Targeted sampling for Pugnose Shiner (*Notropis anogenus*) in eastern Lake Ontario coastal wetlands, 2021

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In September and October of 2021, trawling surveys were completed across four eastern Lake Ontario coastal wetlands to update distribution records for the Threatened Pugnose Shiner (*Notropis anogenus*) and describe habitat characteristics associated with the species. Forty-four sites were sampled in Presqu'ile Bay (n = 13), Wellers Bay (n = 11), West Lake (n = 13), and East Lake (n = 7). Sites were located in areas of vegetated habitat near the sites of previous wetland fishes at risk surveys. Fishes were collected using three consecutive passes of a Mamou (surface) trawl over a 50 m transect. Eighteen species (4,085 individuals) were detected, including Pugnose Shiner, Bridle Shiner (*Notropis bifrenatus; Species at Risk Act* (SARA): Special Concern), and four recreationally important species. Pugnose Shiner (363 individuals) was collected from 70% of sites across all water bodies; the species was most abundant in West Lake and present at all sampling sites. Bridle Shiner (277 individuals) was collected from 64% of sites across all water bodies; the species was most abundant in East Lake and present at 86% of sampling sites. 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 0.7 and 1.8 m, substrate material was largely organics and sand, and submerged vegetation cover was dense. Dominant submerged plant taxa were wild celery (*Vallisneria americana*) and stonewort (*Chara* spp.).

RÉSUMÉ

LeBaron, A. and Reid, S.M. 2023. Target sampling for Pugnose Shiner (*Notropis anogenus*) in eastern Lake Ontario coastal wetlands, 2021. Can. Data Rep. Fish. Aquat. Sci. 1364: vii + 34 p.

En septembre et en octobre 2021, des relevés au chalut ont été menés dans quatre zones humides côtières de l'est 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 l'habitat fréquenté par l'espèce. Quarante-quatre sites ont été échantillonnés dans la baie Presqu'île (n = 13), la baie Wellers (n = 11), le lac West (n = 13) et le lac East (n = 7). Ces sites se trouvaient dans des zones d'habitat végétalisé, à proximité des sites utilisés lors des activités de relevé précédentes visant les poissons en péril des zones humides. Pour capturer des individus, on a effectué trois passes consécutives avec un chalut Mamou (chalut de surface) le long d'un transect de 50 m. Dix-huit espèces (4 085 individus) ont été détectées, dont le méné camus, le méné d'herbe (Notropis bifrenatus), espèce préoccupante selon la LEP et quatre espèces d'importance récréative. Le méné camus (363 individus) a été recueilli dans 70 % des sites dans tous les plans d'eau; l'espèce était plus abondante dans le lac West et présente dans tous les sites d'échantillonnage. Le méné d'herbe (277 individus) a été recueilli dans 64 % des sites dans tous les plans d'eau; l'espèce était la plus abondante dans le lac East et était présente dans 86 % des sites d'échantillonnage. Les distributions des fréquences de longueur indiquent un recrutement continu et plusieurs classes d'âge pour les deux espèces. Aux sites de collecte du méné d'herbe et du méné camus, l'eau était très claire, la profondeur variait de 0,7 à 1,8 m, le substrat était composé en grande partie de matières organiques et de sable, et le couvert de végétation submergée était dense. La vallisnérie d'Amérique (Vallisneria americana) et le chara (Chara spp.) constituaient les taxons de plantes submergés dominant.

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 and Forestry (OMNRF) in 2021 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 this study, a repeat-sampling approach with a Mamou (surface) trawl was used to collect fishes from shoreline and wetland habitats at 44 sites across four eastern Lake Ontario coastal wetlands. Dextrase et al. (2014) recommend electrofishing or seine netting as the optimal gear types for monitoring Pugnose Shiner. However, while seining is very effective at collecting Pugnose Shiner from shallow, vegetated habitats (e.g., Rook et al., 2016), the gear is impractical for deeper (>1 m) sites. The Mamou trawl has been successfully applied to inventory fishes along southern Ontario watercourses, and to investigate the spatial and temporal factors affecting species occurrence (Reid et al. 2016b, Lamothe and Drake 2019, LeBaron and Reid 2021). 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 standardized index population and habitat monitoring program with specific sampling and training protocol.

The project also supports monitoring actions identified in the Bridle Shiner management plan (Boucher et al. 2001).

METHODS

SITE SELECTION

A total of 44 sites were sampled between September 10 and October 13, 2021, across four eastern Lake Ontario coastal wetlands (Figure 1): Presqu'ile Bay (n = 13), Wellers Bay (n = 11), West Lake (n = 13), and East Lake (n = 7). 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). Prior to trawling (August 2021), the suitability of planned sampling areas was assessed at the aforementioned wetlands, as well as Black River, Lake Consecon, North Bay (North Beach Provincial Park), Pleasant Bay, South Bay, and Waupoos Bay. Suitable habitat was identified at Black River, South Bay and Waupoos Bay. However, unsafe boating and trawling conditions (due to high winds) prevented sampling at these locations. Other wetland areas were not sampled due to a lack of suitable habitat (North Bay), or due to poor quality boat launches and low water levels (Consecon Lake and Pleasant Bay).

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–d).

FISH ASSEMBLAGE SAMPLING

Fishes were collected with a Mamou Trawl™ manufactured by Innovative Net Systems (Reid et al. 2016b; Gáspárdy et. al 2020). The approximate length of the trawl was 6.5 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. Sampling was done from a 5.5 m jon boat with a 40 hp motor. Each site was sampled with three consecutive passes along a 50 m transect. Floats were used to mark the boundaries of the transect. All three 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 tow ropes 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 a distance of 50 m was covered, the trawl was pulled in 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.” Pictorial keys and species descriptions (Newmaster et al 1997) were used to aid in identification. Some 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.

SAMPLING PERMITS AND DATA ARCHIVING

Sampling for this project was conducted under Species at Risk Act Permit No. 21-PCAA-00003 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 MNRF 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 and Forestry.

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 three passes. 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, 4,085 individuals were collected, and 18 species were detected. Forty-four sites were sampled with a total of 132 trawls. Three-hundred-sixty-three Pugnose Shiner were collected from 70% of sites (n = 31) across all four water bodies, ranging in total length from 22 to 56 mm (median: 37 mm) (Figure 3). Another fish species at risk, Bridle Shiner (n = 277), was collected from 64% of sites (n = 28) across all four water bodies, ranging in total length from 28 to 63 mm (median: 45 mm) (Figure 4). Four recreationally important species (Black Crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Largemouth Bass

(*Micropterus salmoides*), and Yellow Perch (*Perca flavescens*)) were collected. The most abundant and widespread species were Blackchin Shiner (*Notropis heterodon*) and Bluegill. Other species that were widespread but not abundant were Pugnose Shiner, Yellow Perch, Largemouth Bass, Bridle Shiner, and Bluntnose Minnow (*Pimephales notatus*) (Table 1, Figure 5).

One-hundred thirty-two sampling-related mortalities were recorded, representing a 3.2% mortality rate (Appendix 4). The species most commonly affected was Blackchin Shiner (n = 79), representing 60% of all mortalities. Eleven Pugnose Shiner and eight Bridle Shiner mortalities were observed, representing a 3.0% and 2.9% mortality rate for each species, respectively.

Total length of all fishes ranged from 15 to 253 mm (median: 44 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 Bluegill and Brown Bullhead (*Ameiurus nebulosus*).

The median number of individuals collected from each site was 63 (range: 4 to 450). The median number of species detected was 7 (range: 1 to 12). Numbers of individuals collected from each pass of the trawl declined after the second pass (median number of individuals: first pass = 22.5; second pass = 22; and third pass = 16). Overall, the number of species detected was similar among successive passes of the trawl (median species number: first pass = 4; second pass = 5; and third pass = 4). In comparison with results from first pass of the trawl, the addition of two more passes at each site increased the overall rate of species detection (Figure 6) and increased the frequency of occurrence of each species (Table 2).

Summaries of 2021 fish assemblage sampling results for Presqu'ile Bay, Wellers Bay, West Lake, and East Lake are provided below. Species count data for each water body is presented in Appendix 5(a–d). Photos of Pugnose Shiner and Bridle Shiner are provided in Appendix 6.

Presqu'ile Bay

A total of 476 fishes were trawled (representing 13 species) from 13 sites. The median number of fishes collected from each site was 21 (range: 7 to 156). The median number of species detected from each site was 7 (range: 2 to 10). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected. Based on pooled catch data, the most abundant and widespread species were Blackchin Shiner and Banded Killifish (*Fundulus diaphanus*). Other species that were widespread but not abundant were Pumpkinseed (*Lepomis gibbosus*), Largemouth Bass, Bridle Shiner, and Yellow Perch (Table 3).

Pugnose Shiner was detected at 31% of Presqu'ile Bay sites (n = 4). The species was previously undetected at this location. Five individuals were collected, measuring between 22 and 50 mm in total length (median: 35 mm). Bridle Shiner was detected at 62% of sites (n = 8). Thirty-four individuals were collected, measuring between 28 and 63 mm (median: 46 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes.

Wellers Bay

A total of 1,340 fishes were trawled (representing 13 species) from 11 sites. The median number of fishes collected from each site was 99 (range: 4 to 450). The median number of species detected from each site was 5 (range: 1 to 9). 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, which represented 74% of the total catch. Other species that were widespread but not abundant were Bluegill, Pugnose Shiner, and Bluntnose Minnow (Table 4).

Pugnose Shiner was detected at 73% of Wellers Bay sites (n = 8). Twenty-four individuals were collected, measuring between 31 and 54 mm in total length (median: 38.5 mm). Bridle Shiner was detected at 45% of sites (n = 5). Forty-one individuals were collected, measuring between 37 and 54 mm (median: 45 mm). The distribution of length classes indicates presence of multiple age classes in Wellers Bay.

East Lake

A total of 566 fishes were trawled (representing 11 species) from 7 sites. The median number of fishes collected from each site was 66 (range: 36 to 153). The median number of species detected from each site was 8 (range: 6 to 10). Three recreationally important species (Bluegill, Largemouth Bass, and Yellow Perch) were collected. Based on pooled catch data the most abundant and widespread species were Bluegill, Bridle Shiner, and Blackchin Shiner. Other species that were widespread but not abundant were Yellow Perch, Pumpkinseed, Largemouth Bass, and Pugnose Shiner (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.

West Lake

A total of 1,703 fishes were trawled (representing 16 species) from 13 sites. The median number of fishes collected from each site was 76 (range: 35 to 366). The median number of species detected from each site was 9 (range: 5 to 12). Four recreationally important species (Black Crappie, Bluegill, Largemouth Bass, and Yellow Perch) were collected by trawling. Based on pooled catch data the most abundant and widespread species were Bluegill, Pugnose Shiner, Bluntnose Minnow, and Blackchin Shiner. Other species that were widespread but not abundant were Yellow Perch, Bridle Shiner, and Largemouth Bass (Table 6).

Pugnose Shiner was detected at all West Lakes sites. Three-hundred and twelve individuals were collected, measuring between 25 and 56 mm in total length (median: 37 mm). Bridle Shiner was detected at 69% of sites (n = 9). Eighty-nine individuals were collected, measuring between 34 and 56 mm (median: 42 mm). The distribution of length classes for Pugnose Shiner and Bridle Shiner indicate ongoing recruitment and multiple age classes in West Lake.

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 17 aquatic macrophyte species were identified. An additional three macrophyte taxa were only identified to genus-level. The number of macrophyte taxa per site ranged from 4 to 14 (median 7). The most abundant taxa across all sites were wild celery (*Vallisneria americana*), stonewort (*Chara* spp.), and flatstem pondweed (*Potamogeton zosteriformis*), listed as “dominant” at 23, 20, and 11 sites, respectively. Other taxa that were widespread but not necessarily dominant include Richardson’s pondweed (*Potamogeton richardsonii*; 39 sites), Canada waterweed (*Elodea canadensis*; 26 sites), sago pondweed (*Stuckenia pectinate*; 25 sites), and milfoil sp. (*Myriophyllum* sp.; 23 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 7). Dominant macrophyte taxa at these sites were wild celery and stonewort.

Summaries of 2021 habitat sampling results for Presqu'ile Bay, Wellers Bay, East Lake, and West Lake are provided below. Detailed habitat data are provided in Appendices 7(a–d) and 8(a–d). Photos of dominant macrophyte species are provided in Appendix 9. A complete list of macrophyte taxa by site is provided in Appendix 10.

Presqu'ile Bay

Water depth ranged from 0.9 to 1.8 m (median 1.2 m). Water temperatures ranged from 15.3 to 22.4°C (median 17.8°C). Conductivity ranged from 256 to 375 µS/cm (median 276 µS/cm). Secchi tube values ranged from 0.9 to 1.2 m (median 1.0 m). The substrates at sampling sites were largely organics, ranging from 30 to 100% (median 100%) composition. Clays (ranged from 0 to 70%; median: 0%) and sands (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). Filamentous algae were not present at any site. Submerged vegetation was dominant, ranging from 95 to 100% (median: 100%) coverage. Floating vegetation ranged from 0 to 5% (median: 0%). A total of 13 macrophyte species and two additional genera were identified in Presqu'ile Bay. The number of macrophyte taxa per site ranged from 4 to 10 (median 6). The most abundant taxa were wild celery and flatstem pondweed, listed as "dominant" at 11 and 9 sites, respectively.

Wellers Bay

Water depth ranged from 1.0 to 1.6 m (median 1.4 m). Water temperatures ranged from 15.6 to 22.7 °C (median 17.4 °C). Conductivity ranged from 210 to 310 µS/cm (median 228 µS/cm). Secchi tube values ranged from 1.0 to 1.2 m (median 1.1 m). Organic substrate was dominant across all sites, ranging from 20 to 100% (median 100%) composition. Also present, sands ranged from 0 to 80% (median 0%).

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median 2). Submerged vegetation was dominant across sites, ranging from 60 to 95% (median 90%) coverage. Floating vegetation, emergent vegetation, and open water ranged from 0 to 20% (median 0%), 0 to 15% (median 0%), and 0 to 10% (median 0%), respectively. Seventeen macrophyte species and three additional genera were identified from Wellers Bay. Number of taxa per site ranged from 4 to 14 (median 8). The most abundant taxon was stonewort, listed as "dominant" at eight sites.

East Lake

Water depth ranged from 1.1 to 1.3 m (median 1.2 m). Water temperatures ranged from 19.2 to 20.8°C (median 19.8°C). Conductivity ranged from 195 to 236 µS/cm (median 219 µS/cm). Secchi tube values ranged from 1.0 to 1.2 m (median 1.1 m). Substrates at sampling sites were largely organics, ranging from 40 to 100% (median 100%) composition. Also present, silts ranged from 0 to 60% (median: 0%), and sands ranged from 0 to 50% (median: 0%).

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. Eleven macrophyte species and two additional genera were identified from East Lake. Number of species per site

ranged from 6 to 10 (mean 8). The most abundant taxon was stonewort, listed as “dominant” at three sites.

West Lake

Water depth ranged from 1.0 to 1.4 m (median 1.3 m). Water temperatures ranged from 16.4 to 22.2°C (median 20.7°C). Conductivity ranged from 247 to 284 µS/cm (median 265 µS/cm). Secchi tube values ranged from 0.7 to 1.0 m (median 0.9 m). This reach was characterized by organic substrate, ranging from 70 to 100% (median 100%) composition. Sand ranged from 0 to 30% (median: 0%).

Density of submerged macrophytes as determined by the rake method ranged from 1 to 3 (median 2). Submerged vegetation was dominant across sites, ranging from 60 to 100% (median: 95%) coverage. Emergent vegetation ranged from 0 to 30% (median: 0%), and floating vegetation ranged from 0 to 10% (median: 0%). Twelve macrophyte species and two additional genera were identified from West Lake. Number of species per site ranged from 5 to 11 (mean 7). The most abundant taxa were stonewort and wild celery, listed as “dominant” at eight and seven sites, respectively.

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REFERENCES

Anderson, P., and R.D. Davic. 2004. Use of transparency tube for rapid assessment of total suspended solids and turbidity in streams. Lake and Reservoir Management 20: 110–120.

Boucher, J., M. Bérubé, A. Boyko, and M. Bourgeois. 2011. Management plan for the Bridle Shiner (*Notropis bifrenatus*) in Canada. Species at Risk Act Management Plan Series, Fisheries and Oceans Canada, Ottawa. v + 43 p.

Bouvier, L.D., Boyko, A.L., and Mandrak, N.E. 2010. Information in support of a recovery potential assessment of Pugnose Shiner (*Notropis anogenus*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/009. vi + 23 p.

Colwell, R.K. 2013. EstimateS: statistical estimation of species richness and shared species from samples. Version 9.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2013. COSEWIC assessment and status report on the Pugnose Shiner (*Notropis anogenus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 32 p.

Dextrase, A.J., Mandrak, N.E., Barnucz, J., Bouvier, L., R. Gaspardy, R., and Reid, S.M. 2014. Sampling effort required to detect fishes at risk in Ontario. Can. Manuscr. Rep. Fish. Aquat. Sci. **3024**: v + 50 p.

Fisheries and Oceans Canada (DFO). 2012. Recovery strategy for the Pugnose Shiner (Notropis anogenus) in Canada (Proposed). Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa ON. x + 75 p.

Fisheries and Oceans Canada (DFO). 2010. Recovery Potential Assessment of Pugnose Shiner (Notropis anogenus) in Canada. DFO Canadian Science Advisory Secretariat Science Advisory Report 2010/025. 13 p.

Gáspárdy, R.C., Barnucz, J., and Drake, D.A.R. 2020. Targeted sampling for Pugnose Minnow (*Opsopoeodus emiliae*) in the Canard River, Ontario, 2018. Can. Data Rep. Fish. Aquat. Sci. **1305**: v + 50 p.

Holm, E., Mandrak, N.E., and Burridge, M.E. 2009.The ROM Field Guide to Freshwater Fishes of Ontario. Royal Ontario Museum: Toronto, ON.

Lamothe, K.A., and Drake, D.A.R. 2019. Habitat associations of the Threatened Pugnose Minnow (*Opsopoeodus emiliae*) at the northern edge of the species range. Ecol. Freshw. Fish. **29**(2): 289–298.

LeBaron, A. and Reid, S.M. 2020. Targeted sampling for Pugnose Shiner (Notropis anogenus) in the Trent River, Ontario, 2020. Can. Data Rep. Fish. Aquat. Sci. **1334**: vii + 46 p.

Newmaster, S.G., Harris, A.G., and Kershaw, L.J. 1997. Wetland Plants of Ontario. Lone Pine Publishing: Edmonton, AB.

Reid, S. M., LeBaron, A., and Barnucz, J. 2016. Seasonal variation in the composition of fishes caught during trawl-based surveys of Little Bear Creek, Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/070. v + 16 p.

Rook, N.A, Mandrak, N.E., Reid, S.M., and Barnucz, J. 2016. Evaluation of habitat restoration on fish species at risk within Crown Marsh, Long Point Bay, Lake Erie, Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/59. v + 33 p.

Wagner, K. and Mikulyuk, A. 2012. Rapid Macrophyte Habitat Assessment Methodology. Miscellaneous Publication PUB-SS-1118 2012. Bureau of Science Services, Wisconsin Department of Natural Resources, Madison, WI.

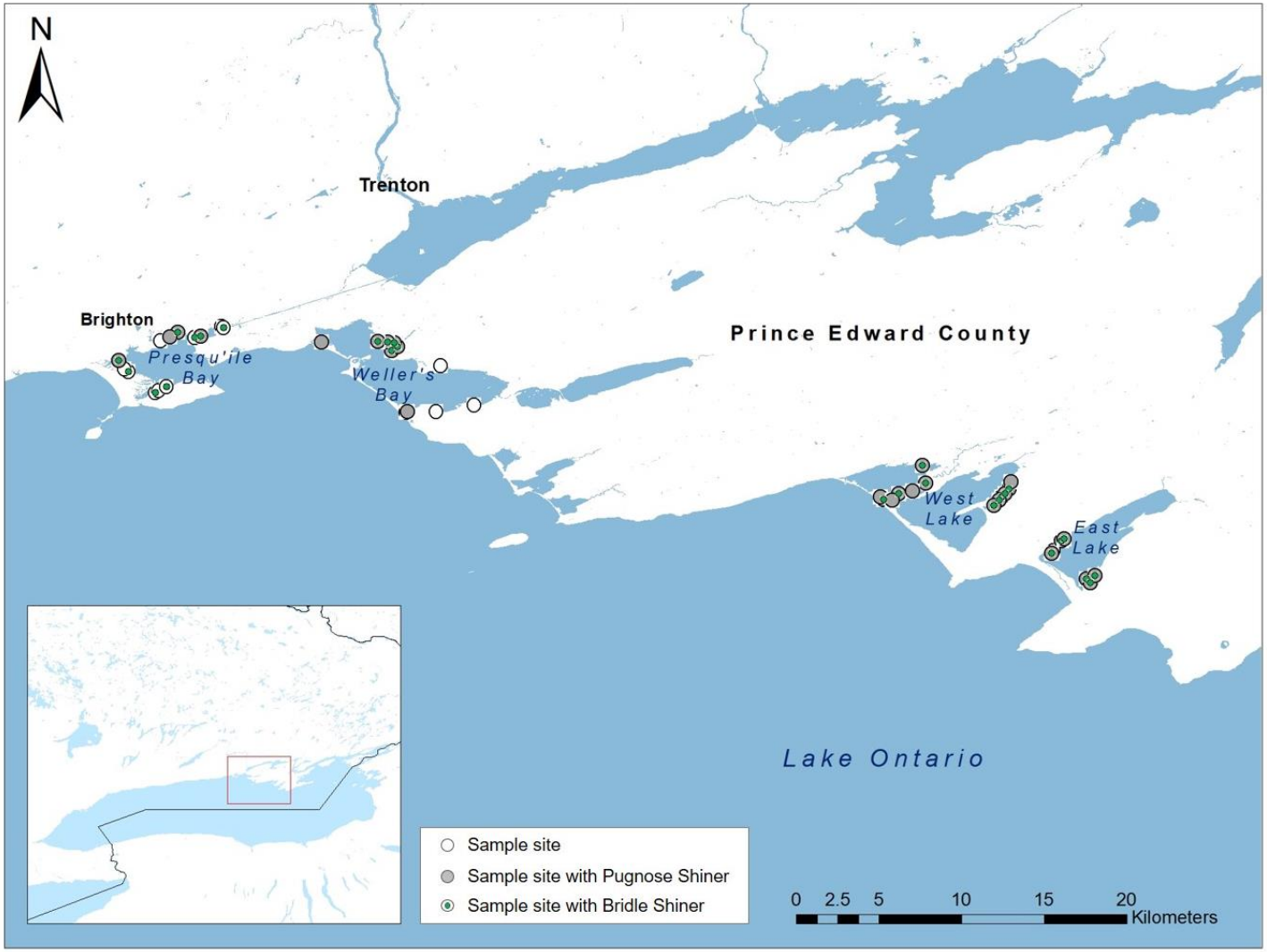


Figure 1. Map of 44 sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Presqu'ile Bay, Wellers Bay, West Lake, and East Lake. Open circle = sample site; grey circle = sample site where Pugnose Shiner was detected; green dot = sample site where Bridle 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.

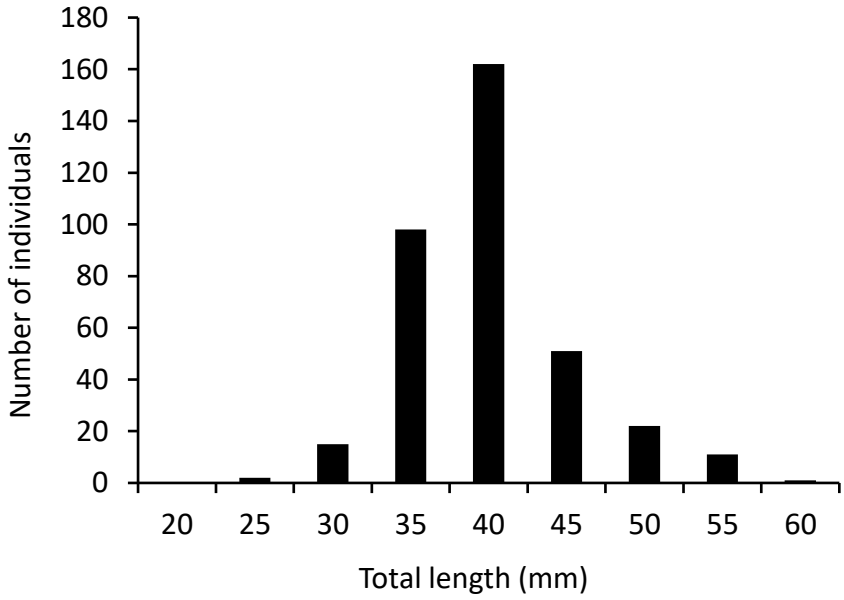


Figure 3. Length distribution of Pugnose Shiner (*Notropis anogenus*; n = 362) captured from four eastern Ontario coastal wetlands during surface trawl surveys in 2021.

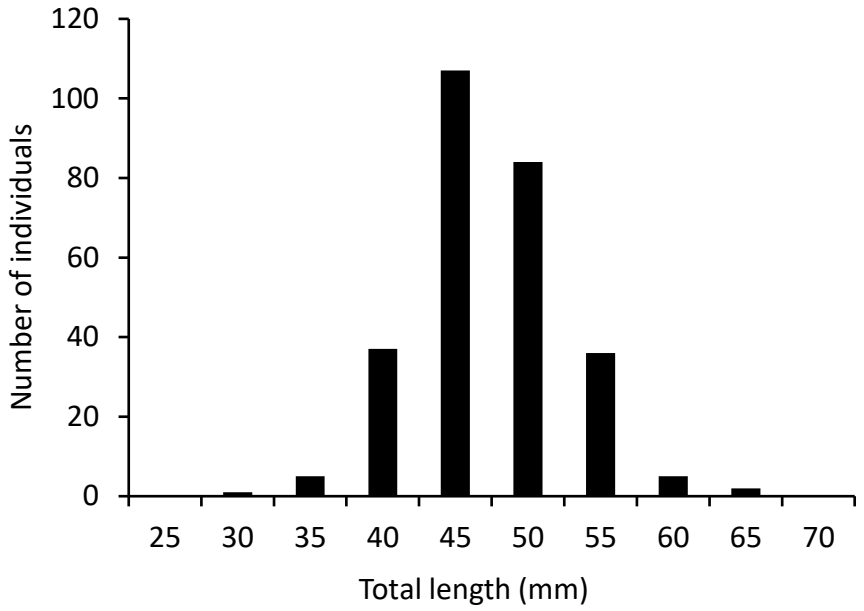


Figure 4. Length distribution of Bridle Shiner (*Notropis bifrenatus*; n = 277) captured from four eastern Ontario coastal wetlands during surface trawl surveys in 2021.

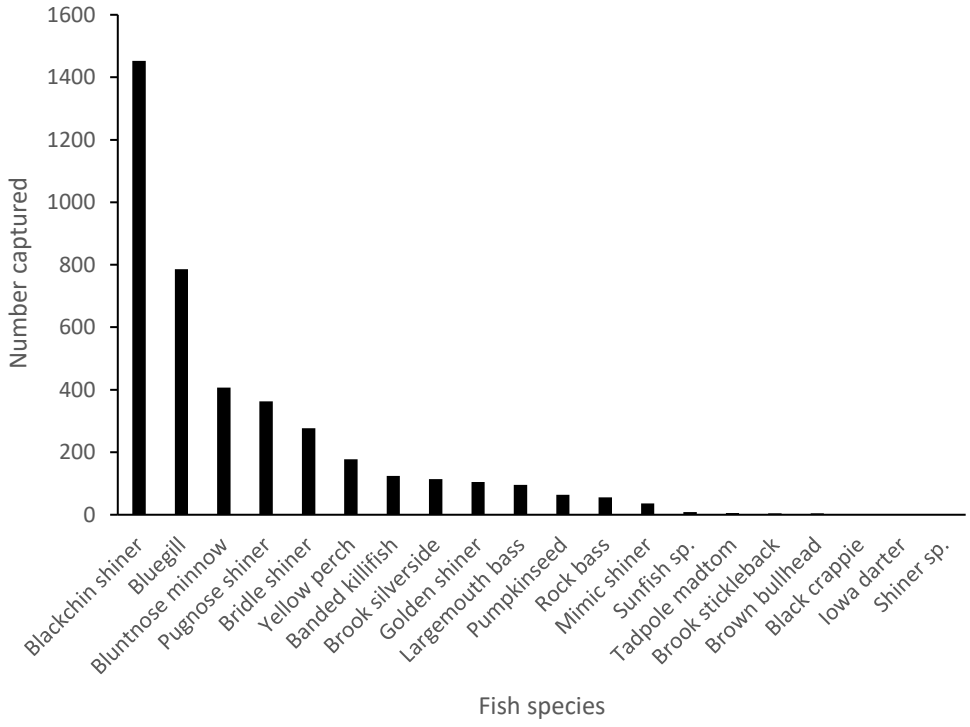


Figure 5. Rank-abundance of fish species captured from four eastern Lake Ontario coastal wetlands in 2021, calculated from pooled (three passes combined) catch data.

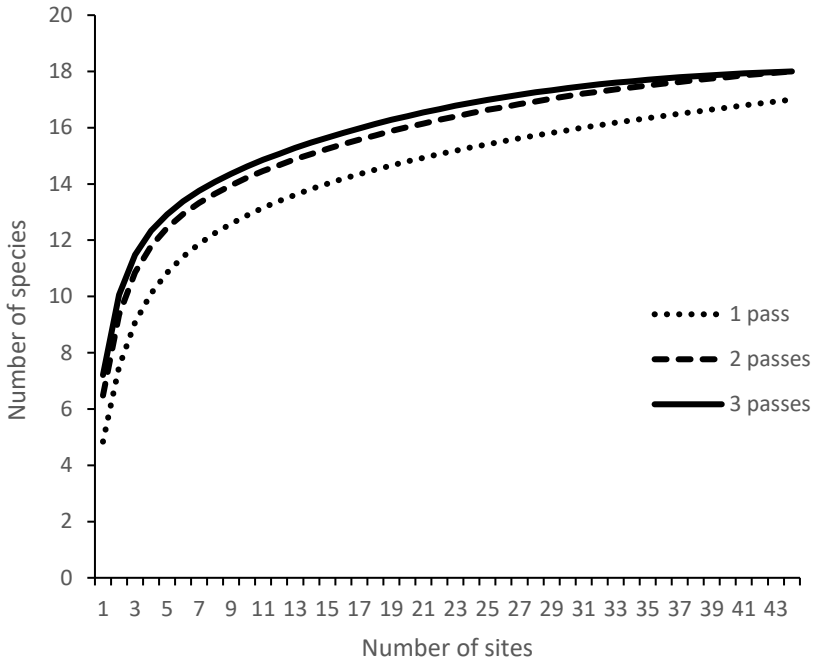


Figure 6. Comparison of species accumulation rates from pass one (dotted line), passes one and two combined (dashed line), and all three passes combined (solid line) from sampling of four eastern Ontario coastal wetlands in 2021. Species accumulation curves were generated using EstimateS software (Colwell 2013).

Table 1. Relative abundance (%) and frequency of occurrence (%) of fishes captured from four eastern Lake Ontario coastal wetlands in 2021, 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	35.57	88.64
Bluegill	19.24	77.27
Bluntnose Minnow	9.96	61.36
Pugnose Shiner	8.89	70.45
Bridle Shiner	6.78	63.64
Yellow Perch	4.36	70.45
Banded Killifish	3.04	45.45
Brook Silverside	2.79	29.55
Golden Shiner	2.57	25.00
Largemouth Bass	2.35	68.18
Pumpkinseed	1.57	54.55
Rock Bass	1.37	34.09
Mimic Shiner	0.88	6.82
Sunfish sp.	0.22	18.18
Tadpole Madtom	0.12	4.55
Brook Stickleback	0.10	6.82
Brown Bullhead	0.10	6.82
Black Crappie	0.05	4.55
Iowa Darter	0.02	2.27
Shiner sp.	0.02	2.27

Table 2. Comparison of fish species frequency of occurrence (%) from one pass and three passes (pooled) at sites across four eastern Lake Ontario coastal wetlands in 2021.

	Frequency of occurrence (% of sites)	
Common name	One pass	Three passes
Banded Killifish	27.27	45.45
Black Crappie	2.27	4.55
Blackchin Shiner	68.18	88.64
Bluegill	59.09	77.27
Bluntnose Minnow	47.73	61.36
Bridle Shiner	45.45	63.64
Brook Silverside	9.09	29.55
Brook Stickleback	0.00	6.82
Brown Bullhead	6.82	6.82
Golden Shiner	11.36	25.00
Iowa Darter	2.27	2.27
Largemouth Bass	50.00	68.18
Mimic Shiner	4.55	6.82
Pugnose Shiner	54.55	70.45
Pumpkinseed	20.45	54.55
Rock Bass	22.73	34.09
Shiner sp.	0.00	2.27
Sunfish sp.	6.82	18.18
Tadpole Madtom	2.27	4.55
Yellow Perch	50.00	70.45

Table 3. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Presqu'ile Bay in 2021, 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	26.68	92.31
Banded Killifish	22.06	69.23
Largemouth Bass	9.87	76.92
Bluntnose Minnow	8.40	53.85
Rock Bass	7.98	38.46
Bridle Shiner	7.14	61.54
Pumpkinseed	6.93	84.62
Yellow Perch	3.99	61.54
Bluegill	2.73	46.15
Sunfish sp.	1.26	38.46
Pugnose Shiner	1.05	30.77
Brown Bullhead	0.84	23.08
Golden Shiner	0.63	15.38
Shiner sp.	0.21	7.69
Tadpole Madtom	0.21	7.69
Black Crappie	0.00	0.00
Brook Silverside	0.00	0.00
Brook Stickleback	0.00	0.00
Iowa Darter	0.00	0.00
Mimic Shiner	0.00	0.00

Table 4. Relative abundance (%) and frequency of occurrence (%) of fishes captured from Wellers Bay in 2021, 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	74.03	90.91
Brook Silverside	5.90	45.45
Bluntnose Minnow	3.81	63.64
Bluegill	3.36	81.82
Golden Shiner	3.36	27.27
Bridle Shiner	3.06	45.45
Mimic Shiner	2.54	18.18
Pugnose Shiner	1.79	72.73
Yellow Perch	1.04	36.36
Largemouth Bass	0.45	36.36
Rock Bass	0.37	27.27
Banded Killifish	0.15	18.18
Pumpkinseed	0.07	9.09
Sunfish sp.	0.07	9.09
Black Crappie	0.00	0.00
Brook Stickleback	0.00	0.00
Brown Bullhead	0.00	0.00
Iowa Darter	0.00	0.00
Shiner sp.	0.00	0.00
Tadpole Madtom	0.00	0.00

Table 5. Relative abundance (%) and frequency of occurrence (%) of fishes captured from East Lake in 2021, 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	37.99	100.00
Bridle Shiner	19.96	85.71
Blackchin Shiner	16.78	85.71
Yellow Perch	4.95	100.00
Bluntnose Minnow	4.42	57.14
Pumpkinseed	4.24	100.00
Pugnose Shiner	3.89	85.71
Largemouth Bass	3.53	100.00
Brook Silverside	3.18	42.86
Banded Killifish	0.53	42.86
Sunfish sp.	0.35	28.57
Iowa Darter	0.18	14.29
Black Crappie	0.00	0.00
Brook Stickleback	0.00	0.00
Brown Bullhead	0.00	0.00
Golden Shiner	0.00	0.00
Mimic Shiner	0.00	0.00
Rock Bass	0.00	0.00
Shiner sp.	0.00	0.00
Tadpole Madtom	0.00	0.00

Table 6. Relative abundance (%) and frequency of occurrence (%) of fishes captured from West Lake in 2021, 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	30.12	92.31
Pugnose Shiner	18.32	100.00
Bluntnose Minnow	17.09	69.23
Blackchin Shiner	14.03	84.62
Yellow Perch	6.87	92.31
Bridle Shiner	5.23	69.23
Golden Shiner	3.35	46.15
Largemouth Bass	1.35	69.23
Brook Silverside	1.00	38.46
Banded Killifish	0.82	46.15
Rock Bass	0.76	53.85
Pumpkinseed	0.35	38.46
Brook Stickleback	0.23	23.08
Tadpole Madtom	0.23	7.69
Black Crappie	0.12	15.38
Mimic Shiner	0.12	7.69
Brown Bullhead	0.00	0.00
Iowa Darter	0.00	0.00
Shiner sp.	0.00	0.00
Sunfish sp.	0.00	0.00

Table 7. Summary of habitat characteristics at sites where Pugnose Shiner (*Notropis anogenus*) and Bridle Shiner (*Notropis bifrenatus*) were detected during surface trawl surveys in 2021. Water clarity, temperature, and conductivity are presented as mean values. Dominant macrophyte taxa and substrate material are listed.

	Habitat Summary	
Water Body	Pugnose Shiner	Bridle Shiner
Presqu'ile Bay	0.9–1.6 m depth	0.7–1.8 m depth
	1.01 m clarity	1.07 m clarity
	16.7°C	19.0°C
	323 µS/cm	273 µS/cm
	flatstem pondweed, wild celery	flatstem pondweed, wild celery
	Organic substrate	Organic substrate
Wellers Bay	0.9–1.8 m depth	0.9–1.8 m depth
	1.07 m clarity	1.06 m clarity
	17.7°C	16.8°C
	237 µS/cm	235 µS/cm
	stonewort, Richardson's pondweed	stonewort, sago pondweed
	Organic substrate	Organic substrate
East Lake	0.9–1.5 m depth	0.9–1.5 m depth
	1.06 m clarity	1.06 m clarity
	19.9°C	19.9°C
	214 µS/cm	214 µS/cm
	stonewort, fern pondweed, flatstem pondweed	stonewort, fern pondweed, flatstem pondweed
	Organic substrate	Organic substrate
West Lake	0.9–1.7 m depth	0.9–1.6 m depth
	0.84 m clarity	0.82 m clarity
	20.1°C	20.5°C
	266 µS/cm	269 µS/cm
	stonewort, wild celery	stonewort, wild celery
	Organic substrate	Organic substrate

APPENDICES

Appendix 1a. Site locality information for 13 sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Presqu'ile Bay, 2021. 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)
Presq01	10-Sep-21	43.99769	-77.71349	0.9	20.3	282	1.21
Presq02	10-Sep-21	43.99874	-77.71143	1.2	22.2	277	1.21
Presq03	10-Sep-21	44.00061	-77.70739	1.3	22.4	275	1.21
Presq04	10-Sep-21	44.00896	-77.72797	1.3	21.9	268	1.21
Presq05	10-Sep-21	44.01030	-77.73029	1.1	22.4	256	1.21
Presq06	28-Sep-21	44.02757	-77.69176	1.1	17.2	277	0.90
Presq07	28-Sep-21	44.03346	-77.67719	1.2	17.4	329	0.97
Presq08	28-Sep-21	44.03295	-77.67632	1.2	18.6	266	1.00
Presq09	28-Sep-21	44.03034	-77.70134	1.2	17.8	-	1.00
Presq10	29-Sep-21	44.02814	-77.68864	1.1	16.5	270	1.02
Presq11	29-Sep-21	44.02807	-77.70546	0.9	15.3	375	0.98
Presq12	29-Sep-21	44.02589	-77.71038	1.8	16.2	-	1.06
Presq13	29-Sep-21	44.01505	-77.73339	1.5	17.3	-	1.02

Appendix 1b. Site locality information for 11 sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in Wellers Bay, 2021.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity (µS/cm)	Secchi tube (m)
Well01	17-Sep-21	43.98698	-77.57689	1.4	20.4	241	1.00
Well02	17-Sep-21	43.98732	-77.57634	1.4	20.5	235	1.03
Well03	17-Sep-21	43.98737	-77.56046	1.6	21.5	228	1.05
Well04	17-Sep-21	43.99093	-77.53986	1.5	22.7	227	1.05
Well05	6-Oct-21	44.01202	-77.55798	1.0	15.6	258	1.03
Well06	6-Oct-21	44.02043	-77.58502	1.3	15.9	214	1.06
Well07	6-Oct-21	44.02248	-77.58154	1.4	16.5	310	1.03
Well08	6-Oct-21	44.02477	-77.58342	1.2	17.4	210	1.05
Well09	7-Oct-21	44.02492	-77.58701	1.2	16.5	220	1.05
Well10	7-Oct-21	44.02517	-77.62294	1.2	16.7	242	1.21
Well11	7-Oct-21	44.02522	-77.59245	1.4	17.7	223	1.10

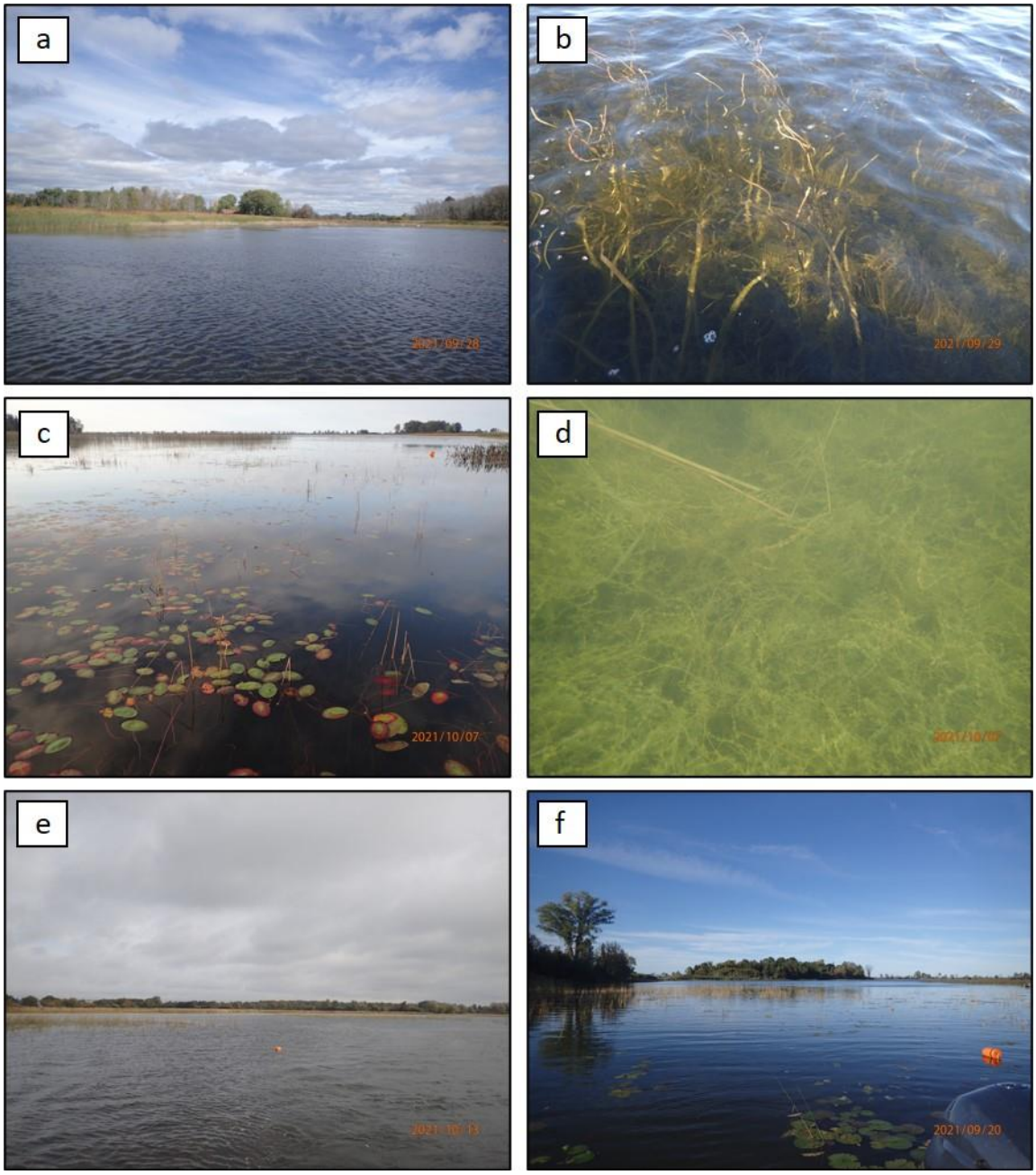
Appendix 1c. Site locality information for seven sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in East Lake, 2021.

Site code	Sample date	Start latitude	Start longitude	Mean depth (m)	Water temperature (C)	Conductivity (µS/cm)	Secchi tube (m)
EastL01	14-Sep-21	43.89622	-77.20687	1.3	19.4	195	1.00
EastL02	14-Sep-21	43.89407	-77.20486	1.3	20.8	199	1.05
EastL03	14-Sep-21	43.89786	-77.20226	1.1	20.7	199	1.05
EastL04	13-Oct-21	43.91687	-77.22037	1.1	19.2	231	1.00
EastL05	13-Oct-21	43.91779	-77.21896	1.2	19.4	222	1.10
EastL06	13-Oct-21	43.91140	-77.22470	1.3	19.9	219	1.10
EastL07	13-Oct-21	43.91025	-77.22578	1.2	19.8	236	1.15

Appendix 1d. Site locality information for 13 sites sampled for Pugnose Shiner (*Notropis anogenus*) using a repeat Mamou (surface) trawl method in West Lake, 2021. 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)
WestL01	13-Sep-21	43.94514	-77.24903	1.2	19.2	-	1.00
WestL02	13-Sep-21	43.94884	-77.24796	1.4	20.8	-	0.95
WestL03	13-Sep-21	43.94080	-77.25304	1.2	20.8	-	0.92
WestL04	13-Sep-21	43.94242	-77.25112	1.3	20.7	-	0.88
WestL05	13-Sep-21	43.93914	-77.25436	1.0	21.8	-	0.80
WestL06	13-Sep-21	43.93633	-77.25737	1.2	22.2	-	0.97
WestL07	20-Sep-21	43.94251	-77.30880	1.3	20.7	284	0.70
WestL08	20-Sep-21	43.93926	-77.31699	1.3	20.1	265	0.65
WestL09	20-Sep-21	43.94087	-77.31908	1.3	21.4	268	0.85
WestL10	20-Sep-21	43.94820	-77.29427	1.4	22.2	281	0.75
WestL11	5-Oct-21	43.95808	-77.29595	1.0	16.4	247	0.70
WestL12	5-Oct-21	43.94403	-77.30153	1.3	17.4	261	0.87
WestL13	5-Oct-21	43.93895	-77.31269	1.4	17.3	253	0.94

Appendix 2. Site photos representing examples of aquatic habitat sampled during 2021 targeted sampling for Pugnose Shiner (*Notropis anogenus*) in four eastern Lake Ontario coastal wetlands: a) Presq09 (Presqu'ile Bay), b) Presq10 (Presqu'ile Bay), c) Well09 (Wellers Bay), d) Well09 (Wellers Bay), e) East05 (East Lake), and f) West07 (West Lake).



Appendix 3a. Common and scientific names of fishes captured from Presqu'ile Bay, Wellers Bay, East Lake, and West Lake during targeted sampling for Pugnose Shiner *(Notropis anogenus*) in 2021.

Common name	Scientific name
Banded Killifish	*Fundulus diaphanus*
Black Crappie	*Pomoxis nigromaculatus*
Blackchin Shiner	*Notropis heterodon*
Bluegill	*Lepomis macrochirus*
Bluntnose Minnow	*Pimephales notatus*
Bridle Shiner	*Notropis bifrenatus*
Brook Silverside	*Labidesthes sicculus*
Brook Stickleback	*Culaea inconstans*
Brown Bullhead	*Ameiurus nebulosus*
Golden Shiner	*Notemigonus crysoleucas*
Iowa Darter	*Etheostoma exile*
Largemouth Bass	*Micropterus salmoides*
Mimic Shiner	*Notropis volucellus*
Pugnose Shiner	*Notropis anogenus*
Pumpkinseed	*Lepomis gibbosus*
Rock Bass	*Ambloplites rupestris*
Shiner sp.	*Notropis* sp.
Sunfish sp.	*Lepomis* sp.
Tadpole Madtom	*Noturus gyrinus*
Yellow Perch	*Perca flavescens*

Appendix 3b. Common and scientific names of aquatic macrophytes collected from Presqu'ile Bay, Wellers Bay, East Lake, and West Lake during targeted sampling for Pugnose Shiner (*Notropis anogenus*) in 2021.

Common name	Scientific name
Canada waterweed	*Elodea canadensis*
stonewort	*Chara* spp.
common bladderwort	*Utricularia vulgaris*
coontail	*Ceratophyllum* sp.
Eurasian watermilfoil	*Myriophyllum spicatum*
fern pondweed	*Potamogeton robbinsii*
flatstem pondweed	*Potamogeton zosteriformis*
hardstem bulrush	*Scirpus acutus*
large-leaved pondweed	*Potamogeton amplifolius*
milfoil sp.	*Myriophyllum* sp.
pondweed sp.	*Potamogeton* sp.
Richardson's pondweed	*Potamogeton richardsonii*
sago pondweed	*Stuckenia pectinata*
slender naiad	*Najas flexilis*
water marigold	*Caltha palustris*
water shield	*Brasenia schreberi*
white pond lily	*Nymphaea alba*
wild celery	*Vallisneria americana*
wild rice	*Zizania palustris*
yellow pond lily	*Nuphar variegatum*

Appendix 4. Species-specific sampling-related mortalities associated with surface trawling at 44 sites across four eastern Lake Ontario coastal wetlands in 2021. Passes with no mortalities are not listed.

Site code	Pass #	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Golden Shiner	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Shiner sp.	Yellow Perch
EastL01	1	0	0	0	1	0	0	0	0	0	0	0
EastL02	2	1	0	0	0	0	0	1	0	0	0	0
EastL02	1	0	0	0	0	0	0	0	0	0	0	1
EastL03	1	1	0	0	0	0	0	0	0	0	0	0
EastL05	2	0	0	0	1	0	0	0	0	0	0	0
EastL07	2	0	0	0	1	0	0	0	0	0	0	0
Presq01	3	1	0	0	1	0	0	0	0	0	0	0
Presq02	2	0	0	0	0	0	0	0	0	0	1	0
Presq09	1	11	0	0	0	0	0	0	0	0	0	0
Well03	1	0	0	0	0	0	0	0	0	0	0	2
Well04	3	0	0	0	0	4	0	0	0	0	0	0
Well06	3	2	0	0	0	0	0	0	0	0	0	0
Well06	1	4	0	0	0	0	0	0	0	0	0	0
Well07	3	3	0	0	0	0	0	0	0	0	0	0
Well07	1	1	0	0	0	0	0	0	0	0	0	0
Well08	2	2	0	0	0	0	0	0	0	0	0	0
Well08	1	1	0	0	0	0	0	0	0	0	0	0
Well09	3	8	0	0	0	0	0	0	2	0	0	0
Well11	2	13	0	0	0	0	1	0	0	0	0	0
Well11	3	0	0	1	0	0	1	0	2	0	0	0
WestL02	2	1	0	0	0	0	0	0	0	0	0	0
WestL02	3	1	0	0	0	0	0	0	0	0	0	0
WestL03	1	0	1	0	0	0	0	0	0	0	0	0
WestL06	2	3	3	0	2	0	0	0	0	0	0	0
WestL06	3	13	1	0	1	0	0	0	0	1	0	0
WestL06	1	2	0	0	1	0	0	0	0	0	0	0
WestL07	2	0	0	2	0	0	0	0	0	0	0	0
WestL08	2	2	0	5	0	0	0	0	0	1	0	0
WestL08	1	0	0	3	0	0	0	0	0	0	0	0
WestL10	2	1	0	0	0	0	0	0	0	0	0	0
WestL10	3	0	0	0	0	0	0	0	0	1	0	0
WestL11	3	0	0	0	0	0	1	0	0	0	0	0
WestL11	1	8	0	1	0	0	0	0	0	8	0	0
WestL13	3	0	0	0	0	0	0	0	0	0	0	1
Total		79	5	12	8	4	3	1	4	11	1	4

Appendix 5a. Pooled species count data for fishes captured at 13 sites in Presqu'ile Bay during surface trawl surveys in 2021.

	Common name																				
Site code	Banded Killifish	Black Crappie	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Golden Shiner	Iowa Darter	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Shiner sp.	Sunfish sp.	Tadpole Madtom	Yellow Perch	Total
Presq01	2	0	1	2	1	2	0	0	0	0	0	1	0	0	2	1	0	0	0	1	13
Presq02	2	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	7
Presq03	0	0	31	0	0	1	0	0	0	2	0	1	0	0	1	1	0	0	0	1	38
Presq04	2	0	5	0	0	2	0	0	0	1	0	0	0	0	2	1	0	0	0	0	13
Presq05	0	0	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8
Presq06	4	0	4	2	9	7	0	0	0	0	0	2	0	0	1	0	0	2	0	0	31
Presq07	1	0	1	0	1	0	0	0	1	0	0	4	0	0	1	0	0	1	0	0	10
Presq08	58	0	31	4	13	9	0	0	0	0	0	0	0	0	6	31	0	1	0	3	156
Presq09	3	0	17	1	2	3	0	0	0	0	0	6	0	1	2	0	0	0	0	5	40
Presq10	32	0	15	1	11	9	0	0	0	0	0	13	0	1	10	4	0	1	0	3	100
Presq11	1	0	2	3	0	0	0	0	1	0	0	9	0	1	3	0	0	0	0	1	21
Presq12	0	0	0	0	0	0	0	0	2	0	0	4	0	0	0	0	0	0	0	2	8
Presq13	0	0	10	0	3	1	0	0	0	0	0	6	0	2	4	0	0	1	1	3	31
Total	105	0	127	13	40	34	0	0	4	3	0	47	0	5	33	38	1	6	1	19	476

Appendix 5b. Pooled species count data for fishes captured at 11 sites in Wellers Bay during surface trawl surveys in 2021.

	Common name																				
Site code	Banded Killifish	Black Crappie	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Golden Shiner	Iowa Darter	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Shiner sp.	Sunfish sp.	Tadpole Madtom	Yellow Perch	Total
Well01	1	0	55	14	5	0	7	0	0	0	0	2	0	4	1	0	0	0	0	10	99
Well02	0	0	2	3	2	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	11
Well03	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	4
Well04	0	0	0	0	0	0	61	0	0	0	0	0	0	0	0	0	0	0	0	0	61
Well05	0	0	9	3	23	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	37
Well06	0	0	169	1	1	5	9	0	0	0	0	1	0	3	0	0	0	0	0	0	189
Well07	0	0	131	1	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	136
Well08	0	0	101	16	0	17	0	0	0	1	0	0	0	5	0	0	0	0	0	0	140
Well09	1	0	123	3	5	6	1	0	0	0	0	1	6	5	0	0	0	0	0	0	151
Well10	0	0	50	3	4	0	1	0	0	0	0	2	0	1	0	0	0	0	0	1	62
Well11	0	0	351	1	11	12	0	0	0	43	0	0	28	3	0	1	0	0	0	0	450
Total	2	0	992	45	51	41	79	0	0	45	0	6	34	24	1	5	0	1	0	14	1340

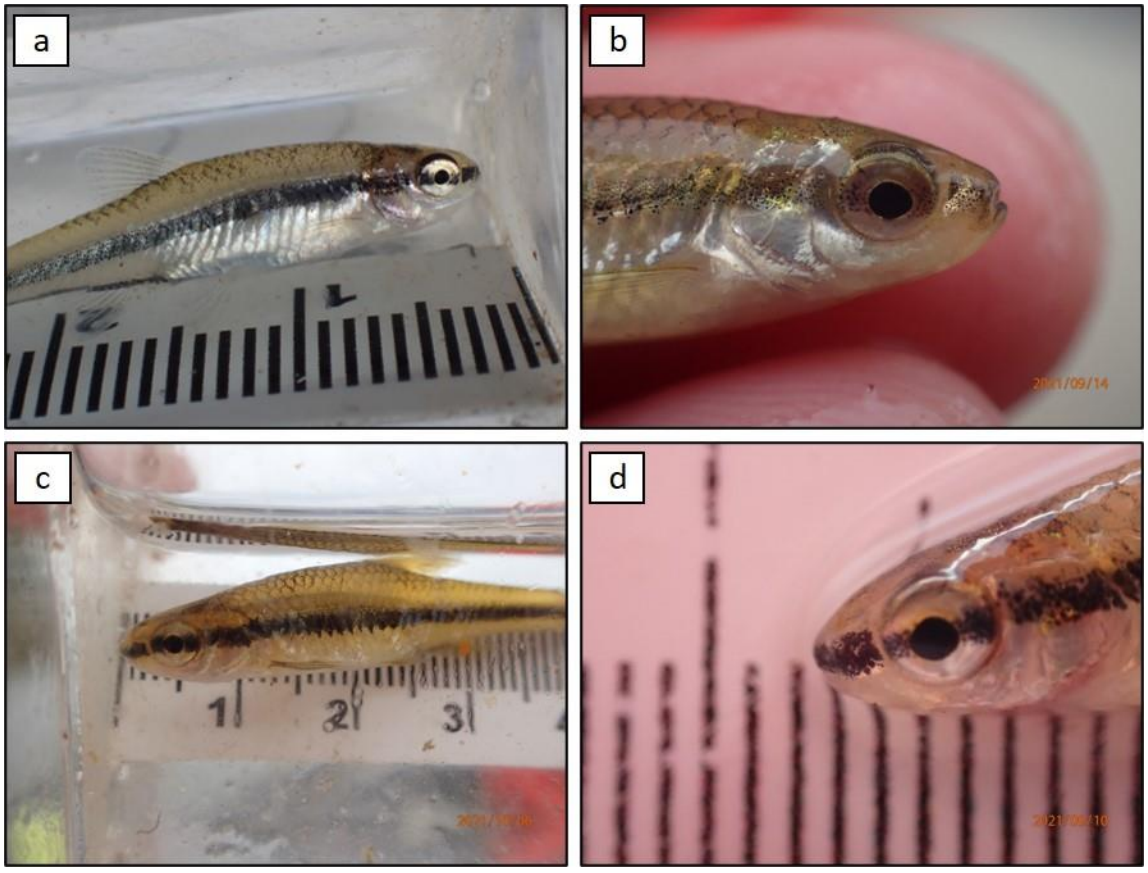
Appendix 5c. Pooled species count data for fishes captured at seven sites on East Lake during surface trawl surveys in 2021.

	Common name																				
Site code	Banded Killifish	Black Crappie	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Golden Shiner	Iowa Darter	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Shiner sp.	Sunfish sp.	Tadpole Madtom	Yellow Perch	Total
EastL01	1	0	6	19	3	4	8	0	0	0	0	4	0	5	5	0	0	0	0	5	60
EastL02	1	0	18	7	3	11	2	0	0	0	0	5	0	4	1	0	0	0	0	14	66
EastL03	0	0	52	61	18	3	0	0	0	0	0	1	0	8	4	0	0	1	0	5	153
EastL04	0	0	13	49	0	25	0	0	0	0	0	3	0	1	5	0	0	0	0	1	97
EastL05	1	0	4	18	1	69	0	0	0	0	1	3	0	2	3	0	0	0	0	1	103
EastL06	0	0	2	21	0	0	8	0	0	0	0	1	0	0	3	0	0	0	0	1	36
EastL07	0	0	0	40	0	1	0	0	0	0	0	3	0	2	3	0	0	1	0	1	51
Total	3	0	95	215	25	113	18	0	0	0	1	20	0	22	24	0	0	2	0	28	566

Appendix 5d. Pooled species count data for fishes captured at 13 sites on West Lake during surface trawl surveys in 2021.

	Common name																			
Site code	Banded Killifish	Black Crappie	Blackchin Shiner	Bluegill	Bluntnose Minnow	Bridle Shiner	Brook Silverside	Brook Stickleback	Brown Bullhead	Golden Shiner	Iowa Darter	Largemouth Bass	Mimic Shiner	Pugnose Shiner	Pumpkinseed	Rock Bass	Shiner sp.	Sunfish sp.	Tadpole Madtom	Yellow Perch	Total
WestL01	0	0	6	10	0	11	0	0	0	0	0	3	0	3	1	0	0	0	0	18	52
WestL02	0	0	10	17	1	0	0	0	0	37	0	0	0	2	0	0	0	0	0	0	67
WestL03	0	0	0	109	0	2	0	0	0	1	0	0	0	6	0	0	0	0	0	4	122
WestL04	0	0	2	61	0	1	2	1	0	0	0	2	0	1	0	3	0	0	0	3	76
WestL05	2	0	0	0	14	2	7	2	0	0	0	2	0	2	2	0	0	0	4	2	39
WestL06	2	1	88	98	0	47	6	0	0	9	0	3	0	24	1	0	0	0	0	15	294
WestL07	0	0	11	49	32	1	1	0	0	2	0	4	0	7	0	0	0	0	0	1	108
WestL08	0	0	6	65	97	1	0	0	0	1	0	2	0	17	0	1	0	0	0	12	202
WestL09	0	0	1	11	11	0	0	0	0	0	0	0	0	3	0	1	0	0	0	8	35
WestL10	1	1	24	30	73	16	0	0	0	0	0	4	0	42	1	3	0	0	0	11	206
WestL11	6	0	55	39	52	8	1	0	0	7	0	2	0	183	1	2	0	0	0	10	366
WestL12	2	0	17	4	7	0	0	1	0	0	0	1	2	11	0	2	0	0	0	17	64
WestL13	1	0	19	20	4	0	0	0	0	0	0	0	0	11	0	1	0	0	0	16	72
Total	14	2	239	513	291	89	17	4	0	57	0	23	2	312	6	13	0	0	4	117	1703

Appendix 6. Photos of species at risk collected from eastern Lake Ontario coastal wetlands during surface trawl surveys in 2021: 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 13 sites sampled in Presqu'ile Bay during surface trawl surveys in 2021.

	Substrate (% composition)							
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Presq01	100	0	0	0	0	0	0	0
Presq02	100	0	0	0	0	0	0	0
Presq03	100	0	0	0	0	0	0	0
Presq04	80	0	0	20	0	0	0	0
Presq05	100	0	0	0	0	0	0	0
Presq06	100	0	0	0	0	0	0	0
Presq07	100	0	0	0	0	0	0	0
Presq08	100	0	0	0	0	0	0	0
Presq09	100	0	0	0	0	0	0	0
Presq10	70	0	0	30	0	0	0	0
Presq11	100	0	0	0	0	0	0	0
Presq12	30	70	0	0	0	0	0	0
Presq13	100	0	0	0	0	0	0	0
Minimum	30	0	0	0	0	0	0	0
Maximum	100	70	0	30	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7b. Percent substrate composition at 11 sites sampled in Wellers Bay during surface trawl surveys in 2021.

	Substrate (% composition)							
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
Well01	40	0	0	60	0	0	0	0
Well02	25	0	0	75	0	0	0	0
Well03	100	0	0	0	0	0	0	0
Well04	100	0	0	0	0	0	0	0
Well05	100	0	0	0	0	0	0	0
Well06	100	0	0	0	0	0	0	0
Well07	100	0	0	0	0	0	0	0
Well08	100	0	0	0	0	0	0	0
Well09	100	0	0	0	0	0	0	0
Well10	20	0	0	80	0	0	0	0
Well11	40	0	0	60	0	0	0	0
Minimum	20	0	0	0	0	0	0	0
Maximum	100	0	0	80	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7c. Percent substrate composition at seven sites sampled on East Lake during surface trawl surveys in 2021.

	Substrate (% composition)							
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
EastL01	50	0	0	50	0	0	0	0
EastL02	100	0	0	0	0	0	0	0
EastL03	60	0	0	40	0	0	0	0
EastL04	100	0	0	0	0	0	0	0
EastL05	40	0	60	0	0	0	0	0
EastL06	100	0	0	0	0	0	0	0
EastL07	100	0	0	0	0	0	0	0
Minimum	40	0	0	0	0	0	0	0
Maximum	100	0	60	50	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 7d. Percent substrate composition at 13 sites sampled on West Lake during surface trawl surveys in 2021.

	Substrate (% composition)							
Site code	Organic	Clay	Silt	Sand	Gravel	Cobble	Rubble	Boulder
WestL01	100	0	0	0	0	0	0	0
WestL02	70	0	0	30	0	0	0	0
WestL03	100	0	0	0	0	0	0	0
WestL04	100	0	0	0	0	0	0	0
WestL05	100	0	0	0	0	0	0	0
WestL06	100	0	0	0	0	0	0	0
WestL07	100	0	0	0	0	0	0	0
WestL08	100	0	0	0	0	0	0	0
WestL09	75	0	0	25	0	0	0	0
WestL10	100	0	0	0	0	0	0	0
WestL11	100	0	0	0	0	0	0	0
WestL12	100	0	0	0	0	0	0	0
WestL13	100	0	0	0	0	0	0	0
Minimum	70	0	0	0	0	0	0	0
Maximum	100	0	0	30	0	0	0	0
Median	100	0	0	0	0	0	0	0

Appendix 2a. Aquatic vegetation data from 13 sites sampled in Presqu'ile Bay during surface trawl surveys in 2021.

	Vegetation rake		Aquatic vegetation cover (%)				
Site code	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	Dominant taxa
Presq01	1	0	0	0	100	0	wild celery, flatstem pondweed
Presq02	2	0	0	0	100	0	wild celery, flatstem pondweed
Presq03	2	0	0	0	100	0	wild celery, flatstem pondweed
Presq04	3	0	0	0	100	0	wild celery, flatstem pondweed, fern pondweed
Presq05	2	0	0	0	100	0	wild celery, fern pondweed
Presq06	2	0	0	0	100	0	flatstem pondweed
Presq07	3	0	0	0	100	0	wild celery, Eurasian watermilfoil
Presq08	3	0	0	0	100	0	wild celery
Presq09	2	0	0	0	100	0	wild celery, flatstem pondweed
Presq10	1	0	0	0	100	0	wild celery, flatstem pondweed
Presq11	3	0	0	0	95	5	flatstem pondweed
Presq12	1	0	0	0	100	0	wild celery, Canada waterweed
Presq13	2	0	0	0	100	0	wild celery, stonewort, flatstem pondweed
Minimum	1	0	0	0	95	0	Overall dominant:
Maximum	3	0	0	0	100	5	wild celery, flatstem pondweed
Median	2	0	0	0	100	0	

Appendix 8b. Aquatic vegetation data from 11 sites sampled in Wellers Bay during surface trawl surveys in 2021.

	Vegetation rake		Aquatic vegetation cover (%)				
Site code	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	Dominant taxa
Well01	2	0	0	10	90	0	stonewort, wild celery, Richardson's pondweed
Well02	2	0	0	5	95	0	stonewort., Richardson's pondweed
Well03	2	0	0	5	95	0	stonewort
Well04	1	0	10	5	85	0	stonewort
Well05	1	0	10	15	60	15	pondweed sp., stonewort
Well06	3	0	0	15	65	20	stonewort
Well07	3	0	0	10	80	10	wild rice, sago pondweed, fern pondweed
Well08	3	0	0	5	95	0	stonewort
Well09	2	0	0	10	80	10	stonewort
Well10	1	0	0	0	95	5	wild celery, Richardson's pondweed
Well11	2	0	5	0	95	0	Richardson's pondweed, sago pondweed
Minimum	1	0	0	0	60	0	Overall dominant:
Maximum	3	0	10	15	95	20	stonewort
Median	2	0	0	5	90	0	

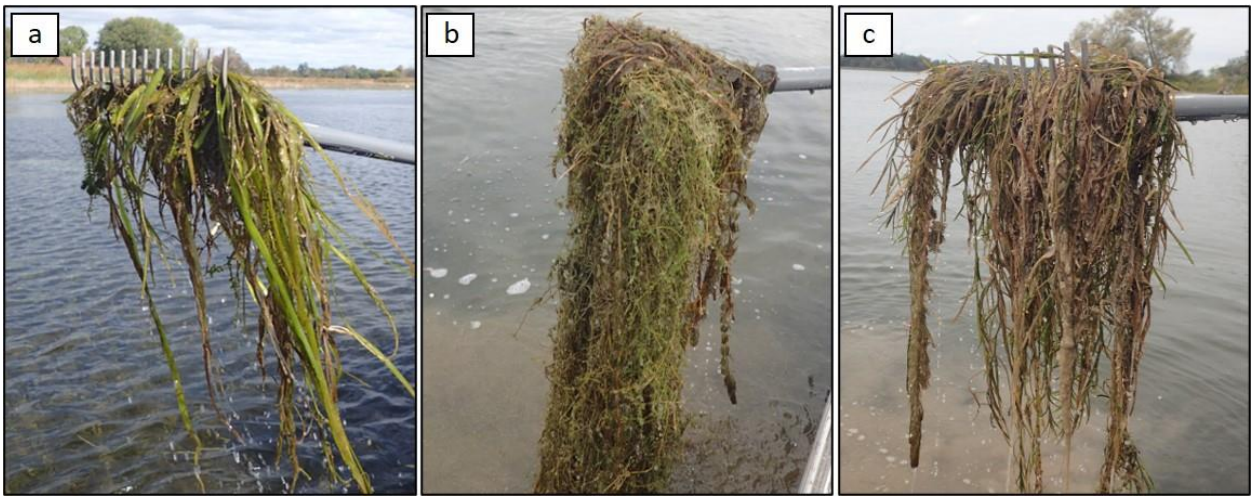
Appendix 8c. Aquatic vegetation data from seven sites sampled on East Lake during surface trawl surveys in 2021.

	Vegetation rake		Aquatic vegetation cover (%)				
Site code	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	Dominant taxa
EastL01	3	0	0	0	100	0	stonewort, wild celery
EastL02	3	0	0	0	100	0	flatstem pondweed, wild celery
EastL03	3	0	0	0	100	0	fern pondweed, flatstem pondweed
EastL04	3	0	0	0	100	0	fern pondweed, milfoil sp.
EastL05	3	0	0	0	100	0	Eurasian watermilfoil
EastL06	3	0	0	0	100	0	stonewort
EastL07	1	0	0	0	100	0	stonewort
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 8d. Aquatic vegetation data from 13 sites sampled on West Lake during surface trawl surveys in 2021.

	Vegetation rake		Aquatic vegetation cover (%)				
Site code	Submerged macrophytes	Filamentous algae	Open water	Emergent	Submerged	Floating	Dominant taxa
WestL01	3	0	0	10	90	0	fern pondweed, Richardson's pondweed, wild celery
WestL02	2	0	0	0	100	0	stonewort, Richardson's pondweed
WestL03	3	0	0	15	85	0	Eurasian watermilfoil
WestL04	2	0	0	5	95	0	stonewort, Eurasian watermilfoil
WestL05	1	0	0	3	95	2	stonewort
WestL06	2	0	0	10	85	5	wild celery, stonewort
WestL07	2	0	0	30	60	10	stonewort, wild rice
WestL08	2	0	0	0	100	0	stonewort, wild celery
WestL09	1	0	0	0	100	0	wild celery, sago pondweed, fern pondweed
WestL10	1	0	0	0	95	5	stonewort
WestL11	2	0	0	0	100	0	wild celery, Richardson's pondweed, sago pondweed
WestL12	3	0	0	0	100	0	stonewort, wild celery
WestL13	3	0	0	0	100	0	wild celery, Richardson's pondweed
Minimum	1	0	0	0	60	0	Overall dominant:
Maximum	3	0	0	30	100	10	stonewort, wild celery
Median	2	0	0	0	95	0	

Appendix 9. Photos of dominant macrophyte species identified from four eastern Lake Ontario coastal wetlands during 2021 targeted sampling for Pugnose Shiner (*Notropis anogenus*): a) wild celery (*Vallisneria americana*), b) stonewort (*Chara* spp.), and c) flatstem pondweed (*Potamogeton zosteriformis*).



Appendix 10. Complete list of macrophytes identified from 44 sites sampled in East Lake, Presqu'ile Bay, Weller's Bay, and West Lake in 2021.

Short code	Dominant species	Other species
EastL01	stonewort, wild celery	Richardson's pondweed, milfoil sp., Eurasian watermilfoil, sago pondweed
EastL02	flatstem pondweed, wild celery	milfoil sp., Richardson's pondweed, Canada waterweed, Eurasian watermilfoil, sago pondweed, fern pondweed
EastL03	fern pondweed, flatstem pondweed	stonewort, milfoil sp., Richardson's pondweed, coontail, Canada waterweed, wild celery, water marigold, slender naiad
EastL04	fern pondweed, milfoil sp.	Eurasian watermilfoil, stonewort, wild celery, Canada waterweed, slender naiad, Richardson's pondweed, coontail
EastL05	Eurasian watermilfoil	flatstem pondweed, Canada waterweed, coontail, milfoil sp., Richardson's pondweed, wild celery, common bladderwort, stonewort
EastL06	stonewort	Eurasian watermilfoil, milfoil sp., wild celery, sago pondweed, Richardson's pondweed
EastL07	stonewort	Richardson's pondweed, Eurasian watermilfoil, milfoil sp., wild celery, sago pondweed, fern pondweed
Presq01	wild celery, flatstem pondweed	water marigold, large-leaved pondweed, Canada waterweed, fern pondweed, Richardson's pondweed
Presq02	wild celery, flatstem pondweed	fern pondweed, Richardson's pondweed, large-leaved pondweed, Canada waterweed
Presq03	wild celery, flatstem pondweed	fern pondweed, coontail, Canada waterweed
Presq04	wild celery, flatstem pondweed, fern pondweed	Canada waterweed, large-leaved pondweed, Richardson's pondweed
Presq05	wild celery, fern pondweed	Richardson's pondweed, Canada waterweed, coontail, flatstem pondweed
Presq06	flatstem pondweed	wild celery, Richardson's pondweed, water marigold
Presq07	wild celery, Eurasian watermilfoil	stonewort, coontail, flatstem pondweed, Canada waterweed
Presq08	wild celery	flatstem pondweed, coontail, Canada waterweed, stonewort
Presq09	wild celery, flatstem pondweed	coontail, water marigold, Canada waterweed
Presq10	wild celery, flatstem pondweed	Richardson's pondweed, slender naiad, coontail, milfoil sp., Canada waterweed
Presq11	flatstem pondweed	wild celery, slender naiad, Canada waterweed, coontail, water marigold, white pond lily, Eurasian watermilfoil
Presq12	wild celery, Canada waterweed	coontail, Richardson's pondweed, sago pondweed
Presq13	wild celery, stonewort, flatstem pondweed	coontail, common bladderwort, Canada waterweed, slender naiad, sago pondweed, large-leaved pondweed, Richardson's pondweed
Well01	stonewort, wild celery. Richardson's pondweed	milfoil sp., wild rice, sago pondweed, water marigold, slender naiad
Well02	stonewort, Richardson's pondweed	milfoil sp., water marigold, slender naiad, wild rice, wild celery
Well03	stonewort	Richardson's pondweed, flatstem pondweed, Eurasian watermilfoil, slender naiad, water marigold, sago pondweed
Well04	stonewort	Richardson's pondweed, hardstem bulrush, sago pondweed

Appendix 10. *(Continued)*

Short code	Dominant species	Other species
Well05	pondweed sp., stonewort	white pond lily, wild rice, wild celery, milfoil sp., sago pondweed, Richardson's pondweed, yellow pond lily, coontail, water marigold
Well06	stonewort	wild rice, yellow pond lily, milfoil sp., pondweed sp., Canada waterweed, white pond lily
Well07	wild rice, sago pondweed, fern pondweed	yellow pond lily, milfoil sp., water marigold, pondweed sp., Richardson's pondweed, common bladderwort, flatstem pondweed, coontail, Canada waterweed, Eurasian watermilfoil, stonewort
Well08	stonewort	Richardson's pondweed, sago pondweed, flatstem pondweed, slender naiad, milfoil sp., Eurasian watermilfoil, Canada waterweed, wild celery, fern pondweed, large-leaved pondweed
Well09	stonewort	white pond lily, wild rice, pondweed sp., milfoil sp., Eurasian watermilfoil, Richardson's pondweed, wild celery, water shield, pondweed sp.
Well10	wild celery	Richardson's pondweed, stonewort, sago pondweed, Canada waterweed, Eurasian watermilfoil, white pond lily
Well11	Richardson's pondweed, sago pondweed	fern pondweed, Canada waterweed, flatstem pondweed, slender naiad, large-leaved pondweed, wild celery, Eurasian watermilfoil, milfoil sp., coontail
WestL01	fern pondweed, Richardson's pondweed, wild celery	wild rice, Canada waterweed, milfoil sp., sago pondweed
WestL02	stonewort, Richardson's pondweed	wild celery, sago pondweed, milfoil sp.
WestL03	Eurasian watermilfoil	flatstem pondweed, sago pondweed, Richardson's pondweed, Canada waterweed, wild rice, fern pondweed, milfoil sp., stonewort, wild celery, coontail
WestL04	stonewort, Eurasian watermilfoil	Richardson's pondweed, sago pondweed, wild rice, white pond lily
WestL05	stonewort	Richardson's pondweed, Eurasian watermilfoil, wild rice, white pond lily, water marigold
WestL06	wild celery, stonewort	sago pondweed, Richardson's pondweed, wild rice, white pond lily, fern pondweed, Eurasian watermilfoil
WestL07	stonewort, wild rice	milfoil sp., white pond lily, wild celery, Richardson's pondweed, slender naiad
WestL08	stonewort, wild celery	sago pondweed, Richardson's pondweed, milfoil sp.
WestL09	wild celery, sago pondweed, fern pondweed	Richardson's pondweed, flatstem pondweed, slender naiad
WestL10	stonewort	Richardson's pondweed, Canada waterweed, slender naiad, water marigold, coontail
WestL11	wild celery, Richardson's pondweed, sago pondweed	Canada waterweed, flatstem pondweed, stonewort., water marigold, slender naiad, fern pondweed, milfoil sp.
WestL12	stonewort, wild celery	Richardson's pondweed, sago pondweed, flatstem pondweed, Canada waterweed, water marigold, milfoil sp., slender naiad
WestL13	wild celery, Richardson's pondweed	flatstem pondweed, fern pondweed, water marigold, sago pondweed, stonewort, slender naiad