Targeted sampling for Grass Pickerel (*Esox americanus vermiculatus*) and Lake Chubsucker (*Erimyzon sucetta*) in Lyons Creek, Ontario, 2010 and 2013

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Targeted sampling for Grass Pickerel (*Esox americanus vermiculatus*) and Lake Chubsucker (*Erimyzon sucetta*) in Lyons Creek, Ontario, 2010 and 2013

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ABSTRACT

Bowman, L.D., Storey, K.M.J., Barnucz, J.M., and Reid, S.M. 2026. Targeted sampling for Grass Pickerel (*Esox americanus vermiculatus*) and Lake Chubsucker (*Erimyzon sucetta*) in Lyons Creek, Ontario, 2010 and 2013. Can. Data. Rep. Fish. Aquat. Sci. 1476: vii + 30 p.

In 2010 and 2013, surveys were conducted along a 19.4 km reach of Lyons Creek to assess the abundance, distribution, and associated habitat of Grass Pickerel (*Esox americanus vermiculatus*; SARA list, Special Concern) and Lake Chubsucker (*Erimyzon sucetta*; SARA list, Endangered). In 2010, 20 sites were sampled with a straight (2 sites) or bag seine (18 sites). Sampling effort was variable, between two and five hauls at each site. In 2013, 16 sites were resampled with five consecutive hauls of a bag seine. In 2010, 19,399 individuals were caught, representing 23 species. Grass Pickerel was detected at 20% of sites and Lake Chubsucker was detected at 25% of sites. In 2013, 1,717 individuals were caught, representing 20 species. Grass Pickerel was detected at 19% of sites and Lake Chubsucker was detected at 25% of sites. Most sites with Grass Pickerel and Lake Chubsucker had more than 50% aquatic vegetation cover (emergent and submergent vegetation). Based on the 5-haul removal sampling dataset (n = 19), 58% of species detections occurred during the first haul. Detection of Grass Pickerel always occurred in the first two hauls; however, Lake Chubsucker was more difficult to detect with 40% of detections occurring on the final haul.

RÉSUMÉ

Bowman, L.D., Storey, K.M.J., Barnucz, J.M., and Reid, S.M. 2026. Targeted sampling for Grass Pickerel (*Esox americanus vermiculatus*) and Lake Chubsucker (*Erimyzon sucetta*) in Lyons Creek, Ontario, 2010 and 2013. Can. Data. Rep. Fish. Aquat. Sci. 1476: vii + 30 p.

En 2010 et 2013, des relevés ont été effectués le long d'un tronçon de 19,4 km du ruisseau Lyons afin d'évaluer l'abondance, la répartition et l'habitat connexe du brochet vermiculé (*Esox americanus vermiculatus;* espèce inscrite sur la liste de la LEP comme étant préoccupante) et du sucet de lac (*Erimyzon sucetta*; espèce inscrite sur la liste de la LEP comme étant en voie de disparition). En 2010, 20 sites ont été échantillonnés à l'aide d'une senne droite (2 sites) ou d'une senne avec poche (18 sites). L'effort d'échantillonnage était variable, entre deux et cinq traits à chaque site. En 2013, 16 sites ont été échantillonnés de nouveau avec cinq traits consécutifs à l'aide d'une senne avec poche. En 2010, 19 399 individus appartenant à 23 espèces ont été capturés. Le brochet vermiculé a été détecté dans 20 % des sites, et le sucet de lac a été détecté dans 25 % des sites. En 2013, 1 717 individus appartenant à 20 espèces ont été capturés. Le brochet vermiculé a été détecté dans 19 % des sites, et le sucet de lac a été détecté dans 25 % des sites. Dans la plupart des sites abritant le brochet vermiculé et le sucet de lac, la couverture végétale aquatique (végétation émergente et submergée) était supérieure à 50 %. D'après l'ensemble de données d'échantillonnage des prélèvements de 5 relevés (n = 19), 58 % des espèces ont été détectées lors du premier trait. La détection du brochet vermiculé a toujours eu lieu dans les deux premiers traits, tandis que le sucet de lac était plus difficile à détecter; 40 % des détections ayant lieu lors du dernier trait.

INTRODUCTION

Fisheries and Oceans Canada (DFO) has the responsibility to provide for the protection and recovery of fishes listed under the Species at Risk Act (SARA). To inform scientific aspects of the recovery process, DFO regularly conducts field sampling to satisfy research objectives for SARA-listed fishes, such as evaluating the distribution and abundance of species, determining species–habitat relationships, and understanding the influence of threats and recovery actions. DFO data reports are published to support the Species at Risk Program by providing an overview of field activities and to provide a medium for archiving data associated with sampling SARA-listed fishes and their habitat.

This data report summarizes targeted field sampling by DFO in 2010 and Ontario Ministry of Natural Resources (MNR) in 2013 to better understand the distribution and abundance of Grass Pickerel (*Esox americanus vermiculatus*; SARA list, Special Concern) and Lake Chubsucker (*Erimyzon sucetta*; SARA list, Endangered) in Lyons Creek, Ontario. Threats affecting both species include degradation and loss of wetland habitats, increased sediment and nutrient inputs, invasive species, and climate change (Staton et al. 2010; Beauchamp et al. 2012). Lyons Creek is affected by legacy polychlorinated biphenyl (PCB) contamination. Contamination issues were identified in the 1990s as part of the Niagara River Remedial Action Plan. Options for site remediation have been developed for the reach where Grass Pickerel and Lake Chubsucker reside (from the Welland Canal to Buchner Road; Geosyntec Consultants 2025). A multi-haul seining strategy was used to sample Lyons Creek sites, supporting an assessment of Lake Chubsucker population status (DFO 2023) and the identification of Lake Chubsucker critical habitat (Staton et al. 2010). Results complement earlier Grass Pickerel and Lake Chubsucker detections by DFO and MNR with multi-gear fish sampling of Lyons Creek from the clear-water overflow of the Welland Ship Canal downstream to the Welland River (Marson et al. 2009; Yagi and Blott 2012).

Data presented in this report support the following priority conservation measures identified in the Recovery Strategy for Lake Chubsucker in Canada (Staton et al. 2010): “Conduct targeted surveys for undetected populations in high probability areas with suitable habitat. Areas to target would include tributaries of the upper Niagara River”; and in the Management Plan for Grass Pickerel in Canada (Beauchamp et al. 2012): “Conduct background surveys to confirm current distribution at sites of known occurrence, including sites that have not been recently sampled”. Results will also inform future fish sampling efforts needed to assess the status of Lake Chubsucker in Lyons Creek (DFO 2025).

METHODS

Study Sites

In 2010, 20 sites were sampled from June 7 to 10 and on August 10. In 2013, 16 sites were resampled from June 3 to 5. Site selection was targeted. Targeted sampling refers to non-random sampling of habitats, thought to contain target species based on past sampling (Marson et al. 2009) and known habitat associations (little flow, dense aquatic vegetation, and low turbidity). Site locality information is presented in Figures 1 and 2 and Table 1. Sites were distributed over a 19.4 km stretch of Lyons Creek. Sites sampled in 2013 were repeat samples of 2010 sites (Appendix 1).

Fish Assemblage Sampling

Fishes were collected using a 9 x 1.8 m bag (1.8 x 1.8 m) seine with a mesh size of 3 mm or a 1.8 x 23 m straight seine with a mesh size of 3 mm. In 2010, sampling was done with a straight seine at 2 sites and a bag seine at 18 sites. Fishes were collected using two (2 sites), three (15 sites), or five (3 sites) hauls of a seine net, for a total of 64 hauls (n = 20 sites). Hauls were done in an upstream to downstream manner at different points (n = 4 sites) or over the same area (n = 16 sites). In 2013, all sampling was conducted using five consecutive hauls of a bag seine over the same area, for a total of 80 hauls (n = 16 sites). Between each haul, a minimum of five minutes elapsed. Sampling designs with three or more repeated seine hauls have been shown to detect > 90% of wetland species in Great Lakes coastal wetlands and are more efficient than increasing the number of sites sampled with a single haul (Samarasin et al. 2016) when the objective is to estimate species richness. Sampling methods for each site are presented in Table 1.

Fishes were sampled at closed (n = 30) or open (n = 6) sites. An open site approach was only used in 2010 (LC15 to LC20). At closed sites, an enclosure was made using a 1.8-m deep and 22.9-m long seine net with a mesh size of 3 mm. In 2013, the dimensions of enclosures were measured. Mean area of closed sites was 47 m^2, ranging from 15 to 100 m^2.

After each haul, all fishes captured were counted, identified to species, and released outside of the enclosure for closed sites or released after all hauls had been completed for open sites. Minimum and maximum total lengths (mm TL) of each species were measured, except for species-at-risk where individual lengths were recorded. At sites LC13, LC18, and LC20, only minimum and maximum total lengths of Grass Pickerel and Lake Chubsucker were measured.

Habitat Sampling

During each sampling event, the following habitat characteristics were measured at each site. Water quality including conductivity (µS/cm), dissolved oxygen (mg/L), pH, and water temperature (°C) were measured using a hand-held water quality meter; and water clarity (m) using a Secchi tube. These metrics were measured either within the sampling enclosure or adjacent to the enclosure, prior to fish sampling. Air temperature and dissolved oxygen were measured in 2010 only. At each site, water depth, substrate, and aquatic vegetation coverage were measured after fish sampling. Depth was measured at three locations and averaged to produce a mean site depth. Substrate type was visually classified based on particle size using the Wentworth scale (Wentworth 1922) and recorded as the percentage of silt, clay, organic, rubble, cobble, sand, boulder, bedrock, hardpan, and concrete. The percent composition of different aquatic vegetation types (submerged, emergent, and floating) was visually assessed. Habitat without vegetation was recorded as open water.

Sampling Permits and Data Archiving

Sampling was conducted under the authority of SARA Permit Numbers SECT 73 SARA C&A 10-015 and 13-015. Data associated with this report may be obtained by contacting the MNR Aquatic Endangered Species Lab.

RESULTS

Habitat characteristics are presented in Table 2 and Appendices 2–7. Fish sampling results can be found in Tables 3–4, Figures 3–9, and Appendices 8–10. Pooled refers to data that combined all five-seine hauls and excludes the data from 2010 where five-seine hauls were not performed. Fish count data includes all individuals captured; species detection/richness data does not include species identified only to genus or hybrids. Common and scientific names for all fishes are provided in Tables 3 and 4.

Habitat

In 2010, habitat sampling was done at all 20 Lyons Creek sites (LC1–LC20). Air temperature ranged from 13.4–32.7 °C (mean: 21.4 °C; Appendix 2). Water temperature ranged from 15.5–25.5 °C (mean: 20.5 °C). Conductivity ranged from 284–430 µS (mean: 322 µS). Dissolved oxygen ranged from 2.0–14.7 mg/L (mean: 8.1 mg/L). The pH ranged from 7.0–8.4 (mean: 7.8). Mean site depth, taken from three depth measurements at each site, ranged from 0.3–1.7 m with an overall mean of 0.7 m. For 17 sites, water clarity ranged from 0.2–0.9 m (mean: 0.4 m); water clarity was not measured at LC18, LC19, and LC20. Abiotic habitat characteristics of sites sampled in 2010 are provided in Appendix 2.

In 2010, the dominant substrate type was organic which ranged from 0–100% (mean: 61%). Silt ranged from 0–95% (mean: 15%), gravel ranged from 0–60% (mean: 8%), cobble ranged from 0–70% (mean: 7%), concrete ranged from 0–100% (mean: 5%), clay ranged from 0–40% (mean: 2%), and sand ranged from 0–15% (mean: 1%; Appendix 3). The dominant aquatic vegetation cover type was open water, which ranged from 0–100% (mean: 44%). Submerged cover ranged from 0–90% (mean: 33%), emergent macrophyte cover ranged from 0–75% (mean: 20%), and floating cover ranged from 0–40% (mean: 4%; Appendix 5). Eight aquatic macrophyte taxa were identified. The most abundant taxon was white water lily (*Nymphaea odorata*), listed as "dominant" at seven sites (LC1, LC9, LC10, LC11, LC12, LC18, and LC20). Other taxa noted included members of bulrush (*Cyperaceae*) and emergent grass (*Poaceae*) families, coontail (*Ceratophyllum demersum*), marsh spike-rush (*Eleocharis palustris*), milfoil (*Myriophyllum* sp.), and pondweed (*Potamogeton* spp.).

In 2013, habitat was characterized at 16 sites (LC21–LC36). Water temperature ranged from 15.6–23.7 °C (mean: 18.9 °C). Conductivity ranged from 150–197 µS (mean: 174 µS). The pH ranged from 7.8–8.6 (mean: 7.7). The mean site depth, taken from three depth measurements at each site, ranged from 0.2–0.7 m with a grand mean of 0.4 m. Water clarity ranged from 0.2–0.9 m (mean: 0.4 m). Abiotic habitat characteristics of sites sampled in 2013 can be found in Appendix 2.

At the 16 sites sampled in 2013, the dominant substrate type was organic, which ranged from 5–90% (mean: 39%). Clay ranged from 0–70% (mean: 25%), silt ranged from 0–50% (mean: 18%), gravel ranged from 0–60% (mean: 10%), cobble ranged from 0–90% (mean: 7%), sand ranged from 0–10% (mean: 0.6%), and boulder ranged from 0–5% (mean: 0.3%; Appendix 4). The dominant vegetation cover type was open water, which ranged from 0–100% (mean: 60%). Submerged cover ranged from 0–90% (mean: 30%), emergent macrophyte cover ranged from 0–30% (mean: 11%), and floating cover was not present (Appendix 6). Six aquatic macrophyte taxa were identified. One site had no vegetation (LC26) and four sites had no recorded macrophyte data (LC27, LC32, LC34, and LC36). The most abundant type was milfoil (*Myriophyllum* sp.) listed as "dominant" at five sites (LC23, LC24, LC25, LC29, and LC30). Other taxa that were present but not necessarily dominant included arrowhead (*Sagittaria* spp.), members of the emergent grasses family, marsh spike-rush, narrow-leaved cattail (*Typha angustifolia*), and pondweed.

Abiotic and biotic habitat characteristics where Lake Chubsucker and Grass Pickerel were collected are presented in Table 2. Twelve of the sites where these species were captured had more than 50% vegetation cover, with a mix of emergent and submergent vegetation (Appendices 5 and 6). Representative site photos are shown in Appendix 7.

Fish Assemblages

Across all 36 sampling events, 21,116 individuals were collected and 24 species were detected. Lyons Creek sites were sampled with a total of 131 seine hauls. A total of 16 Grass Pickerel and 18 Lake Chubsucker were collected. Four recreationally important species [Black Crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Largemouth Bass (*Micropterus nigricans*), and Yellow Perch (*Perca flavescens*)] were collected. Two invasive species [Goldfish (*Carassius auratus*) and Round Goby (*Neogobius melanostomus*)] were collected. The most abundant species were Bluntnose Minnow (*Pimephales notatus*), Emerald Shiner (*Notropis atherinoides*), and Pumpkinseed (*Lepomis gibbosus*) (Figure 3).

In 2010, a total of 19,399 individuals representing 23 species were captured from 20 sites (Appendix 8). The most abundant and widespread species were Bluntnose Minnow (84% of overall catch, occurred at 90% of sites), Golden Shiner (*Notemigonus crysoleucas*; 10.9% of overall catch, occurred at 90% of sites*)*, and Pumpkinseed *(*1.4% of overall catch, occurred at 95% of sites) (Table 3).

In 2013, 1,717 individuals representing 20 species were captured from 16 sites (Appendix 9). The most abundant and widespread species were Emerald Shiner (77.9% of overall catch, occurred at 56.3% of sites), Bluntnose Minnow (10% of overall catch, occurred at 90% of sites), Golden Shiner (10.9% of overall catch, occurred at 69% of sites*)*, and Pumpkinseed (3.3% of overall catch, occurred at 56% of sites). Relative abundance and frequency of occurrence of all species captured in 2013 can be found in Table 4. Species count per site can be found in Appendix 9.

In 2010, 13 Grass Pickerel and 13 Lake Chubsucker were collected (Appendix 8). In 2013, three Grass Pickerel and five Lake Chubsucker were collected (Appendix 9). Grass Pickerel was detected in 20% of Lyons Creek sites (n = 4) in 2010 and 19% of sites (n = 3) in 2013. Lake Chubsucker was detected in 35% of Lyons Creek sites (n = 7) in 2010 and 25% of sites (n = 4) in 2013. Grass Pickerel was captured in 2013 at 75% of 2010 collection sites, and Lake Chubsucker was captured at 29% of 2010 collection sites. Sites where wetland species-at-risk were collected are presented in Figures 1 and 2. In 2010, Grass Pickerel measured between 83 and 234 mm TL and Lake Chubsucker measured between 51 and 76 mm TL. In 2013, Grass Pickerel measured between 131 and 166 mm TL and Lake Chubsucker measured between 58 and 165 mm TL. The length–frequency distribution for Lake Chubsucker is presented in Figure 4.

Six fish species [Black Crappie, Emerald Bowfin (*Amia calva*), Fathead Minnow (*Pimephales promelas*), Goldfish, Iowa Darter (*Etheostoma exile*), and White Sucker (*Catostomus commersonii*)] were only detected in 2010. Mimic Shiner (*Paranotropis volucellus)* was detected in 2013, but not during previous surveys (2004, 2008, 2009, and

2010; Appendix 10). Eleven species detected during previous multi-gear surveys of Lyons Creek were not detected in 2010 and 2013. Some notable absences include Golden Redhorse (*Moxostoma erythrurum*), Greater Redhorse (*M. valenciennesi*), Northern Pike (*Esox lucius*), and Rudd (*Scardinius erythrophthalmus*). Species list differences likely reflect differences in sampling methods and the distribution of sites along Lyons Creek.

A declining trend in catch and species detection was observed after the first seine haul (Figures 5–7). An average of 62 individuals were captured with the first haul,15 individuals in the second haul, four individuals in the third haul, 13 individuals in the fourth haul, and two individuals in the last haul (Figure 5). Forty-seven percent of the last seine haul did not collect any fish and 21% collected no more than a single individual. The maximum number of fish collected on the last haul was 13. On average, the first haul detected four species, two species were detected from each of the second and fourth hauls, and a single species was detected from each of the third and fifth hauls (Figure 6). After the first haul, the average number of newly detected species was less than one (Figure 7).

Compared to a one-haul sampling strategy, species accumulation curves indicate that multiple seine hauls increase the rate of species detection and increase the total number of species detected (Figure 8). While 58% of species detections occurred during the first haul, 16% required a second haul, 14% required a third haul, 8% required a fourth haul, and 2% of detections required a fifth haul. There was little difference between species detection rates associated with three-haul and five-haul repeat seining; both levels of sampling effort detecting an equal species number after 16 sites.

While one or two seine hauls were sufficient to detect many species (including Grass Pickerel), reliable detection of five species required more sampling effort. Eighty percent of Lake Chubsucker detections occurred after the second seine haul. Other species often requiring at least three seine hauls for detection were Central Mudminnow (*Umbra limi*), Green Sunfish (*Lepomis cyanellus*), Johnny Darter (*Etheostoma nigrum*), and Tadpole Madtom (*Noturus gyrinus*) (Figure 9).

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TABLES

Table 1. Summary of site location details, sampling effort (number of hauls), and sampling gear during targeted sampling of Lyons Creek sites in 2010 and 2013. Sites where seine hauls were performed at different spatial locations are identified by an asterisk.

Site code	Detailed site code	Date	Latitude	Longitude	Haul #	Gear
LC1	PDAH-LCS-2010-070610-010A	06/07/2010	42.98036	-79.20615	5	Bag seine
LC2	PDAH-LCS-2010-070610-019A	06/07/2010	42.98026	-79.20566	3	Bag seine
LC3	PDAH-LCS-2010-080610-002A	06/08/2010	42.97642	-79.21863	3	Bag seine
LC4	PDAH-LCS-2010-080610-003A	06/08/2010	42.97675	-79.21658	3	Bag seine
LC5	PDAH-LCS-2010-080610-004A	06/08/2010	42.97667	-79.21504	5	Bag seine
LC6	PDAH-LCS-2010-080610-006A	06/08/2010	42.97767	-79.21152	5	Bag seine
LC7	PDAH-LCS-2010-080610-008A	06/08/2010	42.97738	-79.20811	3	Bag seine
LC8	PDAH-LCS-2010-090610-011A	06/09/2010	42.97595	-79.2189	3	Bag seine
LC9	PDAH-LCS-2010-090610-014A	06/09/2010	42.97663	-79.21339	3	Bag seine
LC10	PDAH-LCS-2010-090610-015A	06/09/2010	42.97732	-79.21149	3	Bag seine
LC11	PDAH-LCS-2010-090610-016A	06/09/2010	42.97711	-79.20955	3	Bag seine
LC12	PDAH-LCS-2010-090610-017A	06/09/2010	42.97716	-79.20751	3	Bag seine
LC13	PDAH-LCS-2010-100610-001A	06/10/2010	42.97399	-79.22046	3	Straight seine
LC14	PDAH-LCS-2010-100610-002A	06/10/2010	42.9755	-79.219	3	Straight seine
LC15	PDAH-LCS-2010-110810-001	08/11/2010	43.04975	-79.06368	3	Bag seine
LC16*	PDAH-LCS-2010-110810-002	08/11/2010	43.0073	-79.11853	3	Bag seine
LC17*	PDAH-LCS-2010-110810-003	08/11/2010	42.99789	-79.14345	3	Bag seine
LC18*	PDAH-LCS-2010-110810-004	08/11/2010	42.98429	-79.20025	3	Bag seine
LC19*	PDAH-LCS-2010-110810-005	08/11/2010	42.99324	-79.18461	2	Bag seine
LC20*	PDAH-LCS-2010-110810-006	08/11/2010	42.99655	-79.16404	2	Bag seine
LC21	2013_LyonsCreek_030613_001A	06/03/2013	42.97399	-79.22046	5	Bag seine
LC22	2013_LyonsCreek_030613_002A	06/03/2013	42.98429	-79.20025	5	Bag seine

Table 1 (continued)

LC23	2013_LyonsCreek_040613_001A	06/04/2013	42.98026	-79.20615	5	Bag seine
LC24	2013_LyonsCreek_040613_001B	06/04/2013	42.98026	-79.20566	5	Bag seine
LC25	2013_LyonsCreek_040613_002A	06/04/2013	42.97738	-79.20811	5	Bag seine
LC26	2013_LyonsCreek_040613_002B	06/04/2013	42.97716	-79.20751	5	Bag seine
LC27	2013_LyonsCreek_040613_003A	06/04/2013	42.97711	-79.20955	5	Bag seine
LC28	2013_LyonsCreek_040613_003B	06/04/2013	42.97732	-79.21149	5	Bag seine
LC29	2013_LyonsCreek_040613_004A	06/04/2013	42.97767	-79.21152	5	Bag seine
LC30	2013_LyonsCreek_040613_004B	06/04/2013	42.97663	-79.21339	5	Bag seine
LC31	2013_LyonsCreek_040613_005A	06/04/2013	42.97667	-79.21504	5	Bag seine
LC32	2013_LyonsCreek_050613_001A	06/05/2013	43.04975	-79.06368	5	Bag seine
LC33	2013_LyonsCreek_050613_002A	06/05/2013	43.0073	-79.11853	5	Bag seine
LC34	2013_LyonsCreek_050613_003A	06/05/2013	42.99789	-79.14345	5	Bag seine
LC35	2013_LyonsCreek_050613_004A	06/05/2013	42.9755	-79.219	5	Bag seine
LC36	2013_LyonsCreek_050613_005A	06/05/2013	42.97642	-79.21863	5	Bag seine

Table 2. Summary of habitat characteristics at Lyons Creek sites where Grass Pickerel (*Esox americanus vermiculatus*) and Lake Chubsucker *(Erimyzon sucetta*) were collected in 2010 and 2013. Water clarity, air and water temperatures, and conductivity are presented as mean values. For comparison, habitat characteristics at sites where each species was not detected are provided.

Year	Lake Chubsucker present	Grass Pickerel present
2010	0.3–1.2 m depth	0.7–1.2 m depth
	0.36 m clarity	1.04 m clarity
	17.1 °C air temperature	29.8 °C air temperature
	17.4 °C water temperature	24.8 °C water temperature
	331 µS/cm	317 µS/cm
	7.67-8.39 pH	6.98-7.75 pH
	organic substrate	silt substrate
	open water, submerged vegetation cover	submerged vegetation cover
	bulrush family, coontail, marsh spike-rush, milfoil sp., white water lily	bulrush family, coontail, milfoil sp., pondweed spp., white water lily
2013	0.3–0.7 m depth	0.3–0.6 m depth
	0.43 m clarity	0.49 m clarity
	18.2 °C water temperature	20.8 °C water temperature
	171 µS/cm	177 µS/cm
	7.94–8.18 pH	7.83–8.31 pH
	organic substrate	organic and clay substrate
	submerged vegetation cover	open water
	milfoil sp., narrow-leaved cattail	emergent grasses, milfoil sp.
	Lake Chubsucker not detected	**Grass Pickerel not detected**
2010	0.33–1.7 m depth	0.30–1.7 m depth
	0.31 m clarity	0.33 m clarity
	18.6 °C air temperature	17.9 °C air temperature
	19.1 °C water temperature	18.4 °C water temperature
	320 µS/cm	324 µS/cm
	7.48–8.34 pH	7.48–8.39 pH
	organic substrate	organic substrate
	open water, submerged vegetation cover	open water
	bulrush family, white water lily	bulrush family, white water lily
2013	0.20–0.66 m depth	0.21–0.66 m depth
	0.40 m clarity	0.39 m clarity
	19.2 °C water temperature	18.5 °C water temperature
	175 µS/cm	173 µS/cm
	7.83–8.58 pH	7.84–8.58 pH
	organic substrate	organic substrate
	open water	open water
	milfoil sp.	narrow-leaved cattail, milfoil sp.

Table 3. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Lyons Creek in 2010, calculated from pooled (combined hauls only from sites where 5 hauls were completed) catch data. Species are listed in order from most to least abundant.

Common name	Scientific name	Relative abundance	Frequency of occurrence
Bluntnose Minnow	*Pimephales notatus*	84.00	90
Golden Shiner	*Notemigonus crysoleucas*	10.99	90
Pumpkinseed	*Lepomis gibbosus*	1.37	95
Largemouth Bass	*Micropterus nigricans*	0.76	60
Round Goby	*Neogobius melanostomus*	0.49	20
White Sucker	*Catostomus commersonii*	0.48	45
Emerald Shiner	*Notropis atherinoides*	0.40	20
Tadpole Madtom	*Noturus gyrinus*	0.29	55
Rock Bass	*Ambloplites rupestris*	0.28	40
Bluegill	*Lepomis macrochirus*	0.19	40
Green Sunfish	*Lepomis cyanellus*	0.18	45
Johnny Darter	*Etheostoma nigrum*	0.13	20
Fathead Minnow	*Pimephales promelas*	0.13	10
Lake Chubsucker	*Erimyzon sucetta*	0.07	35
Grass Pickerel	*Esox americanus vermiculatus*	0.07	20
Iowa Darter	*Etheostoma exile*	0.04	5
Central Mudminnow	*Umbra limi*	0.04	20
Yellow Perch	*Perca flavescens*	0.03	10
Goldfish	*Carassius auratus*	0.03	25
Spottail Shiner	*Hudsonius hudsonius*	0.02	5
Black Crappie	*Pomoxis nigromaculatus*	0.02	15
Brown Bullhead	*Ameiurus nebulosus*	0.01	5
Emerald Bowfin	*Amia calva*	0.01	5

Table 4. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Lyons Creek in 2013, calculated from pooled (all hauls combined) catch data. Species are listed in order from most to least abundant.

Common name	Scientific name	Relative abundance	Frequency of occurrence
Emerald Shiner	*Notropis atherinoides*	77.86	56.25
Bluntnose Minnow	*Pimephales notatus*	10.80	68.75
Pumpkinseed	*Lepomis gibbosus*	3.30	56.25
Round Goby	*Neogobius melanostomus*	2.34	25
Bluegill	*Lepomis macrochirus*	1.92	31.25
Largemouth Bass	*Micropterus nigricans*	0.77	43.75
Rock Bass	*Ambloplites rupestris*	0.66	18.75
Tadpole Madtom	*Noturus gyrinus*	0.48	37.5
Lake Chubsucker	*Erimyzon sucetta*	0.30	25
Johnny Darter	*Etheostoma nigrum*	0.30	18.75
Green Sunfish	*Lepomis cyanellus*	0.30	18.75
Central Mudminnow	*Umbra limi*	0.24	25
Golden Shiner	*Notemigonus crysoleucas*	0.19	12.5
Grass Pickerel	*Esox americanus vermiculatus*	0.18	18.75
Spottail Shiner	*Hudsonius hudsonius*	0.18	6.25
Brown Bullhead	*Ameiurus nebulosus*	0.06	6.25
Mimic Shiner	*Paranotropis volucellus*	0.06	6.25
Yellow Perch	*Perca flavescens*	0.06	6.25

FIGURES

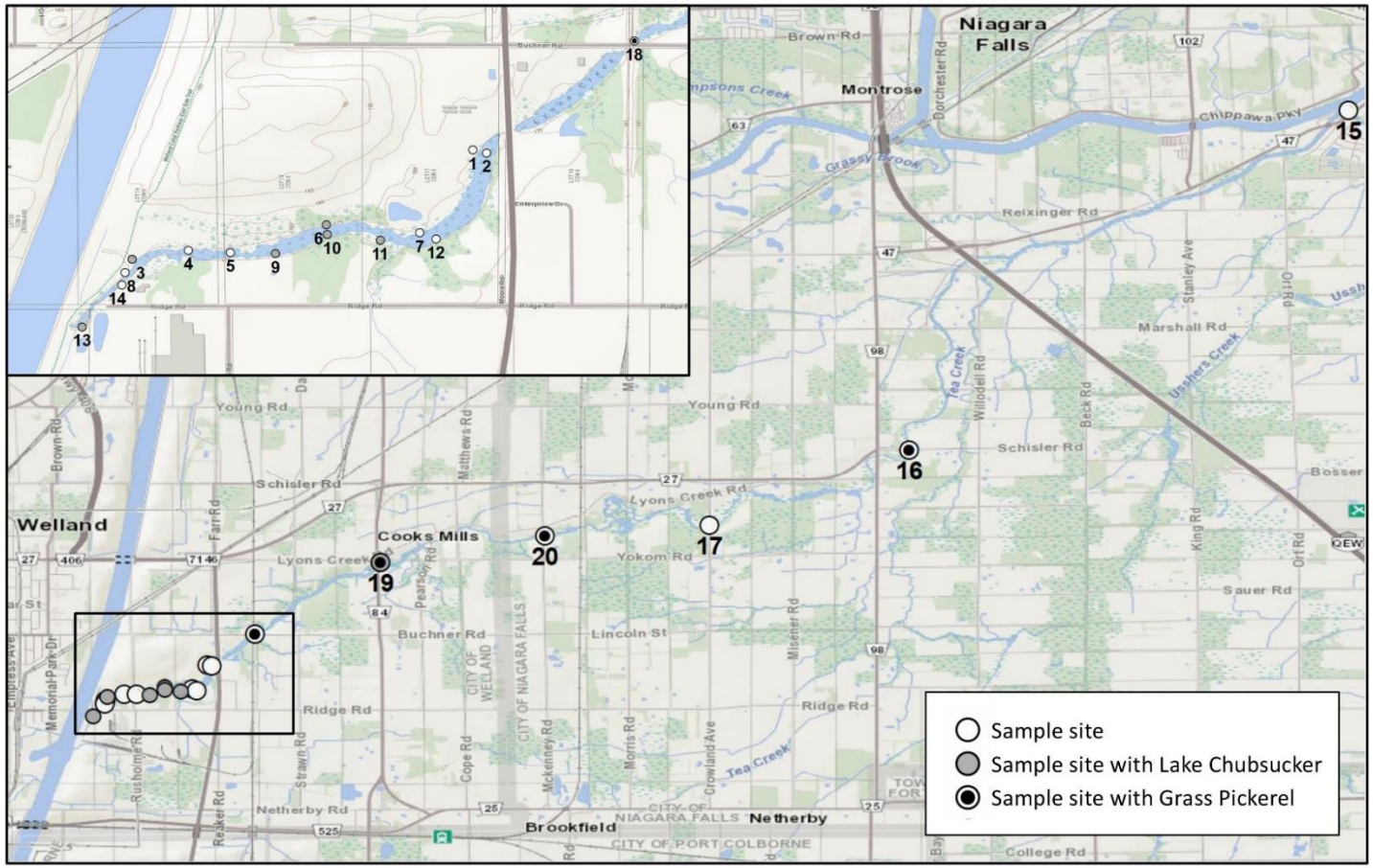


Figure 1. Study area map for Lyons Creek sites sampled in 2010 (LC1–20). Map created using ARCmap software (Esri) and the basemap from the 2006 South Western Ontario Orthophotography Project. White circle = sample site; grey circle = sample site where Lake Chubsucker *(Erimyzon sucetta*) was detected; black dot = sample site where Grass Pickerel (*Esox americanus vermiculatus*) was detected.

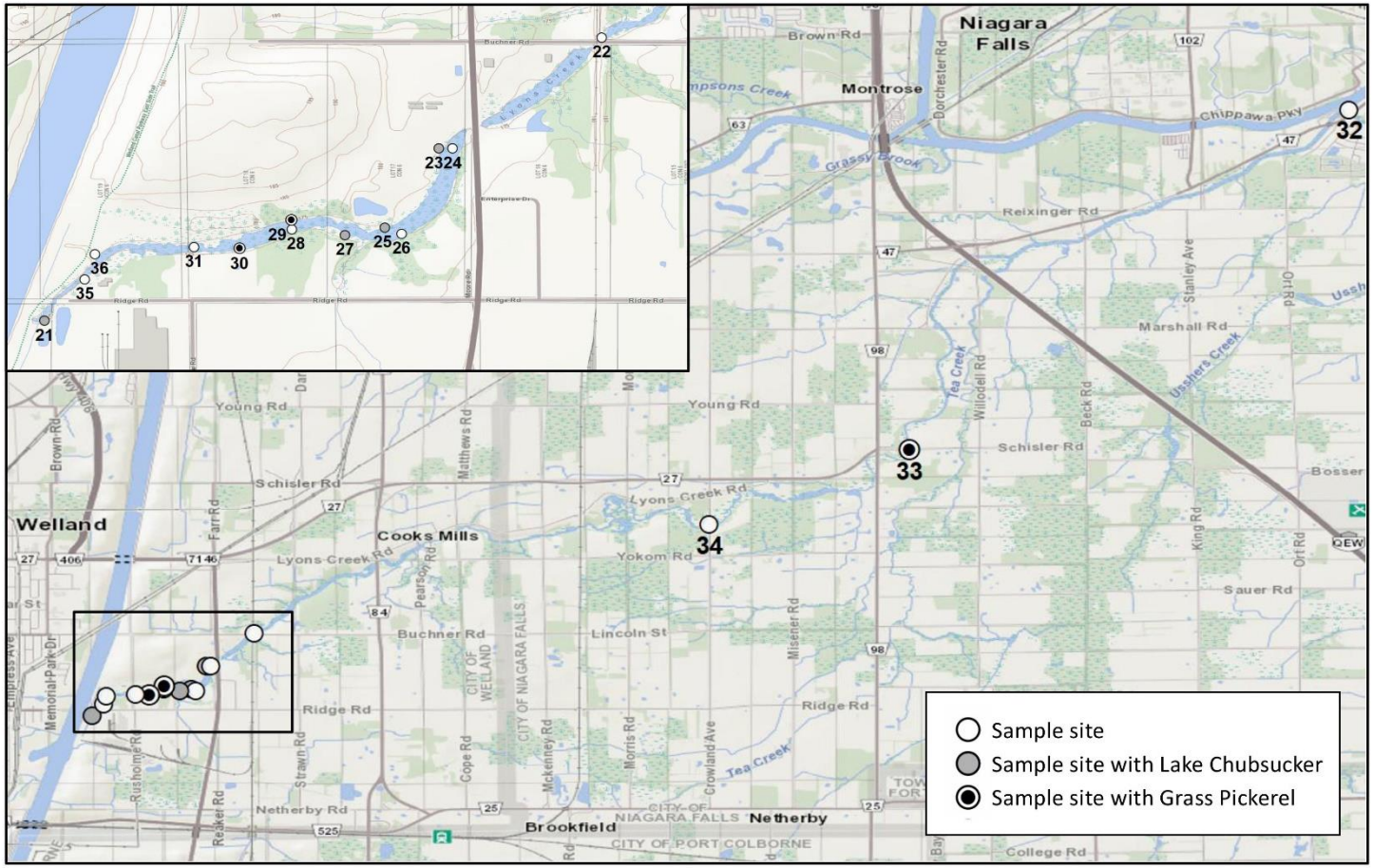


Figure 2. Study area map for Lyons Creek sites sampled in 2013 (LC21–36). Map created using ARCmap software (Esri) and the basemap from the 2006 South Western Ontario Orthophotography Project. White circle = sample site; grey circle = sample site where Lake Chubsucker *(Erimyzon sucetta*) was detected; black dot = sample site where Grass Pickerel (*Esox americanus vermiculatus*) was detected.

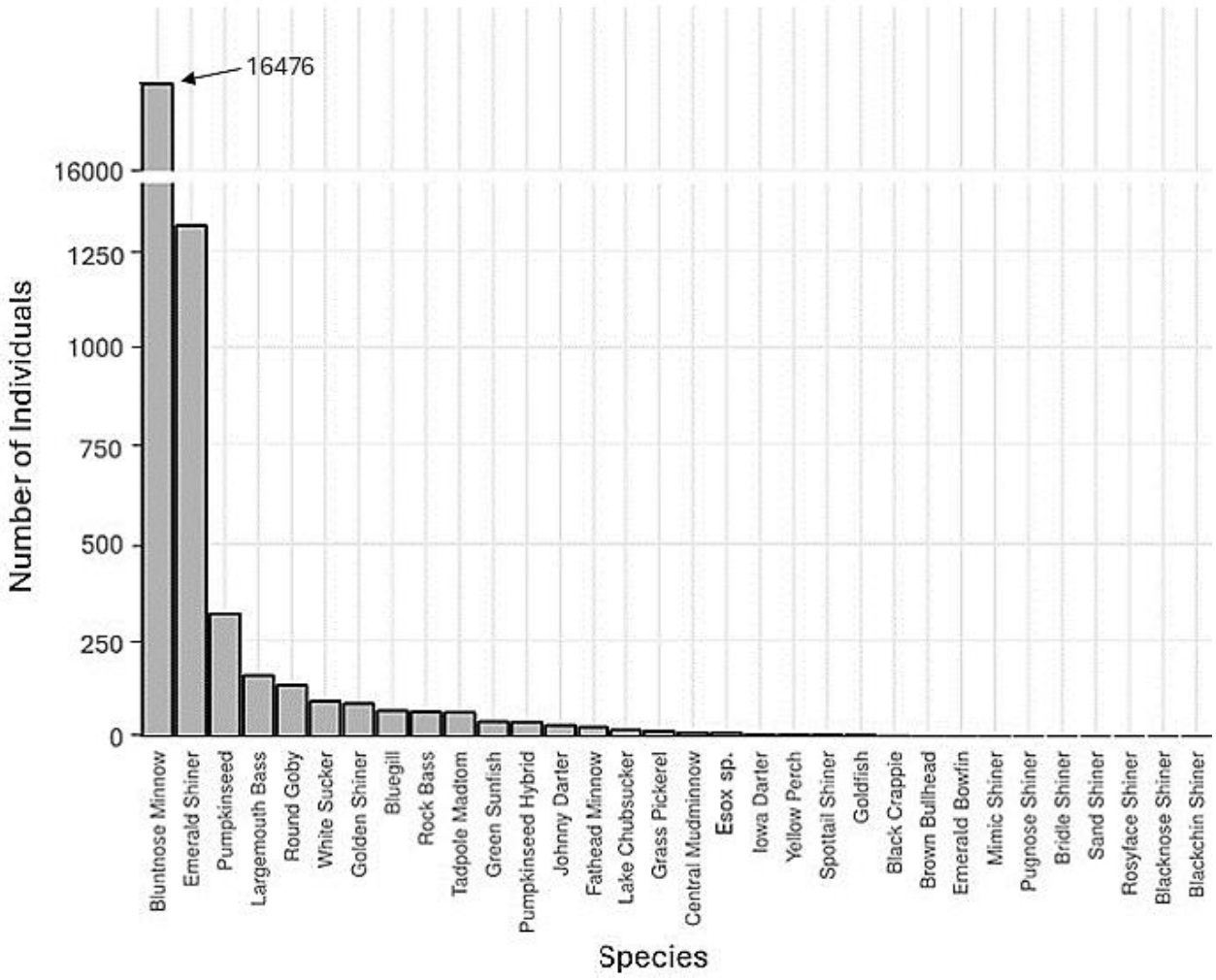


Figure 3. Rank-abundance of fish species captured from Lyons Creek in 2010 and 2013, calculated from pooled (one to five hauls combined) catch data. Y-axis scale break added using RStudio ggbreak function (Xu et al. 2021).

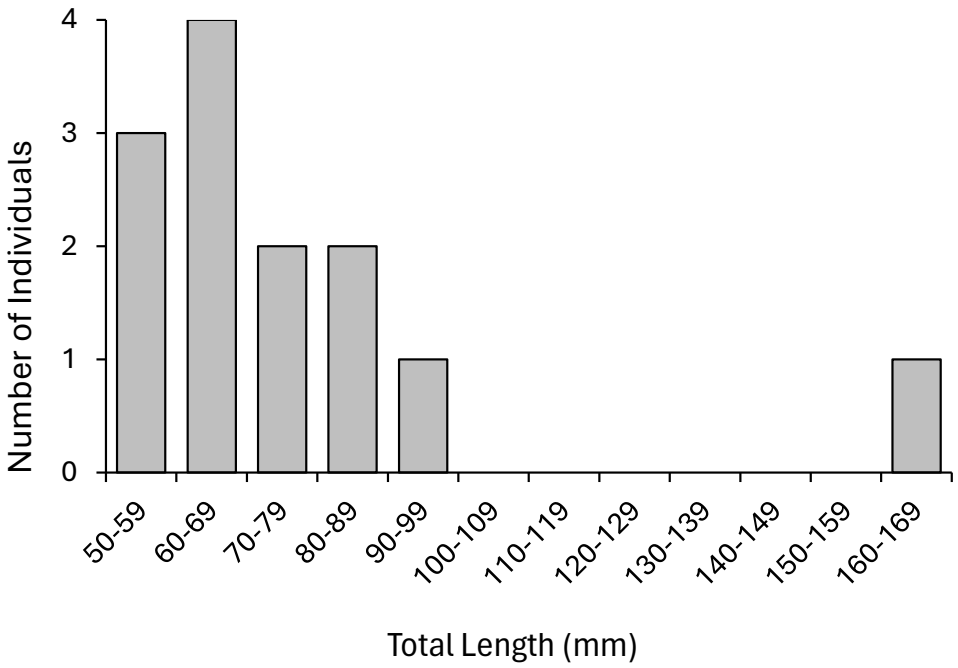


Figure 4. Length–frequency distribution of Lake Chubsucker (*Erimyzon sucetta*; n = 13) seined from Lyons Creek in 2010 and 2013.

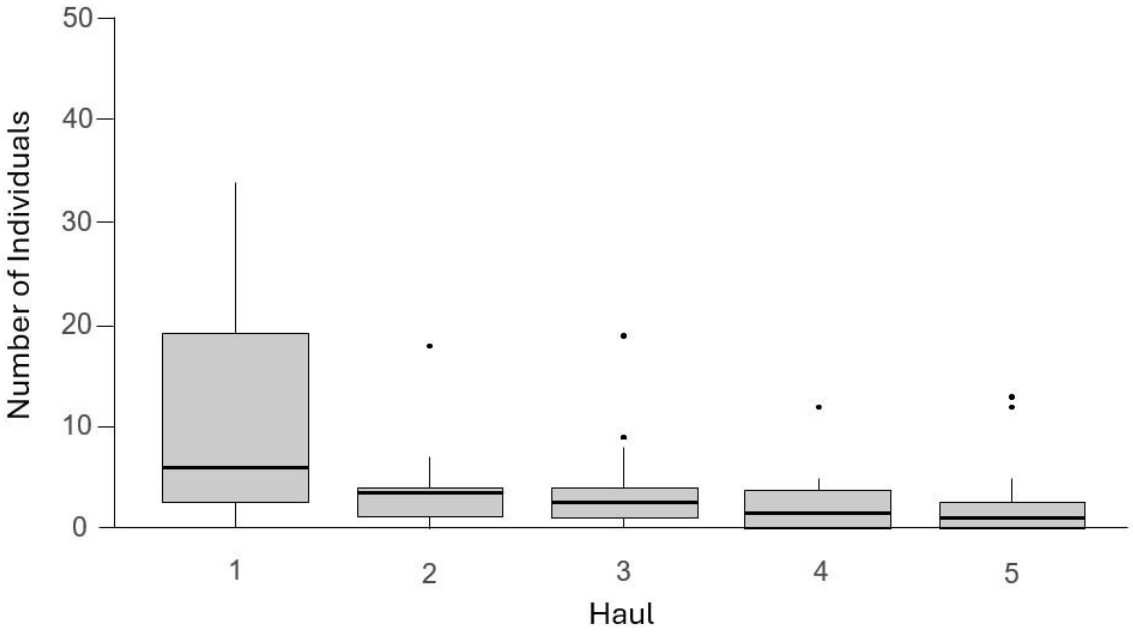


Figure 5. Boxplots of number of individuals collected from Lyons Creek using a bag seine for hauls 1–5. Data were pooled from the 2010 and 2013 sampling events that used the 5-haul method. Outliers above 100 individuals were removed. Median values (horizontal line), upper and lower quartiles (upper/lower edges of the box), minimum and maximum values (whiskers) and outliers (dots) are presented.

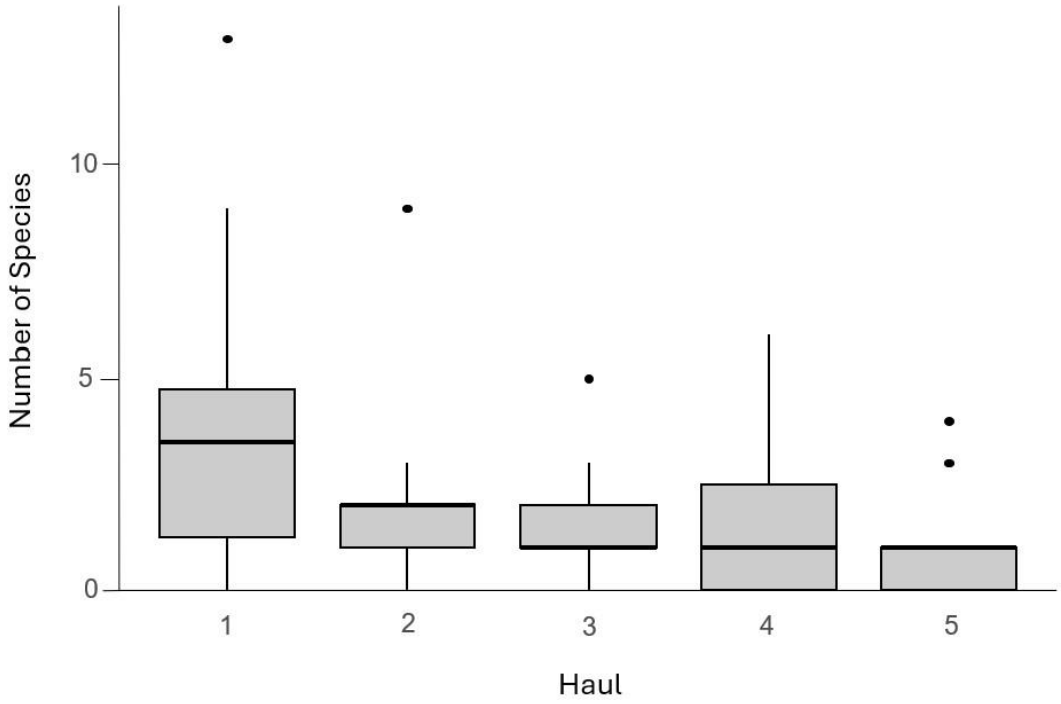


Figure 6. Boxplots of number of species collected from Lyons Creek using a bag seine for hauls 1–5. Data were pooled from 2010 and 2013 sampling events that used the 5-haul method. Median values (horizontal line), upper and lower quartiles (upper/lower edges of the box), minimum and maximum values (whiskers) and outliers (dots) are presented.

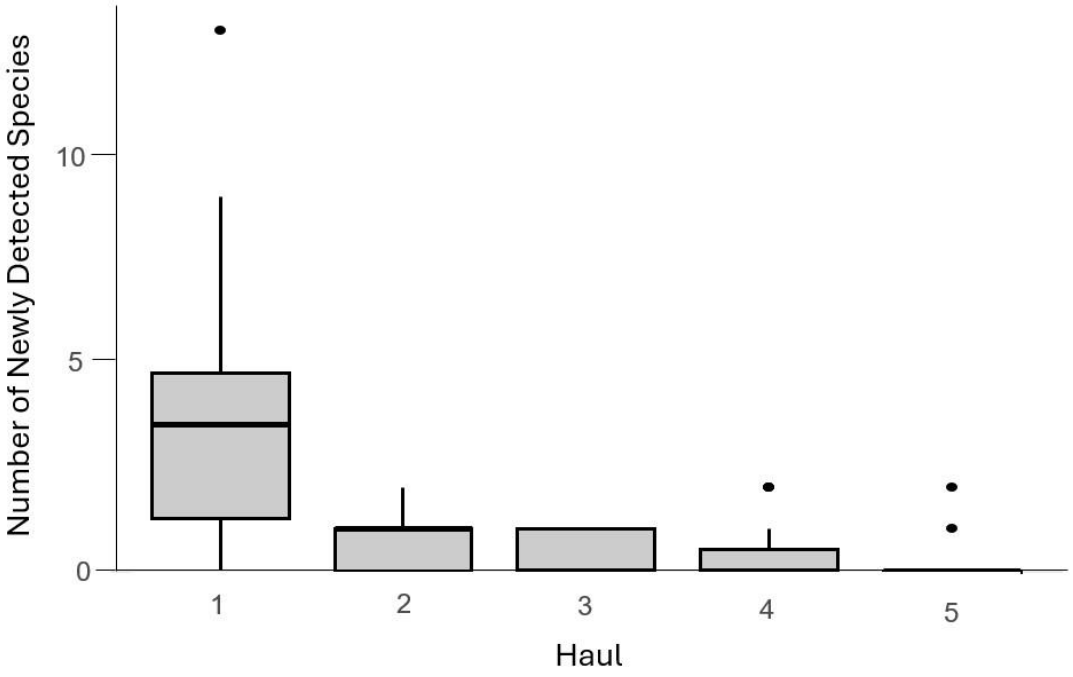


Figure 7. Boxplots of number of new species detected using a bag seine for hauls 1–5. Data were pooled from 2010 and 2013 sampling events that used the 5-haul method. Median values (horizontal line), upper and lower quartiles (upper/lower edges of the box), minimum and maximum values (whiskers) and outliers (dots) are presented.

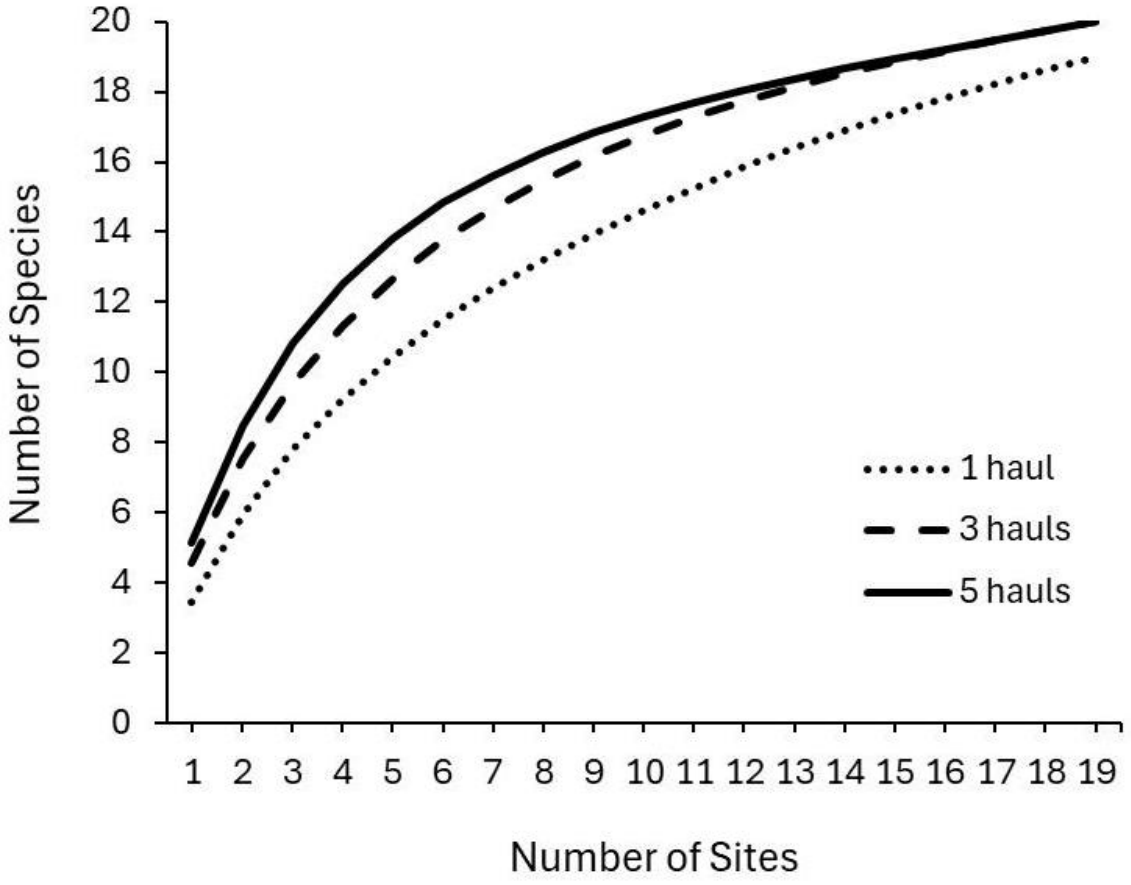


Figure 8. Comparison of Lyons Creek species accumulation rates from seine haul 1 (dotted line), seine hauls 1–3 combined (dashed line), and seine hauls 1–5 combined (solid line). Sample-based species accumulation curves were generated using EstimateS software (Colwell 2013).

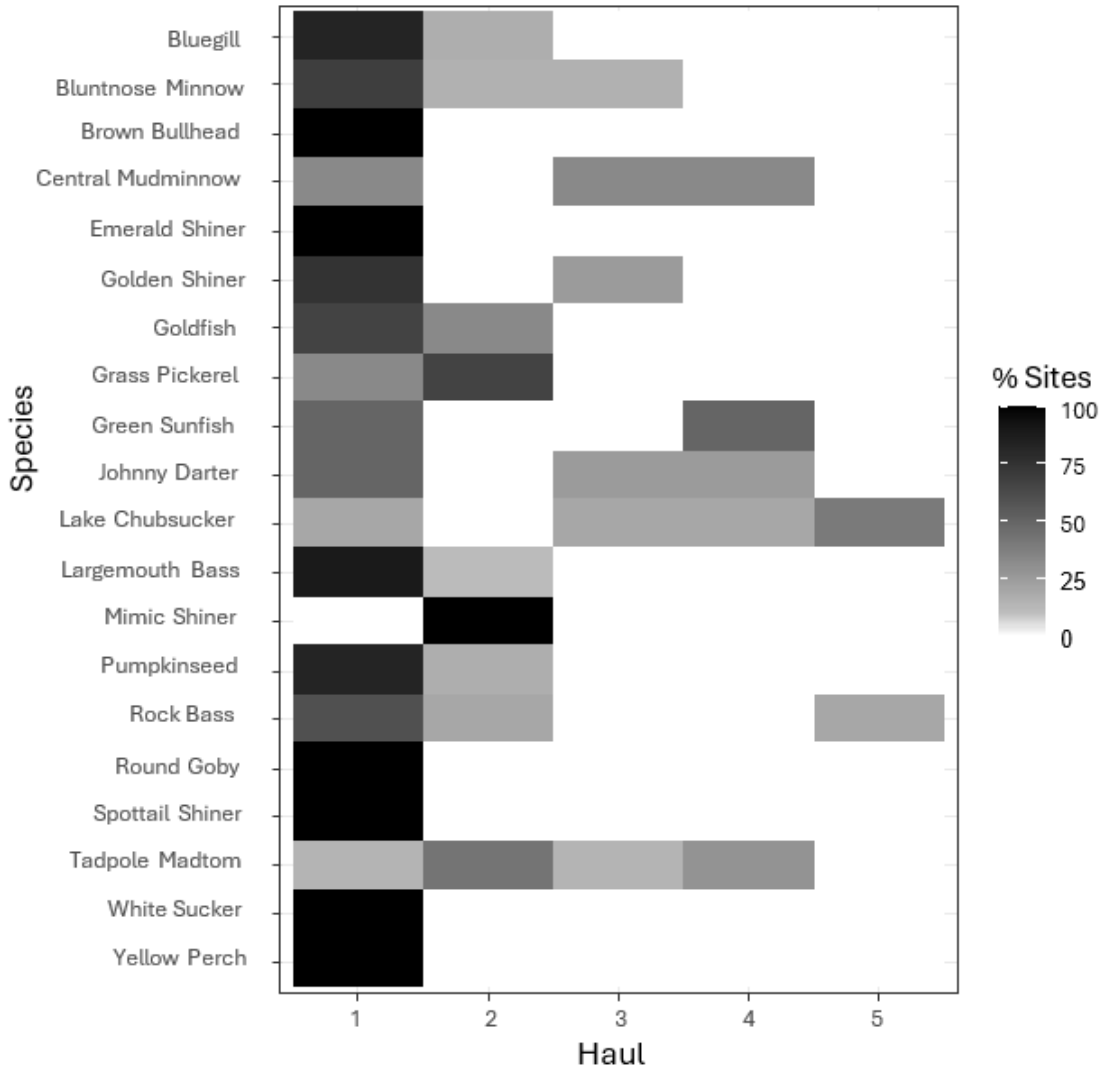


Figure 9. Heatmap of frequencies of first detection for each Lyons Creek species associated with individual bag seine hauls. Detection patterns are based on 5-haul sampling events in 2010 and 2013.

APPENDICES

Appendix 1. Location of sites from 2010 and 2013. A dash (-) indicates the 2010 site was not resampled in 2013.

2010	2013	Latitude	Longitude
LC1	LC23	42.98036	-79.2062
LC2	LC24	42.98026	-79.2057
LC3	LC36	42.97642	-79.2186
LC4	-	42.97675	-79.2166
LC5	LC31	42.97667	-79.2150
LC6	LC28	42.97767	-79.2115
LC7	LC25	42.97738	-79.2081
LC8	-	42.97595	-79.2189
LC9	LC30	42.97663	-79.2134
LC10	LC29	42.97732	-79.2115
LC11	LC27	42.97711	-79.2096
LC12	LC26	42.97716	-79.2075
LC13	LC21	42.97399	-79.2205
LC14	LC35	42.97409	-79.2219
LC15	LC32	43.04975	-79.0637
LC16	LC33	43.0073	-79.1185
LC17	LC34	42.99789	-79.1435
LC18	LC22	42.98429	-79.2003
LC19	-	42.99324	-79.1846
LC20	-	42.99655	-79.1640

Appendix 2. Abiotic habitat characteristics of Lyons Creek sites sampled in 2010 and 2013. Depth values are presented as the mean from three measurements within a site. A dash (-) indicates the measurement was not recorded.

Year	Site	Air temp. (°C)	Water temp. (°C)	Dissolved oxygen (mg/L)	Conductivity (µS/cm)	pH	Secchi tube (m)	Mean depth (m)
2010	LC1	18.5	20.11	7.87	314	7.63	0.161	0.5
2010	LC2	19.4	19.25	7.64	336	7.60	0.161	0.5
2010	LC3	19.6	18.98	10.45	299	8.06	0.362	0.3
2010	LC4	22.7	21.85	10.12	302	7.70	0.500	0.5
2010	LC5	19.6	18.58	10.73	306	8.03	0.441	0.5
2010	LC6	21.6	18.08	14.71	330	8.39	0.381	0.6
2010	LC7	22.2	20.71	12.73	383	8.01	0.226	0.3
2010	LC8	13.4	17.50	9.89	301	8.06	0.340	0.4
2010	LC9	14.0	16.87	8.72	305	7.78	0.210	0.3
2010	LC10	13.5	16.61	6.93	310	7.67	0.280	0.4
2010	LC11	14.0	15.45	8.27	310	7.76	0.680	0.4
2010	LC12	13.9	16.95	4.41	332	7.48	0.280	0.4
2010	LC13	19.6	18.23	7.00	430	7.67	0.230	0.6
2010	LC14	19.3	18.06	10.70	284	8.34	0.250	1.7
2010	LC15	26.5	24.50	6.78	298	8.31	0.900	0.9
2010	LC16	28.5	25.20	5.22	327	7.03	0.890	0.7
2010	LC17	30.4	28.00	8.51	329	6.98	0.840	0.5
2010	LC18	25.9	23.85	1.96	318	7.63	-	1.0
2010	LC19	32.7	24.79	3.04	310	7.59	-	1.2
2010	LC20	32.2	25.48	6.74	314	7.75	-	1.2
2013	LC21	-	17.60	-	170	-	0.640	0.7
2013	LC22	-	21.60	-	191	7.98	0.290	0.6
2013	LC23	-	15.60	-	183	8.18	0.310	0.5
2013	LC24	-	15.60	-	183	8.18	0.310	0.6
2013	LC25	-	20.80	-	162	7.94	0.375	0.3
2013	LC26	-	15.90	-	183	8.12	0.375	0.4
2013	LC27	-	18.60	-	170	8.16	0.380	0.3
2013	LC28	-	19.90	-	168	8.40	0.370	0.4
2013	LC29	-	22.60	-	171	8.31	0.370	0.3
2013	LC30	-	22.20	-	167	8.18	0.650	0.3
2013	LC31	-	23.70	-	169	8.17	0.300	0.3
2013	LC32	-	15.90	-	150	8.15	0.210	0.5
2013	LC33	-	17.50	-	192	7.83	0.450	0.6
2013	LC34	-	18.20	-	197	7.84	0.880	0.7
2013	LC35	-	16.00	-	163	8.34	0.290	0.3
2013	LC36	-	21.40	-	164	8.58	0.290	0.2

Appendix 3. Percent substrate composition at 16 sites sampled in Lyons Creek during seine surveys in 2010.

	Substrate (% composition)						
Site code	**Organic**	**Clay**	**Silt**	**Sand**	**Gravel**	**Cobble**	**Concrete**
LC1	100	0	0	0	0	0	0
LC2	100	0	0	0	0	0	0
LC3	100	0	0	0	0	0	0
LC4	100	0	0	0	0	0	0
LC5	90	0	10	0	0	0	0
LC6	100	0	0	0	0	0	0
LC7	95	0	5	0	0	0	0
LC8	80	0	0	0	20	0	0
LC9	90	0	10	0	0	0	0
LC10	100	0	0	0	0	0	0
LC11	100	0	0	0	0	0	0
LC12	100	0	0	0	0	0	0
LC13	40	0	40	0	0	20	0
LC14	0	0	0	0	0	0	100
LC15	10	0	30	0	60	0	0
LC16	0	0	15	15	40	30	0
LC17	0	40	20	10	30	0	0
LC18	10	0	20	0	0	70	0
LC19	0	0	80	0	0	20	0
LC20	5	0	95	0	0	0	0
Minimum	0	0	0	0	0	0	0
Maximum	100	40	95	15	60	70	100
Median	90	0	2.5	0	0	0	0

Appendix 4. Percent substrate composition at 16 sites sampled in Lyons Creek during seine surveys in 2013.

	Substrate (% composition)						
Site code	**Organic**	**Clay**	**Silt**	**Sand**	**Gravel**	**Cobble**	**Boulder**
LC21	5	0	5	0	0	90	0
LC22	30	50	0	0	0	20	0
LC23	90	5	5	0	0	0	0
LC24	40	60	0	0	0	0	0
LC25	85	5	10	0	0	0	0
LC26	70	0	30	0	0	0	0
LC27	30	50	20	0	0	0	0
LC28	25	60	15	0	0	0	0
LC29	30	60	10	0	0	0	0
LC30	30	30	40	0	0	0	0
LC31	40	10	50	0	0	0	0
LC32	30	0	30	10	30	0	0
LC33	15	0	20	0	55	5	5
LC34	15	0	20	0	60	0	5
LC35	10	70	10	0	10	0	0
LC36	80	0	20	0	0	0	0
Minimum	5	0	0	0	0	0	0
Maximum	90	70	50	10	60	90	5
Median	30	7.5	17.5	0	0	0	0

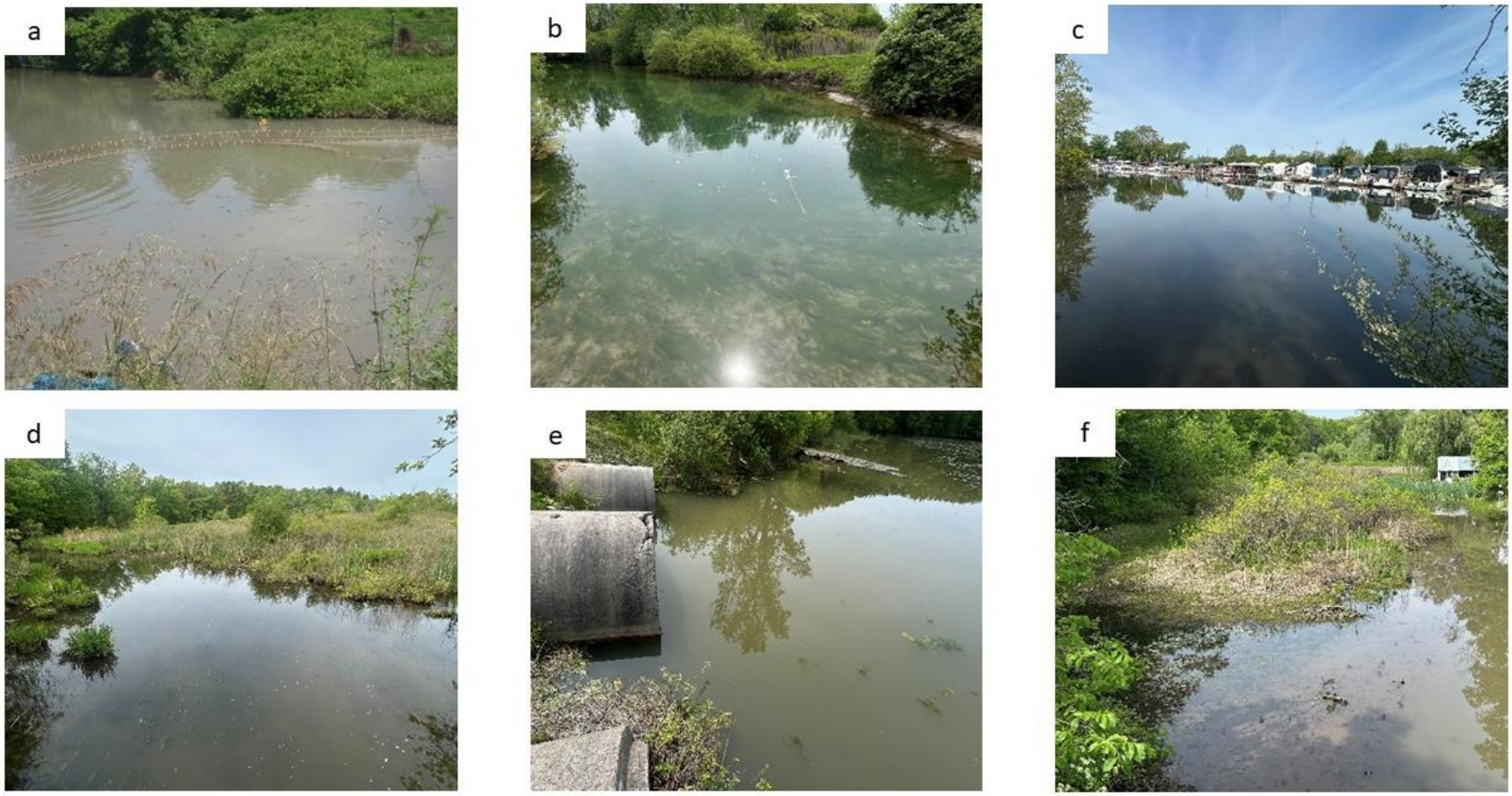
Appendix 5. Aquatic vegetation data from 20 sites sampled in Lyons Creek during seine surveys in 2010.

	Aquatic vegetation cover (%)			
Site code	**Open Water**	**Emergent**	**Submerged**	**Floating**
LC1	20	0	40	40
LC2	90	5	0	5
LC3	60	20	20	0
LC4	94	5	0	1
LC5	90	5	5	0
LC6	70	25	0	5
LC7	20	60	10	10
LC8	80	20	0	0
LC9	50	40	10	0
LC10	0	75	20	5
LC11	60	20	20	0
LC12	30	10	50	10
LC13	40	10	50	0
LC14	100	0	0	0
LC15	30	20	50	0
LC16	40	15	40	5
LC17	0	10	90	0
LC18	0	10	90	0
LC19	0	30	70	0
LC20	0	10	90	0
Minimum	0	0	0	0
Maximum	100	75	90	40
Median	40	12.5	20	0

Appendix 6. Aquatic vegetation data from 16 sites sampled in Lyons Creek during seine surveys in 2013.

	Aquatic vegetation cover (%)			
Site code	**Open Water**	**Emergent**	**Submerged**	**Floating**
LC21	90	10	0	0
LC22	70	0	30	0
LC23	0	10	90	0
LC24	90	0	10	0
LC25	20	20	60	0
LC26	100	0	0	0
LC27	30	10	60	0
LC28	85	15	0	0
LC29	75	5	20	0
LC30	40	10	50	0
LC31	20	0	80	0
LC32	40	30	30	0
LC33	70	20	10	0
LC34	60	30	10	0
LC35	80	20	0	0
LC36	80	0	20	0
Minimum	0	0	0	0
Maximum	100	30	90	0
Median	70	10	20	0

Appendix 7. Site photos representing examples of Lyons Creek habitats sampled in 2010 and 2013. a) Deployment of multiple seine hauls at LC14(35) in 2010; b) LC13(21) where Lake Chubsucker *(Erimyzon sucetta*) was detected in 2010; c) LC15(32); d) LC17(34); e) LC19 where Lake Chubsucker and Grass Pickerel (*Esox americanus vermiculatus*) were detected in 2010; and f) LC20 where Grass Pickerel was detected in 2010. Pictures b) to f) taken in May 2025.



Appendix 8. Fish assemblages from Lyons Creek sites sampled in 2010. Values are aggregate catch (raw abundance, pooled across multiple hauls) for each site. Total number of individuals collected was 19,399. Wetland fish species-at-risk are denoted with bold text.

Site code	Black Crappie	Bluegill	Bluntnose Minnow	Brown Bullhead	Central Mudminnow	Emerald Bowfin	Emerald Shiner	Fathead Minnow	Goldfish	Golden Shiner	**Grass Pickerel**	Green Sunfish	Iowa Darter	Johnny Darter	**Lake Chubsucker**	Largemouth Bass	Pumpkinseed	Rock Bass	Round Goby	Spottail Shiner	Tadpole Madtom	White Sucker	Yellow Perch	**Total**
LC1					1				1							3	16	1			4			**26**
LC2			6	1						10							3				5			**25**
LC3			114							2			7		2						2	1		**128**
LC4			16							5							1				1			**23**
LC5			8						1	18				1			5					1		**34**
LC6		1	2		1				1	15		1			1	1	8	2						**33**
LC7			92							38		7					41				3			**181**
LC8			208											11			1		1			13		**234**
LC9		1	35		2				1	8		1			1	3	18	1				8		**79**
LC10		1	342							17					3	2	21					5		**391**
LC11			54				1			8					2	1	13					1		**80**
LC12			60		3					1		1					13				7			**85**
LC13		5	8,807					19		914		7		13	3	9	32	43	73			1	1	**9,927**
LC14	1		6,482			1	68	7		1,000		4				2	13	2	14	3		62	5	**7,664**
LC15		2					7			11						102	1	1						**124**
LC16		5	32				1			1	1					7	6	4	8		5	1		**71**
LC17	1		21						1	4						2	11				9			**49**
LC18	1		6							34	8	10		1		8	31	1			10			**110**
LC19		5	1							25	1	3			1	7	26				7			**76**
LC20		17	10							20	3	1					5				3			**59**
Total	**3**	**37**	**16,296**	**1**	**7**	**1**	**77**	**26**	**5**	**2,131**	**13**	**35**	**7**	**26**	**13**	**147**	**265**	**55**	**96**	**3**	**56**	**93**	**6**	**19,399**

Appendix 9. Fish assemblage results from Lyons Creek sites sampled in 2013. Values are aggregate catch (raw abundance, pooled across multiple hauls) for each site. Total number of individuals collected was 1,717. Wetland fish species-at-risk are denoted with bold text.

Site Code	Bluegill	Bluntnose Minnow	Brown Bullhead	Central Mudminnow	Emerald Shiner	Esox sp.	Golden Shiner	**Grass Pickerel**	Green Sunfish	Johnny Darter	**Lake Chubsucker**	Largemouth Bass	Mimic Shiner	Pumpkinseed	Pumpkinseed Hybrid	Rock Bass	Round Goby	Spottail Shiner	Tadpole Madtom	Yellow Perch	**Total**
LC21		119		1						1	1					2	23				**147**
LC22	6	12			4				1			3			4		9		1		**40**
LC23		3		1	1	1					1	1		11	1				2		**22**
LC24		4																			**4**
LC25		2									2			1	7						**12**
LC26	1				5									3							**9**
LC27		2									1	1		1							**5**
LC28																			1		**1**
LC29					12			1	1					5	6						**25**
LC30		2		1	7	10		1											1		**22**
LC31					1		2					2		25	21						**51**
LC32	22	5	1	1	1,240		1		3	3		4	1	4		8	6	3		1	**1,303**
LC33	2	1			7			1				1		3		1	1				**17**
LC34	1	3										1									**5**
LC35										1									2		**3**
LC36		27			21									2					1		**51**
Total	**32**	**180**	**1**	**4**	**1,298**	**11**	**3**	**3**	**5**	**5**	**5**	**13**	**1**	**55**	**39**	**11**	**39**	**3**	**8**	**1**	**1,717**

Appendix 10. Presence and absence of species in Lyons Creek from three studies: data from this report (2010, 2013), data from the MNR (2008, 2009), and DFO data (2004). Fish species-at-risk are denoted with bold text.

Common Name	Scientific Name	2004	2008	2009	2010	2013
Bluegill	*Lepomis macrochirus*	+	+	+	+	+
Bluntnose Minnow	*Pimephales notatus*	+	+	+	+	+
Brown Bullhead	*Ameiurus nebulosus*	+	+	+	+	+
Golden Shiner	*Notemigonus crysoleucas*	+	+	+	+	+
Grass Pickerel	***Esox americanus vermiculatus***	**+**	**+**	**+**	**+**	**+**
Green Sunfish	*Lepomis cyanellus*	+	+	+	+	+
Lake Chubsucker	***Erimyzon sucetta***	**+**	**+**	**+**	**+**	**+**
Largemouth Bass	*Micropterus nigricans*	+	+	+	+	+
Pumpkinseed	*Lepomis gibbosus*	+	+	+	+	+
Rock Bass	*Ambloplites rupestris*	+	+	+	+	+
Tadpole Madtom	*Noturus gyrinus*	+	+	+	+	+
Yellow Perch	*Perca flavescens*	+	+	+	+	+
Central Mudminnow	*Umbra limi*	+	+	-	+	+
Emerald Shiner	*Notropis atherinoides*	+	+	-	+	+
Spottail Shiner	*Hudsonius hudsonius*	+	+	-	+	+
Johnny Darter	*Etheostoma nigrum*	+	-	+	+	+
Round Goby	*Neogobius melanostomus*	-	-	+	+	+
Esocid species	Esox sp.	+	-	-	-	+
Mimic Shiner	*Paranotropis volucellus*	-	-	-	-	+
Pumpkinseed hybrid	*Lepomis*	-	-	-	-	+
Black Crappie	*Pomoxis nigromaculatus*	+	+	+	+	-
Emerald Bowfin	*Amia calva*	+	+	+	+	-
White Sucker	*Catostomus commersonii*	+	+	+	+	-
Goldfish	*Carassius auratus*	+	+	-	+	-
Fathead Minnow	*Pimephales promelas*	+	-	-	+	-
Iowa Darter	*Etheostoma exile*	-	-	-	+	-
Common Carp	*Cyprinus carpio*	+	+	+	-	-
White Crappie	*Pomoxis annularis*	+	-	+	-	-
Rudd	*Scardinius erythrophthalmus*	+	-	+	-	-
Northern Pike	*Esox lucius*	+	+	-	-	-
Freshwater Drum	*Aplodinotus grunniens*	-	-	+	-	-
Greater Redhorse	*Moxostoma valenciennesi*	-	+	-	-	-
Common Shiner	*Luxilus cornutus*	-	+	-	-	-
Smallmouth Bass	*Micropterus dolomieu*	-	+	-	-	-
Striped Shiner	*Luxilus chrysocephalus*	+	-	-	-	-
Golden Redhorse	*Moxostoma erythrurum*	+	-	-	-	-