

Targeted sampling for Pugnose Shiner (*Notropis anogenus*) in eastern Lake Ontario coastal wetlands, 2022

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by

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ABSTRACT

LeBaron, A. and Reid, S.M. 2026. Targeted sampling for Pugnose Shiner (*Notropis anogenus*) in eastern Lake Ontario coastal wetlands, 2022. Can. Data Rep. Fish. Aquat. Sci. 1470: viii + 46 p.

From August through October of 2022, trawling surveys were completed across seven Lake Ontario coastal wetlands to update distribution records for the threatened Pugnose Shiner (*Notropis anogenus*) and describe habitat characteristics. Fifty-six sites were sampled in Presqu'île Bay (n = 12), Wellers Bay (n = 6), East Lake (n = 8), South Bay (n = 9), Black River (n = 3), Waupoos Bay (n = 9), and Muscote Bay (n = 9). Sites were in areas of vegetated habitat near previous wetland fishes at risk surveys. Twenty-two species were detected including Pugnose Shiner and Bridle Shiner (*Notropis bifrenatus*; *Species at Risk Act* (SARA): Special Concern). Pugnose Shiner (220 individuals) was collected from 52% of sites across all water bodies; the species was most abundant in Weller's Bay and East Lake. Bridle Shiner (651 individuals) was collected from 54% of sites across all water bodies; the species was most abundant in East Lake and Black River. Length-frequency distributions indicate ongoing recruitment and multiple age classes for both species. At Bridle Shiner and Pugnose Shiner collection sites, water clarity was high, water depths were between 0.6 and 1.4 m, substrate material was largely organics, and submerged vegetation cover was dense.

RÉSUMÉ

LeBaron, A. and Reid, S.M. 2026. Targeted sampling for Pugnose Shiner (*Notropis anogenus*) in eastern Lake Ontario coastal wetlands, 2022. Can. Data Rep. Fish. Aquat. Sci. 1470: viii + 46 p.

D'août à octobre 2022, on a mené des relevés au chalut dans sept zones humides côtières du lac Ontario afin de mettre à jour les rapports sur la répartition du méné camus (*Notropis anogenus*), une espèce menacée, et de décrire les caractéristiques de son habitat. Au total, 56 sites ont été échantillonnés dans la baie Presqu'île (n = 12), la baie Wellers (n = 6), le lac East (n = 8), la baie South (n = 9), la rivière Black (n = 3), la baie Waupoos (n = 9) et la baie Muscote (n = 9). Ces sites se trouvaient dans des milieux couverts de végétation, à proximité de sites utilisés lors d'activités de relevé précédentes ciblant des poissons en péril en zones humides. On y a détecté 22 espèces, dont le méné camus et le méné d'herbe (*Notropis bifrenatus*; *Loi sur les espèces en péril* (LEP): espèce préoccupante). On a capturé le méné camus (220 individus) dans 52 % des sites de tous les plans d'eau; la baie Wellers et le lac East sont les sites où l'on a trouvé l'espèce en plus grande abondance. On a capturé le méné d'herbe (651 individus) dans 54 % des sites de tous les plans d'eau; le lac East et la rivière Black sont les sites où l'on a trouvé l'espèce en plus grande abondance. Les distributions de la fréquence des longueurs indiquent un recrutement continu et de multiples classes d'âges pour les deux espèces. Aux sites d'échantillonnage, l'eau était très claire, la profondeur variait de 0,6 à 1,4 mètre, le substrat était composé en grande partie de matières organiques et le couvert de végétation submergée était dense.

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) of 2002. To inform scientific aspects of the recovery process, DFO regularly conducts field sampling to satisfy various research objectives for SARA-listed fishes, such as evaluating the distribution and abundance of species, determining species-habitat relationships, and better understanding the influence of threats and recovery actions. DFO data reports are published to support the Species at Risk Program by providing a description 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 the Ontario Ministry of Natural Resources (OMNR) in 2022 to better understand the distribution and population status of Pugnose Shiner (*Notropis anogenus*) in Ontario. Pugnose Shiner, a species listed as Threatened under SARA, has a disjunct distribution in Canada; limited to six areas in the southern Lake Huron, Lake St. Clair, western and central Lake Erie drainages, eastern Lake Ontario basin, and in the upper St. Lawrence River (Bouvier et al. 2010). The species is strongly associated with submerged and emergent aquatic vegetation and locations with high water clarity (DFO 2012). Population declines have largely been attributed to habitat loss and degradation (Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2013).

Pugnose Shiner was first collected from the Canadian portion of the Lake Ontario drainage in 2009 (DFO 2010), primarily in the Prince Edward County region; the species was first captured from West Lake in 2009 during boat electrofishing surveys, and targeted seining captured Pugnose Shiner from West Lake in 2009 and 2010, as well as from Wellers Bay, East Lake, Black River, and Waupoos Bay in 2010 (COSEWIC 2013). In 2021, surface trawl surveys detected Pugnose Shiner in Presqu'île Bay, Weller's Bay, East Lake, and West Lake (LeBaron and Reid 2023).

In 2022, a repeat-sampling approach with a Mamou (surface) trawl was used to collect fishes from additional sites in wetlands surveyed in 2021, as well as from four new Lake Ontario coastal wetlands. Sample areas included locations with past collections of Pugnose Shiner, as well as other areas with preferred habitat features. Sampling objectives included: (i) update Pugnose Shiner distribution data; (ii) describe the habitat characteristics at Pugnose Shiner collection sites; and (iii) provide distribution information for other wetland fishes at risk in eastern Lake Ontario coastal wetlands (e.g., Bridle Shiner (*Notropis bifrenatus*)). These objectives support the following research and monitoring actions in the Pugnose Shiner recovery strategy (DFO 2012):

- 1) Conduct targeted surveys at new (where the species has only recently been discovered) and suspected locations.
- 2) Develop and implement a standardized index population and habitat monitoring program with specific sampling and training protocols.

The project also supports monitoring actions identified in the Bridle Shiner management plan (Boucher et al. 2011).

METHODS

SITE SELECTION

A total of 50 sites were sampled between August 11 and October 11, 2022, across seven eastern Lake Ontario coastal wetlands (Figure 1): Presqu'île Bay (n = 10), Wellers Bay (n = 4), East Lake (n = 6), South Bay (n = 9), Black River (n = 3), Waupoos Bay (9), and Muscote Bay (n = 9). Sites were selected based on previous detections of Pugnose Shiner (Biodiversity Science Database, Great Lakes Laboratory for Fisheries and Aquatic Science) as well as other areas with suitable habitat (wetland areas and shoreline with submerged vegetation; Holm et al. 2009). An additional six sites from 2021 sampling were revisited between September 20 and October 11.

Sampling was limited to locations free of obstructions (e.g., fallen trees or boulders) and with water depths greater than 1 m. Site location (latitude, longitude) was recorded using a Garmin® Montana 680 handheld GPS unit. Site locality information is provided in Appendix 1 (a–g).

FISH ASSEMBLAGE SAMPLING

Fishes were collected with a Mamou Trawl™ manufactured by Innovative Net Systems (Reid et al. 2016; Gáspárdy et. al. 2020). The approximate length of the trawl was 6.5 m, with an opening of 0.75 x 1.15 m. The forward sections were constructed of 38 mm high-density, polyethylene stretched mesh, which runs from the head rope (float line) to 2 m back into the body of the trawl. The remainder exterior of the trawl consists of 4 mm polyester knotless mesh. The cod end of the trawl contains an inner bag comprised of 38 mm high-density stretched mesh. During operation, the net was opened by a pair of floating doors (0.6 m long x 0.3 m wide) which were towed on a pair of 23 m bridles tied to two cleats near the bow of the vessel. The length of bridles was adjusted to ensure proper floatation of the trawl. Two different boats were used during the sample period: 1) a 5.5 m jon boat with a 40 hp motor; and 2) a 5.5 m v-hull with a 90 hp motor. Fifty sites were sampled with three consecutive passes along a 50 m transect. Six sites (resamples of 2021 sites) were sampled with six consecutive passes along a 50 m transect. Floats were used to mark the boundaries of the transect. All passes were fished in the same direction.

Prior to sampling, water depths and potential navigation hazards (e.g., large woody debris) were evaluated using a Garmin® Echomap™ Plus 95 SV Sonar Unit. Sites were delineated based on visual assessments of best available habitat: orientation of transects in relation to the shoreline varied, but typically ran parallel to the shoreline or to patches of emergent vegetation. The boat travelled approximately 30 m past the float marking the top end of the site, then moved in reverse toward the float while the trawl was fed into the water off the bow. At the float, the doors were dropped into the water to allow the net to open. Once the towlines were tight, a GPS stopwatch was started to track speed, tow time, and distance travelled. A speed of approximately 2 km/h was maintained while trawling. Once 50 m was covered, the trawl was pulled in by hand and fishes were removed from the cod end and placed in bins of fresh water.

Fishes were processed after each pass and released at least 30 m from the transect. For each pass, captured fishes were identified to species, enumerated, and the minimum and maximum total length (TL; mm) of each species was recorded. Individual TL was recorded for all Pugnose Shiner and Bridle Shiner. Sampling-related mortalities were recorded for each pass. No physical vouchers were retained. Some digital (photograph) vouchers were taken for identification verification.

HABITAT SAMPLING

Prior to trawling, a macrophyte sample was collected at the midpoint of the transect using the rake method (Figure 2) described by Wagner and Mikulyuk (2012). The method uses a rating scale to classify the density of macrophytes and filamentous algae as follows: 0 = no plants present; 1 = less than 25% of rake is full; 2 = 25% to 100% of rake is full, and; 3 = greater than 100% of rake is full. During sampling, species of macrophytes collected by the trawl and visually observed within the transect were also recorded. Macrophytes were recorded to species where possible, and qualitatively classified as “dominant” or “other.” Dominant taxa were not always identifiable. Pictorial keys and species descriptions (Newmaster et al. 1997) were used to aid in identification. Photo vouchers were taken. Percent macrophyte cover was assessed visually within the sample area according to the following vegetation classes to a total of 100%: open water, emergent, submerged, and floating.

Water temperature (°C) and conductivity (µS/cm) were measured approximately 0.05 m beneath the water’s surface using a handheld meter. Water clarity was measured using a Secchi (transparency) tube (Anderson and Davic 2004). Water depth (m) was measured in three representative locations within the boundaries of the transect using the sonar unit. Median water depth values for each wetland were calculated using the mean of the three measurements at each site.

Substrate was sampled at the midpoint of the transect using a Wildco® Petite Ponar™ benthic grab (15 cm x 15 cm). Percent composition of each sample was assessed visually (based on size) and by texture (for clay and organics). Site photos are provided in Appendix 2 as visual examples of aquatic habitat.

At the six 2021 sites re-sampled, water depths, temperature, conductivity, and Secchi tube measurements were taken during the repeat sampling events; macrophytes and substrate composition were not resampled.

SAMPLING PERMITS AND DATA ARCHIVING

Sampling for this project was conducted under Species at Risk Act Permit No. 22-PCAA-00023 and a Letter of Authorization to Conduct Research in a Provincial Park or Conservation Reserve (Ontario Ministry of Environment, Conservation and Parks). Trawling was conducted under Animal Use Protocol ACC 174 approved by the OMNR Aquatic Research and Monitoring Section Animal Care Committee. Every effort has been made to ensure the accuracy of data contained in this report; however, results may be updated as part of ongoing data verification procedures. Data associated with this report may be obtained by contacting the Aquatic Research and Monitoring Section, Ontario Ministry of Natural Resources.

RESULTS

Common and Scientific names for all fishes and macrophytes identified in this study are provided in Appendix 3 (a, b). *Pooled* refers to data that is combined across all passes at a site. Fish count data includes all individuals captured; species detection/richness data does not include those individuals identified only to genus.

FISH ASSEMBLAGE SAMPLING

Across all sample events, 6,205 individuals were collected, and 22 species (plus one hybrid) were detected. Fifty sites were sampled with a total of 150 trawls. Six sites were resampled with an additional 36 trawls. Two-hundred-twenty Pugnose Shiner were collected from 52% of sites (n = 29) across all seven waterbodies, ranging in total length from 19 to 56 mm (median: 37 mm)

(Figure 3). Another fish species at risk, Bridle Shiner ($n = 651$), was collected from 54% of sites ($n = 30$) across all seven waterbodies, ranging in total length from 20 to 61 mm (median: 43 mm) (Figure 4). Five recreationally important species (Black Crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Largemouth Bass (*Micropterus salmoides*), Northern Pike (*Esox lucius*), and Yellow Perch (*Perca flavescens*)) were collected. The most abundant (54% of individuals collected) and widespread (73% of sites) species was Blackchin Shiner (*Notropis heterodon*). Other species that were widespread ($> 50\%$ of sites) but not as abundant ($< 12\%$ of individuals) were Yellow Perch, Pumpkinseed (*Lepomis gibbosus*), Bluegill, young-of-year sunfish, Largemouth Bass, Bridle Shiner, and Pugnose Shiner (Table 1, Figure 5).

One hundred and seventy-five sampling-related mortalities were recorded, representing a 2.8% mortality rate (Appendix 4). The species most affected was Blackchin Shiner ($n = 125$), representing 71% of all mortalities. Twenty-one Bridle Shiner and five Pugnose Shiner mortalities were observed, representing a 3.2% and 2.3% mortality rate for each species, respectively.

Total length of all fishes ranged from 12 to 272 mm (median: 43 mm). Most individuals were either young-of-year and juvenile sunfishes, or small-bodied cyprinids. Catches of larger-bodied individuals (> 200 mm) were limited to Black Crappie, Brown Bullhead (*Ameiurus nebulosus*), Northern Pike, Rock Bass, and Yellow Perch.

The median number of individuals collected from each site was 40 (range: 0 to 839). The median number of species detected was 7 (range: 0 to 15). Numbers of individuals collected from each pass of the trawl increased slightly after the first pass (median number of individuals: first pass = 9; second pass = 12; and third pass = 1). Overall, the number of species detected was similar with successive passes of the trawl (median species number: first pass = 3; second pass = 4; third pass = 4). At sites sampled with 6 successive passes, there was no pattern of decline in number of individuals or species detected. At 50% of sites sampled, Bridle Shiner and Pugnose Shiner were collected after the third pass. At Presq18, Bridle Shiner was first detected during the final pass. Similarly, at Presq19, Pugnose Shiner was first detected during the final pass.

Summaries of 2022 fish assemblage sampling results for Presqu'ile Bay, Wellers Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay are provided below. Species count data for each water body is presented in Appendix 5(a–g). Photos of Pugnose Shiner and Bridle Shiner are provided in Appendix 6.

Presqu'ile Bay

A total of 591 fishes were trawled (representing 18 species) from 12 sites (Appendix 5a). The median number of fishes collected from each site was 37 (range: 8 to 118). The median number of species detected from each site was 8 (range: 4 to 15). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected. Based on pooled catch data, the most abundant and widespread species was Blackchin Shiner. Other species that were widespread but not abundant were Yellow Perch, Largemouth Bass, young-of-year sunfish, Pumpkinseed, Blackchin Shiner, Bridle Shiner, Bluegill, Rock Bass, Banded Killifish, and Pugnose Shiner (Table 3).

Pugnose Shiner was detected at 50% of Presqu'ile Bay sites ($n = 6$). Nine individuals were collected, measuring between 25 and 41 mm in total length (median: 36 mm). Bridle Shiner was detected at 67% of sites ($n = 8$). Fourteen individuals were collected, measuring between 24 and 58 mm (median: 42 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes.

Wellers Bay

A total of 1,095 fishes were trawled (representing 14 species) from six sites (Appendix 5b). The median number of fishes collected from each site was 57 (range: 4 to 839). The median number of species detected from each site was 7 (range: 2 to 12). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected. Based on pooled catch data the most abundant and widespread species was Blackchin Shiner, which represented 71% of the total catch. Other species that were widespread but not abundant were Yellow Perch, Mimic Shiner (*Notropis volucellus*), Bluegill, and Pugnose Shiner (Table 4).

Pugnose Shiner was detected at 67% of Wellers Bay sites (n = 4). Seventy-nine individuals were collected, measuring between 28 and 52 mm in total length (median: 41 mm). The distribution of length classes indicates presence of multiple age classes of Pugnose Shiner in Wellers Bay. Bridle Shiner was detected at 33% of sites (n = 2). Two individuals were collected, measuring 50 and 51 mm.

East Lake

A total of 2,152 fishes were trawled (representing 17 species) from eight sites (Appendix 5c). The median number of fishes collected from each site was 132 (range: 15 to 717). The median number of species detected from each site was 9 (range: 5 to 14). Four recreationally important species (Black Crappie, Bluegill, Largemouth Bass, and Yellow Perch) were collected. Based on pooled catch data the most abundant and widespread species was Blackchin Shiner. Other species that were widespread but not abundant were Bridle Shiner, Yellow Perch, Pugnose Shiner, Pumpkinseed, Bluegill, Mimic Shiner, and young-of-year sunfish (Table 5).

Pugnose Shiner was detected at 86% of East Lake sites (n = 6). Twenty-two individuals were collected, measuring between 26 and 53 mm in total length (median: 40.5 mm). Bridle Shiner was also detected at 86% of sites (n = 6). One-hundred and thirteen individuals were collected, measuring between 37 and 62 mm (median: 47 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes in East Lake.

South Bay

A total of 1,007 fishes were trawled (representing 18 species) from nine sites (Appendix 5d). The median number of fishes collected from each site was 26 (range: 0 to 748). The median number of species detected from each site was 8 (range: 0 to 16). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected by trawling. Based on pooled catch data the most abundant and widespread species was Blackchin Shiner. Other species that were widespread but not abundant were Pugnose Shiner, Banded Killifish, Bridle Shiner, and Pumpkinseed (Table 6).

Pugnose Shiner was detected at 67% of South Bay sites (n = 6). Thirty-nine individuals were collected, measuring between 25 and 45 mm in total length (median: 35 mm). Bridle Shiner was detected at 56% of sites (n = 9). Eighteen individuals were collected, measuring between 34 and 60 mm (median: 45.5 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes in South Bay.

Black River

A total of 531 fishes were trawled (representing 10 species) from three sites (Appendix 5e). The median number of fishes collected from each site was 224 (range: 16 to 291). The median number of species detected from each site was 6 (range: 3 to 9). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected by trawling.

Based on pooled catch data the most abundant and widespread species were Bridle Shiner and Blackchin Shiner. Other species that were widespread but not abundant were Pumpkinseed and Golden Shiner (Table 7).

Pugnose Shiner was detected at 33% of Black River sites ($n = 1$). One individual was collected, measuring 51 mm. Bridle Shiner was detected at 67% of sites ($n = 2$). Two-hundred and ninety-four individuals were collected, measuring between 20 and 61 mm (median: 42 mm). The distribution of length classes for Bridle Shiner indicates ongoing recruitment and multiple age classes in Black River.

Waupoos Bay

A total of 281 fishes were trawled (representing 13 species) from nine sites (Appendix 5f). The median number of fishes collected from each site was 26 (range: 7 to 65). The median number of species detected from each site was 7 (range: 4 to 10). Four recreationally important species (Bluegill, Largemouth Bass, Northern Pike, and Yellow Perch) were collected by trawling. Based on pooled catch data the most abundant and widespread species was Blackchin Shiner. Other species that were widespread but not abundant were Largemouth Bass, Bluegill, Pumpkinseed, young-of-year sunfish, Banded Killifish, and Pugnose Shiner (Table 8).

Pugnose Shiner was detected at 56% of Waupoos Bay sites ($n = 5$). Twenty-six individuals were collected, measuring between 19 and 51 mm in total length (median: 31 mm). The distribution of length classes for Pugnose Shiner indicates ongoing recruitment and multiple age classes in Waupoos Bay. Bridle Shiner was detected at 22% of sites ($n = 2$). Three individuals were collected, measuring 32, 37, and 52 mm.

Muscote Bay

A total of 548 fishes were trawled (representing 11 species) from nine sites (Appendix 5g). The median number of fishes collected from each site was 27 (range: 4 to 178). The median number of species detected from each site was 6 (range: 2 to 7). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected by trawling. Based on pooled catch data the most abundant and widespread species was Bluegill. Other species that were widespread but not abundant were Yellow Perch, Pumpkinseed, young-of-year sunfish, and Bluntnose Minnow (Table 9).

Pugnose Shiner was detected at 67% of South Bay sites ($n = 6$). Thirty-nine individuals were collected, measuring between 25 and 45 mm in total length (median: 35 mm). Bridle Shiner was detected at 56% of sites ($n = 9$). Eighteen individuals were collected, measuring between 34 and 60 mm (median: 45.5 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes in South Bay.

HABITAT SAMPLING

Across all sites, the dominant substrate type was organic (median 100% composition), and dominant vegetation cover type was submerged (median 100% coverage). A total of 19 aquatic macrophyte species were identified. An additional five macrophyte taxa were only identified to genus-level. The number of macrophyte taxa per site ranged from 3 to 13 (median: 7). The most abundant taxa across all sites were Wild Celery (*Vallisneria americana*) and Stonewort (*Chara* spp.), listed as “dominant” at 28 and 12 sites, respectively. Other taxa that were widespread (> 50% of sites) but not necessarily dominant include Richardson’s Pondweed (*Potamogeton richardsonii*; 41 sites), Milfoil spp. (*Myriophyllum* spp.; 29 sites), and Pondweed spp. (*Potamogeton* spp.; 28 sites).

Sites where Pugnose Shiner and Bridle Shiner were detected had similar habitat characteristics across water bodies and between species: sites were characterized by high water clarity, organic substrate, and dense submerged vegetation (Table 10). The dominant macrophyte taxon at these sites was Wild Celery.

Summaries of 2022 habitat sampling results for Presqu'ile Bay, Wellers Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay are provided below. Detailed habitat data are provided in Appendices 7(a – g) and 8(a – g). A complete list of macrophyte taxa by site is provided in Appendix 9.

Presqu'ile Bay

Water depth ranged from 0.9 to 1.3 m (median 1.0 m). Water temperatures ranged from 15.0 to 26.7°C (median: 17.7°C). Conductivity ranged from 134 to 276 $\mu\text{S}/\text{cm}$ (median: 187 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 0.97 to 1.10 m (median: 1.03 m). The substrates at sampling sites were largely organics, ranging from 30 to 100% (median: 100%) composition. Silt (ranged from 0 to 10%; median: 0%) and sand (ranged from 0 to 70%; median: 0%) were also present.

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median: 2). Filamentous algae were not present at any site. Submerged vegetation was dominant with 100% coverage at all sites. A total of 16 macrophyte species and five additional genera were identified in Presqu'ile Bay. The number of macrophyte taxa per site ranged from 4 to 13 (median: 7.5). The most abundant taxa were Wild Celery and Fern Pondweed (*Potamogeton robbinsii*), listed as “dominant” at 8 and 5 sites, respectively.

Wellers Bay

Water depth ranged from 0.9 to 1.3 m (median 1.0 m). Water temperatures ranged from 12.8 to 15.3 °C (median: 14.6 °C). Conductivity ranged from 237 to 247 $\mu\text{S}/\text{cm}$ (median: 245 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 1.02 to 1.08 m (median: 1.04 m). Organic substrate was dominant across all sites, ranging from 30 to 100% (median: 55%) composition. Sand (ranged from 0 to 60%; median 35%) and silt (ranged from 0 to 30%; median 0%) were also present.

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median 2.5). Submerged vegetation was dominant across sites, ranging from 90 to 100% (median 97.5%) coverage. Open water ranged from 0 to 10% (median 2.5%) coverage. Ten macrophyte species and three additional genera were identified from Wellers Bay. Number of taxa per site ranged from 3 to 10 (median 7.5). Fern Pondweed, Sago Pondweed, Stonewort spp., and Wild Celery were each listed as dominant at one site (although different sites for each taxon).

East Lake

Water depth ranged from 0.8 to 1.1 m (median: 1.0 m). Water temperatures ranged from 12.5 to 23.6°C (median: 15.3°C). Conductivity ranged from 117 to 276 $\mu\text{S}/\text{cm}$ (median: 218 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 0.97 to 1.09 m (median: 1.03 m). Substrates at sampling sites were largely organics, ranging from 15 to 100% (median: 90%) composition. Also present, sand ranged from 0 to 85% (median: 0%), and clay ranged from 0 to 50% (median: 0%).

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median: 2). Submerged vegetation was dominant across all sites, ranging from 90 to 100% (median: 95%) coverage. Floating vegetation ranged from 0 to 5% (median: 5%) coverage, and emergent vegetation ranged from 0 to 5% (median: 0%) coverage. Thirteen macrophyte species and four additional genera were identified from East Lake. Number of species per site ranged

from 8 to 12 (mean: 10.5). The most abundant taxon was Wild Celery, listed as “dominant” at four sites.

South Bay

Water depth ranged from 0.9 to 1.1 m (median: 1.0 m). Water temperatures ranged from 11.5 to 14.6°C (median: 14.5°C). Conductivity ranged from 230 to 318 $\mu\text{S}/\text{cm}$ (median: 302 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 0.85 to 1.10 m (median: 1.05 m). Substrates at sampling sites were largely organics, ranging from 50 to 100% (median: 80%) composition. Silt ranged from 0 to 30% (median: 20%) composition, clay ranged from 0 to 30% (median: 0%) composition, and sand ranged from 0 to 10% (median: 0%) composition.

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median: 3). Submerged vegetation represented 100% coverage at all sites. Nine macrophyte species and four additional genera were identified from South Bay. Number of species per site ranged from 3 to 8 (median: 4). The most abundant taxon was Stonewort spp., listed as “dominant” at five sites.

Black River

Water depth ranged from 0.7 to 1.0 m (median: 0.8 m). Water temperatures ranged from 20.8 to 22.1°C (median: 21.8°C). Conductivity ranged from 145 to 174 $\mu\text{S}/\text{cm}$ (median: 165 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 0.95 to 0.98 m (median: 0.96 m). Organic substrate represented 100% composition at all sampling sites.

Density of submerged macrophytes as determined by the rake method ranged from 2 to 3 (median: 3). Submerged vegetation was dominant across all sites, ranging from 85 to 100% (median: 95%) coverage. Floating vegetation ranged from 0 to 15% (median: 5%) coverage. Seven macrophyte species and two additional genera were identified from Black River. Number of species per site ranged from 5 to 8 (median: 6). The most abundant taxon was Richardson's Pondweed, listed as “dominant” at all three sites.

Waupoos Bay

Water depth ranged from 0.8 to 1.6 m (median: 1.1 m). Water temperatures ranged from 21.5 to 23.5°C (median: 23.2°C). Conductivity ranged from 117 to 143 $\mu\text{S}/\text{cm}$ (median: 132 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 1.00 to 1.06 m (median: 1.02 m). Organic substrate represented 100% composition at all sampling sites.

Density of submerged macrophytes as determined by the rake method ranged from 1 to 2 (median: 2). Submerged vegetation was dominant across all sites, ranging from 95 to 100% (median: 100%) coverage. Open water ranged from 0 to 5% (median: 0%) coverage. Twelve macrophyte species and three additional genera were identified from Waupoos Bay. Number of species per site ranged from 3 to 10 (median: 5). The most abundant taxon was Wild Celery, listed as “dominant” at eight sites.

Muscote Bay

Water depth ranged from 1.0 to 1.5 m (median: 1.3 m). Water temperatures ranged from 20.5 to 26.4°C (median: 23.1°C). Conductivity ranged from 99 to 123 $\mu\text{S}/\text{cm}$ (median: 108 $\mu\text{S}/\text{cm}$). Secchi tube values ranged from 0.90 to 1.10 m (median: 1.00 m). Organic substrate ranged from 25 to 100% (median: 100%) composition. Sand ranged from 0 to 75% (median: 0%) composition.

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median: 2). Submerged vegetation represented 100% coverage at all sites. Eleven macrophyte

species and three additional genera were identified from Muscote Bay. Number of species per site ranged from 5 to 11 (median: 8). The most abundant taxon was Pondweed spp., listed as “dominant” at five sites.

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Table 1. Relative abundance (% of individuals) and frequency of occurrence (% of sites) of fishes captured from seven eastern Lake Ontario coastal wetlands in 2022, calculated from pooled (three passes combined) catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	54.21	73.21
Bluegill	11.23	62.50
Bridle Shiner	10.49	53.57
Yellow Perch	4.24	69.64
Pumpkinseed	3.64	67.86
Pugnose Shiner	3.55	51.79
Sunfish spp.	2.95	57.14
Mimic Shiner	2.88	30.36
Banded Killifish	1.77	46.43
Largemouth Bass	1.18	55.36
Bluntnose Minnow	1.03	37.50
Rock Bass	0.87	35.71
Golden Shiner	0.74	21.43
Brook Silverside	0.26	17.86
Brown Bullhead	0.26	14.29
Shiner spp.	0.15	12.50
Brook Stickleback	0.13	7.14
Emerald Shiner	0.08	3.57
Round Goby	0.06	5.36
Tubenose Goby	0.06	3.57
Central Mudminnow	0.05	3.57
Minnow spp.	0.05	3.57
Tadpole Madtom	0.05	5.36
Northern Pike	0.03	3.57
Black Crappie	0.02	1.79
Pumpkinseed x Bluegill	0.02	1.79

Table 2. Comparison of fish species frequency of occurrence (%) from one pass and three passes (pooled) at sites across eastern Lake Ontario coastal wetlands sampled in 2022.

Common name	One pass	Three passes
Banded Killifish	26.79	44.64
Black Crappie	0.00	1.79
Blackchin Shiner	58.93	73.21
Bluegill	48.21	62.50
Bluntnose Minnow	23.21	35.71
Bridle Shiner	32.14	50.00
Brook Silverside	7.14	17.86
Brook Stickleback	0.00	7.14
Brown Bullhead	3.57	14.29
Central Mudminnow	1.79	1.79
Golden Shiner	5.36	19.64
Largemouth Bass	26.79	53.57
Mimic Shiner	14.29	28.57
Minnow spp.	0.00	3.57
Northern Pike	3.57	3.57
Pugnose Shiner	33.93	48.21
Pumpkinseed	44.64	66.07
Rock Bass	23.21	35.71
Round Goby	0.00	5.36
Shiner spp.	5.36	12.50
Sunfish spp.	39.29	57.14
Tadpole Madtom	1.79	5.36
Tubenose Goby	1.79	3.57
Yellow Perch	48.21	69.64

Table 3. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Presqu'ile Bay in 2022, calculated from all catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	41.46	66.67
Pumpkinseed	14.72	75.00
Yellow Perch	10.15	100.00
Largemouth Bass	7.11	91.67
Bluegill	4.74	58.33
Rock Bass	4.40	58.33
Banded Killifish	3.38	58.33
Bluntnose Minnow	2.71	41.67
Bridle Shiner	2.37	66.67
Sunfish spp.	2.20	83.33
Mimic Shiner	1.86	33.33
Pugnose Shiner	1.52	50.00
Brook Silverside	0.85	16.67
Brown Bullhead	0.51	25.00
Golden Shiner	0.51	16.67
Central Mudminnow	0.34	8.33
Minnow spp.	0.34	8.33
Round Goby	0.34	8.33
Tadpole Madtom	0.34	16.67
Brook Stickleback	0.17	8.33

Table 4. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Wellers Bay in 2022, calculated from all catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	70.50	100.00
Mimic Shiner	8.22	66.67
Bluegill	7.31	66.67
Pugnose Shiner	7.21	66.67
Bluntnose Minnow	1.46	33.33
Yellow Perch	1.37	83.33
Pumpkinseed	1.19	16.67
Sunfish spp.	0.82	33.33
Golden Shiner	0.64	33.33
Emerald Shiner	0.46	33.33
Largemouth Bass	0.27	50.00
Banded Killifish	0.18	33.33
Bridle Shiner	0.18	33.33
Brook Silverside	0.09	16.67
Rock Bass	0.09	16.67

Table 5. Relative abundance (%) and frequency of occurrence (%) of fishes captured from East Lake in 2022, calculated from all catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	59.39	87.50
Bridle Shiner	14.68	100.00
Bluegill	7.90	75.00
Yellow Perch	5.86	100.00
Sunfish spp.	3.53	62.50
Pugnose Shiner	3.07	87.50
Pumpkinseed	1.49	75.00
Mimic Shiner	1.35	62.50
Golden Shiner	0.70	37.50
Banded Killifish	0.65	37.50
Rock Bass	0.42	37.50
Bluntnose Minnow	0.28	25.00
Largemouth Bass	0.28	37.50
Brook Silverside	0.09	25.00
Brook Stickleback	0.09	12.50
Black Crappie	0.05	12.50
Brown Bullhead	0.05	12.50
Central Mudminnow	0.05	12.50
Pumpkinseed x Bluegill	0.05	12.50
Shiner spp.	0.05	12.50

Table 6. Relative abundance (%) and frequency of occurrence (%) of fishes captured from South Bay in 2022, calculated from pooled (three passes combined) catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	77.96	88.89
Mimic Shiner	4.84	44.44
Banded Killifish	4.45	55.56
Pugnose Shiner	3.85	66.67
Bridle Shiner	1.78	55.56
Pumpkinseed	0.99	55.56
Rock Bass	0.89	44.44
Golden Shiner	0.69	11.11
Brown Bullhead	0.59	11.11
Sunfish spp.	0.59	22.22
Brook Stickleback	0.49	22.22
Shiner spp.	0.49	33.33
Tube-nose Goby	0.40	22.22
Yellow Perch	0.40	33.33
Bluntnose Minnow	0.30	22.22
Brook Silverside	0.20	11.11
Largemouth Bass	0.20	22.22
Round Goby	0.20	22.22
Bluegill	0.10	11.11
Tadpole Madtom	0.10	11.11

Table 7. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Black River in 2022, calculated from pooled (three passes combined) catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Bridle Shiner	55.26	66.67
Blackchin Shiner	36.09	100.00
Pumpkinseed	4.14	100.00
Golden Shiner	1.69	100.00
Bluegill	0.94	33.33
Sunfish spp.	0.56	33.33
Largemouth Bass	0.38	33.33
Northern Pike	0.19	33.33
Pugnose Shiner	0.19	33.33
Rock Bass	0.19	33.33
Yellow Perch	0.19	33.33

Table 8. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Waupoos Bay in 2022, calculated from pooled (three passes combined) catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Blackchin Shiner	30.60	88.89
Bluegill	18.86	77.78
Sunfish spp.	11.74	66.67
Pugnose Shiner	9.25	55.56
Pumpkinseed	7.83	77.78
Banded Killifish	6.76	66.67
Largemouth Bass	4.27	88.89
Bluntnose Minnow	3.91	44.44
Brown Bullhead	2.14	33.33
Bridle Shiner	1.07	22.22
Shiner spp.	1.07	33.33
Rock Bass	0.71	22.22
Yellow Perch	0.71	22.22
Brook Silverside	0.36	11.11
Minnow spp.	0.36	11.11
Northern Pike	0.36	11.11

Table 9. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Muscote Bay in 2022, calculated from pooled (three passes combined) catch data. Species are listed in order from most to least abundant.

Common name	Relative abundance (%)	Frequency of occurrence (%)
Bluegill	65.57	100.00
Yellow Perch	10.02	88.89
Sunfish spp.	7.83	66.67
Pumpkinseed	7.29	77.78
Bluntnose Minnow	2.19	66.67
Banded Killifish	1.82	33.33
Largemouth Bass	1.09	33.33
Rock Bass	1.09	22.22
Brook Silverside	0.91	33.33
Golden Shiner	0.91	11.11
Bridle Shiner	0.73	33.33
Blackchin Shiner	0.36	11.11

Table 10. Summary of habitat characteristics at sites where Pugnose Shiner (*Notropis anogenus*) and Bridle Shiner (*Notropis bifrenatus*) were detected during surface trawl surveys in 2022. Water clarity, temperature, and conductivity are presented as mean values. Dominant macrophyte taxa and substrate material are listed.

Waterbody	Habitat summary	
	Pugnose Shiner	Bridle Shiner
Presqu'ile Bay	0.7-1.4 m depth	0.7-1.2 m depth
	1.01 m clarity	1.01 m clarity
	17.0°C	17.1°C
	217 µS/cm	217 µS/cm
	Wild Celery organic substrate	Wild Celery organic substrate
Weller's Bay	1.0-1.3 m depth	1.0-1.3 m depth
	1.05 m clarity	1.05 m clarity
	16.1°C	16.1°C
	244 µS/cm	244 µS/cm
	Fern Pondweed, Wild Celery, Stonewort spp. organic substrate	Fern Pondweed, Wild Celery organic substrate
East Lake	0.8-1.1 m depth	0.8-1.1 m depth
	1.03 m clarity	1.03 m clarity
	16.9°C	16.7°C
	202 µS/cm	206 µS/cm
	Wild Celery organic substrate	Wild Celery organic substrate
South Bay	0.8-1.0 m depth	0.9-1.0 m depth
	1.02 m clarity	1.02 m clarity
	14.0°C	13.9°C
	295 µS/cm	293 µS/cm
	Stonewort spp. organic substrate	Wild Celery, Stonewort spp., Eurasian Watermilfoil organic substrate
Black River	0.8 m depth	0.6-0.8 m depth
	0.95 m clarity	0.96 m clarity
	21.8°C	22.0°C
	165 µS/cm	155 µS/cm
	Richardson's Pondweed, Wild Celery organic substrate	Richardson's Pondweed, Wild Celery organic substrate
Waupoos Bay	0.7-1.3 m depth	1.0-1.3 m depth
	1.01 m clarity	1.04 m clarity
	22.7°C	23.0°C
	125 µS/cm	125 µS/cm
	Wild Celery organic substrate	Wild Celery organic substrate
Muscote Bay	No Pugnose Shiner caught	0.8-1.3 m depth 1.01 m clarity 22.5°C 101 µS/cm Pondweed spp., Milfoil spp. organic substrate

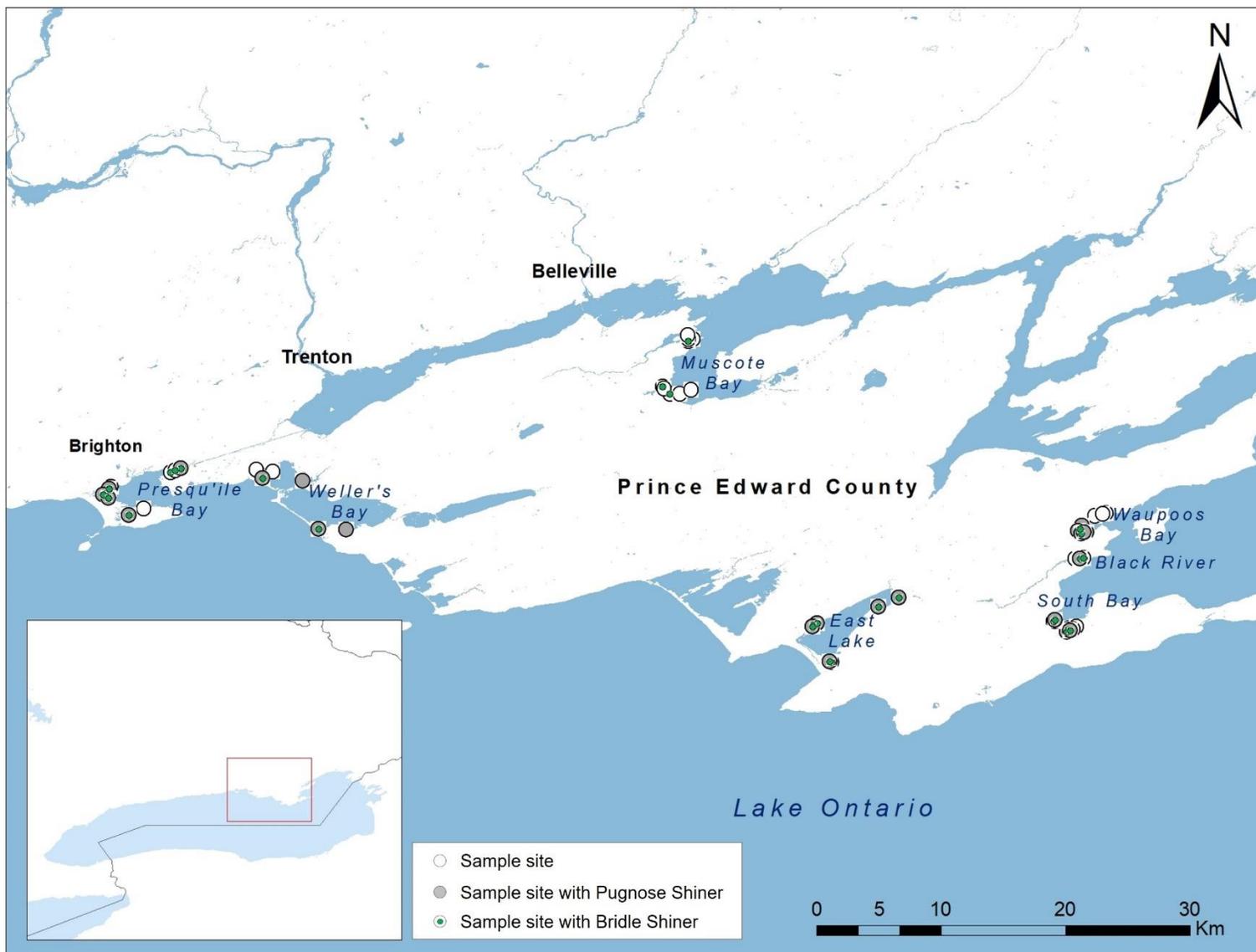


Figure 1. Map of 56 sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Presqu'ile Bay, Weller's Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay. Open circle = sample site; grey circle = sample site where Pugnose Shiner was detected; green dot = sample site where Bridle Shiner (*Notropis bifrenatus*) was detected.



Figure 2. Macrophyte sample collected following methods described by Wagner and Mikulyuk (2012). This sample was classified as 2 on the scale of 0–3 representing density of plants on the rake.

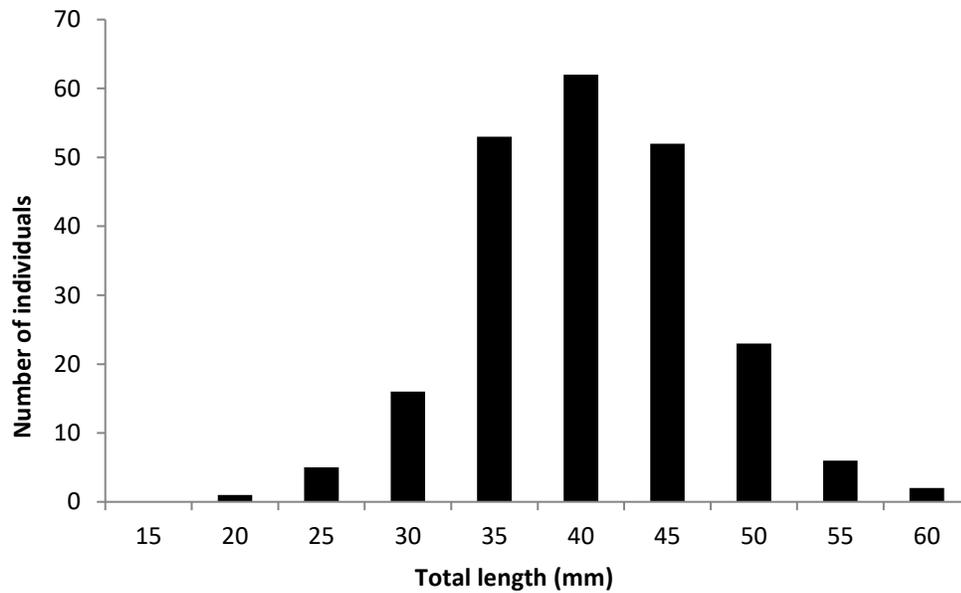


Figure 3. Length distribution of Pugnose Shiner (*Notropis anogenus*; n = 220) captured from seven eastern Ontario coastal wetlands during surface trawl surveys in 2022.

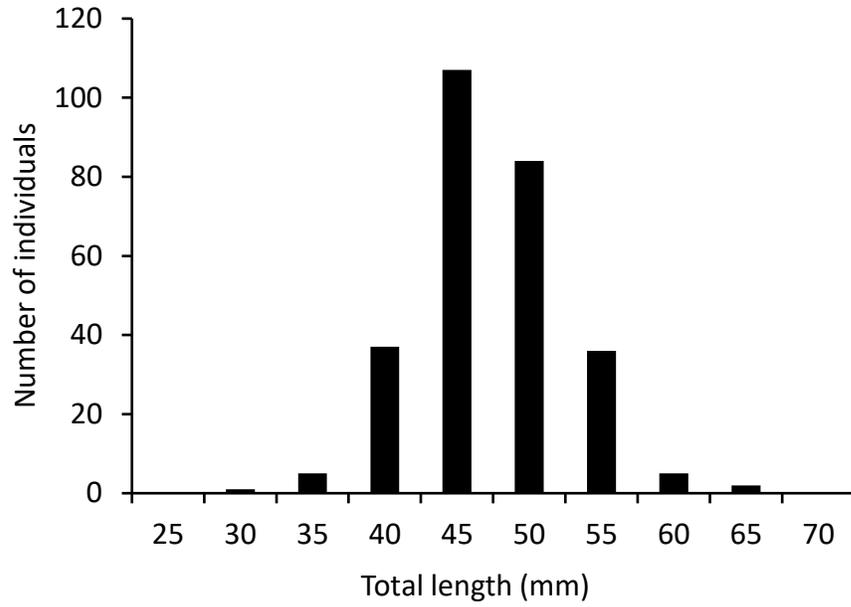


Figure 4. Length distribution of Bridle Shiner (*Notropis bifrenatus*; n = 651) captured from seven eastern Ontario coastal wetlands during surface trawl surveys in 2022.

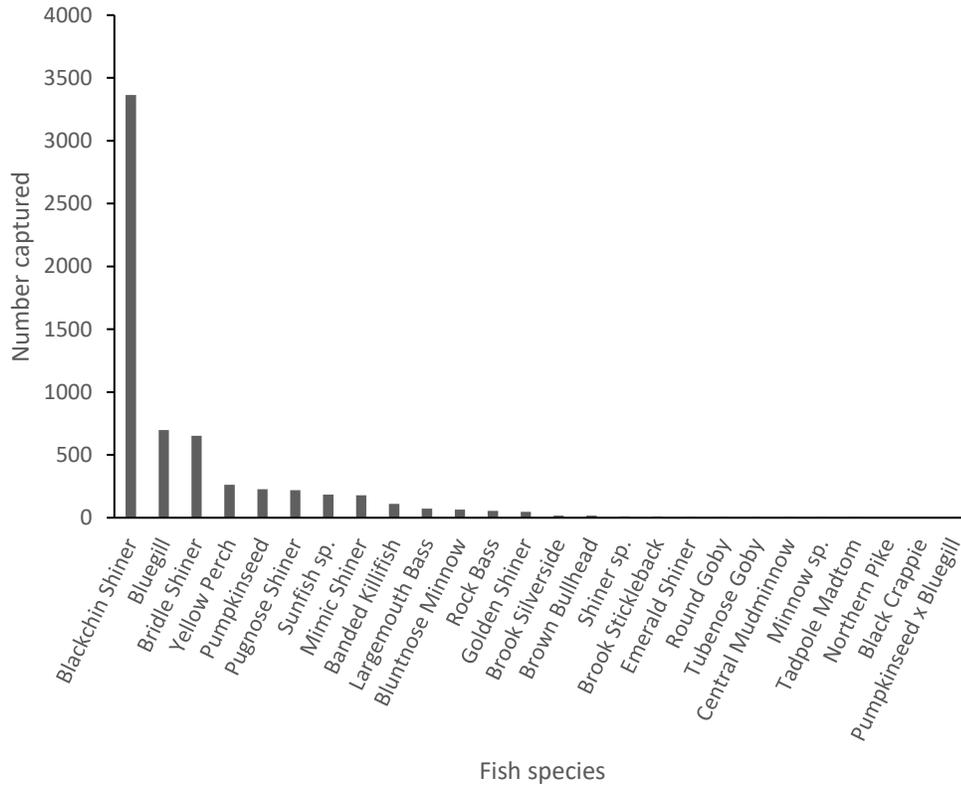


Figure 5. Rank-abundance of fish species captured from seven eastern Lake Ontario coastal wetlands in 2022, calculated from pooled (three passes combined) catch data.

APPENDICES

Appendix 1a. Site locality information for 12 sampling events targeting Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Presqu'île Bay, 2022. Dash (-) indicates measurement not recorded.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity (µS/cm)	Secchi tube (m)
Presq14	11-Aug-22	43.99805	-77.71478	1.0	25.6	142	0.98
Presq15	11-Aug-22	44.00251	-77.70454	1.0	26.6	149	1.10
Presq16	11-Aug-22	44.01309	-77.73223	1.1	26.7	139	1.05
Presq17	11-Aug-22	44.01249	-77.73348	1.0	25.7	148	0.98
Presq18*	20-Sep-22	44.01254	-77.73347	0.9	19.8	140	-
Presq19*	20-Sep-22	44.01015	-77.72942	0.9	20.0	134	-
Presq20	27-Sep-22	44.01568	-77.73006	1.1	15.2	243	1.08
Presq21	27-Sep-22	44.01812	-77.72770	1.2	15.2	225	1.06
Presq22	27-Sep-22	44.01707	-77.72922	1.0	15.3	233	1.00
Presq23	3-Oct-22	44.02888	-77.68481	1.0	15.0	275	1.05
Presq24	3-Oct-22	44.03162	-77.67715	1.1	15.5	274	0.98
Presq25	3-Oct-22	44.03009	-77.68153	1.3	15.1	276	0.97

*resampling events using six passes

Appendix 1b. Site locality information for six sampling events targeting Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Wellers Bay, 2022. Dash (-) indicates measurement not recorded.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity (µS/cm)	Secchi tube (m)
Well12*	21-Sep-22	43.98771	-77.57760	1.1	19.4	241	-
Well13*	21-Sep-22	43.98745	-77.55793	1.1	20.4	246	-
Well14	5-Oct-22	44.02467	-77.61806	1.0	12.8	247	1.05
Well15	5-Oct-22	44.03048	-77.62318	0.9	13.9	242	1.02
Well16	5-Oct-22	44.02925	-77.61119	1.3	15.2	237	1.02
Well17	5-Oct-22	44.02254	-77.58938	1.0	15.3	247	1.08

*resampling events using six passes

Appendix 1c. Site locality information for eight sampling events targeting Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in East Lake, 2022. Dash (-) indicates measurement not recorded.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity ($\mu\text{S}/\text{cm}$)	Secchi tube (m)
EastL08	12-Sep-22	43.93836	-77.15820	1.0	22.6	117	0.97
EastL09	12-Sep-22	43.93153	-77.17309	0.9	23.6	119	1.05
EastL10	29-Sep-22	43.91961	-77.21732	0.8	15.1	253	1.00
EastL11	29-Sep-22	43.91826	-77.22053	-	15.1	235	1.00
EastL12	29-Sep-22	43.89183	-77.20854	1.0	15.4	276	1.05
EastL13	29-Sep-22	43.89173	-77.20703	0.9	15.4	256	1.09
EastL14*	11-Oct-22	43.91742	-77.22090	1.0	12.5	192	1.00
EastL15*	11-Oct-22	43.89223	-77.20827	1.1	13.6	201	1.07

*resampling events using six passes

Appendix 1d. Site locality information for nine sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in South Bay, 2022.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity ($\mu\text{S}/\text{cm}$)	Secchi tube (m)
South01	30-Sep-22	43.91496	-77.03649	0.9	14.5	303	1.07
South02	30-Sep-22	43.91332	-77.03700	1.0	14.5	310	0.85
South03	30-Sep-22	43.91602	-77.03587	1.1	14.5	302	1.03
South04	30-Sep-22	43.92133	-77.04621	0.9	14.6	300	1.06
South05	30-Sep-22	43.92095	-77.04540	0.9	14.3	301	1.05
South06	4-Oct-22	43.91750	-77.03046	1.0	13.4	307	1.10
South07	4-Oct-22	43.91542	-77.03266	1.0	12.2	230	1.05
South08	4-Oct-22	43.91435	-77.03455	1.0	11.5	236	1.06
South09	4-Oct-22	43.92235	-77.04566	0.9	14.5	318	1.04

Appendix 1e. Site locality information for three sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Black River, 2022.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity ($\mu\text{S}/\text{cm}$)	Secchi tube (m)
Black01	7-Sep-22	43.96646	-77.02760	0.8	21.8	165	0.95
Black02	7-Sep-22	43.96622	-77.03140	1.0	20.8	174	0.98
Black03	7-Sep-22	43.96685	-77.02485	0.7	22.1	145	0.96

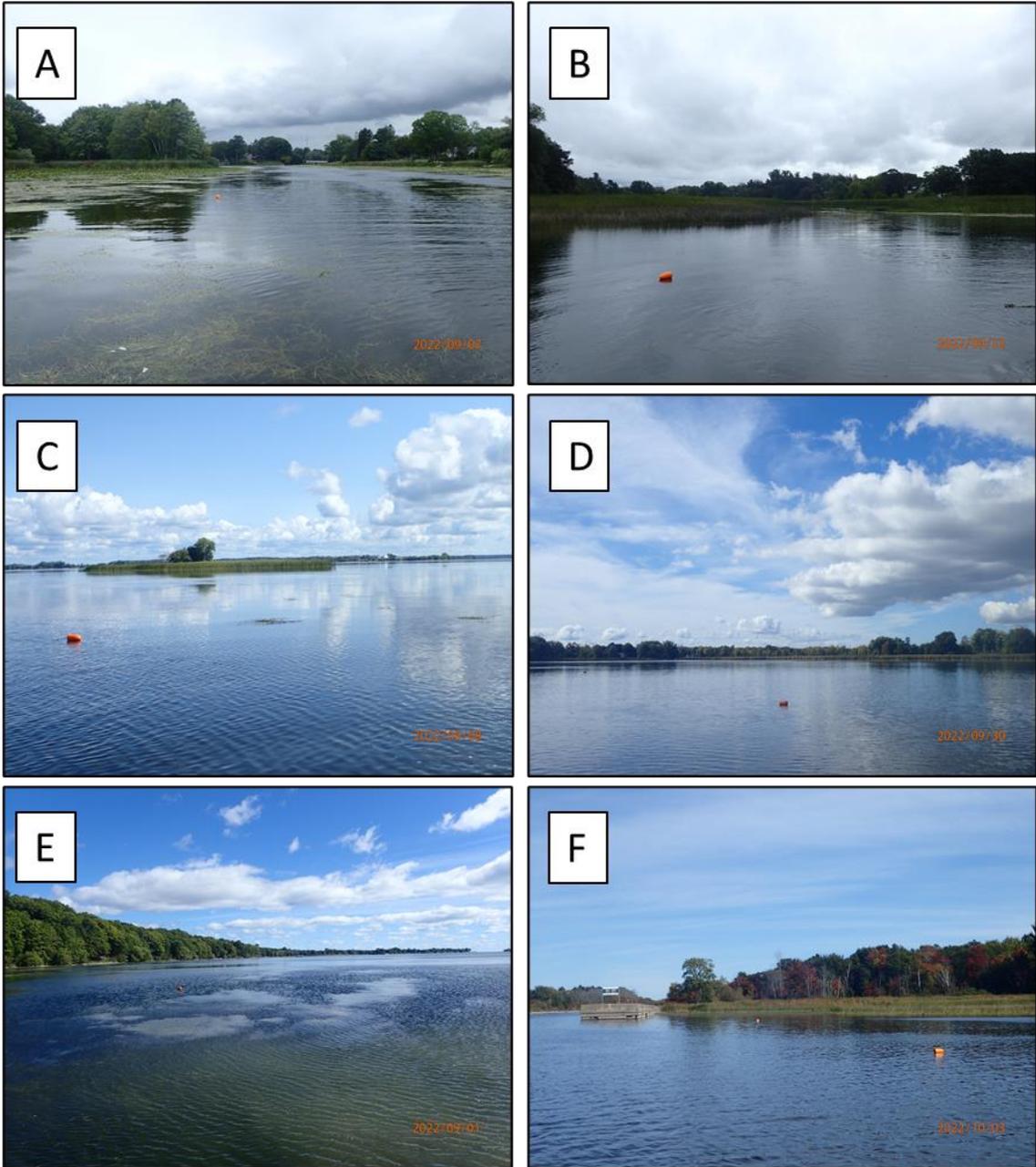
Appendix 1f. Site locality information for nine sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Waupoos Bay, 2022.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity ($\mu\text{S}/\text{cm}$)	Secchi tube (m)
Waup01	1-Sep-22	43.99023	-77.02612	1.1	21.5	117	1.01
Waup02	1-Sep-22	43.98624	-77.02870	1.1	22.4	120	1.00
Waup03	1-Sep-22	43.98440	-77.02634	1.3	22.6	120	1.02
Waup04	1-Sep-22	43.99746	-77.01685	1.6	23.4	132	1.05
Waup05	9-Sep-22	43.99936	-77.00870	1.4	22.7	143	1.04
Waup06	9-Sep-22	43.99864	-77.01112	0.9	23.2	142	1.05
Waup07	9-Sep-22	43.98795	-77.02733	1.0	23.4	130	1.06
Waup08	9-Sep-22	43.98539	-77.02276	0.8	23.5	135	1.00
Waup09	9-Sep-22	43.98552	-77.02464	1.3	23.4	132	1.01

Appendix 1g. Site locality information for nine sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Muscote Bay, 2022.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity ($\mu\text{S}/\text{cm}$)	Secchi tube (m)
Musc01	17-Aug-22	44.12476	-77.30717	1.0	26.1	121	0.90
Musc02	17-Aug-22	44.12363	-77.31054	1.1	26.2	99	1.00
Musc03	17-Aug-22	44.12497	-77.31057	1.5	26.4	109	1.02
Musc04	17-Aug-22	44.12767	-77.31100	1.3	25.8	108	0.98
Musc05	8-Sep-22	44.09088	-77.32936	1.3	20.5	103	1.02
Musc06	8-Sep-22	44.08543	-77.32394	1.1	20.9	101	1.00
Musc07	8-Sep-22	44.08541	-77.31694	1.3	21.9	113	1.07
Musc08	8-Sep-22	44.08845	-77.30898	1.3	22.4	123	0.95
Musc09	8-Sep-22	44.08907	-77.32808	1.1	23.1	102	1.10

Appendix 2. Site photos representing examples of aquatic habitat sampled during 2022 targeted sampling for Pugnose Shiner (*Notropis anogenus*) in six eastern Lake Ontario coastal wetlands: a) Black River, b) East Lake, c) Muscote Bay, d) South Bay, e) Waupoos Bay, and f) Wellers Bay.



Appendix 3a. Common and scientific names of fishes captured from Presqu'île Bay, Wellers Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay during targeted sampling for Pugnose Shiner (*Notropis anogenus*) in 2022.

Common name	Scientific name
Banded Killifish	<i>Fundulus diaphanus</i>
Black Crappie	<i>Pomoxis nigromaculatus</i>
Blackchin Shiner	<i>Notropis heterodon</i>
Bluegill	<i>Lepomis macrochirus</i>
Bluntnose Minnow	<i>Pimephales notatus</i>
Bridle Shiner	<i>Notropis bifrenatus</i>
Brook Silverside	<i>Labidesthes sicculus</i>
Brook Stickleback	<i>Culaea inconstans</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>
Central Mudminnow	<i>Umbra limi</i>
Emerald Shiner	<i>Notropis atherinoides</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Largemouth Bass	<i>Micropterus salmoides</i>
Mimic Shiner	<i>Notropis volucellus</i>
Minnow spp.	<i>Cyprinid spp.</i>
Northern Pike	<i>Esox lucius</i>
Pugnose Shiner	<i>Notropis anogenus</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Pumpkinseed x Bluegill	<i>Lepomis gibbosus x Lepomis macrochirus</i>
Rock Bass	<i>Ambloplites rupestris</i>
Round Goby	<i>Neogobius melanostomus</i>
Shiner spp.	<i>Notropis spp.</i>
Sunfish spp.	<i>Lepomis spp.</i>
Tadpole Madtom	<i>Noturus gyrinus</i>
Tubenose Goby	<i>Proterorhinus semilunaris</i>
Yellow Perch	<i>Perca flavescens</i>

Appendix 3b. Common and scientific names of aquatic macrophytes collected from Presqu'île Bay, Wellers Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay during targeted sampling for Pugnose Shiner (*Notropis anogenus*) in 2022.

Common name	Scientific name
Canadian Waterweed	<i>Elodea canadensis</i>
Common Bladderwort	<i>Utricularia vulgaris</i>
Coontail	<i>Ceratophyllum demersum</i>
Curly-leaf Pondweed	<i>Potamogeton crispus</i>
Eurasian Watermilfoil	<i>Myriophyllum spicatum</i>
Fern Pondweed	<i>Potamogeton robbinsii</i>
Flatstem Pondweed	<i>Potamogeton zosteriformis</i>
Large-leaved Pondweed	<i>Potamogeton amplifolius</i>
Milfoil spp.	<i>Myriophyllum spp.</i>
Nitella spp.	<i>Nitella spp.</i>
Northern Watermilfoil	<i>Myriophyllum sibiricum</i>
Pondweed spp.	<i>Potamogeton spp.</i>
Richardson's Pondweed	<i>Potamogeton richardsonii</i>
Sago Pondweed	<i>Stuckenia pectinata</i>
Slender Naiad	<i>Najas flexilis</i>
Stonewort spp.	<i>Chara spp.</i>
Variable-leaved Pondweed	<i>Potamogeton gramineus</i>
Water Lily spp.	<i>Nymphaea spp.</i>
Water Marigold	<i>Caltha palustris</i>
White Water Crowfoot	<i>Ranunculus aquatilis</i>
White Water Lily	<i>Nymphaea alba</i>
White-stemmed Pondweed	<i>Potamogeton praelongus</i>
Wild Celery	<i>Vallisneria americana</i>
Wild Rice	<i>Zizania palustris</i>

Appendix 4. Species-specific sampling related mortalities associated with surface trawling during 56 sampling events across seven eastern Lake Ontario coastal wetlands in 2022. Passes with no mortalities are not listed.

Site code	Pass #	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Mimic Shiner	Minnow spp.	Pugnose Shiner	Shiner spp.	Sunfish spp.	Tubenose Goby	Yellow Perch
Black01	1	0	4	0	0	3	0	0	0	0	0	0	0	0
Black01	2	0	1	0	0	5	0	0	0	0	0	0	0	0
Black03	1	0	6	0	0	0	0	0	0	0	0	0	0	0
Black03	2	0	0	0	0	1	0	0	0	0	0	0	0	0
EastL08	1	0	3	0	0	3	0	0	0	0	0	0	0	0
EastL08	2	0	1	1	0	1	0	0	0	0	0	0	0	0
EastL08	3	0	6	0	0	2	0	0	0	0	0	0	0	1
EastL09	3	0	0	0	0	0	0	0	0	0	0	0	0	1
EastL10	3	0	1	0	0	0	0	0	0	0	0	0	0	0
EastL12	2	0	2	0	0	1	0	0	0	0	0	0	0	0
EastL12	3	0	7	0	0	0	0	0	0	0	0	0	0	0
EastL13	1	0	4	0	0	0	0	0	0	0	0	0	0	0
EastL13	2	0	0	0	0	0	0	0	0	1	0	0	0	0
EastL14	4	0	9	0	0	0	0	0	0	0	0	0	0	0
EastL14	5	0	16	0	0	0	0	0	0	0	0	0	0	0
EastL14	6	0	0	0	0	3	0	0	0	0	0	0	0	0
EastL15	5	0	3	0	0	0	0	0	0	0	0	0	0	0
EastL15	6	0	0	0	0	0	0	1	0	0	0	0	0	0
Musc01	3	0	0	2	0	0	0	0	0	0	0	0	0	0
Musc02	1	0	0	1	0	0	0	0	0	0	0	1	0	0
Musc03	3	0	0	0	0	0	0	0	0	0	0	1	0	0
Musc08	2	0	0	1	0	0	0	0	0	0	0	0	0	0
Musc08	3	0	0	0	0	0	0	0	0	0	0	1	0	0
Presq14	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Presq14	2	0	3	0	0	0	0	0	1	0	0	0	0	0
Presq14	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Presq18	6	0	0	0	0	1	0	0	0	0	0	0	0	0
Presq19	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Presq20	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Presq21	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Presq21	3	0	6	0	0	0	0	0	0	1	0	0	0	0
South01	1	0	0	0	0	0	1	0	0	0	0	0	0	0
South05	1	0	1	0	1	0	0	0	0	0	0	0	0	0
South05	2	0	1	0	0	0	0	0	0	0	0	0	0	0
South05	3	0	0	0	0	0	0	0	0	0	0	0	1	0
South08	2	0	0	0	0	0	0	0	0	1	1	0	0	0
South09	1	0	2	0	0	0	0	0	0	0	0	0	0	0
South09	2	0	3	0	0	0	0	0	0	0	0	0	0	0
South09	3	0	4	0	0	0	0	2	0	0	0	0	0	0

Appendix 4. (Continued)

Site code	Pass #	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Mimic Shiner	Minnow spp.	Pugnose Shiner	Shiner spp.	Sunfish spp.	Tubenose Goby	Yellow Perch
Waup01	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Waup01	3	0	0	0	0	0	0	0	1	0	0	0	0	0
Waup02	3	0	2	0	0	0	0	0	0	0	0	0	0	0
Waup03	2	0	0	0	0	1	0	0	0	0	0	0	0	0
Waup03	3	0	4	0	0	0	0	0	0	0	0	0	0	0
Waup04	3	0	0	0	0	0	0	0	0	0	0	1	0	0
Waup08	2	0	1	0	0	0	0	0	0	1	0	0	0	0
Waup09	2	0	0	0	1	0	0	0	0	0	0	0	0	0
Waup09	3	0	0	0	0	0	0	0	0	0	1	0	0	0
Well12	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Well12	4	0	4	0	0	0	0	0	0	1	0	0	0	0
Well12	6	0	18	0	0	0	0	0	0	0	0	0	0	0
Well13	5	0	0	0	0	0	0	1	0	0	0	0	0	0
Well14	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Well15	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Well16	3	0	5	0	0	0	0	0	0	0	0	0	0	0
Total		1	125	5	2	21	1	4	2	5	2	4	1	2

Appendix 5a. Pooled species count data for fishes captured at 13 sites in Presqu'ile Bay during surface trawl surveys in 2022.

Site code	Common name																			Total	
	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Central Mudminnow	Golden Shiner	Largemouth Bass	Mimic Shiner	Minnow spp.	Pugnose Shiner	Pumpkinseed	Rock Bass	Round Goby	Sunfish spp.	Tadpole Madtom		Yellow Perch
Presq14	2	15	3	2	1	0	0	1	0	0	4	0	2	2	18	7	0	1	1	3	62
Presq15	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	1	8
Presq16	0	0	0	0	3	0	0	0	0	0	3	0	0	0	2	0	0	1	0	5	14
Presq17	0	0	2	0	0	0	0	1	0	0	2	0	0	0	7	1	0	1	0	2	16
Presq18*	0	0	16	0	2	0	0	0	2	0	8	0	0	1	10	0	0	0	1	1	41
Presq19*	10	31	4	1	1	0	1	0	0	1	5	0	0	1	14	5	2	1	0	21	98
Presq20	0	60	1	0	0	0	0	0	0	0	1	7	0	0	1	1	0	3	0	2	76
Presq21	1	103	0	2	0	0	0	0	0	0	5	1	0	2	1	0	0	1	0	2	118
Presq22	2	11	0	0	1	0	0	0	0	0	5	1	0	2	3	3	0	1	0	4	33
Presq23	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	3	0	1	0	2	10
Presq24	3	21	1	9	3	3	0	1	0	2	3	2	0	1	31	6	0	2	0	16	104
Presq25	1	2	0	2	1	2	0	0	0	0	2	0	0	0	0	0	0	0	0	1	11
Total	20	245	28	16	14	5	1	3	2	3	42	11	2	9	87	26	2	13	2	60	591

*resampling events using six passes

Appendix 5b. Pooled species count data for fishes captured at six sites in Wellers Bay during surface trawl surveys in 2022.

Site code	Common name														Total	
	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Emerald Shiner	Golden Shiner	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Sunfish spp.		Yellow Perch
Well12*	1	662	15	9	1	1	3	0	1	66	72	0	0	6	2	839
Well13*	0	25	56	7	0	0	2	6	1	11	1	13	0	3	1	126
Well14	1	66	6	0	1	0	0	1	1	12	4	0	0	0	9	101
Well15	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	4
Well16	0	10	3	0	0	0	0	0	0	0	0	0	0	0	0	13
Well17	0	8	0	0	0	0	0	0	0	1	2	0	0	0	1	12
Total	2	772	80	16	2	1	5	7	3	90	79	13	1	9	15	1095

*resampling events using six passes

Appendix 5c. Pooled species count data for fishes captured at seven sites on East Lake during surface trawl surveys in 2022.

Site code	Common name																			Total	
	Banded Killifish	Black Crappie	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Central Mudminnow	Golden Shiner	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Pumpkinseed x Bluegill	Rock Bass	Shiner spp.	Sunfish spp.		Yellow Perch
EastL08	0	1	196	132	4	124	1	0	0	0	8	3	0	8	21	0	3	1	53	75	630
EastL09	0	0	8	12	2	3	0	2	1	0	0	2	0	2	7	0	3	0	16	9	67
EastL10	7	0	57	10	0	10	0	0	0	0	1	0	1	5	1	0	3	0	0	15	110
EastL11	5	0	0	1	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	6	15
EastL12	0	0	302	0	0	9	1	0	0	0	6	0	3	26	0	0	0	0	1	2	350
EastL13	0	0	102	5	0	8	0	0	0	0	0	0	1	16	1	0	0	0	1	10	144
EastL14*	2	0	514	10	0	155	0	0	0	1	0	1	14	7	1	0	0	0	5	7	717
EastL15*	0	0	99	0	0	5	0	0	0	0	0	0	10	2	0	1	0	0	0	2	119
Total	14	1	1278	170	6	316	2	2	1	1	15	6	29	66	32	1	9	1	76	126	2152

*resampling events using six passes

Appendix 5d. Pooled species count data for fishes captured at nine sites in South Bay during surface trawl surveys in 2022.

Site code	Common name																			Total	
	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Golden Shiner	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Round Goby	Shiner spp.	Sunfish spp.	Tadpole Madtom	Tubenose Goby		Yellow Perch
South01	2	29	0	0	5	2	0	0	0	1	0	8	1	1	0	0	0	0	0	0	49
South02	0	2	0	0	3	0	0	6	0	0	0	2	4	3	0	1	3	0	0	1	25
South03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South04	33	32	1	0	6	0	4	0	7	1	1	14	3	3	1	1	0	1	2	2	112
South05	4	22	0	1	0	0	1	0	0	0	5	3	1	2	1	0	0	0	2	0	42
South06	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
South07	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
South08	2	6	0	0	2	0	0	0	0	0	0	8	1	0	0	3	3	0	0	1	26
South09	4	694	0	2	2	0	0	0	0	0	42	4	0	0	0	0	0	0	0	0	748
Total	45	789	1	3	18	2	5	6	7	2	49	39	10	9	2	5	6	1	4	4	1007

Appendix 5e. Pooled species count data for fishes captured at three sites in Black River during surface trawl surveys in 2022.

Site code	Common name											Total
	Blackchin Shiner	Bluegill	Bridle Shiner	Golden Shiner	Largemouth Bass	Northern Pike	Pugnose Shiner	Pumpkinseed	Rock Bass	Sunfish spp.	Yellow Perch	
Black01	35	5	223	4	2	0	1	17	0	3	1	291
Black02	10	0	0	4	0	0	0	2	0	0	0	16
Black03	147	0	71	1	0	1	0	3	1	0	0	224
Total	192	5	294	9	2	1	1	22	1	3	1	531

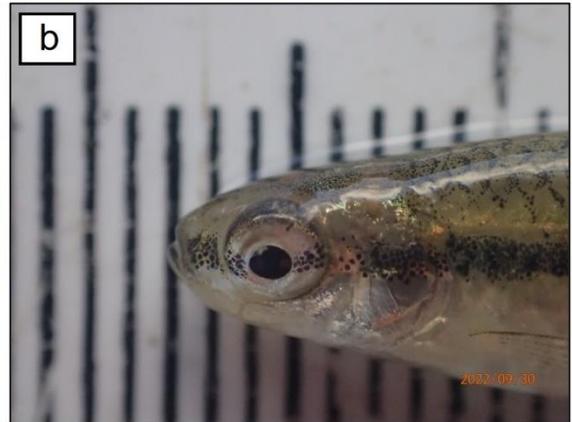
Appendix 5f. Pooled species count data for fishes captured at nine sites in Waupoos Bay during surface trawl surveys in 2022.

Site code	Common name															Total	
	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brown Bullhead	Largemouth Bass	Minnow spp.	Northern Pike	Pugnose Shiner	Pumpkinseed	Rock Bass	Shiner spp.	Sunfish spp.		Yellow Perch
Waup01	3	3	0	0	0	0	0	1	1	0	3	1	0	0	0	0	12
Waup02	0	16	19	3	0	0	0	2	0	0	11	4	0	0	4	0	59
Waup03	0	23	21	2	2	0	0	1	0	0	5	0	0	0	11	0	65
Waup04	0	1	1	0	0	0	0	0	0	0	0	1	0	0	4	0	7
Waup05	2	4	3	0	0	0	0	1	0	1	0	6	1	0	5	1	24
Waup06	1	0	1	0	0	0	1	3	0	0	0	4	0	0	4	0	14
Waup07	2	2	6	0	1	0	4	2	0	0	0	2	1	1	5	0	26
Waup08	10	14	2	1	0	0	1	1	0	0	6	4	0	1	0	0	40
Waup09	1	23	0	5	0	1	0	1	0	0	1	0	0	1	0	1	34
Total	19	86	53	11	3	1	6	12	1	1	26	22	2	3	33	2	281

Appendix 5g. Pooled species count data for fishes captured at nine sites in Muscote Bay during surface trawl surveys in 2022.

Site code	Common name												Total
	Banded Killifish	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Golden Shiner	Largemouth Bass	Pumpkinseed	Rock Bass	Sunfish spp.	Yellow Perch	
Musc01	0	0	48	0	0	0	0	1	0	0	0	7	56
Musc02	1	0	10	2	1	0	0	2	2	0	9	10	37
Musc03	1	0	23	1	0	0	0	0	7	0	3	5	40
Musc04	0	0	6	0	0	0	0	3	7	0	13	4	33
Musc05	0	0	12	1	2	1	0	0	5	0	5	1	27
Musc06	0	2	5	3	1	1	0	0	1	0	0	0	13
Musc07	8	0	95	3	0	0	0	0	14	4	12	24	160
Musc08	0	0	158	2	0	3	5	0	4	2	1	3	178
Musc09	0	0	3	0	0	0	0	0	0	0	0	1	4
Total	10	2	360	12	4	5	5	6	40	6	43	55	548

Appendix 6. Photos of species at risk collected from eastern Lake Ontario coastal wetlands during surface trawl surveys in 2022: a) Pugnose Shiner (*Notropis anogenus*), b) close-up of Pugnose Shiner showing very small, upturned mouth and pigment on chin (Holm et al. 2009), c) Bridle Shiner (*Notropis bifrenatus*), and d) close-up of Bridle Shiner showing dark lateral line on a short snout and no pigment on chin (Holm et al. 2009).



Appendix 7a. Percent substrate composition at ten sites sampled in Presqu'ile Bay during surface trawl surveys in 2022.

Substrate (% composition)								
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Presq14	100	0	0	0	0	0	0	0
Presq15	100	0	0	0	0	0	0	0
Presq16	80	0	10	10	0	0	0	0
Presq17	100	0	0	0	0	0	0	0
Presq20	30	0	0	70	0	0	0	0
Presq21	80	0	0	20	0	0	0	0
Presq22	80	0	0	20	0	0	0	0
Presq23	100	0	0	0	0	0	0	0
Presq24	100	0	0	0	0	0	0	0
Presq25	100	0	0	0	0	0	0	0
Minimum	30	0	0	0	0	0	0	0
Maximum	100	0	10	70	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7b. Percent substrate composition at four sites sampled in Wellers Bay during surface trawl surveys in 2022.

Substrate (% composition)								
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Well14	70	0	0	30	0	0	0	0
Well15	100	0	0	0	0	0	0	0
Well16	40	0	0	60	0	0	0	0
Well17	30	0	30	40	0	0	0	0
Minimum	30	0	0	0	0	0	0	0
Maximum	100	0	30	60	0	0	0	0
Median	55	0	0	35	0	0	0	0

Appendix 7c. Percent substrate composition at six sites sampled on East Lake during surface trawl surveys in 2022.

Substrate (% composition)								
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
EastL08	15	0	0	85	0	0	0	0
EastL09	80	0	0	20	0	0	0	0
EastL10	50	50	0	0	0	0	0	0
EastL11	100	0	0	0	0	0	0	0
EastL12	100	0	0	0	0	0	0	0
EastL13	100	0	0	0	0	0	0	0
Minimum	15	0	0	0	0	0	0	0
Maximum	100	50	0	85	0	0	0	0
Median	90	0	0	0	0	0	0	0

Appendix 7d. Percent substrate composition at nine sites sampled in South Bay during surface trawl surveys in 2022.

Site code	Substrate (% composition)							
	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
South01	50	30	20	0	0	0	0	0
South02	60	10	30	0	0	0	0	0
South03	100	0	0	0	0	0	0	0
South04	70	0	30	0	0	0	0	0
South05	70	0	30	0	0	0	0	0
South06	100	0	0	0	0	0	0	0
South07	80	0	20	0	0	0	0	0
South08	100	0	0	0	0	0	0	0
South09	90	0	0	10	0	0	0	0
Minimum	50	0	0	0	0	0	0	0
Maximum	100	30	30	10	0	0	0	0
Median	80	0	20	0	0	0	0	0

Appendix 7e. Percent substrate composition at three sites sampled in Black River during surface trawl surveys in 2022.

Site code	Substrate (% composition)							
	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Black01	100	0	0	0	0	0	0	0
Black02	100	0	0	0	0	0	0	0
Black03	100	0	0	0	0	0	0	0
Minimum	100	0	0	0	0	0	0	0
Maximum	100	0	0	0	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7f. Percent substrate composition at nine sites sampled in Waupoos Bay during surface trawl surveys in 2022.

Site code	Substrate (% composition)							
	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Waup01	100	0	0	0	0	0	0	0
Waup02	100	0	0	0	0	0	0	0
Waup03	100	0	0	0	0	0	0	0
Waup04	100	0	0	0	0	0	0	0
Waup05	100	0	0	0	0	0	0	0
Waup06	100	0	0	0	0	0	0	0
Waup07	100	0	0	0	0	0	0	0
Waup08	100	0	0	0	0	0	0	0
Waup09	100	0	0	0	0	0	0	0
Minimum	100	0	0	0	0	0	0	0
Maximum	100	0	0	0	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7g. Percent substrate composition at nine sites sampled in Muscote Bay during surface trawl surveys in 2022.

Site code	Substrate (% composition)							
	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Musc01	25	0	0	75	0	0	0	0
Musc02	100	0	0	0	0	0	0	0
Musc03	100	0	0	0	0	0	0	0
Musc04	100	0	0	0	0	0	0	0
Musc05	100	0	0	0	0	0	0	0
Musc06	100	0	0	0	0	0	0	0
Musc07	100	0	0	0	0	0	0	0
Musc08	100	0	0	0	0	0	0	0
Musc09	100	0	0	0	0	0	0	0
Minimum	25	0	0	0	0	0	0	0
Maximum	100	0	0	75	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 8a. Aquatic vegetation data from ten sites sampled in Presqu'ile Bay during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)				Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	
Presq14	3	0	0	0	100	0	Stonewort spp., White-stemmed Pondweed, Wild Celery
Presq15	1	0	0	0	100	0	Wild Celery
Presq16	2	0	0	0	100	0	Fern Pondweed, Large-leaved Pondweed
Presq17	2	0	0	0	100	0	Fern Pondweed, Wild Celery, Large-leaved Pondweed
Presq20	3	0	0	0	100	0	Fern Pondweed
Presq21	2	0	0	0	100	0	Wild Celery, Fern Pondweed
Presq22	3	0	0	0	100	0	Fern Pondweed, Wild Celery
Presq23	3	0	0	0	100	0	Wild Celery
Presq24	2	0	0	0	100	0	Wild Celery
Presq25	1	0	0	0	100	0	Wild Celery
Minimum	1	0	0	0	100	0	Overall dominant:
Maximum	3	0	0	0	100	0	Wild Celery, Fern Pondweed
Median	2	0	0	0	100	0	

Appendix 8b. Aquatic vegetation data from four sites sampled in Wellers Bay during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)				Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	
Well14	3	0	0	0	100	0	Wild Celery, Fern Pondweed
Well15	3	0	10	0	90	0	-
Well16	1	0	5	0	95	0	Sago Pondweed
Well17	2	0	0	0	100	0	Stonewort spp.
Minimum	1	0	0	0	90	0	Overall dominant:
Maximum	3	0	10	0	100	0	-
Median	2.5	0	2.5	0	97.5	0	

Appendix 8c. Aquatic vegetation data from six sites sampled on East Lake during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)					Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating		
EastL08	2	0	0	5	90	5	Wild Celery, Milfoil spp.	
EastL09	2	0	0	5	95	0	Stonewort spp., Wild Celery, Fern Pondweed	
EastL10	1	0	0	0	100	0	Milfoil spp., Wild Celery	
EastL11	1	0	0	0	95	5	Wild Celery	
EastL12	3	0	0	0	95	5	-	
EastL13	3	0	0	0	95	5	Stonewort spp., Pondweed spp.	
Minimum	1	0	0	0	90	0	Overall dominant:	
Maximum	3	0	0	5	100	5	Wild Celery	
Median	2	0	0	0	95	5		

Appendix 8d. Aquatic vegetation data from nine sites sampled in South Bay during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)					Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating		
South01	2	0	0	0	100	0	Wild Celery, Eurasian Watermilfoil	
South02	1	0	0	0	100	0	Pondweed spp., Wild Celery	
South03	3	0	0	0	100	0	Stonewort spp.	
South04	3	0	0	0	100	0	Stonewort spp.	
South05	3	0	0	0	100	0	Stonewort spp.	
South06	3	0	0	0	100	0	Stonewort spp.	
South07	3	0	0	0	100	0	-	
South08	3	0	0	0	100	0	Stonewort spp., Milfoil spp., Eurasian Watermilfoil	
South09	3	0	0	0	100	0	-	
Minimum	1	0	0	0	100	0	Overall dominant:	
Maximum	3	0	0	0	100	0	Stonewort	
Median	3	0	0	0	100	0		

Appendix 8e. Aquatic vegetation data from three sites sampled in Black River during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)				Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	
Black01	2	0	0	0	95	5	Richardson's Pondweed, Wild Celery
Black02	3	0	0	0	100	0	Nitella spp., Richardson's Pondweed
Black03	2	0	0	0	85	15	Richardson's Pondweed, Wild Celery
Minimum	2	0	0	0	85	0	Overall dominant:
Maximum	3	0	0	0	100	15	Richardson's Pondweed
Median	2	0	0	0	95	5	

Appendix 8f. Aquatic vegetation data from three sites sampled in Waupoos Bay during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)				Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	
Waup01	2	0	0	0	100	0	Wild Celery
Waup02	1	0	5	0	95	0	Wild Celery
Waup03	1	0	0	0	100	0	Wild Celery Sago Pondweed, Stonewort spp., Eurasian
Waup04	2	0	0	0	100	0	Watermilfoil
Waup05	2	0	0	0	100	0	Wild Celery, Pondweed spp.
Waup06	1	0	0	0	100	0	Wild Celery
Waup07	1	0	0	0	100	0	Wild Celery
Waup08	1	0	0	0	100	0	Wild Celery, Stonewort spp.
Waup09	1	0	0	0	100	0	Wild Celery
Minimum	1	0	0	0	95	0	Overall dominant:
Maximum	2	0	5	0	100	0	Wild Celery
Median	1	0	0	0	100	0	

Appendix 8g. Aquatic vegetation data from three sites sampled in Muscote Bay during surface trawl surveys in 2022.

Site code	Vegetation rake		Aquatic vegetation cover (%)					Dominant taxa
	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating		
Musc01	1	0	0	0	100	0	Wild Celery	
Musc02	2	0	0	0	100	0	Canadian Waterweed, Slender Naiad	
Musc03	2	0	0	0	100	0	Pondweed spp., Wild Celery, Coontail	
Musc04	1	0	0	0	100	0	Wild Celery	
Musc05	3	0	0	0	100	0	Milfoil spp., Pondweed spp., Stonewort spp.	
Musc06	1	0	0	0	100	0	Milfoil spp., Pondweed spp.	
Musc07	3	0	0	0	100	0	-	
Musc08	3	0	0	0	100	0	Canadian Waterweed, Pondweed spp.	
Musc09	2	0	0	0	100	0	Milfoil spp., Pondweed spp.	
Minimum	1	0	0	0	100	0	Overall dominant:	
Maximum	3	0	0	0	100	0	Pondweed spp.	
Median	2	0	0	0	100	0		

Appendix 9. Complete list of macrophytes identified from 50 sites sampled in Presqu'île Bay, Weller's Bay, East Lake, South Bay, Black River, Waupoos Bay, and Muscote Bay in 2022.

Site code	Dominant species	Other species
Presq14	Stonewort spp., White-stemmed Pondweed, Wild Celery	Coontail, Fern Pondweed, Milfoil spp., Sago Pondweed, Slender Naiad, Water Lily spp.
Presq15	Wild Celery	Flatstem Pondweed, Water Marigold, White Water Lily
Presq16	Fern Pondweed, Large-leaved Pondweed	Canadian Waterweed, Flatstem Pondweed, Milfoil spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad, Water Marigold, Wild Celery
Presq17	Fern Pondweed, Large-leaved Pondweed, Wild Celery	Canadian Waterweed, Common Bladderwort, Coontail, Pondweed spp., Richardson's Pondweed, Slender Naiad, Water Marigold
Presq20	Fern Pondweed	Richardson's Pondweed, Water Marigold, Wild Celery
Presq21	Fern Pondweed, Wild Celery	Canadian Waterweed, Flatstem Pondweed, Large-leaved Pondweed, Nitella spp., Northern Watermilfoil, Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp., Water Marigold, White-stemmed Pondweed
Presq22	Fern Pondweed, Wild Celery	Canadian Waterweed, Large-leaved Pondweed, Richardson's Pondweed, Sago Pondweed, Water Marigold
Presq23	Wild Celery	Canadian Waterweed, Coontail, Eurasian Watermilfoil, Flatstem Pondweed, Pondweed spp., Richardson's Pondweed, White Water Crowfoot
Presq24	Wild Celery	Canadian Waterweed, Coontail, Pondweed spp., Richardson's Pondweed, Water Marigold
Presq25	Wild Celery	Canadian Waterweed, Coontail, Milfoil spp., Richardson's Pondweed
Well14	Fern Pondweed, Wild Celery	Flatstem Pondweed, Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp., Water Marigold
Well15		Fern Pondweed, Large-leaved Pondweed, Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp., Wild Celery
Well16	Sago Pondweed	Stonewort spp., White-stemmed Pondweed
Well17	Stonewort spp.	Coontail, Large-leaved Pondweed, Milfoil spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Water Marigold, White-stemmed Pondweed, Wild Celery
EastL08	Milfoil spp., Wild Celery	Canadian Waterweed, Coontail, Nitella spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp.
EastL09	Fern Pondweed, Stonewort spp., Wild Celery	Canadian Waterweed, Large-leaved Pondweed, Milfoil spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Wild Rice
EastL10	Milfoil spp., Wild Celery	Canadian Waterweed, Pondweed spp., Richardson's Pondweed, Sago Pondweed, Stonewort spp., White Water Lily
EastL11	Wild Celery	Canadian Waterweed, Coontail, Fern Pondweed, Milfoil spp., Pondweed spp., Richardson's Pondweed, White Water Lily
EastL12		Common Bladderwort, Fern Pondweed, Milfoil spp., Nitella spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp., Water Marigold, White Water Lily, Wild Celery
EastL13	Pondweed spp., Stonewort spp.	Common Bladderwort, Fern Pondweed, Flatstem Pondweed, Milfoil spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad, Wild Celery

Appendix 9. (Continued)

Site code	Dominant species	Other species
South01	Eurasian Watermilfoil, Wild Celery	Canadian Waterweed, Flatstem Pondweed, Nitella spp., Pondweed spp., Stonewort spp., Water Marigold
South02	Pondweed spp., Wild Celery	Coontail, Eurasian Watermilfoil, Flatstem Pondweed, Richardson's Pondweed, Water Marigold
South03	Stonewort spp.	Milfoil spp., Wild Celery
South04	Stonewort spp.	Richardson's Pondweed, Wild Celery
South05	Stonewort spp.	Milfoil spp., Richardson's Pondweed, Wild Celery
South06	Stonewort spp.	Sago Pondweed, Variable-leaved Pondweed, Wild Celery
South07		Eurasian Watermilfoil, Milfoil spp., Stonewort spp., Wild Celery
South08	Eurasian Watermilfoil, Milfoil spp., Stonewort spp.	Flatstem Pondweed, Pondweed spp., Richardson's Pondweed, Wild Celery
South09		Milfoil spp., Richardson's Pondweed, Sago Pondweed, Stonewort spp., Wild Celery
Black01	Richardson's Pondweed, Wild Celery	Canadian Waterweed, Coontail, Eurasian Watermilfoil, Milfoil spp., Nitella spp., White Water Lily
Black02	Nitella spp., Richardson's Pondweed	Canadian Waterweed, Coontail, Flatstem Pondweed, Wild Celery
Black03	Richardson's Pondweed, Wild Celery	Eurasian Watermilfoil, Milfoil spp., White Water Lily
Waup01	Wild Celery	Milfoil spp., Richardson's Pondweed, Sago Pondweed, Stonewort spp.
Waup02	Wild Celery	Curly-leaf Pondweed, Eurasian Watermilfoil, Flatstem Pondweed, Pondweed spp., Richardson's Pondweed, White Water Lily
Waup03	Wild Celery	Milfoil spp., Pondweed spp., Richardson's Pondweed, Slender Naiad
Waup04	Eurasian Watermilfoil, Sago Pondweed, Stonewort spp.	
Waup05	Pondweed spp., Wild Celery	Canadian Waterweed, Coontail, Flatstem Pondweed, Milfoil spp., Richardson's Pondweed, Slender Naiad, Water Marigold
Waup06	Wild Celery	Richardson's Pondweed, Stonewort spp.
Waup07	Wild Celery	Milfoil spp., Pondweed spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad, Stonewort spp., White Water Crowfoot
Waup08	Stonewort spp., Wild Celery	Milfoil spp., Richardson's Pondweed, Sago Pondweed, Slender Naiad
Waup09	Wild Celery	Milfoil spp., Pondweed spp., Richardson's Pondweed
Musc01	Wild Celery	Coontail, Flatstem Pondweed, Pondweed spp., Richardson's Pondweed
Musc02	Canadian Waterweed, Slender Naiad	Coontail, Eurasian Watermilfoil, Flatstem Pondweed, Pondweed spp., Richardson's Pondweed, Wild Celery
Musc03	Coontail, Pondweed spp., Wild Celery	Canadian Waterweed, Eurasian Watermilfoil, Flatstem Pondweed, Richardson's Pondweed, Slender Naiad
Musc04	Wild Celery	Canadian Waterweed, Coontail, Eurasian Watermilfoil, Flatstem Pondweed, Richardson's Pondweed, Slender Naiad
Musc05	Milfoil spp., Pondweed spp., Stonewort spp.	Coontail, Large-leaved Pondweed, Richardson's Pondweed, Slender Naiad, Water Marigold, White-stemmed Pondweed
Musc06	Milfoil spp., Pondweed spp.	Large-leaved Pondweed, Sago Pondweed, Stonewort spp., White-stemmed Pondweed

Appendix 9. (Continued)

Site code	Dominant species	Other species
Musc07		Eurasian Watermilfoil, Flatstem Pondweed, Pondweed spp., Richardson's Pondweed, Sago Pondweed, Water Marigold, White-stemmed Pondweed, Wild Celery
Musc08	Canadian Waterweed, Pondweed spp.	Coontail, Eurasian Watermilfoil, Flatstem Pondweed, Richardson's Pondweed, Water Marigold, Wild Celery
Musc09	Milfoil spp., Pondweed spp.	Canadian Waterweed, Coontail, Flatstem Pondweed, Large-leaved Pondweed, Richardson's Pondweed, Stonewort spp., Water Marigold, White-stemmed Pondweed, Wild Celery