Targeted Eastern Pondmussel (*Ligumia nasuta*) Surveys in Eastern Ontario

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ABSTRACT

In eastern Ontario, targeted Eastern Pondmussel (*Ligumia nasuta*) surveys were needed to inform provincial and federal status assessments, delineate critical habitat and support priority research and monitoring recovery actions. In 2015 and 2016, 17 inland lakes in eastern Ontario and 21 sites along the Trent River were surveyed for freshwater mussels. Collections were done using visual-tactile and clam-rake methods. A total of 5,629 live individuals representing 10 mussel species were collected; including Eastern Pondmussel and Rainbow (*Villosa iris*). Compared to mussel assemblages in southwestern Ontario rivers and Great Lakes coastal habitats, species richness was low. Eastern Elliptio (*Elliptio complanata*) was the most widespread and abundant species, accounting for more than 80% of all live individuals. Other common species were Giant Floater (*Pyganodon grandis*) and Fatmucket (*Lampsilis siliquoidea*). Eastern Pondmussel was collected from Beaver, Loughborough and White lakes and the Cataraqui River. Weathered Eastern Pondmussel shells were collected from Cranberry/Dog Lake. Zebra Mussel was detected at 10 of the 17 lakes surveyed. Across the 10 lakes, evidence of Zebra Mussel (byssal threads or attached Zebra Mussels) was observed on more than 75% of the live freshwater mussels collected. Rainbow, but not Eastern Pondmussel, was detected along the Trent River.

RÉSUMÉ

Dans l'est de l'Ontario, des relevés ciblés sur la ligumie pointue (*Ligumia nasuta*) ont été nécessaires afin d'éclairer les évaluations fédérales et provinciales de l'état de l'espèce, de délimiter l'habitat essentiel, et d'appuyer les recherches prioritaires et la supervision des mesures de rétablissement. En 2015 et en 2016, 17 lacs intérieurs de l'est de l'Ontario et 21 sites le long de la rivière Trent ont fait l'objet de relevés sur les moules d'eau douce. Les collectes ont été effectuées à l'aide de méthodes visuelles/tactiles et de méthodes de ratissage. Au total, 5 629 individus vivants, représentant 10 espèces de moules, ont été recueillis, y compris des spécimens de ligumie pointue et de villeuse irisée (*Villosa iris*). Par rapport aux communautés de moules des habitats côtiers des rivières du sud-ouest de l'Ontario et des Grands Lacs, la richesse des espèces était faible. L'elliptio de l'Est (*Elliptio complanata*) était l'espèce la plus répandue et la plus abondante, représentant plus de 80 % de l'ensemble des individus vivants. Parmi les espèces communes, on trouvait également le pyganodon commun (*Pyganodon grandis*) et la lampsile siliquoïde (*Lampsilis siliquoidea*). Des spécimens de ligumie pointue ont été recueillis dans les lacs Beaver, Loughborough et White et la rivière Cataraqui. Des coquilles altérées de ligumie pointue ont été recueillies dans le lac Cranberry/Dog. Des moules zébrées ont été détectées dans 10 des 17 lacs ayant fait l'objet de relevés. Dans les 10 lacs, des preuves de la présence de moules zébrées (byssus ou moules zébrées attachées) ont été observées sur plus de 75 % des moules d'eau douce vivantes recueillies. Des spécimens de villeuse irisée, mais pas de ligumie pointue, ont été détectés le long de la rivière Trent.

INTRODUCTION

In Canada, there are 55 native freshwater mussel species with 41 species occurring in the province of Ontario (Metcalfe-Smith et al. 2005). Almost a third of these species in Ontario are listed as Endangered, Threatened, or of Special Concern under the federal *Species at Risk Act* and the provincial *Endangered Species Act* (COSEWIC 2016; MNRF 2014). The Eastern Pondmussel (*Ligumia nasuta*) (Endangered) was historically one of the most common freshwater mussel species in the nearshore of the lower Laurentian Great Lakes. In 2007, it was estimated that Eastern Pondmussel had been lost from over 90% of its former range in Canada (COSEWIC 2007). Only two extant populations were known: one in Lake St. Clair, and the other in Lyn Creek, a tributary of the upper St. Lawrence River near Brockville, Ontario (COSEWIC 2007). However, subsequent surveys have collected Eastern Pondmussel from 11 additional sites across the lower Great Lakes basin (Fisheries and Ocean Canada, 2016). These collections indicate that additional targeted sampling throughout the lower Great Lakes was needed in order to better understand the status and distribution of Eastern Pondmussel.

Targeted sampling for Eastern Pondmussel has been largely focused on coastal and nearshore habitats along the lower Great Lakes (Reid et al. 2014; 2016). However, over the past two decades, fresh and weathered shells have been collected from inland lakes in eastern Ontario: Beaver Lake, Loughborough Lake, White (or Inglesby) Lake, and Whitefish Lake (Fisheries and Oceans Canada 2016). Recently, timed-search mussel surveys have been undertaken at wadeable river habitats in eastern Ontario (Reid 2016). However, similar efforts to detect freshwater mussel species at risk and collect live individuals have not been undertaken in littoral or wetland-type habitats. In this region, targeted Eastern Pondmussel surveys are needed in order to inform provincial and federal status assessments, delineate critical habitat and support priority research and monitoring recovery actions.

During the summer and early fall of 2015 and 2016, timed-search based inventories of the Trent River and eastern Ontario lakes were completed to: 1) determine the presence of Eastern Pond Mussel; 2) describe freshwater mussel assemblages; and, 3) document the presence of the invasive dreissenid mussels (*i.e.* Zebra Mussel *Dreissena polymorpha*).

METHODS

MUSSEL SAMPLING

In 2015 and 2016, 17 Eastern Ontario inland lakes and 21 sites along the Trent River were surveyed (Figures 1 and 2). Mussel sampling occurred between July 6th and September 13th during 2015, and between July 15th and September 27th during 2016 (Table 1). Effort and collection methods varied among localities, and between years. At 13 lakes, 12 sampling points were randomly selected using provincially-evaluated wetland and waterbody GIS layers. No *a priori* information on sediment characteristics, water depth or spatial variation in mussel densities was used to inform site selection. At each point, effort was divided equally between clam-rake and visual-tactile sampling. Sampling effort at each point differed between years: 1 hour of search effort per method in 2015, and 1.5 hour per method in 2016. Sampling was limited to within 50 m of the starting point, and areas sampled by either method did not overlap. Four lakes were too small to accommodate 12 sampling points. Upper Rock Lake was surveyed using the visual-tactile method at 8 points in 2016. At Guerley, Spectacle, and Elbow lakes, visual-tactile mussel searches were conducted along the shoreline for a total of 4.5 hours at each lake.

Two methods were used to collect mussels from Trent River sites. At 13 sites, mussels were collected by clam-rake and visual-tactile sampling (1.5 hour for each method). At 8 sites, 4.5 hour timed-search surveys along the shoreline were completed.

Visual-tactile searching involved either floating on air mattresses and hand searching the sediment for mussels (both on the surface and probing through sediment for burrowed mussels), or searching for mussels with an underwater viewer (Plastimo® Round Underwater Viewer, 0.33 m diameter) or polarized lenses. In clear habitats, individuals could be visually detected by spotting siphons or small Zebra Mussel clusters. For the clam-rake method, an Eagle Claw® Clam Rake (0.84 m long handle, with a 0.26 x 0.15 m metal basket and ten 0.15 m long steel teeth) was dragged through the sediment and wetland vegetation. The spacing of wire mesh within the basket was 2.5 cm x 5 cm. Water depths at searched habitats were between 5 cm and 150 cm. Live individuals and shells were identified to species (Metcalfe-Smith et al. 2005). Shell length (mm) of live individuals was measured with a dial caliper (±0.1 mm). Live mussels and the total mass of attached Zebra Mussel were weighed separately (±0.1 g). After processing, live mussels were returned to the sediment. Collection data was archived in the Lower Great Lakes Unionid Database (Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada).

The following habitat features were assessed at each site: substrate composition, macrophyte density, water clarity, and water depth. Substrate composition and macrophyte density were visually assessed. Water clarity was measured with a turbidity tube (Anderson and Davic 2004).

DATA ANALYSIS

Gear selection and sampling effort are important considerations for future mussel species at risk surveys. Using data from inland lake sites sampled with both visual-tactile and clam-rake methods, the following measures were compared: 1) number of live individuals collected, 2) number of species detected, and 3) percentage of sites with live individuals. Differences between the two sampling methods were assessed using the Spearman Rank correlation, nonparametric paired-sample Wilcoxon test and species accumulation curves. Statistical analyses were completed using PAST version 1.94 (Hammer et al. 2001).

RESULTS

A total of 5,629 live individuals representing 10 mussel species were collected during 2015 and 2016 sampling (Tables 2 to 5). Two species at risk were detected: Eastern Pondmussel and Rainbow (*Villosa iris*). Two additional species were only identified based on shells collected from the Trent River: Black Sandshell (*Ligumia recta*) and Pimpleback (*Quadrula pustulosa*). Eastern Elliptio (*Elliptio complanata*) was the most widespread and abundant species, accounting for more than 80% of all live individuals. Other common species were Giant Floater (*Pyganodon grandis*), and Fatmucket (*Lampsilis siliquoidea*).

Research underway (Porto-Hannes et al. 2016) indicates that a hybrid zone between Fatmucket and Eastern Lampmussel (*Lampsilis radiata*) exists in the part of Eastern Ontario sampled in 2015 and 2016. Morphological and genetic intermediate forms exist in this region. Species identifications in this study were only based on shell characteristics, without corresponding genetic analysis. Therefore, Fatmucket records presented in this study should be viewed with some caution.

Inland Lakes

2015 Collections

Eastern Pondmussel was collected from Beaver (24 live individuals), Loughborough (19 live individuals) and White (26 live individuals) lakes. Collections from all three lakes included a range of sizes, with small (< 60 mm shell length) individuals indicating ongoing recruitment in Loughborough and White lakes (Figure 3). Live individuals were most often found at sites with low to moderate macrophyte densities, and in sand/gravel and silt/organic substrates, with soft substrate depths of 5 to 9 cm. Live Eastern Pondmussel or shells were not collected from Whitefish Lake.

A total of 2,663 live mussels representing seven species were collected. The abundance of live individuals varied across lakes, ranging from 23 in Moira Lake to 933 in Beaver Lake. Species richness was generally low at each lake, with a maximum of 3 species detected (with the exception of Beaver Lake where 7 species were detected). The dominant species was Eastern Elliptio, which was present in all lakes and represented 89% of live individuals collected.

2016 Collections

Only one live Eastern Pondmussel was collected in 2016 (Cataraqui River). Weathered Eastern Pondmussel shells were collected from Cranberry/Dog Lake. A total of 1,899 live mussels representing six species were collected using combined visual-tactile and clam-rake sampling. The abundance of live individuals was highest in Camden Lake (n=859) and lowest in Sydenham Lake (n=5). Species richness was low across all lakes with a maximum of four species (Cataraqui River and Cranberry/Dog Lake), and a minimum of one species (Gananoque Lake). Eastern Elliptio was present in all lakes and represented 67% of live individuals collected. Forty-two live Eastern Elliptio were collected from Elbow Lake. No shells or live mussels were collected from Guerley and Spectacle lakes.

Clam-rake vs Visual-Tactile Sampling

The numbers of live individuals collected from each lake by clam-rake and visual tactile sampling were significantly different in 2015 ($W = 21$, $p = 0.028$) and in 2016 ($W = 28$, $p = 0.018$). In 2015, 5 times as many live mussels were collected by visual-tactile sampling (median = 303 individuals) than clam-raking (median = 63.5 individuals). In 2016, 1.7 times as many live mussels were collected by visual-tactile sampling (median = 108 individuals) than clam-raking (median = 64 individuals). For both years, there were no significant differences between sampling methods (2015: $W = 18.5$, $p = 0.08$; 2016: $W = 10.0$, $p = 0.49$) in the percentage of sites where live mussels were collected. Across sampled lakes, the numbers of individuals collected by each method were strongly correlated ($r_s = 0.76$; $p = 0.002$).

The total numbers of species detected from each lake by clam-rake and visual tactile sampling were not significantly different in either year (2015: $W = 10.0$, $p = 0.12$; 2016: $W = 4.0$, $p = 0.56$). Across sampled lakes, the numbers of species detected individually by clam-rake and visual-tactile sampling were strongly correlated ($r_s = 0.78$; $p = 0.0017$). In 2015, the rate of species detection was more rapid with visual-tactile sampling than clam-raking (Figure 4). There was little difference in the rate of species detection in 2016 (Figure 4). For both sampling methods, the collection of shells increased the total number of species detected at each lake. The lengths of live individuals collected by clam-rake (median: 56.3 mm, range: 8.4 – 115.4 mm) and visual-tactile (median: 59.9 mm, range: 13.7 – 122.5 mm) sampling were very similar, and included a similar range of shell lengths.

Zebra Mussel Infestation

Zebra Mussel was detected at five of the six lakes surveyed in 2015. Across these lakes, evidence of Zebra Mussel (byssal threads or attached Zebra Mussels) was observed on 76% of the live freshwater mussels collected. This included all Eastern Pondmussel collected from Beaver Lake, and 32% of Eastern Pondmussel collected from Loughborough Lake. Zebra Mussel was present at between 8 and 100% of the sites sampled in each lake. Ratios of Zebra Mussel mass to individual live freshwater mussel mass ranged from 0.001 to 9.2. Median ratio values for each lake ranged from 0.05 to 0.40.

Zebra Mussel was detected at five of the lakes surveyed in 2016. Across these 5 lakes, evidence of Zebra Mussel was observed on 77% of the live freshwater mussels collected. Zebra Mussel was present at between 17 and 42% of the sites sampled in each lake. Ratios of Zebra Mussel mass to individual live freshwater mussel mass ranged from 0.004 to 1.7. Median ratio values for each lake ranged from 0.009 to 0.20. Zebra Mussel was not detected at Camden, Elbow, Guerley, Spectacle, Varty and White lakes.

Habitat Summary

Of the inland lake sites, 46% had low densities of macrophytes, 32% had moderate densities, and 21% had high densities. Silt and organics were the dominant substrate types, representing 56% of sampled substrates. Sand and gravel represent 39% of substrates sampled, while the remaining 5% can be attributed to clay or 'other' (bedrock, boulder, cobble). Soft substrate depths ranged from 0 cm to 100 cm, mean of 16 cm. Water depths ranged from 0 cm (shoreline) to a maximum of 150 cm, mean depth of 62 cm.

Trent River

Mussel Collections

Eastern Pondmussel was not collected from the Trent River. One live Rainbow (plus four weathered valves and three weathered whole shells) was collected. Twelve mussel species were detected during 2015 and 2016 sampling of wetland and wadeable shorelines habitats along the Trent River. Four hundred and fifty-eight live individuals were collected from along shoreline and 120 live individuals were collected from wetland habitats.

Live individuals or weathered shells were collected from 7 of the 8 shoreline sites sampled. At these sites, species richness was low (1 to 6 species). The most widespread species was Eastern Elliptio. Fifty-four percent of species detections were based on weathered shells, with records of Black Sandshell (*Ligumia recta*), Flutedshell (*Lasmigona costata*), and Pimpleback based only on shells. Most live mussels were Eastern Elliptio (63%) or Fatmucket (34%).

Live individuals or weathered shells were collected from 8 of the 13 wetland sites sampled. At these sites, species richness was low (1 to 3 species). The most widespread species were Eastern Elliptio and Fatmucket. Fifty-three percent of species detections were based on weathered shells, with records of Black Sandshell, Pimpleback, and Rainbow based only on shells. Most live mussels (97%) were Eastern Elliptio.

Live Zebra Mussel and shells were detected at all Trent River sites sampled.

Habitat Summary

Of the eight shoreline sites, five had macrophyte coverage ≥25%, and of these, three had macrophyte coverage >75%. Silt represented the highest percentage of sampled substrate at 24%, followed by rubble at 18%. Sand, gravel, and bedrock were also frequently encountered. Of the 13 wetland sites, 31% had low densities of macrophytes, 46% had moderate densities, and 23% had high densities. Sampled substrates were mostly silt/organics (42%) and sand/gravel (43%). Water depths sampled along the Trent River ranged from 5 cm to 120 cm, with mean of 65 cm.

DISCUSSION

Additional inventory and targeted sampling to improve the knowledge of the distribution and status of Eastern Pondmussel populations have been recommended for localities where only shells or a few live individuals have been historically collected (DFO 2011). The recommendation was particularly relevant for eastern Ontario where very limited mussel sampling has occurred. Past shell collections identified the presence of Eastern Pondmussel at Beaver, Loughborough, White (or Inglesby) and Whitefish lakes. In 2015, 69 live individuals (of a range of sizes) were collected from Beaver, Loughborough, and White lakes; indicating population persistence and ongoing recruitment. While Eastern Elliptio and Giant Floater were relatively abundant in Whitefish Lake, neither live Eastern Pondmussel or shells were detected from Whitefish Lake in 2015. Compared to mussel assemblages in southwestern Ontario rivers and Great Lakes coastal habitats, species richness was low in eastern Ontario inland lakes.

In 2013, visual-tactile searches of wadeable, riverine habitats were completed along the Trent River mainstem. A single live Eastern Pondmussel was collected from the confluence of Mayhew Creek with the Trent River (Reid 2016). However, results from the 2015 and 2016 sampling of more typical Eastern Pondmussel habitats indicate that the species is not widespread (or perhaps entirely absent) along the Trent River. Compared to previous surveys of the Trent River (Metcalfe-Smith et al. 1998; Reid 2016), a similar number of mussel species was detected from sampling of these habitats.

Over the last two decades, rapid and large declines in freshwater mussel diversity have occurred since the introduction (and spread) of non-native dreissenid mussels to the Laurentian Great Lakes. In this study, the invasive Zebra Mussel was present at most inland lakes (except White) where Eastern Pondmussel was collected (or historically detected) and was found attached to live freshwater mussels. The percentage of live individuals (all species) with attached Zebra Mussel was similar to observations from Rondeau Bay (Lake Erie), where catastrophic declines in mussel diversity have occurred (Reid et al. 2016). However, given the lack of baseline data on historical distribution or population sizes in this region, it is not possible to describe the impact Zebra Mussel has had on Eastern Pondmussel. The 2015 inventory data from Beaver, Loughborough and White lakes may provide baseline information for future assessments of long-term impacts related to Zebra Mussel invasions.

The selection of sampling gear is an important step when planning freshwater mussel inventories. At Lake Ontario coastal wetlands, Reid et al. (2014) found visual/tactile surveys to be more efficient at collecting individual mussels and detecting species than clam-raking. A broader range of shell lengths were also collected. In this study of eastern Ontario inland lakes, visual/tactile surveys were also more efficient at collecting live individuals than clam-raking. Together, the results of these two studies indicate that visual/tactile sampling is the preferred method to collect Eastern Pondmussel and other freshwater mussels from wetland habitats. Time previously spent clam-raking could be reallocated to additional sites to increase the spatial coverage of sampling within lakes or wetlands. At sites where high water depth or dense aquatic

vegetation prevents visual/tactile searches, clam-raking could be used to supplement mussel inventory data collected at other sites with visual/tactile sampling.

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REFERENCES

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

COSEWIC. 2007. COSEWIC assessment and status report on the Eastern Pondmussel *Ligumia nasuta* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 34 pp. (www.sararegistry.gc.ca/status/e.cfm).

COSEWIC. 2016. Wildlife Species Search. Committee on the Status of Endangered Wildlife in Canada. http://www.cosewic.gc.ca/eng/sct1/searchform_e.cfm (accessed 28 November 2016).

DFO. 2011. Recovery Potential Assessment of Eastern Pondmussel (*Ligumia nasuta*), Fawnsfoot (*Truncilla donaciformis*), Mapleleaf (*Quadrula quadrula*), and Rainbow (*Villosa iris*) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/073.

Fisheries and Oceans Canada. 2016. Recovery strategy and action plan for the Eastern Pondmussel (*Ligumia nasuta*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. vi + 64 pp.

Hammer Ø., Harper D.A.T. and P.D. Ryan. 2001 PAST: paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4: 1–9.

Metcalfe-Smith, J.L., MacKenzie, A., Carmichael, I., and D. McGoldrick. 2005. Photo field guide to the freshwater mussels of Ontario. St. Thomas Field Naturalist Club Inc., St. Thomas, Ontario. 61 p.

Metcalfe-Smith, J.L., J. Di Maio, S.K. Staton, and G. L. Mackie. 2000. Effect of sampling effort on the efficiency of the timed search method for sampling freshwater mussel communities. Journal of the North American Benthological Society 19: 725–732.

Metcalfe-Smith, J.L., Staton S.K., Mackie G.L., and N.M. Lane.1998. Changes in the biodiversity of freshwater mussels in the Canadian waters of the lower Great Lakes drainage basin over the past 140 years. Journal of Great Lakes Research 24: 845–858.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2014. Species at Risk in Ontario (SARO) List. Available from: http://www.ontario.ca/environment-and-energy/speciesrisk-ontario-list.

Porto-Hannes,I., H. Lasker, and L.E. Burlakova. 2016 Species boundaries and levels of intermixing between *Lampsilis siliquoidea* and *L. radiata In*: Morris, T.J., K.A. McNichols-O'Rourke, and S.M. Reid (Editors). Proceedings of the 2016 Canadian Freshwater

Mussel Research Meeting: March 30, 2016, Burlington, Ontario. Can. Tech. Rep. Fish. Aquat. Sci. 3164: vii + 23 pp.

Reid, S.M. 2016. Search effort and imperfect detection: Influence on timed-search mussel (Bivalvia: Unionidae) surveys in Canadian rivers. Knowledge and Management of Aquatic Ecosystems 417: 17.

Reid, S.M., A. LeBaron, V. Kopf. and T. Morris. 2016. Remnant Freshwater Mussel Diversity in Rondeau Bay, Lake Erie. Canadian Field-Naturalist 130:76-81.

Reid, S.M., A. Brumpton, S. Hogg and T. Morris. 2014. A comparison of visual-tactile and clam rake search methods to survey freshwater mussels in Great Lakes coastal wetlands. Walkerana - The Journal of the Freshwater Mollusk Conservation Society 17:17-23.

Table 1. Sampling and location details for eastern Ontario inland lake and Trent River sites surveyed for freshwater mussels in 2015 and 2016.

			Geographic Co-ordinates			
Inland Lakes	**Dates Sampled**		**Latitude**	**Longitude**	**Sampling Method**	**Effort (hr)**
Beaver Lake	15-Jul-15	16-Jul-15	44.51285	-77.03245	Visual-tactile & clam rake	1 per method
Loughborough Lake	20-Jul-15	21-Jul-15	44.35941	-76.55243	Visual-tactile & clam rake	1 per method
Moira Lake	6-Jul-15	7-Jul-15	44.50763	-77.39900	Visual-tactile & clam rake	1 per method
Stoco Lake	8-Jul-15	9-Jul-15	44.45028	-77.30160	Visual-tactile & clam rake	1 per method
White Lake	13-Jul-15	14-Jul-15	44.44800	-77.06257	Visual-tactile & clam rake	1 per method
Whitefish Lake	24-Aug-15	25-Aug-15	44.49154	-76.24664	Visual-tactile & clam rake	1 per method
Camden Lake	17-Aug-16	18-Aug-16	44.48293	-76.09629	Visual-tactile & clam rake	1.5 per method
Cataraqui River (N of 401)	21-Jul-16	22-Jul-16	44.37113	-76.34782	Visual-tactile & clam rake	1.5 per method
Collins Lake	6-Sep-16	7-Sep-16	44.46096	-76.30860	Visual-tactile & clam rake	1.5 per method
Cranberry/Dog Lake	25-Aug-16	26-Aug-16	44.33820	-76.49870	Visual-tactile & clam rake	1.5 per method
Elbow Lake	27-Sep-16		44.49032	-76.41965	Visual-tactile	4.5
Gananoque Lake	19-Jul-16	20-Jul-16	44.48013	-76.36511	Visual-tactile & clam rake	1.5 per method
Guerley Lake	22-Sep-16		44.47505	-76.41384	Visual-tactile	4.5
Spectacle Lake	26-Sep-16		44.47242	-76.42999	Visual-tactile	4.5
Sydenham Lake	23-Aug-16	24-Aug-16	44.36123	-76.82700	Visual-tactile & clam rake	1.5 per method
Upper Rock Lake	20-Sep-16	21-Sep-16	44.41228	-76.87160	Visual-tactile	1.5 per method
Varty Lake	15-Aug-16	16-Aug-16	44.44441	-76.56278	Visual-tactile & clam rake	1.5 per method

Table 1. (con't)

Trent River - Wetland Sites	Dates Sampled	Geographic Co-ordinates		Sampling Method	Effort (hr)
		Latitude	Longitude		
TR-09	31-Aug-16	44.10962	-77.58611	Visual-tactile & clam rake	1.5 per method
TR-10	31-Aug-16	44.14523	-77.58116	Visual-tactile & clam rake	1.5 per method
TR-11	31-Aug-16	44.16293	-77.58672	Visual-tactile & clam rake	1.5 per method
TR-12	1-Sep-16	44.23712	-77.57774	Visual-tactile & clam rake	1.5 per method
TR-13	1-Sep-16	44.25705	-77.57110	Visual-tactile & clam rake	1.5 per method
TR-14	1-Sep-16	44.22756	-77.59621	Visual-tactile & clam rake	1.5 per method
TR-15	12-Sep-16	44.25853	-77.66870	Visual-tactile & clam rake	1.5 per method
TR-16	12-Sep-16	44.25268	-77.61596	Visual-tactile & clam rake	1.5 per method
TR-17	12-Sep-16	44.23362	-77.76232	Visual-tactile & clam rake	1.5 per method
TR-18	13-Sep-16	44.23301	-77.7616	Visual-tactile & clam rake	1.5 per method
TR-19	14-Sep-16	44.38993	-77.85919	Visual-tactile & clam rake	1.5 per method
TR-20	14-Sep-16	44.37987	-77.79675	Visual-tactile & clam rake	1.5 per method
TR-21	13-Sep-16	44.22312	-77.78449	Visual-tactile & clam rake	1.5 per method
Trent River - Shoreline Sites					
TR-1	20-Aug-15	44.15733	-77.5803	Visual-tactile	4.5
TR-2	19-Aug-15	44.21634	-77.60065	Visual-tactile	4.5
TR-3	19-Aug-15	44.25771	-77.57072	Visual-tactile	4.5
TR-4	19-Aug-15	44.23503	-77.58128	Visual-tactile	4.5
TR-5	12-Aug-15	44.25589	-77.70978	Visual-tactile	4.5
TR-6	12-Aug-15	44.38596	-77.82604	Visual-tactile	4.5
TR-7	1-Sep-16	44.26575	-77.58877	Visual-tactile	4.5
TR-8	13-Sep-16	44.29688	-77.80212	Visual-tactile	4.5

Table 2. Summary of freshwater mussel collections from four eastern Ontario inland lakes sampled with visual-tactile methods in 2015 and 2016. Counts are provided for live individuals, weathered whole shells (WW), weathered valves (WV), and fresh whole shells (FW). The percentage of collection sites where the species was found is provided in parentheses.

		Beaver Lake				Camden Lake			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	131 (83.3)	62 (83.3)	112 (83.3)	891 (100)	133 (75)	88 (58.3)	8 (16.7)	545 (100)
Lampsilis cardium	Plain Pocketbook	2 (16.7)	0	0	5 (8.3)	0	0	0	0
Lampsilis siliquoidea	Fatmucket	4 (25)	0	0	7 (16.7)	4 (25)	4 (16.7)	1 (8.3)	25 (58.3)
Lasmigona costata	Flutedshell	1 (8.3)	0	0	3 (25)	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	1 (8.3)	2 (8.3)	5 (25)	24 (75)	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	28 (75)	27 (66.7)	0	289 (100)
Pyganodon sp.	Pyganodon	0	0	1 (8.3)	2 (16.7)	0	0	0	0
Strophitus undulatus	Creeper	0	0	0	1 (8.3)	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0	0	0	0	
Total		**139**	**64**	**118**	**933**	**165**	**119**	**9**	**859**
		Cataraqui River				**Collins Lake**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	0	0	0	5 (25)	47 (33.3)	21 (16.7)	1 (8.3)	217 (41.7)
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	3 (16.7)	1 (8.3)	0	16 (41.7)	0	0	0	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	0	0	0	1 (8.3)	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	1 (8.3)	7 (41.7)	23 (50)	5 (25)	0	56 (58.3)
Pyganodon sp.	Pyganodon	0	0	0	0	0	0	0	0
Strophitus undulatus	Creeper	0	0	0	0	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0	0	0	0	0
Total		**3**	**1**	**1**	**29**	**70**	**26**	**1**	**273**

Table 2. (con't)

		Cranberry/Dog Lake				Gananoque Lake			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	15 (25)	1 (8.3)	1 (8.3)	161 (41.7)	87 (58.3)	57 (58.3)	0	9 (33.3)
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	1 (8.3)	17 (16.7)	0	0	45 (50)	27 (41.7)	0	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	1 (8.3)	1 (8.3)	0	0	0	0	0	0
Pyganodon grandis	Giant Floater	0	1 (8.3)	0	7 (16.7)	0	1 (8.3)	0	0
Pyganodon sp.	Pyganodon	0	0	0	2 (16.7)	0	1 (8.3)	0	0
Strophitus undulatus	Creeper	0	0	0	0	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	1 (8.3)	2 (16.7)	0	0	0	0
Total		**17**	**20**	**2**	**190**	**132**	**86**	**0**	**9**
		Loughborough Lake				**Moira Lake**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	53 (58.3)	14 (33.3)	22 (50)	22 (41.7)	21 (33.3)	17 (58.3)	7 (25)	23 (16.7)
Lampsilis cardium	Plain Pocketbook	0	0	0	0	18 (50)	7 (25)	0	0
Lampsilis siliquoidea	Fatmucket	1 (8.3)	3 (16.7)	0	0	16 (33.3)	24 (58.3)	1 (8.3)	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	3 (16.7)	1 (8.3)	1 (8.3)	19 (41.7)	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	0
Pyganodon sp.	Pyganodon	0	0	1 (8.3)	1 (8.3)	8 (33.3)	1 (8.3)	1 (8.3)	0
Strophitus undulatus	Creeper	0	0	0	0	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0	0	0	0	0
Total		**57**	**18**	**24**	**42**	**63**	**49**	**9**	**23**

Table 2. (con't)

		Stoco Lake				Sydenham Lake			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	176 (66.7)	63 (50)	73 (58.3)	688 (83.3)	75 (33.3)	8 (8.3)	0	2 (16.7)
Lampsilis cardium	Plain Pocketbook	3 (8.3)	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	6 (33.3)	8 (33.3)	6 (41.7)	3 (25)	0	0	0	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	0	0	0	0	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	3 (8.3)
Pyganodon sp.	Pyganodon	0	0	0	0	0	0	0	0
Strophitus undulatus	Creeper	0	0	0	0	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0	0	0	0	0
Total		**185**	**71**	**79**	**691**	**75**	**8**	**0**	**5**
		Varty Lake				**White Lake**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	154 (100)	23 (83.3)	31 (41.7)	332 (100)	199 (91.7)	185 (100)	39 (66.7)	598 (100)
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	55 (58.3)	4 (9)	3 (25)	111 (66.7)	13 (33.3)	9 (25)	1 (8.3)	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	0	0	0	0	3 (16.7)	6 (16.7)	3 (8.3)	26 (16.7)
Pyganodon grandis	Giant Floater	58 (83.3)	12 (33.3)	1 (8.3)	91 (83.3)	0	0	0	0
Pyganodon sp.	Pyganodon	0	0	0	0	18 (66.7	10 (25)	17 (83.3)	174 (100)
Strophitus undulatus	Creeper	0	0	0	0	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0	0	0	0	0
Total		**267**	**39**	**35**	**534**	**233**	**210**	**60**	**798**

Table 2. (con't)

		Whitefish Lake			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	21 (50)	10 (33.3)	55 (50)	159 (50)
Lampsilis cardium	Plain Pocketbook	0	0	0	0
Lampsilis siliquoidea	Fatmucket	0	0	1 (8.3)	1 (8.3)
Lasmigona costata	Flutedshell	0	0	0	0
Ligumia nasuta	Eastern Pondmussel	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0
Pyganodon sp.	Pyganodon	1 (8.3)	3 (8.3)	1 (8.3)	16 (41.7)
Strophitus undulatus	Creeper	0	0	0	0
Utterbackia imbecilis	Paper Pondshell	0	0	0	0
Total		**22**	**13**	**57**	**176**

Table 3. Summary of freshwater mussel collections from four eastern Ontario inland lakes sampled with visual-tactile methods in 2016. Counts are provided for live individuals, weathered whole shells (WW), weathered valves (WV), and fresh whole shells (FW). The percentage of collection sites where the species was found is provided in parentheses.

		Upper Rock Lake				Guerley Lake			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	296 (100)	63 (87.5)	41 (37.5)	441 (100)	0	0	0	0
Lampsilis siliquoidea	Fatmucket	11 (50)	0	2 (12.5)	2 (12.5)	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	4 (25)	0	0	0	0
Total		**307**	**63**	**43**	**447**	**0**	**0**	**0**	**0**
		Spectacle Lake				**Elbow Lake**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	0	0	0	0	182 (88.9)	44 (77.8)	38 (66.7)	42 (66.7)
Lampsilis siliquoidea	Fatmucket	0	0	0	0	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**182**	**44**	**38**	**42**

Table 4. Summary of freshwater mussel collections from 8 Trent R. shoreline sites sampled with visual-tactile methods in 2015 and 2016. Counts are provided for live individuals, weathered whole shells (WW), weathered valves (WV), and fresh whole shells (FW).

		TR-1				TR-2				TR-3				TR-4			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Alasmindonta undulata	Triangle Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elliptio complanata	Eastern Elliptio	1	3	0	0	87	53	1	0	1	0	0	0	0	2	3	87
Lampsilis sp.	Lampsilis	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	3
Lampsilis cardium	Plain Pocketbook	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lasmigona costata	Flutedshell	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0
Ligumia recta	Black Sandshell	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Quadrula pustulosa	Pimpleback	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyganodon sp.	Pyganodon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Utterbackia imbecillis	Paper pondshell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Villosa iris	Rainbow	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Total		**1**	**3**	**0**	**0**	**95**	**62**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**2**	**3**	**91**
		TR-5				**TR-6**				**TR-7**				**TR-8**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Alasmindonta undulata	Triangle Floater	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Elliptio complanata	Eastern Elliptio	3	0	3	197	0	0	0	0	124	31	0	3	3	61	0	0
Lampsilis sp.	Lampsilis	1	0	3	153	0	0	0	0	0	0	0	0	0	0	0	0
Lampsilis cardium	Plain Pocketbook	0	0	0	2	0	0	0	0	6	10	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Lasmigona costata	Flutedshell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ligumia recta	Black Sandshell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quadrula pustulosa	Pimpleback	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Pyganodon sp.	Pyganodon	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0
Utterbackia imbecillis	Paper Pondshell	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Villosa iris	Rainbow	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Total		**4**	**0**	**7**	**363**	**0**	**0**	**0**	**0**	**133**	**42**	**0**	**3**	**3**	**64**	**0**	**0**

Table 5. Summary of freshwater mussel collections from 13 Trent R. wetland sites sampled with visual-tactile and clam-rake methods in 2016. Counts are provided for live individuals, weathered whole shells (WW), weathered valves (WV), and fresh whole shells (FW).

		TR-09				TR-10				TR-11				TR-12			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	0	0	0	0	0	0	0	0	0	0	0	0	11	1	1	102
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lampsilis siliquoidea	Fatmucket	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Ligumia recta	Black Sandshell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quadrula pustulosa	Pimpleback	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Villosa iris	Rainbow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**1**	**1**	**105**
		TR-13				**TR-14**				**TR-15**				**TR-16**			
Scientific Name	**Common Name**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	10	23	0	0	0	0	0	4	14	49	0	0	0	3	0	0
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	1	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0
Ligumia recta	Black Sandshell	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Quadrula pustulosa	Pimpleback	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Villosa iris	Rainbow	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Total		**11**	**24**	**0**	**0**	**0**	**0**	**0**	**4**	**15**	**53**	**0**	**0**	**0**	**4**	**0**	**1**

Table 5. (con't)

Scientific Name	Common Name	TR-17				TR-18				TR-19				TR-20			
		WW	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**	**WW**	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	4	0	0	1	0	1	0	9	0	0	0	0	0	1	0	0
Lampsilis cardium	Plain Pocketbook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampsilis siliquoidea	Fatmucket	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ligumia recta	Black Sandshell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quadrula pustulosa	Pimpleback	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Villosa iris	Rainbow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		**4**	**0**	**0**	**1**	**1**	**1**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**

Scientific Name	Common Name	TR-21			
		WW	**WV**	**FW**	**Live**
Elliptio complanata	Eastern Elliptio	0	0	0	0
Lampsilis cardium	Plain Pocketbook	0	0	0	0
Lampsilis siliquoidea	Fatmucket	0	0	0	0
Ligumia recta	Black Sandshell	0	0	0	0
Pyganodon grandis	Giant Floater	0	0	0	0
Quadrula pustulosa	Pimpleback	0	0	0	0
Villosa iris	Rainbow	0	0	0	0
Total		**0**	**0**	**0**	**0**

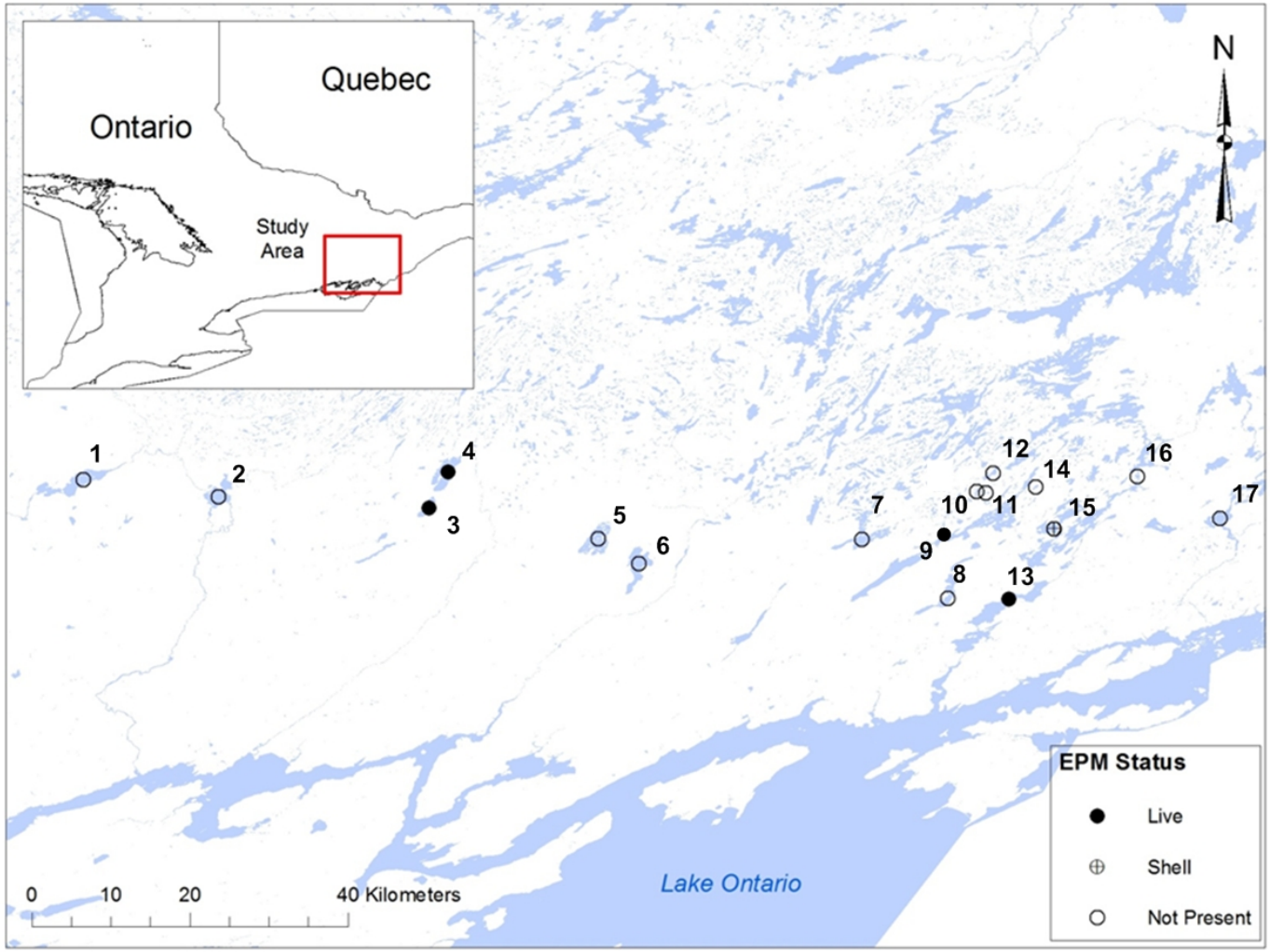

Figure 1. Distribution of Eastern Pondmussel (EPM) survey lakes: 1-Moira; 2-Stoco; 3-White; 4-Beaver; 5-Camden; 6-Varty; 7-Sydenham; 8-Collins; 9- Loughborough; 10-Elbow; 11-Spectacle; 12-Upper Rock; 13-Cataraqui River; 14- Guerley; 15-Cranberry/Dog; 16-Whitefish; 17-Gananoque.

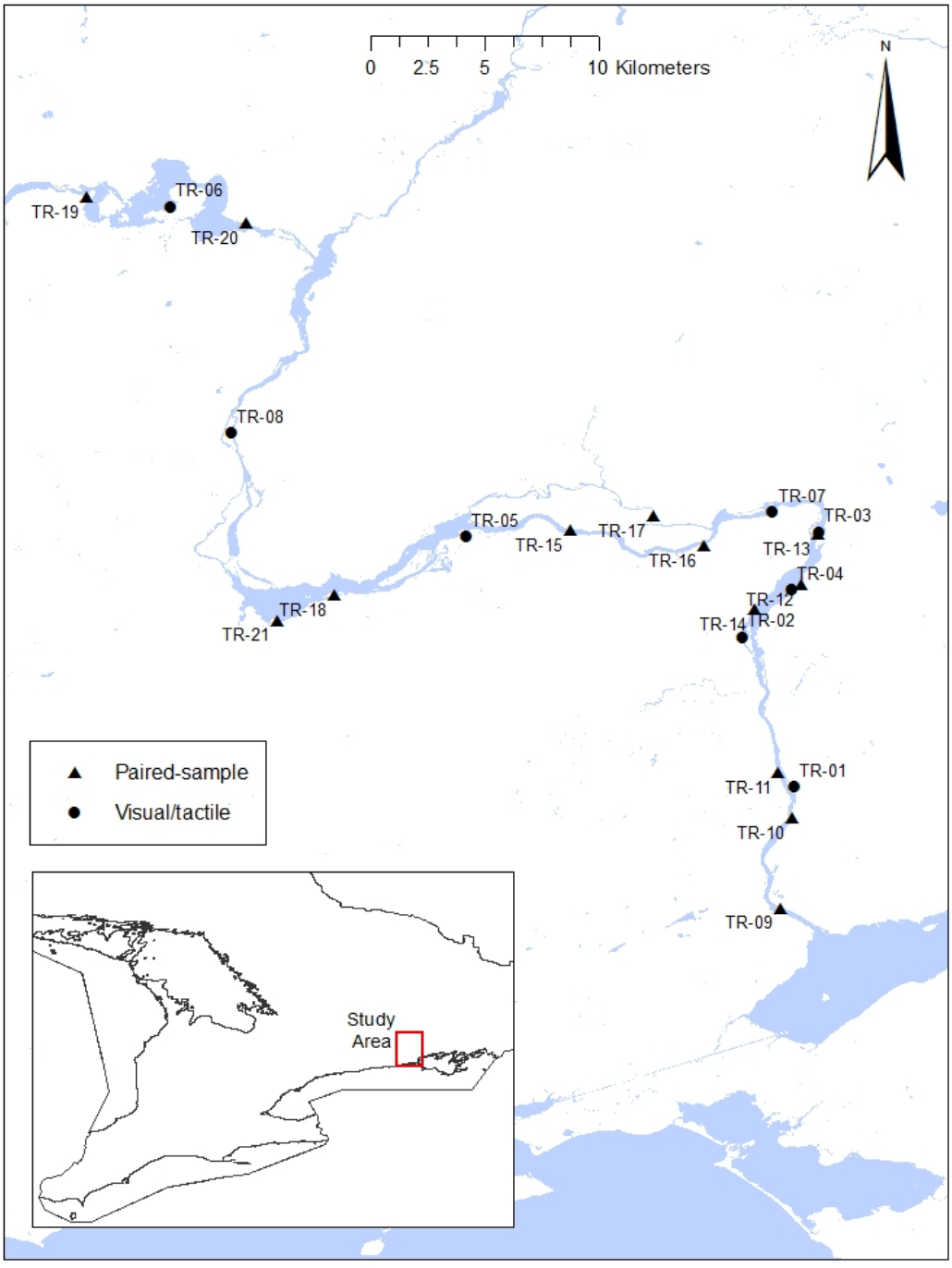

Figure 2. Locations of Eastern Pondmussel survey sites along Trent River (2015 and 2016).

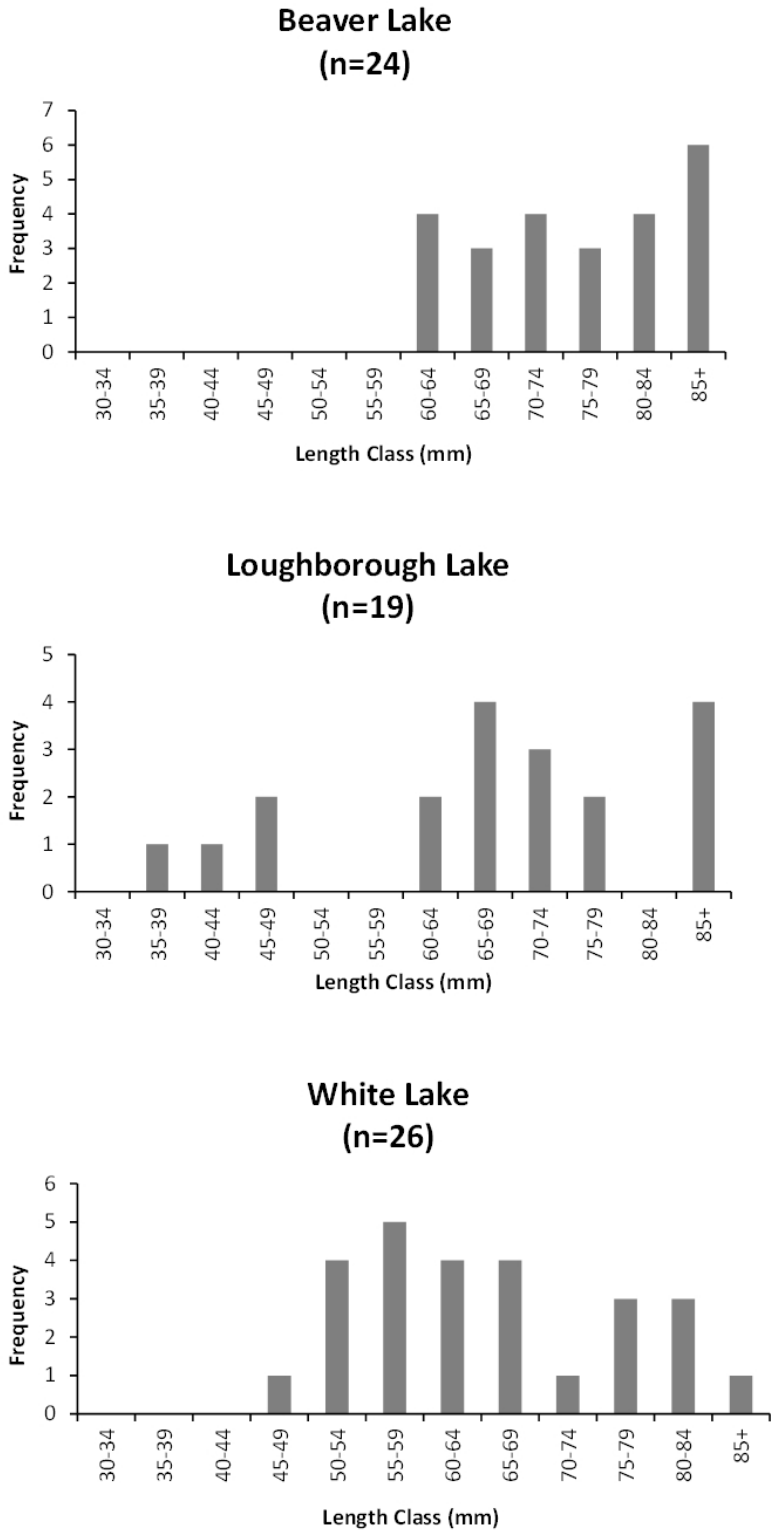

Figure 3. Eastern Pondmussel shell length frequency (number of individuals) distributions from three eastern Ontario inland lakes.

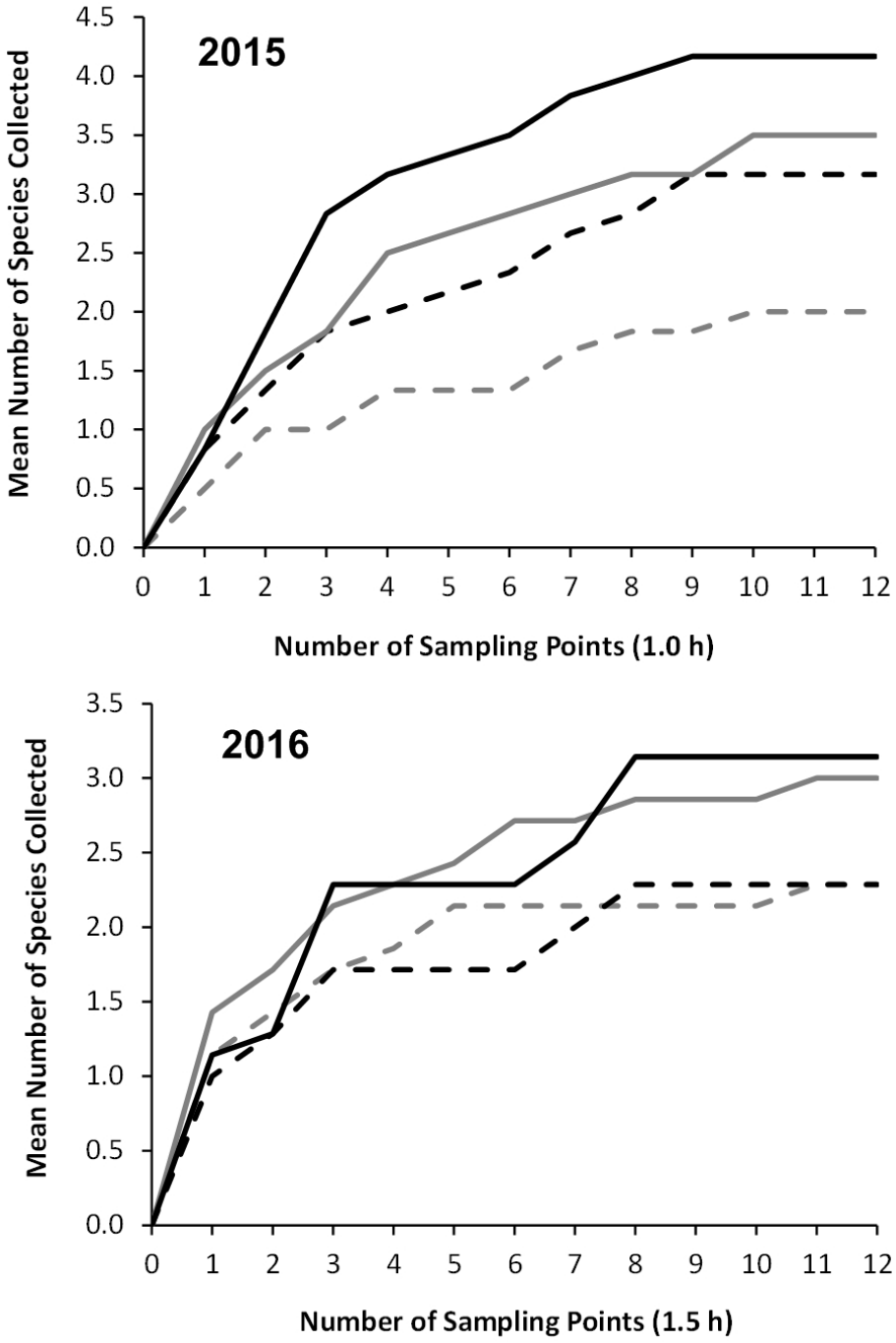

Figure 4. Comparison of mussel species richness estimates with increasing sampling effort, during visual-tactile (black) and clam-rake (grey) surveys of eastern Ontario inland lakes. Solid lines represent species counts based on live individuals and shells, and dashed lines represent species counts based on only live individuals.