



Lake Windermere and Columbia Lake Shoreline Fisheries Assessment, August 2021



Final Report

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Prepared by

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Executive Summary

The Lake Windermere Ambassadors (LWA) and the Columbia Lake Stewardship Society (CLSS) secured limited funding to conduct research on native fish populations within Lake Windermere and Columbia Lake (in British Columbia), in 2021. These organizations reached out to Lotic Environmental Ltd. (Lotic), to design a sampling program based on the funding available, with equal effort conducted in each lake. The purpose of this study was to sample nearshore areas of Windermere and Columbia lakes and compare the results to past studies, in the attempt to provide information on current fish populations and changes over time. Sample sites were chosen to represent different habitat types and disturbance levels, as well as to facilitate comparisons to past studies. Sample methods used were beach seine, minnow trap, and snorkel surveys. Lake Windermere was sampled from August 10 to 12 and Columbia Lake was sampled from August 13 to 15. During the study, water temperatures in the lakes ranged from 19 to 23.3°C.

The overall fish species assemblage in Lake Windermere in 2021 [Northern Pikeminnow = 133 (40.9%), Largemouth Bass = 99 (33.9%), Redside Shiner = 18 (6.5%), Mountain Whitefish = 17 (6.2%), largescale Sucker = 15 (5.4%), Peamouth Chub = 12 (4.4%), Burbot = 1 (0.4%), and Prickly Sculpin = 1 (0.4%)] was similar to that recorded during the summer of 2007 (McPherson and Hlushak 2008). Additional research is needed to determine if differences between years was due to natural variation, the primary sample methods used (snorkel surveys in 2007; beach seining in 2021) or represent changes to the species assemblage of Lake Windermere.

The overall fish species assemblage in Columbia Lake in 2021 [Largemouth Bass = 87 (35.5%), largescale Sucker = 47 (19.2%), Redside Shiner = 33 (13.5%), Peamouth Chub = 26 (10.6%), Mountain Whitefish = 19 (7.8%), Northern Pikeminnow = 15 (6.1%), Pumpkinseed Sunfish = 9 (3.7%), and Prickly Sculpin = 9 (3.7%)] was similar to that recorded during the summer of 2009 (McPherson et al. 2010). As in Lake Windermere, additional research is needed to determine if the differences between years was due to natural variation, the primary sample methods used, differences in areas sampled, or represent changes to the species assemblage of Columbia Lake.

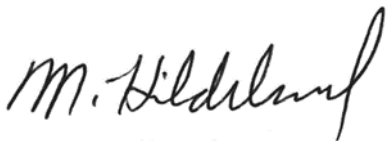
Additional research over multiple seasons (and likely years) is required to determine if any of the changes in fish use recorded during the present study represent actual changes versus natural variation, and to properly determine differences in fish use between habitat types and different disturbance levels. It seems clear that the introduction of Largemouth Bass and Pumpkinseed to the system has resulted in changes to the fish assemblage. These species are better suited to warmer waters and may be displacing/out-competing Salmonids in the lakes. In addition to warming waters affecting the fish assemblage of these lakes, other factors such as habitat disturbance, angling pressure, and increasing urbanization also likely play a role.

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We trust that this document provides adequate information to describe fish use of shoreline habitats in Lake Windermere and Columbia Lake. Please do not hesitate to contact us with any inquiries about this document.



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This report was prepared by Lotic Environmental Ltd. for the exclusive use of the Lake Windermere Ambassadors and the Columbia Lake Stewardship Society. The material in it reflects the best judgement of Lotic Environmental Ltd. considering the information available to it at the time of preparation. Any use that a third party may make of this report, or any reliance on or decisions made based on it, is the responsibility of the third parties. We disclaim responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

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1 Introduction

The Lake Windermere Ambassadors (LWA) and the Columbia Lake Stewardship Society (CLSS) secured funding to conduct research on native fish populations within Lake Windermere and Columbia Lake, in 2021. Funding, although limited, was secured, and these organizations reached out to Lotic Environmental Ltd. (Lotic), who designed a sampling program based on the funding available, with equal effort conducted in each lake.

Lake Windermere is a shallow, moderately sized lake located in the southern interior of British Columbia (BC; Figure 1). The towns of Windermere and Invermere are located on the shores of the lake. Lake Windermere has a surface area of 16.1 km² (approximately 14 km long, with an average width of approximately 1.2 km), a perimeter length of 36.3 km, a mean depth of 3.4 m, and a maximum depth of 6.4 m (McPherson and Hlushak 2008). As such, 95% of the lake is classified as littoral, which means that light can penetrate to the lake bottom, allowing aquatic macrophytes to grow. The lake provides a diversity of values to humans (local and tourists), fish and wildlife. These values have been impacted as a result of increased development pressures in recent years; for example, the lake appears to be becoming more eutrophic over time, due to nutrient enrichment (Masse and Miller 2005).

Columbia Lake, located about 15 km south of Lake Windermere between the villages of Canal Flats and Fairmont Hot Springs, is the largest warm water lake (average July water temperature 18°C) in the East Kootenays (Figure 2). Columbia Lake has a surface area of 27.6 km², is approximately 13.5 km long with a perimeter length of approximately 43.3 km, an average depth of 2.9 m, and a maximum depth of 5.2 m (McPherson et al. 2010). The Columbia Lake area is of great importance to the Ktunaxa First Nation, provides important habitat for many fish, wildlife, and plant species, and is important to local residents. The lake is also facing increased pressure from growing recreational use and development.

1.1 Purpose and Objectives

The purpose of this study was to sample Windermere and Columbia lakes and compare the results to past studies, to provide information on current fish populations and changes over time. Sample sites were chosen to represent different habitat types and disturbance levels, as well as to facilitate comparisons to past studies.

1.2 Study Area and Period

The study areas were Lake Windermere (Figure 1), which was sampled from August 10 to 12 and Columbia Lake (Figure 2), which was sampled from August 13 to 15, 2021.

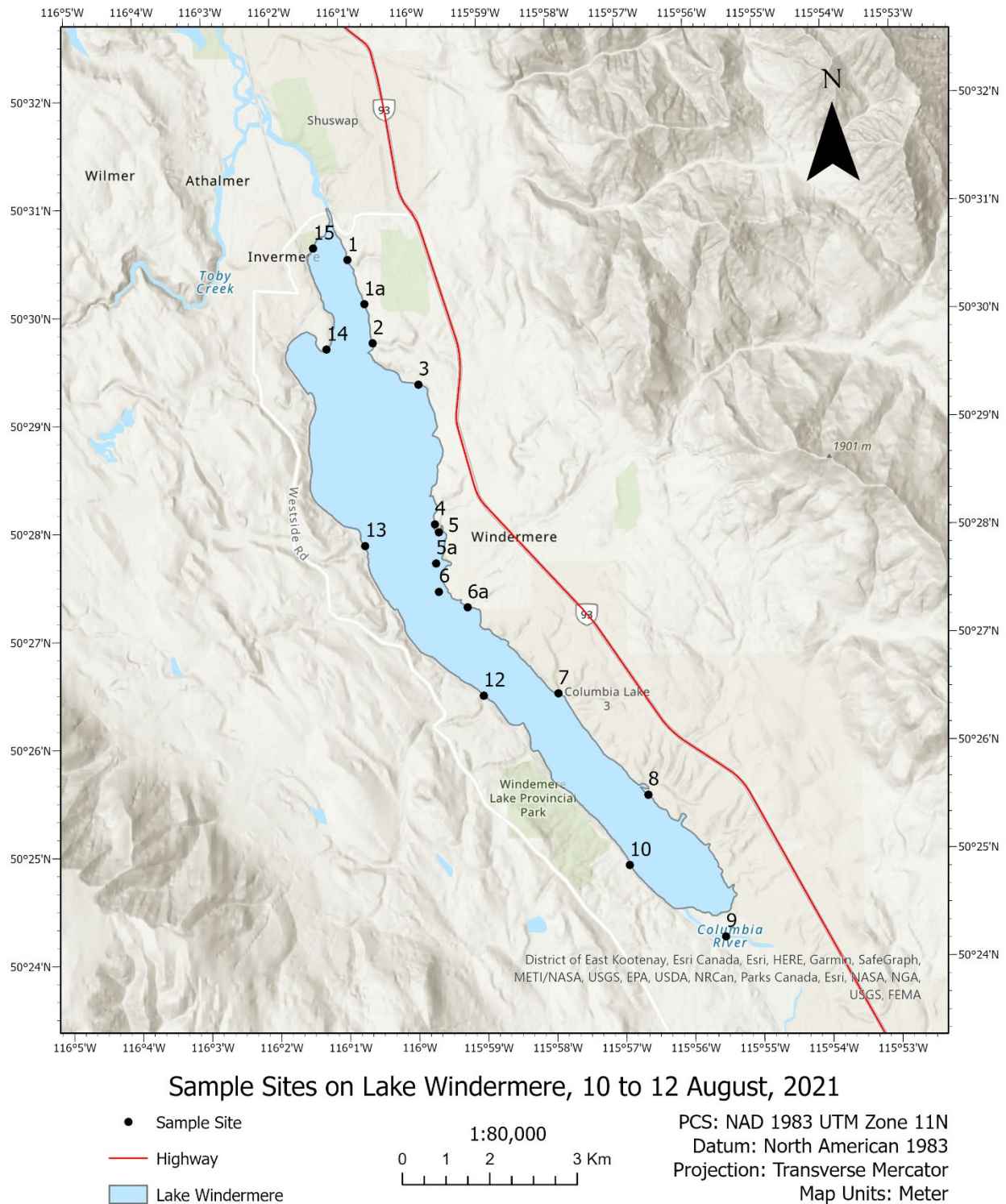


Figure 1: Sample sites on Lake Windermere, 10 to 12 August 2021.

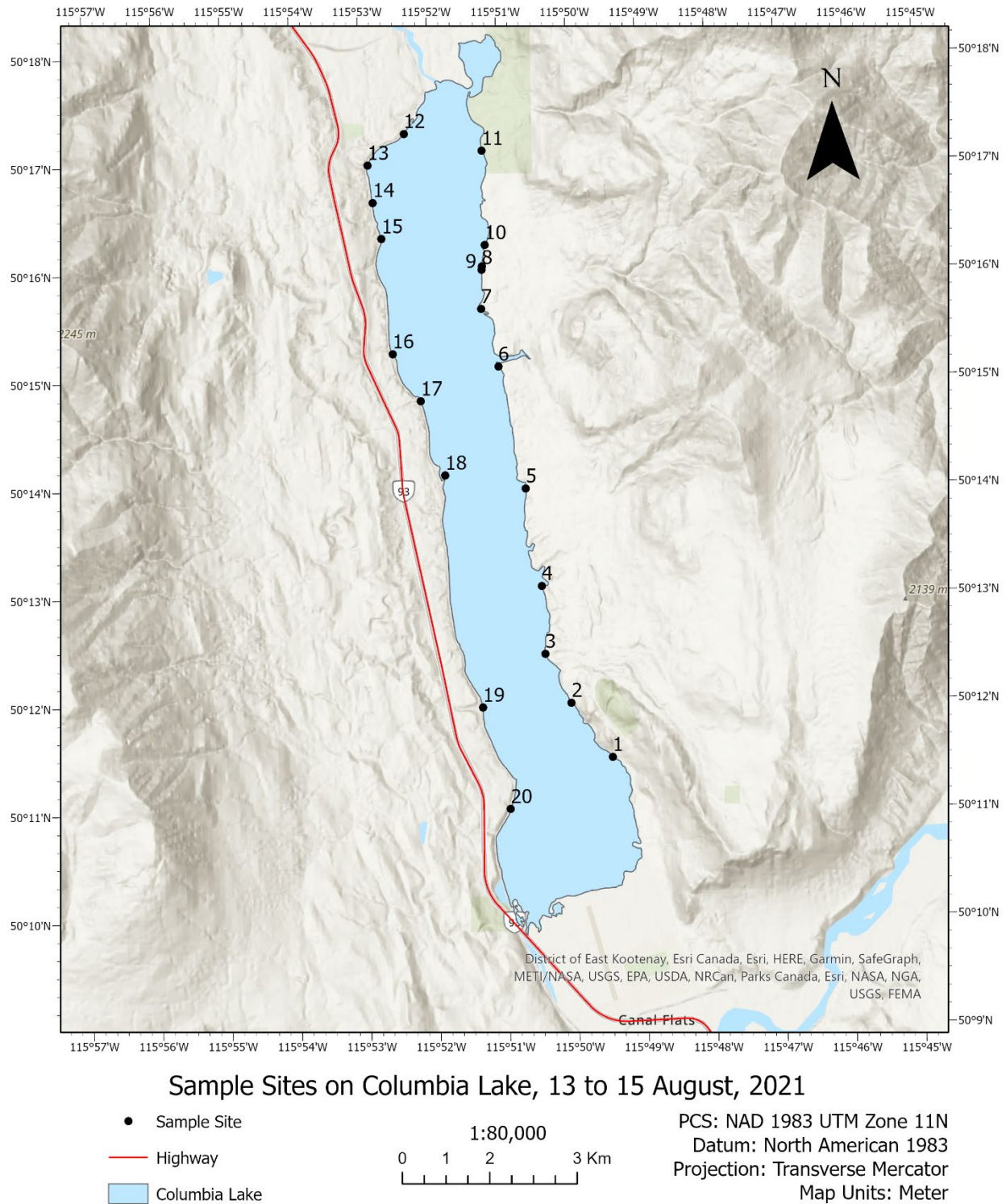


Figure 2: Sample sites on Columbia Lake, 13 to 15 August 2021.

2 Methods

Sample sites chosen for the present study were based on sites sampled during the 2007 Windermere Lake Foreshore Fish and Wildlife Habitat Assessment (McPherson and Hlushak 2008; Appendix A, Table A1). A variety of habitat types at differing levels of disturbance (i.e., low, moderate, high) were sampled.

2.1 Beach Seining

A 10 m long beach seine was used to sample near shore habitats. Lengths and area sampled depended on site conditions (50 to 320 m² sampled). The seine was either hauled parallel to the shore or perpendicular to shore from out deep into shore. Captured fish were held in a bucket to which lake water was frequently added, identified to species, measured for fork length (FL), weighed, and released in the same area captured. Photos were taken of some fish, and all abnormalities observed. Additional data collected at each sample site included site photos, UTM coordinates, length and width sampled, mean and maximum depth sampled, dominant and subdominant substrate, water temperature, and amount of aquatic vegetation.

2.2 Minnow Traps

Minnow traps were used to supplement data obtained from beach seine sampling. Standard minnow traps were baited with cat food, tied to shore, placed on the lake bottom, and fished overnight. Captured fish were sampled as with beach seine captures and released in the same location they were captured. Data recorded at each site included site photos, UTM coordinates, depth, dominant and subdominant substrate, and amount of aquatic vegetation.

2.3 Snorkel Surveys

Snorkel surveys were conducted on an opportunistic basis during the last (third) day of sampling on each lake, to supplement beach seine and minnow trap data, and facilitate comparisons to past studies. Observed fish were identified to species and assigned to 10 cm FL bins (i.e., < 10 cm, 10 to 20 cm, etc.). Additional data recorded included start and end times, start and end UTM coordinates, substrate type, aquatic vegetation type and amount, mean and maximum depth, length and width sampled, water temperature, and visibility. Length surveyed varied from 50 to 200 m, depending on site and lake conditions.

2.4 Data Analysis

Data was not analysed using statistical methods because the sampling program was designed to fit within available funding and allow for simple analyses such as presence/absence, calculation of means, and catch-per-unit-effort (CPUE). Statistical analyses would have required substantially more effort/replication.

3 Results

3.1 *Lake Windermere*

During the present study, 16 of the 18 sites from the 2007 study were sampled (Appendix A, Table A1). Site 4 and site 9 were not sampled during the present study due to accessibility issues, lack of seinable habitat, and/or time constraints. In total, sampling was conducted in six high disturbance sites, five moderate disturbance sites, and five low disturbance sites. Life history data collected from captured fish is provided in Appendix A, Table A2.

3.1.1 Water Temperature

From August 10 to 12, 2021, water temperatures recorded in Lake Windermere ranged from 19.1 to 23.3°C (Appendix A, Table A3). There was variation in water temperatures in areas sampled, but in general water temperatures were between 19 and 20°C in the morning and warmed by several degrees throughout the day to between 22 and 23°C.

3.1.2 Beach Seining

During the present study, 19 seine hauls were conducted at 16 sites, which resulted in 2050 m² of shallow water habitat being sampled (two seine hauls were conducted at three sites; Appendix A, Table A4). In total, 204 fish were captured using this method, comprised of:

- 90 Largemouth Bass (LMB);
- 62 Northern Pikeminnow (NPC);
- 15 Mountain Whitefish (MW);
- 15 Redside Shiner (RSC);
- 12 Peamouth Chub (PCC);
- 9 Largescale Sucker (CSU); and,
- 1 Prickly Sculpin (CAS).

The overall use (i.e., by all fish species) of sites with different levels of disturbance was similar. Some differences were noted in some fish species' use of areas based on disturbance levels, but additional study is required to determine if these are actual trends as opposed to random variation (Table 1). Largemouth Bass and Northern Pikeminnow were common in all disturbance levels, however Northern Pikeminnow were about three times as common in highly disturbed sites than in sites with moderate or low disturbance. Mountain Whitefish, Redside Shiner, Peamouth Chub, and Largescale Sucker appear to prefer low disturbance sites, but as noted above, additional study is required to confirm these results.

Table 1: Beach seine catch and catch-per-unit-effort (CPUE; no. fish/100 m² sampled) of sample sites with differing levels of disturbance, August 10 and 11, 2021.

Disturbance Level	Area (m ²)	LMB	MW	NPC	RSC	CAS	PCC	CSU	All
High	625	35 (5.6)		38 (6.1)					73 (11.7)
Mod.	670	32 (4.8)	1 (0.1)	14 (2.1)		1 (0.1)	1 (0.1)		49 (7.3)
Low	755	23 (3.0)	14 (1.9)	10 (1.3)	15 (2.0)		11 (1.5)	9 (1.2)	82 (10.9)
All	2050	90 (4.4)	15 (0.7)	62 (3.0)	15 (0.7)	1 (0.05)	12 (0.6)	9 (0.4)	204 (10.0)

3.1.3 Minnow Traps

During the present study 17 minnow traps were deployed overnight for a total sample duration of 352.6 hours (Appendix A, Table A5). In total, 13 fish were captured by minnow traps, comprised of 10 Northern Pikeminnow, 2 Redside Shiner, and 1 Burbot. Given the low numbers of fish captured, in-depth analysis was not conducted on minnow trap data. The method did provide useful supplemental data in that the presence of Burbot in the lake was confirmed during the present study.

3.1.4 Snorkel Surveys

Snorkel surveys were not completed in sufficient numbers to warrant statistical analyses. A total of 10 snorkel surveys were completed in Lake Windermere, which resulted in a surveyed area of 7400 m² and 59 fish observed (Appendix A, Table A6). The 59 fish observed were: 41 Northern Pikeminnow (38 juveniles), 9 Largemouth Bass (7 juveniles), 6 largescale sucker juveniles, 2 Mountain Whitefish juveniles, and 1 Redside Shiner.

Differences were noted between the number of fish observed in high disturbance sites when compared to moderate and high disturbance sites (Table 2). During snorkel surveys, fish abundance was substantially higher in low disturbance sites (1.6 fish/100 m²), than in moderately (0.7 fish/100 m²) and highly (0.1 fish/100 m²) disturbed sites. This differed from beach seine results, where the high CPUE was recorded at high disturbance sites (11.7 fish/100 m²), followed by low (10.9 fish/100 m²) and moderate disturbance sites (7.3 fish/100 m²). It is difficult to draw conclusions from these results, other than the differences are likely due to natural variation, and additional research is required to further determine patterns of fish use.

Table 2: Summary of snorkel survey results (with rough abundance/100 m²), Lake Windermere, August 12, 2021.

Disturbance Level	Area (m ²)	LMB	MW	NPC	RSC	CSU	All
High	1600			1 (0.06)			1 (0.06)
Mod.	4050	3 (0.07)	2 (0.05)	18 (0.44)	1 (0.02)	6 (0.15)	30 (0.74)
Low	1750	6 (0.34)		22 (1.26)			28 (1.60)
All	7400	9 (0.12)	2 (0.03)	41 (0.55)	1 (0.01)	6 (0.08)	59 (0.80)

3.2 Columbia Lake

During the present study, 20 sites were sampled on Columbia Lake from August 13 to 15, 2021 (Appendix B, Table B1). In total, sampling was conducted in 7 high disturbance sites, 3 moderate disturbance sites, and 10 low disturbance sites. In general, the shoreline of Columbia lake exhibits less overall disturbance than the shoreline of Lake Windermere. Life history data from captured fish is provided in Appendix B, Table B2.

3.2.1 Water Temperature

From August 13 to 15, 2021, water temperatures recorded in Columbia Lake ranged from 19.2 to 22.6°C (Appendix B, Table B3). There was variation in water temperatures in areas sampled, but in general water temperatures were around 20°C in the morning and warmed by two or more degrees throughout the day to between 22 and 23°C.

3.2.2 Beach Seining

During the present study, 20 seine hauls were conducted in Columbia Lake (one per site), which resulted in 2075 m² of shallow water habitat being sampled; Appendix B, Table B4). In total, 172 fish were captured using this method, comprised of:

- 72 Largemouth Bass (LMB);
- 44 Largescale Sucker (CSU);
- 19 Mountain Whitefish (MW);
- 15 Northern Pikeminnow (NPC);
- 8 Pumpkinseed Sunfish (PSS);
- 7 Redside Shiner (RSC); and,
- 7 Prickly Sculpin (CAS).

Much like results from Lake Windermere, overall use of sites with different disturbance levels by all fish species was similar (Table 3). Differences were noted in some fish species' use of areas based on disturbance levels, but additional study is required to determine if these are actual trends as opposed to random variation. Mountain Whitefish, Largescale Sucker and Prickly Sculpin were more frequently recorded in high disturbance sites. Largemouth Bass, Pumpkinseed Sunfish,

Northern Pikeminnow, and Redside Shiner were more frequently recorded in lower disturbance sites. As noted previously, additional study is required to verify these trends.

Table 3: Beach seine catch and catch-per-unit-effort (CPUE; no. fish/100 m² sampled) of sample sites in Columbia Lake with differing levels of disturbance, August 13 and 14, 2021.

Disturbance Level	Area (m ²)	LMB	MW	PSS	NPC	RSC	CAS	CSU	All
High	700	3 (0.4)	15 (2.1)		2 (0.3)	1 (0.1)	5 (0.7)	35 (5.0)	61 (8.8)
Mod.	300			1 (0.3)	7 (2.3)	5 (1.7)	1 (0.3)	8 (2.7)	22 (7.3)
Low	1075	69 (6.4)	4 (0.4)	7 (0.7)	6 (0.6)	1 (0.1)	1 (0.1)	1 (0.1)	89 (8.3)
All	2075	72 (3.5)	19 (0.9)	8 (0.4)	15 (0.7)	7 (0.3)	7 (0.3)	44 (2.1)	172 (8.3)

3.2.3 Minnow Traps

During the present study 18 minnow traps were deployed overnight in Columbia Lake for a total sample duration of 375.5 hours (Appendix B, Table B5). In total, 11 fish were captured by minnow traps, comprised of 4 Largemouth Bass, 3 Largemouth Sucker, 2 Prickly Sculpin, 1 Pumpkinseed Sunfish, and 1 Redside Shiner. Given the low numbers of fish captured, in-depth analysis was not conducted on minnow trap data.

3.2.4 Snorkel Surveys

A total of 6 snorkel surveys were completed in Columbia Lake, which resulted in a surveyed area of 3800 m² and 62 fish observed (Appendix B, Table B6). The 62 fish were all observed within one site and were comprised of: 26 Peamouth Chub, 25 Redside Shiner, and 11 Largemouth Bass.

Based on snorkel survey results (Table 4), fish were most abundant in low disturbance sites, but given the low sample size and that all fish were observed in one site (Site 8), more study is required to determine if this trend is significant.

Table 4: Summary of snorkel survey results (with rough abundance/100 m²), Columbia Lake, August 15, 2021.

Disturbance Level	Area (m ²)	LMB	RSC	PCC	All
High	1050				0
Moderate	500				0
Low	2250	11 (0.5)	25 (1.1)	26 (1.2)	62 (2.8)
All	3800	11 (0.3)	25 (0.7)	26 (0.7)	62 (1.6)

4 Discussion

4.1 Lake Windermere

The overall fish species assemblage in Lake Windermere in 2021 was similar to that recorded during the summer of 2007 (McPherson and Hlushak 2008). Species recorded in both years include Mountain Whitefish, Largemouth Bass, Redside Shiner, and Largemouth Sucker (Table 5). During the summer of 2007, 133 Cyprinids were recorded, but not identified to species. It is considered likely that Northern Pikeminnow and Peamouth Chub were among the Cyprinid species recorded in 2007. Additional research is needed to determine if the differences between years was due to natural variation, the primary sample methods used (snorkel surveys in 2007; beach seining in 2021 due to funding restrictions) or represent changes to the species assemblage of Lake Windermere. For example, the difference in the numbers of Northern Pikeminnow and Redside Shiner recorded are not considered to represent a large increase in the Northern Pikeminnow population within the lake from 2007 to 2021, nor a large decrease in Redside Shiner numbers.

Table 5: Summary of fish recorded in Lake Windermere during sampling in the summers of 2007 and 2021.

Species	Scientific Name	Species Type	2007	2021
Largemouth Bass	<i>Micropterus salmoides</i>	Non-native	181 (7.1%)	99 (33.9%)
Mountain Whitefish	<i>Prosopium williamsoni</i>	Native	22 (0.9%)	17 (6.2%)
Burbot	<i>Lota lota</i>	Native		1 (0.4%)
Pumpkinseed Sunfish	<i>Lepomis gibbosus</i>	Non-native	44 (1.7%)	
Northern Pikeminnow	<i>Ptychocheilus oregonensis</i>	Native		133 (40.9%)
Redside Shiner	<i>Richardsonius balteatus</i>	Native	2138 (84.1%)	18 (6.5%)
Peamouth Chub	<i>Mylocheilus caurinus</i>	Native		12 (4.4%)
Largemouth Sucker	<i>Catostomus macrocheilus</i>	Native	3 (0.1%)	15 (5.4%)
Prickly Sculpin	<i>Cottus asper</i>	Native		1 (0.4%)
Cyprinids not identified to species			133 (5.2%)	
Suckers not identified to species			4 (0.2%)	
Sculpin not identified to species			15 (0.6%)	
Total			2540	276

The sculpin that were not identified to species in 2007 are considered likely to be Prickly Sculpin. Pumpkinseed Sunfish were recorded in 2007, but not in 2021, and Burbot were recorded in 2021, but not in 2007. Both species were known to be present within the lake in the other year of study, however.

Based on a literature review of past studies conducted by McPherson and Hlushak (2008), Bull Trout (*Salvelinus confluentus*), Rainbow Trout (*Oncorhynchus mykiss*), Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), and Kokanee (*Oncorhynchus nerka*) were species considered possible to inhabit or use the Lake. None of these species were recorded during the present study. Bull Trout (two observed from the dock near a creek mouth) and Kokanee (about 30 observed from the boat, likely migrating) were observed in the fall of 2007, but Rainbow Trout and

Westslope Cutthroat Trout were not recorded in the summer or fall of 2007. It is anticipated that use of the lake by these species may still occur sporadically, but was likely also limited in the past, especially during the summer, due to high water temperatures. Factors such as competition and predation by non-native sportfish and/or native non-sportfish, habitat limitations, increased angling pressure, urbanization, and increasing water temperatures due to climate change will continue to result in low use of Lake Windermere by these species.

Species that were considered likely to be present in Lake Windermere (McPherson and Hlushak 2008), but were not recorded in 2007 or 2021 included Longnose Sucker (*Catostomus catostomus*), Longnose Dace (*Rhinichthys cataractae*) and Torrent Sculpin (*Cottus rhotheus*). These species are considered possible to use the lake, but likely in low numbers if so. Eastern Brook Trout (*Salvelinus fontinalis*), Chiselmouth Chub (*Acrocheilus alutaceus*), and Lake Chub (*Couesius plumbeus*), were considered unlikely to be present in Lake Windermere based on the literature search and were not recorded in 2007 or 2021.

4.2 Columbia Lake

The overall fish species assemblage in Columbia Lake in 2021 was similar to that recorded during the summer of 2009 (McPherson et al. 2010). Species recorded in both years include Mountain Whitefish, Pumpkinseed Sunfish, Redside Shiner, and Northern Pikeminnow (Table 6). During the summer of 2009, 2108 Cyprinids were recorded, but not identifies to species. It is considered likely that Peamouth Chub were among the Cyprinid species recorded in 2009. As in Lake Windermere, additional research is needed to determine if the differences between years was due to natural variation, the primary sample methods used (snorkel surveys in 2009; beach seining in 2021), differences in areas sampled, or represent changes to the species assemblage of Columbia Lake.

Table 6: Summary of fish recorded in Columbia Lake during sampling in the summers of 2009 and 2021.

Species	Scientific Name	Species Type	2009	2021
Largemouth Bass	<i>Micropterus salmoides</i>	Non-native		87 (35.5%)
Mountain Whitefish	<i>Prosopium williamsoni</i>	Native	21 (0.9%)	19 (7.8%)
Burbot	<i>Lota lota</i>	Native		
Pumkinseed Sunfish	<i>Lepomis gibbosus</i>	Non-native	1 (<0.1%)	9 (3.7%)
Northern Pikeminnow	<i>Ptychocheilus oregonensis</i>	Native	14 (0.6%)	15 (6.1%)
Redside Shiner	<i>Richardsonius balteatus</i>	Native	121 (5.3%)	33 (13.5%)
Peamouth Chub	<i>Mylocheilus caurinus</i>	Native		26 (10.6%)
Largescale Sucker	<i>Catostomus macrocheilus</i>	Native		47 (19.2%)
Prickly Sculpin	<i>Cottus asper</i>	Native		9 (3.7%)
Cyprinids not identified to species			2108 (92.3%)	
Suckers not identified to species			16 (0.7%)	
Sculpin not identified to species			2 (0.1%)	
Total			2283	245

The sculpins that were not identified to species in 2009 are considered likely to be Prickly Sculpin and the suckers were likely Largemouth Sucker. Burbot were not recorded in either study year and Largemouth Bass were recorded in 2021, and in the fall of 2009, but not the summer of 2009. Given that they were recorded in Lake Windermere in the years that they were not in Columbia Lake, it is likely that both species were present in Columbia Lake, but potentially in low numbers and/or during other seasons.

Based on past studies (McPherson et al. 2010), and the similarity and connectivity of Lake Windermere and Columbia Lake, Bull Trout (*Salvelinus confluentus*), Rainbow Trout (*Oncorhynchus mykiss*), Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), and Kokanee (*Oncorhynchus nerka*) were species considered possible to inhabit or use Columbia Lake. These species were not recorded during 2009 or 2021. It is likely that use of the lake by these species may still occur sporadically, but similar to Lake Windermere, factors such as competition and predation by non-native sportfish and/or native non-sportfish, habitat limitations, increased angling pressure, forest harvesting, urbanization, and increasing water temperatures will likely continue to result in low use of Columbia Lake by these species.

Species that were considered likely to be present in Columbia Lake (McPherson et al. 2010), but were not recorded in 2009 or 2021 included Longnose Sucker (*Catostomus catostomus*), Longnose Dace (*Rhinichthys cataractae*) and Torrent Sculpin (*Cottus rhotheus*). These species may use the lake, but likely in low numbers. These three species were also not recorded in Lake Windermere in 2007 or 2021. Eastern Brook Trout (*Salvelinus fontinalis*), Chiselmouth Chub (*Acrocheilus alutaceus*), and Lake Chub (*Couesius plumbeus*), were considered unlikely to be present in Columbia Lake based on past studies. Similar to Lake Windermere, these species were not recorded in Columbia lake in 2009 or 2021.

4.3 Conclusion and Recommendations

Additional research over multiple seasons (and likely years) is required to determine if any of the trends/changes in fish use recorded during the present study represent actual changes versus natural variation, and to properly determine differences in fish use between habitat types and different disturbance levels. It seems clear that the introduction of Largemouth Bass and Pumpkinseed to the system has resulted in changes to the fish assemblage. These species are better suited to warmer waters and may be displacing Salmonids in the lakes. Warmer waters also provide Cyprinids a competitive advantage over Salmonids. In addition to warming waters affecting the fish assemblage of these lakes, other factors such as habitat disturbance, angling pressure, and increasing urbanization also likely play a role.

Recommendations for future studies include:

- Conduct seasonal sampling (spring, summer, fall) using additional methods (e.g., electrofishing, gill nets, hoop traps) over multiple years.
 - This would provide information on fish use of the lakes during different conditions and a more complete picture of overall fish use of the lakes.
- Prior to potential future sampling, conduct an in-depth literature review of previous fisheries studies conducted in the lakes.
 - This would provide a better picture of past fish use and a baseline to which future results could be compared, and direction for future sampling efforts.

5 Literature Cited

Masse and Miller Consulting Ltd. 2005. Windermere lake Water Quality Monitoring Program and Literature Review. Report prepared for the Regional District of East Kootenay, Cranbrook, BC. 55 pp.

McPherson, S. and D. Hlushak. 2008. Windermere Lake Fisheries and Wildlife Habitat Assessment. Consultant report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

McPherson, S., D. Hlushak, I. Adams, and M. Polzin. 2010. Columbia lake Sensitive Habitat Inventory and Mapping. Consultant report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

Appendix A: Lake Windermere

Table A1: Sample site descriptions, Lake Windermere, August 10 to 12, 2021. Sites re-sampled from 2007 study (McPherson and Hlushak 2008).

Site Number	Shore Type	Disturbance Level	General Location
1	modified gravel beach	high	downstream of Copper Point intake
1a	modified low rocky shore	high	Irvine retaining wall
2	modified creek mouth	high	Holland Creek/Lakeview Meadows/Timber Ridge
3	modified cliff/bluff	high	around corner and upstream of Site 2
4	modified sand beach	high	downstream of Windermere
5	vegetated shore	low	upstream of Hidden Bay
5a	vegetated shore	low	Windermere Island
6	creek mouth	low	Windermere Creek/Shadybrook Marina
6a	modified creek mouth	high	Jane Creek/Tretheway Marina
7	wetland	low	outlet of Cool Spring Creek
8	sand beach	moderate	First Nations community upstream of inlet
9	wetland	low	Columbia River inlet
10	modified vegetated shore	moderate	near Rushmere
11	vegetated shore	low	below Sunshine Ranch Park
12	creek mouth	moderate	outlet of Brady Creek
13	creek mouth	moderate	Goldie Creek
14	modified cliff/bluff	high	Fort Point
15	gravel beach	moderate	James Chabot Park

Table A2: Fish captured during sampling on Lake Windermere, 10 to 12 August, 2021.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
1	1a	BS	10-Aug-21	LMB	92	10	2 photos (Largemouth Bass)
2	2	BS	10-Aug-21	NPC	40	< 1	(Northern Pikeminnow)
3	2	BS	10-Aug-21	NPC	36	< 1	
4	2	BS	10-Aug-21	NPC	38	< 1	
5	2	BS	10-Aug-21	NPC	34	< 1	
6	2	BS	10-Aug-21	NPC	32	< 1	
7	2	BS	10-Aug-21	NPC	37	< 1	photo w/ fish 8
8	2	BS	10-Aug-21	NPC	35	< 1	photo w/ fish 7
9	2	BS	10-Aug-21	NPC	35	< 1	
10	2	BS	10-Aug-21	NPC	40	< 1	
11	2	BS	10-Aug-21	NPC	40	< 1	
12	2	BS	10-Aug-21	NPC	30	< 1	
13	2	BS	10-Aug-21	NPC	32	< 1	
14	2	BS	10-Aug-21	NPC	27	< 1	
15	2	BS	10-Aug-21	NPC	30	< 1	
16	2	BS	10-Aug-21	NPC	34	< 1	
17	2	BS	10-Aug-21	NPC	29	< 1	
18	2	BS	10-Aug-21	NPC	27	< 1	
19	2	BS	10-Aug-21	NPC	31	< 1	
20	2	BS	10-Aug-21	NPC	32	< 1	
21	2	BS	10-Aug-21	NPC	29	< 1	
22	2	BS	10-Aug-21	NPC	33	< 1	
23	2	BS	10-Aug-21	NPC	29	< 1	
24	2	BS	10-Aug-21	NPC	31	< 1	
25	2	BS	10-Aug-21	NPC	34	< 1	
26	2	BS	10-Aug-21	NPC	24	< 1	
27	2	BS	10-Aug-21	NPC	36	< 1	
28	2	BS	10-Aug-21	NPC	34	< 1	
29	2	BS	10-Aug-21	NPC	25	< 1	
30	2	BS	10-Aug-21	NPC	26	< 1	
31	2	BS	10-Aug-21	NPC	30	< 1	
32	2	BS	10-Aug-21	NPC	31	< 1	
33	2	BS	10-Aug-21	NPC	36	< 1	
34	2	BS	10-Aug-21	NPC	116	20	
35	2	BS	10-Aug-21	NPC	125	30	photo (11:48)
36	2	BS	10-Aug-21	NPC	110	21	
37	2	BS	10-Aug-21	NPC	115	26	
38	2	BS	10-Aug-21	NPC	105	20	
39	2	BS	10-Aug-21	NPC	130	38	
40	5	BS	10-Aug-21	LMB	60	5	2 photos (14:23); haul 1
41	5	BS	10-Aug-21	LMB	69	6	
42	5	BS	10-Aug-21	LMB	58	4	
43	5	BS	10-Aug-21	LMB	58	3	
44	5	BS	10-Aug-21	LMB	57	4	
45	5	BS	10-Aug-21	LMB	60	3	
46	5	BS	10-Aug-21	LMB	62	4	
47	5	BS	10-Aug-21	LMB	60	3	
48	5	BS	10-Aug-21	LMB	52	4	
49	5	BS	10-Aug-21	LMB	54	3	2 photos (14:42); haul 2
50	5	BS	10-Aug-21	LMB	44	3	
51	5	BS	10-Aug-21	LMB	43	2	
52	5	BS	10-Aug-21	LMB	40	2	
53	5	BS	10-Aug-21	LMB	45	2	
54	5	BS	10-Aug-21	LMB	48	3	

Continued...

Table A2: Continued.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
55	5a	BS	10-Aug-21	NPC	31	< 1	photo (15:35); haul 2
56	5a	BS	10-Aug-21	NPC	29	< 1	
57	5a	BS	10-Aug-21	NPC	40	< 1	
58	5a	BS	10-Aug-21	NPC	36	< 1	
59	5a	BS	10-Aug-21	NPC	30	< 1	
60	5a	BS	10-Aug-21	RSC	50	4	photos (Redside Shiner)
61	15	MT	11-Aug-21	NPC	100	9	
62	15	MT	11-Aug-21	NPC	91	10	
63	1a	MT	11-Aug-21	NPC	320	371	photo (08:13)
64	2	MT	11-Aug-21	BB	145	19	dead, photo (08:26; Burbot)
65	3	MT	11-Aug-21	NPC	65	5	
66	3	MT	11-Aug-21	RSC	58	2	
67	13	BS	11-Aug-21	NPC	35	< 1	
68	13	BS	11-Aug-21	NPC	28	< 1	
69	13	BS	11-Aug-21	NPC	27	< 1	
70	13	BS	11-Aug-21	NPC	30	< 1	
71	13	BS	11-Aug-21	NPC	31	< 1	
72	13	BS	11-Aug-21	NPC	42	< 1	
73	13	BS	11-Aug-21	NPC	31	< 1	
74	13	BS	11-Aug-21	NPC	38	< 1	
75	13	BS	11-Aug-21	CAS	30	< 1	(Prickly Sculpin)
76	6	BS	11-Aug-21	LMB	37	< 1	haul 2
77	6	BS	11-Aug-21	SU	28	< 1	(Sucker Spp.)
78	6	BS	11-Aug-21	LMB	38	< 1	
79	6	BS	11-Aug-21	SU	33	< 1	
80	6	BS	11-Aug-21	SU	34	< 1	
81	6a	BS	11-Aug-21	LMB	60	5	
82	6a	BS	11-Aug-21	LMB	53	4	
83	6a	BS	11-Aug-21	LMB	58	6	
84	6a	BS	11-Aug-21	LMB	58	7	
85	6a	BS	11-Aug-21	LMB	55	5	
86	6a	BS	11-Aug-21	LMB	48	4	
87	6a	BS	11-Aug-21	LMB	48	4	
88	6a	BS	11-Aug-21	LMB	60	6	
89	6a	BS	11-Aug-21	LMB	48	5	
90	6a	BS	11-Aug-21	LMB	55	7	
91	6a	BS	11-Aug-21	LMB	53	4	
92	6a	BS	11-Aug-21	LMB	53	4	
93	6a	BS	11-Aug-21	LMB	70	8	
94	6a	BS	11-Aug-21	LMB	38	2	
95	6a	BS	11-Aug-21	LMB	50	4	
96	6a	BS	11-Aug-21	LMB	64	6	
97	6a	BS	11-Aug-21	LMB	40	3	
98	6a	BS	11-Aug-21	LMB	65	6	
99	6a	BS	11-Aug-21	LMB	65	5	
100	6a	BS	11-Aug-21	LMB	56	3	
101	6a	BS	11-Aug-21	LMB	70	7	
102	6a	BS	11-Aug-21	LMB	46	2	
103	6a	BS	11-Aug-21	LMB	38	1	
104	6a	BS	11-Aug-21	LMB	55	3	
105	6a	BS	11-Aug-21	LMB	60	5	
106	6a	BS	11-Aug-21	LMB	45	2	
107	6a	BS	11-Aug-21	LMB	52	3	
108	6a	BS	11-Aug-21	LMB	36	1	
109	6a	BS	11-Aug-21	LMB	40	1	

Continued...

Table A2: Continued.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
110	6a	BS	11-Aug-21	LMB	50	3	
111	6a	BS	11-Aug-21	LMB	36	1	
112	6a	BS	11-Aug-21	LMB	55	3	
113	6a	BS	11-Aug-21	LMB	52	3	
114	6a	BS	11-Aug-21	LMB	45	2	
115	12	BS	11-Aug-21	LMB	48	2	
116	12	BS	11-Aug-21	LMB	55	3	
117	12	BS	11-Aug-21	LMB	55	4	
118	12	BS	11-Aug-21	LMB	60	4	
119	12	BS	11-Aug-21	NPC	105	15	
120	12	BS	11-Aug-21	NPC	30	< 1	
121	12	BS	11-Aug-21	LMB	68	5	
122	12	BS	11-Aug-21	LMB	70	5	
123	12	BS	11-Aug-21	LMB	61	4	
124	12	BS	11-Aug-21	NPC	70	3	
125	12	BS	11-Aug-21	NPC	28	< 1	
126	12	BS	11-Aug-21	LMB	60	4	
127	12	BS	11-Aug-21	LMB	84	6	
128	12	BS	11-Aug-21	LMB	48	2	
129	12	BS	11-Aug-21	LMB	50	2	
130	12	BS	11-Aug-21	LMB	54	2	
131	12	BS	11-Aug-21	LMB	50	2	
132	12	BS	11-Aug-21	LMB	55	4	
133	12	BS	11-Aug-21	NPC	30	1	
134	12	BS	11-Aug-21	LMB	60	4	
135	12	BS	11-Aug-21	LMB	50	3	
136	12	BS	11-Aug-21	LMB	55	2	
137	12	BS	11-Aug-21	LMB	55	3	
138	12	BS	11-Aug-21	LMB	41	3	
139	12	BS	11-Aug-21	LMB	54	3	
140	12	BS	11-Aug-21	LMB	53	2	
141	12	BS	11-Aug-21	LMB	44	2	
142	12	BS	11-Aug-21	LMB	45	2	
143	12	BS	11-Aug-21	LMB	60	3	
144	12	BS	11-Aug-21	LMB	50	2	
145	12	BS	11-Aug-21	LMB	43	2	
146	7	BS	11-Aug-21	MW	80	7	(Mountain Whitefish)
147	7	BS	11-Aug-21	MW	85	8	photo (13:44)
148	7	BS	11-Aug-21	CSU	102	18	(Largescale Sucker)
149	7	BS	11-Aug-21	MW	75	9	
150	7	BS	11-Aug-21	MW	82	9	
151	7	BS	11-Aug-21	NPC	120	24	
152	7	BS	11-Aug-21	LMB	90	18	
153	7	BS	11-Aug-21	CSU	93	13	
154	7	BS	11-Aug-21	MW	70	6	
155	7	BS	11-Aug-21	NPC	86	11	
156	7	BS	11-Aug-21	LMB	65	10	
157	7	BS	11-Aug-21	MW	72	8	
158	7	BS	11-Aug-21	MW	68	9	
159	7	BS	11-Aug-21	MW	85	9	
160	7	BS	11-Aug-21	MW	70	7	
161	7	BS	11-Aug-21	MW	74	13	
162	7	BS	11-Aug-21	PCC	84	11	photo (13:53; Peamouth Chub)
163	7	BS	11-Aug-21	NPC	30	< 1	
164	7	BS	11-Aug-21	CSU	115	25	

Continued...

Table A2: Concluded.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
165	7	BS	11-Aug-21	PCC	38	< 1	
166	7	BS	11-Aug-21	CSU	99	11	
167	7	BS	11-Aug-21	PCC	83	8	
168	7	BS	11-Aug-21	MW	75	6	
169	7	BS	11-Aug-21	MW	70	5	
170	7	BS	11-Aug-21	LMB	90	11	
171	7	BS	11-Aug-21	PCC	94	11	photo (14:24)
172	7	BS	11-Aug-21	PCC	92	11	
173	7	BS	11-Aug-21	PCC	93	11	2 photos (14:27)
174	7	BS	11-Aug-21	NPC	116	19	
175	7	BS	11-Aug-21	PCC	80	11	
176	7	BS	11-Aug-21	PCC	100	15	
177	7	BS	11-Aug-21	CSU	99	17	
178	7	BS	11-Aug-21	PCC	65	8	
179	7	BS	11-Aug-21	LMB	93	18	
180	7	BS	11-Aug-21	LMB	54	3	
181	7	BS	11-Aug-21	PCC	84	8	
182	7	BS	11-Aug-21	CSU	75	8	
183	11	BS	11-Aug-21	RSC	50	3	photo (14:48)
184	11	BS	11-Aug-21	PCC	86	6	photo (14:49)
185	11	BS	11-Aug-21	NPC	68	4	
186	11	BS	11-Aug-21	RSC	58	3	
187	11	BS	11-Aug-21	RSC	58	4	
188	11	BS	11-Aug-21	RSC	45	2	
189	11	BS	11-Aug-21	MW	68	3	
190	11	BS	11-Aug-21	RSC	38	1	
191	11	BS	11-Aug-21	RSC	60	4	
192	11	BS	11-Aug-21	LMB	60	4	
193	11	BS	11-Aug-21	RSC	55	3	
194	11	BS	11-Aug-21	MW	78	6	
195	11	BS	11-Aug-21	RSC	55	3	
196	11	BS	11-Aug-21	RSC	45	4	
197	11	BS	11-Aug-21	RSC	58	4	
198	11	BS	11-Aug-21	RSC	51	4	
199	11	BS	11-Aug-21	RSC	50	3	
200	11	BS	11-Aug-21	RSC	47	4	
201	11	BS	11-Aug-21	RSC	34	2	
202	8	BS	11-Aug-21	NPC	108	14	
203	8	BS	11-Aug-21	PCC	93	9	photo (15:30)
204	8	BS	11-Aug-21	LMB	71	6	
205	8	BS	11-Aug-21	MW	80	5	
206	8	BS	11-Aug-21	LMB	55		too windy for accurate weight
207	8	BS	11-Aug-21	LMB	41		too windy for accurate weight
208	8	BS	11-Aug-21	LMB	42		too windy for accurate weight
209	8	BS	11-Aug-21	LMB	33		too windy for accurate weight
210	8	BS	11-Aug-21	LMB	34		too windy for accurate weight
211	13	MT	12-Aug-21	NPC	109	13	
212	13	MT	12-Aug-21	NPC	59	2	
213	12	MT	12-Aug-21	NPC	76	5	
214	12	MT	12-Aug-21	NPC	70	4	
215	12	MT	12-Aug-21	NPC	134	26	
216	7	MT	12-Aug-21	NPC	113	15	
217	10	MT	12-Aug-21	RSC	41	4	

Table A3: Water temperature data collected from Lake Windermere, August 10 to 12, 2021.

Site	Date	Time	Temp. (°C)	Notes
5a	10-Aug-21	15:50	20.8	
15	11-Aug-21	07:45	19.7	
1	11-Aug-21	08:00	20.2	
14	11-Aug-21	08:45	20.8	
4	11-Aug-21	09:05	20.9	
5	11-Aug-21	09:20	21.0	
13	11-Aug-21	10:02	19.6	near mouth of Goldie Creek
6	11-Aug-21	10:48	11.5	Windermere Creek temp.
6a	11-Aug-21	11:45	21.9	
12	11-Aug-21	12:45	21.8	
7	11-Aug-21	14:00	23.2	
11	11-Aug-21	15:00	22.2	
8	11-Aug-21	15:25	23.3	
10	11-Aug-21	16:00	21.2	
15	12-Aug-21	07:38	18.4	
	12-Aug-21	07:50	19.5	mid-lake
	12-Aug-21	11:10	20.2	mid-lake
13	12-Aug-21	08:00	19.1	
13	12-Aug-21	08:15	11.0	Goldie Creek temp.
6	12-Aug-21	09:30	17.0	cooler due to creek
6a	12-Aug-21	10:00	19.7	
12	12-Aug-21	10:45	19.5	
7	12-Aug-21	11:40	20.3	
11	12-Aug-21	12:10	20.6	
8	12-Aug-21	12:50	20.5	
10	12-Aug-21	13:25	20.5	
4	12-Aug-21	14:35	22.4	
1a	12-Aug-21	15:15	22.5	

Table A4: Beach Seine sample data, Lake Windermere, 10 - 11 August, 2021.

Site	Area	Date	Time	Length Sampled (m)	Width Sampled (m)	Area Sampled (m ²)	Depth (m)		Substrate		UTMs		Catch Summary ^a								Comments		
							Max.	Mean	Dominant	Sub-dom.	Easting	Northing	LMB	MW	NPC	RSC	CAS	PCC	CSU	ALL			
																				No.		CPUE	
15	James Chabot Park	10-Aug-21	08:25	40	8	320	0.9	0.4	gravel	sand	569256	5595830									0	0.0	2 SU juv. escaped net < 5% aquatic veg
1	Copper Point Intake	10-Aug-21	10:15	20	5	100	1.0	0.3	gravel	sand	569843	5595633									0	0.0	
1a	Irvine Retaining Wall	10-Aug-21	10:45	10	5	50	1.0	0.5	gravel	cobble	570133	5594874	1								1	2.0	
2	Holland Creek/Timber Ridge	10-Aug-21	11:25	30	5	150	1.0	0.4	gravel	sand	570278	5594206			38						38	25.3	
14	Fort Point	10-Aug-21	12:20	15	5	75	0.9	0.4	gravel	sand	569485	5594096									0	0.0	
3	upstream of Timber Ridge	10-Aug-21	13:05	30	5	150	0.8	0.3	gravel	sand	571065	5593497									0	0.0	
5	upstream of Hidden Bay	10-Aug-21	14:20	20	5	100	1.0	0.3	gravel	sand	571416	5590964	9								9	9.0	haul 1
5	upstream of Hidden Bay	10-Aug-21	14:40	20	5	100	1.0	0.3	gravel	sand	571362	5590969	6								6	6.0	haul 2
5a	Windermere Island	10-Aug-21	15:10	30	3	90	1.2	0.4	gravel	silt	571366	5590428									0	0.0	haul 1
5a	Windermere Island	10-Aug-21	15:30	30	3	90	0.7	0.3	gravel	sand	571379	5590443			5	1					6	6.7	haul 2, near bullrushes
13	Goldie Creek	11-Aug-21	09:56	10	5	50	0.5	0.2	sand	gravel	570150	5590728			8		1				9	18.0	
6	Windermere Creek	11-Aug-21	10:50	15	5	75	0.5	0.2	silt	sand	571417	5589942									0	0.0	haul 1
6	Windermere Creek	11-Aug-21	11:00	20	5	100	0.5	0.2	silt	sand	571492	5589910	2							3	5	5.0	haul 2
6a	Jane Creek	11-Aug-21	11:50	20	5	100	0.5	0.2	silt		571907	5589672	34								34	34.0	50% aquatic veg
12	Brady Creek	11-Aug-21	12:45	20	5	100	1.0	0.4	gravel		572184	5588159	26		5						31	31.0	75% aquatic veg
7	Cool Spring Creek	11-Aug-21	14:40	10	10	100	1.1	0.4	clay		573463	5588197	5	12	4			10	6	37	37.0		
11	Sunshine Ranch Park	11-Aug-21	14:40	10	10	100	1.3	0.5	sand	gravel	573332	5686808	1	2	1	14		1			19	19.0	
8	First Nations Community	11-Aug-21	15:20	20	5	100	0.9	0.4	clay		575010	5586461	6	1	1			1			9	9.0	60% aquatic veg
10	Near Rushmere	11-Aug-21	16:00	10	10	100	1.3	0.5	gravel	cobble	574692	5585251									0	0.0	
					Total	2050						Total	90	15	62	15	1	12	9	204	10.0		
												CPUE ^b	4.4	0.7	3.0	0.7	0.05	0.6	0.4				

^a LMB = Largemouth Bass, MW = Mountain Whitefish, NPC = Northern Pikeminnow, RSC = Redside Shiner, CAS = Prickly Sculpin, PCC = Peamouth Chub, CSU = Largesscale Sucker.

^b CPUE = catch-per-unit-effort (number of fish/100 m²).

Table A5: Minnow Trap sample data, Lake Windermere, 10 - 12 August, 2021.

Site	Area	Deployed		Retrieved		Sample Duration (h)	Depth (m)	Water Velocity (m/s)	Substrate		UTMs		Catch Summary ^a			Comments
		Date	Time	Date	Time				Dom	Sub	Easting	Northing	BB	NPC	RSC	
15	James Chabot Park	10-Aug-21	08:17	11-Aug-21	07:47	23.5	0.3	nil	silt	sand	569223	5595751		2		in/near bullrushes
1	Copper Point Intake	10-Aug-21	10:25	11-Aug-21	08:02	21.6	0.3	nil	gravel	cobble	569843	5595615				
1a	Irvine Retaining Wall	10-Aug-21	11:02	11-Aug-21	08:10	21.1	0.4	nil	gravel	cobble	570133	5594868		1		
2	Holland Creek/Timber Ridge	10-Aug-21	11:55	11-Aug-21	08:22	20.4	0.5	nil	sand		570281	5594178	1			in/near bullrushes
14	Fort Point	10-Aug-21	12:25	11-Aug-21	08:40	20.3	0.9	nil	gravel	sand	569485	5594096				
3	upstream of Timber Ridge	10-Aug-21	13:10	11-Aug-21	08:50	19.7	0.5	nil	gravel	sand	571050	5593497		1	1	
4	downstream of Windermere	10-Aug-21	13:54	11-Aug-21	09:05	19.2	0.7	nil	sand	silt	571312	5592632				
5	upstream of Hidden Bay	10-Aug-21	14:30	11-Aug-21	09:16	18.8	0.5	nil	sand	silt	571399	5590964				in/near bullrushes
5a	Windermere Island	10-Aug-21	15:47	11-Aug-21	09:25	17.6	0.4	nil	sand	silt	571344	5590436				in/near bullrushes
13	Goldie Creek	11-Aug-21	10:02	12-Aug-21	07:55	21.9	0.5	nil	gravel		570150	5590728		2		near boulders and aquatic veg
6	Windermere Creek	11-Aug-21	11:17	12-Aug-21	09:06	21.8	0.4	nil	silt		571561	5589890				in/near bullrushes
6a	Jane Creek	11-Aug-21	12:20	12-Aug-21	09:43	21.4	0.3	nil	silt		571914	5589660				aquatic veg
12	Brady Creek	11-Aug-21	13:09	12-Aug-21	10:23	21.2	0.4	nil	silt		572184	5588159		3		aquatic veg
7	Cool Spring Creek	11-Aug-21	14:05	12-Aug-21	11:22	21.3	0.4	nil	clay		573484	5588172		1		in/near bullrushes
11	Sunshine Ranch Park	11-Aug-21	14:59	12-Aug-21	11:59	21.0	0.5	nil	sand	gravel	573332	5686808				near woody debris
8	First Nations Community	11-Aug-21	15:37	12-Aug-21	12:30	20.9	0.4	nil	clay		575014	5586441				in/near bullrushes
10	Near Rushmere	11-Aug-21	16:05	12-Aug-21	13:01	20.9	0.5	nil	gravel	cobble	574708	5585224			1	in/near bullrushes
						Total	352.6					Total	1	10	2	

^a BB = Burbot, NPC = Northern Pikeminnow, RSC = Redside Shiner.

Table A6: Snorkel survey data, Lake Windermere, August 12, 2021.

Site	General Location	Substrate		Aq.	Depth (m)		L (m)	W (m)	Area (m ²)	Number of Fish Observed by Size Class (cm FL) ^a												
				Veg.						LMB		MW		NPC		CSU		RSC		Total		
		Dom.	Sub.	(%)	Mean	Max.				0-10	10-20	0-10	10-20	0-10	10-20	0-10	10-20	0-10	10-20	0-10	10-20	0-20
13	Goldie Creek	sand	gravel	30	0.4	0.9	140	10	1400					5	2					5	2	7
6	Windermere Creek	sand	silt	20	0.3	1.0	50	5	250											0	0	0
6a	Jane Creek	clay	silt	80	0.4	0.7	150	5	750											0	0	0
12	Brady Creek	gravel	sand	70	0.4	1.0	130	5	650					3						3	0	3
7	Cool Spring Creek	clay		75	0.7	0.9	150	5	750	4	2			20	1					24	3	27
11	Sunshine Ranch Park	sand	gravel	10	0.5	1.2	150	5	750					1						1	0	1
8	First Nations community	clay	silt	90	0.4	1.0	200	5	1000	3		2		8		5				18	0	18
10	Near Rushmere	gravel	silt	10	0.7	1.0	200	5	1000							1		1		2	0	2
4	D/S of Windermere	gravel	silt	10	0.5	0.9	100	5	500					1						1	0	1
1a	Irvine Retaining Wall	gravel	cobble	0	0.5	1.2	70	5	350											0	0	0
Total									7400	7	2	2	0	38	3	6	0	1	0	54	5	59

^a FL - fork length, LMB = Largemouth Bass, MW = mountain whitefish, NPC = Northern Pikeminnow, CSU = largescale sucker, RSC = Redside Shiner.

Appendix B: Columbia Lake

Table B1: Sample site descriptions, Columbia Lake, August 13 to 15, 2021.

Site Number	Shore Type	Disturbance Level	General Location
1	silt beach/creek mouth	low	north of Tilly Memorial Park
2	gravel beach	low	north of Mt. Sabine Ecological Reserve
3	gravel beach	moderate	near Columbia Lake Ecological Reserve
4	cliff/bluff, clay beach	low	
5	vegetated shore	low	
6	vegetated shore	low	just south of Armstrong Bay
7	rocky, vegetated shore	low	
8	rocky, vegetated shore	low	
9	rocky, vegetated shore	low	
10	vegetated shore	low	Columbia Lake Prov. Park
11	vegetated shore	low	Columbia Lake Prov. Park
12	rocky beach	high	Riverpark Developments/Marina
13	rocky, vegetated shore	high	Near Timbers Resort
14	rocky, vegetated shore	moderate	
15	rocky beach	high	
16	vegetated shore	high	north of Spirits Reach
17	creek mouth	high	near Spirits Reach
18	gravel beach	moderate	
19	gravel beach, creek mouth	high	Marion Creek mouth
20	gravel beach	high	

Table B2: Fish captured during sampling on Columbia Lake, 13 to 15 August, 2021.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
1	1	BS	13-Aug-21	CAS	82	7	photo (08:35)
2	3	BS	13-Aug-21	PSS	26	< 1	3 photos (09:49-09:54)
3	3	BS	13-Aug-21	CAS	28	< 1	photo (09:56)
4	4	BS	13-Aug-21	RSC	54	3	photo (10:33)
5	4	BS	13-Aug-21	LMB	37	1	photo (10:35)
6	4	BS	13-Aug-21	LMB	38	1	
7	4	BS	13-Aug-21	CSU	35	1	
8	4	BS	13-Aug-21	LMB	42	2	
9	4	BS	13-Aug-21	LMB	42	2	
10	4	BS	13-Aug-21	LMB	29	< 1	
11	6	BS	13-Aug-21	LMB	80	8	
12	6	BS	13-Aug-21	LMB	73	6	
13	7	BS	13-Aug-21	NPC	85	10	
14	7	BS	13-Aug-21	LMB	91	15	
15	7	BS	13-Aug-21	PSS	108	33	3 photos (12:41-12:43)
16	7	BS	13-Aug-21	PSS	116	40	photo (12:45)
17	7	BS	13-Aug-21	PSS	96	25	
18	7	BS	13-Aug-21	PSS	100	23	
19	7	BS	13-Aug-21	PSS	119	46	
20	7	BS	13-Aug-21	PSS	118	46	
21	7	found	13-Aug-21	PCC	144	40	photo (13:46) - found dead
22	10	BS	13-Aug-21	LMB	67	6	
23	10	BS	13-Aug-21	LMB	85	14	
24	10	BS	13-Aug-21	NPC	102	15	
25	10	BS	13-Aug-21	LMB	70	7	
26	10	BS	13-Aug-21	LMB	90	12	
27	10	BS	13-Aug-21	LMB	74	7	
28	10	BS	13-Aug-21	LMB	70	7	
29	10	BS	13-Aug-21	LMB	100	16	
30	10	BS	13-Aug-21	LMB	75	7	
31	10	BS	13-Aug-21	LMB	95	14	
32	10	BS	13-Aug-21	LMB	60	6	
33	10	BS	13-Aug-21	LMB	63	5	
34	10	BS	13-Aug-21	LMB	55	5	
35	10	BS	13-Aug-21	LMB	65	6	
36	10	BS	13-Aug-21	LMB	70	7	
37	10	BS	13-Aug-21	LMB	68	5	
38	10	BS	13-Aug-21	LMB	74	7	
39	10	BS	13-Aug-21	LMB	70	6	
40	10	BS	13-Aug-21	LMB	61	5	
41	10	BS	13-Aug-21	PSS	120	40	
42	10	BS	13-Aug-21	LMB	61	5	
43	10	BS	13-Aug-21	LMB	62	5	
44	10	BS	13-Aug-21	LMB	88	12	
45	10	BS	13-Aug-21	LMB	61	5	
46	10	BS	13-Aug-21	LMB	65	6	
47	10	BS	13-Aug-21	LMB	54	3	
48	10	BS	13-Aug-21	LMB	60	3	
49	10	BS	13-Aug-21	LMB	78	10	
50	10	BS	13-Aug-21	LMB	63	4	
51	10	BS	13-Aug-21	LMB	60	3	
52	10	BS	13-Aug-21	LMB	64	4	
53	11	BS	13-Aug-21	MW	75	4	2 photos (15:51)
54	11	BS	13-Aug-21	NPC	102	12	

Continued...

Table B2: Continued.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
55	11	BS	13-Aug-21	NPC	125	26	p(15:54), missing part of operc.
56	11	BS	13-Aug-21	LMB	80	6	
57	11	BS	13-Aug-21	LMB	90	11	
58	11	BS	13-Aug-21	LMB	89	10	
59	11	BS	13-Aug-21	LMB	88	11	
60	11	BS	13-Aug-21	LMB	85	10	
61	11	BS	13-Aug-21	LMB	73	7	
62	11	BS	13-Aug-21	LMB	71	7	
63	11	BS	13-Aug-21	LMB	80	9	
64	11	BS	13-Aug-21	LMB	85	9	
65	11	BS	13-Aug-21	LMB	62	4	
66	11	BS	13-Aug-21	LMB	54	4	
67	11	BS	13-Aug-21	LMB	75	7	
68	11	BS	13-Aug-21	LMB	70	6	
69	11	BS	13-Aug-21	MW	92	8	
70	11	BS	13-Aug-21	LMB	50	4	
71	11	BS	13-Aug-21	LMB	78	8	
72	11	BS	13-Aug-21	LMB	74	8	
73	11	BS	13-Aug-21	MW	90	9	
74	11	BS	13-Aug-21	LMB	100	15	
75	11	BS	13-Aug-21	NPC	90	9	
76	11	BS	13-Aug-21	LMB	60	5	
77	11	BS	13-Aug-21	LMB	80	9	
78	11	BS	13-Aug-21	MW	75	5	
79	11	BS	13-Aug-21	LMB	80	7	
80	11	BS	13-Aug-21	LMB	45	2	
81	11	BS	13-Aug-21	LMB	52	3	
82	11	BS	13-Aug-21	LMB	72	6	
83	11	BS	13-Aug-21	LMB	40	2	
84	11	BS	13-Aug-21	LMB	85	10	
85	11	BS	13-Aug-21	LMB	50	3	
86	11	BS	13-Aug-21	LMB	55	4	
87	11	BS	13-Aug-21	LMB	35	2	
88	11	BS	13-Aug-21	LMB	49	3	
89	11	BS	13-Aug-21	LMB	41	2	
90	11	BS	13-Aug-21	LMB	48	3	
91	11	BS	13-Aug-21	LMB	52	4	
92	11	BS	13-Aug-21	NPC	134	25	
93	3	MT	14-Aug-21	CAS	60	3	
94	4	MT	14-Aug-21	CAS	55	2	
95	5	MT	14-Aug-21	LMB	60	3	
96	5	MT	14-Aug-21	LMB	40	2	
97	5	MT	14-Aug-21	LMB	38	3	
98	5	MT	14-Aug-21	LMB	36	2	
99	6	MT	14-Aug-21	CSU	42	1	
100	9	MT	14-Aug-21	RSC	71	5	
101	12	BS	14-Aug-21	MW	135	35	
102	12	BS	14-Aug-21	MW	51	2	photo (10:22)
103	12	BS	14-Aug-21	MW	61	3	
104	15	BS	14-Aug-21	MW	85	9	
105	16	BS	14-Aug-21	CSU	47	2	
106	16	BS	14-Aug-21	LMB	45	2	
107	16	BS	14-Aug-21	LMB	96	15	
108	17	BS	14-Aug-21	MW	75	54	
109	17	BS	14-Aug-21	MW	83	8	

Continued...

Table B2: Continued.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
110	17	BS	14-Aug-21	MW	79	9	
111	17	BS	14-Aug-21	MW	80	6	
112	17	BS	14-Aug-21	MW	76	5	
113	17	BS	14-Aug-21	LMB	85	10	
114	17	BS	14-Aug-21	MW	86	6	
115	17	BS	14-Aug-21	NPC	78	6	
116	17	BS	14-Aug-21	MW	73	6	
117	17	BS	14-Aug-21	MW	73	6	
118	17	BS	14-Aug-21	MW	78	8	
119	17	BS	14-Aug-21	CAS	86	12	
120	17	BS	14-Aug-21	CAS	26	< 1	
121	17	BS	14-Aug-21	CAS	28	< 1	
122	17	BS	14-Aug-21	CSU	37	< 1	
123	17	BS	14-Aug-21	CAS	58	3	
124	17	BS	14-Aug-21	CAS	32	< 1	
125	18	BS	14-Aug-21	NPC	125	25	
126	18	BS	14-Aug-21	NPC	95	15	
127	18	BS	14-Aug-21	NPC	145	38	
128	18	BS	14-Aug-21	NPC	92	11	
129	18	BS	14-Aug-21	NPC	93	11	
130	18	BS	14-Aug-21	CSU	51	2	
131	18	BS	14-Aug-21	NPC	124	23	
132	18	BS	14-Aug-21	NPC	90	11	
133	18	BS	14-Aug-21	RSC	55	4	
134	18	BS	14-Aug-21	NPC	95	12	
135	18	BS	14-Aug-21	CSU	54	3	
136	18	BS	14-Aug-21	CSU	45	2	
137	18	BS	14-Aug-21	RSC	45		too windy for weight
138	18	BS	14-Aug-21	CSU	39		too windy for weight
139	18	BS	14-Aug-21	CSU	39		too windy for weight
140	18	BS	14-Aug-21	RSC	46		too windy for weight
141	18	BS	14-Aug-21	CSU	48		too windy for weight
142	18	BS	14-Aug-21	RSC	38		too windy for weight
143	18	BS	14-Aug-21	CSU	45		too windy for weight
144	18	BS	14-Aug-21	CSU	44		too windy for weight
145	18	BS	14-Aug-21	RSC	36		too windy for weight
146	19	BS	14-Aug-21	MW	81	7	
147	19	BS	14-Aug-21	MW	78	6	
148	19	BS	14-Aug-21	CSU	44	2	
149	19	BS	14-Aug-21	NPC	45	1	
150	19	BS	14-Aug-21	CSU	38	1	
151	19	BS	14-Aug-21	RSC	51	2	
152	19	BS	14-Aug-21	CSU	33	1	
153	19	BS	14-Aug-21	CSU	46	2	
154	19	BS	14-Aug-21	CSU	36	1	
155	19	BS	14-Aug-21	CSU	34	1	
156	19	BS	14-Aug-21	CSU	46	2	
157	19	BS	14-Aug-21	CSU	45	2	
158	19	BS	14-Aug-21	CSU	40	2	
159	19	BS	14-Aug-21	CSU	40		too windy for weight
160	19	BS	14-Aug-21	CSU	39		too windy for weight
161	19	BS	14-Aug-21	CSU	47		too windy for weight
162	19	BS	14-Aug-21	CSU	45		too windy for weight
163	19	BS	14-Aug-21	CSU	43		too windy for weight
164	19	BS	14-Aug-21	CSU	44		too windy for weight

Continued...

Table B2: Concluded.

Fish #	Site	Method	Date	Species	Length (mm)	Weight (g)	Comments
165	19	BS	14-Aug-21	CSU	53		too windy for weight
166	19	BS	14-Aug-21	CSU	43		too windy for weight
167	19	BS	14-Aug-21	CSU	50		too windy for weight
168	18	MT	15-Aug-21	CSU	48		too windy for weight
169	18	MT	15-Aug-21	PSS	34		too windy for weight, photo 09:01
170	16	MT	15-Aug-21	CSU	37	1	

Table B3: Water temperature data collected from Columbia Lake, August 13 to 15, 2021.

Site	Date	Time	Temp. (°C)	Notes
1	13-Aug-21	08:30	19.8	
2	13-Aug-21	09:15	20.0	
3	13-Aug-21	10:00	19.6	
4	13-Aug-21	10:30	20.6	
5	13-Aug-21	11:10	20.6	
6	13-Aug-21	12:00	21.2	
7	13-Aug-21	12:45	21.7	
8	13-Aug-21	13:40	22.6	
9	13-Aug-21	14:10	22.6	
	14-Aug-21	08:10	19.2	near Tilly Memorial Park
1	14-Aug-21	08:21	20.5	
2	14-Aug-21	08:37	20.9	
3	14-Aug-21	08:45	20.8	
4	14-Aug-21	09:01	21.2	
5	14-Aug-21	09:13	21.4	
6	14-Aug-21	09:30	21.4	
7	14-Aug-21	09:40	21.3	
8	14-Aug-21	09:49	21.2	
9	14-Aug-21	09:48	21.2	
10	14-Aug-21	10:00	20.9	
12	14-Aug-21	10:30	21.1	
13	14-Aug-21	11:00	21.1	
14	14-Aug-21	11:20	21.4	
15	14-Aug-21	11:45	21.1	
16	14-Aug-21	13:00	21.8	
17	14-Aug-21	13:30	21.5	
18	14-Aug-21	14:00	21.5	
19	14-Aug-21	15:30	21.7	
20	14-Aug-21	16:00	21.7	
	14-Aug-21	16:15	22.3	mid-southern end of lake
	15-Aug-21	08:00	20.0	near Tilly Memorial Park
12	15-Aug-21	10:15	20.6	
13	15-Aug-21	10:00	20.6	
14	15-Aug-21	09:48	20.7	
15	15-Aug-21	09:30	20.8	
16	15-Aug-21	09:14	20.7	
18	15-Aug-21	08:54	20.6	
19	15-Aug-21	08:40	20.6	
20	15-Aug-21	08:30	20.6	
11	15-Aug-21	11:15	21.1	
8	15-Aug-21	12:00	21.1	
16	15-Aug-21	12:45	21.0	
18	15-Aug-21	13:20	21.1	
1	15-Aug-21	14:20	21.6	

Table B4: Beach Seine sample data, Columbia Lake, 13 - 14 August, 2021.

Site	Area	Date	Time	Length Sampled (m)	Width Sampled (m)	Area Sampled (m ²)	Depth (m)		Water Temp. (°C)	Substrate		UTMs		Catch Summary ^a										Comments
							Mean	Max.		Dom.	Sub.	Easting	Northing	LMB	MW	PSS	NPC	RSC	CAS	PCC	CSU	ALL		
1	north of Tilly Memorial Park	13-Aug-21	08:30	10	10	100	0.5	1.3	19.8	silt	gravel	583912	5560581						1				1	aq. veg. 50%
2	N of Mt. Sabine Ecological Res.	13-Aug-21	09:10	25	5	125	0.3	0.7	20.0	gravel		583206	5561509										0	near bullrushes
3	near Col. Lk. Ecological Reserve	13-Aug-21	09:44	20	5	100	0.2	0.4	19.6	gravel	sand	582754	5562350			1			1				2	near bullrushes
4		13-Aug-21	10:26	10	10	100	0.3	0.9	20.6	clay		582695	5563515	5				1				1	7	aq. veg. 20%
5		13-Aug-21	11:14	10	10	100	0.3	1.0	20.6	gravel	silt	582419	5565185										0	near bullrushes
6	just south of Armstrong Bay	13-Aug-21	11:56	10	10	100	0.2	0.4	21.2	clay	gravel	581950	5567277	2									2	
7		13-Aug-21	12:35	10	10	100	0.3	0.5	21.7	gravel	silt	581651	5568264	1		6	1						8	5% AV, near bullrushes
8		13-Aug-21	13:30	20	5	100	0.3	1.0	22.6	gravel	silt	581661	5568935										0	5% AV, near bullrushes
9		13-Aug-21	13:55	10	10	100	0.4	1.1	22.6	gravel	silt	581667	5569000										0	5% AV
10	Columbia Lake Prov. Park	13-Aug-21	14:25	30	5	150	0.4	0.7		silt	gravel	581714	5569365	29		1	1						31	70% AV, near bullrushes
11	Columbia Lake Prov. Park	13-Aug-21	15:43	10	10	100	0.3	0.6		clay	gravel	581660	5570981	32	4		4						40	50% AV, near bullrushes
12	Riverpark Developments/Marina	14-Aug-21	10:20	10	10	100	0.4	1.2	21.1	silt	gravel	580322	5571271		3								3	near bullrushes
13	Near Timbers Resort	14-Aug-21	10:57	10	10	100	0.4	1.0	21.1	silt	gravel	579700	5570727										0	50% AV
14		14-Aug-21	11:20	10	10	100	0.5	1.2	21.4	silt	gravel	579793	5570086										0	30% AV, near bullrushes
15		14-Aug-21	11:40	10	10	100	0.2	0.4	21.1	gravel	silt	579941	5569467		1								1	25% AV, near bullrushes
16	north of Spirits Reach	14-Aug-21	12:55	10	10	100	0.3	0.6	21.8	silt		580133	5567491	2								1	3	50% AV, near bullrushes
17	near Spirits Reach	14-Aug-21	13:27	20	5	100	0.3	0.8	21.5	gravel		580617	5566682	1	9		1		5			1	17	5% AV
18		14-Aug-21	14:07	10	10	100	0.4	1.0	21.5	gravel		581036	5565408				7	5				8	20	near bullrushes
19	Marion Creek mouth	14-Aug-21	15:20	20	5	100	0.3	1.0	21.7	gravel		581686	5561427		2		1	1				33	37	
20		14-Aug-21	16:03	20	5	100	0.5	1.3	21.7	gravel	silt	582162	5559686										0	
					Total	2075							Total	72	19	8	15	7	7	0	44	172		
													CPUE ^b	3.5	0.9	0.4	0.7	0.3	0.3	0.0	2.1	8.3		

^a LMB = Largemouth Bass, MW = Mountain Whitefish, PSS = Pumpkinseed Sunfish, NPC = Northern Pikeminnow, RSC = Redside Shiner, CAS = Prickly Sculpin, PCC = Peamouth Chub, CSU = Largesscale Sucker.

^b CPUE = catch-per-unit-effort (number of fish/100 m²).

Table B5: Minnow Trap sample data, Columbia Lake, 13 - 15 August, 2021.

Site	Area	Deployed		Retrieved		Sample Duration (h)	Depth (m)	Substrate		UTMs		Catch Summary ^a					Comments
		Date	Time	Date	Time			Dom	Sub	Easting	Northing	LMB	PSS	CSU	RSC	CAS	
1	southeast corner of lake	13-Aug-21	08:40	14-Aug-21	08:21	23.7	0.4	gravel	silt	583912	5560581						snake captured - see photos
2		13-Aug-21	09:20	14-Aug-21	08:37	23.3	0.4	gravel		583194	5561515						near bullrushes
3		13-Aug-21	10:00	14-Aug-21	08:45	22.8	0.6	gravel	silt	582754	5562350					1	
4		13-Aug-21	10:43	14-Aug-21	09:01	22.3	0.4	clay		582695	5563515					1	
5		13-Aug-21	11:18	14-Aug-21	09:13	21.9	0.5	gravel	silt	582419	5565185	4					near LWD
6	just south of Armstrong Bay	13-Aug-21	12:04	14-Aug-21	09:30	21.4	0.3	clay	gravel	581916	5567323			1			
7		13-Aug-21	12:53	14-Aug-21	09:40	20.8	0.4	gravel	clay	581651	5568264						near aquatic veg
8		13-Aug-21	13:42	14-Aug-21	09:49	20.1	0.5	silt		581655	5568894						set in LWD
9		13-Aug-21	14:10	14-Aug-21	09:48	19.6	0.5	silt	gravel	581667	5568986				1		set in LWD
10		13-Aug-21	14:52	14-Aug-21	10:00	19.1	0.4	silt	gravel	581714	5569365						near bullrushes
12	Riverpark Developments/Marina	14-Aug-21	10:38	15-Aug-21	10:15	23.6	0.4	gravel		580322	5571271						
13	Near Timbers Resort	14-Aug-21	11:00	15-Aug-21	10:00	23.0	0.3	gravel		579700	5570727						
14		14-Aug-21	11:23	15-Aug-21	09:48	22.4	0.4	gravel	cobble	579793	5570059						near bullrushes
15		14-Aug-21	11:50	15-Aug-21	09:30	21.7	0.6	gravel	silt	579941	5569467						in bullrushes, AV25%
16		14-Aug-21	13:05	15-Aug-21	09:14	20.2	0.4	silt		580133	5567491			1			AV25%
18		14-Aug-21	14:34	15-Aug-21	08:54	18.3	0.3	silt	gravel	581001	5565415		1	1			AV90%
19		14-Aug-21	15:44	15-Aug-21	08:40	16.9	0.3	gravel		581694	5561473						AV10%
20		14-Aug-21	16:09	15-Aug-21	08:30	16.3	1.0	gravel	silt	582162	5559686						AV25%
					Total	377.5					Total	4	1	3	1	2	

^a LMB = Largemouth Bass, PSS = Pumpkinseed Sunfish, CSU = largescale sucker, RSC = Redside Shiner, CAS = Prickly Sculpin.

Table B6: Snorkel survey data, Columbia Lake, August 15, 2021.

Site	General Location	Substrate		Aq.	Depth (m)		L (m)	W (m)	Area (m ²)	Number of Fish Observed by Size Class (cm FL) ^a										
				Veg.						LMB		RSC		PCC			Total			
		Dom.	Sub.	(%)	Mean	Max.				0-10	10-20	0-10	10-20	0-10	10-20	20-30	0-10	10-20	20-30	0-30
12	Riverpark Marina	silt		30	1.0	1.5	50	5	250								0	0	0	0
11	Columbia Lake Prov. Park	silt		20	0.8	1.7	120	5	600								0	0	0	0
8		silt	gravel	50	0.3	0.5	170	5	850	10	1	25		25		1	60	1	1	62
16	north of Spirits Reach	silt	gravel	98	0.5	1.2	160	5	800								0	0	0	0
18		silt	gravel	50	0.5	1.0	100	5	500								0	0	0	0
1	north of Tilly Memorial Park	silt	gravel	50	0.6	1.5	160	5	800								0	0	0	0
Total									3800	10	1	25	0	25	0	1	60	1	1	62

^a FL - fork length, LMB = Largemouth Bass, RSC = Redside Shiner, PCC = Peamouth Chub.