 mm (mean = 176 mm FL) and weights that ranged between 43 and 81 g (mean = 63 g). NTF-3-2 tag weight as a percent of total body weight (i.e., tag burden) ranged from 0.7% to 1.3%, with a mean tag burden below 1%. Arctic Grayling implanted with NTF-6-2 radio telemetry tags (n = 33) had fork lengths that ranged between 280 and 391 mm (mean = 340 mm FL) and weights that ranged between 247 and 692 g (mean = 491 g). Tag burden for NTF-6-2 tags in Arctic Grayling ranged from 0.6% to 1.6%, with a mean tag burden below 1%.

Table 24: Summary of radio telemetry tags implanted as part of the Peace River Large Fish Indexing Survey, 2019.

Species	Section	Tag Type				Total
		NTF-3-2 (185 days)	NTF-5-2 (357 days)	NTF-6-1 (525 days)	NTF-6-2 (992 days)	
Arctic Grayling	1					**0**
	3				20	**20**
	5				7	**7**
	6	3			5	**8**
	7	2			1	**3**
	9					**0**
	Total	**5**	**0**	**0**	**33**	**38**
Bull Trout	1			2	26	**28**
	3				25	**25**
	5		1		13	**14**
	6		2	1	10	**13**
	7				4	**4**
	9				1	**1**
	Total	**0**	**3**	**3**	**79**	**85**
Burbot	1					**0**
	3				1	**1**
	5				1	**1**
	6			3		**3**
	7				5	**5**
	9				8	**8**
	Total	**0**	**0**	**3**	**15**	**18**
Rainbow Trout	1	6	2		19	**27**
	3	1	2		17	**20**
	5		1		5	**6**
	6		2			**2**
	7	1				**1**
	9					**0**
	Total	**8**	**7**	**0**	**41**	**56**
Walleye	1					**0**
	3				2	**2**
	5			1		**1**
	6				12	**12**
	7		1		48	**49**
	9					**0**
	Total	**0**	**1**	**1**	**62**	**64**
Grand Total		**13**	**11**	**7**	**230**	**261**

Three Bull Trout were implanted with NTF-5-2 radio telemetry tags. Fork lengths of these individuals were 212 mm, 231 mm, and 235 mm with weights that ranged between 107 and 131 g. Tag burden for NTF-5-2 tags in Bull Trout ranged from 1.1% to 1.4%. Three Bull Trout were implanted with NTF-6-1 radio telemetry tags. Fork lengths of these individuals were 325 mm, 332 mm, and 446 mm with weights that ranged between 317 and 885 g. Tag burden for all NTF-6-1 tags deployed into Bull Trout was less than 1%. Bull Trout implanted with NTF-6-2 radio telemetry tags (n = 79) had fork lengths that ranged between 301 and 835 mm (mean = 499 mm FL) and weights that ranged between 260 and 5386 g (mean = 1437 g; weights were not recorded for all individuals). NTF-6-2 tag weight as a percent of total body weight (i.e., tag burden) ranged from less than 0.1% to 1.5%, with a mean tag burden less than 0.5%.

Three Burbot were implanted with NTF-6-1 radio telemetry tags. Total lengths of these individuals were 356 mm, 437 mm, and 443 mm with weights that ranged between 242 and 585 g. Tag burden for NTF-6-1 tags in Burbot ranged from 0.4% to 1.0%. Burbot implanted with NTF-6-2 radio telemetry tags (n = 15) had total lengths that ranged between 366 and 869 mm (mean = 452 mm TL) and weights that ranged between 326 and 3947 g (mean = 717 g). NTF-6-2 tag weight as a percent of total body weight (i.e., tag burden) ranged from 0.1% to 1.2%, with a mean tag burden less than 1.0%.

Rainbow Trout implanted with NTF-3-2 radio telemetry tags (n = 8) had fork lengths that ranged between 144 and 236 mm (mean = 169 mm FL) and weights that ranged between 30 and 143 g (mean = 58 g). NTF-3-2 tag weight as a percent of total body weight (i.e., tag burden) ranged from 0.4% to 1.9%, with a mean tag burden of 1.2%. Rainbow Trout implanted with NTF-5-2 radio telemetry tags (n = 7) had fork lengths that ranged between 157 and 238 mm (mean = 206 mm FL) and weights that ranged between 38 and 168 g (mean = 102 g). Tag burden for NTF-5-2 tags in Rainbow Trout ranged from 0.9% to 3.9%, with a mean tag burden of 1.8%. Rainbow Trout implanted with NTF-6-2 radio telemetry tags (n = 41) had fork lengths that ranged between 168 and 485 mm (mean = 340 mm FL) and weights that ranged between 58 and 1498 g (mean = 491 g). Tag burden for NTF-6-2 tags in Rainbow Trout ranged from 0.3% to 6.9%, with a mean tag burden of 1.2%.

A single Walleye was implanted with a NTF-5-2 radio telemetry tags. It had a fork length of 283 mm and weighed 238 g (tag burden = 0.6%). A single Walleye was implanted with a NTF-6-1 radio telemetry tags. It had a fork length of 374 mm and weighed 605 g (tag burden = 0.4%). Walleye implanted with NTF-6-2 radio telemetry tags (n = 62) had fork lengths that ranged between 304 and 665 mm (mean = 412 mm FL) and weights that ranged between 306 and 3849 g (mean = 896 g). Tag burden for NTF-6-2 tags in Walleye ranged from 0.1% to 1.3%, with a mean tag burden of 0.6%.

4.0 DISCUSSION

4.1 Management Hypotheses

Management hypotheses for this monitoring program relate to the predicted changes in the biomass and community composition of fish in the Peace River during the construction and operation of the Project. Data collected from 2002 to 2020 will represent the baseline, pre-Project state of the Peace River fish community. Currently, management hypotheses are not scheduled to be statistically tested until after the river diversion phase of construction (i.e., after 2020). Instead, effort has focused on developing analyses and metrics that will eventually be used to test the management hypotheses.

4.2 Annual Sampling Consistency

Field methods employed during the Indexing Survey were standardized in 2002; these methods were carried over to the GMSMON-2 program in 2008 and to the current program in 2015. Over the 18-year study period (2002 to 2019), small changes were occasionally made to the methods based on results of preceding study years or to better address each program's management objectives. Examples of some of these changes include the sections of river sampled and the types of tags deployed (T-bar anchor tags initially, changing to full-duplex PIT tags in 2004, and to half-duplex PIT tags in 2016). For a long-term monitoring program, changes to methods, which also includes changes in handling procedures (such as additive effects associated with collecting tissue or stomach content samples), have the potential to confound results and hinder the identification of patterns and trends in the data through changes in behavior, health, or survival. Changes made between 2002 and 2013 are discussed in previous reports. In 2019, boat electroshocking methods adhered to methods developed by Mainstream and Gazey (2014) and subsequently modified in 2014 to reduce electroshocker related injuries to fish. These modifications included operating the electroshocking equipment at a lower frequency (30 Hz compared to 60 Hz) and amperage (a range 2.0–4.2 A compared to 3.2–5.2 A). Studies from other river systems indicate that salmonids, particularly larger salmonids, are less likely to be injured (i.e., branding, internal hemorrhaging, or spinal injuries) at the lower operational settings (Snyder 2003; Golder 2004, 2005).

It is not known whether the difference in electroshocker settings used in 2014–2019 versus 2002–2013 resulted in differences in the rates of injury, survival, capture probability, and recapture of sampled fishes; however, the Mountain Whitefish synthesis model indicates differences in selectivity between the two epochs for this species. From 2014 to 2019, selectivity was more uniform across size classes when compared to 2002–2013 (Appendix H, Figure H11). Higher frequencies, which were used from 2002–2013, result in greater electrical power. Greater power makes it easier to catch small fish (Dolan and Miranda 2003). Lower frequencies, which were used from 2014 to 2019, have less electrical power, reducing the small fish catch and increasing the portion of large fish in the catch. The change in selectivity confounds comparisons between the two epochs but could prove beneficial to long-term study results, due to reduced injury or mortality associated with electroshocking. Increased selectivity for younger age-classes, particularly age-2 fish because they are young but still large enough to tag, would increase the precision of age-based metrics, including length-at-age, annual growth, recruitment, and inter-annual survival, and improve the precision of the synthesis model.

In 2019, a sixth session was scheduled for all sections but could not be completed for Sections 5 and 9 due to permit conditions preventing sampling when water temperatures were below 5°C. The reduced level of effort in Sections 5 and 9 in 2019 relative to earlier study years should be considered when interpreting total catch data.

4.3 Population Estimates

4.3.1 Evaluation of Assumptions

Mountain Whitefish are an indicator species for the study and are captured in sufficient numbers to allow for detailed population abundance modeling. Based on field observations, Mountain Whitefish are sensitive to external stresses, and that may result in the loss of tagged fish or reduced recapture rates, potentially confounding population abundance estimates and modeling efforts. Factors that affect population estimates can be evaluated through an assessment of assumptions required for the Bayes sequential and stratified population models, which are as follows:

1) The population size in the study area does not change (i.e., is closed) and is not subject to apparent mortality over the period of the experiment.

Few Mountain Whitefish were recaptured in sections other than their section of release (6.8%). The population estimation model accounts for fish that move under the assumption that all movement is described by the history of recaptured marks.

Growth over the study period was not significant; therefore, the number of unmarked fish that entered the population through growth during the study period (i.e., fish that grew from less than 250 mm FL to more than 250 mm FL during the approximate six week study period) was negligible. The CJS analysis revealed no apparent mortality. An inspection of the posterior probability plot sequences generated by the Bayes model indicated that all species and sections, with the exception of Mountain Whitefish in Section 6, were convergent with no marked trend to larger or smaller population sizes. For the Section 6 population abundance model for Mountain Whitefish, the posterior distributions indicated either unaccounted immigration of fish into the section or a trend to lower catchability of marked fish through time. It is unlikely that the catchability of one species would decline over the study period in some sections and remain constant in other sections when the same equipment and methods are used among sections. For that reason, the result is likely indicative of unaccounted for immigration. The high frequency of the violation in Section 6 (i.e., four of the last five years) may partially be due to the low percentage of side channel habitat sampled relative to main channel habitat. Side channels are common in Section 6 but few of the established sites are situated within side channels. It is possible that Mountain Whitefish move between main channel and side channel habitats and therefore are less likely to be recaptured in Section 6 due to the location of the sites. Reallocating some of the effort in Section 6 to side channel habitats may provide insight regarding the frequent assumption violations for this section. For all other sections and species, the available evidence does support a closed population.

2) All fish in a stratum (day and section), whether marked or unmarked, have the same probability of being caught.

The available evidence implies that marked and unmarked Mountain Whitefish in Sections 3 and 6 underwent heterogeneous capture probabilities over the study period. For all other sections and species, the available evidence supports this assumption. The study area was stratified into six sections to account for any differences from marks applied, population size, or spatial catchability. Similarly, the day strata accounted for new marks applied through the study. While some T-bar anchor tags that had been implanted during previous study years were encountered in 2019 (two Mountain Whitefish), only PIT tags were used in the analyses. For Mountain Whitefish in Sections 3 and 6, the time-varying catchability model had a better fit to the data than the constant catchability model. The constant catchability model fit the data better or nearly as well in all other sections.

3) Fish do not lose their marks over the period of the study.

Overall, tag retention was high, with only 3 out of 11,060 Mountain Whitefish (0.03%) showing evidence of a tag implantation wound (current year; *n* = 2) or scar (previous year; *n* = 1) without a tag being detected. This result is similar to results recorded during previous study years. The impact on 2019 population estimates from lost tags was assumed to be negligible.

4) All marked fish are reported on recapture.

Only fish brought on board were included in the number of fish examined for a tag; therefore, it is unlikely that a tagged fish would avoid detection.

4.3.2 Reliability of Estimates

The foremost issue for the reliability of estimates is the weight each session should receive for the estimation of population size. The sequential Bayes algorithm updates the posterior distribution of the previous session by the information from the current session. Gazey and Staley (1986) showed that the sequential capture-recapture experiment can be characterized as a sequential Bayes algorithm updated by the binomial kernel. Thus, the sequential Bayes model weighs each session by the information contained in the sample regardless of variation in catchability or population size. The sequential Bayes algorithm also incorporates time-varying capture probability because capture probability is implicitly linked to sampling intensity (i.e., sample size divided by population size; Williams et al. 2001). In addition, unmarked releases do not bias population estimates. From a practical perspective, when the model assumptions hold, the population estimates will be accurate. When the assumptions do not hold, the population estimate should provide good approximations.

The sequential Bayes model provides good population estimates for within-year sampling on the Peace River. The assumptions required to produce population estimates appear to hold for all species and sections with the exception of Mountain Whitefish in Section 6, which resulted in higher uncertainty in estimates for this section and species relative to others. This uncertainly is due to either the first or second assumptions not being supported by the data.

Low numbers of captured and recaptured Arctic Graying limited the effectiveness of the capture-recapture study for this species; however, estimates were generated for this species for Section 3 in 2019. The model has generated abundance estimates for Arctic Grayling in Section 3 each year since 2016. For Bull Trout, population estimates were available for Sections 1 and 3; however, precision was generally poor (overall CV = 30%).

One less session was conducted in Sections 5 and 9 in 2018 and 2019 relative to the 2002 to 2017 study years. Conducting five sessions instead of six sessions may have reduced the precision of population abundance estimates and widened credible intervals for these two sections.

4.4 Catchability

Catchability coefficients were calculated under the assumption of a closed population with no apparent mortality, and that abundance indices are proportional to the population size (Figure 71 and Figure 72). If the above assumptions are true, coefficients should remain constant over study years and sections. Mainstream and Gazey (2006) provided three caveats for using boat electroshocking catch rates as an index of Mountain Whitefish abundance in the Peace River:

1) Sampling protocols (methods, equipment, and approach) must be consistent;
2) Water clarity must remain above 50 cm; and
3) The target population must remain closed during the sampling period.

The 2019 Indexing Survey generally complied with the above caveats, and estimated catchability coefficients were consistent across sections in 2019. Since 2014, when boat electroshocker settings were altered, catchability coefficients have been consistent with the exception of Section 1 in 2018, albeit lower when compared to estimates prior to 2014 (see Figure 71 and Figure 72). These results indicate that catch rates may be a reasonable index of abundance from 2014 to 2019, but a poor index of abundance for years prior to 2014.

4.5 Arctic Grayling

Insufficient capture-recapture data for Arctic Grayling prevented the generation of population abundance estimates that could corroborate any trend. Over the 18-year monitoring period, the catch rate of Arctic Grayling has generally declined, with the lowest catch rate for Arctic Grayling being recorded in 2014. Arctic Grayling catch rates increased from 2014 to 2016, with catch rates in 2016 being approximately 60% higher than in 2014. Since 2016, Arctic Grayling catch rates have been stable.

Use of the downstream portions of the study area by Arctic Grayling is not fully understood. Between 2015 and 2019, the number of Arctic Grayling captured each year in Sections 6, 7, 9 combined was low, averaging less than 13 fish per year (range = 7 to 25 individuals). Overall, catch data recorded during these study years suggested that Arctic Grayling use of Sections 6, 7, and 9 was limited. However, in 2019, 52 Arctic Grayling were captured in these downstream sections, more than double the previous maximum number of fish per year. The bulk of these fish (85%) were age-0 and age-1 individuals. These data suggest that the downstream portions of the study area may contain important rearing habitat for this species. The low numbers of immature Arctic Grayling in these sections prior to 2019 may have been due to lower abundance. Additional years of data are required to fully understand the importance of Sections 6, 7, 9 to Arctic Grayling.

Of the 40 tagged Arctic Grayling recorded in Sections 6, 7, or 9 since 2015, only one was subsequently recaptured in Section 1, 3, or 5. This individual was initially tagged in Section 7 in 2015 and was recaptured in Section 3 in 2017. To date, two tagged Arctic Grayling that were recorded in the upper sections of the study area have subsequently been recaptured in the downstream sections. AMEC and LGL (2009) detected Arctic Grayling movements between the upstream and downstream sections during radio telemetry surveys conducted in 2008 (i.e., 72% of tagged fish in 2006 and 29% of tagged fish in 2008).

Age data collected since 2015 indicated that all age-classes of Arctic Grayling are present in the study area including age-0 and age-1 juveniles and adults up to age-7. Age-0 fish were not captured in 2017, age-1 fish were not captured in 2018, and age-2 were rarely captured in 2019. These results indicate poor recruitment from the 2017 brood year. The high number of Arctic Grayling less than 150 mm FL in the 2019 catch (*n* = 33) suggests strong recruitment from the 2019 spawning season; however, additional years of data are required to confirm this hypothesis.

Additional years of data from downstream sections could be used to assess the movement and distribution of Arctic Grayling within the study area in response to the construction and operation of the Project. It is anticipated that low recapture rates will result in uncertain absolute abundance estimates for this species during the construction and operation of the Project. Therefore, changes in abundance over time for this species should be assessed using indicators of relative abundance, such as catch-per-unit effort metrics or the relative strengths of individual age-classes. The anticipated reliance on relative abundance metrics highlights the importance of maintaining consistent sampling effort and methods across study years.

The trends observed in Arctic Grayling length-at-age data over the last six years suggests that statistical analyses of growth-related metrics may be possible after additional years of study; however, these analyses are likely to have low statistical power because of continued small sample sizes.

Continued low catch of Arctic Grayling will reduce the precision of abundance estimates for this species, which will prevent the generation of precise biomass estimates. As a result, the survey, in its current format, is unlikely to be able to test Hypothesis #3 for Arctic Grayling.

The bulk of the Arctic Grayling population spawns in Peace River tributaries, most notably the Moberly River (Mainstream 2012). After hatching, age-0 Arctic Grayling disperse downstream into the Peace River mainstem over the summer season. The success of these life stages of Arctic Grayling (i.e., spawning and age-0 dispersal) is paramount to sustaining the Peace River Arctic Grayling population. These early life history stages are also highly susceptible to environmental perturbation (McPhail 2007). Low abundance of a particular cohort, such as the 2011 and 2015 brood years (Appendix F, Figure F3) and the 2017 brood year (as hypothesized above), is likely related to poor environmental conditions during the spring and summer of the cohort's spawning year. In each of 2011, 2015, and 2017, discharges from the Moberly River were substantially greater than average during the spring (Water Office 2019), suggesting a correlation between Moberly River water levels and the spawning/incubation or downstream dispersal success of age-0 Arctic Grayling.

4.6 Bull Trout

The 2019 population abundance estimates and catch-per-unit-effort data did not suggest substantial or sustained changes in Bull Trout abundance when compared to historical data.

Population abundance estimates are not available for all sections during all years. Section 3 is the only section in which population abundance estimates are available for all study years. Credible intervals were wide for some estimates, largely due to low numbers of recaptured individuals in these sections and years (e.g., the estimate for Section 1 from 2011 is based on only two recaptured Bull Trout).

Age-0 to age-2 Bull Trout are not typically captured in the Peace River mainstem during Indexing Surveys. Young Bull Trout are known to rear in Peace River tributaries, most notably tributaries to the Halfway River (Geraldes and Taylor 2020). During the August to September study period, older, mature Bull Trout have migrated into tributaries to spawn and are not present in the Peace River during the Indexing Survey. For these reasons, the Bull Trout population sampled during the Indexing Survey was largely composed of fish that were old enough to have migrated out of their natal streams but had not yet reached sexual maturity (i.e., subadults). However, a small portion of the sampled population may have included adult fish that had forgone spawning (i.e., skip spawners) and Bull Trout that had either not yet migrated into tributaries to spawn or had already returned to the Peace River after spawning. Some of the adult Bull Trout captured in 2019 appeared to be in post-spawning condition (e.g., frayed fins, gaunt, superficial scratches), and one individual that succumbed to sampling in Section 6 on 3 October 2019 was classified as spent by field staff when small numbers of partially reabsorbed eggs were observed inside its abdominal cavity.

A review of Bull Trout age data indicated inconsistencies in age-class assignments. These inconsistences were related to several factors, the most notable included inconsistent annuli development on fin rays, particularly in older individuals with slower growth rates, the youngest annuli not being evident in fin rays because the rays could not always be collected close enough to the body wall of the fish or were not consistently harvested close to the body wall, and frequent and irregular growth checks that could be mistaken for annuli (most likely related to frequent migrations into and out of spawning tributaries). Otoliths (MacKay 1990; Zymonas and McMahon 2009) and vertebrae (Gust 2001) are more accurate methods for ageing Bull Trout but both require lethal sampling. For age-related analyses for Bull Trout in 2019, fish initially captured during the Indexing Survey and during Site C baseline studies (Mainstream 2010, 2011, 2013) that were less than 240 mm FL were assigned an age of age-3 for the reasons detailed in Section 2.1.5. In short, age-4 Bull Trout were expected to be larger than 240 mm FL and age-0 to age-2 individuals were not expected to be present in the Peace River mainstem. Between 2002 and 2019, 418 Bull Trout were recorded in the Peace River mainstem that had fork lengths less than 240 mm FL. This dataset should be considered an approximation of true age-3 fish. An unknown number of age-4 Bull Trout in the Peace River could be smaller than 240 mm FL and an unknown number of age age-3 Bull Trout could be largely than 240 mm FL. Based on length-frequency and annual growth data from recaptured individuals, these portions of the population are expected to be quite small. The dataset was supplemented with length-at-age data from age-0 to age-2 individuals collected from the Halfway River watershed (Golder 2020) to provide a representative dataset that encompasses all age-classes. Age-4 and older fish included in the analyses were limited to individuals that were initially captured in the Peace River at age-3 (i.e., when they had a fork length less than 240 mm FL) and recaptured during a subsequent year. The above approach provided accurate length-at-age data for age-0 to age-8 individuals. The dataset is expected to increase during future study years as immature Bull Trout that were tagged at a known age in the Halfway River watershed are encountered in the Peace River and as more fish initially tagged as age-3 individuals are recaptured.

Length-at-age data indicate slower growth rates for Bull Trout in tributaries when compared to Bull Trout in the Peace River mainstem. von Bertalanffy growth curves fit the data better when the population was split into an age-0 to age-3 cohort (i.e., tributary growth) and an age-3 to age-8 cohort (i.e., Peace River mainstem growth). The increased growth rate in the Peace River is likely related to the transition from a benthic to a fish-based diet.

Similar to most previous study years, the body condition of Bull Trout was higher in Section 1 than most other sections, a result that may be influenced by Bull Trout feeding on dead and injured fish entrained through PCD.

4.7 Mountain Whitefish

Mountain Whitefish abundance estimates were similar over recent study years, suggesting a generally stable population. Sections 1, 3, and 5 were consistently sampled from 2002 to 2019. For all study years, relative population abundance estimates for Mountain Whitefish (greater than 250 mm FL) were typically highest in Section 1 and decreased incrementally downstream, with lower abundance in Section 3 and the lowest abundance estimate in Section 5. In Section 1, abundance in most years between 2002 and 2019 was similar, with the exception of substantial increases in abundance in Section 1 in 2010, 2011, and 2016 to 2018. The 2018 abundance estimates for Mountain Whitefish in Section 1 was higher than all previous study years and likely spurious.

Previous studies found that the abundance of Mountain Whitefish in the study area appeared to be related to water levels, with higher densities generally observed when water levels were lower (e.g., Golder and Gazey 2017). Mainstream and Gazey (2011) postulated that, at lower water levels, side channel habitats become isolated or unsuitable for use by Mountain Whitefish, thereby concentrating fish in remaining portions of the study area, where they are more susceptible to capture during the sampling program. This hypothesis was supported by data from 2010, 2011, 2016, and 2018 that recorded high Mountain Whitefish abundance estimates in years when, for a substantial portion of the study period, flows remained below the historical seasonal average (Appendix C, Figure C1). In years with lower population abundance estimates (i.e., 2012–2015), flows ranged from above average to below average and the relationship between flow and abundance estimates was less evident. The 2019 study year was anomalous in that water levels varied substantially over the study period, with some sessions being conducted at near average water levels while others were conducted at near historic lows and near historic highs. Presently, it is difficult to conclude whether variation in population abundance estimates represent true Peace River fish abundances or are indicative of changes in Peace River water levels and the concentration of fish in sampled areas.

Overall, population abundance estimates for the constant catchability model (i.e., not allowed to vary across sessions within a year) generally exceeded the time-varying catchability model. In 2019, catchability did not vary by time in any section except Sections 3 and 6, where catchability varied by time. Use of specific sections of the river in relation to aspects of Mountain Whitefish life history may influence catchability. The Halfway River's confluence with the Peace River is immediately upstream of Section 3 and is a known spawning area for Mountain Whitefish (RRCS 1978; Mainstream 2012), and the Pine River's confluence with the Peace River is at the upstream end of Section 6 and is an important spawning area for this species (Mainstream 2012). Sections 3 and 6 may serve as holding areas for this species prior to the spawning season. AMEC and LGL (2008) noted substantial movements of Mountain Whitefish as early as August, which they associated with pre-spawning migration. Spawning for this species likely occurs in October when water temperature declines to approximately 7°C (Northcote and Ennis 1994 cited in Mainstream and Gazey 2014). Therefore, differences in the catchability of Mountain Whitefish between sample sessions in Sections 3 and 6 could be due to pre-spawning movements and migration into nearby tributaries to spawn.

Across all sections, the average body condition of Mountain Whitefish was higher in 2018 (K = 1.092) when compared to 2017 (K = 1.037) and 2019 (K = 1.045). Reasons for the approximate 5.0% increase for a single year are unknown. Schleppe et al. (2018) noted that high turbidity in the Peace River during the 2017 growing season reduced light penetration and limited primary productivity. It is possible that a decrease in primary productivity has a measurable effect on Mountain Whitefish body condition during the same year. Turbidity levels in the Peace River mainstem can vary greatly among sections due to tributary inflows, and data are not readily available for most study years or sections.

Consistent among study years, the highest average body condition is typically recorded in the upstream sections and the lowest in the downstream-most sections of the study area. The underlying biological factors responsible for this decline in average body condition were not evident. Future studies will allow further analysis to examine whether or not this trend persists and identification of possible causal factors.

4.7.1 Mountain Whitefish Synthesis Model

The population estimates generated by the synthesis model were based on more information than used for the Bayes within year estimates. Therefore, synthesis population estimates should be more reliable if the model assumptions were consistent with the data.

The altered electroshocker settings that were implemented in 2014 changed the selectivity of the gear. Additional years of data will be required to fully characterize the new selectivity (e.g., the functional form of the selectivity function may require alteration of the model). The Indexing Survey targets large fish, and when combined with high variation in growth, survival, and selectivity, large uncertainty in recruitment estimates should be anticipated.

During most years and sections, synthesis and Bayes model estimates were similar, with the synthesis model generally providing slightly higher values. In 2019, the two models provided substantially different results for Section 1. Reasons for the discrepancy are not known; however, it could be related to water levels. Section 1 is situated immediately downstream of PCD. During the 2019 study period, releases from PCD were below average. Due to the bathymetric profile of Section 1, the low water levels may have resulted in field crews sampling different habitats when compared to habitats available at higher water levels. Further, in 2019, water levels were too low to allow access to some side channel habitat areas. As a result, field crews were prevented from sampling Sites 0103, 0104, and 0105 during Sessions 4 and 5. The Bayes model is only dependant on data collected during the current sample year, which could make it more susceptible to anomalous sampling conditions when compared to the synthesis model.

4.8 Rainbow Trout

Population abundance estimates for Rainbow Trout exhibit large credible intervals for some study years and sections due to the low number of captured and recaptured individuals. This uncertainty hinders interpretation in some situations. Abundance estimates for Sections 3 and 5 were precise and similar to abundance estimates from 2018. This consistency is supported by catch and catch rate data, neither of which indicated substantial changes in Rainbow Trout abundance between 2015 and 2019.

Consistent with previous studies, approximately 90% of the encountered Rainbow Trout were recorded in the upstream two sections of the study area. The higher abundance of Rainbow Trout in these sections was attributed to feeding and rearing habitat provided by tributaries to the Peace River in the upstream portion of the study area. Lynx Creek, which flows into the Peace River in Section 1, is one of three known spawning and rearing streams for Peace River Rainbow Trout (RRCS 1978; Mainstream 2012). It is possible that recent landslides in the

Lynx Creek watershed[7] have left the system undesirable for Rainbow Trout. The extent that Rainbow Trout spawn in Lynx Creek relative to the other two streams (i.e., Maurice and Farrell creeks) is unknown. As such, the long-term effects, if any, that the landslide will have on the Peace River Rainbow Trout population is also unknown.

A comparison of scale-based ages of immature Rainbow Trout from Sections 1 and 3 suggested that Rainbow Trout from Section 1 are larger when compared to Rainbow Trout from Section 1. This difference in growth rates results in overlapping size distributions of individual age-classes in the Peace River as young as age-1 and makes it difficult to validate assigned ages through length-frequency comparisons. The differences in growth are likely related to differences in habitat quality in natal and rearing streams.

4.9 Walleye

Substantially more Walleye were recorded in 2017 (*n* = 389), 2018 (*n* = 363), and 2019 (*n* = 274) than during any previous study year (an average of 42 Walleye were recorded each year between 2002 and 2016). Walleye are more commonly recorded in the downstream sections of the study area. As such, more Walleye have been recorded since 2015 (when Sections 6, 7, and 9 were added to the program).

In 2017, a BC Provincial Park Use Permit was issued that allowed sites historically established in Beatton River Provincial Park (e.g., Mainstream 2010) to be sampled, including sites at the Beatton River's confluence with the Peace River. This confluence area is a known feeding area for Walleye (Mainstream 2012). Two sites located at the confluence area (i.e., 07BEA01 and 07BEA02) have accounted for 17% of the Walleye catch over the last four years.

Mainstream (2012) notes that the Kiskatinaw River is a likely recruitment source for Peace River Walleye. In 2018 and 2019, the Kiskatinaw River confluence area (Site 07KIS01) was sampled a combined 14 times during Goldeye and Walleye Surveys and the Indexing Survey. Over those 14 surveys, 14 Walleye were captured. This site was not surveyed prior to 2018.

Capture-recapture data collected in 2019 allowed the generation of population abundance estimates for Section 7 only. The 2019 estimate was within the confidence intervals of estimates generated in 2017 and 2018; however, the confidence intervals surrounding the 2019 estimate were wider than the previous two study years. Catch rate data from 2016 to 2019 also suggest a stable Walleye population. Catch data suggest increased abundance of age-0 Walleye (i.e., fish less than approximately 150 mm FL) in 2019 relative to previous study years. If the increase in age-0 catch reflects a strong 2019 brood year, population abundance, as measured through catch rate and capture-recapture analyses, will increase in future study years as these fish grow and fully recruit to the electroshocker.

The Goldeye and Walleye Survey was implemented in 2018 in response to low Goldeye catch rates during the Indexing Survey. The Goldeye and Walleye Survey was conducted again in 2019. While Walleye were recorded during the Goldeye and Walleye Survey in both 2018 (*n* = 22) and 2019 (*n* = 24), substantially more Walleye were

[7] http://hudsonshope.ca/residents/water-services/.

recorded during the 2018 (*n* = 362) and 2019 (*n* = 274) Indexing Surveys. During future study years, the Goldeye and Walleye Survey should be tailored as needed to maximize Goldeye catch rates, provided Walleye catches remain high during the Indexing Survey.

4.10 Sucker species

Although none of the sucker species are considered indicator species under this program's objectives, all adult large-bodied fishes are monitored as part of the program to test Management Hypothesis #4 regarding fish community structure. Sucker species may be useful for detecting changes in the fish community in the study area for several reasons. Suckers can contribute substantially to ecosystem function through nutrient cycling, affect the invertebrate communities through grazing, and serve as prey items (both as eggs and fish) for other fish species (Cooke et al. 2005). For these reasons, and their low trophic position as grazers, suckers can be an important sentinel species for monitoring changes in fish communities and ecosystems (Cooke et al. 2005).
Suckers (all species combined) are common in the Peace River catch data and their large sample sizes and recapture rates will likely result in greater precision in estimates of fish population metrics and greater power to detect change as a result of the construction and operation of the Project when compared to some less abundant indicator fish species.

Population abundance estimates for Largescale Sucker were consistent among years and sections with suitable data (2015 and 2018), a result supported by catch rate data for this species. For Longnose Sucker, abundance was consistent among years and sections with a few potential outliers (e.g., Section 1 in 2019). The consistency in Longnose Sucker abundance estimates is not supported by catch rate data for this species, as Longnose Sucker catch rates have generally declined over the last four years. Reasons for the discrepancy are not known. Abundance estimates are infrequently generated for White Sucker due to the low number of recaptured individuals. In 2019, White Sucker abundance was not estimated for any sections due to the low number of recaptured individuals (*n* = 7 for all sections combined).

The distribution of suckers varied by species, life-stage, and section. During most study years, immature Largescale Sucker and Longnose Sucker were infrequently captured in Section 1 and were common in Section 9. White Sucker was the least common of the three species in all six sections, and nearly all captured White Sucker were adults.

4.11 Other species

For two of the seven indicator species (Burbot and Goldeye), there were not enough capture-recapture data to calculate precise population abundance estimates for any sections.

In 2019, 47 Burbot were captured, which was more than in any previous study year. The high number of Burbot recorded in 2016 (*n* = 37) and 2019 were anomalous. With the exception of these two study years, Burbot catch averaged only three individuals per year (range 0 to 14 individuals) over the 18-year monitoring period. Reasons for the higher catch in 2016 and 2019 are not known, but reduced habitat quality in the Moberly River, resulting in Burbot moving into the Peace River, was identified as a likely factor contributing to the higher Burbot catch in 2016 (Golder and Gazey 2017). In both 2016 and 2019, discharge from the Moberly River was substantially higher than average during the study period (Water Office 2019).

Given Burbot's propensity for deeper water during the daytime, boat electroshocking is not an ideal capture method for this species. Due to typically low catch numbers, it is unlikely that Burbot catches will allow for meaningful inter-annual comparisons of life history metrics or abundance levels during future years of the study.

Goldeye were not captured prior to 2015 and from 2015 to 2018 combined, only 13 Goldeye were captured during Indexing Surveys. In 2019, 14 Goldeye were captured during the Indexing Survey, and an additional five Goldeye were captured during the Goldeye and Walleye Survey. Goldeye are seasonal residents in the study area, migrating upstream into the study area in the spring to feed in select tributaries, most notably the Beatton River (Mainstream 2011). Microchemistry data from 13 Goldeye captured during the Indexing Survey indicated that all 13 fish originated from the Smokey River, which flows into the Peace River approximately 284 km downstream of the Project (TrichAnalytics 2020). Goldeye encountered during the 2019 Goldeye and Walleye Survey were recorded at the confluences with the Peace River of the Beatton (n = 3) and Clear (n = 2) rivers, two rivers that Mainstream (2012) identified as important spawning and recruitment sources for the Peace River Goldeye population. The Goldeye encountered during the Goldeye and Walleye Survey had substantially lower body condition (K) (average = 0.98; range 0.90 to 1.13) compared to Goldeye captured during the Indexing Survey (average = 1.28; range 1.06 to 1.43). The lower body condition in the spring may be related to higher energy expenditures or the release of gametes during spawning, which would indicate that this species spawns in the spring prior to June. Goldeye encountered during the Indexing Survey likely represent the last of this population migrating out of these tributaries and travelling back downstream. All 14 of Goldeye captured during the Indexing Survey were captured in Section 9. The Indexing Survey in its current form will continue to encounter sporadic captures and small sample sizes and is unlikely to generate enough data to allow for meaningful inter-annual comparisons of life history metrics or abundance levels for this species in future study years.

Northern Pike is not an indicator species under the current program but is a frequent target of anglers. It was captured in low numbers during most previous study years. During the four years that sampling was conducted in the downstream sections, more Northern Pike were captured in 2017 (n = 37), 2018 (n = 39), and 2019 (n = 25) than in the 2015 (n = 13) and 2016 (n = 17). Reasons for the higher catch during the recent study years and increasing catch rate for this species over the last five years are not known.

In 2019, 14 Spottail Shiner were encountered in Sections 5 (n = 3), 6 (n = 8), 7 (n = 1), and 9 (n = 2). Spottail Shiner is a species of conservation concern and is on the Provincial red list[8]. Spottail Shiner are not native in the Peace River, and those present likely originated from a population introduced into Charlie Lake, which flows into the Beatton River (McPhail 2007).

4.12 Species Diversity

Consistent with 2017 (Golder and Gazey 2018) and 2018 (Golder and Gazey 2019), species richness (diversity) was generally greater in the downstream portion of the study area (Sections 6, 7, and 9) than in the upstream portion (Sections 1, 3, and 5). The downstream sections of the study represent the transition zone between cold/clear and cool/turbid habitats detailed by Mainstream (2012). As such, these sections likely include fish species that prefer both habitat types.

[8] http://www.speciesatriskbc.ca/node/9189.

Based on the current results, diversity profiles will potentially be an effective method for testing H_4 and should identify changes in species richness in response to the construction and operation of the Project.

4.13 Radio Telemetry Tagging

In total, 261 Arctic Grayling, Bull Trout, Burbot, Rainbow Trout, and Walleye were implanted with radio telemetry tags over the course of the 2019 Indexing Survey. The movements of these fish will be monitored and interpreted under other components of the FAHMFP.

5.0 CONCLUSIONS

Sampling conducted since 2002 provides a long-term, baseline dataset that can be used to estimate the abundance, spatial distribution, body condition, and growth rates of large-bodied fish populations in the Peace River prior to the construction, and during construction and operation of the Project. During future study years, data from this program will be used to test management hypotheses that relate to predicted changes in biomass and fish community composition in the Peace River during and after the construction and operation of the Project.

The confidence bounds from most 2019 population estimates overlapped estimates from previous study years and were, in many cases, not statistically different. For Mountain Whitefish, 2019 catch rates were the highest recorded since 2013 and catch rates for this species have increased each year since 2017. Between 2017 and 2019, catch rates increased 48% in Sections 1, 3, and 5 combined.

Overall, higher catches of Arctic Grayling, Burbot, Largescale Sucker, Goldeye, Longnose Sucker, Mountain Whitefish, Northern Pike, Rainbow Trout, and Walleye were recorded in 2019. Catches of Bull Trout and White Sucker were similar to recent historical study years.

For some indicator fish species, most notably Burbot and Goldeye, small sample sizes and limited capture-recapture data will likely limit the program’s ability to generate absolute abundance estimates during all study years. For these species, changes in abundance over time will be monitored using measures of relative abundance and catch rate data. The Goldeye and Walleye Survey provided supplemental Goldeye data in 2019; however, several more years of data from these surveys would be required to adequately characterize the Goldeye population in the Peace River. Without higher Burbot and Goldeye catches, the program is likely to only detect large changes in population abundance for these species.

6.0 CLOSURE

We trust that the information contained in this report meets your present requirements. Please contact us if you have any questions or concerns regarding the above.

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https://golderassociates.sharepoint.com/sites/108497/project files/6 deliverables/issued to client_for wp/19121769-007-r-rev0/19121769-007-r-rev0-peace indexing 2019 annual report 31dec_20.docx

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APPENDIX A

Maps and UTM Locations

Table A1. Location and distance from WAC Bennett Dam of Peace River boat electroshocking sites sampled in 2019.

Section	Site Name	Bank[a]	Bank Habitat Type[b]	Upper Site Limit				Lower Site Limit				Site Length (m)
				Zone[c]	Easting	Northing	River Km[d]	Zone[c]	Easting	Northing	River Km[d]	
1	0101	ILDB	A3	10	566453	6207858	25.4	10	566936	6208239	25.9	600
	0102	ILDB	A3	10	566936	6208240	25.9	10	567497	6208907	26.9	975
	0103	RDB	A1	10	566302	6207742	25.3	10	567401	6208075	26.2	1200
	0104	IRDB	A3	10	566460	6207754	25.4	10	566934	6207880	25.8	500
	0105	RDB	A2	10	567402	6208074	26.2	10	568000	6208913	27.3	1100
	0107	LDB	A1	10	568372	6210050	28.4	10	568798	6210402	28.9	550
	0108	RDB	A3	10	568605	6209966	28.5	10	569259	6210477	29.3	850
	0109	RDB	A3	10	569260	6210478	29.3	10	569850	6211235	30.3	975
	0110	LDB	A1	10	568798	6210403	28.9	10	569302	6211053	29.7	650
	0111	LDB	A1	10	569302	6211053	29.7	10	569825	6211869	30.7	1000
	0112	LDB	A1	10	569824	6211868	30.7	10	570686	6212472	31.8	1070
	0113	RDB	A2	10	569994	6211528	30.6	10	570510	6212043	31.3	750
	0114	LDB	A2	10	570686	6212474	31.8	10	571342	6213121	32.8	950
	0116	RDB	A3	10	570511	6212043	31.3	10	571265	6212633	32.3	985
	0119	LDB	A1	10	567516	6209096	27.0	10	568019	6209628	27.8	750
3	0301	RDB	A2	10	600824	6232860	71.3	10	602606	6233198	73.1	1800
	0302	IRDB	A2	10	599753	6233307	70.2	10	601597	6233232	72.0	1900
	0303	IRDB	A2	10	601597	6233232	72.0	10	602930	6233597	73.6	1450
	0304	ILDB	A2	10	602583	6233193	73.1	10	603787	6233290	74.5	1350
	0305	LDB	A2	10	603204	6233827	73.8	10	604640	6233426	75.4	1550
	0306	LDB	A3	10	604655	6233435	75.4	10	605586	6233750	76.5	1000
	0307	IRDB	A3	10	605976	6233888	77.0	10	606935	6234160	78.0	950
	0308	IRDB	A3	10	606935	6234158	78.0	10	607692	6235034	79.4	1350
	0309	ILDB	A3	10	605976	6233878	77.0	10	606666	6234387	77.8	950
	0310	ILDB	A3	10	606662	6234395	77.8	10	607691	6235034	79.4	1200
	0311	LDB	A3	10	605585	6233743	76.5	10	606512	6234441	77.7	1250
	0312	LDB	A2	10	607058	6234840	78.6	10	608047	6235753	80.2	1170
	0314	RDB	A2	10	604468	6233079	75.1	10	605400	6233321	76.1	975
	0315	RDB	A3	10	605400	6233320	76.1	10	606956	6233951	77.9	1700
	0316	RDB	A2	10	606956	6233951	77.9	10	607974	6234928	79.3	1475
5	0502	RDB	A2	10	630016	6229305	106.2	10	630954	6229298	107.1	950
	0505	LDB	A1	10	630553	6229765	106.7	10	631540	6229590	107.7	1000
	0506	LDB	A2	10	631539	6229590	107.7	10	632491	6229713	108.6	1000
	0507	RDB	A2	10	632339	6229356	108.4	10	633099	6229489	109.1	780
	0508	LDB	A2	10	637926	6227901	115.5	10	638432	6227150	116.4	925
	0509	IRDB	A3	10	632785	6229686	108.9	10	633704	6229905	109.8	975
	0510	RDB	A1	10	634530	6229634	110.5	10	635555	6230048	111.6	1130
	0511	LDB	A2	10	635651	6230419	111.8	10	636334	6230361	112.4	720
	0512	IRDB	A3	10	633855	6229835	110.0	10	634872	6230026	111.0	1280
	0513	RDB	A3	10	637113	6228814	114.2	10	637433	6228125	115.0	770
	0514	ILDB	A3	10	637427	6228123	115.0	10	637735	6227647	115.5	560
	0515	IRDB	A3	10	637376	6229072	114.1	10	637591	6228192	115.0	970
	0516	ILDB	n/a	10	633861	6229939	58.2	10	634404	6230473	57.7	800
	0517	ILDB	n/a	10	634513	6230626	57.7	10	635000	6230250	56.8	700
	05SC060	RDB	n/a	10	633456	6229118	58.7	10	633909	6229258	58.3	530

[a] RDB=Right bank as viewed facing downstream; LDB=Left bank as viewed facing downstream; IRDB=Right bank of island as viewed facing downstream; ILDB=Left bank of island as viewed facing downstream.

[b] Bank Habitat Type as assigned by R.L.&L. (2001). See Appendix D, Table D2 for a description of each bank habitat type.

[c] NAD 83.

[d] River kilometres measured downstream from WAC Bennett Dam (RiverKm 0.0).

Continued . . .

Table A1. Concluded.

Section	Site Name	Bank[a]	Bank Habitat Type[b]	Upper Site Limit				Lower Site Limit				Site Length (m)
				Zone[c]	Easting	Northing	River Km[d]	Zone[c]	Easting	Northing	River Km[d]	
6	0601	LDB	n/a	10	643238	6224330	122.0	10	644400	6224099	123.0	1200
	0602	RDB	n/a	10	644567	6223590	123.3	10	645385	6223368	124.1	900
	0603	IRDB	n/a	10	646156	6223144	124.8	10	647208	6222813	125.9	1300
	0604	RDB	n/a	10	646546	6222599	125.4	10	647508	6222650	126.2	1000
	0605	IRDB	n/a	10	647888	6222979	126.5	10	648668	6223109	127.3	800
	0606	LDB	n/a	10	649302	6223371	127.1	10	650601	6222912	129.3	1400
	0607	IRDB	n/a	10	651250	6222649	130.0	10	652139	6222123	131.0	1000
	0608	RDB	n/a	10	647711	6222699	126.4	10	648681	6222855	127.3	1000
	0609	ILDB	n/a	10	649423	6223115	128.0	10	650300	6222732	129.0	1000
	0610	ILDB	n/a	10	650309	6222738	129.0	10	651089	6222427	129.9	850
	0611	ILDB	n/a	10	651070	6222442	129.9	10	651842	6221990	130.9	900
	0612	IRDB	n/a	10	652136	6222141	131.0	10	652937	6221822	132.0	850
	0613	RDB	n/a	10	653270	6221438	132.4	10	654182	6221491	133.2	900
	0614	IRDB	n/a	10	645301	6223722	123.5	10	646108	6223365	124.7	975
	06PIN01	RDB	n/a	10	641497	6223588	1.9[e]	10	642638	6224067	0.3[f]	1500
	06PIN02	RDB	n/a	10	642639	6224071	0.3[e]	10	643433	6224055	122.2	1000
	06SC036	IRDB	n/a	10	654048	6222162	133.3	10	654522	6222203	133.8	500
	06SC047	RDB	n/a	10	644017	6223518	122.8	10	644510	6223546	123.2	550
7	0701	LDB	n/a	10	662099	6220280	141.8	10	662869	6220173	142.5	785
	0702	IRDB	n/a	10	664322	6219824	144.0	10	665185	6220188	144.8	950
	0703	LDB	n/a	10	665724	6220631	145.5	10	666643	6220828	146.4	950
	0704	IRDB	n/a	10	667149	6220752	146.8	10	668100	6220738	147.7	1000
	0705	RDB	n/a	10	667571	6220294	147.2	10	668547	6220497	148.1	1000
	0706	RDB	n/a	10	668544	6220498	148.1	10	669537	6220614	149.0	1000
	0707	IRDB	n/a	10	669735	6220916	149.3	10	670551	6221286	150.1	980
	0708	LDB	n/a	10	663908	6220160	143.6	10	665071	6220480	144.8	1240
	0709	IRDB	n/a	10	665176	6220191	144.8	10	666096	6220512	145.7	1000
	0710	IRDB	n/a	10	668109	6220743	147.7	10	669272	6220889	148.8	1400
	0711	ILDB	n/a	10	669781	6220712	149.3	10	671111	6221081	150.6	1390
	0712	ILDB	n/a	10	671288	6221104	150.8	10	672241	6220774	151.9	1065
	0713	IRDB	n/a	10	672355	6221006	151.7	10	672991	6220293	152.7	980
	0714	IRDB	n/a	10	673481	6220112	153.2	10	674730	6219912	154.4	1275
	07BEA01	LDB	n/a	10	662969	6220383	0.4[f]	10	663146	6220001	0.0[g]	430
	07BEA02	LDB	n/a	10	663146	6220001	143.9	10	663728	6220100	143.5	600
	07KIS01	RDB	n/a	10	676794	6219192	1.0[g]	10	676743	6220010	157.7	1300
	07SC012	LDB	n/a	10	676579	6220730	156.4	10	676792	6220831	156.6	220
	07SC022	RDB	n/a	10	666832	6219962	146.3	10	667130	6220145	146.7	360
9	0901	LDB	n/a	11	357843	6239030	217.6	11	358391	6239968	218.7	1100
	0902	LDB	n/a	11	358391	6239968	218.6	11	359350	6240287	219.5	1000
	0903	ILDB	n/a	11	358363	6239289	218.1	11	359084	6240016	219.2	1100
	0904	ILDB	n/a	11	359520	6240016	219.4	11	360625	6240169	220.7	1100
	0905	LDB	n/a	11	361692	6240512	221.7	11	362771	6240709	222.9	1100
	0906	RDB	n/a	11	363235	6241089	223.5	11	363870	6241929	224.6	1000
	0907	ILDB	n/a	11	364583	6242344	225.2	11	365319	6243257	226.3	1200
	0908	ILDB	n/a	11	365837	6243458	226.6	11	366849	6243231	228.0	1100
	0909	ILDB	n/a	11	366849	6243231	228.0	11	367534	6242583	228.9	950
	0910	LDB	n/a	11	363258	6240685	223.3	11	364070	6241393	224.3	1100
	0911	IRDB	n/a	11	366799	6243728	227.6	11	367379	6243081	228.4	1000
	0912	LDB	n/a	11	368560	6241724	230.0	11	368549	6240689	231.0	1100
	0913	RDB	n/a	11	367347	6241966	229.5	11	367721	6241096	230.5	1000
	0914	IRDB	n/a	11	367734	6241649	230.0	11	368179	6240875	230.8	950
	09SC53	RDB	n/a	11	360795	6239970	220.8	11	361029	6240059	221.1	260
	09SC61	RDB	n/a	11	366861	6242408	228.6	11	367347	6241966	229.4	675

[a] RDB=Right bank as viewed facing downstream; LDB=Left bank as viewed facing downstream; IRDB=Right bank of island as viewed facing downstream; ILDB=Left bank of island as viewed facing downstream.

[b] Bank Habitat Type as assigned by R.L.&L. (2001). See Appendix D, Table D2 for a description of each bank habitat type.

[c] NAD 83.

[d] River kilometres measured downstream from WAC Bennett Dam (RiverKm 0.0).

[e] River kilometres measured upstream from the Pine River's confluence with the Peace River (RiverKm 0.0).

[f] River kilometres measured upstream from the Beatton River's confluence with the Peace River (RiverKm 0.0).

Table A2 Location and distance from WAC Bennett Dam of Peace River boat electroshocking sites sampled for Goldeye and Walleye in 2019.

Section	Site Name	Bank[a]	Upper Site Limit				Lower Site Limit				Site Length (m)
			Zone[b]	Easting	Northing	River Km[c]	Zone[b]	Easting	Northing	River Km[c]	
7	07ALC01	LDB	10	682614	6223992	163.5	10	683384	6224198	164.3	796
	07BEA01	LDB	10	662969	6220383	0.4[d]	10	663146	6220001	0.0[d]	430
	07BEA02	LDB	10	663146	6220001	143.9	10	663728	6220100	143.5	600
	07KIS01	RDB	10	676794	6219192	1.0[e]	10	676743	6220010	157.7	1300
	07MileEight01	RDB	10	655782	6222032	135.1	10	656456	6221827	135.8	700
	07MileSix01	RDB	10	655486	6222037	134.7	10	655782	6222032	135.1	300
8	08CLEA01	LDB	11	331479	6228739	187.4	11	332103	6228412	188.1	700
	08POC01	RDB	11	318808	6224656	173.6	11	319816	6224760	174.5	1035

[a] RDB=Right bank as viewed facing downstream; LDB=Left bank as viewed facing downstream.

[b] NAD 83.

[c] River kilometres measured downstream from WAC Bennett Dam (RiverKm 0.0).

[d] River kilometres measured upstream from the Beatton River's confluence with the Peace River (RiverKm 0.0).

[e] River kilometres measured upstream from the Kiskatinaw River's confluence with the Peace River (RiverKm 0.0).

LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION
- A1 WITH PHYSICAL COVER
- A2 WITH PHYSICAL COVER
- A3 WITHOUT PHYSICAL COVER

BASE DATA

- ROAD
- WATERBODY

0 750 1,500

1:30,000 metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT

BC HYDRO

PROJECT

PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE

SECTION 1 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT

GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\BC_Hydro\Peace_River_GMS\99_PROJECTS\19121769_PeaceRiver_GMS\02_PRODUCTION\MXD\Report\2019_Peace_Indexing_Report\19121769_FIG_A1_to_A6_PEACE_RIVER_SECTIONS.mxd

LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION
- A2 WITH PHYSICAL COVER
- A2 WITHOUT PHYSICAL COVER
- A3 WITH PHYSICAL COVER
- A3 WITHOUT PHYSICAL COVER

BASE DATA

- ROAD
- WATERBODY

0 750 1,500

1:40,000 metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

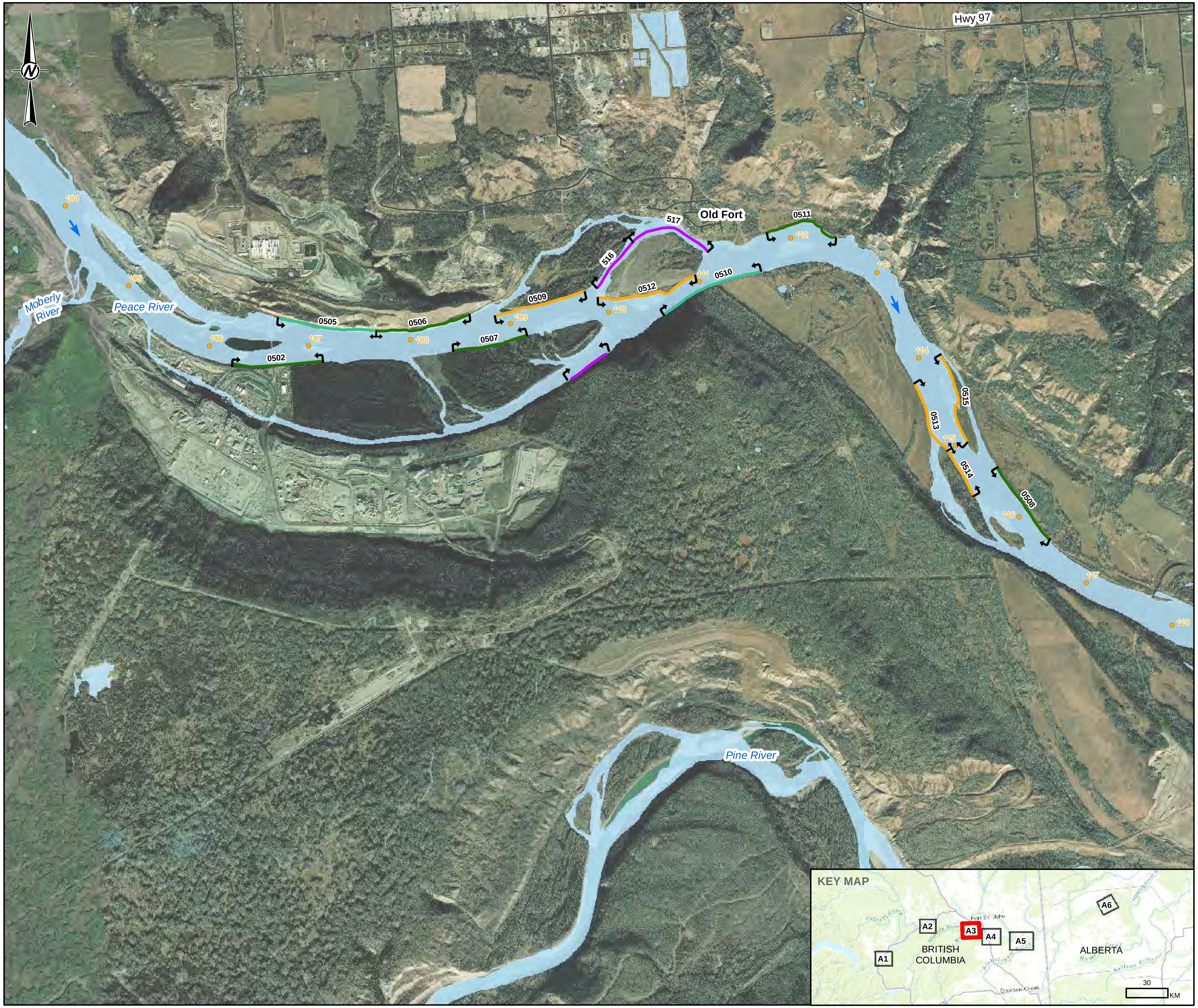
PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 3 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A2



LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION
- A1 WITH PHYSICAL COVER
- A2 WITH PHYSICAL COVER
- A3 WITHOUT PHYSICAL COVER

BASE DATA

- ROAD
- WATERBODY

0 750 1,500

1:40,000 metres

REFERENCES
1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 5 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT

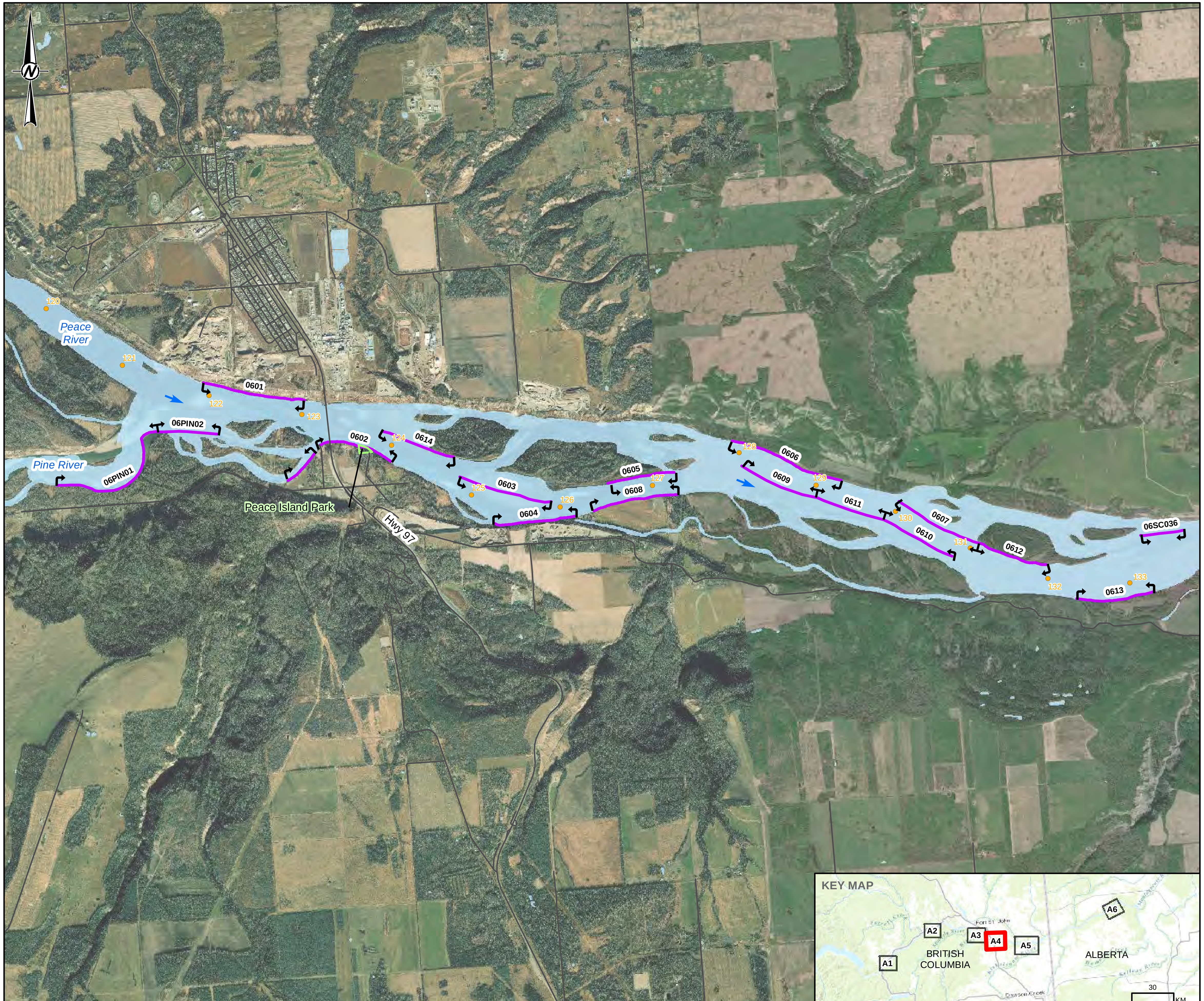
GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0

PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\BC_Hydro\Peace_River_GMS\99_PROJECTS\19121769_PeaceRiver_GMS\02_PRODUCTION\MXD\Report\2019_Peace_Indexing_Report\19121769_FIG_A1_to_A6_PEACE_RIVER_SECTIONS.mxd



LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

- ROAD
- PROVINCIAL PARK AND PROTECTED AREA
- WATERBODY

0 750 1,500

1:45,000 metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 6 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM

FLOW DIRECTION

0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

ROAD

PROVINCIAL PARK AND PROTECTED AREA

WATERBODY

0 750 1,500

1:60,000 metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 7 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

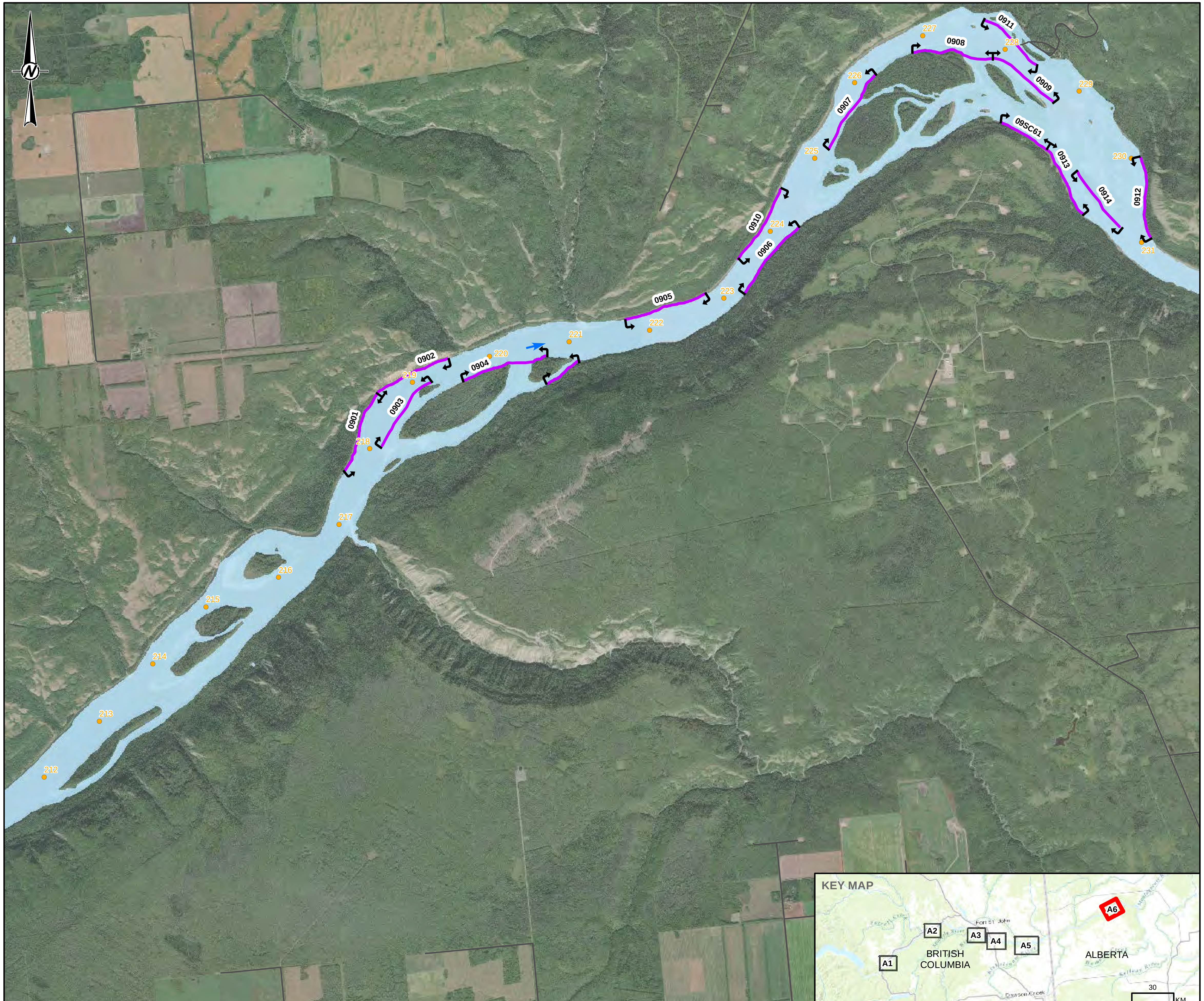
PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A5

PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\BC_Hydro\Peace_River_GMS\99_PROJECTS\19121769_PeaceRiver_GMS\02_PRODUCTION\MXD\Report\2019_Peace_Indexing_Report\19121769_FIG_A1_to_A6_PEACE_RIVER_SECTIONS.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0



LEGEND

RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM

FLOW DIRECTION

0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

ROAD

WATERBODY

0 750 1,500

1:50,000 metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 9 - PEACE RIVER LARGE FISH INDEXING SURVEY (TASK 2A)

CONSULTANT

GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A6

LEGEND

RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM

FLOW DIRECTION

0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

ROAD

PROVINCIAL PARK AND PROTECTED AREA

WATERBODY

0 750 1,500

1:50,000 Metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS

CLIENT

BC HYDRO

PROJECT

PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE

SECTION 7 – PEACE RIVER LARGE FISH INDEXING SUIRVEY (TASK 2A) – GOLDEYE AND WALLEYE SAMPLING SITES

CONSULTANT

GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

- ROAD
- PROVINCIAL PARK AND PROTECTED AREA
- WATERBODY

0 750 1,500

1:50,000 Metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 7 – PEACE RIVER LARGE FISH INDEXING SUIRVEY (TASK 2A) – GOLDEYE AND WALLEYE SAMPLING SITES

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- FLOW DIRECTION
- 0110 BOAT ELECTROSHOCKING SITE

SITE HABITAT CLASSIFICATION

- UNASSIGNED HABITAT CLASSIFICATION

BASE DATA

- ROAD
- WATERBODY

0 750 1,500

1:50,000 Metres

REFERENCES

1. TRANSPORTATION, HYDROLOGY AND TOPOGRPHY LAYERS CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. RAILROAD OBTAINED FROM IHS ENERGY.
3. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
4. DAM SECTION AND ISLANDS OBTAINED FROM FROM GEOBASE®.
5. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS

CLIENT
BC HYDRO

PROJECT
PEACE RIVER FISH COMMUNITY MONITORING PROGRAM (MON-2)

TITLE
SECTION 8 – PEACE RIVER LARGE FISH INDEXING SUIRVEY (TASK 2A) – GOLDEYE AND WALLEYE SAMPLING SITES

CONSULTANT

GOLDER

YYYY-MM-DD	2021-02-01
DESIGNED	DF
PREPARED	CD
REVIEWED	KL
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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APPENDIX B

Historical Datasets

Table B1 Summary of historical datasets by sample section as delineated in Mainstream (2012). The summary is limited to studies that used similar capture techniques (i.e., boat electroshocking) during similar times of the year (i.e., August to October) when compared to the current program.

Year	Study Period	Effort (# of Days)	Section									
			1a	1	2	3	4	5	6	7	8	9
2002	21-Aug to 1-Oct	43		P&E and Gazey 2003	P&E and Gazey 2003	P&E and Gazey 2003	P&E and Gazey 2003					
2003	22-Aug to 2-Oct	48		Mainstream and Gazey 2004	Mainstream and Gazey 2004	Mainstream and Gazey 2004	Mainstream and Gazey 2004					
2004	24-Aug to 6-Oct	36		Mainstream and Gazey 2005		Mainstream and Gazey 2005		Mainstream and Gazey 2005				
2005	17-Aug to 26-Sep	33		Mainstream and Gazey 2006		Mainstream and Gazey 2006		Mainstream and Gazey 2006				
2006	16-Aug to 21-Sep	36		Mainstream and Gazey 2007	Mainstream and Gazey 2007	Mainstream and Gazey 2007						
2007	22-Aug to 24-Sep	30		Mainstream and Gazey 2008		Mainstream and Gazey 2008		Mainstream and Gazey 2008				
2008	20-Aug to 20-Sep	32		Mainstream and Gazey 2009		Mainstream and Gazey 2009		Mainstream and Gazey 2009				
2009	18-Aug to 27-Sep	37	Mainstream 2010a	Mainstream and Gazey 2010; Mainstream 2010a	Mainstream 2010a	Mainstream and Gazey 2010; Mainstream 2010a		Mainstream and Gazey 2010; Mainstream 2010a	Mainstream 2010a	Mainstream 2010a		
2010	24-Aug to 19-Oct	40	Mainstream 2011a	Mainstream and Gazey 2011; Mainstream 2011a	Mainstream 2011a	Mainstream and Gazey 2011; Mainstream 2011a		Mainstream and Gazey 2011; Mainstream 2011a	Mainstream 2011a	Mainstream 2011a	Mainstream 2011a	
2011	24-Aug to 19-Oct	37	Mainstream 2013a	Mainstream and Gazey 2012; Mainstream 2013a	Mainstream 2013a	Mainstream and Gazey 2012; Mainstream 2013a		Mainstream and Gazey 2012; Mainstream 2013a	Mainstream 2013a	Mainstream 2013a	Mainstream 2013a	Mainstream 2013a
2012	23-Aug to 21-Sep	30		Mainstream and Gazey 2013		Mainstream and Gazey 2013		Mainstream and Gazey 2013				
2013	24-Aug to 26-Sep	30		Mainstream and Gazey 2014		Mainstream and Gazey 2014		Mainstream and Gazey 2014				
2014	25-Aug to 4-Oct	35		Golder and Gazey 2015		Golder and Gazey 2015		Golder and Gazey 2015				
2015	25-Aug to 7-Oct	39		Golder and Gazey 2016		Golder and Gazey 2016		Golder and Gazey 2016	Golder and Gazey 2016	Golder and Gazey 2016		Golder and Gazey 2016
2016	23-Aug to 1-Oct	39		Golder and Gazey 2017		Golder and Gazey 2017		Golder and Gazey 2017	Golder and Gazey 2017	Golder and Gazey 2017		Golder and Gazey 2017
2017	21-Aug to 4-Oct	39		Golder and Gazey 2018		Golder and Gazey 2018		Golder and Gazey 2018	Golder and Gazey 2018	Golder and Gazey 2018		Golder and Gazey 2018
2018	27-Aug to 10-Oct	41		Golder and Gazey 2019		Golder and Gazey 2019		Golder and Gazey 2019	Golder and Gazey 2019	Golder and Gazey 2019		Golder and Gazey 2019
2019	20-Aug to 14-Oct	56		Current Study Year		Current Study Year		Current Study Year	Current Study Year	Current Study Year		Current Study Year

APPENDIX C

Discharge and Temperature

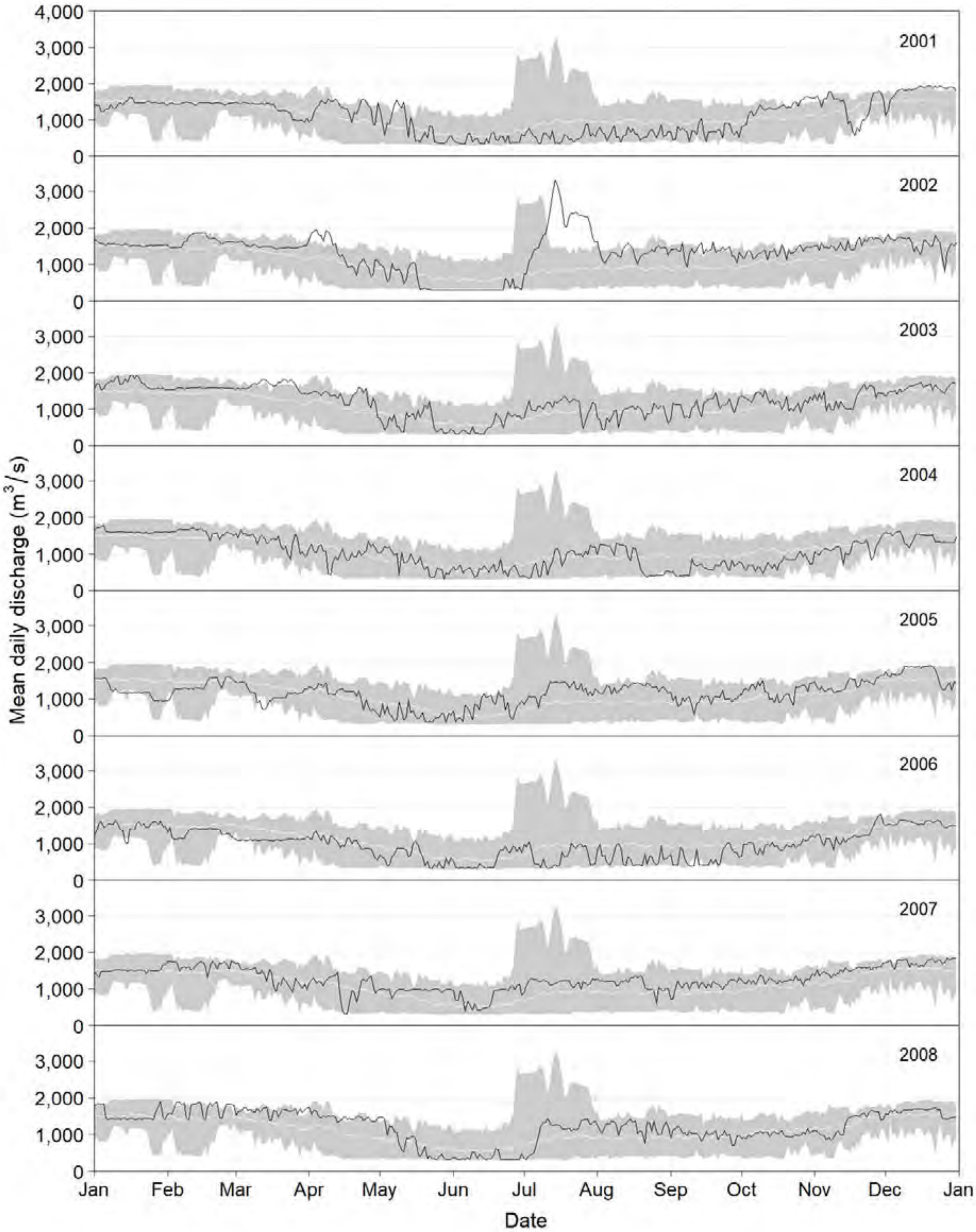

Figure C1: Mean daily discharge (m³/s) for the Peace River at Peace Canyon Dam (PCD; black line), 2001 to 2019. The shaded area represents minimum and maximum mean daily discharge recorded at PCD during other study years between 2001 and 2018. The white line represents average mean daily discharge over the same time period.

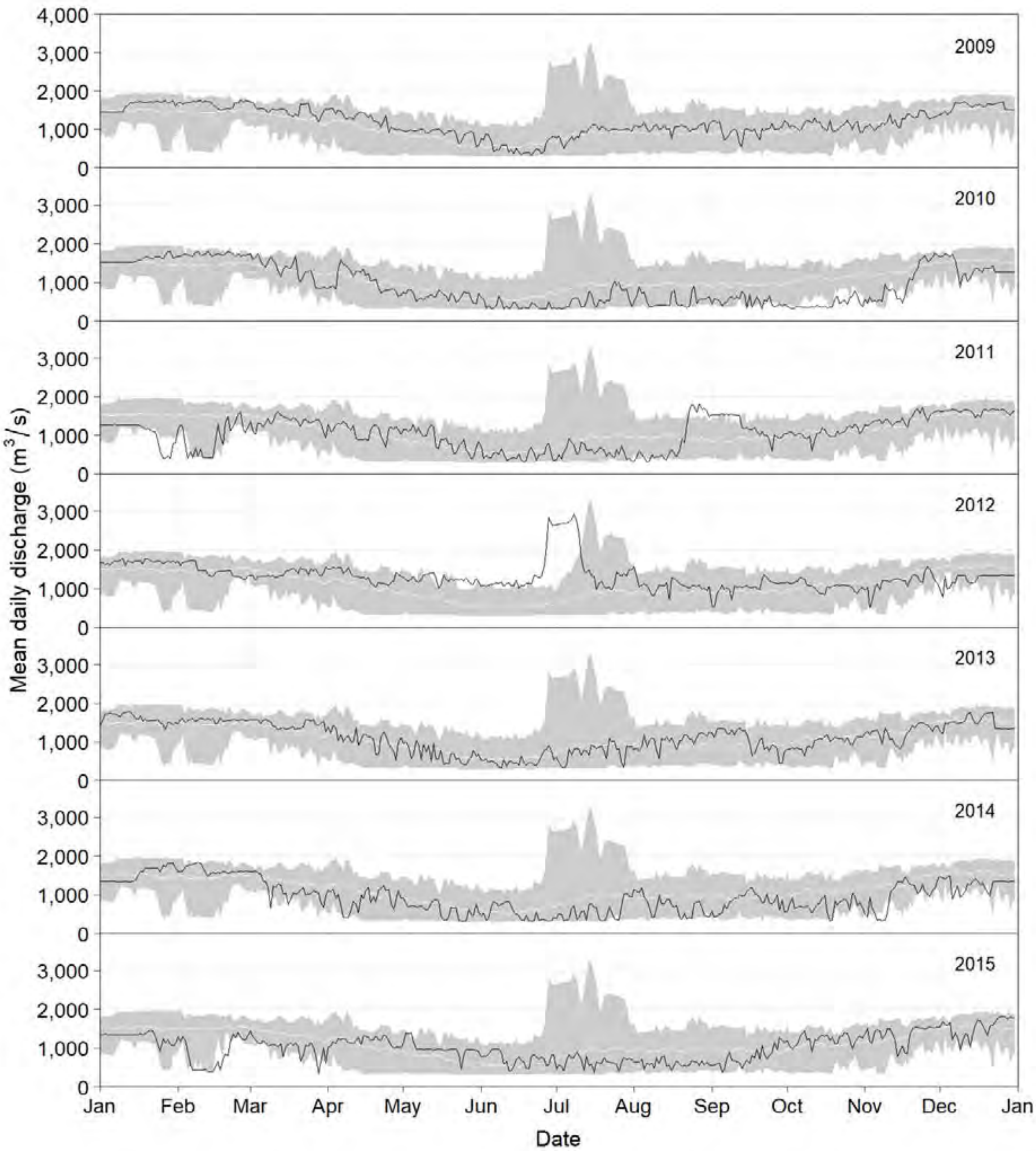

Figure C1: **Continued.**

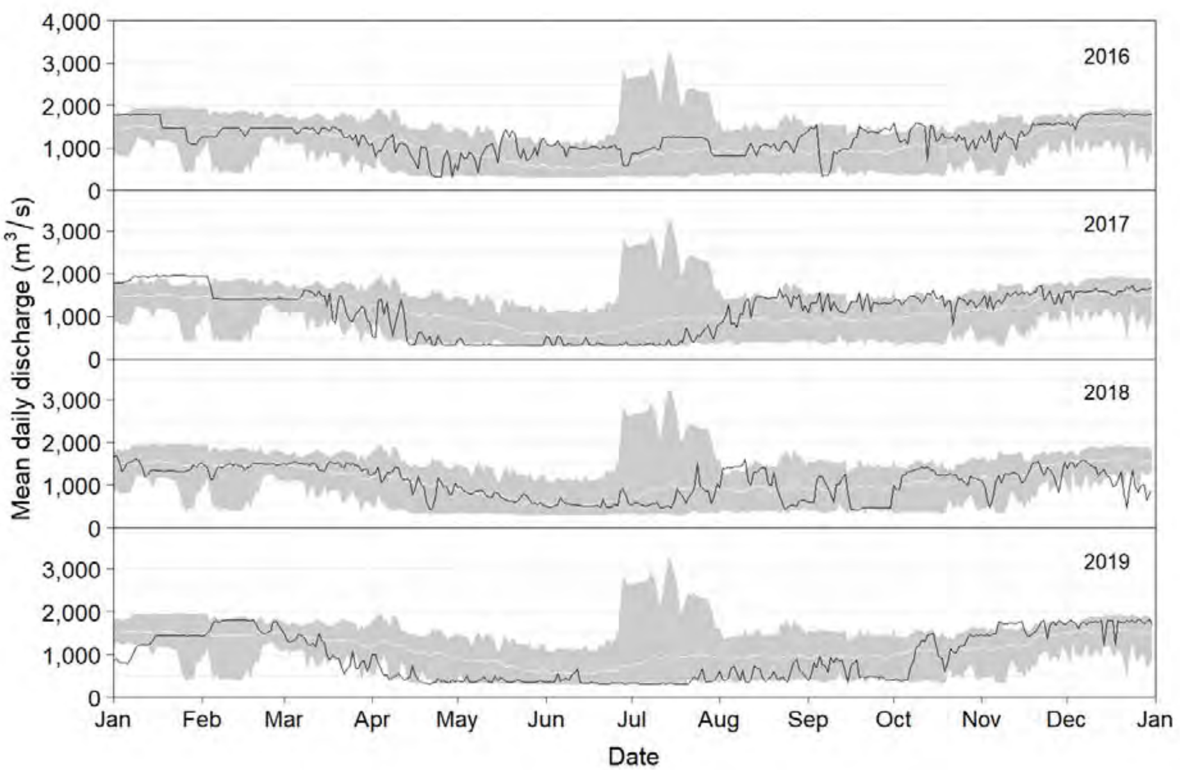

Figure C1: **Concluded.**

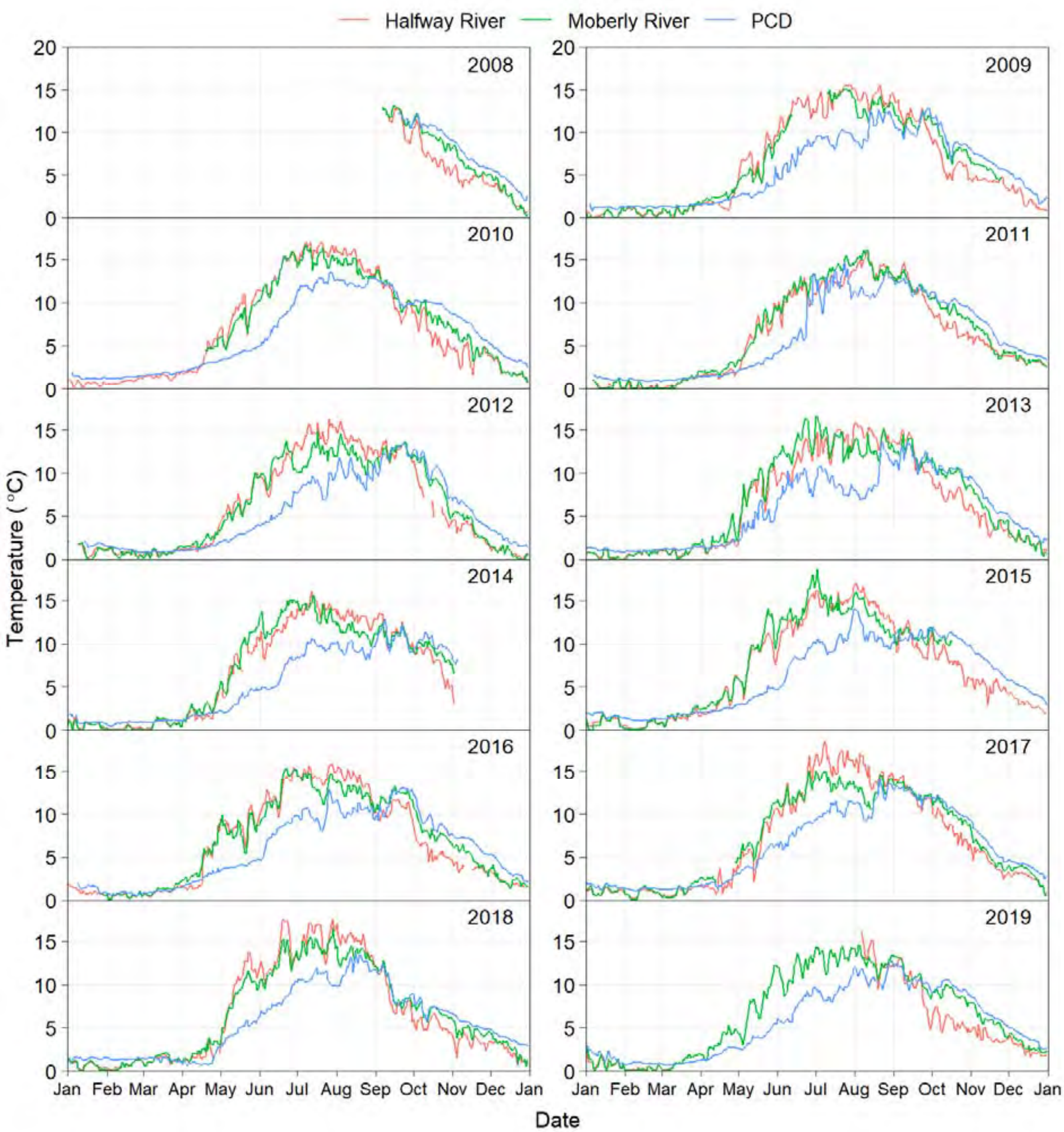

Figure C2: Mean daily water temperatures (°C) for the Peace River downstream of Peace Canyon Dam (PCD; blue line), downstream of the Halfway River confluence (red line) and downstream of the Moberly River confluence (green line), 2008 to 2019. Data were collected under the Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9).

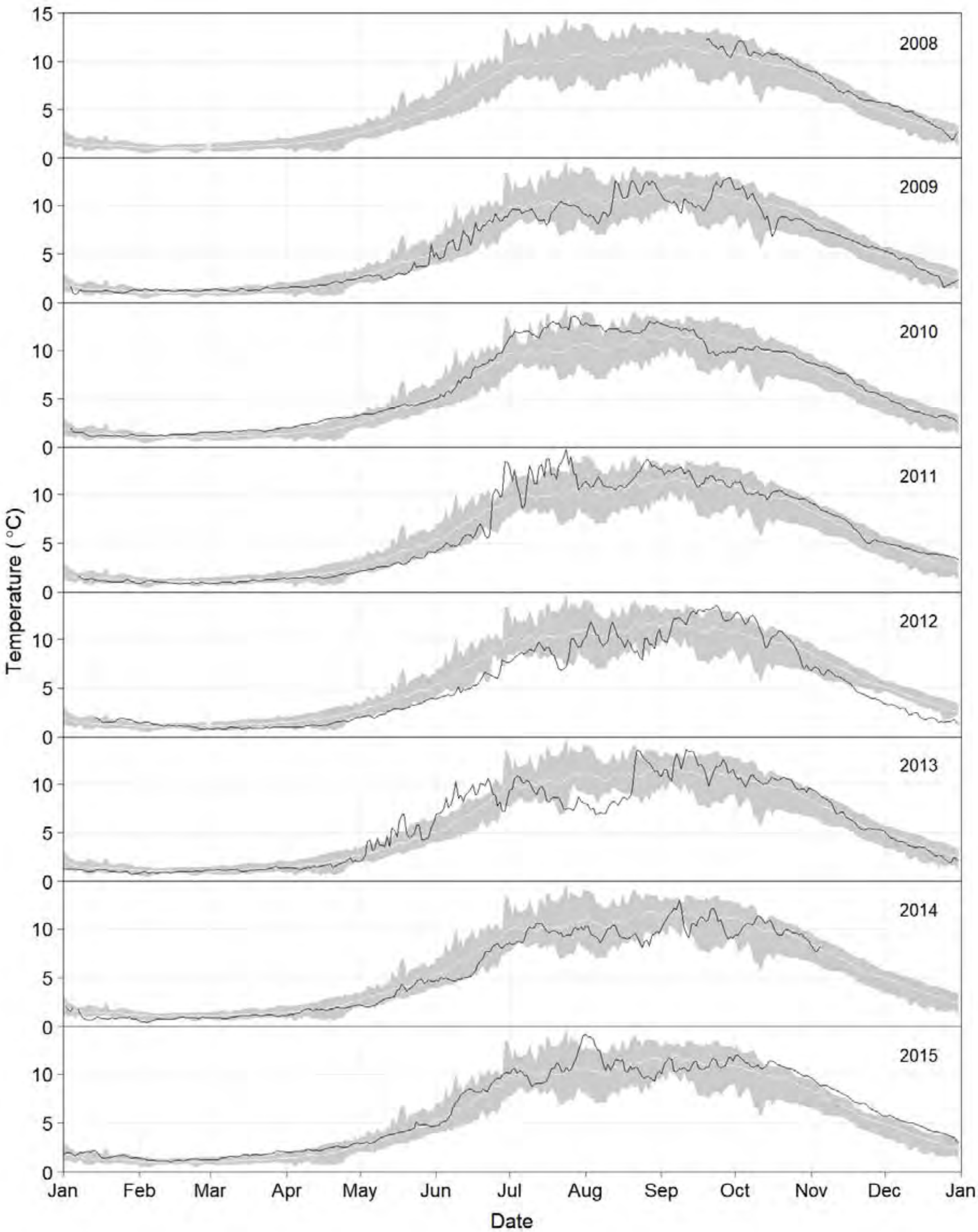

Figure C3: Mean daily water temperature (°C) for the Peace River at Peace Canyon Dam (PCD; black line), 2008 to 2019. The shaded area represents minimum and maximum water temperatures recorded at PCD during other study years between 2008 and 2018. The white line represents average mean daily water temperatures over the same time period. Data were collected under the Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9).

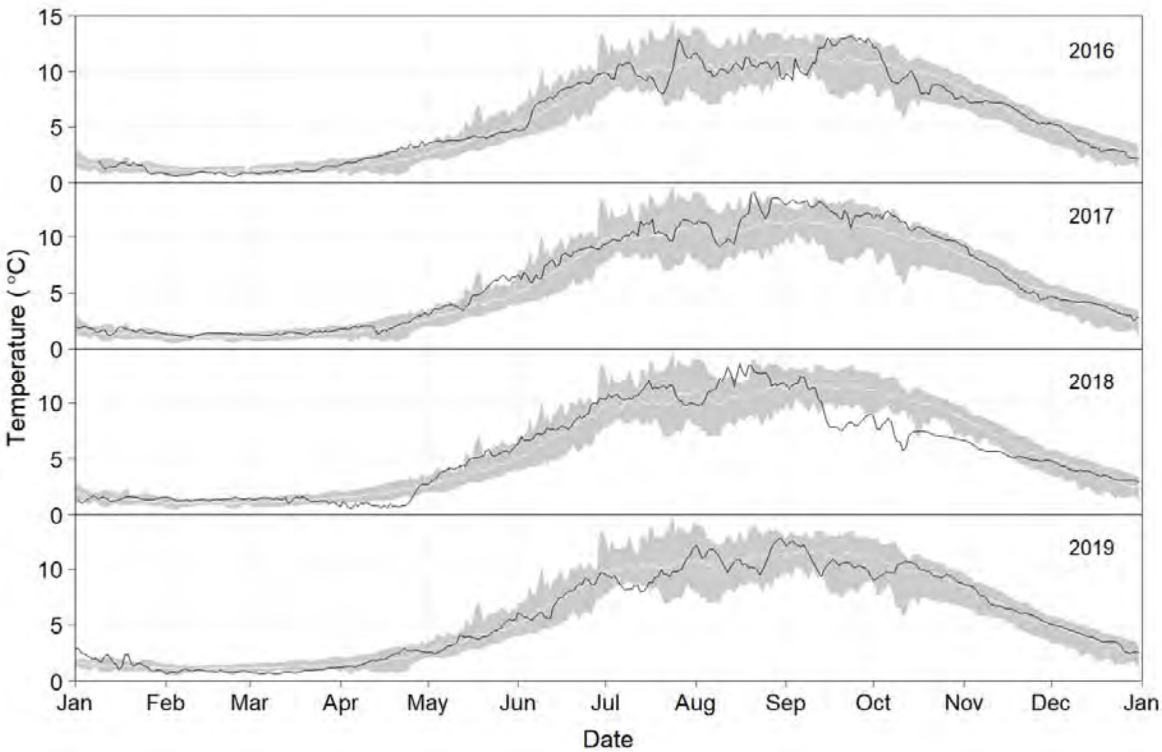

Figure C3: Concluded.

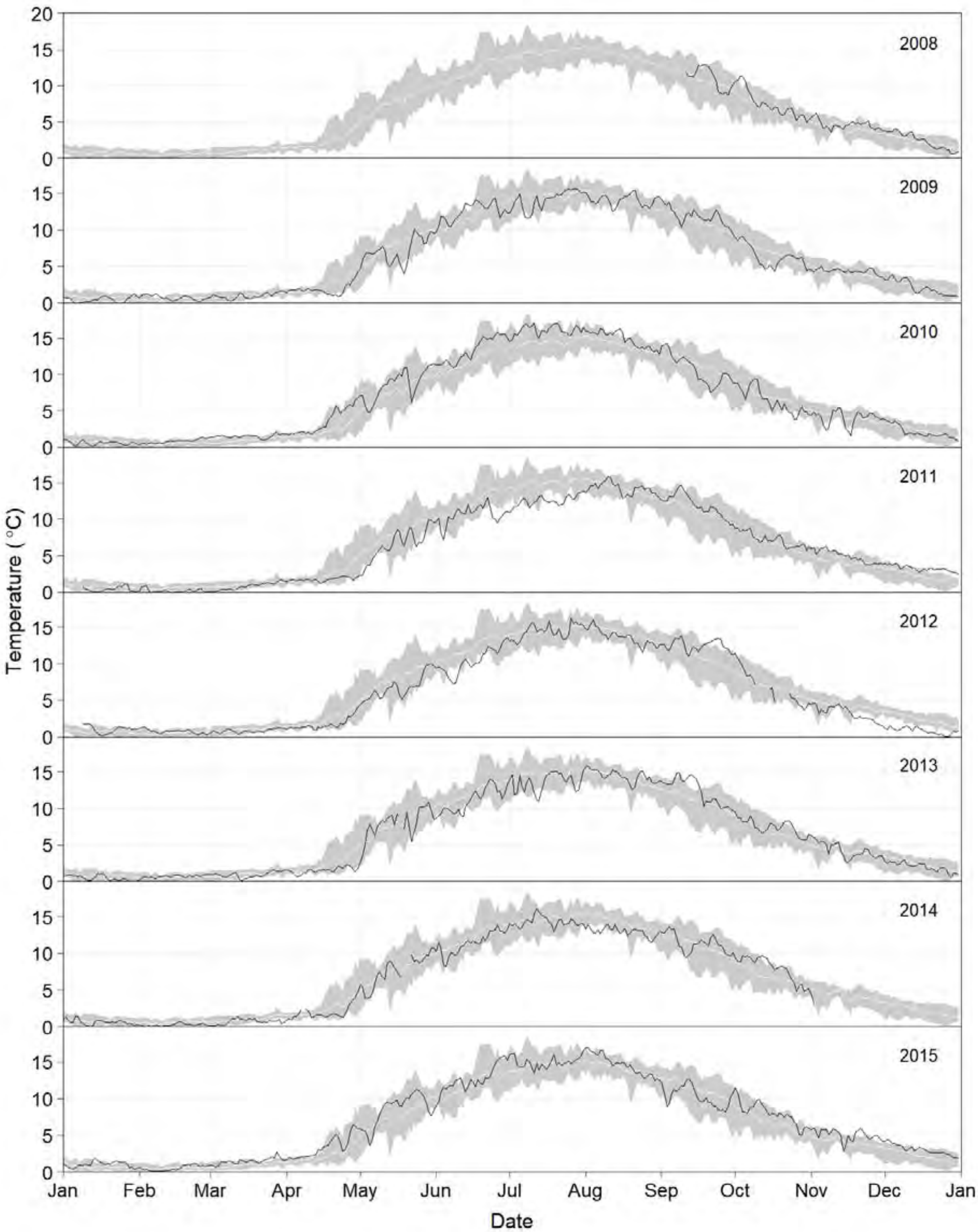

Figure C4: Mean daily water temperature (°C) for the Peace River downstream of the Halfway River confluence (black line), 2008 to 2019. The shaded area represents minimum and maximum water temperatures recorded at the site during other study years between 2008 and 2018. The white line represents average mean daily water temperatures over the same time period. Data were collected under the Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9).

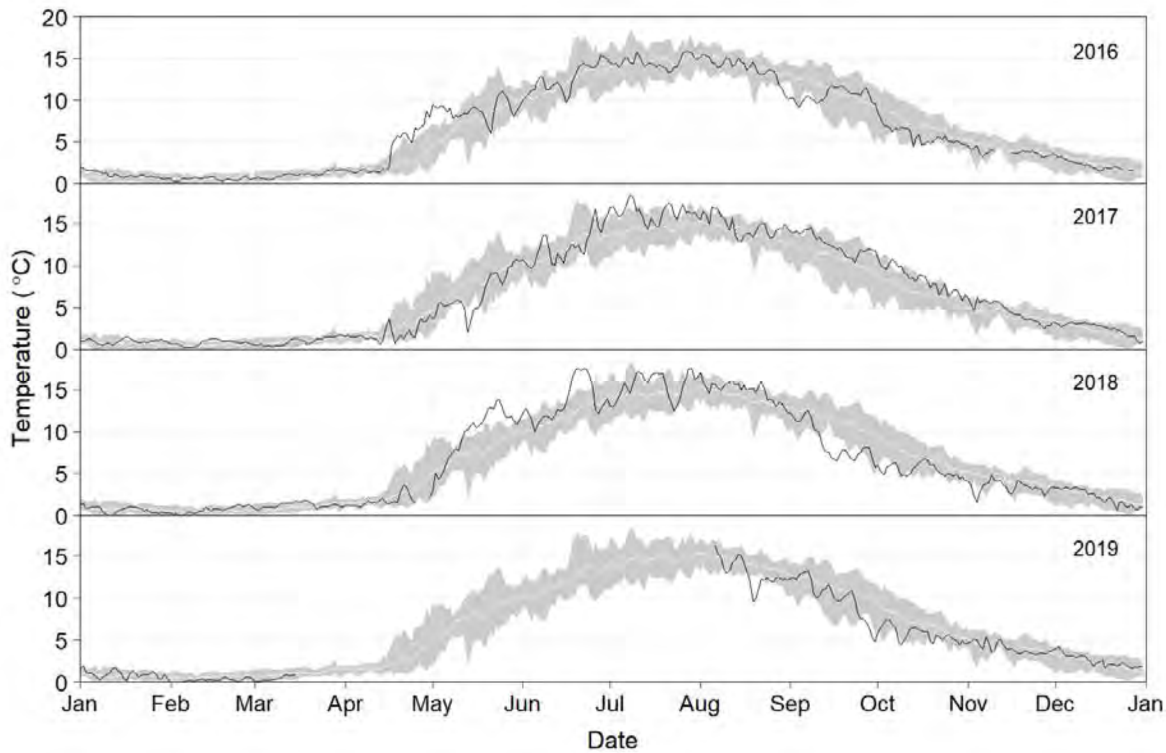

Figure C4: Concluded.

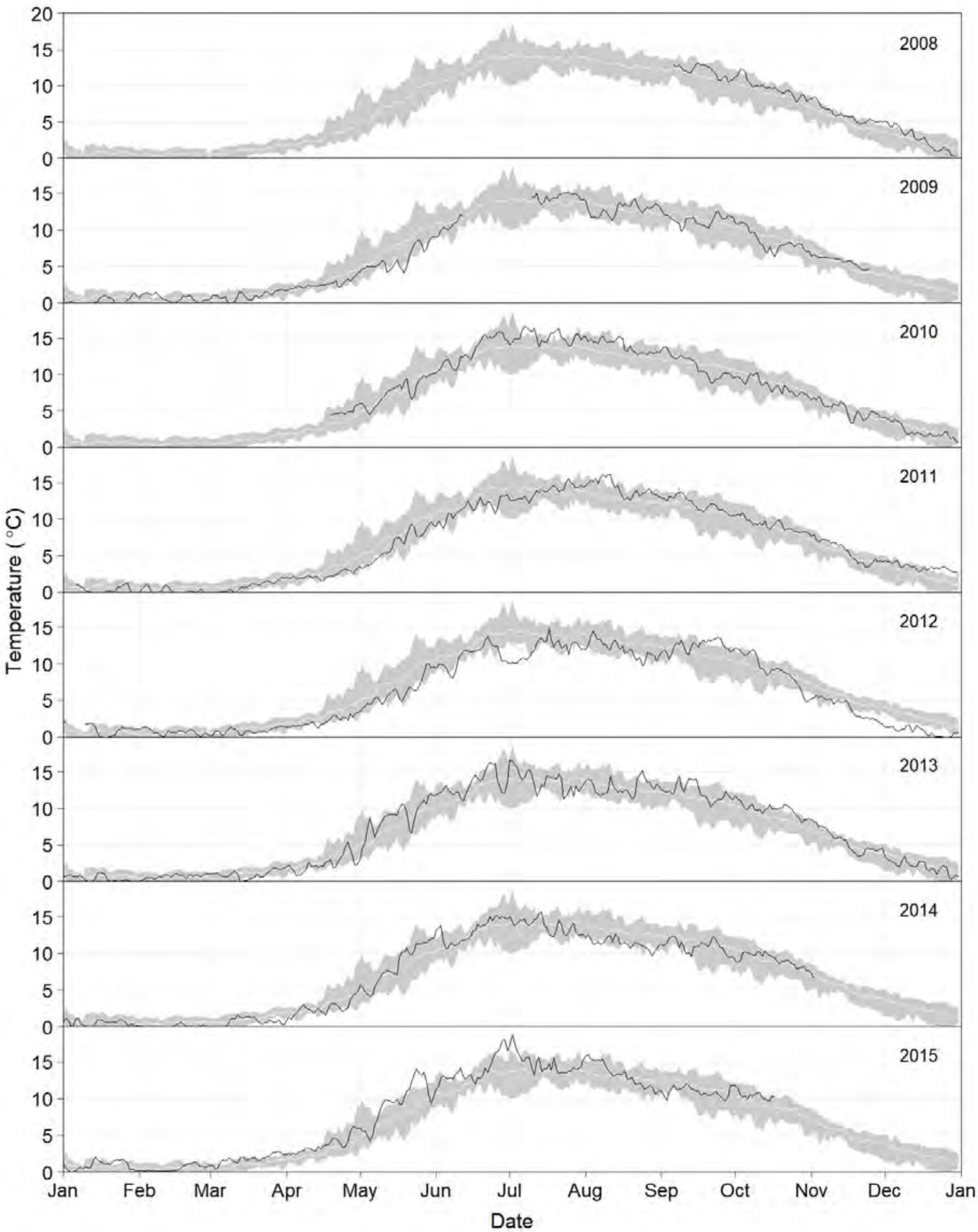

Figure C5: Mean daily water temperature (°C) for the Peace River downstream of the Moberly River confluence (black line), 2008 to 2019. The shaded area represents minimum and maximum water temperatures recorded at the site during other study years between 2008 and 2018. The white line represents average mean daily water temperatures over the same time period. Data were collected under the Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9).

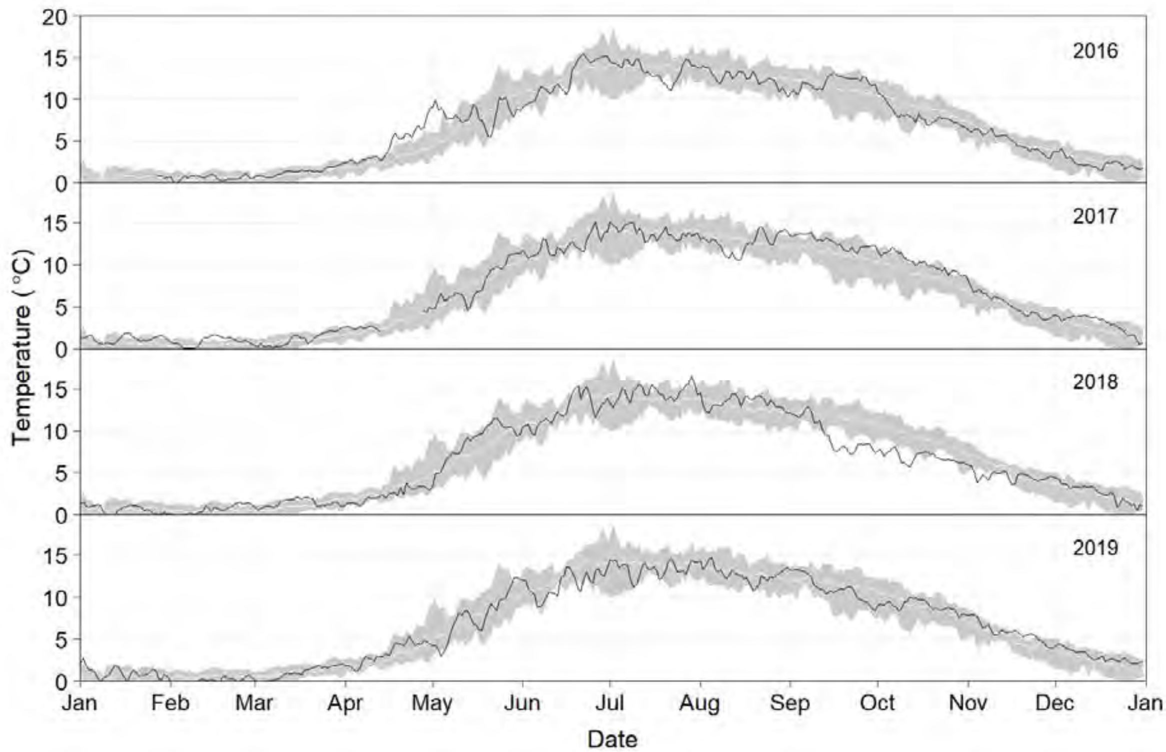

Figure C5: Concluded

APPENDIX D

Habitat Data

Table D1 Lengths of boat electroshocking sites by habitat type in the Peace River, 2019. Bank habitat data were not available for Sections 6, 7, or 9.

Section	Site[a]	Length (m) of Site			Total Length (m)
		A1[b]	A2[b]	A3[b]	
1	0101			600	**600**
	0102			975	**975**
	0103	1200			**1200**
	0104			500	**500**
	0105		1100		**1100**
	0107	550			**550**
	0108			850	**850**
	0109			975	**975**
	0110	650			**650**
	0111	1000			**1000**
	0112	1070			**1070**
	0113		750		**750**
	0114		950		**950**
	0116			985	**985**
	0119	750			**750**
Section 1 Total		**5220**	**2800**	**4885**	**12905**
3	0301		1800		**1800**
	0302		1900		**1900**
	0303		1450		**1450**
	0304		1350		**1350**
	0305		1550		**1550**
	0306			1000	**1000**
	0307			950	**950**
	0308			1350	**1350**
	0309			950	**950**
	0310			1200	**1200**
	0311			1250	**1250**
	0312		1170		**1170**
	0314		975		**975**
	0315			1700	**1700**
	0316		1475		**1475**
Section 3 Total		**0**	**11670**	**8400**	**20070**
5	0502		950		**950**
	0505	1000			**1000**
	0506		1000		**1000**
	0507		780		**780**
	0508		925		**925**
	0509			975	**975**
	0510	1130			**1130**
	0511		720		**720**
	0512			1280	**1280**
	0513			770	**770**
	0514			560	**560**
	0515			970	**970**
	0516		800		**800**
	0517		700		**700**
	05SC060	530			**530**
Section 5 Total		**2660**	**5875**	**4555**	**13090**
Grand Total		**7880**	**20345**	**17840**	**46065**

[a] See Appendix A, Figures A1 to A3 for sample site locations.

[b] Bank Habitat Type as assigned by R.L.&L. (2001). See Appendix D, Table D2 for a description of each bank habitat type.

Table D2 Descriptions of categories used in the Bank Habitat Types Classification System as summarized from R.L.&L. (2001).

Category	Code	Description
Armoured/Stable	A1	Banks generally stable and at repose with cobble/small boulder/gravel substrates predominating; uniform shoreline configuration with few/minor bank irregularities; velocities adjacent to bank generally low-moderate, instream cover limited to substrate roughness (i.e., cobble/small boulder interstices).
	A2	Banks generally stable and at repose with cobble/small boulder and large boulder substrates predominating; irregular shoreline configuration generally consisting of a series of armoured cobble/boulder outcrops that produce Backwater habitats; velocities adjacent to bank generally moderate with low velocities provided in BW habitats: instream cover provided by BW areas and substrate roughness; overhead cover provided by depth and woody debris; occasionally associated with C2, E4, and E5 banks.
	A3	Similar to A2 in terms of bank configuration and composition although generally with higher composition of large boulders/bedrock fractures; very irregular shoreline produced by large boulders and bed rock outcrops; velocities adjacent to bank generally moderate to high; instream cover provided by numerous small BW areas, eddy pools behind submerged boulders, and substrate interstices; overhead cover provided by depth; exhibits greater depths offshore than found in A1 or A2 banks; often associated with C1 banks.
	A4	Gently sloping banks with predominantly small and large boulders (boulder garden) often embedded in finer materials; shallow depths offshore, generally exhibits moderate to high velocities; instream cover provided by "pocket eddies" behind boulders; overhead cover provided by surface turbulence.
	A5	Bedrock banks, generally steep in profile resulting in deep water immediately offshore; often with large bedrock fractures in channel that provide instream cover; usually associated with moderate to high current velocities; overhead cover provided by depth.
	A6	Man-made banks usually armoured with large boulder or concrete rip-rap; depths offshore generally deep and usually found in areas with moderate to high velocities; instream cover provided by rip-rap interstices; overhead cover provided by depth and turbulence.
Depositional	D1	Low relief, gently sloping bank type with shallow water depths offshore; substrate consists predominantly of fines (i.e., sand/silt); low current velocities offshore; instream cover generally absent or, if present, consisting of shallow depressions produced by dune formation (i.e., in sand substrates) or embedded cobble/boulders and vegetative debris; this bank type was generally associated with bar formations or large backwater areas.
	D2	Low relief, gently sloping bank type with shallow water depths offshore; substrate consists of coarse materials (i.e., gravels/cobbles); low-moderate current velocities offshore; areas with higher velocities usually producing riffle areas; overhead cover provided by surface turbulence in riffle areas; instream cover provided by substrate roughness; often associated with bar formations and shoal habitat.
	D3	Similar to D2 but with coarser substrates (i.e., large cobble/small boulder) more dominant; boulders often embedded in cobble/gravel matrix; generally found in areas with higher average flow velocities than D1 or D2 banks; instream cover abundantly available in form of substrate roughness; overhead cover provided by surface turbulence; often associated with fast riffle transitional bank type that exhibits characteristics of both Armoured and Depositional bank types.
SPECIAL HABITAT FEATURES		
BACKWATER POOLS	-	These areas represent discrete areas along the channel margin where backwater irregularities produce localized areas of counter-current flows or areas with reduced flow velocities relative to the mainstem; can be quite variable in size and are often an integral component of Armoured and erosional bank types. The availability and suitability of Backwater pools are determined by flow level. To warrant separate identification as a discrete unit, must be a minimum of 10 m in length; widths highly variable depending on bank irregularity that produces the pool. Three classes are identified:
	BW-P1	Highest quality pool habitat type for adult and subadult cohorts for feeding/holding functions. Maximum depth exceeding 2.5 m, average depth 2.0 m or greater; high availability of instream cover types (e.g., submerged boulders, bedrock fractures, depth, woody debris); usually with Moderate to High countercurrent flows that provide overhead cover in the form of surface turbulence.
	BW-P2	Moderate quality pool type for adult and subadult cohorts for feeding/holding; also provides moderate quality habitat for smaller juveniles for rearing. Maximum depths between 2.0 to 2.5 m, average depths generally in order of 1.5 m. Moderate availability of instream cover types; usually with Low to Moderate countercurrent flow velocities that provide limited overhead cover.

Continued.

Table D2 Concluded.

	BW-P3	Low quality pool type for adult/subadult classes; moderate-high quality habitat for y-o-y and small juveniles for rearing. Maximum depth <1.0 m. Low availability of instream cover types; usually with Low-Nil current velocities.
EDDY POOL	EDDY	Represent large (<30 m in diameter) areas of counter current flows with depths generally >5 m; produced by major bank irregularities and are available at all flow stages although current velocities within eddy are dependent on flow levels. High quality areas for adult and subadult life stages. High availability of instream cover.
SNYE	SN	A side channel area that is separated from the mainstem at the upstream end but retains a connection at the lower end. SN habitats generally present only at lower flow stages since area is a flowing side channel at higher flows: characterized by low-nil velocity, variable depths (generally <3 m) and predominantly depositional substrates (i.e., sand/silt/gravel); often supports growths of aquatic vegetation; very important areas for rearing and feeding.

Velocity Classifications:

Low: <0.5 m/s
Moderate: 0.5 to 1.0 m/s
High: >1.0 m/s

Table D3 Summary of habitat variables recorded at boat electroshocking sites in the Peace River, 20 August to 14 October 2019.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
1	119	1	17		130		Medium	Medium	1.2	20		5			65	10	0
1	119	2	17	11.8	160	Partly cloudy	Medium	Medium	n/a	70		5			10	15	0
1	119	3	15	9.4	160	Partly cloudy	Low		n/a	60		20				20	0
1	119	4	14	9.5		Overcast	Medium	Medium	n/a	30					40	30	0
1	119	5	0	8.8	150		Medium	Medium	n/a	40					20	40	0
1	119	6	0	9.2	170	Clear		Medium	2	20	10				30	40	0
1	116	1	18	10.7	150	Clear	High	Low	0.8	20		20			60		0
1	116	2	17	11.6	160	Mostly cloudy	Medium	Medium	2.3	15		5		20	60		0
1	116	3	14	9.3	160	Partly cloudy	Medium	High	n/a	50					50		0
1	116	4	12	9.1	160	Mostly cloudy	Medium	Medium	2	30					70		0
1	116	5	8	10.1	150	Clear	High	Medium	n/a	40					60		0
1	116	6	3	9.7	170	Mostly cloudy	High	Medium	2	20				20	40	20	0
1	114	1	14	10.0	160		Medium	Medium	1.4	60				2	18	20	0
1	114	2	18	11.6	160	Mostly cloudy	Medium	Medium	2.3	20	5	20		15	20	20	0
1	114	3	10			Mostly cloudy			n/a	50					25	25	0
1	114	4	14	9.8	160	Partly cloudy	Medium	Medium	n/a	20					80		0
1	114	5	10	9.5	150	Clear	High	Medium	n/a	40					60		0
1	114	6	0	9.3	170	Mostly cloudy	High	Medium	2	40				20	40		0
1	113	1	16		160	Partly cloudy	Medium	Medium	1.1	30		2		5	63		0
1	113	2	18	12.6	160	Overcast	Medium	Medium	n/a	65					30	5	0
1	113	3	12	9.0	160	Partly cloudy	Medium	High	n/a	50					50		0
1	113	4	11	9.2	160	Overcast	Medium	Medium	n/a	40		10			50		0
1	113	5	8	10.1	150	Clear	High	Medium	n/a	40					60		0
1	113	6	3	9.7	170	Overcast	High	Medium	2	20				20	60		0
1	112	1	15	11.0	160	Clear	Medium	Medium	1.7	50					40	10	0
1	112	2	18	11.8	160	Mostly cloudy	Medium	Medium	2.2	33		33			15	15	4
1	112	3	13	8.8	230	Mostly cloudy	Medium	Medium	2.5	40					60		0
1	112	4	14	9.8	160	Mostly cloudy	Medium	Medium	n/a	75					15	10	0
1	112	5	10	9.5	150	Clear	High	Medium	n/a	40					60		0
1	112	6	2	9.6	170	Clear	High	Medium	2	20				20	40	20	0
1	111	1	15	10.2	160	Clear	Medium	Medium	1.7	25					65	10	0
1	111	2	17	11.6	160	Overcast	Medium	Low	1.8	35					60	5	0
1	111	3	9	7.9	220	Mostly cloudy		Low	n/a	50					50		0
1	111	4	13	9.3	160	Mostly cloudy	Medium	Low	2	15					70	15	0
1	111	6	2	9.6	170	Clear	High	Medium	2	15	10	5		10	20	40	0
1	110	1	17		130	Mostly cloudy	Medium	Medium	1.2	50					45	5	0
1	110	2	20	12.2	160	Mostly cloudy	Medium	Low	n/a	70					30		0
1	110	3	16	9.3	160	Partly cloudy	Medium	High	n/a	40		20				40	0
1	110	4	12	9.2	160	Mostly cloudy		Medium	n/a	40					50	10	0
1	110	5	4	9.1	150	Clear		Medium	n/a	20					60	20	0
1	110	6	2	9.2	170	Clear	Medium	Medium	2	20			30		30	20	0
1	109	1	20	11.8	130	Mostly cloudy	Medium	Medium	1.2	50					50		0
1	109	2	20	13.0	160	Partly cloudy	Medium	Medium	2.3	50					50		0
1	109	3	11	8.6	160	Mostly cloudy		Medium	n/a	50					50		0
1	109	4	14	10.5	150	Mostly cloudy	Medium	Medium	n/a	30					50	20	0
1	109	5	5	9.3	150	Clear	High	Medium	n/a	40					60		0
1	109	6	2	9.5	170		High	Medium	2	30				10	40	20	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.

[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.

[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.

[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
1	108	1	17	9.5	130	Mostly cloudy	Medium	Medium	1.2	50					50		0
1	108	2	21	13.0	160	Partly cloudy	High	Low	n/a	10					90		0
1	108	3	10	8.5	160	Mostly cloudy	Medium	Medium	n/a	50					50		0
1	108	4	14	9.6	150	Mostly cloudy	Medium	Medium	n/a	30					70		0
1	108	5	5	9.1	150	Clear	High	Medium	n/a	20					80		0
1	108	6	2	9.5	170	Clear	High	Medium	2	20				10	70		0
1	107	1	15	8.8	160	Mostly cloudy	Medium	Medium	1.2	50					50		0
1	107	2	20	11.7	160	Partly cloudy	High	Low	n/a	55					5	40	0
1	107	3	16	9.3	160	Partly cloudy	Medium	High	n/a	60		20				20	0
1	107	4	10	9.6	150	Overcast	High	Medium	n/a	40					20	40	0
1	107	5	4	8.8	150	Clear	High	Low	n/a						70	30	0
1	107	6	2	9.2	170	Clear	Medium	Medium	2	20					20	60	0
1	105	1	16	10.3	160	Mostly cloudy	Medium	High	1.7	50	1	5			44		0
1	105	2	17	11.6	160	Mostly cloudy	Medium	High	2.3	33		33			33		1
1	105	3	18	8.0	160	Partly cloudy	Medium	High	n/a	40		20			40		0
1	105	6	-3	9.2	170	Clear	Medium	Medium	2	20		30			50		0
1	104	1	16	10.2	160	Partly cloudy	Medium	Medium	1.7	20				10	70		0
1	104	2	17	11.5	160	Mostly cloudy	Medium	Low	2.3	60					30	10	0
1	104	3	19	8.2	160	Partly cloudy	High	Medium	n/a	20			30		40	10	0
1	104	6	-2	9.2	170	Clear	Medium	Medium	2				30		30	40	0
1	103	1	18	10.2	150	Mostly cloudy	High	Low	0.9	4	1	35			60		0
1	103	2	15	11.3	160	Mostly cloudy	Medium	Medium	2.5	45	5	5			40	5	0
1	103	3	17	8.3	160	Clear	Medium	High	2.4	30	5	20			40	5	0
1	103	6	-5	9.1	170	Clear	Medium	Medium	2	30		20			30	20	0
1	102	1	15	9.8	150	Partly cloudy	Medium	High	0.9	10		40			50		0
1	102	2	15	11.2	160	Clear	Low	High	n/a	30		35			10	25	0
1	102	3	16			Mostly cloudy	Medium	High	n/a	40		30			30		0
1	102	4	12	9.4	150	Overcast	Low	High	n/a	40		20			40		0
1	102	5	0	8.8	150	Clear	Low	High	n/a	40		40			20		0
1	102	6	0	9.2	170	Clear	Low	High	2	20		40			40		0
1	101	1	13	9.8	150	Clear	Medium	High	0.9			50			50		0
1	101	2	15	11.2	160			High	2.5	33		33			33		1
1	101	3	20	8.5	160	Partly cloudy		High	n/a	20		40			40		0
1	101	4	13	9.3	150	Partly cloudy	Low	High	n/a	30		30			40		0
1	101	5	-2	8.8	150	Clear	Low	High	n/a	30		30			40		0
1	101	6	0	9.2	170	Clear	Low	High	2	20		40			40		0
3	316	1	20	11.8	200	Partly cloudy	Medium	Medium	0.3	20		10			15	15	40
3	316	2	15	10.7	170	Overcast	Medium	Medium	0.7	50		40			5	5	0
3	316	3	14	9.8	220	Partly cloudy	Medium	Medium	0.4	30		10			40	20	0
3	316	4	12	8.7	190	Overcast	Medium	Medium	1	33		33			33		1
3	316	5	5	8.3	170	Overcast	High	Medium	1.1	75					20	5	0
3	316	6	9	10.5	160	Clear	High	High	0.7	50	5	5			20	20	0
3	315	1	17	11.1	200	Partly cloudy	Medium	Medium	0.3	20					65	15	0
3	315	2	15	10.5	170	Overcast	Medium	Medium	0.7	60	10				10	20	0
3	315	3	10	9.1	220	Partly cloudy		High	2.2	60					20	20	0
3	315	4	9	7.8	300	Overcast	Medium	Medium	1.5	60					40		0
3	315	5	4	7.9	170	Overcast	High	Medium	1.1	80					10	10	0
3	315	6	7	9.7	160	Clear		High	0.7	10	10			10	20	50	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.

[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.

[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.

[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
3	314	1	16	10.7	180	Partly cloudy		Medium	0.8	30					40	30	0
3	314	2	12	10.5		Overcast	Medium	Medium	0.7	50					25	25	0
3	314	3	10	8.9	220	Partly cloudy	Medium	Medium	0.4	10	5				10		75
3	314	4	10	8.8	310	Overcast	Medium	Low	0.5						70		30
3	314	5	2	7.9	170	Overcast	High	Medium	1.1	60					20	20	0
3	314	6	5	9.5	160	Clear	High	Medium	0.7	30				10	20	40	0
3	312	1	17	10.7	260		Medium	Low	0.3						30	5	65
3	312	2	8	11.7	310	Overcast	Medium	Medium	0.6	30					40	30	0
3	312	3	18	10.5	240	Mostly cloudy	High	Medium	0.2	20					20	10	50
3	312	4	8	7.8	300	Overcast	High	Medium	0.6	50					50		0
3	312	5	15	7.1	260	Clear		Medium	0.4	15		5			80		0
3	312	6	9	9.7	160	Clear	High	High	0.6	30				20	20	30	0
3	311	1	18	11.9	120	Partly cloudy	Medium	Medium	0.2					20			80
3	311	2	17	11.7	300	Overcast	Medium	Medium	0.4	33					33		34
3	311	3	20	10.2	260	Partly cloudy	High	Medium	0.2		5				35	10	50
3	311	4	4	7.7	300	Mostly cloudy		Medium	0.6						50		50
3	311	5	5	6.2	260	Clear	High	Medium	0.4	30					70		0
3	311	6	7	8.1	230	Clear		High	0.6	30				10	10	30	20
3	310	1	12	10.5	210	Fog	Medium	Medium	0.5	80		5			10	5	0
3	310	2	15	9.7	230	Overcast	Medium	Medium	0.3							10	90
3	310	3	12	9.4	270	Partly cloudy	Medium	Medium	0.2						45	15	40
3	310	4	8	8.0	300	Overcast	High	Low	0.6	25		5			50		20
3	310	5	6	8.3	170	Overcast	High	Medium	0.6	20		10			70		0
3	310	6	7	10.5	160	Clear	High	High	0.9	50	5			10	30	5	0
3	309	1	14	10.7	210		High	Medium	0.5	55					20	25	0
3	309	2	9	10.6	290	Overcast	High	Medium	0.1	50				10	40		0
3	309	3	10	9.1	270	Partly cloudy	High	Low	2.2						45	5	50
3	309	4	6	8.0	300	Mostly cloudy	High	Low	0.6	20	5	5			40		30
3	309	5	12	7.1	260	Clear	Low	Low	0.4						90	10	0
3	309	6	7	8.0	160	Clear	Medium	High	0.9	40				15	40	5	0
3	308	1	17	11.1	200	Partly cloudy		Medium	0.3						25	5	70
3	308	2	8	9.7	290	Overcast	High	Medium	0.1	50					50		0
3	308	3	6	8.8	270	Mostly cloudy		Medium	0.2	40					5	5	50
3	308	4	11	7.7	190	Overcast	Medium	Medium	1.0	40		5			50	5	0
3	308	5	15	7.9	260	Mostly cloudy		Medium	0.5	15					80	5	0
3	308	6	9	9.3	160	Clear	Medium	High	0.7	20				20	40	20	0
3	307	1	18	11.0	200	Partly cloudy		Medium	0.3						55	5	40
3	307	2	12	9.3	290	Overcast	Medium	Low	0.1	10					10		80
3	307	3	6	8.3	240	Mostly cloudy	Medium	Medium	0.2	80		10			10		0
3	307	4	10	8.4	190	Overcast	Medium	Medium	1.0	20					80		0
3	307	5	17	7.5	260	Partly cloudy		Medium	0.8	10					90		0
3	307	6	7	10.5	160	Clear	High	Medium	0.7		5			20	70	5	0
3	306	1	17	12.6	280	Partly cloudy	Medium	Medium	0.2	25					75		0
3	306	2	8	11.7	310	Overcast	High	Medium	0.4	30					70		0
3	306	3	18	9.0	240	Partly cloudy	High	Medium	0.2						50		50
3	306	4	10	7.9	310	Overcast	Medium	Low	0.2						90		10
3	306	5	3	5.9	260	Clear	Low	Medium	0.4	10					90		0
3	306	6	7	7.3	230	Clear	Medium	Medium	0.6					10	80		10

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
3	0305	1	16	12.3	280	Partly cloudy	Medium	Medium	0.2	50					50		0
3	0305	2	8	11.7	300	Overcast	Medium	Medium	0.4	40					40	20	0
3	0305	3	15			Partly cloudy	High	Medium	0.2						50		50
3	0305	4	12	7.2	310		Medium	Medium	0.2						50		50
3	0305	5	2	5.8	260	Clear	Medium	Medium	0.4	40					50	10	0
3	0305	6	7	7.7	230	Clear	Medium	Medium	0.6	30				10	40	10	10
3	0304	1	16	11.3	160	Partly cloudy	Medium	Medium	0.9	50				1	49		0
3	0304	2	18	12.0	170	Mostly cloudy	Medium	Medium	1.2	50					45	5	0
3	0304	3	10	8.6	200			Medium	0.4	5		5			90		0
3	0304	4	10	8.7	310	Overcast	Medium	Medium	0.8			5			70		25
3	0304	5	2	7.9	170	Mostly cloudy	High	Medium	1.1	20					80		0
3	0303	1	16	11.2	250	Partly cloudy	Medium	Medium	0.2	50					45	5	0
3	0303	2	15	11.5	160	Overcast	Medium	Medium	0.9	33					33	33	1
3	0303	3	8	8.5	240	Mostly cloudy	Medium	Medium	0.2						50		50
3	0303	4	10	8.6	190	Partly cloudy	Medium	Medium	0.3	20					30	5	45
3	0303	5	17	7.4	190	Partly cloudy	Medium	Medium	0.7	45					45	10	0
3	0303	6	5	10.1	170	Clear	Medium	Medium	1.3					10		10	80
3	0302	1	16	10.8	250	Partly cloudy	Medium	Medium	0.2	39	1				50	10	0
3	0302	2	15	11.3	170	Overcast	High	Medium	0.9	40					50	10	0
3	0302	3	9	9.8	240	Overcast		Medium	0.2	60					20	20	0
3	0302	4	6	8.3	190	Clear	High	Medium	0.3						50		50
3	0302	5	15	8.2	170	Partly cloudy	Medium	Medium	0.6	50					50		0
3	0302	6	5	8.2	170	Clear	High	High	1.3	45	5				20	30	0
3	0301	1	17	11.3	160	Partly cloudy	Medium	Medium	0.9	50					25	25	0
3	0301	2	15	11.5	170	Overcast	Medium	Medium	0.9	45	5				45	5	0
3	0301	3	13	9.1	170	Mostly cloudy	Medium	High	0.4	60		10			10	20	0
3	0301	4	16	8.6	190	Mostly cloudy	Medium	Medium	0.8	40					40	20	0
3	0301	5	2	7.9	170	Partly cloudy	High	Medium	1.1	50		20			10	20	0
5	05SC060	2	9	10.4	230	Overcast	Medium	Low	0.3				50		50		0
5	0517	1	18	15.0	240	Mostly cloudy		Low	0.5	14	2				50		34
5	0517	2	9	9.3	180	Overcast	High	Low	0.2	30			20		30	20	0
5	0517	3	15	11.4	210	Clear	High	Low	0.6		2				89	10	-1
5	0517	4	5	8.5	230	Overcast	High	Low	1	5	5				80	10	0
5	0517	5	6	9.3	200	Overcast	Medium	Low	1	5	5				75	15	0
5	0516	1	10	13.1		Clear	High	Low	0.7		1				70	4	25
5	0516	2	5	9.3	180	Overcast	High	Medium	0.2	10	1	4			25	60	0
5	0515	1	12	12.9	210	Clear	High	Low	0.2			5			50	5	40
5	0515	2	10	11.5	190	Overcast	High	Low	0.1	30					30	5	35
5	0515	3	15	10.4	200	partly cloudy	High	Low	0.2	50					50		0
5	0515	4	10	8.1	200	Mostly cloudy	High	Low	0.8	50					50		0
5	0515	5	6	9.7	200	Overcast		Medium	0.7	50					50		0
5	0514	1	15	13.2	200	Clear	High	Low	0.2						40		60
5	0514	2	10	12.0	190	Overcast	High	Low	0.5	40					40		20
5	0514	3	15	10.2	200	Mostly cloudy	High	Medium	0.2	50					50		0
5	0514	4	12	9.1		Overcast	High	Low	n/a	40					60		0
5	0514	5	8	7.9	190	Overcast	High	Medium	0.6	25					75		0
5	0513	1	20	12.8	200	Clear	High	Low	n/a	20					30		50
5	0513	2	10	12.0	190	Overcast	High	Medium	0.5	60					25	5	10

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
5	513	3	15	9.9	200		High	Medium	0.3	40					60		0
5	513	4	10	9.0	200	Overcast	Medium	Low	0.5	50					50		0
5	513	5	6	9.5	190	Overcast		Low	0.8	50					50		0
5	512	1	8	11.7		Clear	Medium	Low	0.1	5	5				6	10	74
5	512	2	10	12.1	190	Overcast	Medium	Medium	0.3	30		5		5	40	20	0
5	512	3	9	9.5	200	Overcast	High	Medium	0.3	50		5			35	10	0
5	512	4	4	9.4	190	Overcast	High	Medium	0.3	35					60	5	0
5	512	5	6	9.3	200	Overcast	Medium	Medium	n/a	40					50	10	0
5	511	1		11.7	210	Clear	High	Low	0.1	10	5	5			50		30
5	511	2	10	11.3	190	Overcast		High	0.1	30		10			30	10	20
5	511	3	10	9.8	200	Mostly cloudy	High	Medium	0.3	30		5			60	5	0
5	511	4	4	9.5	180	Overcast	High	Medium	0.8	35		10			50	5	0
5	511	5	6	9.7	200	Overcast	Medium	High	1	50		10			30	10	0
5	510	1	7	10.7	220	Clear	High	Medium	0.2	24	1			5	35	10	25
5	510	2	10	12.0	180	Overcast	Medium		0.5	55	1			4	30	10	0
5	510	3	5	9.5	200	Overcast	High	Medium	0.2	70					30		0
5	510	4	4	9.5	190	Overcast	High	Medium	0.9	45					50	5	0
5	510	5	6	9.7	190	Overcast	Medium	Medium	0.8	80					20		0
5	509	1	15	13.2	190	Mostly cloudy	Medium	High	0.4	60					30		10
5	509	2	10	10.1	200	Overcast	Medium	Medium	0.2	40					30	10	20
5	509	3	15	10.2	190	Clear	High	Medium	0.4	40					50	10	0
5	509	4	5	9.0	190	Overcast	High	Medium	0.9	80					15	5	0
5	509	5	6	9.3	200	Overcast	High	Medium	0.8								100
5	508	1	20	12.4	200	Clear		Medium	0.2	14	1			5	40		40
5	508	2	10	11.5	190	Overcast		Low	0.1	40					20	20	20
5	508	3	15	10.4	200	partly cloudy	High	Low	0.3	45	1				50	4	0
5	508	4	12	9.1	170	Overcast	High	Medium	1	45					50	5	0
5	508	5	8	7.9	190	Overcast	High	Medium	0.6		30				70		0
5	507	1	13	13.1	190	Mostly cloudy	High	Medium	0.4	30					39	1	30
5	507	2	9	10.1	180	Overcast	Medium	Medium	0.2	30					30		40
5	507	4	5	9.0	200	Overcast	High	Medium	0.5	55					40	5	0
5	507	5	6	9.0	190	Overcast	High	Medium	0.4	50					45	5	0
5	506	1	20	13.8	190	Clear	High	Low	0.5	85					10	5	0
5	506	2	9	9.9	180	Overcast	Medium	Low	0.2	60						40	0
5	506	3	15	9.8	190	Clear	High	Low	0.4	50						50	0
5	506	4	7	8.5	190	Clear	High	Low	0.7	70					20	10	0
5	506	5	3	8.4	210	Overcast	Medium	High	0.8	50					10	40	0
5	505	1	20	13.4	180	Clear	Medium	Medium	0.5	70		20			10		0
5	505	2	10	9.5	180	Mostly cloudy		High	0.2	30	5	15			20	30	0
5	505	3	7	9.8	190	Clear	High	High	0.4	30	1	30			10	29	0
5	505	4	1	8.6	190	Clear	High	High	0.7	30		10			10	50	0
5	505	5	3	8.4	210	Overcast	Medium	Medium	0.8	50					40	10	0
5	502	1	15	13.1	180	Clear	High	Medium	0.8	60		2			35	3	0
5	502	2	5	9.7	170	Overcast	High	Medium	0.2	50		10			20	20	0
5	502	3	5	9.7	190	Clear	High	High	0.5	35		5			30	10	20
5	502	4	-5	7.9	210	Fog		High	0.8	50							50
5	502	5	3	8.1	200	Overcast	High	Medium	0.7	55					40	5	0
5	502	6	-1	8.4	180	Overcast	High	High	0.5	20	2				18	60	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
6	06SC047	1	18	11.4	190	Overcast	High	Low	0.1		2					2	96
6	06SC047	2	11	13.1	240	Overcast	High	Low	0.6	3	2				90	5	0
6	06SC047	3	8	11.6	230	Clear	High	Low	0.2		1					14	85
6	06SC047	4	10	11.9	230			Low	0.6		5				90	5	0
6	06SC047	5	3	5.7	240	Clear	High	Low	0.6		5				95		0
6	06SC047	6	-1	2.4	240	Fog	High	Low	0.4						40	20	40
6	06SC036	1	10	13.0	210	Mostly cloudy		Low	0.2		5		10	5	30	10	40
6	06SC036	2	18	14.2	180	Overcast	High	Low	0.6	5	5				80	10	0
6	06SC036	3		10.6	200	partly cloudy	Low	Low	0.4		70			30			0
6	06SC036	6	1	7.4	190	partly cloudy			0.6		10		20	10	20	40	0
6	06PIN02	1		11.5	190	Mostly cloudy	High		0.2		5				20		75
6	06PIN02	2	12	13.9	260	Mostly cloudy	High	Medium	0.5	10	30				30	30	0
6	06PIN02	3	10	11.0	230	Clear	Medium	Medium	0.4	30	5				30	30	5
6	06PIN02	4	10	11.4	230	partly cloudy	Medium	Medium	0.6	35	10				50	5	0
6	06PIN02	5	5	6.0	260	Clear	High	Medium	0.4	45	5				45	5	0
6	06PIN02	6	-1	2.6	220	Clear	High	Medium	0.4	10	20				30	30	10
6	06PIN01	1	15	11.1	190	Mostly cloudy	High	Medium	0.2		20						80
6	06PIN01	2	20	14.1	230	Overcast	High	Medium	0.5	40	10				30	10	10
6	06PIN01	3		10.7	230	Clear		High	0.4	10	30				20	30	10
6	06PIN01	4	10	11.3	230	Overcast	High	Medium	0.6	30	10				40	20	0
6	06PIN01	5	3	5.7	260	Clear	High	Medium	0.4	30	20				40	10	0
6	06PIN01	6	-1	2.2	220	Fog	High	Medium	0.4		10				10	60	20
6	0614	1	18	11.2	190	Overcast	Medium	Low	0.2					1	4		95
6	0614	2	18	13.6	170	Clear	High	Low	n/a	10				5	80	5	0
6	0614	3	15	10.2	190	partly cloudy	High	Medium	0.4	30					30	20	20
6	0614	4	15	11.7	180	Overcast	Medium	Medium	0.8	30					65	5	0
6	0614	5	18	10.0	180	Clear	High	Low	0.9	25					70	5	0
6	0614	6	1	8.9	190	Clear	High	Medium	0.4	10				20	30	30	10
6	0613	1	9	11.9	200	Overcast	High	Medium	0.2	10					10	80	0
6	0613	2	10	11.3	190	Overcast	High	Low	0.4	50					10		40
6	0613	3		11.1	220	Clear	Low	Low	0.4	99	1						0
6	0613	4	10	9.8	200	Overcast	Medium	Medium	0.5	50					50		0
6	0613	5	10	8.9	220	Overcast	High	Medium	0.8	60					40		0
6	0613	6	-1	7.4	220	Overcast	Medium	Medium	0.5	20	5			5	75		-5
6	0612	1	19		190	Mostly cloudy	Medium		0.2		5				60	5	30
6	0612	2	10	11.3	180	Overcast		Medium	0.3	30					30	10	30
6	0612	3		11.1	220	partly cloudy	Low	Medium	0.4	98	1			1			0
6	0612	4	5	9.6	200	partly cloudy	Medium	Medium	0.6	29	1				65	5	0
6	0612	5	10	9.3	200	Overcast	High	Medium	0.8	60					35	5	0
6	0612	6	-1	8.2	190	Overcast	Medium	Medium	0.4	45					50	5	0
6	0611	1	21	12.6	190	Mostly cloudy	Medium	Medium	0.2					4	48	1	47
6	0611	2	15	12.0	210	Overcast	High	Low	0.7	10					80	10	0
6	0611	3		11.1	220	Overcast	Low	Low	0.4	50					50		0
6	0611	4	15	10.7	230	partly cloudy	Medium	Low	0.6	30					70		0
6	0611	5	10	8.0	220	Overcast	High	Medium	0.8	50					50		0
6	0611	6	7	5.6	220	Clear	High	Medium	0.3	15					60	5	20
6	0610	1	20	12.4	190	Mostly cloudy	Medium	Medium	0.2		20				5	1	74
6	0610	2	15	13.4	210	Overcast	High	Low	0.7	30	5				60	5	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
6	610	3		11.1	220	Mostly cloudy	Low	Low	0.4	98	2						0
6	610	4	15	10.8	230	partly cloudy	High	Low	0.6	40	10				50		0
6	610	5	10	8.1	200	Overcast	High	Low	0.8	35	5				60		0
6	610	6	-1	5.3	220	Clear	Medium	Low	0.5	30	5				60	5	0
6	609	1	18	12.3	190	Mostly cloudy	Medium	Medium	0.2		5			5	45		45
6	609	2	15	12.0	210	Overcast		Low	0.7	4	1				75	10	10
6	609	3		11.5	230	Mostly cloudy	Low	Low	0.3	50					50		0
6	609	4	15		230	partly cloudy	Medium	Low	0.6	10					90		0
6	609	5	7	9.3	220	Overcast	High	Low	0.8	30					70		0
6	609	6	7	6.4	220	Clear	High	Medium	0.3	10					40	10	40
6	608	1	17	11.9	190	Overcast	Medium	Medium	0.1						20		80
6	608	2	20	13.2	230	Clear	High	Low	0.6	50	2				48		0
6	608	3		10.5	230	partly cloudy	Low	Low	0.4	90	10						0
6	608	4	10	10.1	230	Clear	High	Low	0.6	50					50		0
6	608	5	3	6.5	220	partly cloudy		Medium	0.7	50					50		0
6	608	6	5		220	Clear	High	Medium	0.3	50					40	10	0
6	607	1	19	11.9	190	Overcast	Medium	Medium	0.2		1				50		49
6	607	2	18	13.0	190	Overcast	High	Low	0.4	50					50		0
6	607	3		11.1	220	Mostly cloudy	Low	Low	0.4	50					50		0
6	607	4	10	10.0	200	Mostly cloudy	Medium	Medium	0.6	30					70		0
6	607	5	10	9.3	200	Overcast	High	Low	0.8	15					80	5	0
6	607	6	7	8.9	190	Clear	High	Medium	0.4	35					40	5	20
6	606	1	17	11.3	190	Mostly cloudy	Medium	Medium	n/a	10					25	5	60
6	606	2	12	12.0	190	Overcast		Medium	0.4	45		5			45	5	0
6	606	3		11.5	180	Mostly cloudy	Low	Medium	0.3	100							0
6	606	4	10	10.5	180	Overcast	Medium	Medium	0.8	50					50		0
6	606	5	5	9.3	200	Overcast	High	Medium	0.8	50					50		0
6	606	6	7	9.3	190	Clear	High	Medium	0.4	30					30	30	10
6	605	1	18	11.0	190	Overcast	High	Medium	n/a						30		70
6	605	2	20	12.6	170	Clear	High	Low	0.6	50					50		0
6	605	3		11.5	180	partly cloudy	Low	Low	0.3	90			10				0
6	605	4	10	10.4		Overcast	Medium	Medium	0.8	45					50	5	0
6	605	5	5	8.2	200	Mostly cloudy	High	Medium	0.8	50					45	5	0
6	605	6	5	8.5	190	Clear	High	Medium	0.4	10				10	40	10	30
6	604	1	17	11.6	190	Mostly cloudy	Medium	Medium	0.1		10			10	10		70
6	604	2	20	13.2	230	Clear	High	Medium	0.6	50	15				30	5	0
6	604	3		10.5	230	partly cloudy	Low	Medium	0.4	80	20						0
6	604	4	9	10.1	230	Clear	High	Medium	0.6	30	20				40	10	0
6	604	5	19	9.6	210	Clear	High	High	0.7	50	5				40	5	0
6	604	6	5	7.6	220	Clear	High	High	0.3	25	10				30	5	30
6	603	1	18	11.2	190	Mostly cloudy	High	Low	0.1						20		80
6	603	2	12	12.1	190	Overcast	High	Medium	0.4	50					50		0
6	603	3		10.1	180	Mostly cloudy	Low	Medium	0.2	100							0
6	603	4	15	11.5	180	Overcast	High	Low	0.8	50					50		0
6	603	5	19	9.7	180	Clear	High	Low	0.9	30					65	5	0
6	603	6	1	9.5	190	Clear	High	Medium	0.4	20				10	70		0
6	602	1	18	13.1	190	Mostly cloudy	Medium	Medium	0.2	10		5			5	20	60
6	602	2	15	13.5	240	Clear	High	High	0.4	30	5	10			5	50	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
6	0602	3	15	9.8		Clear	High	High	n/a	30	10	10			10	30	10
6	0602	4	15	11.5		Overcast	High	High	n/a	30	10				30	30	0
6	0602	5	18	7.6	210	Clear	High	Medium	0.7	65	5	10			10	10	0
6	0602	6	1	3.8	220	Clear	High	High	0.3	10	10	10				70	0
6	0601	1	15	11.1	190	Mostly cloudy	High	Medium	0.1	10						30	60
6	0601	2	15	14.0	190		High	High	0.4	30	5				35	30	0
6	0601	3	10	9.4	160	Clear		High	0.4	25	1				25	25	24
6	0601	4	15	11.2	190			Medium	0.6	50	2				30	18	0
6	0601	5	10	9.2	180	Clear	High	Medium	0.8	50					20	30	0
6	0601	6	1	8.6	190	Fog	High	High	0.4	20		10		20	20	30	0
7	07SC022	1		12.6	200	Clear	High	Low	0.1		5				45	10	40
7	07SC022	2	7	9.7	210	Fog	High	Low	0.2		5				30	5	60
7	07SC022	3	4	9.5	190	Fog	High	Low	0.4	5	5				35	5	50
7	07SC022	4	3	7.0	220		High	Low	0.7		5				10	85	0
7	07SC022	5	0	6.4	230	Mostly cloudy	Medium	Low	0.5							100	0
7	07SC022	6	5	7.7	180		High	Low	n/a	5	5				25	35	30
7	07SC012	1	14	12.0	160	Mostly cloudy	Medium	Medium	0.2		5			4	20	10	61
7	07SC012	2	12	10.7	170	Mostly cloudy	Medium	Medium	0.2								100
7	07SC012	3	15	11.8	140	Mostly cloudy		Low	0.2	4	1				20	40	35
7	07SC012	4	8	7.4		Mostly cloudy	High	Low	0.2								100
7	07SC012	5	12	7.6	170	Mostly cloudy	Medium	Medium	0.4	10	10				70	10	0
7	07SC012	6	5	7.3	170	Clear	High	Low	0.4	5	5				15	50	25
7	07KIS01	1	16	13.2	280	Partly cloudy	Medium	Medium	0.2						20	5	75
7	07KIS01	2	15	11.6	170	Partly cloudy	Medium	Medium	0.1						10		90
7	07KIS01	3	10	11.4	240			Medium	0.1	9	1				20	20	50
7	07KIS01	4	8	6.7	200	Mostly cloudy	Medium	Medium	0.2								100
7	07KIS01	5	12	7.3	170	Mostly cloudy		Medium	0.1						50		50
7	07KIS01	6	5	7.3	320	Clear	High	Medium	0.2		5				25	20	50
7	07BEA02	1	15	13.5	110	Mostly cloudy	High	Medium	0.1	15	1				24	5	55
7	07BEA02	2	10	12.5	180	Overcast	High	Medium	0.1	20	5				30	5	40
7	07BEA02	3	7	10.4	120	partly cloudy		Low	0.2	30					30	10	30
7	07BEA02	4	15	10.4	120	Mostly cloudy	Medium	Medium	0.2	25	1				69	5	0
7	07BEA02	5	5	7.4	200	Overcast	Low	Medium	0.5						70	30	0
7	07BEA02	6	5	6.2	140	partly cloudy		Medium	0.2						20	30	50
7	07BEA01	1	15	13.8	100	Mostly cloudy	High	Medium	0		5			5	30	20	40
7	07BEA01	2	10	12.5	150	Overcast	High	Low	0.1		10				40	30	20
7	07BEA01	3	7	9.9	120	Clear	High	Low	0.2	10	5				70	5	10
7	07BEA01	4	15	10.4	120	Overcast	Medium	Low	0.2	20					20		60
7	07BEA01	6	5	6.1	140	Mostly cloudy	High	Medium	0.2	5	5				10	50	30
7	0714	1	20	13.0	180	Partly cloudy	Medium	Low	0.2						30	10	60
7	0714	2	16	10.7	170	Partly cloudy	Medium	Medium	0.3						50		50
7	0714	3	10	10.2	160	Overcast		Low	0.2	30				5	30	5	30
7	0714	4	-5	5.7	230	Clear		Medium	0.5	20					60		20
7	0714	5	12	7.8	170	Overcast	Medium	Medium	0.4						100		0
7	0714	6	5	9.7	190	Clear	High	Medium	0.5	30				10	40	20	0
7	0713	1	18	12.8	180	Partly cloudy	Medium	Medium	0.2						25	15	60
7	0713	2	18	10.7	170	Mostly cloudy	High	Medium	0.2	30					30		40
7	0713	3	10	10.2	160	Overcast	High	Medium	0.2	30					25	5	40

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
7	713	4	-1	6.0	230	Clear	High	Medium	0.5	20					50	5	25
7	713	5	12	7.7	170	Overcast			0.4	25					75		0
7	713	6	5	8.5	190	Clear	High	Medium	0.5	40				10	40	10	0
7	712	1	18	14.0	190	Clear	High	Low	0.2	20					30	20	30
7	712	2	17	10.9	170	Partly cloudy	Medium	Medium	0.4						50		50
7	712	3	10	10.6	170	Clear		Medium	0.4	40					40		20
7	712	4	1	6.8	200	Clear	High	Low	0.6	45					50	5	0
7	712	5	10	7.6	170	Overcast		Medium	1.0	15					85		0
7	712	6	5	8.2	220	partly cloudy		Medium	0.5	15	5				70	10	0
7	711	1	15	14.0	190	partly cloudy	High	Medium	0.2	30	2			3	30	5	30
7	711	2	15	10.6	200	Clear	High	Medium	0.2	30	2				30		38
7	711	3	15	10.2	170	Clear	High	Medium	0.4	35					30	5	30
7	711	4	7	7.3	200	Clear	High	Low	0.6	50					50		0
7	711	5	0	6.2	230	Mostly cloudy	Medium	Medium	0.5	80		5			15		0
7	711	6	5	8.5	220	Clear	High	Medium	0.5	45	5			5	30	15	0
7	710	1	15	13.4	160	Mostly cloudy	High	Low	0.1	5	1			10	30	14	40
7	710	2	15	10.6	160	Clear	High	Low	0.2	10	5		5		35	5	40
7	710	3	15	10.2	160	Clear	High	Low	0.1		1				50		49
7	710	4	7	7.3	180	Overcast	High	Low	0.3						50	20	30
7	710	5	0	6.4	230		Medium	Medium	0.5	75					20	5	0
7	710	6	-3	7.8	190	Overcast		Low	0.5	10	5				70	5	10
7	709	1	20	13.2	190		Low	Medium	0.2						10	80	10
7	709	2		11.3	190	Overcast	Low	Low	0.2	60	20			5	15		0
7	709	3	15	10.2	180	Clear	High	Low	0.2	30					50		20
7	709	4	10	7.7	200	Overcast	High	Low	0.7	50					50		0
7	709	5	0	6.2	220			Medium	0.5	80					15	5	0
7	709	6	5	7.7	180	Mostly cloudy	High	Low	0.5	25	5				70		0
7	708	1	18	14.0	120	Mostly cloudy	Medium	High	0.0	10	1				20	19	50
7	708	2	10	12.3	180	Overcast	Medium	High	0.2	10		10				50	30
7	708	3	12	10.6	140	Clear	High	High	0.1	20		20				30	30
7	708	4	10	7.7	150	Overcast		High	0.2	30					15	5	50
7	708	5	4	5.2	200	Overcast	Low	Medium	0.5			15			45	40	0
7	708	6	5	7.3	160	partly cloudy		High	0.4	30					10	30	30
7	707	1	18	13.2	190	partly cloudy	High	Medium	0.1	20	1				35	4	40
7	707	2	18	11.0	160	Mostly cloudy	High	Medium	0.2	30					30	10	30
7	707	3	10	9.9	170	Clear	Medium	Medium	0.2	30					30	10	30
7	707	4	5	6.8	200	Clear	High	Medium	0.4	45					45	10	0
7	707	5	0	6.3	230	Mostly cloudy	Medium	Medium	0.5	70		10			20		0
7	707	6	3	9.3	190	partly cloudy	High	Medium	0.5	45					45	10	0
7	706	1	15	13.0	200	partly cloudy		Low	0.1	5	20				30	5	40
7	706	2	10	10.4	200	Overcast	High	Medium	0.2	20	20				30	10	20
7	706	3	7	9.7	190	Clear	High	Low	0.4	30	30				30		10
7	706	4	5	7.7	220	Overcast	High	Low	0.7	30	20				30	20	0
7	706	5	0	6.2	230		Medium	Medium	0.5	50					10	40	0
7	706	6	-3	8.2	210	Overcast	High	Medium	0.5	20	20				20	30	10
7	705	1	12	13.0	200	Clear	High	High	0.1	10	5	5		10	30	20	20
7	705	2	7	10.5	200	Fog	High	High	0.2	10	5	5		5	25	25	25
7	705	3	7	9.7	190	Clear	High	Medium	0.4	20	10				30	10	30

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
7	0705	4	3	7.0	220	Overcast	High	Medium	0.7	80					15	5	0
7	0705	5	0	6.0	230	Mostly cloudy	Medium	Medium	0.5	40		10				50	0
7	0705	6	-3	6.1	210	Mostly cloudy	High	High	0.5	30	5				25	30	10
7	0704	1	7	12.2	190	Clear	High	Medium	0.2	10	5			5	35	5	40
7	0704	2		11.3	190	Overcast	Low	Medium	0.2	98	2						0
7	0704	3	10	10.2	160	Clear	High	Medium	0.1	20					35	5	40
7	0704	4	3	6.5	180	Overcast	High	Medium	0.2	25					30	5	40
7	0704	5	0	6.2	230	Mostly cloudy	Medium	Medium	0.5	40					50	10	0
7	0704	6	5	8.5	160	Overcast	High	Medium	0.4	35	5			5	30	5	20
7	0703	1	18	14.4	140	partly cloudy	High	Medium	0.1	3	2				5	10	80
7	0703	2	10	12.3	180	Overcast	High	Low	0.2	10					30	10	50
7	0703	2		11.3	170	Overcast		Low	0.2	97	2			1			0
7	0703	3	4	9.3	170	Fog	High	Medium	0.1	5	5				20	10	60
7	0703	4	10	6.8	170	Overcast	Medium	Low	0.2	20					30	20	30
7	0703	5	0	5.7	230	Partly cloudy	Medium	Medium	0.2	10					10		80
7	0703	6	5	7.7	160	Overcast	High	Medium	0.4	20					50	10	20
7	0702	1	20	13.2	190	partly cloudy	Medium	Medium	0.2	30	5				45		20
7	0702	2		11.2	190	Overcast	Low	Medium	0.2	80	10				10		0
7	0702	3	15	10.2	180	Clear	High	Medium	0.2	30					30	5	35
7	0702	4	10	8.1	200	Overcast	High	Medium	0.7	45		10			45		0
7	0702	5	0	6.8	220			Medium	0.5	55		10			25	10	0
7	0702	6	5	7.7	180	Mostly cloudy	High	High	0.5	45				5	45	5	0
7	0701	1	18	12.9	190	Partly cloudy	High	Medium	0.4	10					45	5	40
7	0701	2	10	11.5	180	Overcast	High	Low	0.4	5					40	5	50
7	0701	3	3	8.9	190	partly cloudy		Low	0.3	20					75	5	0
7	0701	4	15	10.1	180	Mostly cloudy	Low	Low	0.4	20					80		0
7	0701	5	5	7.4	200	Overcast	Low	Medium	0.5		5				80	15	0
7	0701	6	5	7.4	190	partly cloudy	Medium	Low	0.6					5	90	5	0
9	09SC061	1	15	13.1	190	Mostly cloudy	Medium	Low	0.2		1			1	20	40	38
9	09SC061	2	14	10.7	200	Overcast	High	Medium	0.2						30	10	60
9	09SC061	3	10	9.6	200	Partly cloudy		Low	0.2		5				40	5	50
9	09SC061	4	5	6.9		Mostly cloudy	High	Low	0.4						100		0
9	09SC061	5	5	7.5		Mostly cloudy	Low	Low	0.4						80	20	0
9	09SC053	1	20	14.8	190			Low	0.1					5	75	1	19
9	09SC053	2	12	11.0		Overcast	Medium	Low	0.2					10	5	5	80
9	09SC053	3	12	9.7	200	Mostly cloudy	High	Low	0.2		10				20	10	60
9	09SC053	4	3	7.6	260	Overcast	Low	Low	0.6		10				50		40
9	09SC053	5	5	7.5	280	Mostly cloudy	Low	Low	0.4						100		0
9	0914	1	14	12.8	190	Overcast	Medium	Medium	0.2						40	20	40
9	0914	2	14	10.7	200	Mostly cloudy	High	Medium	0.2						40	20	40
9	0914	3	17	10.3	170	Clear	Medium	Medium	0.2			5			30	10	55
9	0914	4	5	7.0	200	Mostly cloudy		Medium	0.6			10			45		45
9	0914	5	10	7.6	230	Partly cloudy	Medium	Medium	0.4						90	10	0
9	0913	1	16	13.0	190	Mostly cloudy	Medium	Medium	0.2		1				10	30	59
9	0913	2	14	10.7	200	Mostly cloudy		Medium	0.2						30	40	30
9	0913	3	15	10.2	190	Clear	Medium	Medium	0.2						25	25	50
9	0913	4	5	7.1	190	Mostly cloudy	Medium	Medium	0.2								100
9	0913	5	8	7.5	230	Mostly cloudy	Medium	Medium	0.4	20					30	50	0

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Continued.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
9	912	1	14	13.0	190	Overcast	Medium	Medium	0.2	40					30	30	0
9	912	2	14	10.7	200	Overcast	High	Medium	0.2	20					20	20	40
9	912	3	15	10.8	190	Clear	Medium	Low	0.2			5			10	5	80
9	912	4	8	7.3	220	Mostly cloudy	Medium	Low	0.2	25						75	0
9	912	5	10	7.6	230	Partly cloudy	Low	Low	0.4	20					40	40	0
9	911	1	14	12.8	190	Overcast		Medium	0.2	40					40	20	0
9	911	2	12	10.7	200	Overcast	High	Medium	0.2						45	5	50
9	911	3	12	10.3	200	Overcast	Medium	Medium	0.2						30	30	40
9	911	4	0	4.5	260	Partly cloudy	High	Medium	0.4	20					30	15	35
9	911	5	10	7.8	260	Overcast		Medium	0.5	35					60	5	0
9	910	1	16	12.9	190	Mostly cloudy		Medium	0.2	1	1				50	10	38
9	910	2	12	11.0	200	Overcast	Medium	Low	0.2								100
9	910	3	14	10.2	200	Overcast	High	Low	0.2	10					20	20	50
9	910	4	4	7.7	260	Overcast	Medium	Low	0.6	30					10	40	20
9	910	5	12	7.9	230	Partly cloudy		Medium	0.6	30					70		0
9	909	1	16	13.0	190	Mostly cloudy	Medium	Medium	0.2						80	10	10
9	909	2	11	10.7		Overcast	High	Medium	0.2						40	10	50
9	909	3	12	10.1	170	Partly cloudy	Medium	Medium	0.2						25		75
9	909	4	0	7.0	260	Overcast	Low	Low	0.4						80	20	0
9	909	5	5	7.2	230	Mostly cloudy	Low	Low	0.4						90	10	0
9	908	1	17	13.0	190	Mostly cloudy	Medium	Medium	0.2						80		20
9	908	2	10	10.7		Overcast	High	Medium	0.2						50		50
9	908	3	12	9.5	210	Partly cloudy		Medium	0.2						50		50
9	908	4	0	7.0	260	Overcast	Low	Low	0.4						100		0
9	908	5	5	7.2	230	Mostly cloudy	Low	Low	0.4						100		0
9	907	1	16	13.2	190	Mostly cloudy	Medium	Medium	0.2						40	10	50
9	907	2	10	10.6	200	Overcast	High	Medium	0.2						50		50
9	907	3	13	10.4	200	Mostly cloudy	High	Low	0.2	20					30		50
9	907	4	4	7.7	260	Overcast	Medium	Medium	0.6						50		50
9	907	5	12	8.5	260	Overcast	Medium	Medium	0.5						95	5	0
9	906	1	16	12.5	190	Mostly cloudy	Medium	Medium	0.2					1	75	0	24
9	906	2	9	10.2	200	Mostly cloudy	High	Low	0.2						50		50
9	906	3	14	10.5	200	Overcast	Medium	Low	0.2						50		50
9	906	4	3	7.7	260	Mostly cloudy	Medium	Low	0.6						50		50
9	906	5	12	7.9	260	Mostly cloudy	Medium	Low	0.5	10					90		0
9	905	1	18	13.1	190	Partly cloudy	Medium	Medium	0.1	10					5	15	70
9	905	2	12	11.1	200	Overcast	Medium	Medium	0.2			2		2		5	91
9	905	3	14	10.2	200	Overcast	High	Low	0.2						40	10	50
9	905	4	5	7.7	260	Mostly cloudy	Medium	Medium	0.6	30					20	40	10
9	905	5	12	7.9	230	Partly cloudy	Medium	Medium	0.5	10					75	15	0
9	904	1	20	13.7	190	Partly cloudy	Medium	Medium	0.1						60	5	35
9	904	2	12	10.8	200	Overcast	High	High	0.2	5	10			25	30	30	0
9	904	3	14	10.3	200	Overcast	Medium	Medium	0.2						40	10	50
9	904	4	5	7.7	260	Mostly cloudy	Medium	Medium	0.6	20					40	20	20
9	904	5	8	8.3	260	Partly cloudy	High	Medium	0.5			5			90	5	0
9	903	1	20	14.3	190	Partly cloudy	Medium	Medium	0.1						50	0	50
9	903	2	12	10.9	200	Overcast	Medium	Medium	0.2	10				5	75	10	0
9	903	3	14	10.2	200	Mostly cloudy	Medium	Medium	0.2						40	10	50

[a] See Appendix A, Figures A1 to A6 for sample site locations.
[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.
[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.
[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

Continued...

Table D3 Concluded.

Section	Site[a]	Session	Air Temperature (°C)	Water Temperature (°C)	Conductivity (µS /cm)	Cloud Cover[b]	Water Clarity[d]	Instream Velocity[c]	Secchi Bar Depth (m)	Cover Types (%)							
										Substrate Interstices	Woody Debris	Turbulence	Aquatic Vegetation	Terrestrial Vegetation	Shallow Water	Deep Water	Other Cover
9	903	4	4	7.7	260	Mostly cloudy	Low	Low	0.6						70	10	20
9	903	5	12	8.3	230	Partly cloudy	High	Low	0.5	20					70	10	0
9	902	1	18	12.7	190	Partly cloudy	Medium	Medium	0.1				0	0	15	5	80
9	902	2	12	10.8	200	Overcast	Medium	Medium	0.2			2		5	2	10	81
9	902	3	14	10.1	200	Overcast	Medium	Medium	0.2	15	5				20	20	40
9	902	4	3	7.7	260	Overcast	Medium	Medium	0.6	10		10			40	20	20
9	902	5	5	7.6	260	Clear	Medium	Low	0.4	30					50	20	0
9	901	1	13	11.5	190	Partly cloudy	Medium	Medium	0.1						5	5	90
9	901	2	12	10.8	200		Medium	Medium	0.2						5	5	90
9	901	3	12	10.1	200	Mostly cloudy	Medium	Medium	0.2	20					30		50
9	901	4	2	7.7	260	Overcast	Medium	Medium	0.6	10		10			50		30
9	901	5	5	7.6	260	Clear	Low	Low	0.4	10		15			75		0

[a] See Appendix A, Figures A1 to A6 for sample site locations.

[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.

[c] High = >1.0 m/s; Medium = 0.5-1.0 m/s; Low = <0.5 m/s.

[d] High = >3.0 m; Medium = 1.0-3.0 m; Low = <1.0 m.

APPENDIX E

Catch and Effort Data

Table E1 Number of fish caught during boat electroshocking surveys and their frequency of occurrence in Sections 1, 3, and 5 of the Peace River, 2002 to 2019.

	2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019	
Species	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]	n^a	%[b]
Large-bodied																																				
Arctic Grayling	13	*<1*	54	*1*	271	*2*	280	*2*	93	*1*	344	*3*	202	*2*	116	*1*	59	*1*	135	*1*	43	*<1*	27	*<1*	10	*<1*	48	*<1*	85	*1*	80	*1*	49	*<1*	52	*<1*
Bull Trout	105	*2*	91	*1*	122	*1*	175	*1*	76	*1*	156	*1*	170	*1*	144	*1*	97	*1*	206	*1*	186	*1*	180	*2*	143	*2*	169	*2*	205	*2*	180	*2*	167	*2*	152	*1*
Burbot					5	*<1*	2	*<1*	5	*<1*	4	*<1*			2	*<1*	2	*<1*	1	*<1*	3	*<1*	1	*<1*	1	*<1*			3	*<1*	2	*<1*	4	*<1*	10	*<1*
Kokanee	24	*<1*	5	*<1*	18	*<1*	43	*<1*	16	*<1*	154	*1*	49	*<1*	28	*<1*	25	*<1*	73	*1*	99	*1*	27	*<1*	20	*<1*	20	*<1*	21	*<1*	51	*1*	11	*<1*	16	*<1*
Lake Trout					1	*<1*	1	*<1*			2	*<1*			3	*<1*	1	*<1*	2	*<1*	4	*<1*	5	*<1*	2	*<1*	3	*<1*	1	*<1*	1	*<1*			3	*<1*
Lake Whitefish	2	*<1*	2	*<1*	13	*<1*			1	*<1*	4	*<1*	1	*<1*	3	*<1*			7	*<1*	3	*<1*					1	*<1*	3	*<1*			1	*<1*	1	*<1*
Mountain Whitefish	5496	*88*	5686	*89*	10 418	*88*	10 658	*86*	6365	*93*	10 436	*86*	11 565	*87*	10 005	*89*	10 633	*93*	13 174	*90*	10 825	*86*	8429	*86*	7274	*85*	6729	*67*	7104	*70*	5968	*65*	7826	*77*	8254	*76*
Northern Pike					1	*<1*	4	*<1*	1	*<1*	7	*<1*	8	*<1*	8	*<1*	4	*<1*	11	*<1*	7	*<1*	5	*<1*	4	*<1*			4	*<1*	11	*<1*	18	*<1*	5	*<1*
Northern Pikeminnow	20	*<1*	25	*<1*	57	*<1*	34	*<1*	6	*<1*	24	*<1*	28	*<1*	16	*<1*	13	*<1*	21	*<1*	41	*<1*	37	*<1*	39	*<1*	102	*1*	122	*1*	78	*1*	48	*<1*	109	*1*
Rainbow Trout	50	*1*	63	*1*	107	*1*	94	*1*	39	*1*	102	*1*	169	*1*	165	*1*	131	*1*	171	*1*	139	*1*	67	*1*	106	*1*	105	*1*	176	*2*	115	*1*	140	*1*	151	*1*
Sucker spp.[c]	533	*9*	435	*7*	879	*7*	1088	*9*	238	*3*	835	*7*	1103	*8*	787	*7*	500	*4*	733	*5*	1118	*9*	1011	*10*	963	*11*	2822	*28*	2455	*24*	2571	*28*	1821	*18*	2088	*19*
Walleye	3	*<1*			6	*<1*	5	*<1*			17	*<1*	58	*<1*	17	*<1*	3	*<1*	49	*<1*	48	*<1*	43	*<1*	19	*<1*	12	*<1*	33	*<1*	60	*1*	54	*1*	35	*<1*
Large-bodied subtotal	6246	*100*	6361	*100*	11 898	*100*	12 384	*100*	6840	*100*	12 085	*100*	13 353	*100*	11 294	*100*	11 468	*100*	14 583	*100*	12 516	*98*	9832	*100*	8581	*100*	10 011	*100*	10 212	*100*	9117	*100*	10 139	*100*	10 876	*98*
Small-bodied																																				
Flathead Chub																			1	*100*											1	*1*	3	*2*	3	*2*
Lake Chub																									4	*5*	1	*1*	2	*1*	3	*3*	5	*4*	26	*14*
Longnose Dace																									2	*2*	3	*4*	7	*5*	8	*7*			6	*3*
Peamouth	3	*43*																			1	*100*	1	*100*							4	*4*				
Redside Shiner	2	*29*																							1	*1*	15	*20*	71	*51*	49	*44*	44	*35*	75	*41*
Sculpin spp.[c]	2	*29*																							78	*92*	44	*58*	53	*38*	42	*38*	58	*46*	60	*33*
Spottail Shiner																											5	*7*	4	*3*	2	*2*	2	*2*	3	*2*
Troutperch																																	12	*10*	8	*4*
Yellow Perch											1	*100*															8	*11*	2	*1*	2	*2*	2	*2*	1	*1*
Small-bodied subtotal	7	*100*									1	*100*							1	*100*	1	*100*	1	*100*	85	*100*	76	*100*	139	*100*	111	*100*	126	*100*	182	*100*
All species	6253		6361		11 898		12 384		6840		12 086		13 353		11 294		11 468		14 584		12 517		9833		8666		10 087		10 351		9228		10 265		11 058	

[a] Includes fish captured and identified to species; does not include fish recaptured within the year.
[b] Percent composition of large-bodied or small-bodied catch.
[c] Species combined for table or not identified to species.

Table E2 Number of fish caught during boat electroshocking surveys and their frequency of occurrence in Sections 6, 7, and 9 of the Peace River, 2015 to 2019.

	2015		2016		2017		2018		2019	
Species	*n*[a]	%[b]	*n*[a]	%[b]	*n*[a]	%[b]	*n*[a]	%[b]	*n*[a]	%[b]
Large-bodied										
Arctic Grayling	7	*<1*	26	*<1*	7	*<1*	6	*<1*	49	*1*
Bull Trout	88	*1*	90	*1*	57	*1*	47	*1*	48	*1*
Burbot	2	*<1*	34	*1*	4	*<1*	9	*<1*	37	*1*
Goldeye	1	*<1*	7	*<1*	3	*<1*			14	*<1*
Kokanee	1	*<1*	2	*<1*	5	*<1*			1	*<1*
Lake Trout	1	*<1*					1	*<1*		
Lake Whitefish							2	*<1*		
Mountain Whitefish	3250	*42*	2679	*44*	2141	*35*	3419	*53*	2766	*47*
Northern Pike	12	*<1*	12	*<1*	26	*<1*	16	*<1*	20	*<1*
Northern Pikeminnow	151	*2*	88	*1*	117	*2*	75	*1*	74	*1*
Rainbow Trout	24	*<1*	10	*<1*	7	*<1*	6	*<1*	6	*<1*
Sucker spp.[c]	4072	*53*	2988	*49*	3411	*56*	2606	*40*	2586	*44*
Walleye	102	*1*	194	*3*	306	*5*	282	*4*	239	*4*
Large-bodied subtotal	7711	*100*	6130	*100*	6084	*100*	6469	*100*	5840	*100*
Small-bodied										
Finescale Dace	1	*<1*								
Flathead Chub	3	*1*	18	*8*	34	*11*	8	*11*	46	*14*
Lake Chub	40	*19*	26	*12*	62	*20*	18	*25*	124	*39*
Longnose Dace	9	*4*	9	*4*	36	*12*	5	*7*	12	*4*
Peamouth					1	*<1*				
Redside Shiner	137	*64*	95	*43*	133	*43*	10	*14*	58	*18*
Sculpin spp.[c]	6	*3*	55	*25*	9	*3*	6	*8*	23	*7*
Spottail Shiner	10	*5*	9	*4*	8	*3*	3	*4*	11	*3*
Troutperch	5	*2*	9	*4*	26	*8*	21	*30*	35	*11*
Yellow Perch	3	*1*			2	*1*			11	*3*
Small-bodied subtotal	214	*100*	221	*100*	311	*100*	71	*100*	320	*100*
All species	7925		6351		6395		6540		6160	

[a] Includes fish captured and identified to species; does not include fish recaptured within the year.
[b] Percent composition of large-bodied or small-bodied catch.
[c] Species combined for table or not identified to species.

Table E3 Summary of boat electroshocking large-bodied catch (only includes fish captured and identified to species) and catch-per-unit-effort (CPUE = no. fish/km/hour) in the Peace River, 20 August to 14 October 2019.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 1	1	0101	22-Aug-19	283	0.60															79	1674.91											79	1674.91
		0102	22-Aug-19	388	0.98															66	628.07											66	628.07
		0103	22-Aug-19	748	1.03			3	14.02											75	350.45					1	4.67	5	23.36			84	392.5
		0104	26-Aug-19	447	0.50			1	16.11											15	241.61							10	161.07			26	418.79
		0105	26-Aug-19	473	1.10															63	435.9							4	27.68			67	463.58
		0107	23-Aug-19	219	0.30															23	1260.27					2	109.59	2	109.59			27	1479.45
		0108	23-Aug-19	655	0.85			2	12.93											20	129.32							22	142.25			44	284.51
		0109	23-Aug-19	509	0.98															51	369.96							13	94.3			64	464.26
		0110	23-Aug-19	516	0.65															18	193.2							10	107.33			28	300.54
		0111	26-Aug-19	653	0.60			2	18.38											13	119.45							6	55.13			21	192.96
		0112	26-Aug-19	777	1.07			1	4.33											50	216.5					6	25.98	17	73.61			74	320.43
		0113	26-Aug-19	493	0.75			1	9.74											82	798.38					1	9.74	10	97.36			94	915.21
		0114	27-Aug-19	494	0.95															52	398.89							11	84.38			63	483.27
		0116	22-Aug-19	546	0.98			2	13.39											61	408.32							9	60.24			72	481.95
		0119	23-Aug-19	490	0.75			1	9.8											38	372.24							11	107.76			50	489.8
	Session Summary			**512.7**	**12.00**	**0**	**0**	**13**	**7.61**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**706**	**413.11**	**0**	**0**	**0**	**0**	**10**	**5.85**	**130**	**76.07**	**0**	**0**	**859**	**502.63**
Section 1	2	0101	02-Sep-19	246	0.55															45	1197.34											45	1197.34
		0102	02-Sep-19	373	0.98															63	623.63											63	623.63
		0103	03-Sep-19	715	1.20			4	16.78											37	155.24							7	29.37			48	201.4
		0104	03-Sep-19	509	0.50									1	14.15					17	240.47							4	56.58			22	311.2
		0105	03-Sep-19	514	1.10			1	6.37											35	222.85					1	6.37	1	6.37			38	241.95
		0107	02-Sep-19	576	0.55															2	22.73					2	22.73	2	22.73			6	68.18
		0108	01-Sep-19	939	0.85															9	40.59							4	18.04			13	58.64
		0109	01-Sep-19	753	0.98															28	137.3					1	4.9	23	112.78			52	254.98
		0110	02-Sep-19	638	0.65															41	355.92							2	17.36			43	373.28
		0111	02-Sep-19	567	1.00															24	152.38					1	6.35	2	12.7			27	171.43
		0112	03-Sep-19	667	1.07			2	10.09											48	242.12			2	10.09	2	10.09	29	146.28			83	418.67
		0113	02-Sep-19	311	0.75															19	293.25							3	46.3			22	339.55
		0114	03-Sep-19	702	0.95															29	156.55					2	10.8	6	32.39			37	199.73
		0116	03-Sep-19	506	0.98			1	7.22											69	498.38							6	43.34			76	548.95
		0119	02-Sep-19	586	0.75			1	8.19					1	8.19					22	180.2					1	8.19					25	204.78
	Session Summary			**573.5**	**13.00**	**0**	**0**	**9**	**4.35**	**0**	**0**	**0**	**0**	**2**	**0.97**	**0**	**0**	**0**	**0**	**488**	**235.64**	**0**	**0**	**2**	**0.97**	**10**	**4.83**	**89**	**42.97**	**0**	**0**	**600**	**289.72**
Section 1	3	0101	13-Sep-19	266	0.60			1	22.56											92	2075.19							3	67.67			96	2165.41
		0102	13-Sep-19	396	0.98															69	643.36											69	643.36
		0103	13-Sep-19	710	1.20			1	4.23											55	232.39					2	8.45	4	16.9			62	261.97
		0104	13-Sep-19	423	0.50									3	51.06					19	323.4							15	255.32			37	629.79
		0105	13-Sep-19	479	1.10															33	225.47							2	13.66			35	239.13
		0107	14-Sep-19	679	0.55			1	9.64											36	347.03											37	356.67
		0108	14-Sep-19	626	0.85															4	27.06							1	6.77			5	33.83
		0109	14-Sep-19	760	0.98									1	4.86					62	301.21			2	9.72	1	4.86	15	72.87			81	393.52
		0110	14-Sep-19	521	0.65															31	329.54					1	10.63	3	31.89			35	372.07
		0112	15-Sep-19	760	1.07			1	4.43											87	385.15					2	8.85	8	35.42			98	433.84
		0113	14-Sep-19	379	0.75			1	12.66											15	189.97					1	12.66	11	139.31			28	354.62
		0114	15-Sep-19	561	0.95			3	20.26											40	270.19					1	6.75					44	297.21
		0116	14-Sep-19	548	0.98			1	6.67											65	433.51							1	6.67			67	446.85
		0119	14-Sep-19	486	0.75															41	404.94							2	19.75			43	424.69
	Session Summary			**542.4**	**12.00**	**0**	**0**	**9**	**4.98**	**0**	**0**	**0**	**0**	**4**	**2.21**	**0**	**0**	**0**	**0**	**649**	**358.96**	**0**	**0**	**2**	**1.11**	**8**	**4.42**	**65**	**35.95**	**0**	**0**	**737**	**407.63**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 1	4	0101	21-Sep-19	318	0.60															102	*1924.53*											102	*1924.53*
		0102	21-Sep-19	372	0.98															63	*625.31*											63	*625.31*
		0107	21-Sep-19	462	0.55															27	*382.53*					3	*42.5*	3	*42.5*			33	*467.53*
		0108	21-Sep-19	641	0.85			1	*6.61*					1	*6.61*					17	*112.32*					1	*6.61*	1	*6.61*			21	*138.75*
		0109	21-Sep-19	636	0.98			2	*11.61*											73	*423.8*					2	*11.61*	27	*156.75*			104	*603.77*
		0110	22-Sep-19	549	0.65															15	*151.32*											15	*151.32*
		0111	22-Sep-19	517	0.50															6	*83.56*					1	*13.93*					7	*97.49*
		0112	22-Sep-19	732	1.07			5	*22.98*											96	*441.24*					1	*4.6*	14	*64.35*			116	*533.17*
		0113	22-Sep-19	416	0.75															70	*807.69*							1	*11.54*			71	*819.23*
		0114	22-Sep-19	644	0.95															63	*370.71*					2	*11.77*	2	*11.77*			67	*394.25*
		0116	22-Sep-19	530	0.98															29	*199.98*											29	*199.98*
		0119	21-Sep-19	596	0.75			1	*8.05*											49	*394.63*											50	*402.68*
	Session Summary			**534.4**	**10.00**	**0**	***0***	**9**	***6.06***	**0**	***0***	**0**	***0***	**1**	***0.67***	**0**	***0***	**0**	***0***	**610**	***410.93***	**0**	***0***	**0**	***0***	**10**	***6.74***	**48**	***32.34***	**0**	***0***	**678**	***456.74***
Section 1	5	0101	30-Sep-19	299	0.60															34	*682.27*							2	*40.13*			36	*722.41*
		0102	30-Sep-19	417	0.98			1	*8.85*											30	*265.63*											31	*274.49*
		0107	30-Sep-19	610	0.55									1	*10.73*					12	*128.76*					4	*42.92*	5	*53.65*			22	*236.07*
		0108	30-Sep-19	811	0.85			3	*15.67*											12	*62.67*					1	*5.22*					16	*83.56*
		0109	30-Sep-19	711	0.98			2	*10.39*											45	*233.69*							5	*25.97*			52	*270.04*
		0110	30-Sep-19	616	0.65															24	*215.78*					1	*8.99*	3	*26.97*			28	*251.75*
		0112	30-Sep-19	636	1.07			1	*5.29*											55	*290.95*							2	*10.58*			58	*306.82*
		0113	30-Sep-19	427	0.75															56	*629.51*											56	*629.51*
		0114	30-Sep-19	657	0.95			1	*5.77*											46	*265.32*					4	*23.07*					51	*294.16*
		0116	30-Sep-19	542	0.98															50	*337.16*							1	*6.74*			51	*343.9*
		0119	30-Sep-19	836	0.75			4	*22.97*											19	*109.09*					3	*17.22*					26	*149.28*
	Session Summary			**596.5**	**9.00**	**0**	***0***	**12**	***8.05***	**0**	***0***	**0**	***0***	**1**	***0.67***	**0**	***0***	**0**	***0***	**383**	***256.83***	**0**	***0***	**0**	***0***	**13**	***8.72***	**18**	***12.07***	**0**	***0***	**427**	***286.34***
Section 1	6	0101	09-Oct-19	284	0.60															64	*1352.11*											64	*1352.11*
		0102	09-Oct-19	370	0.98															25	*249.48*							1	*9.98*			26	*259.46*
		0103	09-Oct-19	653	1.20			1	*4.59*											75	*344.56*					3	*13.78*	9	*41.35*			88	*404.29*
		0104	09-Oct-19	432	0.50									1	*16.67*					56	*933.33*			1	*16.67*			15	*250*			73	*1216.67*
		0105	09-Oct-19	507	1.10			2	*12.91*											43	*277.57*							8	*51.64*			53	*342.12*
		0107	09-Oct-19	400	0.55															24	*392.73*			1	*16.36*	2	*32.73*	3	*49.09*			30	*490.91*
		0108	09-Oct-19	640	0.85			1	*6.62*											23	*152.21*					1	*6.62*	13	*86.03*			38	*251.47*
		0109	09-Oct-19	561	0.98			1	*6.58*											35	*230.36*					1	*6.58*	7	*46.07*			44	*289.59*
		0110	09-Oct-19	571	0.65			2	*19.4*											13	*126.09*					5	*48.5*	6	*58.2*			26	*252.19*
		0111	09-Oct-19	624	1.00			1	*5.77*											30	*173.08*					1	*5.77*					32	*184.62*
		0112	09-Oct-19	633	1.07									1	*5.32*					70	*372.06*					5	*26.58*	1	*5.32*			77	*409.27*
		0113	09-Oct-19	453	0.75															46	*487.42*					1	*10.6*	29	*307.28*			76	*805.3*
		0114	09-Oct-19	573	0.95			2	*13.23*											93	*615.05*			1	*6.61*			4	*26.45*			100	*661.34*
		0116	09-Oct-19	491	0.98															53	*394.51*					1	*7.44*	3	*22.33*			57	*424.29*
		0119	09-Oct-19	543	0.75			1	*8.84*											27	*238.67*					4	*35.36*	8	*70.72*			40	*353.59*
	Session Summary			**515.7**	**13.00**	**0**	***0***	**11**	***5.91***	**0**	***0***	**0**	***0***	**2**	***1.07***	**0**	***0***	**0**	***0***	**677**	***363.54***	**0**	***0***	**3**	***1.61***	**24**	***12.89***	**107**	***57.46***	**0**	***0***	**824**	***442.48***
Section Total All Samples				**44597**	**68.46**	**0**	***0***	**63**	***0***	**0**	***0***	**0**	***0***	**10**	***0***	**0**	***0***	**0**	***0***	**3513**	***0***	**0**	***0***	**7**	***0***	**75**	***0***	**457**	***0***	**0**	***0***	**4125**	***0***
Section Average All Samples				**544**	**0.83**	**0**	***0***	**1**	***6.09***	**0**	***0***	**0**	***0***	**0**	***0.97***	**0**	***0***	**0**	***0***	**43**	***339.58***	**0**	***0***	**0**	***0.68***	**1**	***7.25***	**6**	***44.18***	**0**	***0***	**50**	***398.74***
Section Standard Error of Mean						**0**	***0***	**0.12**	***0.74***	**0**	***0***	**0**	***0***	**0.05**	***0.69***	**0**	***0***	**0**	***0***	**2.67**	***42.87***	**0**	***0***	**0.04**	***0.33***	**0.15**	***1.73***	**0.77**	***6.75***	**0**	***0***	**2.84**	***43.54***

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Arctic Grayling No.	Arctic Grayling CPUE	Bull Trout No.	Bull Trout CPUE	Burbot No.	Burbot CPUE	Goldeye No.	Goldeye CPUE	Kokanee No.	Kokanee CPUE	Lake Trout No.	Lake Trout CPUE	Lake Whitefish No.	Lake Whitefish CPUE	Mountain Whitefish No.	Mountain Whitefish CPUE	Northern Pike No.	Northern Pike CPUE	Northern Pikeminnow No.	Northern Pikeminnow CPUE	Rainbow Trout No.	Rainbow Trout CPUE	Sucker spp. No.	Sucker spp. CPUE	Walleye No.	Walleye CPUE	All Species No.	All Species CPUE
						Number Caught (CPUE = no. fish/km/h)																											
Section 3	1	0301	27-Aug-19	1121	1.80			1	1.78											29	51.74			2	3.57			4	7.14			36	64.23
		0302	27-Aug-19	1043	1.90															5	9.08			3	5.45			15	27.25	1	1.82	24	43.6
		0303	27-Aug-19	810	1.45															11	33.72							1	3.07			12	36.78
		0304	27-Aug-19	752	1.35															23	81.56							2	7.09	1	3.55	26	92.2
		0305	27-Aug-19	870	1.55															8	21.36							18	48.05			26	69.41
		0306	27-Aug-19	732	1.00					1	4.92									5	24.59							7	34.43			13	63.93
		0307	28-Aug-19	742	0.95															14	71.5							3	15.32			17	86.82
		0308	28-Aug-19	674	1.35															6	23.74											6	23.74
		0309	29-Aug-19	703	0.95															9	48.51			3	16.17			16	86.25			28	150.93
		0310	29-Aug-19	905	1.20															11	36.46			3	9.94			13	43.09	1	3.31	28	92.82
		0311	28-Aug-19	652	1.25																							2	8.83			2	8.83
		0312	28-Aug-19	1103	1.17			2	5.58											4	11.16			4	11.16			37	103.22	1	2.79	48	133.9
		0314	28-Aug-19	803	0.98															9	41.38			1	4.6	1	4.6	13	59.78			24	110.36
		0315	28-Aug-19	1356	1.70	1	1.56													26	40.6			1	1.56	1	1.56	21	32.8			50	78.08
		0316	28-Aug-19	870	1.48	1	2.81	2	5.61											31	86.97			1	2.81	3	8.42	10	28.05			48	134.66
	Session Summary			**875.7**	**20.00**	**2**	**0.41**	**5**	**1.03**	**1**	**0.21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**191**	**39.26**	**0**	**0**	**18**	**3.7**	**5**	**1.03**	**162**	**33.3**	**4**	**0.82**	**388**	**79.75**
Section 3	2	0301	04-Sep-19	1378	1.80	2	2.9													25	36.28					6	8.71	24	34.83			57	82.73
		0302	04-Sep-19	1023	1.90			2	3.7											29	53.71			1	1.85			4	7.41			36	66.68
		0303	04-Sep-19	757	1.45															16	52.48			1	3.28			7	22.96			24	78.71
		0304	04-Sep-19	751	1.35															15	53.26							5	17.75			20	71.02
		0305	07-Sep-19	1143	1.55															19	38.61			1	2.03			29	58.93	1	2.03	50	101.6
		0306	07-Sep-19	900	1.00			1	4											8	32			5	20			28	112			42	168
		0307	09-Sep-19	943	0.95															91	365.69							3	12.06			94	377.74
		0308	09-Sep-19	976	1.35															106	289.62			2	5.46			17	46.45			125	341.53
		0309	09-Sep-19	765	0.95			1	4.95											43	213			1	4.95			11	54.49			56	277.4
		0310	09-Sep-19	845	1.20															52	184.62							4	14.2			56	198.82
		0311	07-Sep-19	1099	1.25			2	5.24											14	36.69			3	7.86			39	102.2			58	151.99
		0312	07-Sep-19	1348	1.17			2	4.57											29	66.19							34	77.61	2	4.57	67	152.93
		0314	08-Sep-19	970	0.98	4	15.23													10	38.07			2	7.61			20	76.13			36	137.03
		0315	08-Sep-19	1552	1.70	4	5.46	3	4.09											50	68.22			1	1.36	5	6.82	17	23.2			80	109.16
		0316	08-Sep-19	1277	1.48	8	15.29	2	3.82											71	135.7			2	3.82	2	3.82	32	61.16	2	3.82	119	227.44
	Session Summary			**1048.5**	**20.00**	**18**	**3.09**	**13**	**2.23**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**578**	**99.23**	**0**	**0**	**19**	**3.26**	**13**	**2.23**	**274**	**47.04**	**5**	**0.86**	**920**	**157.94**
Section 3	3	0301	15-Sep-19	1215	1.80	3	4.94	1	1.65											63	103.7			1	1.65	2	3.29	17	27.98			87	143.21
		0302	15-Sep-19	1104	1.90			2	3.43											121	207.67			1	1.72			3	5.15	1	1.72	128	219.68
		0303	16-Sep-19	1052	1.45			1	2.36											118	278.48							7	16.52			126	297.36
		0304	17-Sep-19	774	1.35															53	182.6					2	6.89	30	103.36			85	292.85
		0305	16-Sep-19	1129	1.50															57	121.17							13	27.64			70	148.8
		0306	16-Sep-19	861	1.00															30	125.44							7	29.27			37	154.7
		0307	18-Sep-19	582	0.95			2	13.02											55	358.11							2	13.02			59	384.16
		0308	18-Sep-19	611	1.35															14	61.1			1	4.36			5	21.82			20	87.29
		0309	18-Sep-19	578	0.95											1	6.56			24	157.35			1	6.56			5	32.78			31	203.24
		0310	18-Sep-19	702	1.20															21	89.74							8	34.19			29	123.93
		0311	16-Sep-19	743	1.25			1	3.88	1	3.88									28	108.53							8	31.01			38	147.29
		0312	16-Sep-19	910	1.17			1	3.38											38	128.49							8	27.05			47	158.92
		0314	17-Sep-19	747	0.98			2	9.89											18	88.97							15	74.14			35	173
		0315	17-Sep-19	1177	1.70	2	3.6													90	161.93					2	3.6	12	21.59			106	190.71
		0316	17-Sep-19	969	1.48	2	5.04													35	88.16					2	5.04	26	65.49			65	163.72
	Session Summary			**876.9**	**20.00**	**7**	**1.44**	**10**	**2.05**	**1**	**0.21**	**0**	**0**	**0**	**0**	**1**	**0.21**	**0**	**0**	**765**	**157.03**	**0**	**0**	**4**	**0.82**	**8**	**1.64**	**166**	**34.07**	**1**	**0.21**	**963**	**197.67**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 3	4	0301	23-Sep-19	1364	1.80			4	5.87											62	90.91					11	16.13	9	13.2			86	126.1
		0302	23-Sep-19	1367	1.90			4	5.54											104	144.15							15	20.79			123	170.48
		0303	23-Sep-19	991	1.45			1	2.51											70	175.37							16	40.08			87	217.96
		0304	24-Sep-19	768	1.35															42	145.83					1	3.47					43	149.31
		0305	24-Sep-19	1069	1.47			2	4.58											60	137.45			1	2.29			29	66.44			92	210.76
		0306	24-Sep-19	707	1.00															35	178.22			2	10.18			9	45.83			46	234.23
		0307	26-Sep-19	747	0.95															66	334.81							22	111.6			88	446.42
		0308	26-Sep-19	799	1.35															115	383.81					1	3.34	10	33.38			126	420.53
		0309	25-Sep-19	953	0.95															29	115.31			1	3.98			13	51.69	2	7.95	45	178.94
		0310	25-Sep-19	1011	1.20			1	2.97											27	80.12							3	8.9			31	91.99
		0311	25-Sep-19	979	1.25															31	91.2							9	26.48			40	117.67
		0312	25-Sep-19	1294	1.17			1	2.38											41	97.49							20	47.56			62	147.43
		0314	24-Sep-19	846	0.98	1	4.36													16	69.83			1	4.36	1	4.36	8	34.92			27	117.84
		0315	25-Sep-19	1422	1.70	1	1.49	1	1.49											54	80.42					1	1.49	8	11.91			65	96.8
		0316	26-Sep-19	1084	1.48	2	4.5	2	4.5											70	157.61			1	2.25	10	22.52	8	18.01			93	209.39
	Session Summary			**1026.7**	**20.00**	**4**	**0.7**	**16**	**2.81**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**822**	**144.11**	**0**	**0**	**6**	**1.05**	**25**	**4.38**	**179**	**31.38**	**2**	**0.35**	**1054**	**184.79**
Section 3	5	0301	03-Oct-19	1258	1.80	1	1.59	1	1.59											63	100.16					3	4.77	6	9.54			74	117.65
		0302	01-Oct-19	1228	1.90			2	3.09											96	148.12							23	35.49			121	186.7
		0303	01-Oct-19	899	1.45															53	146.37					1	2.76	27	74.57			81	223.7
		0304	03-Oct-19	968	1.35															59	162.53											59	162.53
		0305	02-Oct-19	1188	1.55			2	3.91											91	177.91							3	5.87			96	187.68
		0306	02-Oct-19	776	1.00									1	4.64					16	74.23			1	4.64			4	18.56			22	102.06
		0307	02-Oct-19	770	0.95			2	9.84											62	305.13					1	4.92	13	63.98			78	383.87
		0308	02-Oct-19	732	1.35			1	3.64											100	364.3							13	47.36			114	415.3
		0309	02-Oct-19	748	0.95															14	70.93							13	65.86			27	136.79
		0310	03-Oct-19	989	1.20															31	94.03							3	9.1			34	103.13
		0311	02-Oct-19	895	1.25			1	3.22							1	3.22			11	35.4							4	12.87			17	54.7
		0312	02-Oct-19	1204	1.17											1	2.56			36	92			1	2.56			12	30.67			50	127.78
		0314	03-Oct-19	1033	0.98			1	3.57					1	3.57					21	75.06					5	17.87	3	10.72			31	110.8
		0315	03-Oct-19	1539	1.70	2	2.75													72	99.07					1	1.38	19	26.14	1	1.38	95	130.72
		0316	03-Oct-19	1023	1.48	3	7.16	1	2.39											55	131.22					2	4.77	4	9.54			65	155.08
	Session Summary			**1016.7**	**20.00**	**6**	**1.06**	**11**	**1.95**	**0**	**0**	**0**	**0**	**2**	**0.35**	**2**	**0.35**	**0**	**0**	**780**	**138.09**	**0**	**0**	**2**	**0.35**	**13**	**2.3**	**147**	**26.03**	**1**	**0.18**	**964**	**170.67**
Section 3	6	0302	12-Oct-19	661	1.90			1	2.87											72	206.39							4	11.47			77	220.72
		0303	12-Oct-19	873	1.45															90	255.95							2	5.69			92	261.64
		0305	12-Oct-19	907	1.55															65	166.45					1	2.56	4	10.24			70	179.25
		0306	12-Oct-19	650	1.00			1	5.54											20	110.77			1	5.54			6	33.23			28	155.08
		0307	12-Oct-19	583	0.95															47	305.5							5	32.5			52	338
		0308	12-Oct-19	694	1.35															33	126.8					1	3.84	2	7.68			36	138.33
		0309	12-Oct-19	614	0.95									1	6.17					25	154.29			1	6.17			2	12.34			29	178.98
		0310	12-Oct-19	730	1.20			2	8.22					2	8.22					25	102.74							8	32.88			37	152.05
		0311	12-Oct-19	598	1.25			1	4.82											5	24.08			1	4.82							7	33.71
		0312	12-Oct-19	794	1.17			1	3.88											26	100.76			1	3.88			3	11.63			31	120.13
		0314	12-Oct-19	880	0.98			2	8.39											20	83.92											22	92.31
		0315	12-Oct-19	1217	1.70															61	106.14					1	1.74	12	20.88			74	128.76
		0316	12-Oct-19	740	1.48	1	3.3													11	36.28							3	9.89			15	49.47
	Session Summary			**764.7**	**17.00**	**1**	**0.28**	**8**	**2.22**	**0**	**0**	**0**	**0**	**3**	**0.83**	**0**	**0**	**0**	**0**	**500**	**138.46**	**0**	**0**	**4**	**1.11**	**3**	**0.83**	**51**	**14.12**	**0**	**0**	**570**	**157.85**
Section Total All Samples				**82609**	**117.14**	**38**	**0**	**63**	**0**	**2**	**0**	**0**	**0**	**5**	**0**	**3**	**0**	**0**	**0**	**3636**	**0**	**0**	**0**	**53**	**0**	**67**	**0**	**979**	**0**	**13**	**0**	**4859**	**0**
Section Average All Samples				**939**	**1.33**	**0**	**1.24**	**1**	**2.06**	**0**	**0.07**	**0**	**0**	**0**	**0.16**	**0**	**0.1**	**0**	**0**	**41**	**119**	**0**	**0**	**1**	**1.73**	**1**	**2.19**	**11**	**32.04**	**0**	**0.43**	**55**	**159.03**
Section Standard Error of Mean						**0.13**	**0.28**	**0.1**	**0.3**	**0.02**	**0.07**	**0**	**0**	**0.03**	**0.13**	**0.02**	**0.09**	**0**	**0**	**3.25**	**9.56**	**0**	**0**	**0.11**	**0.39**	**0.2**	**0.41**	**1.01**	**2.96**	**0.05**	**0.13**	**3.5**	**9.99**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 5	1	0502	31-Aug-19	490	0.70	1	10.5	1	10.5											12	125.95							15	157.43			29	304.37
		0505	31-Aug-19	1100	1.00			2	6.55									1	3.27	3	9.82			1	3.27	3	9.82	11	36	1	3.27	22	72
		0506	31-Aug-19	864	1.00			1	4.17											1	4.17			3	12.5			13	54.17	1	4.17	19	79.17
		0507	01-Sep-19	533	0.78	1	8.66													19	164.53	1	8.66	6	51.96			9	77.93			36	311.73
		0508	24-Aug-19	700	0.92					2	11.12									6	33.36							2	11.12			10	55.6
		0509	01-Sep-19	760	0.98															9	43.72			1	4.86			10	48.58			20	97.17
		0510	26-Aug-19	797	1.13															9	35.98			1	4			19	75.95			29	115.92
		0511	26-Aug-19	485	0.72			1	10.31											15	154.64							3	30.93			19	195.88
		0512	26-Aug-19	791	1.28															15	53.33							6	21.33			21	74.67
		0513	24-Aug-19	512	0.77															4	36.53			2	18.26			14	127.84	1	9.13	21	191.76
		0514	26-Aug-19	512	0.56	1	12.56													8	100.45							19	238.56	1	12.56	29	364.12
		0515	26-Aug-19	633	0.97															19	111.4			2	11.73			16	93.81			37	216.93
		0516	31-Aug-19	740	0.80															5	30.41							7	42.57			12	72.97
		0517	01-Sep-19	639	0.35															2	32.19			1	16.1			6	96.58	2	32.19	11	177.06
	Session Summary			**682.6**	**12.00**	**3**	**1.32**	**5**	**2.2**	**2**	**0.88**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.44**	**127**	**55.82**	**1**	**0.44**	**17**	**7.47**	**3**	**1.32**	**150**	**65.92**	**6**	**2.64**	**315**	**138.44**
Section 5	2	0502	11-Sep-19	537	0.95															27	190.53							5	35.28			32	225.82
		0505	11-Sep-19	1083	1.00			2	6.65	1	3.32									11	36.57			2	6.65	1	3.32	6	19.94			23	76.45
		0506	11-Sep-19	1181	1.00					2	6.1									12	36.58							15	45.72			29	88.4
		0507	09-Sep-19	490	0.78															33	310.83	1	9.42			1	9.42	8	75.35			43	405.02
		0508	07-Sep-19	743	0.92					1	5.24									13	68.1			1	5.24			5	26.19	1	5.24	21	110
		0509	09-Sep-19	670	0.98			1	5.51											17	93.69							3	16.53			21	115.73
		0510	07-Sep-19	725	1.13	1	4.39													18	79.1			1	4.39			19	83.49	3	13.18	42	184.56
		0511	07-Sep-19	427	0.72															8	93.68							9	105.39			17	199.06
		0512	07-Sep-19	681	1.28															31	128.03							10	41.3			41	169.33
		0513	07-Sep-19	533	0.77															24	210.52							16	140.35			40	350.87
		0514	07-Sep-19	475	0.56															14	189.47	1	13.53					20	270.68			35	473.68
		0515	07-Sep-19	654	0.97															38	215.64							18	102.15	1	5.67	57	323.47
		0516	11-Sep-19	505	0.80															7	62.38			1	8.91			4	35.64			12	106.93
		0517	11-Sep-19	648	0.70															3	23.81							8	63.49			11	87.3
		05SC060	11-Sep-19	543	0.53																	1	12.51					3	37.53			4	50.04
	Session Summary			**659.7**	**13.00**	**1**	**0.42**	**3**	**1.26**	**4**	**1.68**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**256**	**107.46**	**3**	**1.26**	**5**	**2.1**	**2**	**0.84**	**149**	**62.55**	**5**	**2.1**	**428**	**179.66**
Section 5	3	0502	20-Sep-19	415	0.70			1	12.39											20	247.85							8	99.14			29	359.38
		0505	20-Sep-19	1128	1.00	1	3.19			1	3.19									6	19.15			2	6.38	3	9.57	6	19.15			19	60.64
		0506	20-Sep-19	955	1.00			1	3.77											10	37.7			3	11.31			14	52.77			28	105.55
		0508	16-Sep-19	731	0.92	2	10.65													29	154.4							9	47.92			40	212.96
		0509	20-Sep-19	689	0.98															12	64.31							7	37.51	3	16.08	22	117.9
		0510	16-Sep-19	863	1.13	1	3.69													20	73.83			1	3.69			16	59.07	1	3.69	39	143.97
		0511	16-Sep-19	541	0.72	1	9.24													22	203.33							4	36.97			27	249.54
		0512	16-Sep-19	880	1.28															27	86.29							10	31.96			37	118.25
		0513	16-Sep-19	712	0.77															15	98.5							20	131.33			35	229.83
		0514	16-Sep-19	633	0.56															10	101.56							15	152.34			25	253.89
		0515	16-Sep-19	481	0.97															58	447.52							21	162.03	1	7.72	80	617.27
		0517	20-Sep-19	532	0.35															1	19.33			5	96.67			8	154.67	1	19.33	15	290.01
	Session Summary			**713.3**	**10.00**	**5**	**2.52**	**2**	**1.01**	**1**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**230**	**116.08**	**0**	**0**	**11**	**5.55**	**3**	**1.51**	**138**	**69.65**	**6**	**3.03**	**396**	**199.86**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 5	4	0502	29-Sep-19	414	0.68															14	180.35							3	38.65			17	219
		0505	29-Sep-19	989	1.00			2	7.28											6	21.84							4	14.56	1	3.64	13	47.32
		0506	29-Sep-19	1000	1.00			1	3.6											12	43.2			3	10.8			7	25.2			23	82.8
		0507	28-Sep-19	476	0.78			1	9.7											34	329.67											35	339.37
		0508	25-Sep-19	758	0.92			2	10.27											32	164.3			2	10.27			6	30.81			42	215.65
		0509	28-Sep-19	694	0.98			2	10.64											10	53.2							5	26.6			17	90.45
		0510	25-Sep-19	855	1.13	1	3.73													30	111.78			3	11.18			9	33.54	1	3.73	44	163.95
		0511	25-Sep-19	475	0.72															22	231.58			1	10.53			4	42.11	1	10.53	28	294.74
		0512	25-Sep-19	864	1.28															21	68.36			2	6.51			15	48.83			38	123.7
		0513	28-Sep-19	549	0.77															26	221.42							7	59.61			33	281.03
		0514	25-Sep-19	492	0.56															22	287.46			1	13.07			21	274.39			44	574.91
		0515	28-Sep-19	751	0.97															21	103.78			1	4.94			32	158.14			54	266.86
		0517	28-Sep-19	585	0.35					1	17.58									3	52.75							1	17.58			5	87.91
	Session Summary			**684.8**	**11.00**	**1**	**0.48**	**8**	**3.82**	**1**	**0.48**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**253**	**120.91**	**0**	**0**	**13**	**6.21**	**0**	**0**	**114**	**54.48**	**3**	**1.43**	**393**	**187.82**
Section 5	5	0502	07-Oct-19	406	0.66	1	13.54													24	324.9							1	13.54			26	351.97
		0505	07-Oct-19	806	1.00															15	67							8	35.73			23	102.73
		0506	07-Oct-19	978	1.00			2	7.36											11	40.49			1	3.68			16	58.9			30	110.43
		0507	04-Oct-19	457	0.78	1	10.1													19	191.89											20	201.99
		0508	06-Oct-19	765	0.92															22	111.92							7	35.61			29	147.54
		0509	04-Oct-19	132	0.98									1	27.97					20	559.44	1	27.97					7	195.8			29	811.19
		0510	04-Oct-19	824	1.13	2	7.73													28	108.26			1	3.87			8	30.93			39	150.79
		0511	04-Oct-19	541	0.72			2	18.48											13	120.15					1	9.24	4	36.97			20	184.84
		0512	04-Oct-19	854	1.28															16	52.69			1	3.29			14	46.11			31	102.09
		0513	04-Oct-19	550	0.77															26	221.02							6	51			32	272.02
		0514	06-Oct-19	495	0.56															14	181.82							7	90.91	1	12.99	22	285.71
		0515	04-Oct-19	676	0.97			2	10.98											22	120.78							21	115.29			45	247.06
		0517	04-Oct-19	491	0.70																							2	20.95			2	20.95
	Session Summary			**613.5**	**11.00**	**4**	**2.13**	**6**	**3.2**	**0**	**0**	**0**	**0**	**1**	**0.53**	**0**	**0**	**0**	**0**	**230**	**122.69**	**1**	**0.53**	**3**	**1.6**	**1**	**0.53**	**101**	**53.88**	**1**	**0.53**	**348**	**185.64**
Section 5	6	0502	14-Oct-19	516	0.95			2	14.69											17	124.85							6	44.06	1	7.34	26	190.94
	Session Summary			**516**	**1.00**	**0**	**0**	**2**	**13.95**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17**	**118.6**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**41.86**	**1**	**6.98**	**26**	**181.4**
Section Total All Samples				**45404**	**58.98**	**14**	**0**	**26**	**0**	**8**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**1113**	**0**	**5**	**0**	**49**	**0**	**9**	**0**	**658**	**0**	**22**	**0**	**1906**	**0**
Section Average All Samples				**668**	**0.87**	**0**	**1.28**	**0**	**2.38**	**0**	**0.73**	**0**	**0**	**0**	**0.09**	**0**	**0**	**0**	**0.09**	**16**	**101.7**	**0**	**0.46**	**1**	**4.48**	**0**	**0.82**	**10**	**60.12**	**0**	**2.01**	**28**	**174.16**
Section Standard Error of Mean						**0.06**	**0.42**	**0.09**	**0.53**	**0.05**	**0.33**	**0**	**0**	**0.01**	**0.41**	**0**	**0**	**0.01**	**0.05**	**1.28**	**12.94**	**0.03**	**0.52**	**0.15**	**1.64**	**0.07**	**0.28**	**0.78**	**7.4**	**0.08**	**0.69**	**1.6**	**17.39**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																									
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 6	1	0601	20-Aug-19	509	1.20															1	5.89											1	5.89
		0602	21-Aug-19	592	0.90			1	6.76	1	6.76									3	20.27							3	20.27	1	6.76	9	60.81
		0603	20-Aug-19	826	1.30	1	3.35													17	56.99			1	3.35			3	10.06	2	6.71	24	80.46
		0604	21-Aug-19	630	1.00															5	28.57							7	40			12	68.57
		0605	20-Aug-19	479	0.80															9	84.55							1	9.39			10	93.95
		0606	21-Aug-19	956	1.40															11	29.59							5	13.45			16	43.04
		0607	21-Aug-19	903	1.00															20	79.73							14	55.81			34	135.55
		0608	20-Aug-19	578	1.00					1	6.23									12	74.74			1	6.23			3	18.69			17	105.88
		0609	21-Aug-19	647	1.00					1	5.56									9	50.08			2	11.13			4	22.26	1	5.56	17	94.59
		0610	21-Aug-19	622	0.85					1	6.81									4	27.24							9	61.28	1	6.81	15	102.14
		0611	21-Aug-19	664	0.90															18	108.43							8	48.19	1	6.02	27	162.65
		0612	21-Aug-19	589	0.85															3	21.57							3	21.57			6	43.14
		0613	27-Aug-19	653	0.90	1	6.13													8	49							15	91.88	1	6.13	25	153.14
		0614	20-Aug-19	527	0.98															14	98.09							4	28.03			18	126.11
		06SC036	27-Aug-19	748	0.40																							7	84.22	2	24.06	9	108.29
	Session Summary			**661.5**	**14.00**	**2**	**0.78**	**1**	**0.39**	**4**	**1.55**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**134**	**52.09**	**0**	**0**	**4**	**1.55**	**0**	**0**	**86**	**33.43**	**9**	**3.5**	**240**	**93.29**
Section 6	2	0601	01-Sep-19	864	1.20															5	17.36			2	6.94			12	41.67			19	65.97
		0602	05-Sep-19	585	0.90																	1	6.84					2	13.68			3	20.51
		0603	06-Sep-19	740	1.30															15	56.13							47	175.88	1	3.74	63	235.76
		0604	05-Sep-19	724	1.00					1	4.97									4	19.89			1	4.97			11	54.7			17	84.53
		0605	05-Sep-19	511	0.80	1	8.81													18	158.51							26	228.96			45	396.28
		0606	06-Sep-19	1072	1.40															26	62.37							11	26.39	4	9.59	41	98.35
		0607	06-Sep-19	796	1.00															5	22.61			1	4.52			70	316.58			76	343.72
		0608	05-Sep-19	641	1.00															14	78.63							33	185.34	1	5.62	48	269.58
		0609	06-Sep-19	769	1.00																			3	14.04			7	32.77	3	14.04	13	60.86
		0610	06-Sep-19	773	0.85			1	5.48											2	10.96			1	5.48			19	104.1			23	126.02
		0611	06-Sep-19	804	0.90																	1	4.98					14	69.65			15	74.63
		0612	08-Sep-19	520	0.85	2	16.29													24	195.48							13	105.88			39	317.65
		0613	08-Sep-19	654	0.90															9	55.05							16	97.86			25	152.91
		0614	05-Sep-19	647	0.98															12	68.48							47	268.22			59	336.7
		06PIN01	01-Sep-19	833	1.45															1	2.98			1	2.98			12	35.77	1	2.98	15	44.71
		06PIN02	05-Sep-19	541	1.00															1	6.65							5	33.27	4	26.62	10	66.54
		06SC036	06-Sep-19	543	0.28																							7	162.84	2	46.53	9	209.36
		06SC047	02-Sep-19	561	0.35																	2	36.67					2	36.67			4	73.34
	Session Summary			**698.8**	**17.00**	**3**	**0.91**	**1**	**0.3**	**1**	**0.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**136**	**41.21**	**4**	**1.21**	**9**	**2.73**	**0**	**0**	**354**	**107.28**	**16**	**4.85**	**524**	**158.79**
Section 6	3	0601	13-Sep-19	692	1.20															12	52.02							4	17.34			16	69.36
		0602	13-Sep-19	610	0.90			2	13.11											2	13.11	1	6.56					2	13.11	1	6.56	8	52.46
		0603	14-Sep-19	689	1.25															22	91.96							10	41.8	1	4.18	33	137.94
		0604	14-Sep-19	637	1.00															11	62.17			1	5.65	1	5.65	9	50.86			22	124.33
		0605	14-Sep-19	514	0.80															25	218.87							14	122.57			39	341.44
		0606	14-Sep-19	914	1.40	1	2.81	1	2.81											19	53.45	1	2.81	1	2.81			11	30.95	2	5.63	36	101.28
		0607	15-Sep-19	812	1.00															40	177.34							15	66.5	2	8.87	57	252.71
		0608	14-Sep-19	620	1.00	1	5.81													11	63.87	1	5.81					15	87.1	1	5.81	29	168.39
		0609	14-Sep-19	758	1.10															11	47.49	1	4.32	2	8.64			25	107.94	3	12.95	42	181.34
		0610	15-Sep-19	728	0.85															13	75.63	2	11.64	2	11.64			30	174.53	1	5.82	48	279.25
		0611	15-Sep-19	722	0.90															14	77.56							25	138.5	4	22.16	43	238.23
		0612	15-Sep-19	535	0.85	5	39.58													25	197.91			1	7.92			11	87.08	1	7.92	43	340.41
		0613	15-Sep-19	632	0.90	1	6.33													6	37.97							6	37.97	1	6.33	14	88.61
		0614	13-Sep-19	640	0.98			1	5.77											12	69.23							16	92.31			29	167.31
		06PIN01	13-Sep-19	1039	1.50															4	9.24							12	27.72	1	2.31	17	39.27
		06PIN02	13-Sep-19	451	1.00			1	7.98											12	95.79							2	15.96			15	119.73
		06SC036	15-Sep-19	352	0.25																							8	327.27			8	327.27
		06SC047	13-Sep-19	366	0.37																							2	53.17	1	26.58	3	79.75
	Session Summary			**650.6**	**17.00**	**8**	**2.6**	**5**	**1.63**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**239**	**77.79**	**6**	**1.95**	**7**	**2.28**	**1**	**0.33**	**217**	**70.63**	**19**	**6.18**	**502**	**163.4**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 6	4	0601	22-Sep-19	812	1.20	1	3.69													17	62.81			2	7.39			9	33.25			29	107.14
		0602	22-Sep-19	525	0.90															5	38.1							1	7.62	1	7.62	7	53.33
		0603	22-Sep-19	2079	1.30	1	1.33													24	31.97			1	1.33			55	73.26	2	2.66	83	110.56
		0604	23-Sep-19	677	1.00			1	5.32											12	63.81			1	5.32			4	21.27			18	95.72
		0605	23-Sep-19	482	0.80															16	149.38							21	196.06			37	345.44
		0606	23-Sep-19	1429	1.40															14	25.19			1	1.8			27	48.59	2	3.6	44	79.18
		0607	24-Sep-19	730	1.00															16	78.9							48	236.71	3	14.79	67	330.41
		0608	23-Sep-19	593	1.00			2	12.14											17	103.2			1	6.07			7	42.5			27	163.91
		0609	23-Sep-19	603	1.00															7	41.79							2	11.94			9	53.73
		0610	23-Sep-19	671	0.85															6	37.87							13	82.05			19	119.93
		0611	23-Sep-19	608	0.90															14	92.11			1	6.58			6	39.47	1	6.58	22	144.74
		0612	24-Sep-19	591	0.85	1	7.17	1	7.17											15	107.49							6	43			23	164.83
		0613	24-Sep-19	565	0.90	1	7.08													10	70.8							6	42.48			17	120.35
		0614	22-Sep-19	1191	0.98															15	46.5							29	89.91			44	136.41
		06PIN01	22-Sep-19	933	1.50															17	43.73							11	28.3	1	2.57	29	74.6
		06PIN02	22-Sep-19	503	1.00															11	78.73							8	57.26	2	14.31	21	150.3
		06SC047	22-Sep-19	466	0.38																	2	41.2					3	61.8	2	41.2	7	144.21
	Session Summary			**791.6**	**17.00**	**4**	**1.07**	**4**	**1.07**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**216**	**57.78**	**2**	**0.54**	**7**	**1.87**	**0**	**0**	**256**	**68.48**	**14**	**3.75**	**503**	**134.56**
Section 6	5	0601	02-Oct-19	922	1.20			1	3.25											24	78.09			1	3.25	1	3.25	5	16.27	3	9.76	35	113.88
		0602	02-Oct-19	564	0.90			2	14.18											11	78.01											13	92.2
		0603	02-Oct-19	916	1.30	2	6.05													29	87.67			1	3.02			38	114.88			70	211.62
		0604	02-Oct-19	708	1.00			1	5.08											20	101.69			1	5.08			2	10.17			24	122.03
		0605	03-Oct-19	521	0.80															38	328.21							15	129.56			53	457.77
		0606	03-Oct-19	1084	1.40	1	2.37	1	2.37											40	94.89							24	56.93	1	2.37	67	158.94
		0607	03-Oct-19	846	1.00															17	72.34							41	174.47	1	4.26	59	251.06
		0608	03-Oct-19	569	1.00	1	6.33													47	297.36							2	12.65			50	316.34
		0609	03-Oct-19	698	1.00															20	103.15							4	20.63			24	123.78
		0610	03-Oct-19	739	0.85															29	166.2							5	28.66			34	194.86
		0611	03-Oct-19	778	0.90	1	5.14													33	169.67							8	41.13			42	215.94
		0612	03-Oct-19	574	0.85	2	14.76	1	7.38											32	236.11							2	14.76			37	273.01
		0613	03-Oct-19	773	0.90	1	5.17													26	134.54			1	5.17			10	51.75	1	5.17	39	201.81
		0614	02-Oct-19	776	0.98	1	4.76													16	76.13			1	4.76			33	157.02	1	4.76	52	247.42
		06PIN01	02-Oct-19	951	1.50															110	277.6			2	5.05			1	2.52			113	285.17
		06PIN02	02-Oct-19	532	1.00															34	230.08			1	6.77	1	6.77					36	243.61
		06SC047	02-Oct-19	467	0.30																	1	25.7					1	25.7			2	51.39
	Session Summary			**730.5**	**17.00**	**9**	**2.61**	**6**	**1.74**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**526**	**152.48**	**1**	**0.29**	**8**	**2.32**	**2**	**0.58**	**191**	**55.37**	**7**	**2.03**	**750**	**217.42**
Section 6	6	0601	10-Oct-19	619	1.20															12	58.16							1	4.85			13	63
		0602	10-Oct-19	559	0.90															8	57.25											8	57.25
		0603	10-Oct-19	704	1.30	1	3.93	1	3.93											29	114.07							4	15.73	1	3.93	36	141.61
		0604	10-Oct-19	648	1.00															24	133.33											24	133.33
		0605	10-Oct-19	510	0.80															27	238.24							4	35.29			31	273.53
		0606	10-Oct-19	888	1.40	3	8.69													18	52.12	1	2.9	1	2.9			7	20.27	1	2.9	31	89.77
		0607	10-Oct-19	828	1.00			1	4.35											11	47.83			2	8.7			18	78.26			32	139.13
		0608	10-Oct-19	520	1.00	1	6.92													32	221.54							2	13.85			35	242.31
		0609	10-Oct-19	676	1.00	1	5.33	1	5.33											27	143.79							1	5.33			30	159.76
		0610	11-Oct-19	627	0.85			1	6.75											29	195.89							2	13.51			32	216.16
		0611	10-Oct-19	603	0.90	1	6.63	1	6.63											27	179.1	1	6.63					2	13.27			32	212.27
		0612	11-Oct-19	546	0.85	2	15.51							1	7.76					19	147.38							2	15.51	1	7.76	25	193.92
		0613	11-Oct-19	618	0.90															22	142.39											22	142.39
		0614	10-Oct-19	649	0.98			2	11.38											15	85.34							13	73.96	2	11.38	32	182.06
		06PIN01	10-Oct-19	1206	1.50															26	51.74							1	1.99			27	53.73
		06PIN02	10-Oct-19	434	1.00															8	66.36											8	66.36
		06SC036	11-Oct-19	695	0.47																							2	22.04			2	22.04
		06SC047	10-Oct-19	411	0.55															5	79.63											5	79.63
	Session Summary			**652.3**	**18.00**	**9**	**2.76**	**7**	**2.15**	**0**	**0**	**0**	**0**	**1**	**0.31**	**0**	**0**	**0**	**0**	**339**	**103.94**	**2**	**0.61**	**3**	**0.92**	**0**	**0**	**59**	**18.09**	**5**	**1.53**	**425**	**130.31**
Section Total All Samples				**71829**	**100.30**	**35**	**0**	**24**	**0**	**5**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1590**	**0**	**15**	**0**	**38**	**0**	**3**	**0**	**1163**	**0**	**70**	**0**	**2944**	**0**
Section Average All Samples				**697**	**0.97**	**0**	**1.8**	**0**	**1.24**	**0**	**0.26**	**0**	**0**	**0**	**0.05**	**0**	**0**	**0**	**0**	**15**	**81.88**	**0**	**0.77**	**0**	**1.96**	**0**	**0.15**	**11**	**59.89**	**1**	**3.6**	**29**	**151.6**
Section Standard Error of Mean						**0.07**	**0.5**	**0.05**	**0.3**	**0.02**	**0.13**	**0**	**0**	**0.01**	**0.08**	**0**	**0**	**0**	**0**	**1.4**	**7.05**	**0.04**	**0.6**	**0.06**	**0.3**	**0.02**	**0.09**	**1.31**	**6.72**	**0.1**	**0.79**	**1.94**	**9.39**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 7	1	0701	30-Aug-19	698	0.78																			1	6.57			6	39.42			7	45.99
		0702	27-Aug-19	530	0.95	1	7.15													4	28.6							14	100.1			19	135.85
		0703	27-Aug-19	671	0.95															1	5.65			2	11.3			14	79.07			17	96.01
		0704	28-Aug-19	584	1.00															10	61.64							8	49.32			18	110.96
		0705	28-Aug-19	695	1.00															5	25.9							4	20.72	1	5.18	10	51.8
		0706	28-Aug-19	948	1.00																					1	3.8	10	37.97	1	3.8	12	45.57
		0707	28-Aug-19	667	0.98															17	93.63			1	5.51			2	11.01			20	110.15
		0708	27-Aug-19	638	1.22					1	4.63									1	4.63							8	37	1	4.63	11	50.88
		0709	27-Aug-19	655	1.00															9	49.47							22	120.92			31	170.38
		0710	28-Aug-19	943	1.40															2	5.45			2	5.45			13	35.45	1	2.73	18	49.08
		0711	28-Aug-19	822	1.39	1	3.15													14	44.11			1	3.15			12	37.81			28	88.22
		0712	28-Aug-19	730	1.06															7	32.41			1	4.63			6	27.78			14	64.83
		0713	30-Aug-19	495	0.98															8	59.37			1	7.42							9	66.79
		0714	30-Aug-19	764	1.27															2	7.39							3	11.09			5	18.48
		07BEA01	27-Aug-19	798	0.43																							1	10.49			1	10.49
		07BEA02	27-Aug-19	380	0.60																							3	47.37	1	15.79	4	63.16
		07KIS01	30-Aug-19	475	1.04					1	7.29													1	7.29			23	167.61			25	182.19
		07SC012	30-Aug-19	953	0.22																							24	412.1	2	34.34	26	446.44
		07SC022	28-Aug-19	360	0.36																			1	27.78			1	27.78	6	166.67	8	222.22
	Session Summary			**674**	**18.00**	**2**	**0.59**	**0**	**0**	**2**	**0.59**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**80**	**23.74**	**0**	**0**	**11**	**3.26**	**1**	**0.3**	**174**	**51.63**	**13**	**3.86**	**283**	**83.98**
Section 7	2	0701	08-Sep-19	736	0.78															1	6.23							14	87.23			15	93.46
		0702	10-Sep-19	509	0.93															13	98.87							3	22.82	2	15.21	18	136.89
		0703	08-Sep-19	777	0.95					1	4.88									13	63.4							10	48.77			24	117.05
		0703	10-Sep-19	868	0.95															7	30.56			1	4.37			8	34.93	1	4.37	17	74.22
		0704	10-Sep-19	777	1.00															14	64.86							15	69.5	2	9.27	31	143.63
		0705	12-Sep-19	674	1.00															10	53.41							7	37.39	3	16.02	20	106.82
		0706	12-Sep-19	908	1.00															3	11.89			3	11.89			10	39.65	2	7.93	18	71.37
		0707	12-Sep-19	671	0.98															9	49.27							7	38.32			16	87.59
		0708	08-Sep-19	743	1.24			1	3.91											9	35.17							5	19.54	1	3.91	16	62.52
		0709	10-Sep-19	819	1.00															12	52.75							25	109.89	1	4.4	38	167.03
		0710	12-Sep-19	928	1.40															10	27.71							15	41.56	1	2.77	26	72.04
		0711	12-Sep-19	862	1.39			1	3											24	72.11	1	3					10	30.05			36	108.16
		0712	12-Sep-19	815	1.06															9	37.33							26	107.84	1	4.15	36	149.31
		0713	12-Sep-19	458	0.88															18	160.78			1	8.93			1	8.93			20	178.64
		0714	12-Sep-19	937	1.27					1	3.01									51	153.68							8	24.11			60	180.8
		07BEA01	08-Sep-19	474	0.43																							2	35.33			2	35.33
		07BEA02	08-Sep-19	483	0.60															3	37.27							1	12.42	2	24.84	6	74.53
		07KIS01	12-Sep-19	549	0.84																							7	54.64	1	7.81	8	62.45
		07SC012	12-Sep-19	905	0.22			1	18.08																			10	180.81			11	198.9
		07SC022	12-Sep-19	420	0.36																							1	23.81	2	47.62	3	71.43
	Session Summary			**715.6**	**18.00**	**0**	**0**	**3**	**0.84**	**2**	**0.56**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**206**	**57.57**	**1**	**0.28**	**5**	**1.4**	**0**	**0**	**185**	**51.7**	**19**	**5.31**	**421**	**117.66**
Section 7	3	0701	17-Sep-19	857	0.78															1	5.35							10	53.51	3	16.05	14	74.92
		0702	17-Sep-19	572	0.95	1	6.62													9	59.62			1	6.62			8	53			19	125.87
		0703	18-Sep-19	666	0.95					2	11.38									1	5.69							8	45.52	1	5.69	12	68.28
		0704	18-Sep-19	752	1.00					1	4.79									16	76.6							2	9.57			19	90.96
		0705	18-Sep-19	685	1.00															6	31.53			1	5.26			3	15.77			10	52.55
		0706	18-Sep-19	869	1.00															2	8.29			1	4.14			12	49.71	4	16.57	19	78.71
		0707	19-Sep-19	602	0.98															7	42.71							1	6.1			8	48.82
		0708	17-Sep-19	675	1.24															5	21.51							2	8.6	1	4.3	8	34.41
		0709	17-Sep-19	784	1.00															17	78.06			1	4.59			11	50.51	1	4.59	30	137.76
		0710	18-Sep-19	1046	1.40															2	4.92							7	17.21	2	4.92	11	27.04
		0711	18-Sep-19	902	1.39	1	2.87													19	54.56							16	45.94	1	2.87	37	106.24
		0712	19-Sep-19	711	1.06			1	4.75											13	61.81			1	4.75			21	99.84	4	19.02	40	190.17
		0713	19-Sep-19	523	0.98															8	56.19							3	21.07	1	7.02	12	84.29
		0714	19-Sep-19	777	1.27															31	112.65							2	7.27			33	119.92
		07BEA01	17-Sep-19	367	0.43																							1	22.81			1	22.81
		07BEA02	17-Sep-19	518	0.60															1	11.58									2	23.17	3	34.75
		07KIS01	19-Sep-19	462	0.67					1	11.63																	2	23.26			3	34.89
		07SC012	19-Sep-19	335	0.22																							11	537.31			11	537.31
		07SC022	18-Sep-19	404	0.36																	1	24.75					2	49.5	1	24.75	4	99.01
	Session Summary			**658.3**	**17.00**	**2**	**0.64**	**1**	**0.32**	**4**	**1.29**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**138**	**44.39**	**1**	**0.32**	**5**	**1.61**	**0**	**0**	**122**	**39.25**	**21**	**6.76**	**294**	**94.58**

Number Caught (CPUE = no. fish/km/h)

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						Number Caught (CPUE = no. fish/km/h)																											
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 7	4	0701	24-Sep-19	665	0.78																							18	124.13	1	6.9	19	131.03
		0702	01-Oct-19	604	0.95															14	87.84											14	87.84
		0703	30-Sep-19	896	0.95															7	29.61							15	63.44	3	12.69	25	105.73
		0704	01-Oct-19	702	1.00															23	117.95							5	25.64			28	143.59
		0705	01-Oct-19	767	1.00															15	70.4							1	4.69			16	75.1
		0706	01-Oct-19	1093	1.00															2	6.59			1	3.29			2	6.59			5	16.47
		0707	30-Sep-19	675	0.98	1	5.44													15	81.63							6	32.65			22	119.73
		0708	01-Oct-19	740	1.24			1	3.92											8	31.39							2	7.85	3	11.77	14	54.93
		0709	01-Oct-19	842	1.00															8	34.2							12	51.31			20	85.51
		0710	01-Oct-19	1050	1.10			1	3.12											3	9.35							8	24.94	6	18.7	18	56.1
		0711	30-Sep-19	982	1.39			1	2.64											41	108.13					1	2.64	2	5.27			45	118.68
		0712	30-Sep-19	945	1.06															16	57.23							9	32.19	1	3.58	26	93
		0713	30-Sep-19	588	0.98	1	6.25													20	124.95											21	131.2
		0714	30-Sep-19	1033	1.27	1	2.73													31	84.73							3	8.2			35	95.67
		07BEA01	24-Sep-19	399	0.43																							2	41.97	12	251.79	14	293.76
		07BEA02	24-Sep-19	354	0.60			1	16.95	3	50.85																			3	50.85	7	118.64
		07KIS01	28-Sep-19	291	1.04					2	23.79									2	23.79							5	59.48			9	107.06
		07SC012	28-Sep-19	986	0.22																							7	116.17	2	33.19	9	149.36
	Session Summary			**756.2**	**17.00**	**3**	**0.84**	**4**	**1.12**	**5**	**1.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**205**	**57.41**	**0**	**0**	**1**	**0.28**	**1**	**0.28**	**97**	**27.16**	**31**	**8.68**	**347**	**97.17**
Section 7	5	0701	06-Oct-19	632	0.78																							9	65.31	3	21.77	12	87.08
		0702	08-Oct-19	506	0.95															27	202.21							10	74.89			37	277.1
		0703	08-Oct-19	715	0.95															3	15.9							13	68.9	2	10.6	18	95.4
		0704	08-Oct-19	545	1.00			1	6.61											17	112.29							16	105.69			34	224.59
		0705	08-Oct-19	721	1.00			1	4.99											7	34.95							4	19.97			12	59.92
		0706	08-Oct-19	861	1.00															5	20.91							2	8.36			7	29.27
		0707	08-Oct-19	573	0.98															5	32.05							9	57.7			14	89.75
		0708	06-Oct-19	571	1.24			1	5.08											4	20.34							2	10.17			7	35.59
		0709	08-Oct-19	729	1.00			1	4.94											10	49.38							21	103.7	1	4.94	33	162.96
		0710	08-Oct-19	863	1.40			1	2.98											4	11.92							5	14.9			10	29.8
		0711	08-Oct-19	875	1.39	1	2.96													46	136.16							24	71.04			71	210.15
		0712	05-Oct-19	739	1.06															7	32.02							24	109.78	1	4.57	32	146.37
		0713	05-Oct-19	485	0.98															22	166.63							3	22.72			25	189.35
		0714	05-Oct-19	765	1.27															11	40.6							2	7.38			13	47.98
		07BEA02	06-Oct-19	372	0.60															2	32.26									4	64.52	6	96.77
		07SC012	05-Oct-19	910	0.22															4	71.93			1	17.98			6	107.89			11	197.8
		07SC022	08-Oct-19	364	0.36																							1	27.47			1	27.47
	Session Summary			**660.4**	**16.00**	**1**	**0.34**	**5**	**1.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**174**	**59.28**	**0**	**0**	**1**	**0.34**	**0**	**0**	**151**	**51.45**	**11**	**3.75**	**343**	**116.86**
Section 7	6	0701	11-Oct-19	759	0.78															3	18.13							9	54.38	15	90.63	27	163.14
		0702	11-Oct-19	538	0.95	1	7.04													25	176.09							1	7.04			27	190.18
		0703	11-Oct-19	618	0.95			1	6.13											7	42.92	1	6.13					17	104.24	3	18.4	29	177.82
		0704	11-Oct-19	637	1.00			2	11.3											15	84.77							11	62.17	1	5.65	29	163.89
		0705	13-Oct-19	597	1.00			1	6.03											7	42.21							4	24.12			12	72.36
		0706	13-Oct-19	861	1.00															5	20.91							13	54.36	1	4.18	19	79.44
		0707	13-Oct-19	508	0.82															6	51.85							8	69.14			14	120.99
		0708	11-Oct-19	1560	1.24															12	22.33							3	5.58	1	1.86	16	29.78
		0709	11-Oct-19	633	1.00	1	5.69													16	91							19	108.06			36	204.74
		0710	13-Oct-19	878	1.40															6	17.57			1	2.93			19	55.65	5	14.64	31	90.79
		0711	13-Oct-19	776	1.39	2	6.68													16	53.4							6	20.03	1	3.34	25	83.44
		0712	13-Oct-19	748	1.06			1	4.52											12	54.23							19	85.86	1	4.52	33	149.13
		0713	13-Oct-19	569	0.98															7	45.19							4	25.82			11	71.02
		0714	13-Oct-19	883	1.27															17	54.36							4	12.79			21	67.15
		07BEA01	11-Oct-19	590	0.43															2	28.38							1	14.19	1	14.19	4	56.76
		07BEA02	11-Oct-19	415	0.60			1	14.46											7	101.2							1	14.46	3	43.37	12	173.49
		07KIS01	13-Oct-19	624	0.74															6	46.78							3	23.39			9	70.17
		07SC012	13-Oct-19	419	0.22			1	39.05																			2	78.11	1	39.05	4	156.22
		07SC022	11-Oct-19	498	0.36	1	20.08																					4	80.32			5	100.4
	Session Summary			**690.1**	**17.00**	**5**	**1.53**	**7**	**2.15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**169**	**51.86**	**1**	**0.31**	**1**	**0.31**	**0**	**0**	**148**	**45.42**	**33**	**10.13**	**364**	**111.7**
Section Total All Samples				**77575**	**103.64**	**13**	**0**	**20**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**972**	**0**	**3**	**0**	**24**	**0**	**2**	**0**	**877**	**0**	**128**	**0**	**2052**	**0**
Section Average All Samples				**693**	**0.93**	**0**	**0.65**	**0**	**1**	**0**	**0.65**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**48.72**	**0**	**0.15**	**0**	**1.2**	**0**	**0.1**	**8**	**43.96**	**1**	**6.42**	**18**	**102.85**
Section Standard Error of Mean						**0.03**	**0.23**	**0.04**	**0.45**	**0.04**	**0.52**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.91**	**4.14**	**0.02**	**0.23**	**0.05**	**0.36**	**0.01**	**0.04**	**0.64**	**6.5**	**0.2**	**2.92**	**1.15**	**7.31**

Table E3 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h) Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 9	1	0901	24-Aug-19	616	1.10					2	10.63																	7	37.19			9	47.82
		0902	24-Aug-19	605	1.00															1	5.95											1	5.95
		0903	24-Aug-19	623	1.10					2	10.51	1	5.25															2	10.51	1	5.25	6	31.52
		0904	24-Aug-19	717	1.10					1	4.56																	2	9.13			3	13.69
		0905	24-Aug-19	723	1.10																							1	4.53			1	4.53
		0906	25-Aug-19	885	1.00					1	4.07																	3	12.2			4	16.27
		0907	25-Aug-19	782	1.20																							1	3.84			1	3.84
		0908	25-Aug-19	606	1.10															1	5.4							1	5.4			2	10.8
		0909	25-Aug-19	843	0.95															1	4.5							1	4.5			2	8.99
		0910	25-Aug-19	1179	1.10					2	5.55																	4	11.1	3	8.33	9	24.98
		0911	25-Aug-19	632	1.00					1	5.7																	3	17.09			4	22.78
		0912	25-Aug-19	701	1.10																							2	9.34			2	9.34
		0914	25-Aug-19	482	0.95															1	7.86									1	7.86	2	15.72
		09SC053	24-Aug-19	379	0.16					1	59.37																	2	118.73			3	178.1
		09SC061	25-Aug-19	716	0.68					1	7.45									1	7.45							3	22.35	1	7.45	6	44.69
	Session Summary			**699.3**	**15.00**	**0**	**0**	**0**	**0**	**11**	**3.78**	**1**	**0.34**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**1.72**	**0**	**0**	**0**	**0**	**0**	**0**	**32**	**10.98**	**6**	**2.06**	**55**	**18.88**
Section 9	2	0901	10-Sep-19	815	1.10															12	48.19							11	44.17	4	16.06	27	108.42
		0902	10-Sep-19	826	1.00							3	13.08							4	17.43			1	4.36			5	21.79	3	13.08	16	69.73
		0903	10-Sep-19	754	1.10							1	4.34							18	78.13	1	4.34	1	4.34			22	95.49	3	13.02	46	199.66
		0904	10-Sep-19	784	1.10			1	4.17											3	12.52							7	29.22	1	4.17	12	50.09
		0905	10-Sep-19	909	1.10															17	61.21							3	10.8	3	10.8	23	82.81
		0906	11-Sep-19	981	1.00					1	3.67									3	11.01			1	3.67			17	62.39			22	80.73
		0907	11-Sep-19	1010	1.20															4	11.88	1	2.97					12	35.64			17	50.5
		0908	11-Sep-19	715	1.10															7	32.04							6	27.46			13	59.5
		0909	11-Sep-19	758	0.95															5	25							8	39.99			13	64.99
		0910	10-Sep-19	974	1.10															1	3.36							5	16.8	1	3.36	7	23.52
		0911	11-Sep-19	752	1.00					1	4.79																	7	33.51	1	4.79	9	43.09
		0912	11-Sep-19	835	1.10															3	11.76							11	43.11			14	54.87
		0913	11-Sep-19	598	0.90															2	13.38							1	6.69			3	20.07
		0914	11-Sep-19	571	0.95															1	6.64											1	6.64
		09SC053	10-Sep-19	376	0.16																							1	59.84			1	59.84
		09SC061	11-Sep-19	720	0.68																							11	81.48			11	81.48
	Session Summary			**773.6**	**16.00**	**0**	**0**	**1**	**0.29**	**2**	**0.58**	**4**	**1.16**	**0**	**0**	**0**	**0**	**0**	**0**	**80**	**23.27**	**2**	**0.58**	**3**	**0.87**	**0**	**0**	**127**	**36.94**	**16**	**4.65**	**235**	**68.35**
Section 9	3	0901	19-Sep-19	716	1.10					1	4.57									11	50.28			2	9.14			11	50.28			25	114.27
		0902	19-Sep-19	423	1.00							2	17.02											2	17.02			6	51.06	1	8.51	11	93.62
		0903	19-Sep-19	662	1.10															6	29.66							19	93.93			25	123.59
		0904	19-Sep-19	655	1.10					1	5									1	5							4	19.99	1	5	7	34.98
		0905	19-Sep-19	812	1.10					2	8.06									4	16.12							3	12.09	1	4.03	10	40.3
		0906	19-Sep-19	827	1.00					1	4.35																	15	65.3			16	69.65
		0907	19-Sep-19	916	1.20															3	9.83							17	55.68			20	65.5
		0908	20-Sep-19	789	1.10															4	16.59							12	49.78	1	4.15	17	70.52
		0909	20-Sep-19	853	0.95																							20	88.85			20	88.85
		0910	19-Sep-19	1026	1.10							4	12.76															10	31.9	1	3.19	15	47.85
		0911	19-Sep-19	578	1.00			1	6.23											1	6.23			1	6.23			4	24.91			7	43.6
		0912	20-Sep-19	471	0.60																							7	89.17			7	89.17
		0913	20-Sep-19	632	0.90																							2	12.66			2	12.66
		0914	20-Sep-19	485	0.95															1	7.81							1	7.81	1	7.81	3	23.44
		09SC053	19-Sep-19	460	0.26																							4	120.4			4	120.4
		09SC061	19-Sep-19	737	0.68																							7	50.66	1	7.24	8	57.89
	Session Summary			**690.1**	**15.00**	**0**	**0**	**1**	**0.35**	**5**	**1.74**	**6**	**2.09**	**0**	**0**	**0**	**0**	**0**	**0**	**31**	**10.78**	**0**	**0**	**5**	**1.74**	**0**	**0**	**142**	**49.38**	**7**	**2.43**	**197**	**68.51**

Table E3 Concluded.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																											
						Arctic Grayling		Bull Trout		Burbot		Goldeye		Kokanee		Lake Trout		Lake Whitefish		Mountain Whitefish		Northern Pike		Northern Pikeminnow		Rainbow Trout		Sucker spp.		Walleye		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 9	4	0901	27-Sep-19	721	1.10															9	40.85							2	9.08			11	49.93
		0902	27-Sep-19	900	1.00	1	4													2	8					1	4	6	24			10	40
		0903	27-Sep-19	926	1.10															4	14.14							10	35.34	1	3.53	15	53.01
		0904	27-Sep-19	1033	1.10															9	28.51							9	28.51	2	6.34	20	63.36
		0905	27-Sep-19	799	1.10															2	8.19							2	8.19	1	4.1	5	20.48
		0906	27-Sep-19	996	1.00															4	14.46							14	50.6			18	65.06
		0907	27-Sep-19	1112	1.20															10	26.98							23	62.05			33	89.03
		0908	28-Sep-19	788	1.10															4	16.61							14	58.14			18	74.76
		0909	28-Sep-19	744	0.95																							13	66.21			13	66.21
		0910	27-Sep-19	1316	1.10															1	2.49							11	27.36			12	29.84
		0911	28-Sep-19	697	1.00															3	15.49							12	61.98	3	15.49	18	92.97
		0912	28-Sep-19	535	0.60																							2	22.43			2	22.43
		0913	28-Sep-19	634	0.90															1	6.31											1	6.31
		0914	28-Sep-19	569	0.95															1	6.66							2	13.32	1	6.66	4	26.64
		09SC053	27-Sep-19	326	0.26																							4	169.89			4	169.89
		09SC061	28-Sep-19	565	0.68																							6	56.64			6	56.64
	Session Summary			**791.3**	**15.00**	**1**	**0.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**50**	**15.16**	**0**	**0**	**0**	**0**	**1**	**0.3**	**130**	**39.43**	**8**	**2.43**	**190**	**57.63**
Section 9	5	0901	04-Oct-19	730	1.10			1	4.48											7	31.38							1	4.48			9	40.35
		0902	04-Oct-19	796	1.00							3	13.57							2	9.05			2	9.05			15	67.84			22	99.5
		0903	04-Oct-19	793	1.10															8	33.02							5	20.64			13	53.65
		0904	04-Oct-19	848	1.10															5	19.3			1	3.86			7	27.02	1	3.86	14	54.03
		0905	04-Oct-19	751	1.10					1	4.36									3	13.07							2	8.72	1	4.36	7	30.5
		0906	04-Oct-19	879	1.00															3	12.29							4	16.38			7	28.67
		0907	04-Oct-19	1021	1.20															7	20.57							7	20.57	1	2.94	15	44.07
		0908	05-Oct-19	682	1.10			1	4.8											4	19.19							11	52.79			16	76.78
		0909	05-Oct-19	782	0.95															2	9.69			1	4.85			17	82.38			20	96.92
		0910	04-Oct-19	1029	1.10															2	6.36							3	9.54			5	15.9
		0911	04-Oct-19	751	1.00															15	71.9							37	177.36	1	4.79	53	254.06
		0912	05-Oct-19	567	0.57															1	11.04							2	22.08			3	33.13
		0913	05-Oct-19	634	0.90															4	25.24							2	12.62			6	37.85
		0914	05-Oct-19	553	0.95															2	13.71							2	13.71			4	27.41
		09SC053	04-Oct-19	331	0.04																							2	543.81			2	543.81
		09SC061	05-Oct-19	514	0.68															1	10.38							14	145.27			15	155.64
	Session Summary			**728.8**	**15.00**	**0**	**0**	**2**	**0.66**	**1**	**0.33**	**3**	**0.99**	**0**	**0**	**0**	**0**	**0**	**0**	**66**	**21.73**	**0**	**0**	**4**	**1.32**	**0**	**0**	**131**	**43.14**	**4**	**1.32**	**211**	**69.48**
Section Total All Samples				**58231**	**75.33**	**1**	**0**	**4**	**0**	**19**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**232**	**0**	**2**	**0**	**12**	**0**	**1**	**0**	**562**	**0**	**41**	**0**	**888**	**0**
Section Average All Samples				**737**	**0.95**	**0**	**0.06**	**0**	**0.26**	**0**	**1.23**	**0**	**0.91**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**15.04**	**0**	**0.13**	**0**	**0.78**	**0**	**0.06**	**7**	**36.44**	**1**	**2.66**	**11**	**57.58**
Section Standard Error of Mean						**0.01**	**0.05**	**0.02**	**0.12**	**0.06**	**0.79**	**0.08**	**0.36**	**0**	**0**	**0**	**0**	**0**	**0**	**0.45**	**1.85**	**0.02**	**0.07**	**0.05**	**0.29**	**0.01**	**0.05**	**0.75**	**7.68**	**0.1**	**0.44**	**1.09**	**8.06**
All Sections Total All Samples				**380245**	**523.85**	**101**	**0**	**200**	**0**	**47**	**0**	**14**	**0**	**17**	**0**	**3**	**0**	**1**	**0**	**11056**	**0.2**	**25**	**0**	**183**	**0**	**157**	**0**	**4696**	**0.08**	**274**	**0**	**16774**	**0.3**
All Sections Average All Samples						**0**	**0.97**	**0**	**1.92**	**0**	**0.45**	**0**	**0.13**	**0**	**0.16**	**0**	**0.03**	**0**	**0.01**	**21**	**106.3**	**0**	**0.24**	**0**	**1.76**	**0**	**1.51**	**9**	**45.15**	**1**	**2.63**	**32**	**161.28**
All Sections Standard Error of Mean						**0.03**	**0.13**	**0.03**	**0.19**	**0.02**	**0.17**	**0.01**	**0.05**	**0.01**	**0.12**	**0**	**0.01**	**0**	**0.01**	**1.01**	**9.05**	**0.01**	**0.14**	**0.03**	**0.25**	**0.04**	**0.3**	**0.39**	**2.69**	**0.05**	**0.67**	**1.12**	**9.5**

Table E4 Summary of boat electroshocking small-bodied catch (only includes fish captured and identified to species) and catch-per-unit-effort (CPUE = no. fish/km/hour) in the Peace River, 20 August to 14 October 2019.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h) Flathead Chub No.	Flathead Chub CPUE	Lake Chub No.	Lake Chub CPUE	Redside Shiner No.	Redside Shiner CPUE	Sculpin spp. No.	Sculpin spp. CPUE	Shiner spp. No.	Shiner spp. CPUE	Spottail Shiner No.	Spottail Shiner CPUE	Troutperch No.	Troutperch CPUE	Yellow Perch No.	Yellow Perch CPUE	All Species No.	All Species CPUE
Section 1	1	0102	22-Aug-19	388	0.98							1	*9.52*									1	*9.52*
		0112	26-Aug-19	777	1.07							2	*8.66*									2	*8.66*
		0116	22-Aug-19	546	0.98					1	*6.69*											1	*6.69*
	Session Summary			**570.3**	**3.00**	**0**	*0*	**0**	*0*	**1**	*2.1*	**3**	*6.31*	**0**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**4**	*8.42*
Section 1	2	0104	03-Sep-19	509	0.50							2	*28.29*									2	*28.29*
		0105	03-Sep-19	514	1.10							1	*6.37*									1	*6.37*
		0109	01-Sep-19	753	0.98							1	*4.9*									1	*4.9*
	Session Summary			**592**	**3.00**	**0**	*0*	**0**	*0*	**0**	*0*	**4**	*8.11*	**0**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**4**	*8.11*
Section Total All Samples				**3487**	**5.61**	**0**	*0*	**0**	*0*	**1**	*0*	**7**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**8**	*0*
Section Average All Samples				**581**	**0.93**	**0**	*0*	**0**	*0*	**0**	*1.11*	**1**	*7.74*	**0**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**1**	*8.84*
Section Standard Error of Mean						**0**	*0*	**0**	*0*	**0.17**	*1.12*	**0.31**	*3.98*	**0**	*0*	**0**	*0*	**0**	*0*	**0**	*0*	**0.21**	*3.58*

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Flathead Chub		Lake Chub		Redside Shiner		Sculpin spp.		Shiner spp.		Spottail Shiner		Troutperch		Yellow Perch		All Species	
						Number Caught (CPUE = no. fish/km/h)																	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 3	1	0305	27-Aug-19	870	1.55									1	2.67							1	2.67
		0310	29-Aug-19	905	1.20					3	9.94			1	3.31							4	13.26
		0312	28-Aug-19	1103	1.17			16	44.63	14	39.05	2	5.58					1	2.79			33	92.06
		0315	28-Aug-19	1356	1.70							1	1.56									1	1.56
	Session Summary			**1058.5**	**6.00**	**0**	**0**	**16**	**9.07**	**17**	**9.64**	**3**	**1.7**	**2**	**1.13**	**0**	**0**	**1**	**0.57**	**0**	**0**	**39**	**22.11**
Section 3	2	0302	04-Sep-19	1023	1.90	1	1.85															1	1.85
		0305	07-Sep-19	1143	1.55			1	2.03	1	2.03	4	8.13									6	12.19
		0306	07-Sep-19	900	1.00			2	8	4	16	1	4									7	28
		0307	09-Sep-19	943	0.95							1	4.02									1	4.02
		0308	09-Sep-19	976	1.35							8	21.86									8	21.86
		0309	09-Sep-19	765	0.95							1	4.95									1	4.95
		0311	07-Sep-19	1099	1.25			2	5.24	4	10.48	2	5.24	2	5.24							10	26.21
		0312	07-Sep-19	1348	1.17					3	6.85	3	6.85									6	13.7
		0315	08-Sep-19	1552	1.70							1	1.36									1	1.36
		0316	08-Sep-19	1277	1.48							3	5.73									3	5.73
	Session Summary			**1102.6**	**13.00**	**1**	**0.25**	**5**	**1.26**	**12**	**3.01**	**24**	**6.03**	**2**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**44**	**11.05**
Section 3	3	0303	16-Sep-19	1052	1.45			1	2.36													1	2.36
		0305	16-Sep-19	1129	1.50							1	2.13									1	2.13
		0312	16-Sep-19	910	1.17													1	3.38			1	3.38
	Session Summary			**1030.3**	**4.00**	**0**	**0**	**1**	**0.87**	**0**	**0**	**1**	**0.87**	**0**	**0**	**0**	**0**	**1**	**0.87**	**0**	**0**	**3**	**2.62**
Section 3	4	0302	23-Sep-19	1367	1.90					2	2.77											2	2.77
		0306	24-Sep-19	707	1.00			1	5.09													1	5.09
		0311	25-Sep-19	979	1.25							2	5.88									2	5.88
	Session Summary			**1017.7**	**4.00**	**0**	**0**	**1**	**0.88**	**2**	**1.77**	**2**	**1.77**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**4.42**
Section 3	6	0312	12-Oct-19	794	1.17							1	3.88									1	3.88
	Session Summary			**794**	**1.00**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**4.53**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**4.53**
Section Total All Samples				**22198**	**28.36**	**1**	**0**	**23**	**0**	**31**	**0**	**31**	**0**	**4**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**92**	**0**
Section Average All Samples				**1057**	**1.35**	**0**	**0.12**	**1**	**2.76**	**1**	**3.72**	**1**	**3.72**	**0**	**0.48**	**0**	**0**	**0**	**0.24**	**0**	**0**	**4**	**11.05**
Section Standard Error of Mean						**0.05**	**0.09**	**0.76**	**2.13**	**0.7**	**2**	**0.41**	**1.07**	**0.11**	**0.31**	**0**	**0**	**0.07**	**0.2**	**0**	**0**	**1.55**	**4.37**

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																	
						Flathead Chub		Lake Chub		Redside Shiner		Sculpin spp.		Shiner spp.		Spottail Shiner		Troutperch		Yellow Perch		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 5	1	0502	31-Aug-19	490	0.70					1	***10.5***											1	***10.5***
		0505	31-Aug-19	1100	1.00					1	***3.27***					1	***3.27***					2	***6.55***
		0506	31-Aug-19	864	1.00					4	***16.67***											4	***16.67***
		0507	01-Sep-19	533	0.78			1	***8.66***	10	***86.59***	1	***8.66***	1	***8.66***			1	***8.66***			14	***121.23***
		0508	24-Aug-19	700	0.92													1	***5.56***			1	***5.56***
		0509	01-Sep-19	760	0.98					7	***34.01***	1	***4.86***			1	***4.86***					9	***43.72***
		0510	26-Aug-19	797	1.13							1	***4***									1	***4***
		0514	26-Aug-19	512	0.56							1	***12.56***									1	***12.56***
		0516	31-Aug-19	740	0.80					6	***36.49***											6	***36.49***
		0517	01-Sep-19	639	0.35					2	***32.19***											2	***32.19***
	Session Summary			**713.5**	**8.00**	**0**	***0***	**1**	***0.63***	**31**	***19.55***	**4**	***2.52***	**1**	***0.63***	**2**	***1.26***	**2**	***1.26***	**0**	***0***	**41**	***25.86***
Section 5	2	0505	11-Sep-19	1083	1.00							2	***6.65***									2	***6.65***
		0506	11-Sep-19	1181	1.00													1	***3.05***			1	***3.05***
		0509	09-Sep-19	670	0.98					1	***5.51***	1	***5.51***									2	***11.02***
		0510	07-Sep-19	725	1.13			1	***4.39***	1	***4.39***			1	***4.39***							3	***13.18***
		05SC060	11-Sep-19	543	0.53															1	***12.51***	1	***12.51***
	Session Summary			**840.4**	**5.00**	**0**	***0***	**1**	***0.86***	**2**	***1.71***	**3**	***2.57***	**1**	***0.86***	**0**	***0***	**1**	***0.86***	**1**	***0.86***	**9**	***7.71***
Section 5	3	0502	20-Sep-19	415	0.70					1	***12.39***							1	***12.39***			2	***24.78***
		0505	20-Sep-19	1128	1.00					2	***6.38***	1	***3.19***									3	***9.57***
		0508	16-Sep-19	731	0.92	1	***5.32***	1	***5.32***			1	***5.32***									3	***15.97***
		0509	20-Sep-19	689	0.98					2	***10.72***	1	***5.36***									3	***16.08***
		0510	16-Sep-19	863	1.13	1	***3.69***			1	***3.69***											2	***7.38***
		0511	16-Sep-19	541	0.72							1	***9.24***									1	***9.24***
		0515	16-Sep-19	481	0.97							1	***7.72***									1	***7.72***
		0517	20-Sep-19	532	0.35					1	***19.33***											1	***19.33***
	Session Summary			**672.5**	**7.00**	**2**	***1.53***	**1**	***0.76***	**7**	***5.35***	**5**	***3.82***	**0**	***0***	**0**	***0***	**1**	***0.76***	**0**	***0***	**16**	***12.24***
Section 5	4	0506	29-Sep-19	1000	1.00					1	***3.6***	2	***7.2***									3	***10.8***
		0509	28-Sep-19	694	0.98							4	***21.28***									4	***21.28***
		0511	25-Sep-19	475	0.72					1	***10.53***	1	***10.53***									2	***21.05***
		0514	25-Sep-19	492	0.56							1	***13.07***									1	***13.07***
		0517	28-Sep-19	585	0.35					1	***17.58***					1	***17.58***	1	***17.58***			3	***52.75***
	Session Summary			**649.2**	**4.00**	**0**	***0***	**0**	***0***	**3**	***4.16***	**8**	***11.09***	**0**	***0***	**1**	***1.39***	**1**	***1.39***	**0**	***0***	**13**	***18.02***
Section 5	5	0510	04-Oct-19	824	1.13							2	***7.73***									2	***7.73***
		0512	04-Oct-19	854	1.28													1	***3.29***			1	***3.29***
	Session Summary			**839**	**2.00**	**0**	***0***	**0**	***0***	**0**	***0***	**2**	***4.29***	**0**	***0***	**0**	***0***	**1**	***2.15***	**0**	***0***	**3**	***6.44***
Section Total All Samples				**21641**	**25.64**	**2**	***0***	**3**	***0***	**43**	***0***	**22**	***0***	**2**	***0***	**3**	***0***	**6**	***0***	**1**	***0***	**82**	***0***
Section Average All Samples				**721**	**0.85**	**0**	***0.39***	**0**	***0.58***	**1**	***8.37***	**1**	***4.28***	**0**	***0.39***	**0**	***0.58***	**0**	***1.17***	**0**	***0.19***	**3**	***15.97***
Section Standard Error of Mean						**0.05**	***0.21***	**0.06**	***0.36***	**0.43**	***3.27***	**0.17**	***0.97***	**0.05**	***0.32***	**0.06**	***0.61***	**0.07**	***0.76***	**0.03**	***0.42***	**0.5**	***4.14***

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h) Flathead Chub No.	Flathead Chub CPUE	Lake Chub No.	Lake Chub CPUE	Redside Shiner No.	Redside Shiner CPUE	Sculpin spp. No.	Sculpin spp. CPUE	Shiner spp. No.	Shiner spp. CPUE	Spottail Shiner No.	Spottail Shiner CPUE	Troutperch No.	Troutperch CPUE	Yellow Perch No.	Yellow Perch CPUE	All Species No.	All Species CPUE
Section 6	1	0609	21-Aug-19	647	1.00					1	*5.56*											1	*5.56*
		0613	27-Aug-19	653	0.90			1	*6.13*													1	*6.13*
		06SC036	27-Aug-19	748	0.40					1	*12.03*					3	*36.1*	2	*24.06*			6	*72.19*
	Session Summary			**682.7**	**2.00**	**0**	***0***	**1**	***2.64***	**2**	***5.27***	**0**	***0***	**0**	***0***	**3**	***7.91***	**2**	***5.27***	**0**	***0***	**8**	***21.09***
Section 6	2	0601	01-Sep-19	864	1.20					1	*3.47*			1	*3.47*							2	*6.94*
		0604	05-Sep-19	724	1.00			2	*9.94*	8	*39.78*											10	*49.72*
		0605	05-Sep-19	511	0.80			1	*8.81*			1	*8.81*									2	*17.61*
		0606	06-Sep-19	1072	1.40			5	*11.99*	8	*19.19*							2	*4.8*			15	*35.98*
		0607	06-Sep-19	796	1.00			2	*9.05*													2	*9.05*
		0608	05-Sep-19	641	1.00					3	*16.85*			2	*11.23*	1	*5.62*					6	*33.7*
		0609	06-Sep-19	769	1.00					1	*4.68*											1	*4.68*
		0610	06-Sep-19	773	0.85					1	*5.48*											1	*5.48*
		0611	06-Sep-19	804	0.90									1	*4.98*							1	*4.98*
		0612	08-Sep-19	520	0.85	1	*8.14*	1	*8.14*	1	*8.14*											3	*24.43*
		0613	08-Sep-19	654	0.90			5	*30.58*													5	*30.58*
		06PIN01	01-Sep-19	833	1.45			1	*2.98*													1	*2.98*
		06SC036	06-Sep-19	543	0.28											4	*93.05*					4	*93.05*
		06SC047	02-Sep-19	561	0.35					1	*18.33*											1	*18.33*
	Session Summary			**718.9**	**13.00**	**1**	***0.39***	**17**	***6.55***	**24**	***9.24***	**1**	***0.39***	**4**	***1.54***	**5**	***1.93***	**2**	***0.77***	**0**	***0***	**54**	***20.8***
Section 6	3	0601	13-Sep-19	692	1.20			1	*4.34*			2	*8.67*									3	*13.01*
		0602	13-Sep-19	610	0.90							2	*13.11*									2	*13.11*
		0603	14-Sep-19	689	1.25			1	*4.18*													1	*4.18*
		0605	14-Sep-19	514	0.80									1	*8.75*							1	*8.75*
		0606	14-Sep-19	914	1.40			2	*5.63*	4	*11.25*											6	*16.88*
		0608	14-Sep-19	620	1.00			2	*11.61*	1	*5.81*											3	*17.42*
		0609	14-Sep-19	758	1.10			2	*8.64*													2	*8.64*
		0610	15-Sep-19	728	0.85			4	*23.27*	1	*5.82*							3	*17.45*			8	*46.54*
		0611	15-Sep-19	722	0.90			4	*22.16*	4	*22.16*							1	*5.54*			9	*49.86*
		0612	15-Sep-19	535	0.85			6	*47.5*	1	*7.92*							1	*7.92*			8	*63.33*
		0613	15-Sep-19	632	0.90			1	*6.33*			1	*6.33*									2	*12.66*
		06PIN01	13-Sep-19	1039	1.50					1	*2.31*											1	*2.31*
	Session Summary			**704.4**	**13.00**	**0**	***0***	**23**	***9.04***	**12**	***4.72***	**5**	***1.97***	**1**	***0.39***	**0**	***0***	**5**	***1.97***	**0**	***0***	**46**	***18.08***
Section 6	4	0603	22-Sep-19	2079	1.30			1	*1.33*													1	*1.33*
		0609	23-Sep-19	603	1.00			1	*5.97*													1	*5.97*
		0610	23-Sep-19	671	0.85							1	*6.31*									1	*6.31*
		0611	23-Sep-19	608	0.90					2	*13.16*											2	*13.16*
		0612	24-Sep-19	591	0.85			2	*14.33*	1	*7.17*											3	*21.5*
		06PIN01	22-Sep-19	933	1.50					4	*10.29*											4	*10.29*
	Session Summary			**914.2**	**6.00**	**0**	***0***	**4**	***2.63***	**7**	***4.59***	**1**	***0.66***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**12**	***7.88***
Section 6	5	0601	02-Oct-19	922	1.20			3	*9.76*	1	*3.25*	1	*3.25*									5	*16.27*
		0605	03-Oct-19	521	0.80							1	*8.64*									1	*8.64*
		0610	03-Oct-19	739	0.85													1	*5.73*			1	*5.73*
		0612	03-Oct-19	574	0.85							1	*7.38*									1	*7.38*
		0614	02-Oct-19	776	0.98							3	*14.27*									3	*14.27*
	Session Summary			**706.4**	**5.00**	**0**	***0***	**3**	***3.06***	**1**	***1.02***	**6**	***6.12***	**0**	***0***	**0**	***0***	**1**	***1.02***	**0**	***0***	**11**	***11.21***
Section 6	6	0603	10-Oct-19	704	1.30			1	*3.93*									1	*3.93*			2	*7.87*
		0609	10-Oct-19	676	1.00			1	*5.33*	1	*5.33*											2	*10.65*
		0613	11-Oct-19	618	0.90			1	*6.47*													1	*6.47*
		06SC036	11-Oct-19	695	0.47															1	*11.02*	1	*11.02*
	Session Summary			**673.2**	**4.00**	**0**	***0***	**3**	***4.01***	**1**	***1.34***	**0**	***0***	**0**	***0***	**0**	***0***	**1**	***1.34***	**1**	***1.34***	**6**	***8.02***
Section Total All Samples				**32276**	**42.68**	**1**	***0***	**51**	***0***	**47**	***0***	**13**	***0***	**5**	***0***	**8**	***0***	**11**	***0***	**1**	***0***	**137**	***0***
Section Average All Samples				**734**	**0.97**	**0**	***0.11***	**1**	***5.86***	**1**	***5.4***	**0**	***1.49***	**0**	***0.57***	**0**	***0.92***	**0**	***1.26***	**0**	***0.11***	**3**	***15.74***
Section Standard Error of Mean						**0.02**	***0.19***	**0.23**	***1.43***	**0.28**	***1.22***	**0.1**	***0.57***	**0.06**	***0.34***	**0.11**	***2.25***	**0.1**	***0.7***	**0.02**	***0.25***	**0.46**	***3.04***

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																	
						Flathead Chub		Lake Chub		Redside Shiner		Sculpin spp.		Shiner spp.		Spottail Shiner		Troutperch		Yellow Perch		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 7	1	0701	30-Aug-19	698	0.78			4	26.28													4	26.28
		0702	27-Aug-19	530	0.95	1	7.15	3	21.45													4	28.6
		0703	27-Aug-19	671	0.95	1	5.65															1	5.65
		0704	28-Aug-19	584	1.00	2	12.33															2	12.33
		0706	28-Aug-19	948	1.00			2	7.59	1	3.8	1	3.8									4	15.19
		0709	27-Aug-19	655	1.00			2	10.99													2	10.99
		0710	28-Aug-19	943	1.40	1	2.73	1	2.73													2	5.45
		0711	28-Aug-19	822	1.39			2	6.3					1	3.15							3	9.45
		0712	28-Aug-19	730	1.06									1	4.63							1	4.63
		0713	30-Aug-19	495	0.98									1	7.42							1	7.42
		07KIS01	30-Aug-19	475	1.04	4	29.15															4	29.15
	Session Summary			**686.5**	**12.00**	**9**	**3.93**	**14**	**6.12**	**1**	**0.44**	**1**	**0.44**	**3**	**1.31**	**0**	**0**	**0**	**0**	**0**	**0**	**28**	**12.24**
Section 7	2	0701	08-Sep-19	736	0.78			1	6.23													1	6.23
		0703	08-Sep-19	777	0.95	1	4.88															1	4.88
		0704	10-Sep-19	777	1.00	1	4.63					1	4.63									2	9.27
		0705	12-Sep-19	674	1.00			1	5.34													1	5.34
		0706	12-Sep-19	908	1.00					1	3.96											1	3.96
		0707	12-Sep-19	671	0.98			1	5.47			1	5.47					1	5.47			3	16.42
		0708	08-Sep-19	743	1.24	2	7.81															2	7.81
		0709	10-Sep-19	819	1.00	1	4.4			2	8.79											3	13.19
		0710	12-Sep-19	928	1.40	1	2.77															1	2.77
		0711	12-Sep-19	862	1.39	1	3	3	9.01			1	3									5	15.02
		07SC022	12-Sep-19	420	0.36													2	47.62			2	47.62
	Session Summary			**755.9**	**11.00**	**7**	**3.03**	**6**	**2.6**	**3**	**1.3**	**3**	**1.3**	**0**	**0**	**0**	**0**	**3**	**1.3**	**0**	**0**	**22**	**9.53**
Section 7	3	0701	17-Sep-19	857	0.78			2	10.7									1	5.35			3	16.05
		0702	17-Sep-19	572	0.95			1	6.62													1	6.62
		0703	18-Sep-19	666	0.95	1	5.69															1	5.69
		0704	18-Sep-19	752	1.00	1	4.79	2	9.57													3	14.36
		0705	18-Sep-19	685	1.00			4	21.02	1	5.26							1	5.26			6	31.53
		0706	18-Sep-19	869	1.00			2	8.29									1	4.14			3	12.43
		0707	19-Sep-19	602	0.98			1	6.1													1	6.1
		0708	17-Sep-19	675	1.24	1	4.3					2	8.6									3	12.9
		0709	17-Sep-19	784	1.00			1	4.59			2	9.18									3	13.78
		0711	18-Sep-19	902	1.39			4	11.49	1	2.87			1	2.87			1	2.87			7	20.1
		0712	19-Sep-19	711	1.06			1	4.75													1	4.75
		0713	19-Sep-19	523	0.98	1	7.02	2	14.05	1	7.02											4	28.1
		07BEA02	17-Sep-19	518	0.60	1	11.58															1	11.58
		07SC012	19-Sep-19	335	0.22													3	146.54			3	146.54
		07SC022	18-Sep-19	404	0.36													1	24.75			1	24.75
	Session Summary			**657**	**14.00**	**5**	**1.96**	**20**	**7.83**	**3**	**1.17**	**4**	**1.57**	**1**	**0.39**	**0**	**0**	**8**	**3.13**	**0**	**0**	**41**	**16.05**

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Number Caught (CPUE = no. fish/km/h)																	
						Flathead Chub		Lake Chub		Redside Shiner		Sculpin spp.		Shiner spp.		Spottail Shiner		Troutperch		Yellow Perch		All Species	
						No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE	No.	CPUE
Section 7	4	0703	30-Sep-19	896	0.95	1	4.23	1	4.23													2	8.46
		0704	01-Oct-19	702	1.00					1	5.13											1	5.13
		0707	30-Sep-19	675	0.98			1	5.44									2	10.88			3	16.33
		0708	01-Oct-19	740	1.24	1	3.92															1	3.92
		0709	01-Oct-19	842	1.00			1	4.28													1	4.28
		0710	01-Oct-19	1050	1.10	1	3.12	1	3.12	1	3.12											3	9.35
		0712	30-Sep-19	945	1.06													2	7.15			2	7.15
		0713	30-Sep-19	588	0.98			3	18.74													3	18.74
		0714	30-Sep-19	1033	1.27			2	5.47													2	5.47
	Session Summary			**830.1**	**10.00**	**3**	**1.3**	**9**	**3.9**	**2**	**0.87**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**1.73**	**0**	**0**	**18**	**7.81**
Section 7	5	07KIS01	05-Oct-19	249	1.24	1	11.66															1	11.66
	Session Summary			**249**	**1.00**	**1**	**14.46**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**14.46**
Section 7	6	0701	11-Oct-19	759	0.78			1	6.04													1	6.04
		0703	11-Oct-19	618	0.95	1	6.13											1	6.13			2	12.26
		0704	11-Oct-19	637	1.00	1	5.65	3	16.95													4	22.61
		0706	13-Oct-19	861	1.00			3	12.54									2	8.36			5	20.91
		0707	13-Oct-19	508	0.82					1	8.64											1	8.64
		0708	11-Oct-19	1560	1.24	1	1.86	2	3.72													3	5.58
		0709	11-Oct-19	633	1.00			2	11.37													2	11.37
		0710	13-Oct-19	878	1.40	4	11.71	4	11.71									1	2.93			9	26.36
		0711	13-Oct-19	776	1.39	1	3.34					1	3.34									2	6.68
		07BEA01	11-Oct-19	590	0.43													1	14.19			1	14.19
		07KIS01	13-Oct-19	624	0.74	1	7.8	2	15.59									2	15.59			5	38.98
		07SC012	13-Oct-19	419	0.22											1	39.05					1	39.05
	Session Summary			**738.6**	**11.00**	**9**	**3.99**	**17**	**7.53**	**1**	**0.44**	**1**	**0.44**	**0**	**0**	**1**	**0.44**	**7**	**3.1**	**0**	**0**	**36**	**15.95**
Section Total All Samples				**42304**	**57.99**	**34**	**0**	**66**	**0**	**10**	**0**	**9**	**0**	**4**	**0**	**1**	**0**	**22**	**0**	**0**	**0**	**146**	**0**
Section Average All Samples				**717**	**0.98**	**1**	**2.94**	**1**	**5.71**	**0**	**0.87**	**0**	**0.78**	**0**	**0.35**	**0**	**0.09**	**0**	**1.9**	**0**	**0**	**2**	**12.64**
Section Standard Error of Mean						**0.11**	**0.64**	**0.16**	**0.85**	**0.05**	**0.28**	**0.06**	**0.25**	**0.03**	**0.16**	**0.02**	**0.66**	**0.09**	**2.63**	**0**	**0**	**0.22**	**2.6**

Table E4 Continued.

Section	Session	Site	Date	Time Sampled (s)	Length Sampled (km)	Flathead Chub No.	Flathead Chub CPUE	Lake Chub No.	Lake Chub CPUE	Redside Shiner No.	Redside Shiner CPUE	Sculpin spp. No.	Sculpin spp. CPUE	Shiner spp. No.	Shiner spp. CPUE	Spottail Shiner No.	Spottail Shiner CPUE	Troutperch No.	Troutperch CPUE	Yellow Perch No.	Yellow Perch CPUE	All Species No.	All Species CPUE
						Number Caught (CPUE = no. fish/km/h)																	
Section 9	1	0901	24-Aug-19	616	1.10							1	*5.31*									1	*5.31*
		0906	25-Aug-19	885	1.00	1	*4.07*															1	*4.07*
		0909	25-Aug-19	843	0.95	1	*4.5*			1	*4.5*											2	*8.99*
		0911	25-Aug-19	632	1.00									1	*5.7*							1	*5.7*
		0912	25-Aug-19	701	1.10									1	*4.67*							1	*4.67*
		09SC053	24-Aug-19	379	0.16													1	*59.37*			1	*59.37*
	Session Summary			**676**	**5.00**	**2**	***2.13***	**0**	***0***	**1**	***1.07***	**1**	***1.07***	**2**	***2.13***	**0**	***0***	**1**	***1.07***	**0**	***0***	**7**	***7.46***
Section 9	2	0901	10-Sep-19	815	1.10			1	*4.02*													1	*4.02*
		0903	10-Sep-19	754	1.10	1	*4.34*	1	*4.34*													2	*8.68*
		0904	10-Sep-19	784	1.10	2	*8.35*	1	*4.17*													3	*12.52*
		0905	10-Sep-19	909	1.10	1	*3.6*															1	*3.6*
		0911	11-Sep-19	752	1.00	2	*9.57*	4	*19.15*													6	*28.72*
		0914	11-Sep-19	571	0.95									1	*6.64*							1	*6.64*
		09SC053	10-Sep-19	376	0.16											2	*119.68*					2	*119.68*
	Session Summary			**708.7**	**7.00**	**6**	***4.35***	**7**	***5.08***	**0**	***0***	**0**	***0***	**1**	***0.73***	**2**	***1.45***	**0**	***0***	**0**	***0***	**16**	***11.61***
Section 9	3	0905	19-Sep-19	812	1.10													1	*4.03*			1	*4.03*
		0908	20-Sep-19	789	1.10	1	*4.15*															1	*4.15*
	Session Summary			**800.5**	**2.00**	**1**	***2.25***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**1**	***2.25***	**0**	***0***	**2**	***4.5***
Section 9	4	0906	27-Sep-19	996	1.00	1	*3.61*															1	*3.61*
	Session Summary			**996**	**1.00**	**1**	***3.61***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**1**	***3.61***
Section 9	5	0914	05-Oct-19	553	0.95	1	*6.85*															1	*6.85*
		09SC053	04-Oct-19	331	0.04															10	*2719.03*	10	*2719.03*
	Session Summary			**442**	**1.00**	**1**	***8.14***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**0**	***0***	**10**	***81.45***	**11**	***89.59***
Section Total All Samples				**12498**	**16.01**	**11**	***0***	**7**	***0***	**1**	***0***	**1**	***0***	**3**	***0***	**2**	***0***	**2**	***0***	**10**	***0***	**37**	***0***
Section Average All Samples				**694**	**0.89**	**1**	***3.56***	**0**	***2.27***	**0**	***0.32***	**0**	***0.32***	**0**	***0.97***	**0**	***0.65***	**0**	***0.65***	**1**	***3.24***	**2**	***11.99***
Section Standard Error of Mean						**0.16**	***0.75***	**0.23**	***1.09***	**0.06**	***0.25***	**0.06**	***0.3***	**0.09**	***0.52***	**0.11**	***6.65***	**0.08**	***3.29***	**0.56**	***151.06***	**0.55**	***150.26***
All Sections Total All Samples				**134404**	**176.28**	***49***	***0.01***	***150***	***0.02***	***133***	***0.02***	***83***	***0.01***	***18***	***0***	***14***	***0***	***43***	***0.01***	***12***	***0***	***502***	***0.08***
All Sections Average All Samples						***0***	***1.33***	***1***	***4.06***	***1***	***3.6***	***0***	***2.24***	***0***	***0.49***	***0***	***0.38***	***0***	***1.16***	***0***	***0.32***	***3***	***13.58***
All Sections Standard Error of Mean						***0.05***	***0.25***	***0.12***	***0.55***	***0.14***	***0.72***	***0.07***	***0.33***	***0.03***	***0.13***	***0.03***	***0.9***	***0.04***	***0.96***	***0.06***	***15.27***	***0.25***	***15.26***

Table E5 Summary of the number (N) of fish captured and recaptured in sampled sections of the Peace River, 20 August to 14 October 2019.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Arctic Grayling	Section 1	1	0	0	-	0
		2	0	0	0	0
		3	0	0	0	0
		4	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
	Section 1 subtotal		0	0	0	0
	Section 3	1	2	1	-	1
		2	19	9	1	8
		3	9	5	2	2
		4	7	1	3	3
		5	12	4	6	2
		6	3	1	2	0
	Section 3 subtotal		52	21	14	16
	Section 5	1	3	2	-	1
		2	1	0	0	1
		3	5	4	0	1
		4	1	1	0	0
		5	5	4	1	0
		6	0	0	0	0
	Section 5 subtotal		15	11	1	3
	Section 6	1	2	2	-	0
		2	3	3	0	0
		3	8	8	0	0
		4	5	4	1	0
		5	9	5	0	0
		6	11	9	2	0
	Section 6 subtotal		38	31	3	0
	Section 7	1	2	2	-	0
		2	0	0	0	0
		3	2	2	0	0
		4	3	3	0	0
		5	1	1	0	0
		6	5	5	0	0
	Section 7 subtotal		13	13	0	0
	Section 9	1	0	0	-	0
		2	0	0	0	0
		3	0	0	0	0
		4	1	1	0	0
		5	0	0	0	0
		6	0	0	0	0
	Section 9 subtotal		1	1	0	0
Arctic Grayling Total			119	77	18	19

Continued...

Table E5 Continued.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Bull Trout	Section 1	1	13	13	-	0
		2	9	9	0	0
		3	11	6	2	3
		4	9	7	0	2
		5	13	6	1	6
		6	16	9	5	2
	Section 1 subtotal		71	50	8	13
	Section 3	1	5	5	-	0
		2	14	8	1	5
		3	11	7	1	3
		4	18	14	2	2
		5	14	9	3	2
		6	10	6	2	2
	Section 3 subtotal		72	49	9	14
	Section 5	1	5	4	-	1
		2	3	3	0	0
		3	2	1	0	1
		4	8	8	0	0
		5	6	3	0	3
		6	2	2	0	0
	Section 5 subtotal		26	21	0	5
	Section 6	1	1	1	-	0
		2	1	1	0	0
		3	5	3	0	2
		4	4	4	0	0
		5	6	5	0	0
		6	8	7	1	0
	Section 6 subtotal		25	21	1	2
	Section 7	1	0	0	-	0
		2	3	3	0	0
		3	1	1	0	0
		4	4	4	0	0
		5	6	3	1	2
		6	8	7	1	0
	Section 7 subtotal		22	18	2	2
	Section 9	1	0	0	-	0
		2	1	1	0	0
		3	1	1	0	0
		4	0	0	0	0
		5	2	2	0	0
		6	0	0	0	0
	Section 9 subtotal		4	4	0	0
Bull Trout Total			220	163	20	36

Continued...

Table E5 Continued.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Largescale Sucker	Section 1	1	25	23	-	2
		2	32	30	1	1
		3	30	22	1	7
		4	22	18	1	3
		5	6	4	0	2
		6	81	74	2	5
	Section 1 subtotal		196	171	5	20
	Section 3	1	66	62	-	3
		2	91	84	4	3
		3	50	46	2	2
		4	54	47	1	6
		5	38	32	4	2
		6	14	12	0	2
	Section 3 subtotal		313	283	12	18
	Section 5	1	51	48	-	3
		2	39	35	0	4
		3	43	38	1	4
		4	48	44	2	2
		5	38	32	3	3
		6	4	4	0	0
	Section 5 subtotal		223	201	6	16
	Section 6	1	22	20	-	2
		2	66	57	0	9
		3	64	56	1	7
		4	69	53	7	9
		5	49	44	2	3
		6	14	12	0	2
	Section 6 subtotal		284	242	10	32
	Section 7	1	36	32	-	4
		2	20	19	0	1
		3	22	18	0	4
		4	18	14	2	2
		5	36	32	0	4
		6	14	12	1	1
	Section 7 subtotal		146	127	3	16
	Section 9	1	4	4	-	0
		2	6	6	0	0
		3	4	4	0	0
		4	15	13	2	0
		5	13	12	0	1
		6	0	0	0	0
	Section 9 subtotal		42	39	2	1
Largescale Sucker Total			1204	1063	38	103

Continued...

Table E5 Continued.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Longnose Sucker	Section 1	1	91	82	-	9
		2	54	46	1	7
		3	35	30	1	4
		4	27	22	1	4
		5	7	6	1	0
		6	23	21	0	2
	Section 1 subtotal		237	207	4	26
	Section 3	1	93	79	-	13
		2	189	159	5	25
		3	118	103	3	12
		4	126	104	1	21
		5	109	92	3	14
		6	39	33	2	4
	Section 3 subtotal		674	570	15	89
	Section 5	1	90	81	-	9
		2	101	92	3	6
		3	90	81	1	8
		4	62	53	5	4
		5	60	54	2	4
		6	2	2	0	0
	Section 5 subtotal		405	363	11	31
	Section 6	1	59	51	-	8
		2	279	249	3	27
		3	149	132	2	15
		4	204	174	13	17
		5	145	122	7	16
		6	44	39	1	4
	Section 6 subtotal		880	767	26	87
	Section 7	1	136	124	-	11
		2	162	151	4	7
		3	105	84	5	16
		4	79	71	1	7
		5	117	100	6	11
		6	135	119	2	14
	Section 7 subtotal		734	649	19	66
	Section 9	1	27	25	-	2
		2	123	105	2	16
		3	140	121	6	13
		4	113	100	5	8
		5	115	96	5	14
		6	0	0	0	0
	Section 9 subtotal		518	447	18	53
Longnose Sucker Total			3448	3003	93	352

Continued...

Table E5 Continued.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Mountain Whitefish	Section 1	1	708	607	-	99
		2	498	402	10	83
		3	672	561	23	87
		4	661	532	51	78
		5	413	342	30	41
		6	721	607	44	70
	Section 1 subtotal		3673	3051	160	458
	Section 3	1	193	140	-	51
		2	590	404	12	172
		3	823	537	58	219
		4	948	626	126	196
		5	906	634	126	146
		6	558	438	58	62
	Section 3 subtotal		4018	2779	382	846
	Section 5	1	127	104	-	23
		2	259	210	3	44
		3	241	191	11	39
		4	267	210	14	43
		5	251	190	21	40
		6	19	16	2	1
	Section 5 subtotal		1164	921	51	190
	Section 6	1	135	104	-	30
		2	143	91	7	40
		3	247	193	8	45
		4	243	164	27	52
		5	563	454	37	72
		6	357	307	18	32
	Section 6 subtotal		1688	1313	98	271
	Section 7	1	80	68	-	12
		2	207	171	1	35
		3	144	118	6	17
		4	218	169	13	36
		5	202	148	28	26
		6	176	154	7	15
	Section 7 subtotal		1027	828	55	141
	Section 9	1	5	4	-	1
		2	85	70	5	10
		3	32	24	1	7
		4	57	41	7	9
		5	74	55	8	11
		6	0	0	0	0
	Section 9 subtotal		253	194	21	38
Mountain Whitefish Total			11823	9086	767	1944

Continued...

Table E5 Continued.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
Rainbow Trout	Section 1	1	10	9	-	1
		2	10	10	0	0
		3	8	7	0	1
		4	10	8	0	2
		5	15	13	2	0
		6	26	23	2	1
	Section 1 subtotal		79	70	4	5
	Section 3	1	5	4	-	1
		2	13	11	0	2
		3	8	6	0	2
		4	30	24	5	1
		5	17	10	4	3
		6	8	2	5	1
	Section 3 subtotal		81	57	14	10
	Section 5	1	3	0	-	3
		2	2	2	0	0
		3	4	3	1	0
		4	1	0	1	0
		5	3	1	2	0
		6	0	0	0	0
	Section 5 subtotal		13	6	4	3
	Section 6	1	0	0	-	0
		2	0	0	0	0
		3	1	1	0	0
		4	0	0	0	0
		5	2	2	0	0
		6	0	0	0	0
	Section 6 subtotal		3	3	0	0
	Section 7	1	1	0	-	1
		2	0	0	0	0
		3	0	0	0	0
		4	1	1	0	0
		5	0	0	0	0
		6	0	0	0	0
	Section 7 subtotal		2	1	0	1
	Section 9	1	0	0	-	0
		2	0	0	0	0
		3	0	0	0	0
		4	1	1	0	0
		5	0	0	0	0
		6	0	0	0	0
	Section 9 subtotal		1	1	0	0
Rainbow Trout Total			179	138	22	19

Continued...

Table E5 Concluded.

Species Name	Section	Session	N Captured	N Marked	N Recaptured (within year)	N Recaptured (between years)
White Sucker	Section 1	1	14	14	-	0
		2	5	5	0	0
		3	2	2	0	0
		4	1	1	0	0
		5	6	6	0	0
		6	5	4	0	1
	Section 1 subtotal		33	32	0	1
	Section 3	1	5	4	-	1
		2	3	3	0	0
		3	3	3	0	0
		4	2	1	1	0
		5	7	7	0	0
		6	0	0	0	0
	Section 3 subtotal		20	18	1	1
	Section 5	1	9	9	-	0
		2	12	12	0	0
		3	8	6	1	1
		4	12	11	1	0
		5	11	8	3	0
		6	0	0	0	0
	Section 5 subtotal		52	46	5	1
	Section 6	1	5	5	-	0
		2	12	11	0	1
		3	7	6	0	1
		4	3	2	0	1
		5	6	6	0	0
		6	2	2	0	0
	Section 6 subtotal		35	32	0	3
	Section 7	1	3	2	-	1
		2	7	7	0	0
		3	0	0	0	0
		4	3	3	0	0
		5	4	4	0	0
		6	2	2	0	0
	Section 7 subtotal		19	18	0	1
	Section 9	1	1	1	-	0
		2	0	0	0	0
		3	4	3	0	1
		4	9	9	0	0
		5	9	8	1	0
		6	0	0	0	0
	Section 9 subtotal		23	21	1	1
White Sucker Total			182	167	7	8

APPENDIX G

Population Analysis Output

Introduction

In 2019, Bayes sequential modelling as part of the Peace River Large Fish Indexing Survey was conducted by Bill Gazey of W.J. Gazey Research. Appendix G was written by W.J. Gazey Research and provides additional information on the model and its corresponding output.

Mountain Whitefish

Characteristics that Impact Population Estimates

For the 2019 study, PIT tags were applied to lengths ≥ 200 mm; however, in past studies tag application was restricted to lengths ≥ 250 mm. In order to obtain population estimates consistent with past studies and to minimize bias from size selectivity to electrofishing, only fish marked and sampled of length ≥ 250 mm were used to obtain population estimates. Histograms of Mountain Whitefish lengths at release and recapture are plotted in Figure G1. Inspection of the figures reveals that smaller fish (200-250 mm) were not recaptured with the same frequency. Comparison of the sample cumulative proportion of length at release and recapture illustrates (see Figure G2) that the distributions were similar for lengths greater than 250 mm. The substantial overlap of the cumulative release and recapture offset by 14 mm proportions illustrate that the difference was attributable to the capture of small fish. A consistent, but statistically nonsignificant, under representation of recaptured smaller Mountain Whitefish (250-275 mm) has been noted in all previous studies. A comparison of lengths at release and recapture ≥ 250 mm accumulated into 25 mm bins (not shown) for the 2019 study was not significantly different (test for independence, P > 0.05).

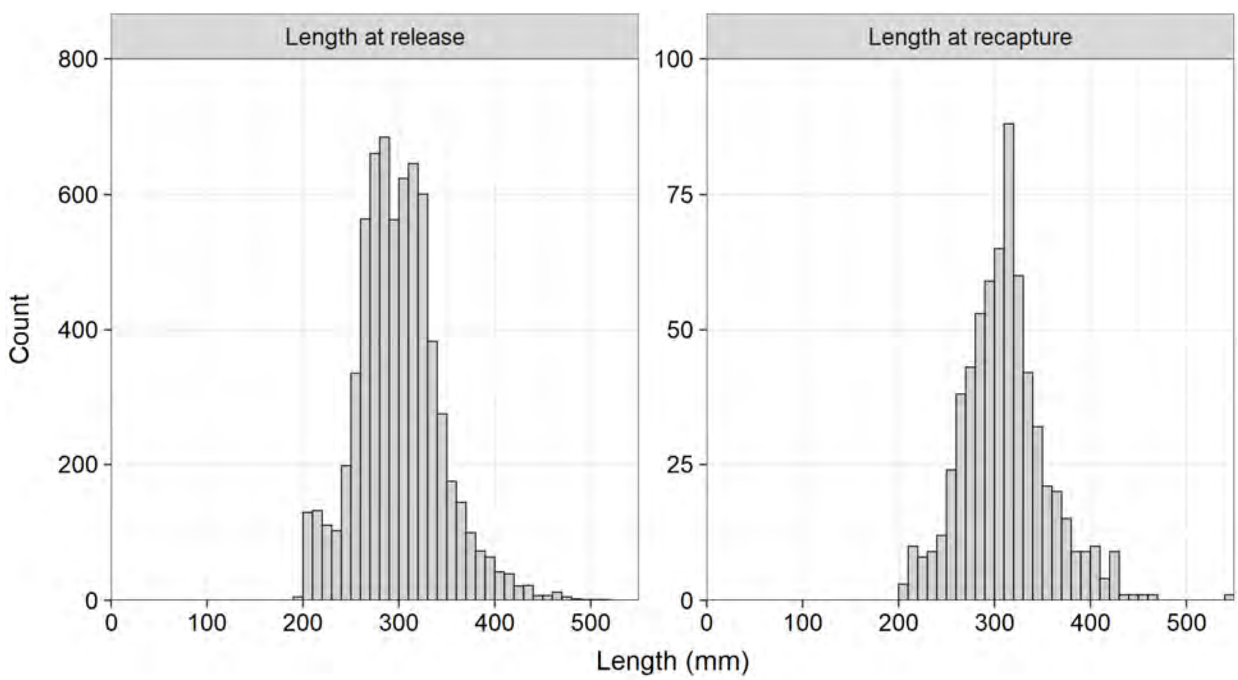

Figure G1: Histogram of Mountain Whitefish lengths at release and recapture.

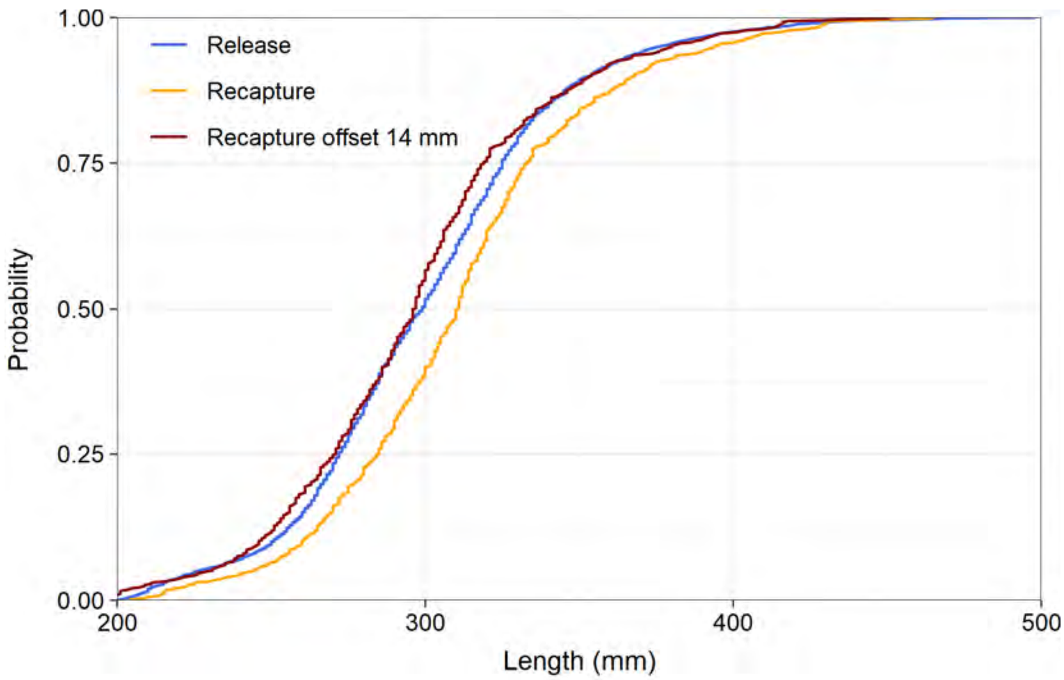

Figure G2: Mountain Whitefish cumulative proportion of length at release and recapture.

Time at large of recaptured Mountain Whitefish regressed on the growth increment (length at release minus length at recapture) is plotted in Figure G3. The growth trend of -0.002 mm per day was not statistically significant (P = 0.93). The boarder histogram of the growth increment provides an indication of measurement error (residual standard deviation of 3.0 mm for each measurement), which was slightly larger than the historical mean of 2.8 mm.

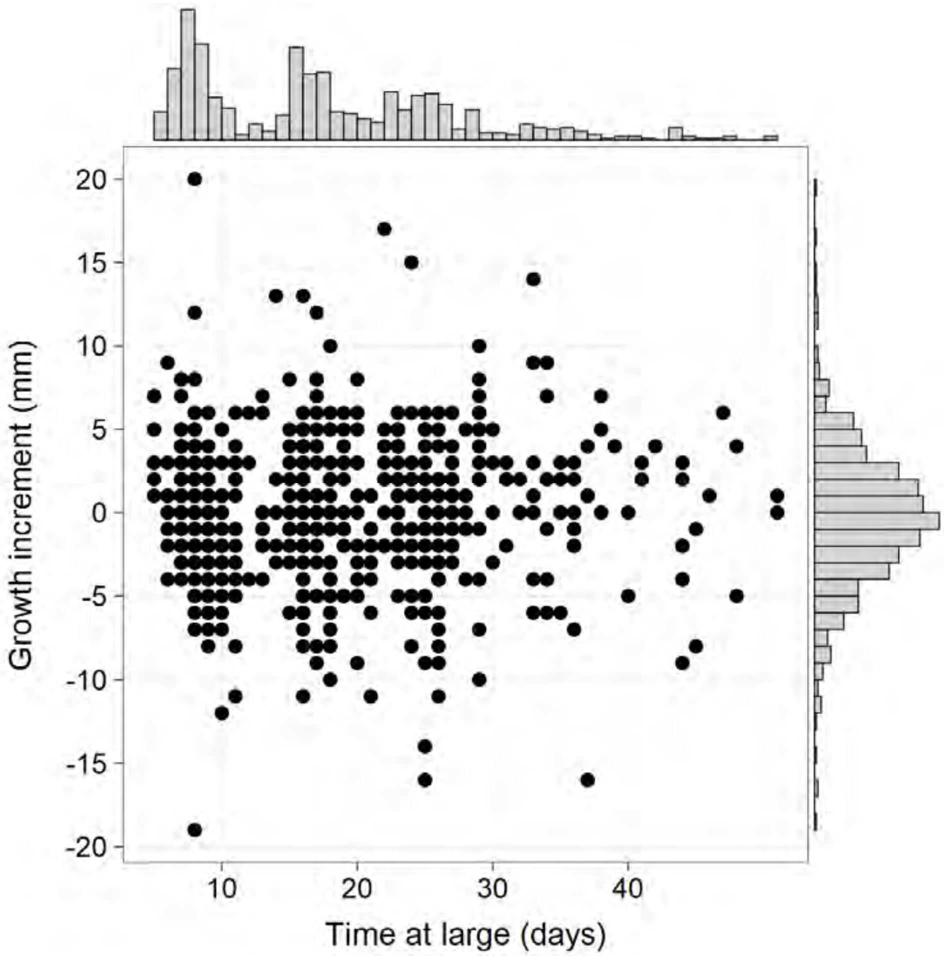

Figure G3: Growth over the study period of Mountain Whitefish with border histograms of time at large and growth increment.

The movement of recaptured Mountain Whitefish between sections during 2019 is listed in Table G1 along with the estimates of the migration proportions adjusted for the number of fish examined (Equation 4). These proportions are plotted in Figure G4. Figure G5 provides a bar plot of the distance traveled within each section for marked fish released in 2019. Positive values indicate fish were recaptured upstream of the release site and vice-versa. Note that most fish were recaptured in the same site-of-release. Consistent with movement patterns in previous studies, Mountain Whitefish had strong fidelity to a site.

Table G1: Mountain Whitefish recaptures and migration proportions adjusted (inverse weight) for fish examined by section during 2019.

Release	Recapture Section						
Section	**One**	**Three**	**Five**	**Six**	**Seven**	**Nine**	**Total**
One	123	12	1	1	0	0	137
Three	0	287	6	2	0	0	295
Five	1	1	35	6	1	0	44
Six	0	0	2	70	3	0	75
Seven	0	0	0	5	42	0	47
Nine	0	0	0	0	1	16	17
Sample:	2,665	3,122	789	1,347	816	214	8,953
Recap. %	4.65	9.61	5.58	6.24	5.76	7.48	6.87
Proportions:							
One	0.887	0.074	0.024	0.014	0.000	0.000	1.000
Three	0.000	0.910	0.075	0.015	0.000	0.000	1.000
Five	0.007	0.006	0.874	0.088	0.024	0.000	1.000
Six	0.000	0.000	0.044	0.893	0.063	0.000	1.000
Seven	0.000	0.000	0.000	0.067	0.933	0.000	1.000
Nine	0.000	0.000	0.000	0.000	0.016	0.984	1.000

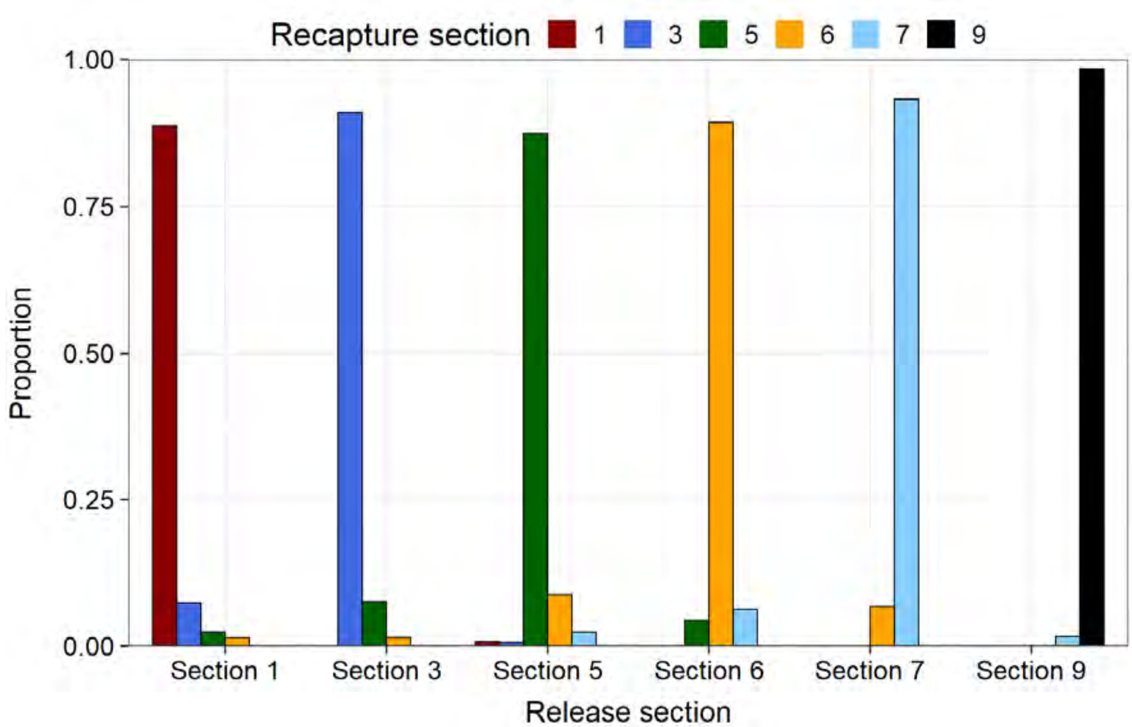

Figure G4: Distribution of Mountain Whitefish released and recaptured marks in 2019 standardized for sampling effort by river section.

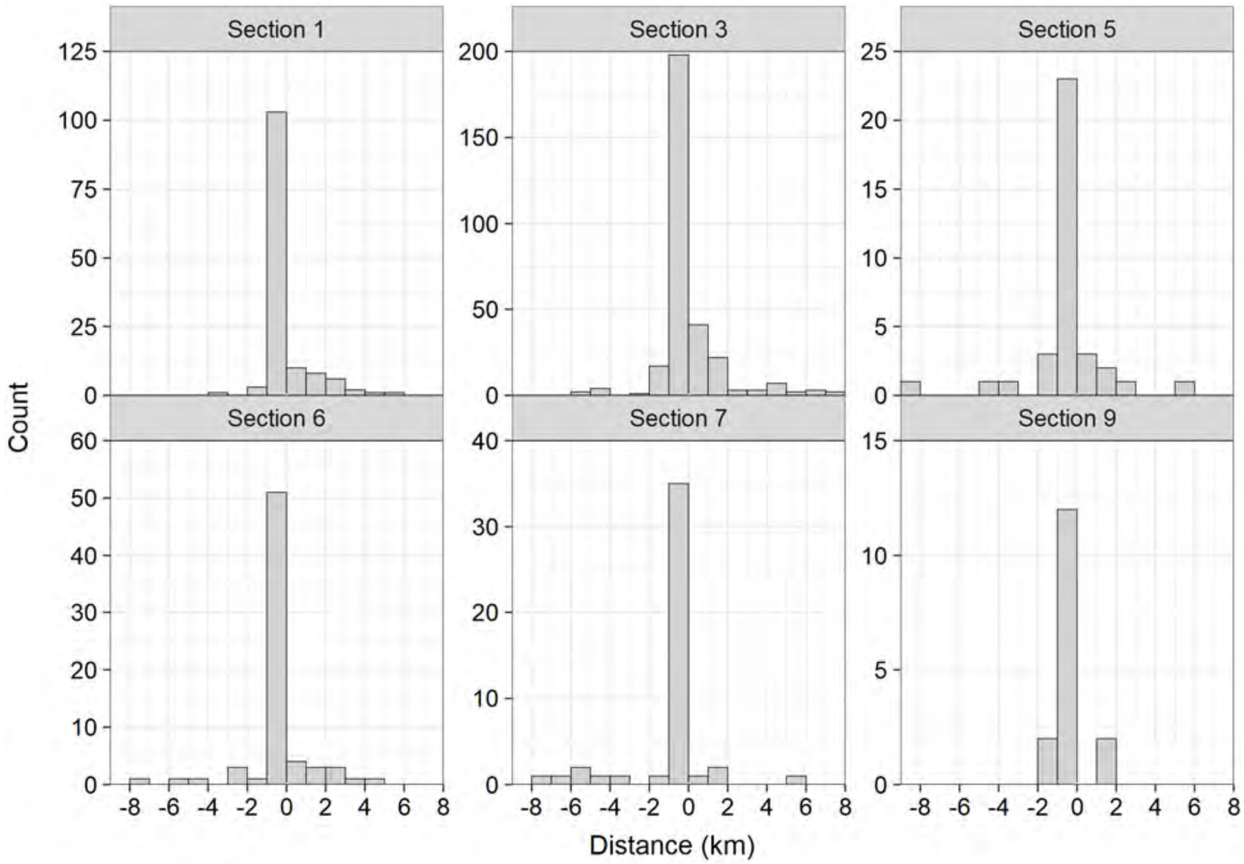

Figure G5: Bar plot of the travel distance (1 km bins) of recaptured Mountain Whitefish released in 2019 within each of the sections sampled (positive values indicate upstream movement and negative values downstream movement). Each section is independently scaled.

Empirical Model Selection

The number of captures by encounter history (six sessions with the exception of river Section 9 that had five sessions) and by section used for the CJS analysis are listed in Table G2. Capture probabilities were evaluated by session (time varying) and pooled over sessions 1 to 4 and 5 to 6 within each section. Survival was evaluated by session (time varying) and as constant within each section. Constant survival provided the best fit to the data based on Akaike information criteria (AIC) in all river sections (see Table G3). Capture probability by session provided the best fit in Section 9. Pooled capture probability provided the best fit in all other sections. Survival estimates were not significantly different than 1.0 in all sections for the best fitting models (not shown, P > 0.8). Based on these results, we applied no apparent mortality for Mountain Whitefish within 2019.

A direct test of catchability is provided with population estimates using ADMB with Equations (1 to 8) in Table G4 (input data corrected for movement listed in Table G1, which was also used for the Bayesian model). The Bayesian population model assumed constant catchability for samples taken during the year. The time varying catchability model provided a better fit to the data in Sections 3 and 6, and a slightly better fit in river section 7. The constant catchability model fit better in the other river sections (1, 5 and 9). Population estimates were generally similar for the two models. The logarithmic population deviation estimates for the time varying catchability model (Equation 2) are plotted by section and date in Figure G6. River section 6 trended upward over time, while all other sections had no apparent trend. The largest variations were exhibited by Sections 6 and 7.

Table G2: Mountain Whitefish captures by encounter history and section used for the Cormack-Jolly-Seber analysis. A '1' indicates a capture and '0' no capture in the session. Negative values indicate mortality at capture.

	Section					
History	**One**	**Three**	**Five**	**Six**	**Seven**	**Nine**
000011	2	10	0	2	1	0
000101	12	13	3	1	3	0
000110	12	39	1	12	12	2
000111	0	2	0	1	0	0
001001	14	14	0	5	0	0
001010	8	33	5	6	4	3
001011	0	3	0	0	0	0
001100	17	41	1	7	3	3
001101	0	1	0	1	1	0
001110	0	6	2	2	0	0
010001	10	7	1	1	1	1
010010	5	28	4	4	6	1
010100	8	24	7	7	5	1
010101	0	0	0	0	1	0
010110	0	2	2	2	1	2
010111	0	1	0	0	0	0

	Section					
History	One	Three	Five	Six	Seven	Nine
011000	5	24	3	1	4	0
011010	0	3	0	0	0	0
011100	0	1	0	0	0	0
100001	9	2	1	2	0	0
100010	4	5	3	2	0	0
100011	0	1	0	0	0	0
100100	20	11	1	2	0	0
100110	0	1	0	0	0	0
101000	14	11	4	3	0	0
101100	0	0	0	1	0	0
101110	0	0	0	0	1	0
110000	5	1	2	5	0	2
110010	1	0	0	0	0	0

Table G3: Evaluation of various Mountain Whitefish survival Cormack-Jolly-Seber models using MARK based on delta Akaike information criteria (ΔAIC).

Model	ΔAIC	AIC Weights	Model Like.	Num. Par
River Section One:				
{S(.)p(2 levels)}	0.0	0.790	1.000	3
{S(.)p(t)}	3.8	0.121	0.153	5
{S(t)p(2 levels)}	4.6	0.079	0.100	5
{S(t)p(t)}	8.8	0.010	0.013	7
River Section Three:				
{S(.)p(2 levels)}	0.0	0.605	1.000	3
{S(.)p(t)}	1.5	0.280	0.463	5
{S(t)p(2 levels)}	4.1	0.079	0.130	5
{S(t)p(t)}	5.7	0.036	0.059	7
River Section Five:				
{S(.)p(2 levels)}	0.0	0.632	1.000	3
{S(.)p(t)}	1.3	0.332	0.526	5
{S(t)p(t)}	5.7	0.036	0.057	7
{S(t)p(2 levels)}	102.2	0.000	0.000	5
River Section Six:				
{S(.)p(2 levels)}	0.0	0.488	1.000	3
{S(.)p(t)}	0.4	0.404	0.829	5

Model	ΔAIC	AIC Weights	Model Like.	Num. Par
{S(t)p(2 levels)}	4.2	0.060	0.123	5
{S(t)p(t)}	4.7	0.048	0.097	7
River Section Seven:				
{S(.)p(2 levels)}	0.0	0.619	1.000	3
{S(.)p(t)}	1.8	0.256	0.414	5
{S(t)p(2 levels)}	4.3	0.072	0.116	5
{S(t)p(t)}	4.9	0.053	0.085	7
River Section Nine:				
{S(.)p(t)}	0.0	0.864	1.000	5
{S(.)p(2 levels)}	5.0	0.071	0.082	3
{S(t)p(t)}	5.4	0.059	0.068	7
{S(t)p(2 levels)}	9.9	0.006	0.007	5

Models:

S(.)p(2 levels) - constant survival, capture probabilities pooled for Sessions 1 to 4 and Session 5 to 6.
S(.)p(t) - constant survival, capture probabilities by session.
S(.)p(t) - constant survival, capture probabilities by session.
S(t)p(t) - survival by session, capture probabilities by session.

Table G4: Mountain Whitefish population estimates using AD Model Builder assuming constant population size (M0t) and time varying catchability (Mtt).

Model	N	SD	Function	Param.	AIC	ΔAIC	Weight	Model Like.
Section One:								
M_{0t}	19,328	1,687	443.3	1	888.7	0.00	0.993	1.000
M_{tt}	23,584	2,758	441.3	8	898.6	9.99	0.007	0.007
Section Three:								
M_{tt}	13,986	1,537	859.7	12	1743.5	0.00	1.000	1.000
M_{0t}	11,610	622	886.3	1	1774.7	31.20	0.000	0.000
Section Five:								
M_{0t}	6,649	981	146.2	1	294.4	0.00	0.941	1.000
M_{tt}	6,940	1,445	142.0	8	300.0	5.55	0.059	0.062

Model	N	SD	Function	Param.	AIC	ΔAIC	Weight	Model Like.
Section Six:								
M_{tt}	6,338	995	289.1	10	598.3	0.00	0.999	1.000
M_{0t}	6,401	995	305.1	1	612.2	13.94	0.001	0.001
Section Seven:								
M_{tt}	6,607	1,893	147.1	7	308.3	0.00	0.641	1.000
M_{0t}	5,084	723	153.7	1	309.4	1.16	0.359	0.559
Section Nine:								
M_{0t}	984	255	39.3	1	80.6	0.00	0.836	1.000
M_{tt}	937	261	38.9	3	83.9	3.26	0.164	0.196

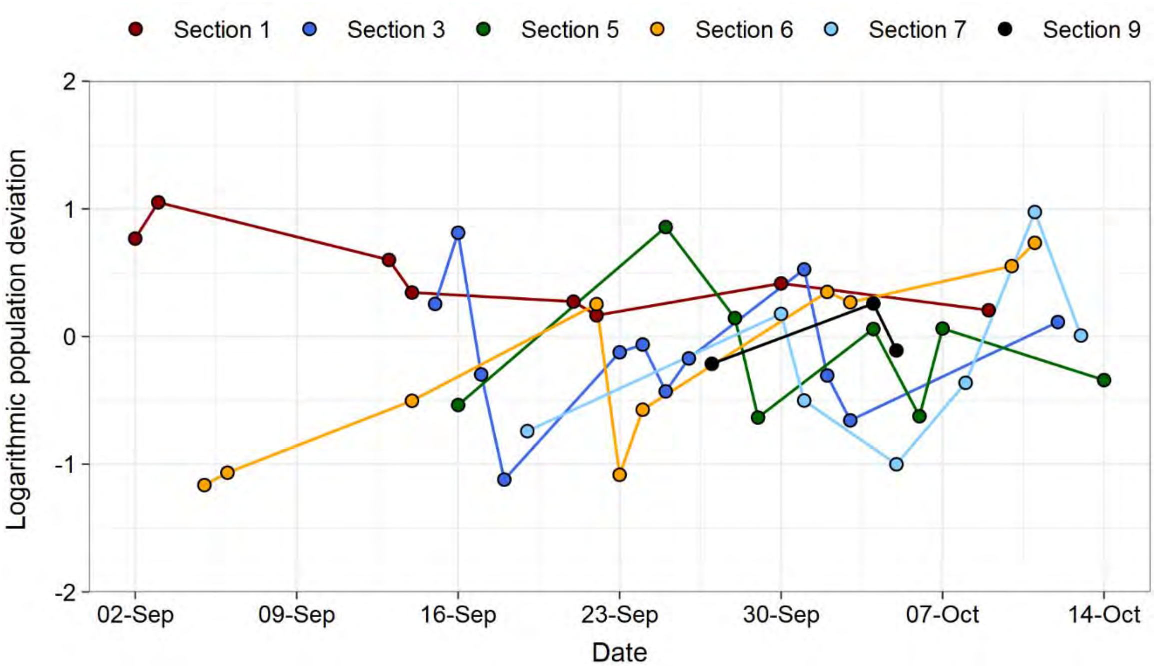

Figure G6: Logarithmic population deviation from the mean by river section and date for Mountain Whitefish.

Bayes Sequential Model for a Closed Population

The mark-recapture data were extracted by section from the database based on PIT tags applied during 2019 and PIT tags that were observed during 2019 that were originally applied in 2004 through 2018 and a minimum length of 250 mm. Table G5 lists Mountain Whitefish examined for marks and recaptures by date and section. The estimated releases, adjusted for movement between sections and availability delay to allow mixing or recovery from electro-shock (Equation 4) by section and date, are given in Table G6. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no instantaneous mortality rate or undetected mark rate are listed in Table G7. The subsequent population estimates using the Bayesian closed model are given in Table G8.
The sequential posterior probability plots by section are provided in Figure G7. The final posterior distributions for the six sections are drawn in Figure G8.

Table G5: Sample size and recaptures of Mountain Whitefish by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-20	0	0	0	0	0	0	36	0	0	0	0	0	36	0
2019-08-21	0	0	0	0	0	0	55	0	0	0	0	0	55	0
2019-08-22	228	0	0	0	0	0	0	0	0	0	0	0	228	0
2019-08-23	125	0	0	0	0	0	0	0	0	0	0	0	125	0
2019-08-24	0	0	0	0	5	0	0	0	0	0	1	0	6	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	4	0	4	0
2019-08-26	113	1	0	0	47	0	0	0	0	0	0	0	160	1
2019-08-27	45	1	65	0	0	0	5	1	10	0	0	0	125	2
2019-08-28	0	0	70	0	0	0	0	0	36	0	0	0	106	0
2019-08-29	0	0	17	0	0	0	0	0	0	0	0	0	17	0
2019-08-30	0	0	0	0	0	0	0	0	7	0	0	0	7	0
2019-08-31	0	0	0	0	12	0	0	0	0	0	0	0	12	0
2019-09-01	32	0	0	0	18	0	6	0	0	0	0	0	56	0
2019-09-02	200	3	0	0	0	0	0	0	0	0	0	0	200	3
2019-09-03	178	2	0	0	0	0	0	0	0	0	0	0	178	2
2019-09-04	0	0	70	0	0	0	0	0	0	0	0	0	70	0
2019-09-05	0	0	0	0	0	0	44	3	0	0	0	0	44	3
2019-09-06	0	0	0	0	0	0	39	2	0	0	0	0	39	2
2019-09-07	0	0	65	0	93	1	0	0	0	0	0	0	158	1
2019-09-08	0	0	94	1	0	0	19	0	25	0	0	0	138	1
2019-09-09	0	0	258	0	21	1	0	0	0	0	0	0	279	1
2019-09-10	0	0	0	0	0	0	0	0	33	0	44	1	77	1
2019-09-11	0	0	0	0	20	0	0	0	0	0	21	1	41	1
2019-09-12	0	0	0	0	0	0	0	0	109	1	0	0	109	1

Date	One		Three		Five		Six		Seven		Nine		Total	
	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-13	222	7	0	0	0	0	24	0	0	0	0	0	246	7
2019-09-14	221	9	0	0	0	0	72	4	0	0	0	0	293	13
2019-09-15	92	0	169	6	0	0	49	1	0	0	0	0	310	7
2019-09-16	0	0	246	5	123	8	0	0	0	0	0	0	369	13
2019-09-17	0	0	174	11	0	0	0	0	21	0	0	0	195	11
2019-09-18	0	0	122	18	0	0	0	0	34	1	0	0	156	19
2019-09-19	0	0	0	0	0	0	0	0	55	4	26	0	81	4
2019-09-20	0	0	0	0	29	0	0	0	0	0	5	0	34	0
2019-09-21	320	22	0	0	0	0	0	0	0	0	0	0	320	22
2019-09-22	196	15	0	0	0	0	88	4	0	0	0	0	284	19
2019-09-23	0	0	221	23	0	0	86	15	0	0	0	0	307	38
2019-09-24	0	0	143	14	0	0	38	4	0	0	0	0	181	18
2019-09-25	0	0	181	26	111	3	0	0	0	0	0	0	292	29
2019-09-26	0	0	223	25	0	0	0	0	0	0	0	0	223	25
2019-09-27	0	0	0	0	0	0	0	0	0	0	39	5	39	5
2019-09-28	0	0	0	0	83	5	0	0	2	0	10	1	95	6
2019-09-29	0	0	0	0	22	3	0	0	0	0	0	0	22	3
2019-09-30	264	21	0	0	0	0	0	0	115	5	0	0	379	26
2019-10-01	0	0	122	10	0	0	0	0	70	6	0	0	192	16
2019-10-02	0	0	239	45	0	0	250	16	0	0	0	0	489	61
2019-10-03	0	0	228	61	0	0	259	18	0	0	0	0	487	79
2019-10-04	0	0	0	0	125	12	0	0	0	0	52	6	177	18
2019-10-05	0	0	0	0	0	0	0	0	48	10	12	2	60	12
2019-10-06	0	0	0	0	26	5	0	0	5	0	0	0	31	5
2019-10-07	0	0	0	0	41	4	0	0	0	0	0	0	41	4
2019-10-08	0	0	0	0	0	0	0	0	117	13	0	0	117	13

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-10-09	429	43	0	0	0	0	0	0	0	0	0	0	429	43
2019-10-10	0	0	0	0	0	0	217	13	0	0	0	0	217	13
2019-10-11	0	0	0	0	0	0	60	3	67	2	0	0	127	5
2019-10-12	0	0	415	55	0	0	0	0	0	0	0	0	415	55
2019-10-13	0	0	0	0	0	0	0	0	62	5	0	0	62	5
2019-10-14	0	0	0	0	13	2	0	0	0	0	0	0	13	2
Total	2,665	124	3,122	300	789	44	1,347	84	816	47	214	16	8,953	615

Table G6: Estimated Mountain Whitefish mark releases by river section and date adjusted for migration and availability.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-23	0.0	0.0	1.6	32.2	2.3	0.0	36
2019-08-24	0.0	0.0	2.4	49.1	3.5	0.0	55
2019-08-25	202.3	16.9	5.6	3.3	0.0	0.0	228
2019-08-26	110.9	9.2	3.0	1.8	0.0	0.0	125
2019-08-27	0.0	0.0	4.4	0.4	0.1	1.0	6
2019-08-28	0.0	0.0	0.0	0.0	0.1	3.9	4
2019-08-29	99.7	8.6	42.9	5.6	1.1	0.0	158
2019-08-30	39.0	62.4	6.1	5.8	9.6	0.0	123
2019-08-31	0.0	63.7	5.3	3.4	32.6	0.0	105
2019-09-01	0.0	15.5	1.3	0.2	0.0	0.0	17
2019-09-02	0.0	0.0	0.0	0.5	6.5	0.0	7
2019-09-03	0.1	0.1	10.5	1.1	0.3	0.0	12
2019-09-04	26.8	2.3	16.7	6.5	0.8	0.0	53
2019-09-05	174.8	14.6	4.8	2.8	0.0	0.0	197
2019-09-06	149.1	12.4	4.1	2.4	0.0	0.0	168
2019-09-07	0.0	62.8	5.2	1.0	0.0	0.0	69
2019-09-08	0.0	0.0	1.6	33.0	2.3	0.0	37
2019-09-09	0.0	0.0	1.4	29.5	2.1	0.0	33
2019-09-10	0.7	57.9	85.2	9.0	2.2	0.0	155
2019-09-11	0.0	81.9	7.6	20.0	24.5	0.0	134
2019-09-12	0.1	233.1	36.8	5.5	0.5	0.0	276
2019-09-13	0.0	0.0	0.0	2.2	31.5	42.3	76
2019-09-14	0.1	0.1	17.5	1.8	0.8	19.7	40
2019-09-15	0.0	0.0	0.0	7.2	99.8	0.0	107
2019-09-16	189.9	15.8	6.0	20.0	1.2	0.0	233
2019-09-17	188.1	15.7	8.1	63.8	4.3	0.0	280
2019-09-18	81.6	154.2	16.5	45.7	3.0	0.0	301
2019-09-19	0.8	216.4	116.6	13.4	2.7	0.0	350
2019-09-20	0.0	147.4	12.2	3.7	18.7	0.0	182
2019-09-21	0.0	94.6	7.8	3.7	30.8	0.0	137
2019-09-22	0.0	0.0	0.0	3.3	46.1	25.6	75
2019-09-23	0.2	0.2	25.4	2.5	0.8	4.9	34
2019-09-24	263.6	22.0	7.2	4.2	0.0	0.0	297
2019-09-25	158.0	13.2	8.0	76.7	5.2	0.0	261
2019-09-26	0.0	180.2	18.0	65.4	4.4	0.0	268

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-27	0.0	117.4	11.2	32.3	2.1	0.0	163
2019-09-28	0.8	141.7	105.2	11.7	2.6	0.0	262
2019-09-29	0.0	180.2	14.9	2.9	0.0	0.0	198
2019-09-30	0.0	0.0	0.0	0.0	0.5	33.5	34
2019-10-01	0.6	0.5	68.2	7.0	3.9	8.9	89
2019-10-02	0.1	0.1	16.6	1.7	0.5	0.0	19
2019-10-03	35.5	3.0	1.0	7.8	100.7	0.0	148
2019-10-04	0.0	24.6	2.0	4.6	57.8	0.0	89
2019-10-05	0.0	57.3	6.0	25.9	1.8	0.0	91
2019-10-06	0.0	51.0	6.2	41.9	2.9	0.0	102
2019-10-07	0.2	0.2	22.7	2.3	0.8	7.9	34
2019-10-08	0.0	0.0	0.0	0.5	7.5	3.0	11
2019-10-09	0.1	0.1	7.0	1.0	3.9	0.0	12
2019-10-10	0.0	0.0	5.2	0.5	0.1	0.0	6
2019-10-11	0.0	0.0	0.0	1.0	14.0	0.0	15
2019-10-12	62.1	5.2	1.7	1.0	0.0	0.0	70
2019-10-13	0.0	0.0	1.1	23.2	1.6	0.0	26
2019-10-14	0.0	0.0	0.3	6.7	6.0	0.0	13
Total	1,786	2,082	759	699	545	151	6,021

Table G7: Mountain Whitefish sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
Section One:				**Section Six:**			
2019-08-26	113	202	1	2019-08-27	5	86	1
2019-08-27	45	313	1	2019-09-01	6	102	
2019-09-01	32	452		2019-09-05	44	110	3
2019-09-02	200	452	3	2019-09-06	39	113	2
2019-09-03	178	452	2	2019-09-08	19	116	
2019-09-13	222	804	7	2019-09-13	24	213	
2019-09-14	221	804	9	2019-09-14	72	215	4
2019-09-15	92	804		2019-09-15	49	217	1
2019-09-21	320	1264	22	2019-09-22	88	375	4
2019-09-22	196	1264	15	2019-09-23	86	378	15
2019-09-30	264	1687	21	2019-09-24	38	380	4

Date	Sample	Marks	Recap.
2019-10-09	429	1723	43
Section Three:			
2019-08-27	65	26	
2019-08-28	70	26	
2019-08-29	17	26	
2019-09-04	70	176	
2019-09-07	65	206	
2019-09-08	94	268	1
2019-09-09	258	268	
2019-09-15	169	641	6
2019-09-16	246	641	5
2019-09-17	174	657	11
2019-09-18	122	673	18
2019-09-23	221	1286	23
2019-09-24	143	1286	14
2019-09-25	181	1308	26
2019-09-26	223	1321	25
2019-10-01	122	1940	10
2019-10-02	239	1941	45
2019-10-03	228	1941	61
2019-10-12	415	2077	55
Section Five:			
2019-08-24	5	2	
2019-08-26	47	10	
2019-08-31	12	66	
2019-09-01	18	71	
2019-09-07	93	109	1
2019-09-09	21	115	1
2019-09-11	20	202	
2019-09-16	123	264	8
2019-09-20	29	411	
2019-09-25	111	464	3
2019-09-28	83	501	5
2019-09-29	22	606	3
2019-10-04	125	707	12
2019-10-06	26	715	5
2019-10-02	250	581	16
2019-10-03	259	582	18
2019-10-10	217	666	13
2019-10-11	60	667	3
Section Seven:			
2019-08-27	10	6	
2019-08-28	36	6	
2019-08-30	7	7	
2019-09-08	25	57	
2019-09-10	33	61	
2019-09-12	109	88	1
2019-09-17	21	222	
2019-09-18	34	226	1
2019-09-19	55	229	4
2019-09-28	2	340	
2019-09-30	115	343	5
2019-10-01	70	343	6
2019-10-05	48	506	10
2019-10-06	5	508	
2019-10-08	117	511	13
2019-10-11	67	523	2
2019-10-13	62	537	5
Section Nine:			
2019-09-10	44	5	1
2019-09-11	21	5	1
2019-09-19	26	67	
2019-09-20	5	67	
2019-09-27	39	97	5
2019-09-28	10	97	1
2019-10-04	52	140	6
2019-10-05	12	140	2

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
2019-10-07	41	721	4				
2019-10-14	13	759	2				

Table G8: Mountain Whitefish population estimates by river section.

Section	Bayes Mean	MLE	95% HPD		Standard	CV
			Low	High	Deviation	(%)
One	20,324	20,010	16,940	23,900	1,786	8.8
Three	12,015	11,940	10,760	13,310	649	5.4
Five	7,506	7,180	5,440	9,770	1,128	15.0
Six	7,433	7,260	5,940	9,030	794	10.7
Seven	5,698	5,460	4,180	7,360	826	14.5
Nine	1,152	1,010	640	1,760	303	26.3
Total	54,128		49,212	59,044	2,508	4.6

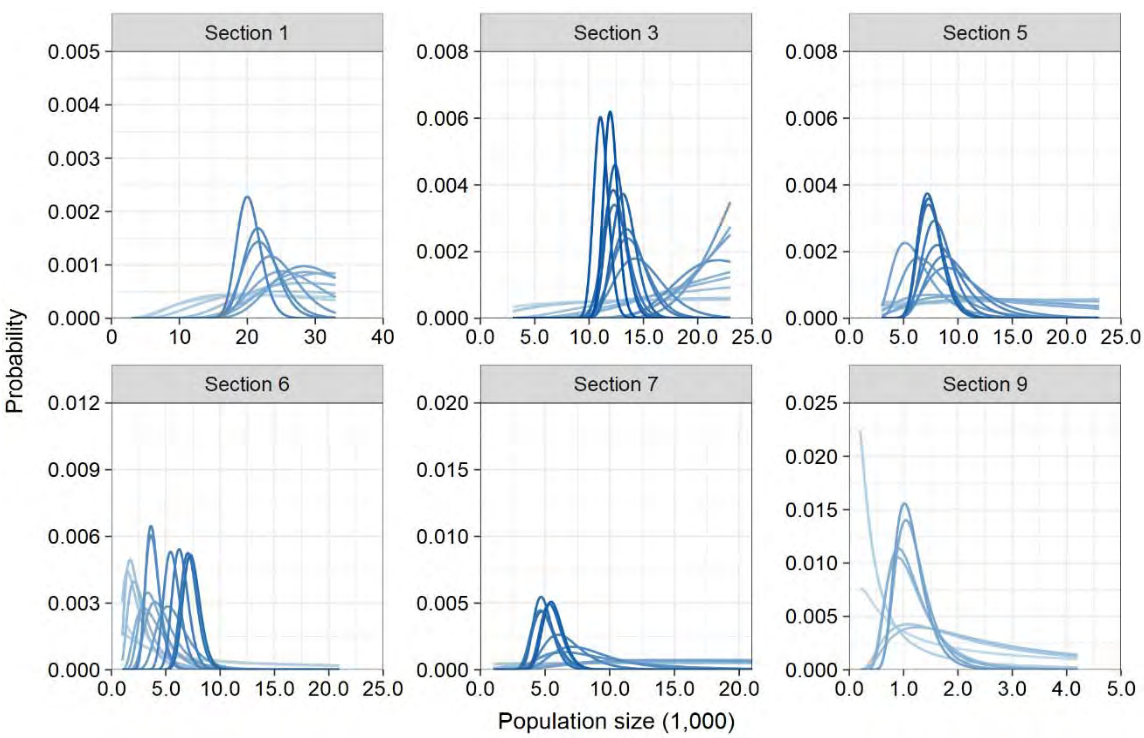

Figure G7: Sequential posterior probability plots of population size for Mountain Whitefish in 2019 in Sections 1, 3, 5, 6, 7, and 9. Each line is the posterior probability updated by a sample day.

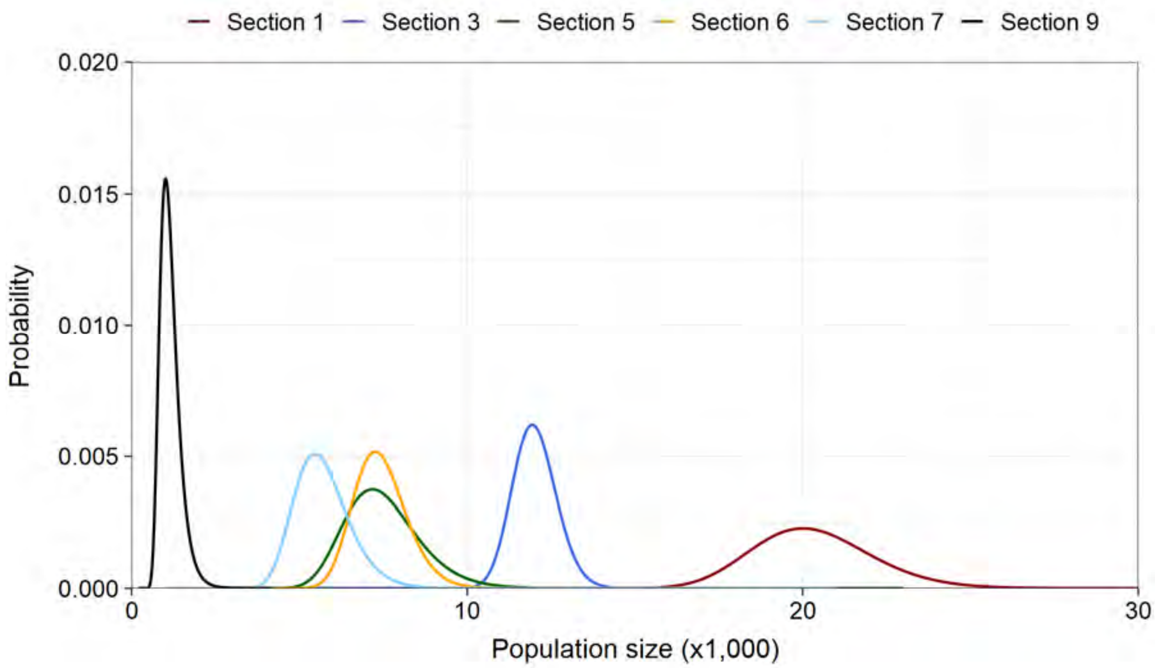

Figure G8: Final posterior distributions by river section for Mountain Whitefish in 2019.

The sequence of posterior probability plots were used as an indicator of closure or change in the population size over the study period (Gazey and Staley 1986). Trends in the posterior plots can also be caused by trends in catchability (changes in population size and catchability are confounded). Inspection of the posterior probability plot sequences appear stable (no marked trend or sequence to larger or smaller population sizes) and were consistent with a convergence to a modal population size except for Section 6. Section 6 displayed a trend in catchability (Figure G7) and/or immigration of unmarked fish.

Arctic Grayling

The mark-recapture data were extracted by section from the database using all available marks (smallest length 200 mm). No recaptured fish were observed to move between sections. Table G9 lists Arctic Grayling examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G10. Only Section 3 had sufficient captures to enable population estimates. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G11. The sequential posterior probability plots for the population estimates are provided in Figure G9 and the population estimates in Table G12.

Table G9: Sample size and recaptures of Arctic Grayling by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-28	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-08-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-31	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-01	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-04	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-05	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-09-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-07	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-08	0	0	16	0	0	0	1	0	0	0	0	0	17	0
2019-09-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-15	0	0	3	0	0	0	0	0	0	0	0	0	3	0
2019-09-16	0	0	1	1	3	0	0	0	0	0	0	0	4	1
2019-09-17	0	0	5	1	0	0	0	0	0	0	0	0	5	1
2019-09-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-20	0	0	0	0	1	0	0	0	0	0	0	0	1	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-09-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-22	0	0	0	0	0	0	2	0	0	0	0	0	2	0
2019-09-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-24	0	0	2	1	0	0	0	0	0	0	0	0	2	1
2019-09-25	0	0	2	1	1	0	0	0	0	0	0	0	3	1
2019-09-26	0	0	3	1	0	0	0	0	0	0	0	0	3	1
2019-09-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-02	0	0	2	2	0	0	1	0	0	0	0	0	3	2
2019-10-03	0	0	10	4	0	0	3	0	0	0	0	0	13	4
2019-10-04	0	0	0	0	2	1	0	0	0	0	0	0	2	1
2019-10-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-07	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-10-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-10	0	0	0	0	0	0	1	1	0	0	0	0	1	1
2019-10-11	0	0	0	0	0	0	1	0	1	0	0	0	2	0
2019-10-12	0	0	3	2	0	0	0	0	0	0	0	0	3	2
Total	0	0	51	13	11	1	10	1	1	0	0	0	73	15

Table G10: Estimated Arctic Grayling mark releases by river section and date.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-31	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-03	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-09-04	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-09-05	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-06	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-07	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-08	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-09-09	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-10	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-09-11	0.0	15.0	0.0	1.0	0.0	0.0	16
2019-09-12	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-13	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-14	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-15	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-16	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-17	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-18	0.0	3.0	0.0	0.0	0.0	0.0	3
2019-09-19	0.0	0.0	3.0	0.0	0.0	0.0	3
2019-09-20	0.0	4.0	0.0	0.0	0.0	0.0	4
2019-09-21	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-22	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-23	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-09-24	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-25	0.0	0.0	0.0	2.0	0.0	0.0	2
2019-09-26	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-27	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-09-28	0.0	1.0	1.0	0.0	0.0	0.0	2
2019-09-29	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-30	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-03	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-04	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-05	0.0	0.0	0.0	1.0	0.0	0.0	1

Date	One	Three	Five	Six	Seven	Nine	Total
2019-10-06	0.0	6.0	0.0	1.0	0.0	0.0	7
2019-10-07	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-09	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-10	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-11	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-12	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-13	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-14	0.0	0.0	0.0	1.0	1.0	0.0	2
Total	0.0	36.0	10.0	7.0	1.0	0.0	54

Table G11: Arctic Grayling sample, cumulative marks available for recapture and recaptures for river Section 3.

Date	Sample	Marks	Recap.
Section Three:			
2019-09-04	2	2	
2019-09-08	16	4	
2019-09-15	3	19	
2019-09-16	1	19	1
2019-09-17	5	19	1
2019-09-24	2	26	1
2019-09-25	2	26	1
2019-09-26	3	26	1
2019-10-02	2	30	2
2019-10-03	10	30	4
2019-10-12	3	36	2

Table G12: Arctic Grayling population estimates for river Section 3.

			95% HPD		Standard	CV
Section	Bayes Mean	MLE	Low	High	Deviation	(%)
Three	75	65	44	113	19	25.3

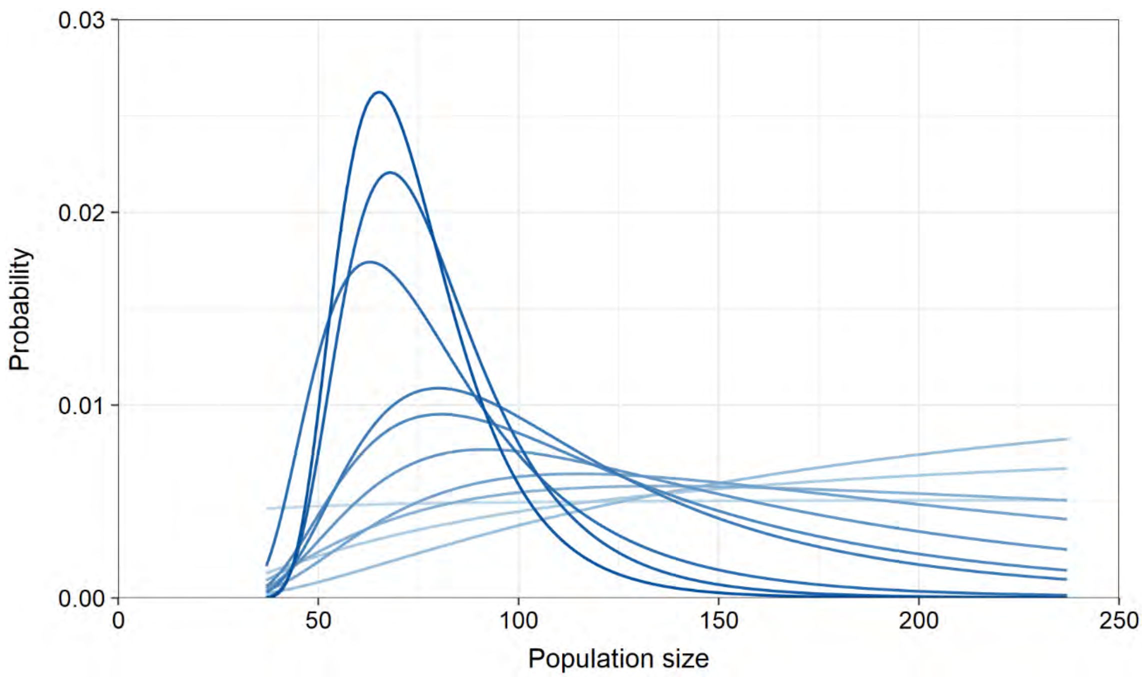

Figure G9: Sequential posterior probability plots of population size for Section 3 Arctic Grayling in 2019. Each line is the posterior probability updated by a sample day.

Bull Trout

The mark-recapture data were extracted by section from the database, with a minimum length of 250 mm. One fish released in Section 3 was recaptured in Section 1; otherwise, there were no movements between sections (see Table G13). Table G14 lists Bull Trout examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G15. Only Sections 1 and 3 had sufficient recaptures to generate population estimates. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G16. The population estimates using the Bayesian model are given in Table G17, and the associated sequential posterior probability plots are provided in Figure G10. None of the posterior probability plots display trends over time. The total population estimate was calculated from the joint distribution of Sections 1 and 3. The final posterior distributions are drawn in Figure G11.

Table G13: Bull Trout recaptures and migration proportions adjusted (inverse weight) for fish examined by section during 2019.

Release	Recapture Section						
Section	One	Three	Five	Six	Seven	Nine	Total
One	7	0	0	0	0	0	7
Three	1	7	0	0	0	0	8
Five	0	0	1	0	0	0	1
Six	0	0	0	1	0	0	1
Seven	0	0	0	0	1	0	1
Nine	0	0	0	0	0	0	0
Sample:	68	58	20	18	14	2	180
Recap. %	11.76	12.07	5.00	5.56	7.14	0.00	10.00
Proportions:							
One	1.000	0.000	0.000	0.000	0.000	0.000	1.000
Three	0.109	0.891	0.000	0.000	0.000	0.000	1.000
Five	0.000	0.000	1.000	0.000	0.000	0.000	1.000
Six	0.000	0.000	0.000	1.000	0.000	0.000	1.000
Seven	0.000	0.000	0.000	0.000	1.000	0.000	1.000
Nine	0.000	0.000	0.000	0.000	0.000	1.000	1.000

Table G14: Sample size and recaptures of Bull Trout by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-21	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-08-22	5	0	0	0	0	0	0	0	0	0	0	0	5	0
2019-08-23	3	0	0	0	0	0	0	0	0	0	0	0	3	0
2019-08-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-26	3	0	0	0	1	0	0	0	0	0	0	0	4	0
2019-08-27	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-08-28	0	0	4	0	0	0	0	0	0	0	0	0	4	0
2019-08-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-31	0	0	0	0	4	0	0	0	0	0	0	0	4	0
2019-09-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-02	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-03	8	0	0	0	0	0	0	0	0	0	0	0	8	0
2019-09-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-06	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-09-07	0	0	5	0	0	0	0	0	0	0	0	0	5	0
2019-09-08	0	0	5	0	0	0	0	0	0	0	0	0	5	0
2019-09-09	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-09-10	0	0	0	0	0	0	0	0	0	0	1	0	1	0
2019-09-11	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-12	0	0	0	0	0	0	0	0	2	0	0	0	2	0
2019-09-13	2	0	0	0	0	0	4	0	0	0	0	0	6	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-14	5	2	0	0	0	0	0	0	0	0	0	0	5	2
2019-09-15	4	0	2	0	0	0	0	0	0	0	0	0	6	0
2019-09-16	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-17	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-18	0	0	3	1	0	0	0	0	0	0	0	0	3	1
2019-09-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-20	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-21	4	0	0	0	0	0	0	0	0	0	0	0	4	0
2019-09-22	5	0	0	0	0	0	0	0	0	0	0	0	5	0
2019-09-23	0	0	6	0	0	0	2	0	0	0	0	0	8	0
2019-09-24	0	0	2	0	0	0	1	0	0	0	0	0	3	0
2019-09-25	0	0	3	1	1	0	0	0	0	0	0	0	4	1
2019-09-26	0	0	3	1	0	0	0	0	0	0	0	0	3	1
2019-09-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-28	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-29	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-30	13	1	0	0	0	0	0	0	1	0	0	0	14	1
2019-10-01	0	0	1	0	0	0	0	0	1	0	0	0	2	0
2019-10-02	0	0	6	1	0	0	2	0	0	0	0	0	8	1
2019-10-03	0	0	4	2	0	0	2	0	0	0	0	0	6	2
2019-10-04	0	0	0	0	3	0	0	0	0	0	1	0	4	0
2019-10-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-06	0	0	0	0	0	0	0	0	1	0	0	0	1	0
2019-10-07	0	0	0	0	3	1	0	0	0	0	0	0	3	1
2019-10-08	0	0	0	0	0	0	0	0	3	0	0	0	3	0
2019-10-09	15	5	0	0	0	0	0	0	0	0	0	0	15	5

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-10-10	0	0	0	0	0	0	4	1	0	0	0	0	4	1
2019-10-11	0	0	0	0	0	0	1	0	3	0	0	0	4	0
2019-10-12	0	0	8	1	0	0	0	0	0	0	0	0	8	1
2019-10-13	0	0	0	0	0	0	0	0	3	1	0	0	3	1
2019-10-14	0	0	0	0	2	0	0	0	0	0	0	0	2	0
Total	68	8	58	7	20	1	18	1	14	1	2	0	180	18

Table G15: Estimated Bull Trout mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-24	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-08-25	5.0	0.0	0.0	0.0	0.0	0.0	5
2019-08-26	3.0	0.0	0.0	0.0	0.0	0.0	3
2019-08-27	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-28	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-29	3.0	0.0	1.0	0.0	0.0	0.0	4
2019-08-30	0.1	0.9	0.0	0.0	0.0	0.0	1
2019-08-31	0.4	3.6	0.0	0.0	0.0	0.0	4
2019-09-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-03	0.0	0.0	4.0	0.0	0.0	0.0	4
2019-09-04	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-05	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-06	8.0	0.0	0.0	0.0	0.0	0.0	8
2019-09-07	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-09	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-09-10	0.5	4.5	0.0	0.0	0.0	0.0	5
2019-09-11	0.5	4.5	0.0	0.0	0.0	0.0	5
2019-09-12	0.1	0.9	0.0	0.0	0.0	0.0	1
2019-09-13	0.0	0.0	0.0	0.0	0.0	1.0	1
2019-09-14	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-09-15	0.0	0.0	0.0	0.0	2.0	0.0	2
2019-09-16	2.0	0.0	0.0	4.0	0.0	0.0	6
2019-09-17	3.0	0.0	0.0	0.0	0.0	0.0	3
2019-09-18	4.2	1.8	0.0	0.0	0.0	0.0	6
2019-09-19	0.2	1.8	0.0	0.0	0.0	0.0	2
2019-09-20	0.2	1.8	0.0	0.0	0.0	0.0	2
2019-09-21	0.2	1.8	0.0	0.0	0.0	0.0	2
2019-09-22	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-23	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-24	4.0	0.0	0.0	0.0	0.0	0.0	4
2019-09-25	5.0	0.0	0.0	0.0	0.0	0.0	5
2019-09-26	0.7	5.3	0.0	2.0	0.0	0.0	8
2019-09-27	0.2	1.8	0.0	0.0	0.0	0.0	2
2019-09-28	0.2	1.8	1.0	0.0	0.0	0.0	3

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-29	0.2	1.8	0.0	0.0	0.0	0.0	2
2019-09-30	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-01	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-10-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-03	12.0	0.0	0.0	0.0	1.0	0.0	13
2019-10-04	0.1	0.9	0.0	0.0	1.0	0.0	2
2019-10-05	0.5	4.5	0.0	2.0	0.0	0.0	7
2019-10-06	0.2	1.8	0.0	1.0	0.0	0.0	3
2019-10-07	0.0	0.0	3.0	0.0	0.0	1.0	4
2019-10-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-09	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-10-10	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-10-11	0.0	0.0	0.0	0.0	3.0	0.0	3
2019-10-12	10.0	0.0	0.0	0.0	0.0	0.0	10
2019-10-13	0.0	0.0	0.0	2.0	0.0	0.0	2
2019-10-14	0.0	0.0	0.0	1.0	3.0	0.0	4
Total	64.8	39.2	16.0	14.0	11.0	2.0	147

Table G16: Bull Trout sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.
Section One:			
2019-08-26	3	5	
2019-09-02	1	12	
2019-09-03	8	12	
2019-09-13	2	22	
2019-09-14	5	22	2
2019-09-15	4	22	
2019-09-21	4	31	
2019-09-22	5	32	
2019-09-30	13	42	1
2019-10-09	15	55	5
Section Three:			
2019-09-07	5	4	
2019-09-08	5	4	
2019-09-09	1	4	
2019-09-15	2	14	
2019-09-16	2	14	
2019-09-17	2	14	
2019-09-18	3	14	1
2019-09-23	6	21	
2019-09-24	2	21	
2019-09-25	3	21	1
2019-09-26	3	21	1
2019-10-01	1	32	
2019-10-02	6	32	1

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
				2019-10-03	4	32	2
				2019-10-12	8	39	1

Table G17: Bull Trout population estimates by river section.

Section	Bayes Mean	MLE	95% HPD		Standard Deviation	CV (%)
			Low	High		
One	321	247	134	578	128	39.7
Three	224	164	85	423	104	46.5
Total[1]	545	462	287	859	165	30.2

[1] Calculated from the joint distributions of Sections 1 and 3.

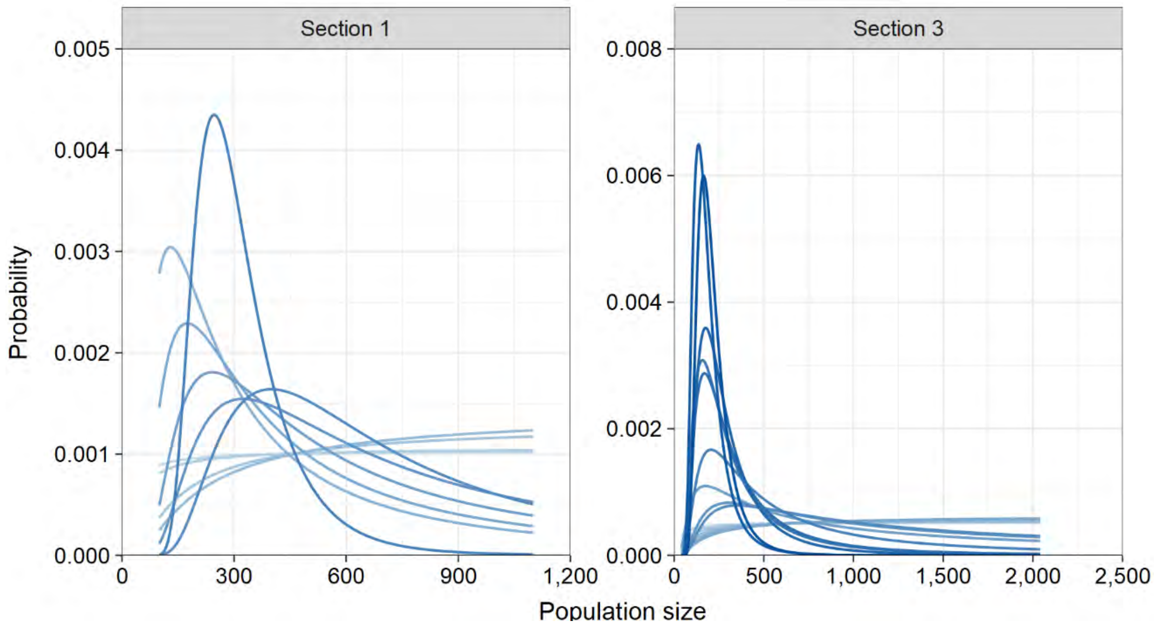

Figure G10: Sequential posterior probability plots of population size for Sections 1 and 3 Bull Trout in 2019. Each line is the posterior probability updated by a sample day.

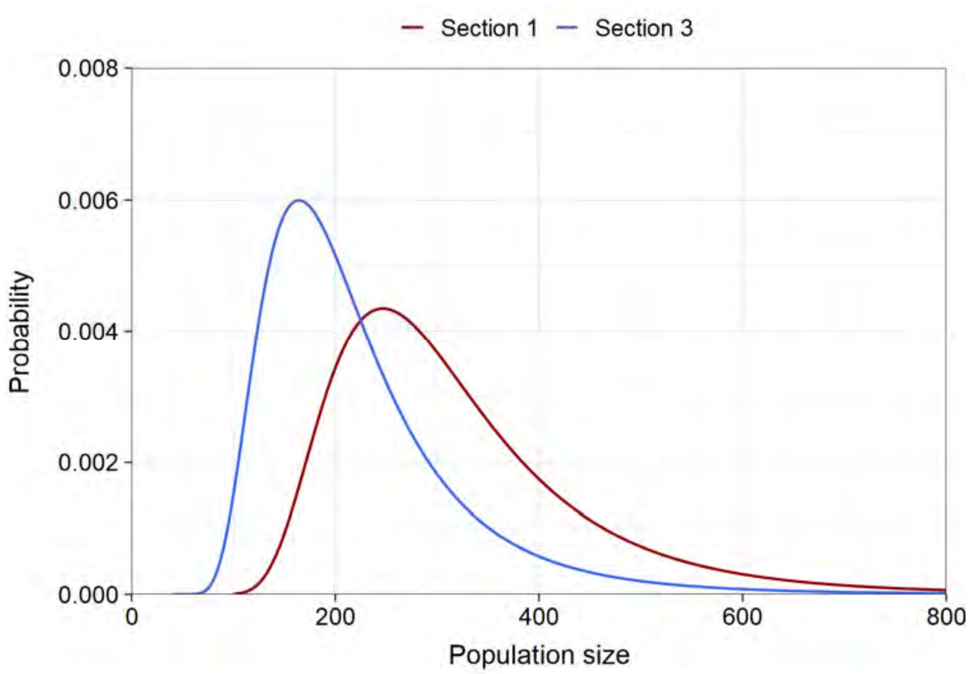

Figure G11: Final posterior distributions by river section for Bull Trout.

Walleye

The mark-recapture data were extracted by section from the database using a minimum length of 250 mm. Movement between river sections was not observed. Table G18 lists Walleye examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G19. Only Section 7 had sufficient recaptures to enable population estimates. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G20. The population estimates using the Bayesian model are given in Table G21, and the associated sequential posterior probability plot is provided in Figure G12. The posterior probability plot did not display a trend over time.

Table G18: Sample size and recaptures of Walleye by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-20	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-08-21	0	0	0	0	0	0	4	0	0	0	0	0	4	0
2019-08-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-24	0	0	0	0	1	0	0	0	0	0	1	0	2	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	2	0	2	0
2019-08-26	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-08-27	0	0	2	0	0	0	1	0	2	0	0	0	5	0
2019-08-28	0	0	1	0	0	0	0	0	3	0	0	0	4	0
2019-08-29	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-08-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-31	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-01	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-05	0	0	0	0	0	0	5	0	0	0	0	0	5	0
2019-09-06	0	0	0	0	0	0	8	0	0	0	0	0	8	0
2019-09-07	0	0	3	0	5	0	0	0	0	0	0	0	8	0
2019-09-08	0	0	2	0	0	0	0	0	3	0	0	0	5	0
2019-09-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-10	0	0	0	0	0	0	0	0	6	0	11	0	17	0
2019-09-11	0	0	0	0	0	0	0	0	0	0	1	0	1	0
2019-09-12	0	0	0	0	0	0	0	0	7	0	0	0	7	0

Date	One Sample	One Recap.	Three Sample	Three Recap.	Five Sample	Five Recap.	Six Sample	Six Recap.	Seven Sample	Seven Recap.	Nine Sample	Nine Recap.	Total Sample	Total Recap.
2019-09-13	0	0	0	0	0	0	2	0	0	0	0	0	2	0
2019-09-14	0	0	0	0	0	0	3	0	0	0	0	0	3	0
2019-09-15	0	0	1	0	0	0	7	0	0	0	0	0	8	0
2019-09-16	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-17	0	0	0	0	0	0	0	0	5	0	0	0	5	0
2019-09-18	0	0	0	0	0	0	0	0	4	0	0	0	4	0
2019-09-19	0	0	0	0	0	0	0	0	3	0	3	0	6	0
2019-09-20	0	0	0	0	4	0	0	0	0	0	2	0	6	0
2019-09-21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-22	0	0	0	0	0	0	9	0	0	0	0	0	9	0
2019-09-23	0	0	0	0	0	0	2	0	0	0	0	0	2	0
2019-09-24	0	0	0	0	0	0	3	0	15	0	0	0	18	0
2019-09-25	0	0	2	0	2	0	0	0	0	0	0	0	4	0
2019-09-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-27	0	0	0	0	0	0	0	0	0	0	3	0	3	0
2019-09-28	0	0	0	0	0	0	0	0	1	0	4	0	5	0
2019-09-29	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-09-30	0	0	0	0	0	0	0	0	4	0	0	0	4	0
2019-10-01	0	0	0	0	0	0	0	0	9	1	0	0	9	1
2019-10-02	0	0	0	0	0	0	3	0	0	0	0	0	3	0
2019-10-03	0	0	1	0	0	0	1	0	0	0	0	0	2	0
2019-10-04	0	0	0	0	0	0	0	0	0	0	5	1	5	1
2019-10-05	0	0	0	0	0	0	0	0	2	1	0	0	2	1
2019-10-06	0	0	0	0	1	0	0	0	8	1	0	0	9	1
2019-10-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-08	0	0	0	0	0	0	0	0	4	1	0	0	4	1

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-10-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-10	0	0	0	0	0	0	3	0	0	0	0	0	3	0
2019-10-11	0	0	0	0	0	0	0	0	24	1	0	0	24	1
2019-10-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-13	0	0	0	0	0	0	0	0	7	1	0	0	7	1
2019-10-14	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Total	0	0	13	0	22	0	52	0	107	6	32	1	226	7

Table G19: Estimated Walleye mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-23	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-08-24	0.0	0.0	0.0	0.0	4.0	0.0	4
2019-08-25	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-26	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-27	0.0	0.0	1.0	0.0	0.0	1.0	2
2019-08-28	0.0	0.0	0.0	0.0	0.0	2.0	2
2019-08-29	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-08-30	0.0	2.0	0.0	0.0	3.0	0.0	5
2019-08-31	0.0	1.0	0.0	0.0	3.0	0.0	4
2019-09-01	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-09-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-03	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-04	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-05	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-06	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-07	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-08	0.0	0.0	0.0	0.0	5.0	0.0	5
2019-09-09	0.0	0.0	0.0	0.0	8.0	0.0	8
2019-09-10	0.0	3.0	5.0	0.0	0.0	0.0	8
2019-09-11	0.0	2.0	0.0	0.0	3.0	0.0	5
2019-09-12	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-13	0.0	0.0	0.0	0.0	6.0	11.0	17
2019-09-14	0.0	0.0	0.0	0.0	0.0	1.0	1
2019-09-15	0.0	0.0	0.0	0.0	7.0	0.0	7
2019-09-16	0.0	0.0	0.0	0.0	2.0	0.0	2
2019-09-17	0.0	0.0	0.0	0.0	3.0	0.0	3
2019-09-18	0.0	1.0	0.0	0.0	7.0	0.0	8
2019-09-19	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-20	0.0	0.0	0.0	0.0	5.0	0.0	5
2019-09-21	0.0	0.0	0.0	0.0	4.0	0.0	4
2019-09-22	0.0	0.0	0.0	0.0	3.0	3.0	6
2019-09-23	0.0	0.0	4.0	0.0	0.0	2.0	6
2019-09-24	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-25	0.0	0.0	0.0	0.0	9.0	0.0	9
2019-09-26	0.0	0.0	0.0	0.0	2.0	0.0	2
2019-09-27	0.0	0.0	0.0	0.0	18.0	0.0	18

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-28	0.0	2.0	2.0	0.0	0.0	0.0	4
2019-09-29	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-30	0.0	0.0	0.0	0.0	0.0	3.0	3
2019-10-01	0.0	0.0	0.0	0.0	1.0	4.0	5
2019-10-02	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-03	0.0	0.0	0.0	0.0	4.0	0.0	4
2019-10-04	0.0	0.0	0.0	0.0	8.0	0.0	8
2019-10-05	0.0	0.0	0.0	0.0	3.0	0.0	3
2019-10-06	0.0	1.0	0.0	0.0	1.0	0.0	2
2019-10-07	0.0	0.0	0.0	0.0	0.0	4.0	4
2019-10-08	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-10-09	0.0	0.0	1.0	0.0	7.0	0.0	8
2019-10-10	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-11	0.0	0.0	0.0	0.0	3.0	0.0	3
2019-10-12	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-13	0.0	0.0	0.0	0.0	3.0	0.0	3
2019-10-14	0.0	0.0	0.0	0.0	22.0	0.0	22
Total	0.0	13.0	21.0	0.0	146.0	31.0	211

Table G20: Walleye sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.
Section Seven:			
2019-08-27	2	5	
2019-08-28	3	5	
2019-09-08	3	11	
2019-09-10	6	24	
2019-09-12	7	27	
2019-09-17	5	42	
2019-09-18	4	45	
2019-09-19	3	52	
2019-09-24	15	64	
2019-09-28	1	93	
2019-09-30	4	93	
2019-10-01	9	93	1
2019-10-05	2	106	1

Date	Sample	Marks	Recap.
2019-10-06	8	109	1
2019-10-08	4	110	1
2019-10-11	24	118	1
2019-10-13	7	121	1

Table G21: Walleye population estimates by river section.

			95% HPD		Standard	CV
Section	**Bayes Mean**	**MLE**	**Low**	**High**	**Deviation**	**(%)**
Seven	2,028	1,390	640	4,115	1030	50.8

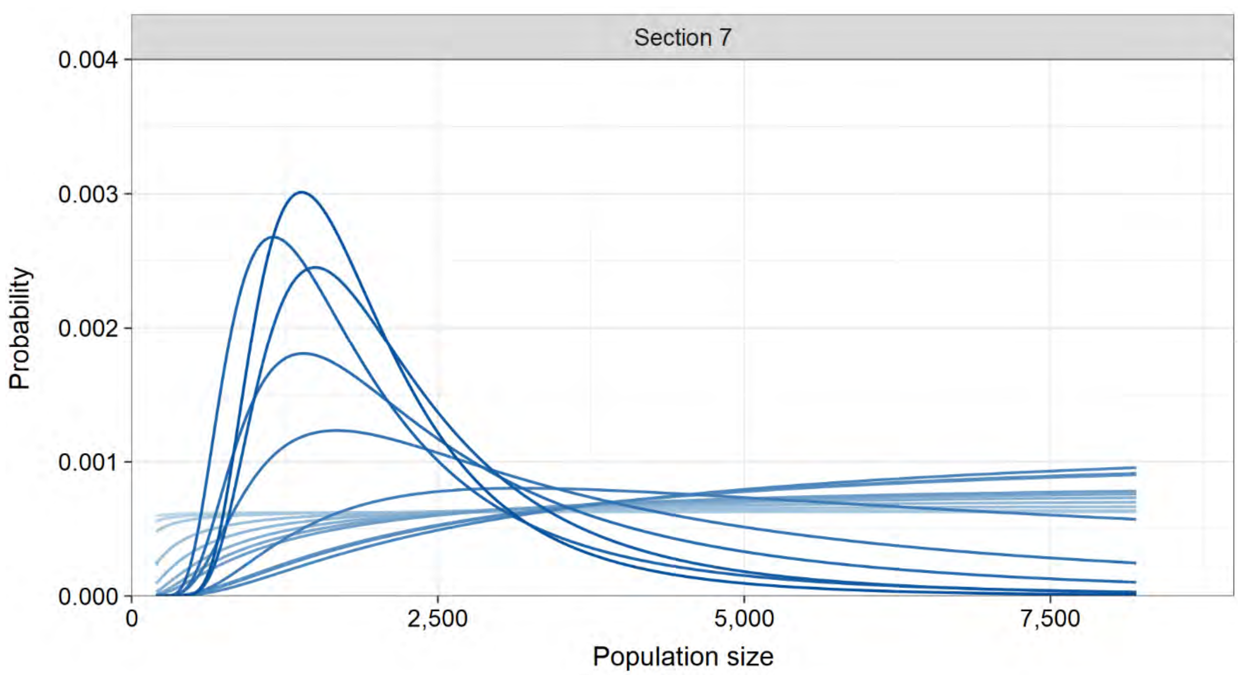

Figure G12: Sequential posterior probability plots of population size for Section 7 Walleye in 2019. Each line is the posterior probability updated by a sample day.

Largescale Sucker

The mark-recapture data were extracted by section from the database using a minimum length of 250 mm. The movement of recaptured Largescale Sucker between sections is listed in Table G22 along with the estimates of the migration proportions adjusted for the number of fish examined (Equation 4). Table G23 lists Largescale Sucker examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G24. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G25. The population estimates using the Bayesian model are given in Table G26, and the associated sequential posterior probability plots are provided in Figure G13. None of the posterior probability plots display trends over time. The final posterior distributions are drawn in Figure G14.

Table G22: Largescale Sucker recaptures and migration proportions adjusted (inverse weight) for fish examined by river section during 2019.

Release	Recapture Section						
Section	**One**	**Three**	**Five**	**Six**	**Seven**	**Nine**	**Total**
One	4	0	0	0	0	0	4
Three	0	8	1	1	0	0	10
Five	0	0	4	0	0	0	4
Six	0	0	0	7	0	0	7
Seven	0	0	0	0	3	0	3
Nine	0	0	0	0	0	2	2
Sample:	194	199	200	247	120	26	986
Recap. %	2.06	4.02	2.50	3.24	2.50	7.69	3.04
Proportions:							
One	1.000	0.000	0.000	0.000	0.000	0.000	1.000
Three	0.000	0.816	0.102	0.082	0.000	0.000	1.000
Five	0.000	0.000	1.000	0.000	0.000	0.000	1.000
Six	0.000	0.000	0.000	1.000	0.000	0.000	1.000
Seven	0.000	0.000	0.000	0.000	1.000	0.000	1.000
Nine	0.000	0.000	0.000	0.000	0.000	1.000	1.000

Table G23: Sample size and recaptures of Largescale Sucker by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-20	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-08-21	0	0	0	0	0	0	10	0	0	0	0	0	10	0
2019-08-22	3	0	0	0	0	0	0	0	0	0	0	0	3	0
2019-08-23	7	0	0	0	0	0	0	0	0	0	0	0	7	0
2019-08-24	0	0	0	0	6	0	0	0	0	0	1	0	7	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-26	12	0	0	0	23	0	0	0	0	0	0	0	35	0
2019-08-27	2	0	12	0	0	0	6	0	14	0	0	0	34	0
2019-08-28	0	0	18	0	0	0	0	0	5	0	0	0	23	0
2019-08-29	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-08-30	0	0	0	0	0	0	0	0	10	0	0	0	10	0
2019-08-31	0	0	0	0	8	0	0	0	0	0	0	0	8	0
2019-09-01	3	0	0	0	7	0	14	0	0	0	0	0	24	0
2019-09-02	3	0	0	0	0	0	0	0	0	0	0	0	3	0
2019-09-03	25	0	0	0	0	0	0	0	0	0	0	0	25	0
2019-09-04	0	0	15	0	0	0	0	0	0	0	0	0	15	0
2019-09-05	0	0	0	0	0	0	19	0	0	0	0	0	19	0
2019-09-06	0	0	0	0	0	0	25	0	0	0	0	0	25	0
2019-09-07	0	0	22	0	31	0	0	0	0	0	0	0	53	0
2019-09-08	0	0	12	1	0	0	0	0	1	0	0	0	13	1
2019-09-09	0	0	8	0	0	0	0	0	0	0	0	0	8	0
2019-09-10	0	0	0	0	0	0	0	0	3	0	1	0	4	0
2019-09-11	0	0	0	0	6	0	0	0	0	0	4	0	10	0
2019-09-12	0	0	0	0	0	0	0	0	11	0	0	0	11	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-13	17	0	0	0	0	0	18	1	0	0	0	0	35	1
2019-09-14	12	1	0	0	0	0	22	0	0	0	0	0	34	1
2019-09-15	1	0	2	0	0	0	12	0	0	0	0	0	15	0
2019-09-16	0	0	18	1	28	1	0	0	0	0	0	0	46	2
2019-09-17	0	0	14	0	0	0	0	0	7	0	0	0	21	0
2019-09-18	0	0	4	1	0	0	0	0	11	0	0	0	15	1
2019-09-19	0	0	0	0	0	0	0	0	2	0	1	0	3	0
2019-09-20	0	0	0	0	9	0	0	0	0	0	1	0	10	0
2019-09-21	16	1	0	0	0	0	0	0	0	0	0	0	16	1
2019-09-22	6	0	0	0	0	0	32	2	0	0	0	0	38	2
2019-09-23	0	0	3	0	0	0	25	2	0	0	0	0	28	2
2019-09-24	0	0	9	0	0	0	7	1	3	0	0	0	19	1
2019-09-25	0	0	11	1	22	1	0	0	0	0	0	0	33	2
2019-09-26	0	0	10	0	0	0	0	0	0	0	0	0	10	0
2019-09-27	0	0	0	0	0	0	0	0	0	0	2	1	2	1
2019-09-28	0	0	0	0	17	0	0	0	0	0	6	1	23	1
2019-09-29	0	0	0	0	5	0	0	0	0	0	0	0	5	0
2019-09-30	6	0	0	0	0	0	0	0	5	1	0	0	11	1
2019-10-01	0	0	0	0	0	0	0	0	5	1	0	0	5	1
2019-10-02	0	0	13	2	0	0	19	0	0	0	0	0	32	2
2019-10-03	0	0	13	2	0	0	26	2	0	0	0	0	39	4
2019-10-04	0	0	0	0	19	2	0	0	0	0	9	0	28	2
2019-10-05	0	0	0	0	0	0	0	0	7	0	1	0	8	0
2019-10-06	0	0	0	0	8	1	0	0	1	0	0	0	9	1
2019-10-07	0	0	0	0	7	0	0	0	0	0	0	0	7	0
2019-10-08	0	0	0	0	0	0	0	0	27	0	0	0	27	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-10-09	81	2	0	0	0	0	0	0	0	0	0	0	81	2
2019-10-10	0	0	0	0	0	0	8	0	0	0	0	0	8	0
2019-10-11	0	0	0	0	0	0	3	0	7	1	0	0	10	1
2019-10-12	0	0	13	0	0	0	0	0	0	0	0	0	13	0
2019-10-13	0	0	0	0	0	0	0	0	1	0	0	0	1	0
2019-10-14	0	0	0	0	4	0	0	0	0	0	0	0	4	0
Total	194	4	199	8	200	5	247	8	120	3	26	2	986	30

Table G24: Estimated Largescale Sucker mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-23	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-08-24	0.0	0.0	0.0	10.0	0.0	0.0	10
2019-08-25	3.0	0.0	0.0	0.0	0.0	0.0	3
2019-08-26	7.0	0.0	0.0	0.0	0.0	0.0	7
2019-08-27	0.0	0.0	6.0	0.0	0.0	1.0	7
2019-08-28	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-29	12.0	0.0	22.0	0.0	0.0	0.0	34
2019-08-30	2.0	9.8	1.2	7.0	14.0	0.0	34
2019-08-31	0.0	14.7	1.8	1.5	5.0	0.0	23
2019-09-01	0.0	1.6	0.2	0.2	0.0	0.0	2
2019-09-02	0.0	0.0	0.0	0.0	10.0	0.0	10
2019-09-03	0.0	0.0	8.0	0.0	0.0	0.0	8
2019-09-04	3.0	0.0	7.0	14.0	0.0	0.0	24
2019-09-05	3.0	0.0	0.0	0.0	0.0	0.0	3
2019-09-06	25.0	0.0	0.0	0.0	0.0	0.0	25
2019-09-07	0.0	12.2	1.5	1.2	0.0	0.0	15
2019-09-08	0.0	0.0	0.0	17.0	0.0	0.0	17
2019-09-09	0.0	0.0	0.0	24.0	0.0	0.0	24
2019-09-10	0.0	18.0	32.2	1.8	0.0	0.0	52
2019-09-11	0.0	9.0	1.1	0.9	1.0	0.0	12
2019-09-12	0.0	6.5	0.8	0.7	0.0	0.0	8
2019-09-13	0.0	0.0	0.0	0.0	3.0	1.0	4
2019-09-14	0.0	0.0	6.0	0.0	0.0	4.0	10
2019-09-15	0.0	0.0	0.0	0.0	9.0	0.0	9
2019-09-16	17.0	0.0	0.0	17.0	0.0	0.0	34
2019-09-17	11.0	0.0	0.0	22.0	0.0	0.0	33
2019-09-18	1.0	1.6	0.2	11.2	0.0	0.0	14
2019-09-19	0.0	13.9	28.7	1.4	0.0	0.0	44
2019-09-20	0.0	11.4	1.4	1.2	7.0	0.0	21
2019-09-21	0.0	2.4	0.3	0.2	11.0	0.0	14
2019-09-22	0.0	0.0	0.0	0.0	2.0	1.0	3
2019-09-23	0.0	0.0	9.0	0.0	0.0	1.0	10
2019-09-24	15.0	0.0	0.0	0.0	0.0	0.0	15
2019-09-25	6.0	0.0	0.0	27.0	0.0	0.0	33
2019-09-26	0.0	2.4	0.3	23.2	0.0	0.0	26
2019-09-27	0.0	7.3	0.9	6.7	3.0	0.0	18

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-28	0.0	8.2	20.0	0.8	0.0	0.0	29
2019-09-29	0.0	8.2	1.0	0.8	0.0	0.0	10
2019-09-30	0.0	0.0	0.0	0.0	0.0	1.0	1
2019-10-01	0.0	0.0	17.0	0.0	0.0	5.0	22
2019-10-02	0.0	0.0	5.0	0.0	0.0	0.0	5
2019-10-03	2.0	0.0	0.0	0.0	4.0	0.0	6
2019-10-04	0.0	0.0	0.0	0.0	4.0	0.0	4
2019-10-05	0.0	0.8	0.1	0.1	0.0	0.0	1
2019-10-06	0.0	0.8	0.1	3.1	0.0	0.0	4
2019-10-07	0.0	0.0	1.0	0.0	0.0	1.0	2
2019-10-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-09	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-10	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-11	0.0	0.0	0.0	0.0	5.0	0.0	5
2019-10-12	5.0	0.0	0.0	0.0	0.0	0.0	5
2019-10-13	0.0	0.0	0.0	2.0	0.0	0.0	2
2019-10-14	0.0	0.0	0.0	0.0	1.0	0.0	1
Total	112	129	175	196	79	15	706

Table G25: Largescale Sucker sample, cumulative marks available for recapture, and recaptures by river section and date.

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
Section One:				**Section Six:**			
2019-08-26	12	3		2019-08-27	6	11	
2019-08-27	2	10		2019-09-01	14	19	
2019-09-01	3	24		2019-09-05	19	34	
2019-09-02	3	24		2019-09-06	25	34	
2019-09-03	25	24		2019-09-13	18	79	1
2019-09-13	17	55		2019-09-14	22	79	
2019-09-14	12	55	1	2019-09-15	12	79	
2019-09-15	1	55		2019-09-22	32	132	2
2019-09-21	16	84	1	2019-09-23	25	132	2
2019-09-22	6	84		2019-09-24	7	132	1
2019-09-30	6	105		2019-10-02	19	191	
2019-10-09	81	107	2	2019-10-03	26	191	2

Date	Sample	Marks	Recap.
Section Three:			
2019-09-04	15	26	
2019-09-07	22	26	
2019-09-08	12	38	1
2019-09-09	8	38	
2019-09-15	2	72	
2019-09-16	18	72	1
2019-09-17	14	72	
2019-09-18	4	72	1
2019-09-23	3	101	
2019-09-24	9	101	
2019-09-25	11	101	1
2019-09-26	10	101	
2019-10-02	13	127	2
2019-10-03	13	127	2
2019-10-12	13	129	
Section Five:			
2019-08-31	8	29	
2019-09-01	7	31	
2019-09-07	31	46	
2019-09-11	6	80	
2019-09-16	28	88	1
2019-09-20	9	117	
2019-09-25	22	128	1
2019-09-28	17	129	
2019-09-29	5	149	
2019-10-04	19	172	2
2019-10-06	8	172	1
2019-10-07	7	172	
2019-10-14	4	175	
2019-10-10	8	194	
2019-10-11	3	194	
Section Seven:			
2019-09-08	1	29	
2019-09-10	3	29	
2019-09-12	11	30	
2019-09-17	7	42	
2019-09-18	11	42	
2019-09-19	2	42	
2019-09-24	3	62	
2019-09-30	5	65	1
2019-10-01	5	65	1
2019-10-05	7	73	
2019-10-06	1	73	
2019-10-08	27	73	
2019-10-11	7	73	1
2019-10-13	1	78	
Section Nine:			
2019-09-10	1	1	
2019-09-11	4	1	
2019-09-19	1	6	
2019-09-20	1	6	
2019-09-27	2	8	1
2019-09-28	6	8	1
2019-10-04	9	14	
2019-10-05	1	14	

Table G26: Largescale Sucker population estimates by river section.

Section	Bayes Mean	MLE	95% HPD Low	95% HPD High	Standard Deviation	CV (%)
One	6,336	3,400	1,260	15,420	4,365	68.9
Three	2,111	1600	810	3,890	922	43.7
Five	5,872	3,610	1,500	12,970	3,580	61.0
Six	4,165	3,140	1,590	7,690	1,824	43.8
Seven	4,443	1750	540	12,900	4,151	93.4
Nine	554	110	30	2,080	672	121.4
Total	23,481		9,114	37,848	7,330	31.2

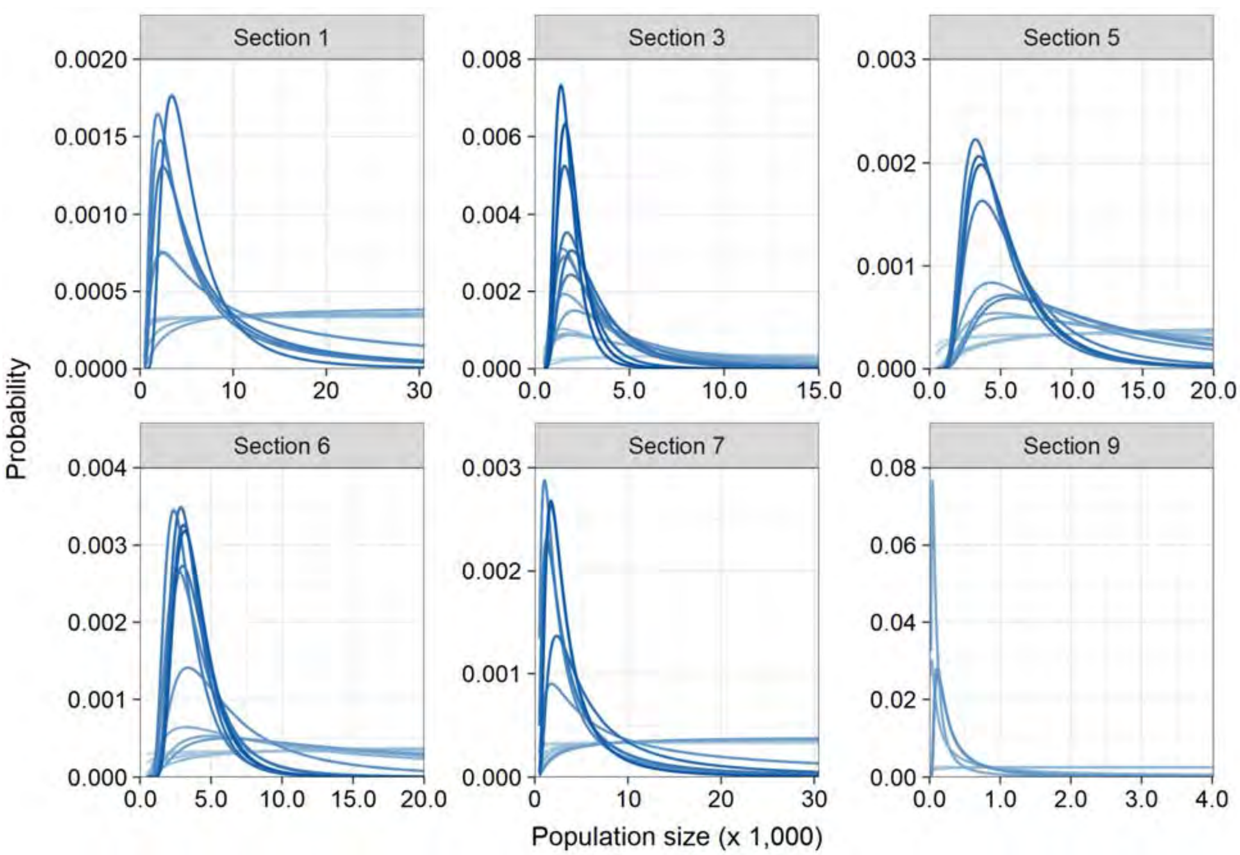

Figure G13: Sequential posterior probability plots of population size for Largescale Sucker in 2019 in Sections 1, 3, 5, 6, 7, and 9. Each line is the posterior probability updated by a sample day.

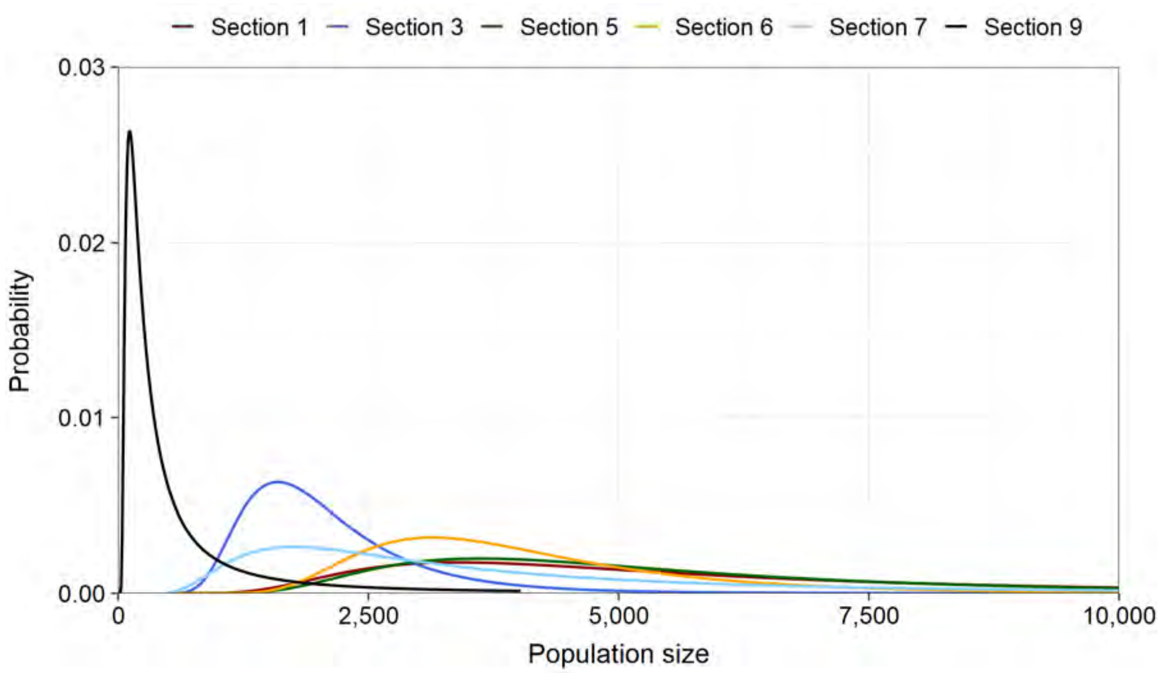

Figure G14: Final posterior distributions by river section for Largescale Sucker.

Longnose Sucker

The mark-recapture data were extracted by section from the database using a minimum length of 250 mm. The movement of recaptured Longnose Sucker between sections is listed in Table G27, along with the estimates of the migration proportions adjusted for the number of fish examined (Equation 4). Table G28 lists Longnose Sucker examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G29. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G30. The population estimates using the Bayesian model are given in Table G31, and the associated sequential posterior probability plots are provided in Figure G15. The posterior probability plots do not display trends over time. The final posterior distributions are drawn in Figure G16.

Table G27: Longnose Sucker recaptures and migration proportions adjusted (inverse weight) for fish examined by river section during 2019.

Release	Recapture Section						
Section	One	Three	Five	Six	Seven	Nine	Total
One	3	0	0	1	0	0	4
Three	0	10	1	0	0	0	11
Five	0	0	10	3	0	0	13
Six	0	0	0	17	2	0	19
Seven	0	0	0	0	14	0	14
Nine	0	0	0	0	0	16	16
Sample:	234	562	314	735	669	447	2,961
Recap. %	1.28	1.78	3.50	2.86	2.39	3.58	2.60
Proportions:							
One	0.904	0.000	0.000	0.096	0.000	0.000	1.000
Three	0.000	0.848	0.152	0.000	0.000	0.000	1.000
Five	0.000	0.000	0.886	0.114	0.000	0.000	1.000
Six	0.000	0.000	0.000	0.886	0.114	0.000	1.000
Seven	0.000	0.000	0.000	0.000	1.000	0.000	1.000
Nine	0.000	0.000	0.000	0.000	0.000	1.000	1.000

Table G28: Sample size and recaptures of Longnose Sucker by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-20	0	0	0	0	0	0	8	0	0	0	0	0	8	0
2019-08-21	0	0	0	0	0	0	35	0	0	0	0	0	35	0
2019-08-22	9	0	0	0	0	0	0	0	0	0	0	0	9	0
2019-08-23	49	0	0	0	0	0	0	0	0	0	0	0	49	0
2019-08-24	0	0	0	0	9	0	0	0	0	0	9	0	18	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	13	0	13	0
2019-08-26	24	0	0	0	32	0	0	0	0	0	0	0	56	0
2019-08-27	7	0	30	0	0	0	9	0	44	0	0	0	90	0
2019-08-28	0	0	26	0	0	0	0	0	39	0	0	0	65	0
2019-08-29	0	0	10	0	0	0	0	0	0	0	0	0	10	0
2019-08-30	0	0	0	0	0	0	0	0	42	0	0	0	42	0
2019-08-31	0	0	0	0	23	0	0	0	0	0	0	0	23	0
2019-09-01	24	0	0	0	3	0	5	0	0	0	0	0	32	0
2019-09-02	4	0	0	0	0	0	0	0	0	0	0	0	4	0
2019-09-03	26	1	0	0	0	0	0	0	0	0	0	0	26	1
2019-09-04	0	0	22	0	0	0	0	0	0	0	0	0	22	0
2019-09-05	0	0	0	0	0	0	92	1	0	0	0	0	92	1
2019-09-06	0	0	0	0	0	0	116	0	0	0	0	0	116	0
2019-09-07	0	0	57	1	50	1	0	0	0	0	0	0	107	2
2019-09-08	0	0	47	1	0	0	19	1	32	1	0	0	98	3
2019-09-09	0	0	23	1	4	0	0	0	0	0	0	0	27	1
2019-09-10	0	0	0	0	0	0	0	0	39	1	50	1	89	2
2019-09-11	0	0	0	0	24	2	0	0	0	0	66	0	90	2
2019-09-12	0	0	0	0	0	0	0	0	78	2	0	0	78	2

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-13	5	0	0	0	0	0	17	0	0	0	0	0	22	0
2019-09-14	23	1	0	0	0	0	43	1	0	0	0	0	66	2
2019-09-15	7	0	13	0	0	0	38	0	0	0	0	0	58	0
2019-09-16	0	0	19	0	39	1	0	0	0	0	0	0	58	1
2019-09-17	0	0	47	1	0	0	0	0	24	2	0	0	71	3
2019-09-18	0	0	14	0	0	0	0	0	37	1	0	0	51	1
2019-09-19	0	0	0	0	0	0	0	0	30	1	98	6	128	7
2019-09-20	0	0	0	0	17	0	0	0	0	0	38	0	55	0
2019-09-21	15	0	0	0	0	0	0	0	0	0	0	0	15	0
2019-09-22	11	0	0	0	0	0	75	2	0	0	0	0	86	2
2019-09-23	0	0	23	0	0	0	54	7	0	0	0	0	77	7
2019-09-24	0	0	26	0	0	0	47	1	17	0	0	0	90	1
2019-09-25	0	0	37	0	21	1	0	0	0	0	0	0	58	1
2019-09-26	0	0	27	1	0	0	0	0	0	0	0	0	27	1
2019-09-27	0	0	0	0	0	0	0	0	0	0	55	4	55	4
2019-09-28	0	0	0	0	26	2	0	0	12	0	29	0	67	2
2019-09-29	0	0	0	0	6	2	0	0	0	0	0	0	6	2
2019-09-30	7	1	0	0	0	0	0	0	25	0	0	0	32	1
2019-10-01	0	0	44	0	0	0	0	0	24	1	0	0	68	1
2019-10-02	0	0	45	2	0	0	54	3	0	0	0	0	99	5
2019-10-03	0	0	20	1	0	0	83	4	0	0	0	0	103	5
2019-10-04	0	0	0	0	37	2	0	0	0	0	61	4	98	6
2019-10-05	0	0	0	0	0	0	0	0	27	1	28	1	55	2
2019-10-06	0	0	0	0	5	0	0	0	8	0	0	0	13	0
2019-10-07	0	0	0	0	16	0	0	0	0	0	0	0	16	0
2019-10-08	0	0	0	0	0	0	0	0	74	5	0	0	74	5

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-10-09	23	0	0	0	0	0	0	0	0	0	0	0	23	0
2019-10-10	0	0	0	0	0	0	39	1	0	0	0	0	39	1
2019-10-11	0	0	0	0	0	0	1	0	51	0	0	0	52	0
2019-10-12	0	0	32	2	0	0	0	0	0	0	0	0	32	2
2019-10-13	0	0	0	0	0	0	0	0	66	1	0	0	66	1
2019-10-14	0	0	0	0	2	0	0	0	0	0	0	0	2	0
Total	234	3	562	10	314	11	735	21	669	16	447	16	2,961	77

Table G29: Estimated Longnose Sucker mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-23	0.0	0.0	0.0	7.1	0.9	0.0	8
2019-08-24	0.0	0.0	0.0	31.0	4.0	0.0	35
2019-08-25	8.1	0.0	0.0	0.9	0.0	0.0	9
2019-08-26	44.3	0.0	0.0	4.7	0.0	0.0	49
2019-08-27	0.0	0.0	8.0	1.0	0.0	8.0	17
2019-08-28	0.0	0.0	0.0	0.0	0.0	13.0	13
2019-08-29	21.7	0.0	26.6	5.7	0.0	0.0	54
2019-08-30	6.3	25.4	4.6	7.8	43.9	0.0	88
2019-08-31	0.0	22.1	3.9	0.0	37.0	0.0	63
2019-09-01	0.0	8.5	1.5	0.0	0.0	0.0	10
2019-09-02	0.0	0.0	0.0	0.0	42.0	0.0	42
2019-09-03	0.0	0.0	20.4	2.6	0.0	0.0	23
2019-09-04	21.7	0.0	2.7	7.1	0.6	0.0	32
2019-09-05	3.6	0.0	0.0	0.4	0.0	0.0	4
2019-09-06	22.6	0.0	0.0	2.4	0.0	0.0	25
2019-09-07	0.0	18.7	3.3	0.0	0.0	0.0	22
2019-09-08	0.0	0.0	0.0	80.6	10.4	0.0	91
2019-09-09	0.0	0.0	0.0	102.7	13.3	0.0	116
2019-09-10	0.0	46.7	51.8	5.6	0.0	0.0	104
2019-09-11	0.0	39.0	7.0	15.9	33.1	0.0	95
2019-09-12	0.0	18.7	6.9	0.5	0.0	0.0	26
2019-09-13	0.0	0.0	0.0	0.0	38.0	49.0	87
2019-09-14	0.0	0.0	18.6	2.4	0.0	66.0	87
2019-09-15	0.0	0.0	0.0	0.0	75.0	0.0	75
2019-09-16	4.5	0.0	0.0	15.5	1.9	0.0	22
2019-09-17	19.9	0.0	0.0	39.3	4.8	0.0	64
2019-09-18	6.3	11.0	2.0	34.3	4.3	0.0	58
2019-09-19	0.0	16.1	35.7	4.2	0.0	0.0	56
2019-09-20	0.0	39.0	7.0	0.0	22.0	0.0	68
2019-09-21	0.0	11.9	2.1	0.0	36.0	0.0	50
2019-09-22	0.0	0.0	0.0	0.0	29.0	92.0	121
2019-09-23	0.0	0.0	15.1	1.9	0.0	38.0	55
2019-09-24	13.6	0.0	0.0	1.4	0.0	0.0	15
2019-09-25	9.9	0.0	0.0	65.7	8.4	0.0	84
2019-09-26	0.0	19.5	3.5	40.7	5.3	0.0	69
2019-09-27	0.0	22.1	3.9	39.8	21.2	0.0	87

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-28	0.0	31.4	23.3	2.3	0.0	0.0	57
2019-09-29	0.0	22.1	3.9	0.0	0.0	0.0	26
2019-09-30	0.0	0.0	0.0	0.0	0.0	51.0	51
2019-10-01	0.0	0.0	20.4	2.6	12.0	29.0	64
2019-10-02	0.0	0.0	3.5	0.5	0.0	0.0	4
2019-10-03	0.0	0.0	0.0	0.0	24.0	0.0	24
2019-10-04	0.0	3.4	0.6	0.0	23.0	0.0	27
2019-10-05	0.0	5.9	1.1	8.0	1.0	0.0	16
2019-10-06	0.0	2.5	0.5	6.2	0.8	0.0	10
2019-10-07	0.0	0.0	1.8	0.2	0.0	10.0	12
2019-10-08	0.0	0.0	0.0	0.0	1.0	4.0	5
2019-10-09	0.0	0.0	0.9	0.1	1.0	0.0	2
2019-10-10	0.0	0.0	0.9	0.1	0.0	0.0	1
2019-10-11	0.0	0.0	0.0	0.0	9.0	0.0	9
2019-10-12	1.8	0.0	0.0	0.2	0.0	0.0	2
2019-10-13	0.0	0.0	0.0	2.7	0.3	0.0	3
2019-10-14	0.0	0.0	0.0	0.0	6.0	0.0	6
Total	184.4	363.9	281.4	544.1	509.2	360.0	2,243

Table G30: Longnose Sucker sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
Section One:				**Section Six:**			
2019-08-26	24	8		2019-08-27	9	44	
2019-08-27	7	52		2019-09-01	5	58	
2019-09-01	24	80		2019-09-05	92	68	1
2019-09-02	4	80		2019-09-06	116	68	
2019-09-03	26	80	1	2019-09-08	19	71	1
2019-09-13	5	128		2019-09-13	17	276	
2019-09-14	23	128	1	2019-09-14	43	276	1
2019-09-15	7	128		2019-09-15	38	278	
2019-09-21	15	159		2019-09-22	75	372	2
2019-09-22	11	159		2019-09-23	54	372	7
2019-09-30	7	183	1	2019-09-24	47	374	1
2019-10-09	23	183		2019-10-02	54	526	3

Date	Sample	Marks	Recap.
Section Three:			
4-Sep-19	22	56	
7-Sep-19	57	56	1
8-Sep-19	47	75	1
9-Sep-19	23	75	1
15-Sep-19	13	179	
16-Sep-19	19	179	
17-Sep-19	47	179	1
18-Sep-19	14	179	
23-Sep-19	23	257	
24-Sep-19	26	257	
25-Sep-19	37	257	
26-Sep-19	27	257	1
1-Oct-19	44	352	
2-Oct-19	45	352	2
3-Oct-19	20	352	1
12-Oct-19	32	364	2
Section Five:			
31-Aug-19	23	39	
1-Sep-19	3	43	
7-Sep-19	50	68	1
9-Sep-19	4	71	
11-Sep-19	24	123	2
16-Sep-19	39	155	1
20-Sep-19	17	193	
25-Sep-19	21	217	1
28-Sep-19	26	225	2
29-Sep-19	6	248	2
4-Oct-19	37	276	2
6-Oct-19	5	277	
7-Oct-19	16	278	
14-Oct-19	2	281	

Date	Sample	Marks	Recap.
2019-10-03	83	527	4
2019-10-10	39	541	1
2019-10-11	1	541	
Section Seven:			
2019-08-27	44	5	
2019-08-28	39	5	
2019-08-30	42	5	
2019-09-08	32	128	1
2019-09-10	39	152	1
2019-09-12	78	185	2
2019-09-17	24	300	2
2019-09-18	37	305	1
2019-09-19	30	309	1
2019-09-24	17	396	
2019-09-28	12	431	
2019-09-30	25	431	
2019-10-01	24	431	1
2019-10-05	27	490	1
2019-10-06	8	491	
2019-10-08	74	492	5
2019-10-11	51	494	
2019-10-13	66	503	1
Section Nine:			
2019-09-10	50	21	1
2019-09-11	66	21	
2019-09-19	98	136	6
2019-09-20	38	136	
2019-09-27	55	266	4
2019-09-28	29	266	
2019-10-04	61	346	4
2019-10-05	28	346	1

Table G31: Longnose Sucker population estimates by river section.

Section	Bayes Mean	MLE	95% HPD Low	95% HPD High	Standard Deviation	CV (%)
One	14,409	6,340	2,080	38,580	10,826	75.1
Three	13,168	10,560	5,760	22,840	4,901	37.2
Five	5,041	4,140	2,340	8,500	1,745	34.6
Six	10,651	9,660	6,420	15,600	2,462	23.1
Seven	14,165	12,420	7,740	21,900	3,870	27.3
Nine	5,308	4,660	2,920	8,180	1,428	26.9
Total	62,742		37,387	88,097	12,936	20.6

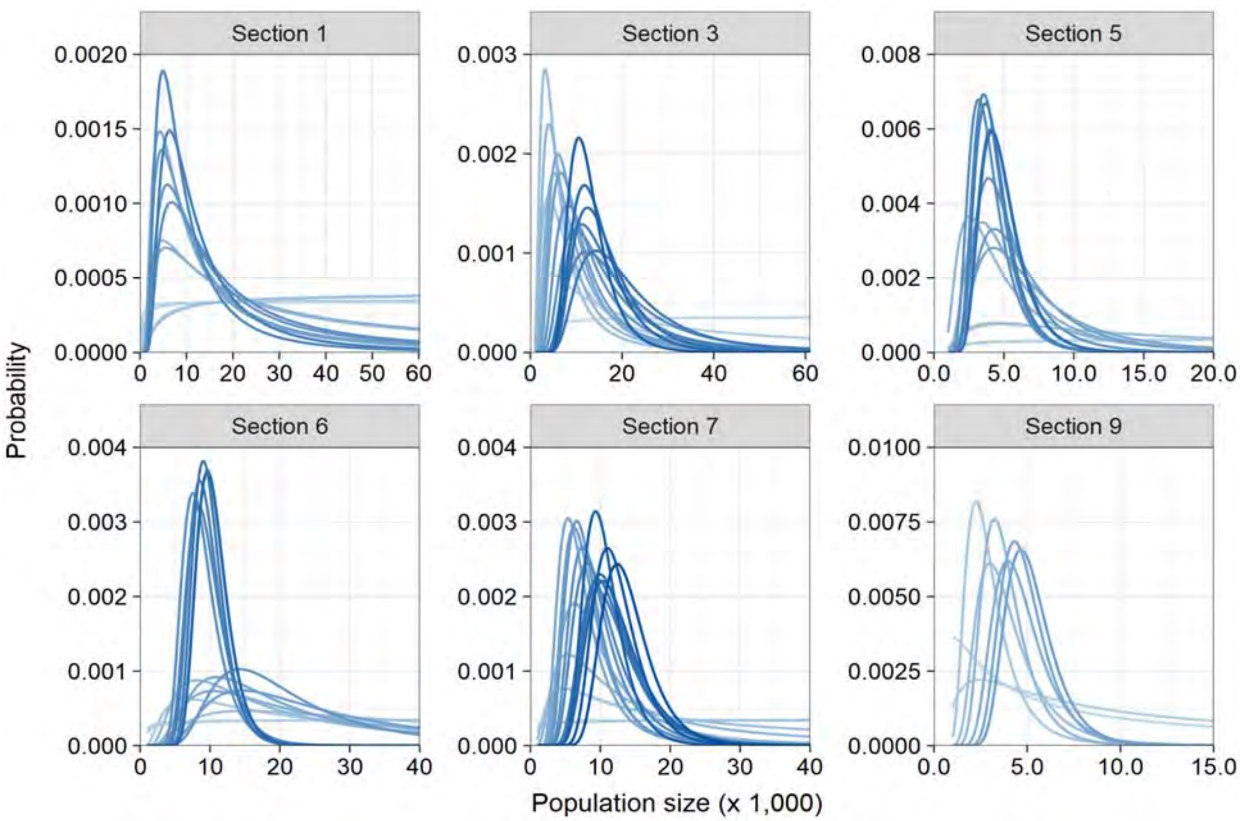

Figure G15: Sequential posterior probability plots of population size for Longnose Sucker in 2019 in Sections 1, 3, 5, 6, 7, and 9. Each line is the posterior probability updated by a sample day.

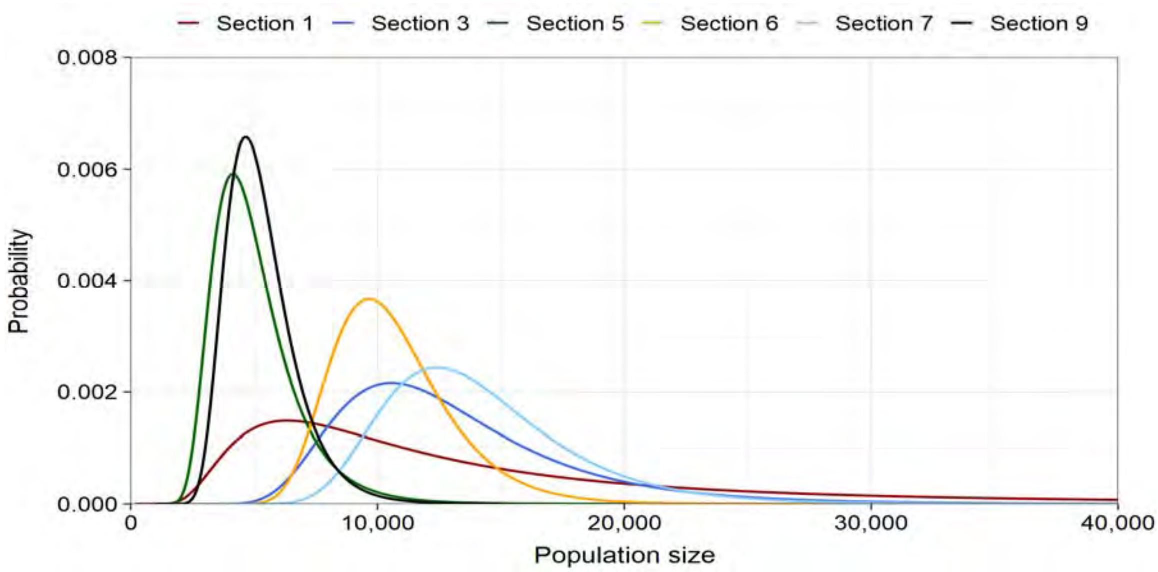

Figure G16: Final posterior distributions by river section for Longnose Sucker.

White Sucker

The mark-recapture data were extracted by section from the database using a minimum length of 250 mm. No movement between river sections of recaptured White Sucker was observed. Table G32 lists White Sucker examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G33. Only Section 5 had sufficient recaptures to enable population estimates. The compilation of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G34. The population estimates using the Bayesian model are given in Table G35 and the associated sequential posterior probability plot is provided by Figure G17. The posterior probability plot does not display a trend over time.

Table G32: Sample size and recaptures of White Sucker by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-21	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-08-22	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-08-23	2	0	0	0	0	0	0	0	0	0	0	0	2	0
2019-08-24	0	0	0	0	0	0	0	0	0	0	1	0	1	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-26	9	0	0	0	1	0	0	0	0	0	0	0	10	0
2019-08-27	2	0	1	0	0	0	4	0	0	0	0	0	7	0
2019-08-28	0	0	3	0	0	0	0	0	2	0	0	0	5	0
2019-08-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-30	0	0	0	0	0	0	0	0	1	0	0	0	1	0
2019-08-31	0	0	0	0	4	0	0	0	0	0	0	0	4	0
2019-09-01	0	0	0	0	4	0	1	0	0	0	0	0	5	0
2019-09-02	2	0	0	0	0	0	2	0	0	0	0	0	4	0
2019-09-03	3	0	0	0	0	0	0	0	0	0	0	0	3	0
2019-09-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-05	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-09-06	0	0	0	0	0	0	7	0	0	0	0	0	7	0
2019-09-07	0	0	0	0	2	0	0	0	0	0	0	0	2	0
2019-09-08	0	0	2	0	0	0	1	0	0	0	0	0	3	0
2019-09-09	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-09-10	0	0	0	0	0	0	0	0	6	0	0	0	6	0
2019-09-11	0	0	0	0	8	0	0	0	0	0	0	0	8	0
2019-09-12	0	0	0	0	0	0	0	0	1	0	0	0	1	0
2019-09-13	2	0	0	0	0	0	1	0	0	0	0	0	3	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-15	0	0	0	0	0	0	6	0	0	0	0	0	6	0
2019-09-16	0	0	1	0	2	0	0	0	0	0	0	0	3	0
2019-09-17	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-19	0	0	0	0	0	0	0	0	0	0	3	0	3	0
2019-09-20	0	0	0	0	6	1	0	0	0	0	0	0	6	1
2019-09-21	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-22	0	0	0	0	0	0	2	0	0	0	0	0	2	0
2019-09-23	0	0	0	0	0	0	1	0	0	0	0	0	1	0
2019-09-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-25	0	0	2	1	5	0	0	0	0	0	0	0	7	1
2019-09-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-27	0	0	0	0	0	0	0	0	0	0	6	0	6	0
2019-09-28	0	0	0	0	3	0	0	0	0	0	1	0	4	0
2019-09-29	0	0	0	0	4	1	0	0	0	0	0	0	4	1
2019-09-30	6	0	0	0	0	0	0	0	1	0	0	0	7	0
2019-10-01	0	0	0	0	0	0	0	0	1	0	0	0	1	0
2019-10-02	0	0	3	0	0	0	4	0	0	0	0	0	7	0
2019-10-03	0	0	3	0	0	0	1	0	0	0	0	0	4	0
2019-10-04	0	0	0	0	8	1	0	0	0	0	4	0	12	1
2019-10-05	0	0	0	0	0	0	0	0	2	0	5	1	7	1
2019-10-06	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-10-07	0	0	0	0	2	2	0	0	0	0	0	0	2	2
2019-10-08	0	0	0	0	0	0	0	0	2	0	0	0	2	0
2019-10-09	5	0	0	0	0	0	0	0	0	0	0	0	5	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-10-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-11	0	0	0	0	0	0	2	0	1	0	0	0	3	0
Total	33	0	18	1	50	5	34	0	17	0	20	1	172	7

Table G33: Estimated White Sucker mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-24	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-08-25	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-08-26	2.0	0.0	0.0	0.0	0.0	0.0	2
2019-08-27	0.0	0.0	0.0	0.0	0.0	1.0	1
2019-08-28	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-29	9.0	0.0	1.0	0.0	0.0	0.0	10
2019-08-30	2.0	1.0	0.0	4.0	0.0	0.0	7
2019-08-31	0.0	3.0	0.0	0.0	2.0	0.0	5
2019-09-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-02	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-09-03	0.0	0.0	4.0	0.0	0.0	0.0	4
2019-09-04	0.0	0.0	4.0	1.0	0.0	0.0	5
2019-09-05	2.0	0.0	0.0	2.0	0.0	0.0	4
2019-09-06	3.0	0.0	0.0	0.0	0.0	0.0	3
2019-09-07	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-08	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-09-09	0.0	0.0	0.0	7.0	0.0	0.0	7
2019-09-10	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-11	0.0	2.0	0.0	1.0	0.0	0.0	3
2019-09-12	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-09-13	0.0	0.0	0.0	0.0	6.0	0.0	6
2019-09-14	0.0	0.0	8.0	0.0	0.0	0.0	8
2019-09-15	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-16	2.0	0.0	0.0	1.0	0.0	0.0	3
2019-09-17	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-18	0.0	0.0	0.0	5.0	0.0	0.0	5
2019-09-19	0.0	1.0	2.0	0.0	0.0	0.0	3
2019-09-20	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-21	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-22	0.0	0.0	0.0	0.0	0.0	3.0	3
2019-09-23	0.0	0.0	4.0	0.0	0.0	0.0	4
2019-09-24	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-25	0.0	0.0	0.0	2.0	0.0	0.0	2
2019-09-26	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-09-27	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-28	0.0	1.0	5.0	0.0	0.0	0.0	6

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-29	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-30	0.0	0.0	0.0	0.0	0.0	6.0	6
2019-10-01	0.0	0.0	3.0	0.0	0.0	1.0	4
2019-10-02	0.0	0.0	3.0	0.0	0.0	0.0	3
2019-10-03	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-10-04	0.0	0.0	0.0	0.0	1.0	0.0	1
2019-10-05	0.0	0.0	0.0	1.0	0.0	0.0	1
2019-10-06	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-07	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-09	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-10	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-11	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-12	1.0	0.0	0.0	0.0	0.0	0.0	1
Total	23.0	11.0	36.0	27.0	11.0	11.0	119

Table G34: White Sucker sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.
Section Five:			
2019-08-31	4	1	
2019-09-01	4	1	
2019-09-07	2	9	
2019-09-11	8	11	
2019-09-16	2	19	
2019-09-20	6	21	1
2019-09-25	5	25	
2019-09-28	3	25	
2019-09-29	4	30	1
2019-10-04	8	36	1
2019-10-06	1	36	
2019-10-07	2	36	2

Table G35: White Sucker population estimates by river section.

Section	Bayes Mean	MLE	95% HPD Low	95% HPD High	Standard Deviation	CV (%)
Five	300	194	89	638	159	53.0

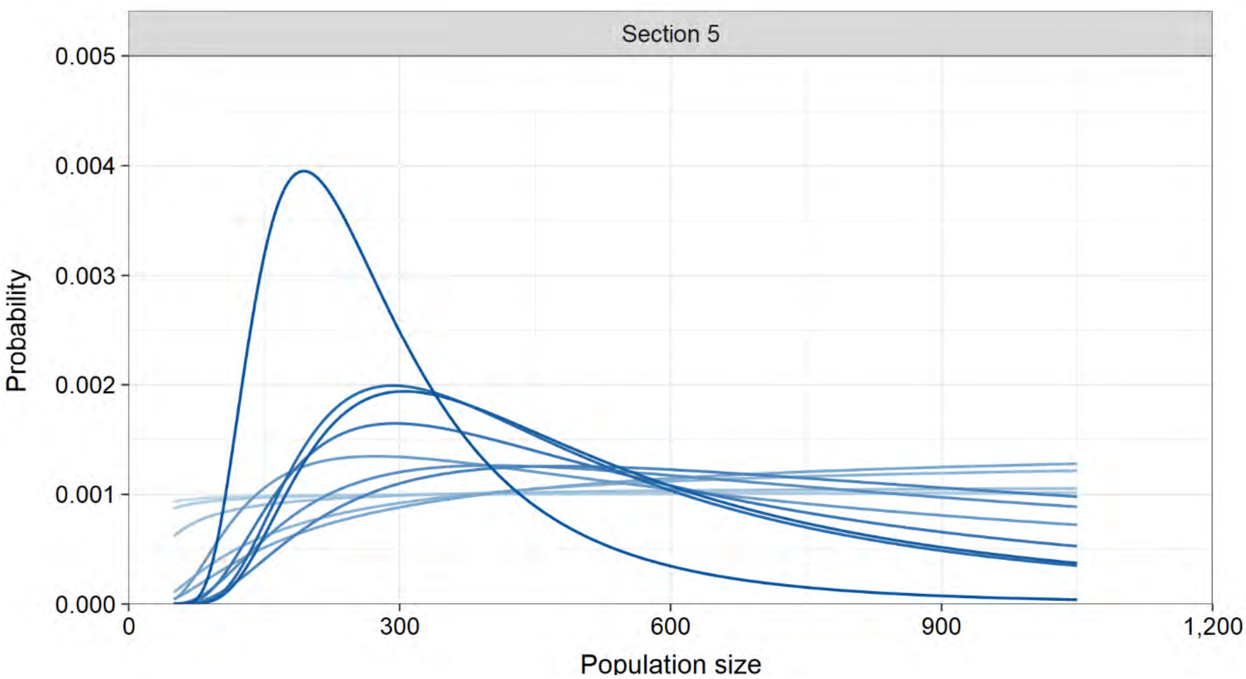

Figure G17: Sequential posterior probability plots of population size for Section 5 White Sucker in 2019. Each line is the posterior probability updated by a sample day.

Rainbow Trout

The mark-recapture data were extracted by section from the database using a minimum length of 250 mm. There was no movement between sections. Table G36 lists Rainbow Trout examined for marks and recaptures by date and section. The estimated releases by section and date are given in Table G37. Only Sections 1, 3, and 5 had sufficient recaptures to enable population estimates. The compilations of marks available (Equation 6), fish examined (Equation 7), and recaptures (Equation 8) assuming no mortality and 0% undetected mark rate are listed in Table G38. The population estimates using the Bayesian model are given in Table G39, and the associated sequential posterior probability plots are provided in Figure G18. None of the posterior probability plots display trends over time. Because of highly skewed posterior distributions, the total population estimate was calculated from the joint distribution of Sections 1, 3 and 5. The final posterior distributions are drawn in Figure G19.

Table G36: Sample size and recaptures of Rainbow Trout by river section and date.

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-08-22	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-08-23	2	0	0	0	0	0	0	0	0	0	0	0	2	0
2019-08-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-26	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-08-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-28	0	0	2	0	0	0	0	0	1	0	0	0	3	0
2019-08-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-08-31	0	0	0	0	3	0	0	0	0	0	0	0	3	0
2019-09-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-02	2	0	0	0	0	0	0	0	0	0	0	0	2	0
2019-09-03	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-04	0	0	3	0	0	0	0	0	0	0	0	0	3	0
2019-09-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-08	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-13	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-14	2	0	0	0	0	0	1	0	0	0	0	0	3	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.	Sample	Recap.
2019-09-15	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-17	0	0	3	0	0	0	0	0	0	0	0	0	3	0
2019-09-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-20	0	0	0	0	3	1	0	0	0	0	0	0	3	1
2019-09-21	4	0	0	0	0	0	0	0	0	0	0	0	4	0
2019-09-22	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2019-09-23	0	0	1	1	0	0	0	0	0	0	0	0	1	1
2019-09-24	0	0	2	0	0	0	0	0	0	0	0	0	2	0
2019-09-25	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-09-26	0	0	5	2	0	0	0	0	0	0	0	0	5	2
2019-09-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-09-29	0	0	0	0	1	1	0	0	0	0	0	0	1	1
2019-09-30	7	1	0	0	0	0	0	0	0	0	0	0	7	1
2019-10-01	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-10-02	0	0	1	0	0	0	0	0	0	0	0	0	1	0
2019-10-03	0	0	10	3	0	0	0	0	0	0	0	0	10	3
2019-10-04	0	0	0	0	1	0	0	0	0	0	0	0	1	0
2019-10-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-07	0	0	0	0	1	1	0	0	0	0	0	0	1	1
2019-10-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-09	13	2	0	0	0	0	0	0	0	0	0	0	13	2
2019-10-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	One		Three		Five		Six		Seven		Nine		Total	
Date	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**	**Sample**	**Recap.**
2019-10-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019-10-12	0	0	4	2	0	0	0	0	0	0	0	0	4	2
Total	36	3	35	8	9	3	1	0	1	0	0	0	82	14

Table G37: Estimated Rainbow Trout mark releases by river section and date adjusted for migration.

Date	One	Three	Five	Six	Seven	Nine	Total
2019-08-25	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-08-26	2.0	0.0	0.0	0.0	0.0	0.0	2
2019-08-27	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-28	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-29	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-08-30	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-08-31	0.0	2.0	0.0	0.0	1.0	0.0	3
2019-09-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-03	0.0	0.0	3.0	0.0	0.0	0.0	3
2019-09-04	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-05	2.0	0.0	0.0	0.0	0.0	0.0	2
2019-09-06	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-07	0.0	3.0	0.0	0.0	0.0	0.0	3
2019-09-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-09	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-10	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-11	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-12	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-13	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-14	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-15	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-16	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-17	2.0	0.0	0.0	1.0	0.0	0.0	3
2019-09-18	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-19	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-20	0.0	3.0	0.0	0.0	0.0	0.0	3
2019-09-21	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-22	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-23	0.0	0.0	2.0	0.0	0.0	0.0	2
2019-09-24	4.0	0.0	0.0	0.0	0.0	0.0	4
2019-09-25	1.0	0.0	0.0	0.0	0.0	0.0	1
2019-09-26	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-09-27	0.0	2.0	0.0	0.0	0.0	0.0	2
2019-09-28	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-09-29	0.0	3.0	0.0	0.0	0.0	0.0	3

Date	One	Three	Five	Six	Seven	Nine	Total
2019-09-30	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-01	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-02	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-03	6.0	0.0	0.0	0.0	0.0	0.0	6
2019-10-04	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-10-05	0.0	1.0	0.0	0.0	0.0	0.0	1
2019-10-06	0.0	7.0	0.0	0.0	0.0	0.0	7
2019-10-07	0.0	0.0	1.0	0.0	0.0	0.0	1
2019-10-08	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-09	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-10	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-11	0.0	0.0	0.0	0.0	0.0	0.0	0
2019-10-12	11.0	0.0	0.0	0.0	0.0	0.0	11
Total	33.0	25.0	6.0	1.0	1.0	0.0	66

Table G38: Rainbow Trout sample, cumulative marks available for recapture and recaptures by river section and date.

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
Section One:				**Section Five:**			
2019-08-26	1	1		2019-09-20	3	3	1
2019-09-02	2	4		2019-09-29	1	5	1
2019-09-03	1	4		2019-10-04	1	5	
2019-09-13	1	7		2019-10-07	1	5	1
2019-09-14	2	7					
2019-09-15	1	7					
2019-09-21	4	11					
2019-09-22	1	11					
2019-09-30	7	16	1				
2019-10-09	13	22	2				
Section Three:							
2019-09-04	3	2					
2019-09-08	2	5					
2019-09-17	3	7					
2019-09-23	1	10	1				

Date	Sample	Marks	Recap.	Date	Sample	Marks	Recap.
2019-09-24	2	10					
2019-09-25	1	10					
2019-09-26	5	10	2				
2019-10-01	1	16					
2019-10-02	1	16					
2019-10-03	10	16	3				
2019-10-12	4	25	2				

Table G39: Population estimates by river section for Rainbow Trout.

			95% HPD		Standard	CV
Section	Bayes Mean	MLE	Low	High	Deviation	(%)
One	384	163	56	1,073	319	83.0
Three	67	52	31	118	26	38.3
Five	18	8	6	50	18	101.4
Total[1]	469	255	122	1,162	320	68.3

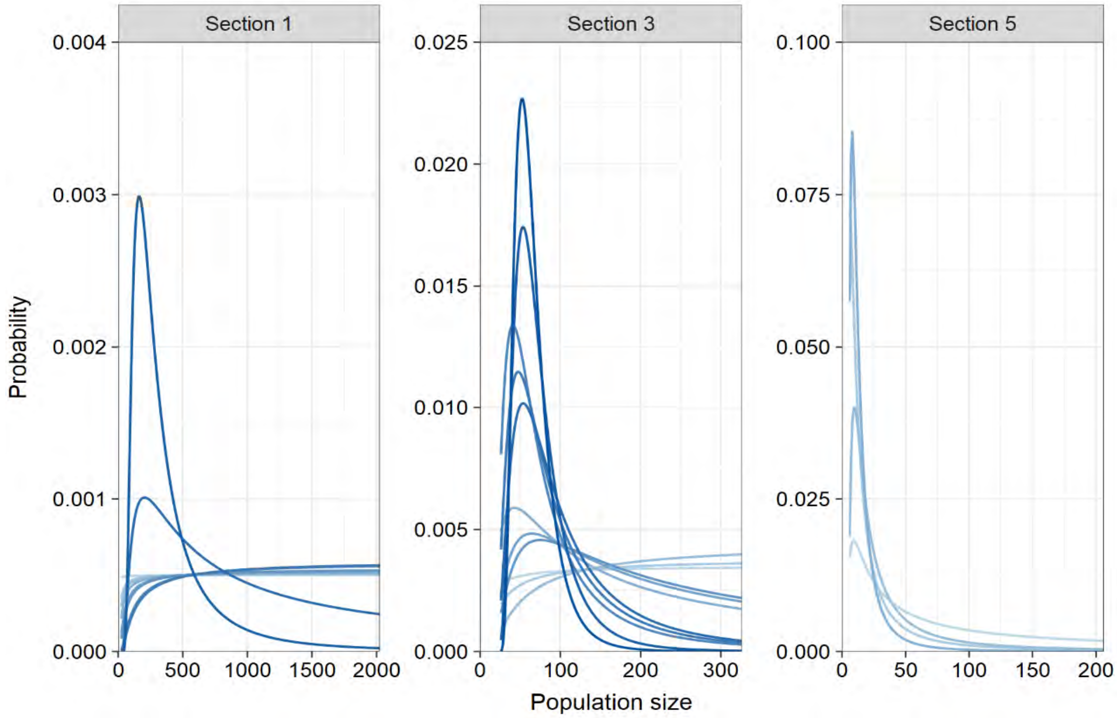

Figure G18: Sequential posterior probability plots of population size for Rainbow Trout in 2019 for Sections 1, 3, and 5. Each line is the posterior probability updated by a sample day.

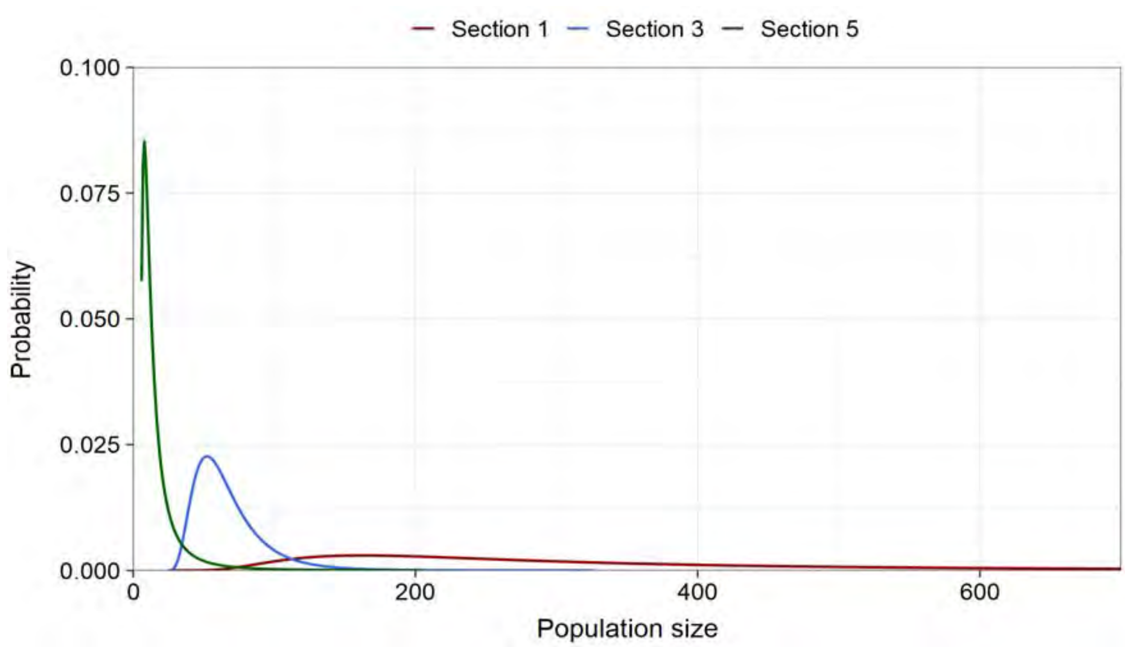

Figure G19: Final posterior distributions by river section for Rainbow Trout.

APPENDIX H

Mountain Whitefish Synthesis Model

AVAILABLE DATA

Mountain Whitefish data were extracted from the Peace River Fish Index Database and compiled by Cameron MacKenzie of Golder Associates Ltd. The data currently used in the Synthesis Model were organized into the following four text files.

Length-at-age. The ageing of mountain whitefish by reading scales is suspect, particularly for larger and older fish. In the hope that younger and smaller fish were aged more accurately, age data from reading scales were restricted to fish age 3 or younger. We also included any of these aged fish that were subsequently recaptured (i.e., the time from scale reading to recapture was known without error so the age of the fish at recapture was known). Five fish were censored as outliers (extreme length for estimated age). A total of 3,656 fish were aged as age 3 and younger, and 330 of these fish were subsequently recaptured for a total of 3,986 observations (Table H1).

Table H1: Number of length-at-age samples by estimated age and river section. Five outliers not included.

River	Estimated age																
Section	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	13	167	308	602	26	22	17	11	3	5	1	2	1	1	1	1	1,181
3	57	457	637	631	64	50	34	20	5	7	5	4	1			1	1,973
5	51	251	257	225	15	12	8	2	3	3	1	3	2				833
Total	121	875	1,202	1,458	105	84	59	33	11	15	7	9	4	1	1	2	3,987

Growth increments from mark-recapture. When a recaptured fish was released, it served as the release for a future encounter. For example, if a fish was encountered at times A, B, and C, then two incremental growth records were recorded for times A-B and B-C. The release-recapture pair had to be in the same river section for inclusion in the growth increments data. Within year release-recapture events were not recorded. Table H2 provides the number of sampled pairs (sum of Floy and PIT tags) by river section, release year and recapture year. In total, 116 fish with abnormal growth (< -15 mm/yr or > 50 mm/yr) were subsequently censored by the synthesis model as outliers. While fish should not shrink, measurement error in conjunction with independent length measurements generated negative growth increments.

Table H2: Number (sum of Floy and PIT tags) of incremental length samples by river section, release year, and recapture year. The model subsequently excluded 116 of these samples based on the outlier criteria (< -15 mm/yr and > 50 mm/yr).

Release	River	Recapture year																	
Year	Section	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
2002	1	213	147	78	26	30	10	4	1	2									511
	3	279	119	109	25	23	18	8	4	4			1						590
2003	1		284	192	96	63	26	11	5	3	7	2	1						690
	3		248	217	50	46	28	14	11	5	4								623
2004	1			324	177	93	70	33	15	13	11	1	1	1					739
	3			358	84	112	63	16	15	23	8	3	1	1	1				685
	5			173		67	31	16	8	8	6	1							310
2005	1				178	153	77	28	19	29	10	7	1						502
	3				194	316	137	49	35	46	14	11	3	4					809
	5					192	71	43	16	21	9	5							357
2006	1					261	156	85	48	49	27	16	4	6	2		1		655
	3					221	110	51	37	36	12	6	1	3		1	2		480
2007	1						204	90	36	40	28	10	3	2	1				414
	3						331	160	76	99	34	19	8	6	4		1	1	739
	5						162	81	33	52	30	11	3	2			2		376
2008	1							200	85	87	56	23	6	2	4		3	1	467
	3							271	138	157	74	38	12	9	7	5	4		715

Release	River	Recapture year																	
Year	Section	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
	5							184	55	79	43	21	4	4	4	2	3	1	400
2009	1								130	129	101	30	9	8	6	4	5	2	424
	3								203	192	90	40	8	7	7	2	5	2	556
	5								115	134	72	39	13	4	2	1	4		384
2010	1									153	107	37	22	17	9	7	10	6	368
	3									369	153	103	37	30	14	8	10	3	727
	5									148	66	32	21	15	5	6	4	3	300
2011	1										237	73	30	52	39	16	11	13	471
	3										397	221	62	66	47	25	22	22	862
	5										197	102	32	18	8	7	7	2	373
2012	1											203	98	58	45	21	17	19	461
	3											453	87	78	55	39	28	17	757
	5											229	49	27	9	17	8	6	345
2013	1												115	76	68	46	21	27	353
	3												197	190	113	76	69	31	676
	5												111	55	35	31	30	14	276
2014	1													128	72	33	26	28	287
	3													165	102	66	37	27	397
	5													74	32	29	30	8	173

Release	River	Recapture year																	
Year	Section	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
2015	1														112	59	43	43	257
	3														238	140	111	64	553
	5														50	33	25	11	119
2016	1															91	56	97	244
	3															202	170	92	464
	5															58	27	15	100
2017	1																70	82	152
	3																226	142	368
	5																52	26	78
2018																		113	113
	1																	391	391
	3																	78	78
	5																		
Total		492	798	1,451	830	1,577	1,494	1,344	1,085	1,878	1,793	1,736	940	1,108	1,091	1,025	1,140	1,387	21,169

Length frequency. A fish was only counted once in a year for the compilation of length frequency. If multiple captures occurred during a year, then only the first encounter was recorded. Newly marked fish were counted as unmarked for the year marks were applied. Fish counted as marked were recaptures that were marked in a previous year. Table H3 provides a length frequency summary of marked (Floy and PIT combined) and Table H4 of unmarked fish. The data file also lists unmeasured unmarked fish sorted into two bins of less than or greater than or equal to 250 mm (Table H5) for 2002 through 2015. These samples were obtained from sessions 5 and 6. During 2016 through 2019, several length bins were employed: “<150 mm”, “150 - 199 mm”, “200 - 299 mm”, “200 - 249”, “250 - 299”, and “≥ 300 mm”. In order to compute the number of fish in the bins less than or greater than 250 mm consistent with 2002 through 2015, the “200 - 299 mm” bin was prorated based on the proportion of observed fish 250-299 mm captured in sessions 1 to 4 in the associated section. Concurrent data collected for each captured fish was the associated river section.

Table H3: Length frequency of marked (Floy and PIT) Mountain Whitefish.

Size	Capture year																	
Bin (mm)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
200-209								1		2								3
210-219																	1	1
220-229								1					2	1	1		1	6
230-239		2											1		3	3	11	20
240-249			1		1					1				5	6	11	19	44
250-259		1	3		6	3	3	2	20	12	11	1		9	15	17	35	138
260-269	2	5	11	13	18	13	19	16	52	64	76	5	1	6	27	44	71	443
270-279	11	23	40	23	39	58	66	38	104	161	174	34	16	20	26	57	95	985
280-289	29	42	94	58	86	100	88	61	159	233	257	61	41	32	35	65	136	1,577
290-299	26	54	129	108	117	139	137	100	199	234	276	122	114	73	69	68	131	2,096
300-309	46	81	144	91	171	158	152	134	231	223	242	178	146	137	142	144	184	2,604
310-319	65	102	188	112	173	179	168	128	211	177	191	161	185	169	175	191	228	2,803
320-329	72	136	183	111	209	179	153	124	191	167	140	117	190	208	181	169	202	2,732
330-339	82	120	176	103	187	170	133	108	155	131	115	72	137	144	114	141	131	2,219
340-349	53	90	131	73	154	140	98	96	141	116	103	67	90	81	87	82	69	1,671
350-359	41	51	91	50	109	107	75	83	102	80	69	51	74	50	60	55	42	1,190
360-369	22	33	69	42	73	71	69	49	81	51	30	36	47	52	34	55	39	853
370-379	15	27	54	17	56	48	46	42	79	56	31	19	30	38	34	35	16	643
380-389	15	26	48	19	62	51	48	40	53	39	23	21	23	28	19	29	20	564
390-399	11	10	36	10	43	33	26	31	38	33	12	11	16	24	14	13	12	373
400-409	7	21	30	9	34	25	30	19	28	23	8	7	8	12	8	6	11	286
410-419	9	9	24	10	23	16	19	18	29	12	11	7	6	15	5	15	6	234
420-429	4	6	25	6	31	20	17	9	17	14	12	5	9	6	3	4	5	193
430-439	3	6	13	3	16	9	13	17	22	7	8	4	4	5	2	3	2	137

Size	Capture year																	
Bin (mm)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
440-449	1	4	21	2	15	9	6	9	12	6	4	1	4	6	1	4	5	110
≥450		6	17	2	25	17	14	10	16	7	4	8	5	17	12	11	12	183
Total	514	855	1,528	862	1,648	1,545	1,380	1,136	1,940	1,849	1,797	988	1,149	1,138	1,073	1,222	1,484	22,108

Table H4: Length frequency of unmarked Mountain Whitefish.

Size	Capture year																	
Bin (mm)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
30-39															2			
40-49															1			
50-59																		1
60-69							1						1	4	3		3	11
70-79			1	1		2	2	2		1		1	19	11	28	8	11	41
80-89			17		4		19	8	5	1		4	80	80	50	18	54	95
90-99		2	23	6	11		7	8	17	1		5	164	64	47	18	59	53
100-109		1	6	3	18		5	3	19	2			97	35	7	15	23	13
110-119		1			14	3			10	3	2		34	6		2	7	
120-129	1	2	3	1	2	22	1	1		15	1	7	4	1	2	3	2	4
130-139	3	7	5	22	2	101	17	11	1	19	5	35	2		11	13	3	18
140-149	10	24	17	93	1	267	76	51	6	33	19	73	6	6	68	41	1	81
150-159	27	77	110	146	29	266	91	180	41	6	31	90	56	55	152	71	36	128
160-169	10	80	256	96	102	113	63	224	163	18	24	44	341	198	140	26	81	93
170-179	5	28	188	28	203	57	38	101	234	28	9	10	570	232	75	14	141	34
180-189	16	3	43	34	143	27	220	31	84	94	44	18	205	159	18	40	98	8

Size	Capture year																	
Bin (mm)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
190-199	40	18	21	140	48	55	387	65	36	164	112	43	62	60	24	121	32	28
200-209	36	75	84	238	67	175	484	212	61	179	126	73	56	15	64	143	74	92
210-219	32	82	236	261	243	286	300	217	230	115	156	65	189	67	163	70	118	146
220-229	70	61	345	159	259	239	140	269	304	168	220	80	179	193	188	76	106	109
230-239	175	57	167	130	168	209	137	498	172	286	306	160	77	156	114	134	145	86
240-249	206	99	95	247	151	338	230	568	172	321	327	226	48	77	91	141	275	144
250-259	113	166	146	234	257	285	306	332	356	352	435	337	71	91	156	149	301	256
260-269	112	231	237	170	228	261	385	293	514	567	457	434	122	119	169	206	410	428
270-279	148	242	346	222	252	294	411	339	629	789	604	441	222	140	143	190	474	489
280-289	150	195	454	317	293	349	398	330	536	914	632	482	319	133	175	165	446	474
290-299	188	175	527	368	343	291	393	335	455	749	506	411	379	250	207	192	381	336
300-309	305	229	563	339	340	337	365	310	416	621	392	337	335	301	317	250	354	326
310-319	441	284	602	366	289	306	343	244	319	453	286	239	298	313	403	307	438	298
320-329	517	336	618	383	278	293	296	226	317	370	216	148	193	272	416	268	350	264
330-339	416	295	502	341	205	234	256	203	238	289	170	135	121	182	245	187	250	165
340-349	291	196	373	251	150	184	182	167	183	248	143	85	93	126	149	111	181	100
350-359	158	119	253	191	80	127	162	143	171	204	103	83	81	74	100	94	129	64
360-369	85	82	232	141	69	136	130	99	125	139	74	66	39	60	67	42	79	39
370-379	72	60	130	126	35	85	95	90	100	102	58	36	44	39	56	40	49	31
380-389	67	53	94	74	34	69	70	56	75	70	60	22	34	52	36	19	30	18
390-399	45	46	92	58	24	64	62	55	59	49	45	21	20	30	20	16	30	17
400-409	24	31	73	51	19	51	43	32	39	53	27	17	10	14	12	10	17	5
410-419	27	24	65	53	24	45	43	33	37	39	18	10	13	12	21	10	18	13
420-429	15	15	61	25	14	30	28	15	16	25	26	11	8	5	10	5	18	11
430-439	10	5	37	24	12	28	12	14	11	17	8	7	8	5	15	6	10	11
440-449	9	9	37	30	7	19	8	8	9	13	7	3	4	8	4	5	9	3

Size	Capture year																	
Bin (mm)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
≥450	9	12	81	36	10	37	22	16	14	21	9	10	6	8	10	10	10	7
Total	3,833	3,422	7,140	5,405	4,428	5,685	6,228	5,789	6,174	7,538	5,658	4,269	4,610	3,653	3,979	3,236	5,253	4,540

Table H5: Length frequency of unmarked Mountain Whitefish classified into length bins.

Year	River Section	Length Bin <250 mm	≥250 mm
2002	1	73	769
	3	97	722
2003	1	47	602
	3	358	743
2004	1	49	690
	3	245	831
	5	274	330
2005	1	182	966
	3	635	928
	5	352	660
2006	1	39	451
	3	276	309
2007	1	170	647
	3	412	826
	5	358	686
2008	1	257	791
	3	757	941
	5	344	702
2009	1	281	712
	3	389	634
	5	202	616
2010	1	92	756
	3	462	982
	5	245	784
2011	1	202	1,038
	3	307	1,175
	5	167	806

	River	Length Bin	
Year	Section	<250 mm	≥250 mm
2012	1	299	1,355
	3	210	783
	5	139	531
2013	1	32	561
	3	104	867
	5	75	724
2014	1	13	434
	3	296	382
	5	169	382
2015	1	85	480
	3	255	636
	5	182	289
2016	1	116	480
	3	346	668
	5	159	215
2017	1	130	419
	3	155	493
	5	140	321
2018	1	33	289
	3	190	606
	5	69	164
2019	1	430	519
	3	442	632
	5	65	142

Mark-recapture. The file contains three sets of information. First, the time interval between the cessation of sampling and the commencement of sampling in the following year is provided (not tabulated). The second set contains the within year sample size excluding recaptures. Table H6 presents a summary (tag-type and session combined) of newly marked, marked in a previous year and unmarked fish encountered by year and river section. The third information set records recaptures. Similar to the growth increment data, when a recaptured fish was released, it served as the release for a future encounter. For example, if a fish was encountered at times A, B, and C, then two recapture records were entered for times A-B and B-C. Table H7 displays a summary (tag type and session combined) of recaptures by river section, release year and recapture year.

Table H6: Number of newly marked, marked in a previous year and unmarked Mountain Whitefish encountered by year and river section.

Year	River Section	Newly Marked	Previously Marked	Unmarked	Dead Unmarked	Dead Marked
2002	1	1,646	0	2,619	5	0
	3	1,279	0	2,074	11	0
2003	1	1,523	214	2,243	15	5
	3	1,099	296	1,907	3	2
2004	1	2,284	435	3,565	94	12
	3	1,361	387	2,374	8	2
	5	1,008	20	1,434	0	0
2005	1	1,027	600	2,211	3	6
	3	1,423	719	2,479	2	9
	5	971	199	1,662	3	2
2006	1	1,780	473	2,335	5	43
	3	1,035	370	1,388	3	2
2007	1	1,020	611	1,755	14	5
	3	1,318	746	2,211	7	4
	5	989	281	1,717	6	0
2008	1	1,281	550	2,149	4	2
	3	1,465	710	2,447	7	0
	5	1,111	283	1,848	2	1
2009	1	1,183	455	1,938	3	1

Year	River Section	Newly Marked	Previously Marked	Unmarked	Dead Unmarked	Dead Marked
	3	1,071	576	1,728	2	3
	5	992	345	1,636	2	1
2010	1	1,315	342	2,112	7	2
	3	1,950	541	3,005	0	5
	5	1,207	244	2,024	1	2
2011	1	2,352	519	3,537	0	2
	3	2,087	958	3,319	0	0
	5	1,413	459	2,247	1	0
2012	1	1,795	608	3,196	7	2
	3	1,522	807	2,320	4	0
	5	875	430	1,429	10	1
2013	1	1,064	421	1,688	15	3
	3	1,216	913	2,098	3	1
	5	931	459	1,701	2	11
2014	1	823	298	1,307	9	3
	3	677	436	1,087	2	2
	5	821	253	1,224	1	1
2015	1	757	359	1,250	1	1
	3	908	579	1,549	0	0
	5	537	210	837	0	0
2016	1	1,298	371	1,786	1	0
	3	1,065	598	1,740	1	0
	5	349	158	569	0	0
2017	1	930	278	1,352	2	0
	3	900	577	1,419	5	1
	5	438	199	762	0	0
2018	1	1,099	260	1,394	1	0
	3	1,908	713	2,522	2	0
	5	958	215	1,127	1	0

Year	River Section	Newly Marked	Previously Marked	Unmarked	Dead Unmarked	Dead Marked
2019	1	1,558	447	2,092	3	0
	3	1,354	823	1,998	5	2
	5	411	184	556	0	1
Total		61,384	21,929	96,967	283	140

Table H7: Recapture of Mountain Whitefish by river section, release year and year of recapture.

Release	River	Recapture Year																		
Year	**Section**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
2002	1	207	213	147	78	26	31	10	4	1	2									719
	3	261	280	120	109	25	23	18	8	4	4			1						853
2003	1		200	282	191	95	63	26	11	5	3	7	2	1						886
	3		275	251	218	50	47	28	14	11	5	4								903
2004	1			258	323	175	93	70	33	15	13	11	1	1	1					994
	3			159	357	84	113	62	16	15	23	8	3	1	1	1				843
	5			63	174		67	31	15	8	8	5	1							372
2005	1				255	178	153	76	28	19	29	10	7	1						756
	3				357	196	314	137	49	35	45	14	11	3	4					1,165
	5				227		192	71	45	16	21	10	5							587
2006	1					199	260	156	84	48	49	27	16	4	6	2		1		852
	3					92	224	110	51	37	36	12	6	1	3		1	2		575
2007	1						157	204	90	36	40	28	10	3	2	1				571
	3						281	332	160	75	99	34	19	8	6	4		1	1	1,020
	5						185	162	81	33	52	30	11	3	2			2		561
2008	1							161	200	85	87	56	23	6	2	4		3	1	628
	3							302	271	137	154	74	39	12	9	7	5	4		1,014
	5							168	184	54	79	43	21	4	4	4	2	3	1	567

Release	River	Recapture Year																		
Year	Section	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
2009	1								131	129	129	101	30	9	8	6	4	5	2	554
	3								215	203	192	90	40	8	7	7	2	5	2	771
	5								151	114	135	72	39	13	4	2	1	4		535
2010	1									84	153	107	37	22	17	9	7	10	6	452
	3									198	368	153	102	37	30	14	8	10	3	923
	5									85	147	66	32	21	14	5	6	4	3	383
2011	1										244	235	74	30	52	39	16	11	13	714
	3										421	396	222	62	66	47	25	22	22	1,283
	5										206	197	102	32	18	8	7	7	2	579
2012	1											354	202	98	58	45	21	17	19	814
	3											534	452	87	77	55	40	28	17	1,290
	5											226	229	49	26	9	17	8	6	570
2013	1												126	114	76	68	46	21	27	478
	3												426	197	191	113	75	69	30	1,101
	5												230	111	55	35	31	30	14	506
2014	1													75	128	72	32	26	28	361
	3													82	167	100	66	36	27	478
	5													51	74	32	29	30	8	224
2015	1														75	106	58	40	41	320

Release	River	Recapture Year																		
Year	Section	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
	3														132	226	125	96	51	630
	5														46	48	30	20	9	153
2016	1															61	82	50	83	276
	3															148	198	150	79	575
	5															23	57	25	13	118
2017	1																49	55	63	167
	3																110	209	129	448
	5																45	45	24	114
2018	1																	26	95	121
	3																	293	354	647
	5																	66	71	137
2019	1																		120	120
	3																		278	278
	5																		34	34
Total		468	968	1,280	2,289	1,120	2,203	2,124	1,841	1,447	2,744	2,904	2,518	1,147	1,361	1,301	1,195	1,434	1,676	30,020

RESULTS

The parameter estimates and associated standard errors (SEs), with the exception of the capture probabilities, for the three river sections with the synthesis model are listed in Table H8. The across year capture probabilities were transformed from the 303 logit parameters estimated by the synthesis model. The CVs for these estimates were generally less than 0.05 (not shown). The associated transformed capture probabilities are plotted in Figure H1. Note the downward trend in capture probability over the study (2002 through 2019).

Table H8: Parameter estimates and associated standard errors (SE).

		River Section 1		River Section 3		River Section 5	
Parameter	**Year**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
Nuisance length-at-age							
Length age-10 (mm)		323.0	3.9	321.1	2.6	354.5	6.1
Growth coefficient		0.391	0.017	0.378	0.010	0.275	0.013
Individual length SD (mm)		27.4	0.7	26.0	0.5	33.5	1.2
Growth							
Length age-0 (mm)		97.6	2.2	93.6	1.0	92.5	1.1
Growth coefficient		0.205	0.005	0.155	0.005	0.159	0.006
Individual length SD (mm)		25.9	0.5	41.7	1.1	41.3	1.4
Length age-10 (mm)	2003	295.5	2.1	296.8	2.8		
	2004	313.3	1.5	347.1	2.5		
	2005	283.9	1.6	301.1	2.6	314.3	3.3
	2006	295.6	1.8	340.5	2.5		
	2007	292.7	1.8	311.6	2.3	345.1	3.4
	2008	308.5	1.7	303.6	1.9	324.5	3.2
	2009	293.7	1.7	299.9	2.4	326.3	2.9
	2010	310.2	1.7	308.7	3.0	322.5	2.9
	2011	289.2	1.4	282.6	2.0	293.2	2.5
	2012	280.1	1.4	270.2	2.0	277.9	2.6
	2013	289.2	1.7	272.4	1.9	282.2	2.6
	2014	333.6	2.0	330.8	2.5	329.2	3.2
	2015	331.4	2.1	321.9	2.6	320.3	4.0
	2016	309.2	2.0	296.6	2.4	299.8	4.1
	2017	295.7	1.9	279.9	2.4	292.1	3.5
	2018	307.9	2.1	298.6	2.2	298.4	3.7
	2019	285.6	1.9	270.2	2.1	289.1	3.8

Selectivity							
Mid length bin (10 mm increments)	2002-13	28.7	0.28	30.7	0.56	35.3	0.68
	2014-19	30.3	0.78	31.5	2.53	490.0	
Slope	2002-13	1.8	0.05	2.9	0.09	3.7	0.15
	2014-19	2.2	0.14	6.0	1.14	13.3	1.86
Asymptotic Survival (logit)	2002-04	-1.175	0.046	-1.264	0.032		
	2005-07	-0.895	0.057	-1.345	0.056	-0.896	0.045
	2008-10	-1.331	0.087	-1.164	0.055	-1.905	0.130
	2011-13	0.078	0.064	-0.606	0.061	-0.533	0.101
	2014-16	-33.565		-2.059	0.192	-1.696	0.243
	2017-18	-2.367	0.760	-1.910	0.409	-0.994	0.445
Recruitment (log_e)	2002	11.54	0.14	11.26	0.13		
	2003	11.66	0.43	13.73	0.14		
	2004	13.17	0.29	10.55	0.63	13.02	0.20
	2005	13.65	0.24	13.43	0.29	14.34	0.29
	2006	12.47	0.49	13.21	0.39	13.54	0.34
	2007	12.22	0.50	10.30	0.58	10.82	0.68
	2008	12.53	0.34	10.15	0.53	10.50	0.50
	2009	11.43	0.51	9.93	0.53	10.12	0.55
	2010	11.40	0.53	10.49	0.61	10.62	0.57
	2011	11.92	0.60	13.16	0.23	10.76	0.68
	2012	13.88	0.31	11.50	0.51	12.65	0.33
	2013	12.63	0.37	9.91	0.49	10.35	0.58
	2014	11.00	0.44	9.62	0.37	10.02	0.47
	2015	11.44	0.53	9.05	0.42	9.83	0.44
	2016	13.39	0.62	9.04	0.46	9.44	0.45
	2017	14.76	0.62	8.99	0.51	9.01	0.50
	2018	12.89	0.90	10.25	0.48	9.37	0.51
	2019	12.55	0.77	10.50	0.51	9.98	0.46
Miscellaneous							
Capture probability coefficient		0.0451	0.0096	0.0465	0.0108	0.0795	0.016 0
Negative binomial dispersion coefficient		1.74	0.10	2.83	0.16	2.68	0.17

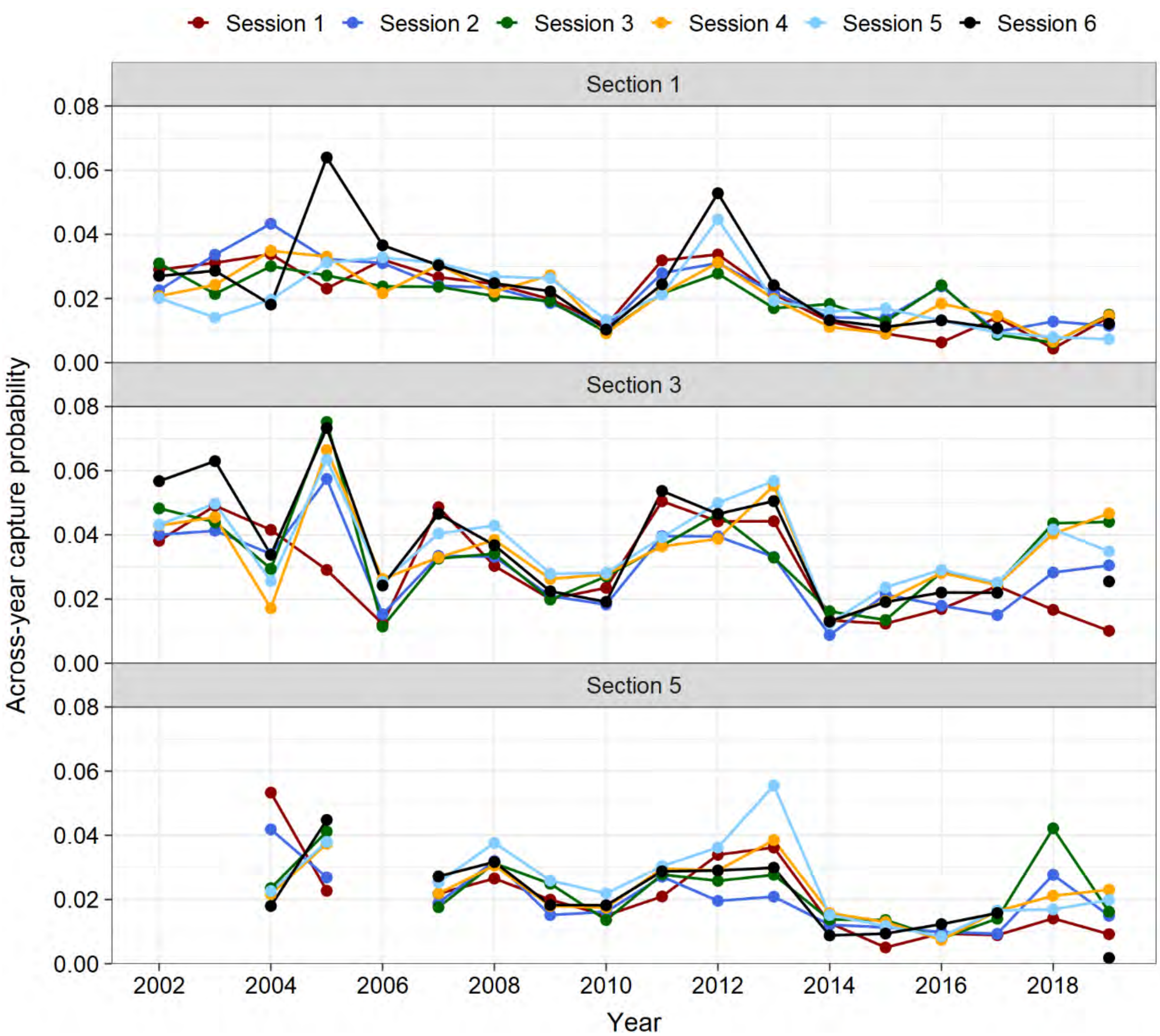

Figure H1: Across year capture probability estimates by river section, year and session.

The synthesis model goodness of fit to the data was examined graphically (Figures H2 through H8). Figure H2 plots the observed length-at-age data (points) versus the model predicted values (lines) for each river section. Note that the predicted length-at-age did not vary by year. Only the mean length at age 0 was shared by the rest of the model. The remaining length-at-age growth parameters were unique to that data and served to enhance the estimate of the age-0 mean length parameter (termed nuisance parameters). Also note that these nuisance parameters were not consistent with that estimated by the synthesis model primarily based on growth increment of marked fish and length frequency (see Table H8).

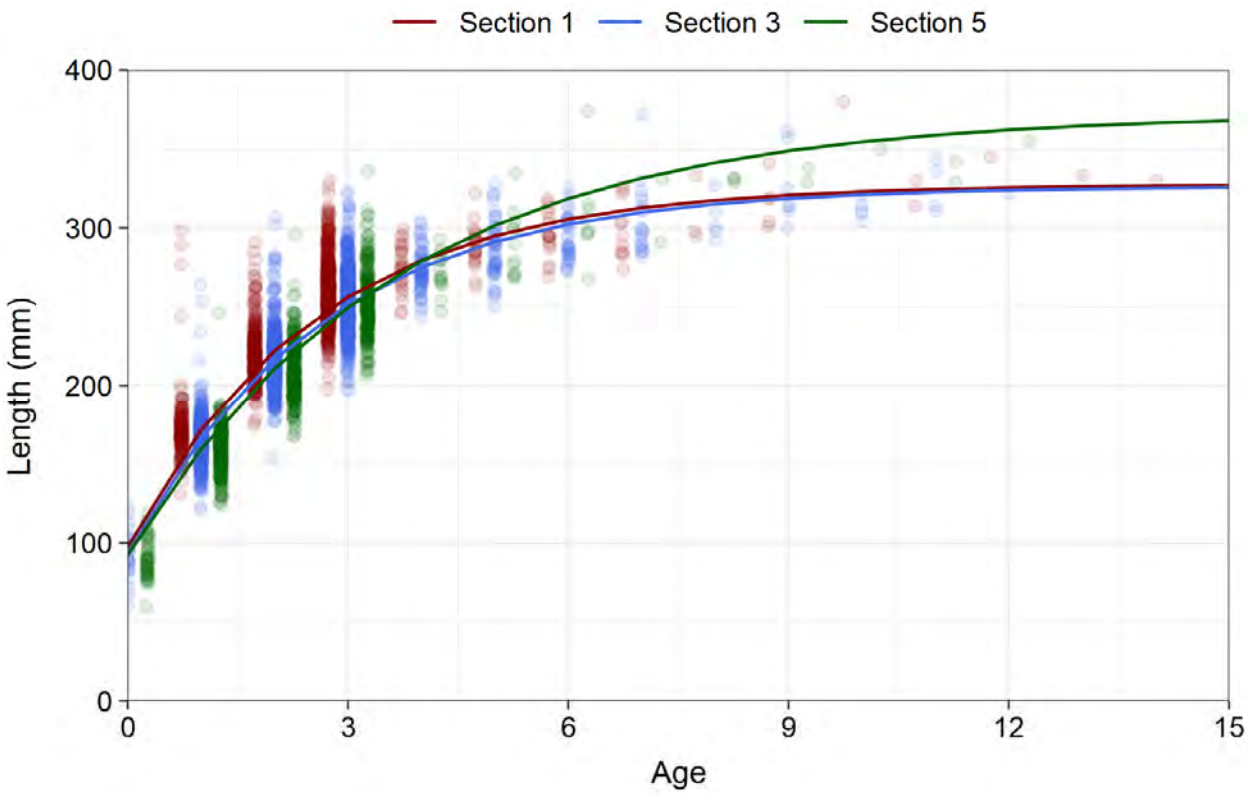

Figure H2: Observed (points) and expected (lines) length-at-age by river section.

Observed (points) and predicted (lines) incremental growth of marked fish as a function of size at release by year of recapture for Sections 1, 3, and 5 are displayed in Figure H3. Predictions were based on observations from all years. Also, the predicted increment was restricted to positive values (i.e., fish cannot shrink). Since the growth coefficient and the mean length at age 0 were assumed to be the same for all years within a river section, then the predicted slope of the increment over size at release is the same for all years within a river section. Only mean length parameter at age 10 was allowed to vary with year which was expressed in Figure H3 by the alternative X-intercepts (where the prediction is horizontal on the X-axis). By inspection, the assumption appears to be generally consistent with observed incremental growth. Commencing in 2016, Mountain Whitefish of length less than 250mm were tagged. These fish in river sections 1 and 3 displayed greater growth rates than predicted (see Figure H3).

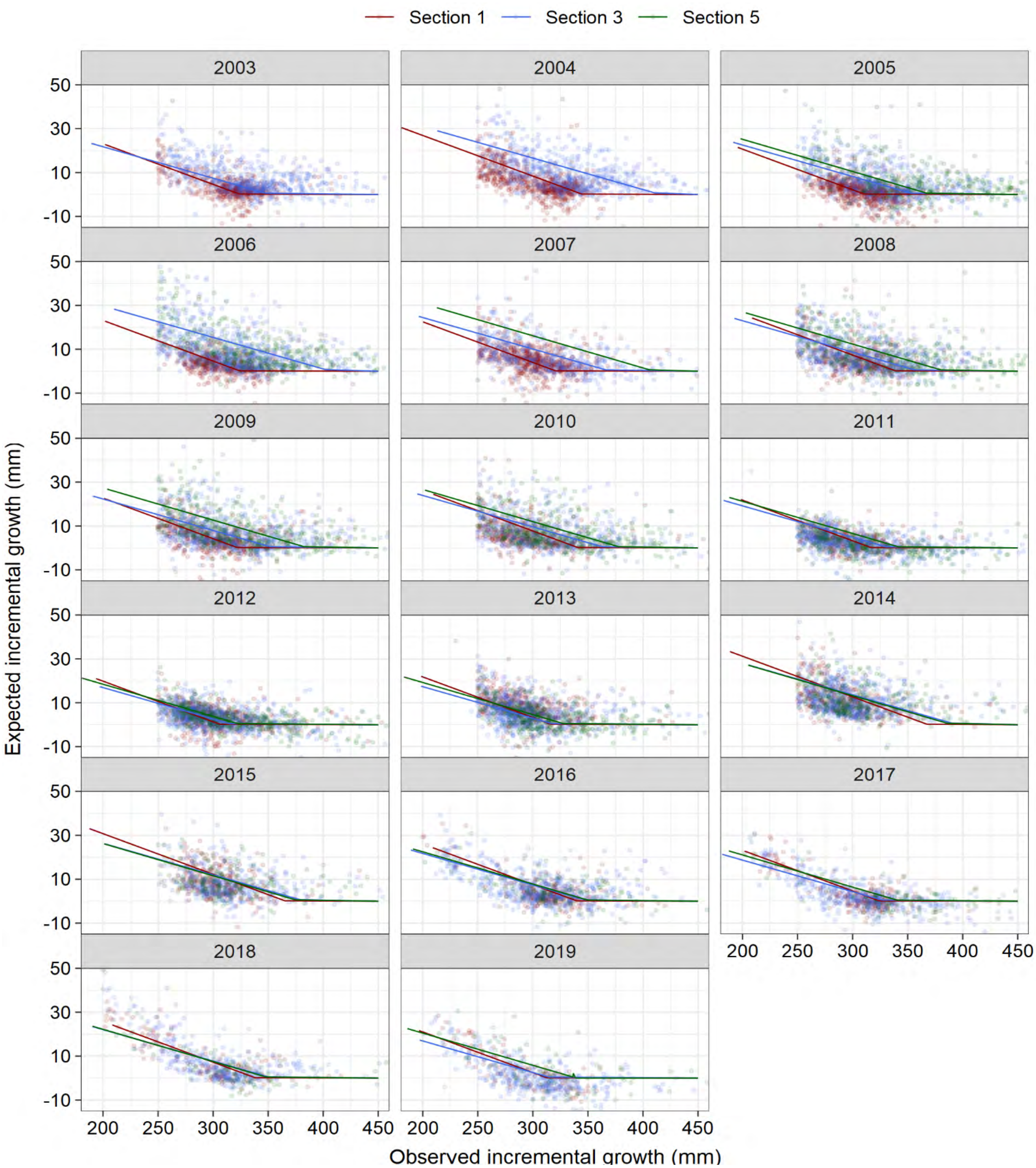

Figure H3: Observed (points) and expected (line) incremental growth of marked Mountain Whitefish as a function of size at release for Sections 1, 3, and 5, and year of recapture. Note that the expected increment is based on all observations, which include recaptures from adjacent years.

The length frequency of observed (histograms) and predicted (lines) for unmarked fish by year for Sections 1, 3, and 5 are drawn in Figure H4. The predicted lines in 2002 (Sections 1 and 3) and 2004 in Section 5 were based on the mean growth for the section (i.e., year specific predicted growth was not available in the first year of sampling). In general, the best fit to the data was obtained in Section 1. Note in Section 3, a predicted recruitment bump in 2003 (see Figure H4 and Table H8) allowed for better fits in subsequent years. Similar predicted recruitment bumps occurred in Section 5 during 2005 and Section 1 during 2017. Observed and predicted number of unmarked fish grouped into less than and greater than 250 mm bins are plotted by river section in Figure H5.

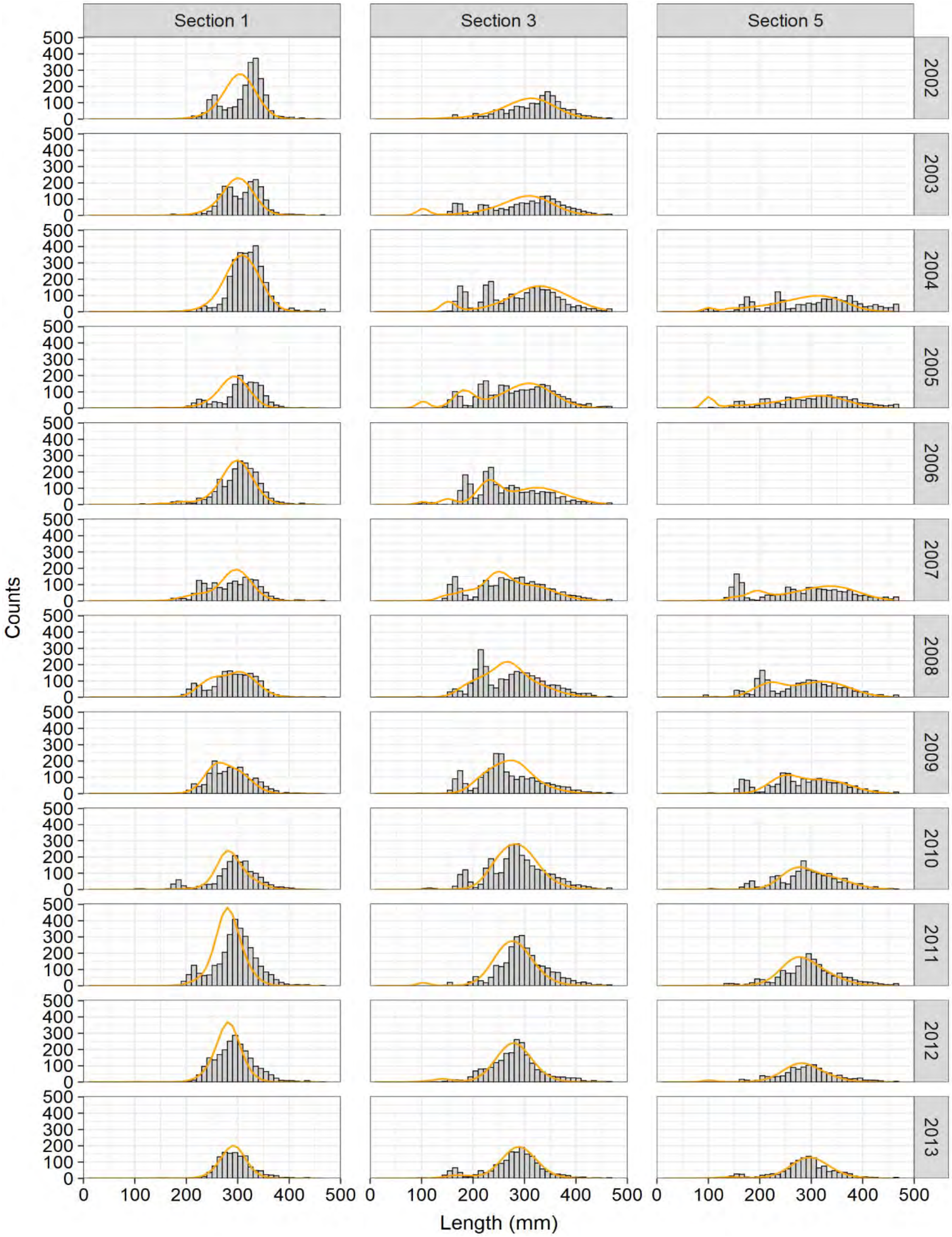

Figure H4: Length frequency of observed (histogram) and predicted (lines) by year for unmarked Mountain Whitefish in Sections 1, 3, and 5.

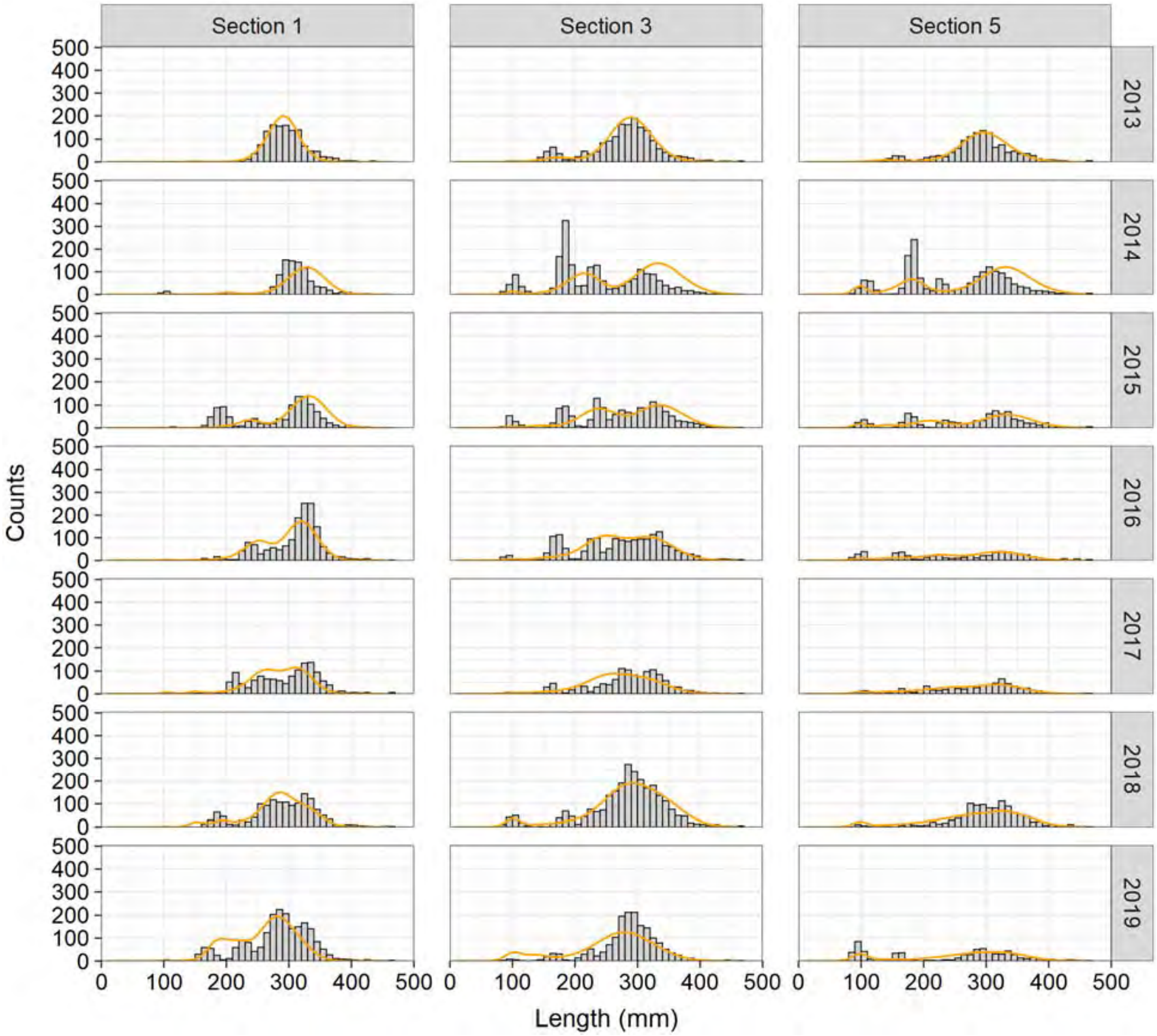

Figure H4: Continued

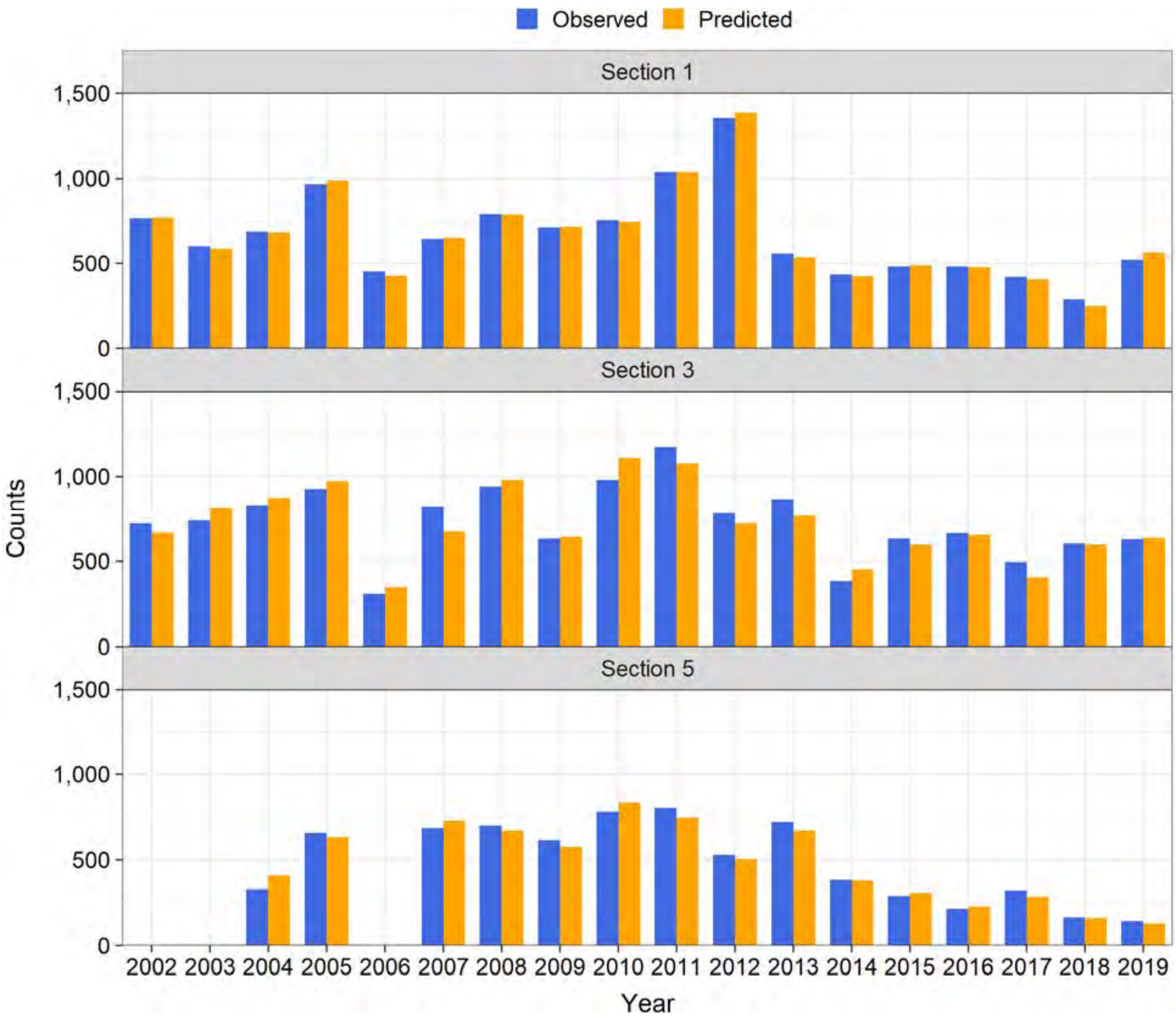

Figure H5: Observed and predicted number of unmarked and unmeasured Mountain Whitefish by river section. The fish were grouped into < 250 mm and ≥ 250 mm bins.

The length frequency of observed (histogram) and predicted (lines) for marked fish by year for river sections (1, 3, and 5) are plotted in Figure H6. A prediction for the number of marked fish was not feasible in the first year of structured data collection (2002 in Sections 1 and 3, and 2004 in Section 5). These years were not used for the likelihood calculations.

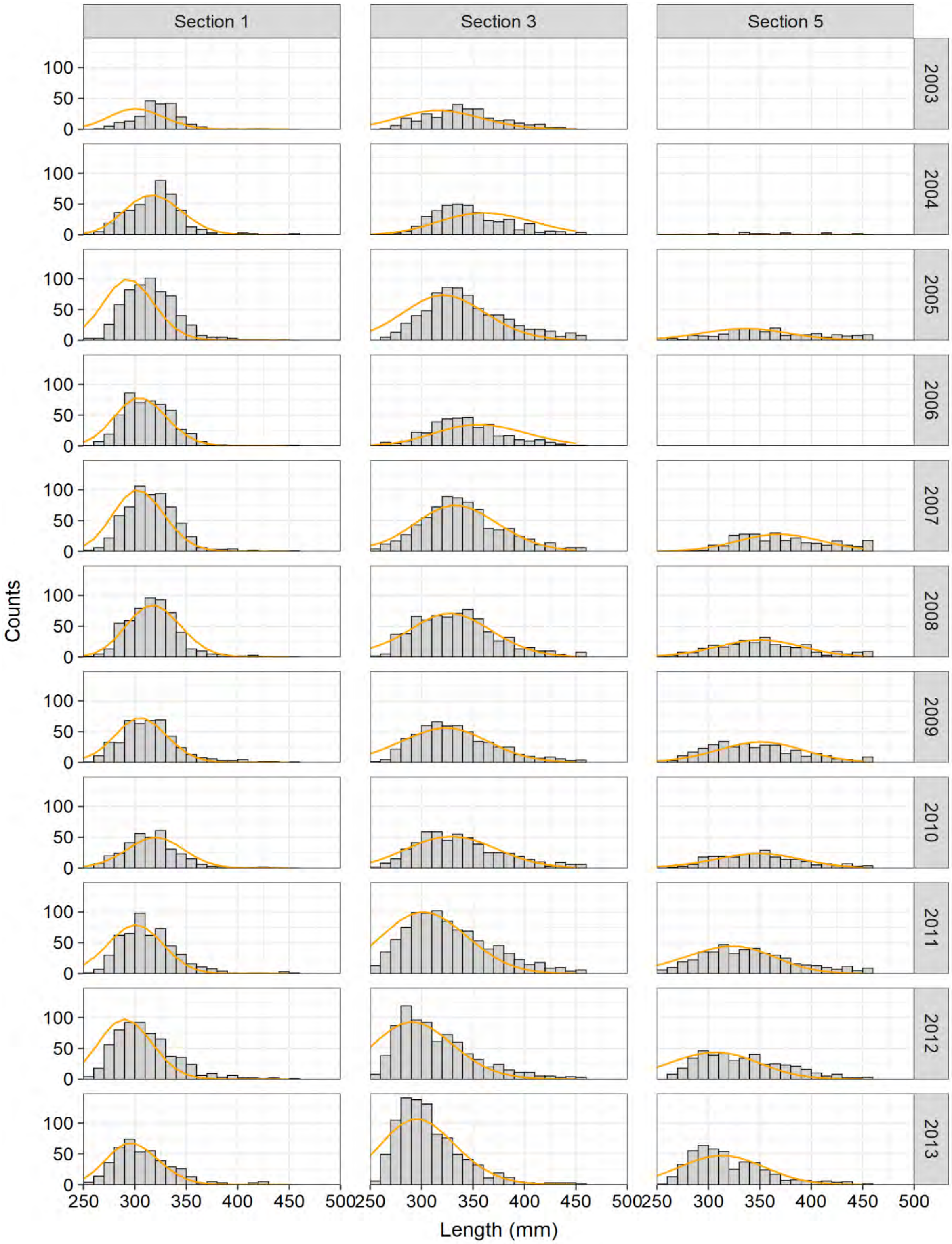

Figure H6: Length frequency of observed (histogram) and predicted (lines) by year for marked Mountain Whitefish in Sections 1, 3, and 5.

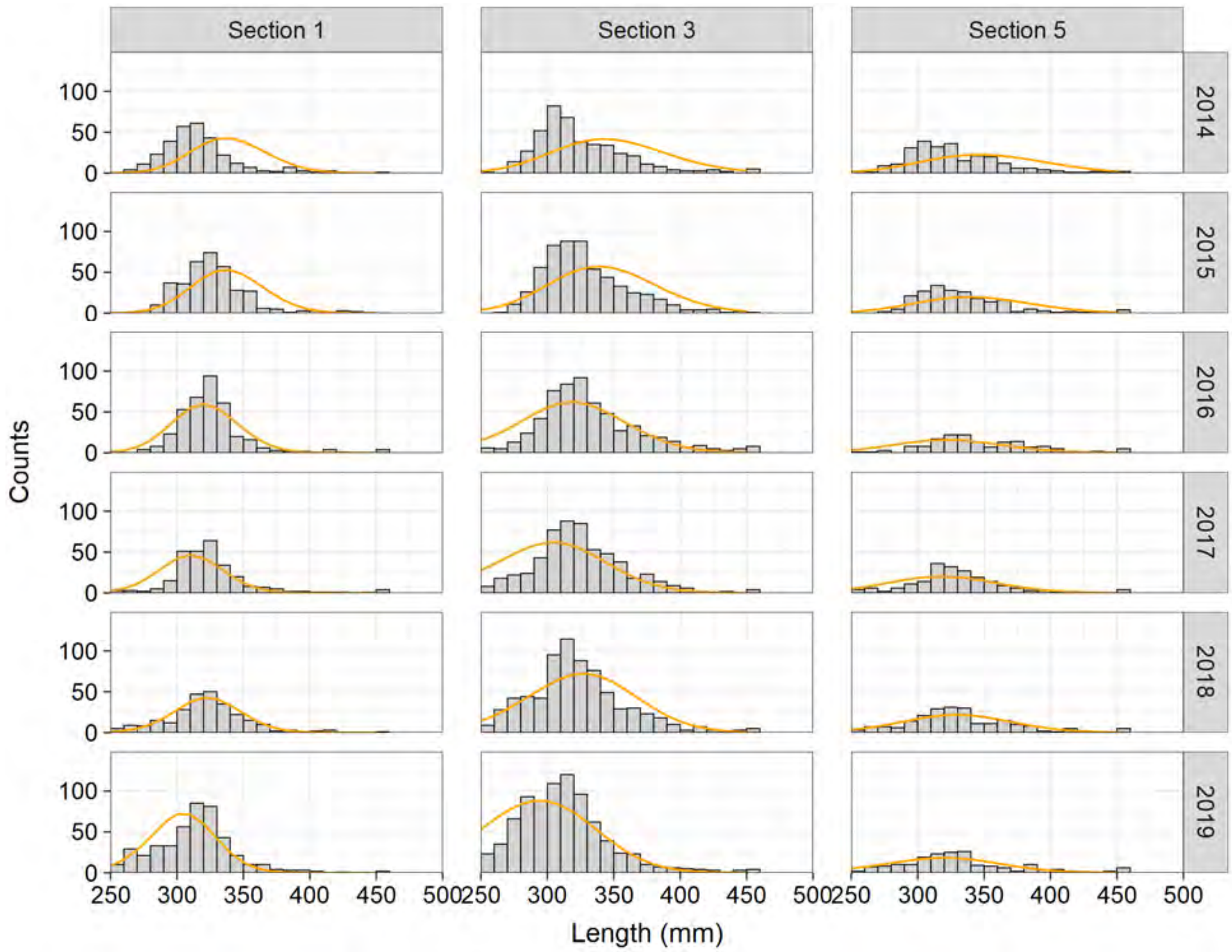

Figure H6: Continued.

Observed versus predicted recaptures by river section are drawn in Figure H7. The scatter (variation) of points was smaller for river Section 1 in comparison to river Sections 2 and 3 consistent with estimates of the negative binomial dispersion coefficient (1.74, 2.83, and 2.68 for Sections 1, 3, and 5, respectively; see Table H8). Sections 1 and 3 did not display any trends with the number of recaptures; however, Section 5 across-year recaptures were consistently under estimated (predicted) for number of observations > 25, approximately. More detailed examination revealed better agreement in the estimates as within year sampling progressed (sessions 1 through 6). The observed versus predicted captures of unmarked fish were in good agreement and did not display any apparent trends with the number observed for any of the river sections (see Figure H8). Because the sample size was large for the capture of unmarked fish in comparison to recaptured marks, the computed likelihoods effectively placed priority on obtaining the fit to unmarked captures.

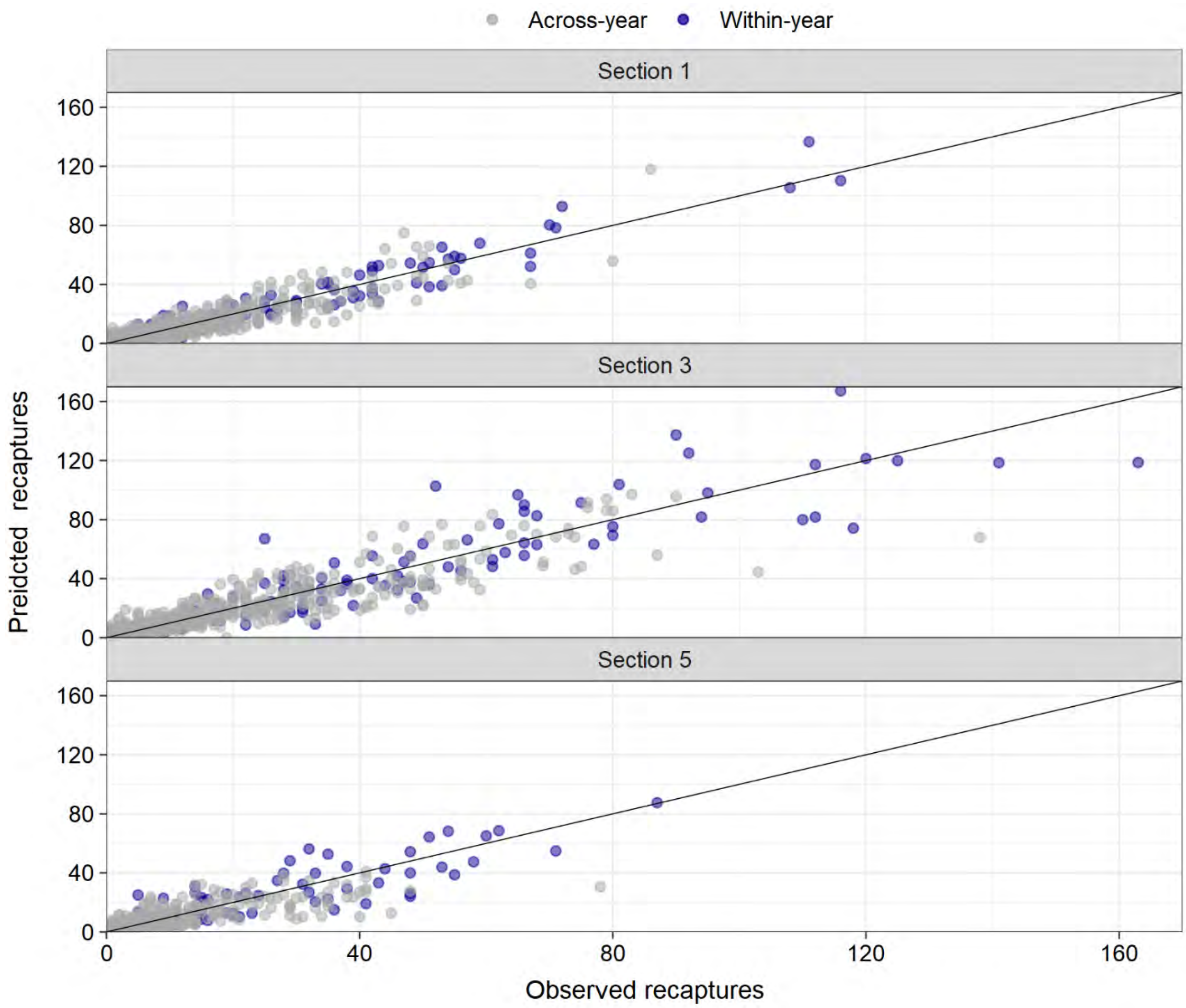

Figure H7: Observed versus predicted recaptures by river section. The line is the 1:1 association or line of equality. The solid points are within year and the grey points across year recaptures.

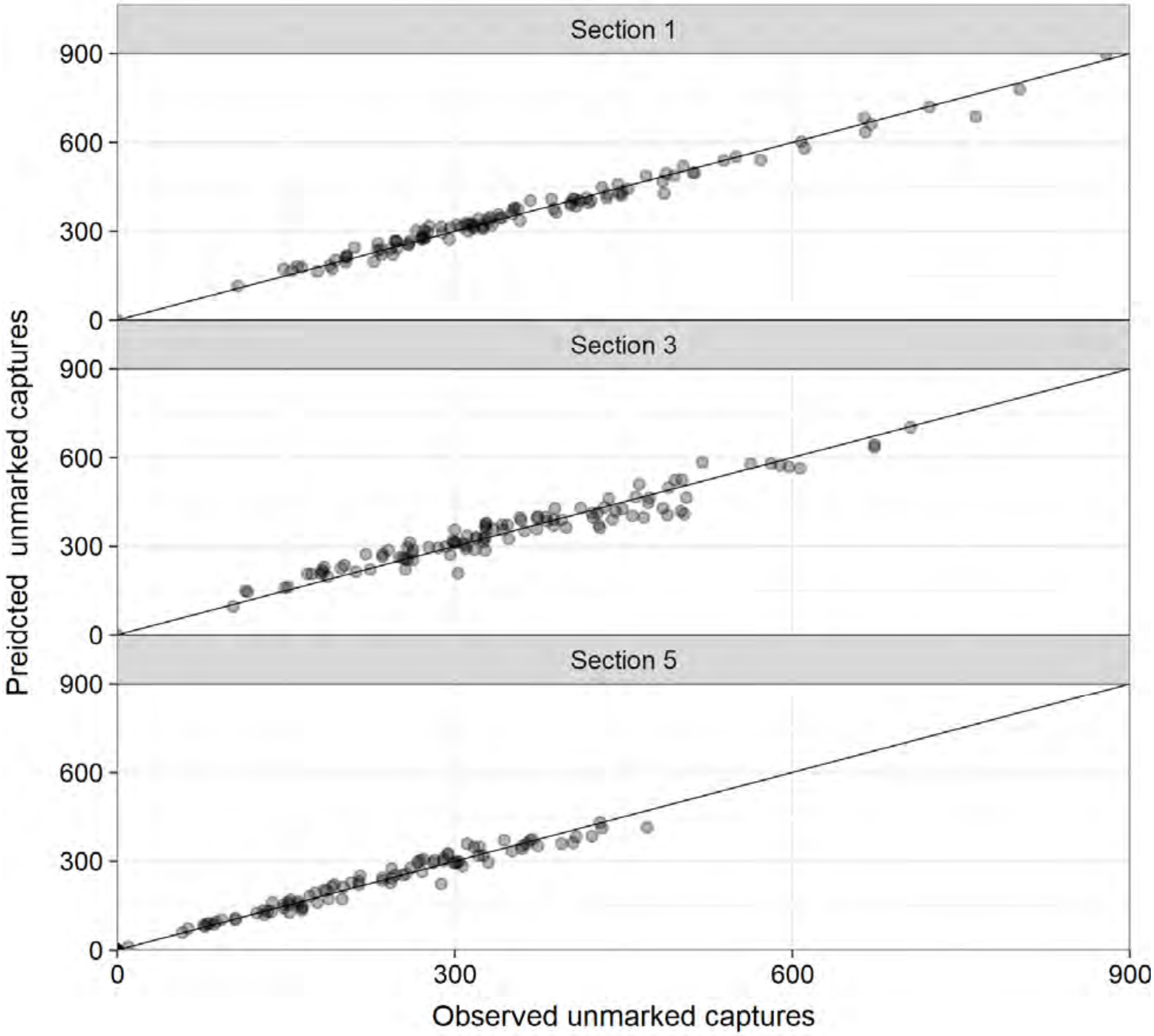

Figure H8: Observed versus predicted unmarked captures by river section. The line is the 1:1 association or line of equality.

Functions of the fundamental parameter estimates in conjunction with other data were employed to display information on growth, selectivity, mortality, recruitment, and population size. The predicted mean length of age-10 fish by river section and year of recapture are plotted in Figure H9. The overall trends in size over time were generally similar, particularly for 2010 through 2019. Also note the extremely tight error bars. However, the individual variation in length is large (asymptotic length SD of 25.9 mm, 41.7 mm, and 41.3 mm for Sections 1, 3, and 5, respectively, see Table H8). Using all growth parameters, the predicted length-at-age by year (growth history if the fish were subject to that observed in the identified year) is shown in Figure H10. For reference, the predicted growth curve obtained from the length-at-age data is overlaid on the plot. Note that the mean length-at-age was used for 2002 in river Sections 1 and 3, and 2004 in Section 5 (first years of tag application).

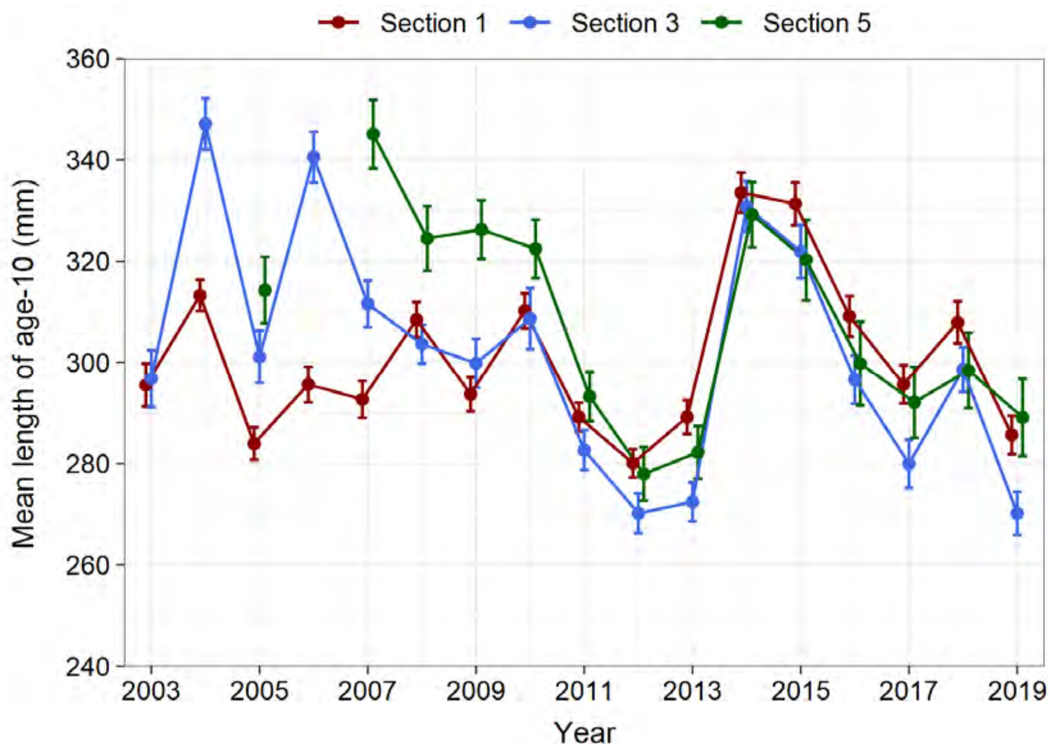

Figure H9: Predicted mean length of age-10 Mountain Whitefish by river section and year. The error bars represent ± 2 standard errors.

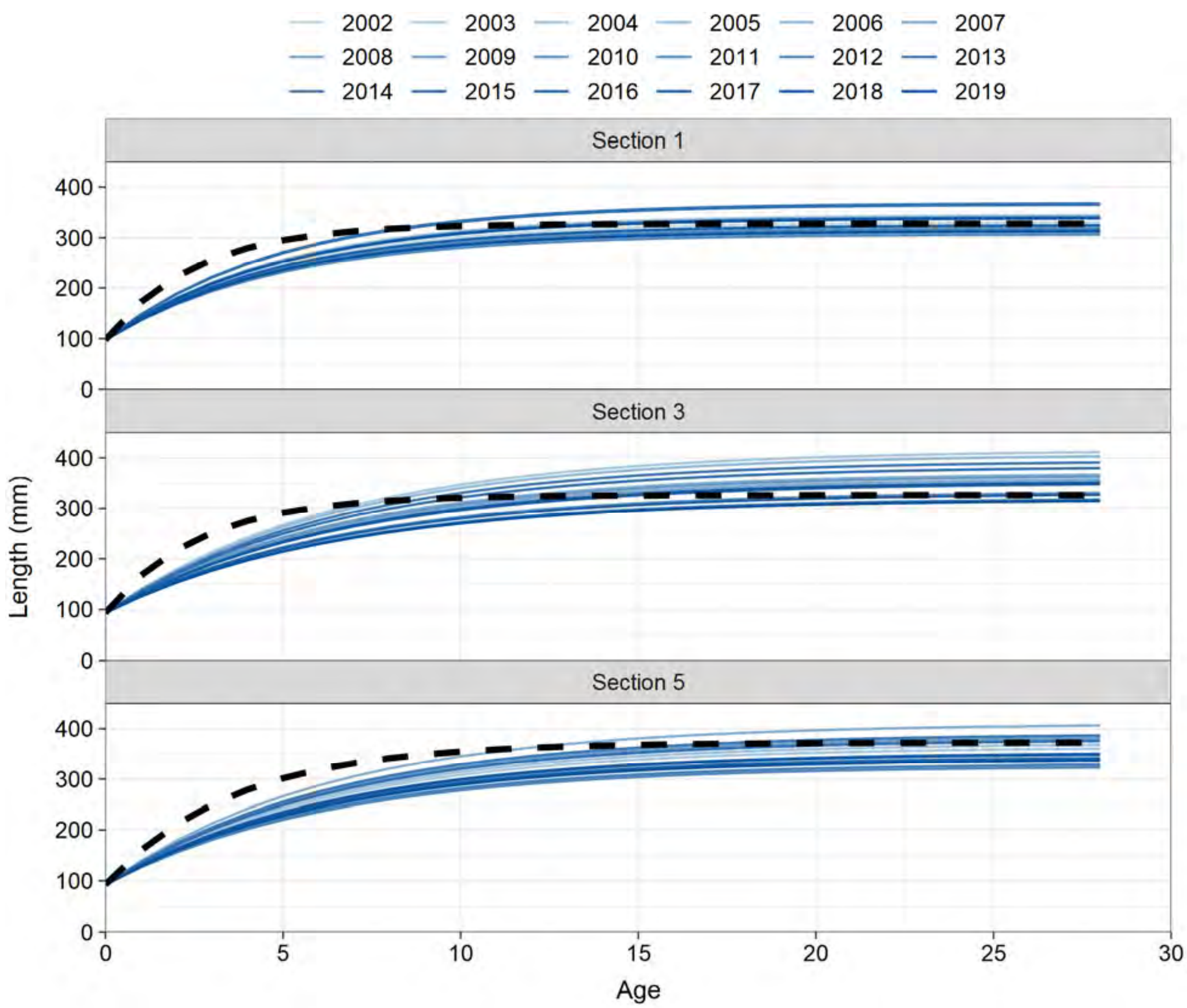

Figure H10: Predicted length-at-age by year and river section. The predicted lengths based on age data (Age) are shown as a thick dashed line.

The predicted size selectivity by river section is plotted in Figure H11. Selectivity as a function of length was flatter for the 2014-2019 period consistent with the change in electro-fishing power. The predicted instantaneous mortality by age and river section is plotted in Figure H12. Note that the mortalities for a year were largely defined by the asymptotic mortality (fundamental parameters that were estimated). The predicted mean survival by year of marked fish (weighted by the number at age) is depicted in Figure H13. These survival rates were used to predict the number of available marks across years for mark-recapture computations. Predicted recruitment by river section and year is presented in Figure H14. Population estimates and the associated standard errors by river section and year are listed in Table H9.

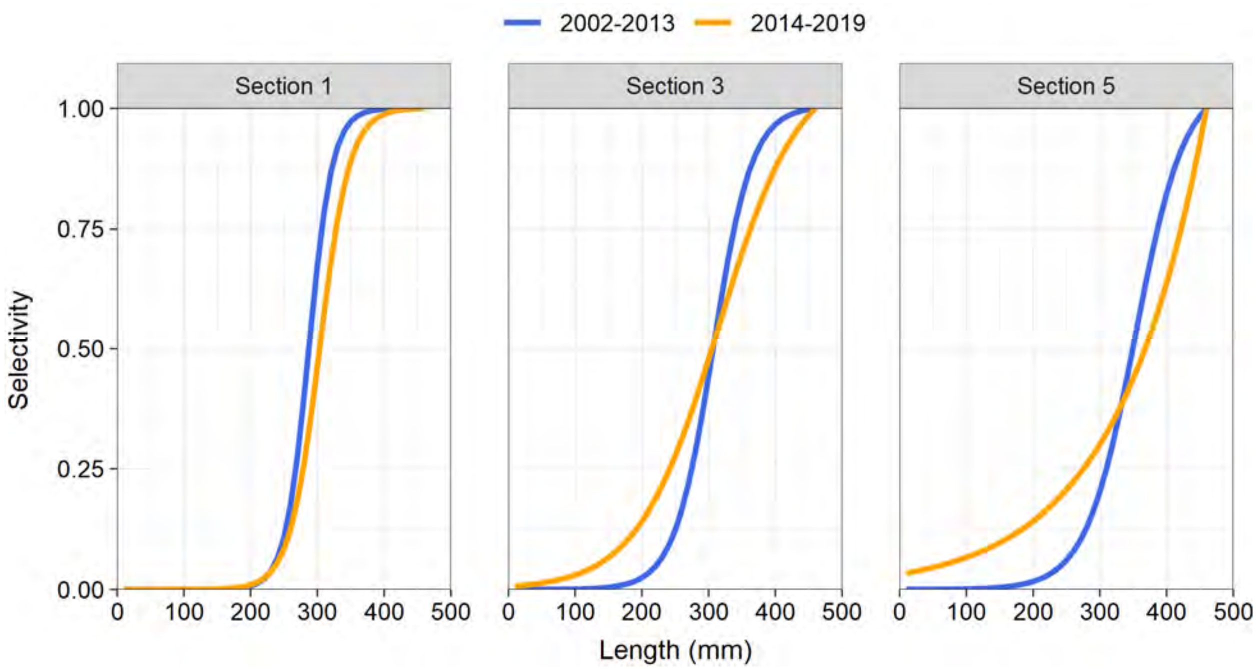

Figure H11: Predicted size selectivity by epoch and river section.

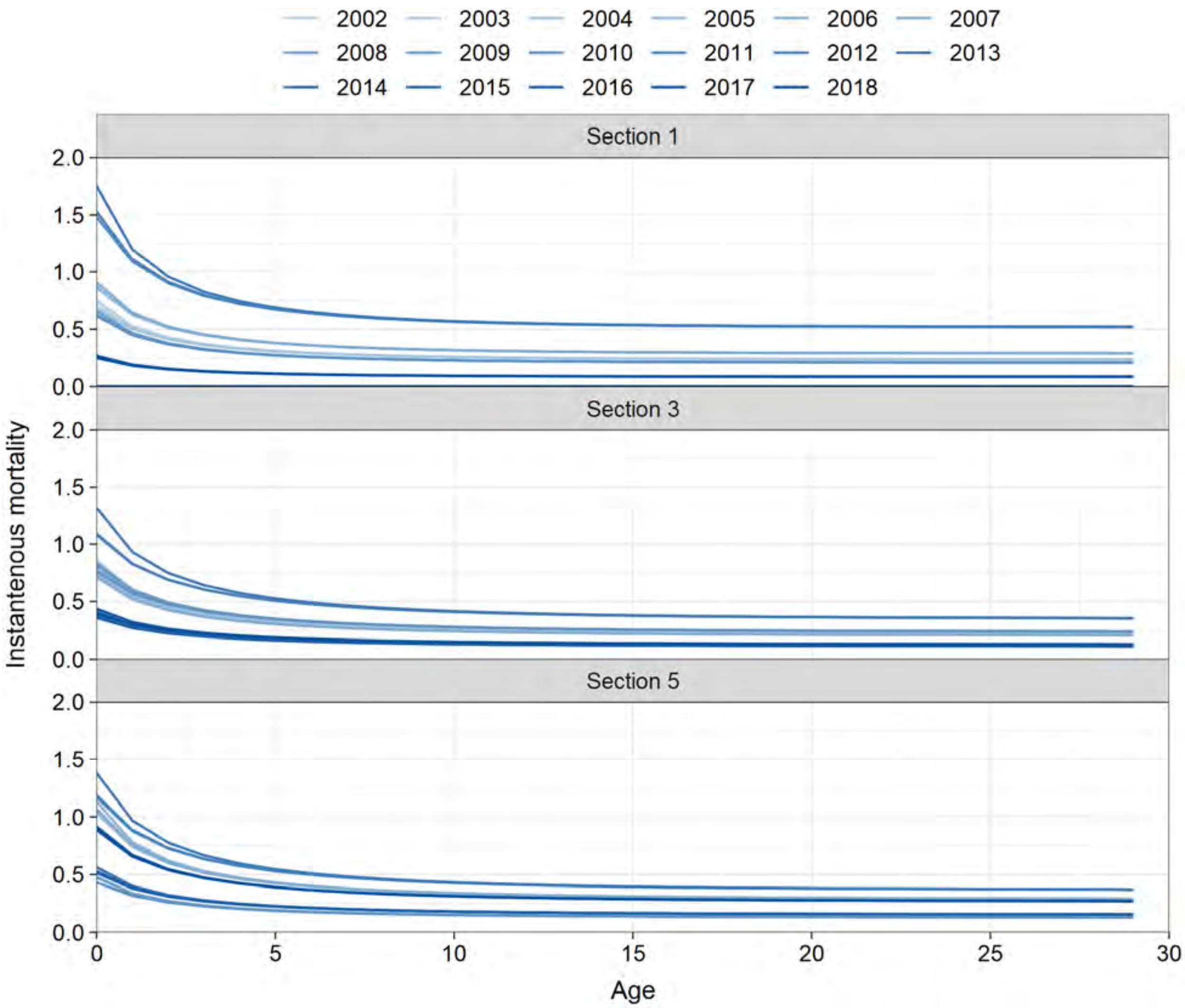

Figure H12: Predicted instantaneous mortality by age and river section.

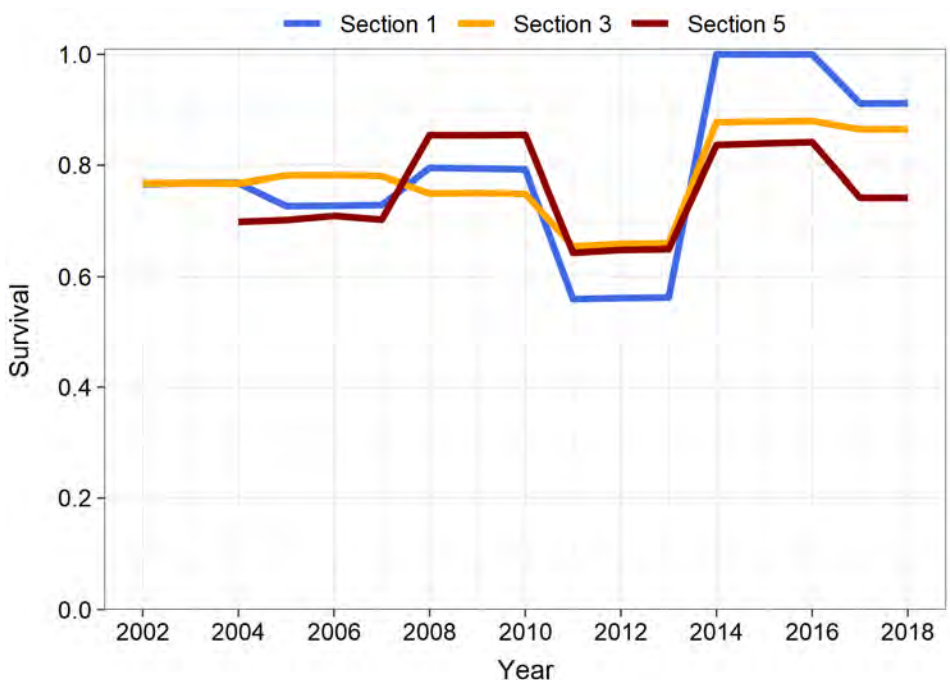

Figure H13: Predicted mean survival of marked Mountain Whitefish by year and river section, weighted by the number at age.

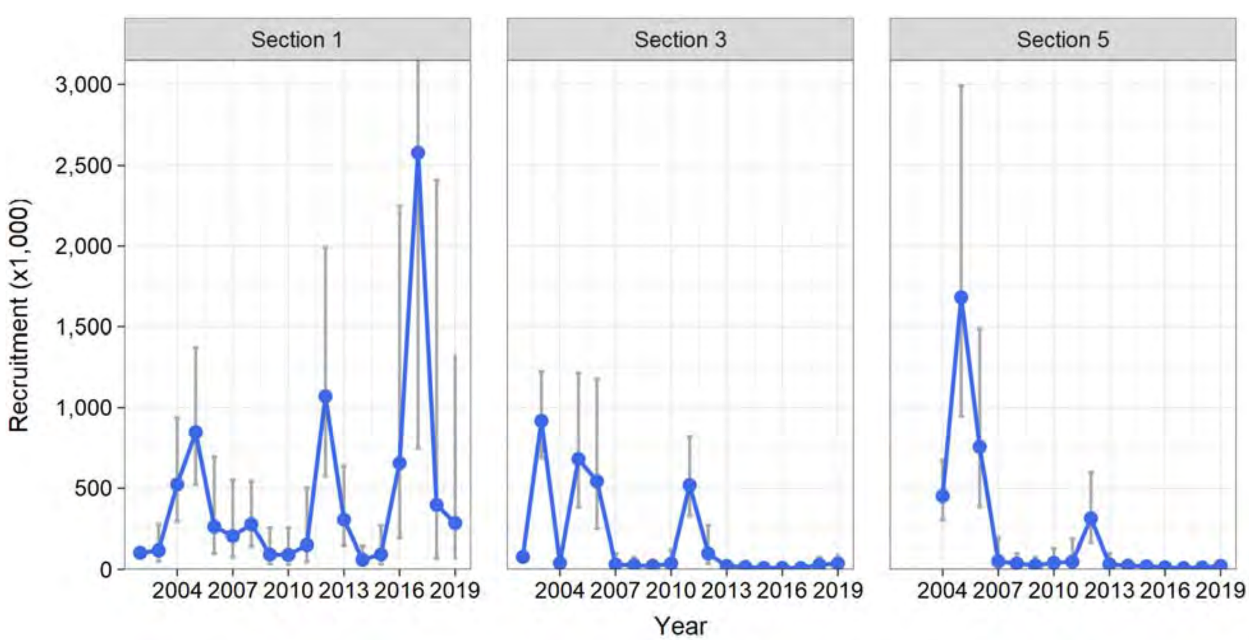

Figure H14: Predicted recruitment by river section and year. Error bars represent ± 2 standard errors. The error bar for Section 1 in 2017 was truncated to 3.0 million recruits.

Table H9: Population estimates and the associated standard errors (SE) for Mountain Whitefish based on the synthesis model.

	River Section 1		River Section 3		River Section 5	
Year	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
2002	18,617	642	8,573	352		
2003	17,221	814	8,358	376		
2004	23,495	811	15,799	599	8,069	549
2005	14,423	516	9,500	314	9,580	693
2006	16,753	576	15,980	594		
2007	15,107	591	13,739	502	15,652	1,028
2008	19,952	902	15,834	607	11,806	706
2009	18,821	757	18,208	818	16,982	892
2010	38,840	1,816	25,968	1,075	22,678	1,108
2011	28,672	1,211	18,245	628	17,299	916
2012	18,517	638	13,571	433	11,807	589
2013	17,879	867	12,494	495	11,038	665
2014	19,396	1,101	20,512	1,169	19,213	1,478
2015	22,744	1,184	20,273	885	16,924	1,110
2016	22,070	967	17,284	758	13,587	1,089
2017	24,641	1,080	15,451	872	12,196	1,278
2018	43,728	3,448	19,993	1,019	11,083	1,102
2019	34,449	4,241	15,146	1,280	8,770	1,495

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