2014

Invading Species Watch Program Annual Report

Ontario Federation of Anglers and Hunters
2014

ACKNOWLEDGEMENTS

The *Invading Species Watch Program* is an initiative of the *Invading Species Awareness Program*, a partnership of the Ontario Federation of Anglers and Hunters (OFAH) and the Ontario Ministry of Natural Resources and Forestry (OMNRF).

We would like to take this opportunity to introduce and thank some of the program's partners. These new and longstanding partnerships allowed for program expansion into new areas and improved delivery in existing areas in 2014:

- Bruce Trail Conservancy
- Central Lake Ontario Conservation Authority (CLOCA)
- Credit Valley Conservation Authority (CVC)
- Ducks Unlimited
- Human Resources and Skills Department Canada's Summer Jobs Program
- Kawartha Conservation
- Kids For Turtles Environmental Education (KFT)
- Killbear Provincial Park
- Kirkland Lake District MNR Office
- Lake of the Woods District Property Owners Association (LOWDPOA)
- Lower Trent Conservation Authority
- Manitoulin and Area Stewardship Council
- Mississippi Valley Conservation (MVC)
- Nottawasaga Valley Conservation Authority (NVCA)
- Ontario Streams
- Pinery Provincial Park
- Plenty Canada
- Ontario Streams
- Rideau Valley Conservation Authority (RVCA)
- Rondeau Provincial Park
- Sibbald Point Provincial Park
- South Nation Conservation Authority
- University of Windsor
- Voyageur Provincial Park
- Wasaga Beach Provincial Park
- Wheatley Provincial Park

We would also like to extend our gratitude to Terry Rees (Federation of Ontario Cottagers' Associations), Jacquie Kent (Kids for Turtles Environmental Education), Susan McLeod (Lake of the Woods District Property Owners Association), Anne Anderson (Lower Trent Conservation), Seija Deschenes (Manitoulin Area Stewardship Council), Susan Lee (Mississippi Valley Conservation), David Featherstone (Nottawasaga Valley Conservation Authority), Larry McDermott and Karen Beckwith (Plenty Canada), Dayna Laxton (Ontario Streams/Aurora District MNRF), Michael Yee and Sarah McLeod (Rideau Valley Conservation Authority), Terry Crawford (Eastern Georgian Bay Stewardship Council), Michelle Scheerder (South Nation Conservation), Patricia Lowe, Diana Shermet (Central Lake Ontario Conservation Authority), Lindsay McLean (Kirkland Lake District MNR), Donna Wales (Biodiversity Section MNR), and Renata Claudi of RNT Consulting for their technical advice and support.

We extend thanks to our summer students Amber Hawkins, Autumn Linklater, Becca Ascott, Brandon Baer, Brent Harbers, Brittany Williams, Cassidy Cameron, Christine Brennan, Duncan McTaggart, Emily Robinson, Eric Fargo, Eric Labelle, Evan Fantin, Jelena Petrovic, Jennifer Baici, Jessica Poole, Justin Hunter-Bechard, Kelly Skaug, Laura Kielek-Caster, Laura Wensink, Maria Varaeva, Mike Judson, Mitchell Keller and Nick Clark.

We would also like to take this opportunity to thank many of the OFAH staff for their assistance and support, including Matt DeMille, Matt Smith, Alison Kirkpatrick, Emily Johnston, Laura Wensink and David Ryrie.

We extend special thanks to the volunteers participating in the *Invading Species Watch* program. Volunteer involvement in monitoring and raising awareness is fundamental to the success of invasive species prevention efforts.

Finally, thanks are also extended to all individuals and lake and cottage associations who financially assisted the *Invading Species Awareness Program* through monetary donations. The support of these organizations has been essential to the success of this program and is appreciated. Thank you. If you wish to contribute to the *Invading Species Awareness Program,* donations can be made to the:

Ontario Federation of Anglers and Hunters
Invading Species Awareness Program
Box 2800, 4601 Guthrie Drive
Peterborough, Ontario, K9J 8L5

EXECUTIVE SUMMARY

The spring of 2014 marked the beginning of another extremely busy and successful year for the *Invading Species Watch Program.* The program is in its 22nd year of operation and is coordinated by the Ontario Federation of Anglers and Hunters (OFAH) in partnership with the Ontario Ministry of Natural Resources and Forestry (OMNRF). In 2014, the program monitored 123 lakes and waterways for the presence of spiny waterflea (*Bythotrephes longimanus)* and zebra mussel veligers (*Dreissena polymorpha).*

The program was delivered through the participation of lake associations and conservation clubs across the province. The response to these new partnerships and continued dedication of existing partners was outstanding, enabling the program to achieve the following objectives:

1. Establish a provincial volunteer network to track the spread of Zebra Mussels (*Dreissena polymorpha*), and spiny waterflea (*Bythotrephes longimanus*) in Ontario waters.
2. Update Ontario distribution information and an international database that tracks the spread of aquatic invasive species in North America;
3. Increase the local awareness of aquatic invasive species and encouraged greater public involvement in preventing the spread to inland lakes;
4. Provide participants with early identification of the presence of aquatic invasive species, thus providing an opportunity to initiate protection systems to minimize impacts.

Forty monitoring kits containing all the necessary equipment and instructions were circulated to program volunteers. In the fall and winter of 2014, RNT Consulting performed the analysis of water samples from the 123 lakes that were monitored during the summer. **Spiny waterfleas were discovered in 19 lakes, 14 of which were new occurrences. Zebra mussel veligers were found in 27 lakes, with 18 new occurrences.**

The results of the *Invading Species Watch Program* were entered into EDDMapS Ontario which allows users to link with existing MNRF databases and information systems, and provides access to the complete lake history. This database also enables the generation of updated GIS based distribution maps of both the spiny waterflea and the zebra mussel, which is critical to the development of awareness initiatives and prevention strategies, to prevent the spread of invasive species into new areas.

THE ONTARIO FEDERATION OF ANGLERS AND HUNTERS

T A B L E O F C O N T E N T S

THE ONTARIO FEDERATION OF ANGLERS AND HUNTERS

SECTION 1:

1.0 THE ONTARIO FEDERATION OF ANGLERS AND HUNTERS: WHO WE ARE

The Ontario Federation of Anglers and Hunters (OFAH) is Ontario's largest, non-profit, fish and wildlife conservation-based organization, representing 100,000 members, subscribers and supporters, and 725 member clubs. The OFAH's dedication to conservation can be seen through our numerous youth and adult conservation programs, fisheries and wildlife research and restoration initiatives, and the partnerships we have formed with government and conservation organizations across the province.

1.1 THE INVADING SPECIES AWARENESS PROGRAM

In 1992, in response to growing concern over the threat of aquatic invasive species to Ontario's lakes and waterways, the OFAH formed a partnership with the Ontario Ministry of Natural Resources and Forestry (OMNRF) to implement the *Invading Species Awareness Program* (ISAP). The primary objective of the program is to prevent the spread of aquatic invasive species through accessible, educational hands-on programs and initiatives. Some of the program's successful initiatives include:

- **Asian Carps Signage** If you or your lake association would like to receive a 12" x 18" metal sign featuring the identification of the four Asian carp species, please call Emily Johnston at 705-748-6324 ext. 238 or email her at Emily_johnston@ofah.org

- **Invading Species Hotline (1-800-563-7711)** – a toll-free Ontario wide number for the public to report sightings or to obtain information on aquatic invasive species.

- **EDDMapS** – a web-based mapping system used to depict the distribution of invasive species throughout North America. It is easy to use, open to the public to use and contribute to and no knowledge of GIS is required. Reports entered into EDDMapS can be publicly viewed after they have been confirmed by expert verifiers. ISW volunteers will also be able to view the results of their lake each year. Visit www.eddmaps.org/Ontario to sign up and start tracking invasive species today.

- **Invaders in Our Waters DVD -** An interactive DVD with downloads of educational material in both English and French. The DVD also includes short informative video breaks describing the impacts, pathways of introductions and prevention of invasive species. The DVD is available to schools, libraries, public interest groups and cottage associations for presentations.

- **Making Waves! Protecting Aquatic Habitats From Invasive Species -** Curriculum and lesson plans designed to assist grade 4 and grade 6 teachers to introduce students to the concept of healthy habitats and our role in protecting them from invasive species.

- **Invasive Species Workshops** – The invading species workshops are designed to provide training on the proper methods of invasive species collection and identification.

SECTION 2:

2.0 INVADING SPECIES WATCH

2.1 PROJECT GOALS AND OBJECTIVES

In 1998, in response to the need for information on the spread and distribution of invasive species in Ontario waterways, the OFAH created the *Invading Species Watch Program*. Since this time, over 600 lakes have been monitored for the presence of zebra mussel and spiny waterflea through this volunteer based program. Each year a growing number of cottage associations, conservation organizations, and concerned citizens participate in this important initiative.

The objectives of the program are the following:

1. Establish a volunteer network to track the spread of zebra mussel (*Dreissena polymorpha)* and spiny waterflea (*Bythotrephes longimanus)* in Ontario waters;

2. Increase local awareness of the threat of aquatic invasive species and encourage greater public involvement in preventing the spread to Ontario's inland waters;

3. Update Ontario distribution maps and contribute to an international database that tracks the spread of aquatic invasive species in North America;

4. Provide participants with early identification of the presence of aquatic invasive species, thus providing an opportunity to initiate prevention measures to minimize impacts and spread;

5. Expand the monitoring program into regions of the province that have not been monitored extensively, such as northern Ontario.

Would your lake association or organization like to help spread the word on Asian carp?

The Ontario Federation of Anglers and Hunters in partnership with the Department of Fisheries and Oceans Canada have launched a comprehensive Asian Carp Awareness Campaign with the overall theme, "Report all potential Asian Carp sightings".

Free 18"x12" metal signs with mounting posts for outdoors as well as several print resources are available for distribution. ISAP staff are available to give formal presentations at your lake association meetings or community events. Please contact the Invading Species Hotline at 1-800-563-7711 for more information.

SECTION 3:

3.0 METHODS
3.1 VOLUNTEER RECRUITMENT

In 2014, the program was promoted extensively to recruit new volunteers from across the province. Program promotion occurred at over 150 events including the Toronto Sportsmen Show, lake association and stewardship council meetings and local community events.

3.2 MEDIA PROMOTION:

The *Invading Species Awareness Program* was also promoted through a variety of media across the province, including more than 50 newspaper, radio, and magazine articles.

3.3 PROGRAM PARTNER PROMOTION:

ISAP program staff promoted the program through the *Invading Species Hotline,* as well as through their attendance at trade shows and conferences. RVCA, SNC, MVC, Manitoulin Area Stewardship Council and LOWDPA also promoted the *Invading Species Watch Program* through their community programs and initiatives such as the Watershed Watch program.

3.4 PROGRAM IMPLEMENTATION

The OFAH coordinates the participation of lake associations and volunteers. Volunteers receive an introductory package in the early spring (prior to their sampling date), which includes the sample bottles, forwarding instructions, courier labels and scheduled date to receive the monitoring equipment during the summer.

Twenty-six students participated as part of the Invading Species Hit Squad. In partnership with the Rideau Valley, South Nation, Lower Trent, and Mississippi Valley Conservation Authorities, Kirkland Lake, and Nipigon OMNRF District Offices, Pinery Provincial Park, OFAH, and Lake of the Woods District Property Owners Association some students coordinated and facilitated volunteers, as well as lake associations and conservation clubs in their respective areas. All students managed volunteers in their areas, arranged sampling dates and assisted volunteers with actual sampling. In addition, they increased public awareness of invasive species by attending over 151 events throughout the summer.

Figure 2: Summer students (Dean Nolan, left and David Ryrie) with the Invading Species Awareness Program 2012

3.5 PROGRAM MONITORING

Following the protocol in the program manual, participants monitored their lakes once between mid-June and early September; collecting lake samples using plankton haul nets (63 microns) at 3-5 locations on the lake. In total, 310 samples were collected from 123 lakes averaging 2.5 samples per lake. The participants were responsible for disinfecting the equipment before and after they monitored their lakes. The samples were returned to the OFAH, and then shipped to RNT Consulting for analysis. In total 40 monitoring kits were circulated in the summer of 2014 to volunteers throughout Ontario, sampling 123 lakes.

3.6 PROGRAM ANALYSIS: METHODS

RNT Consulting provided analysis of the plankton samples, following the Schaner protocol using a sugar solution to separate zebra mussel veligers from the sample[1] (Schaner, 1990). The refined sample was then observed under a cross-polarized light, as described by Johnson (Johnson, 1995) to cause the zebra mussel veligers to appear as small glowing 'D' shaped objects with dark crosses. [2] Volunteers were contacted at the end of the program and provided with the results.

3.7 RESULTS

Of the 123 lakes or waterways sampled in 2014, zebra mussel veligers were found in 27 lakes with 18 first occurrences. Spiny waterflea were discovered in 19 lakes with 14 new occurrences.

[1] Schaner, Ted, 1990. Detection of Zebra Mussel Veligers in Plankton Samples Using Sugar Solution. Ontario Ministry of Natural Resources, Lake Ontario Fisheries Unit 1990 Annual Report, LOA 91.1 (Chapter 6).
[2] Johnson, L.E., 1995. Enhanced Early Detection and Enumeration Of Zebra Mussel (Dreissena spp.) Veligers Using Cross-Polarized Light Microscopy, Williams College-Mystic Seaport.

Zebra mussel veligers were discovered in the following lakes:

Zebra Mussels (*Dreissena polymorpha*)		
Waterbody	**County**	**Township**
Bennett Lake	**Lanark**	**Tay Valley**
Big Rideau Lake	**Leeds Grenville**	**Rideau Lakes**
Burridge Lake	Frontenac	South Frontenac
Butterill Lake	**Frontenac**	**South Frontenac**
Canonto Lake	**Frontenac**	**North Frontenac**
Christie Lake	**Lanark**	**Tay Valley**
Clayton Lake	Lanark	Mississippi Mills and Lanark Highlands
Clayton Lake	Lanark	Mississippi Mills and Lanark Highlands
Constance Lake	West Carleton	City of Ottawa
Farren Lake	**Lanark**	**Tay Valley**
Leggat Lake	Frontenac	Central Frontenac
Loon Lake	Lanark	Tay Valley
Lower Rideau	**Leeds Grenville**	**Rideau Lakes**
Mississippi Lake	**Lanark**	**Drummond, Beckwith, Mississippi Mills**
O'Brien Lake	**Lanark**	**Tay Valley**
Otty Lake	**Lanark**	**Tay Valley**
Shabomeka Lake	Frontenac	North Frontenac
Sharbot Lake	**Frontenac**	**Central Frontenac**
Sharbot Lake; West basin	**Frontenac**	**Oso**
Silver Lake	**Frontenac**	**Central Frontenac**
South Lake	**Leeds Grenville**	**Leeds & 1000 Islands**
South Nation River	**South Dundas and Grenville**	**North Stormont**
St. Lawrence and South Nation River	**South Dundas and Grenville**	**South Dundas**
Taylor Lake	**Lanark**	**Lanark Highlands**
Upper Rideau	**Leeds Grenville**	**Rideau Lakes**
Westport Sands	Leeds Grenville	Rideau Lakes
White Lake	Renfrew and Lanark Counties	Greater Madawaska and Lanark Highlands

bolded names are first occurrences of reports within EDDMapS Ontario

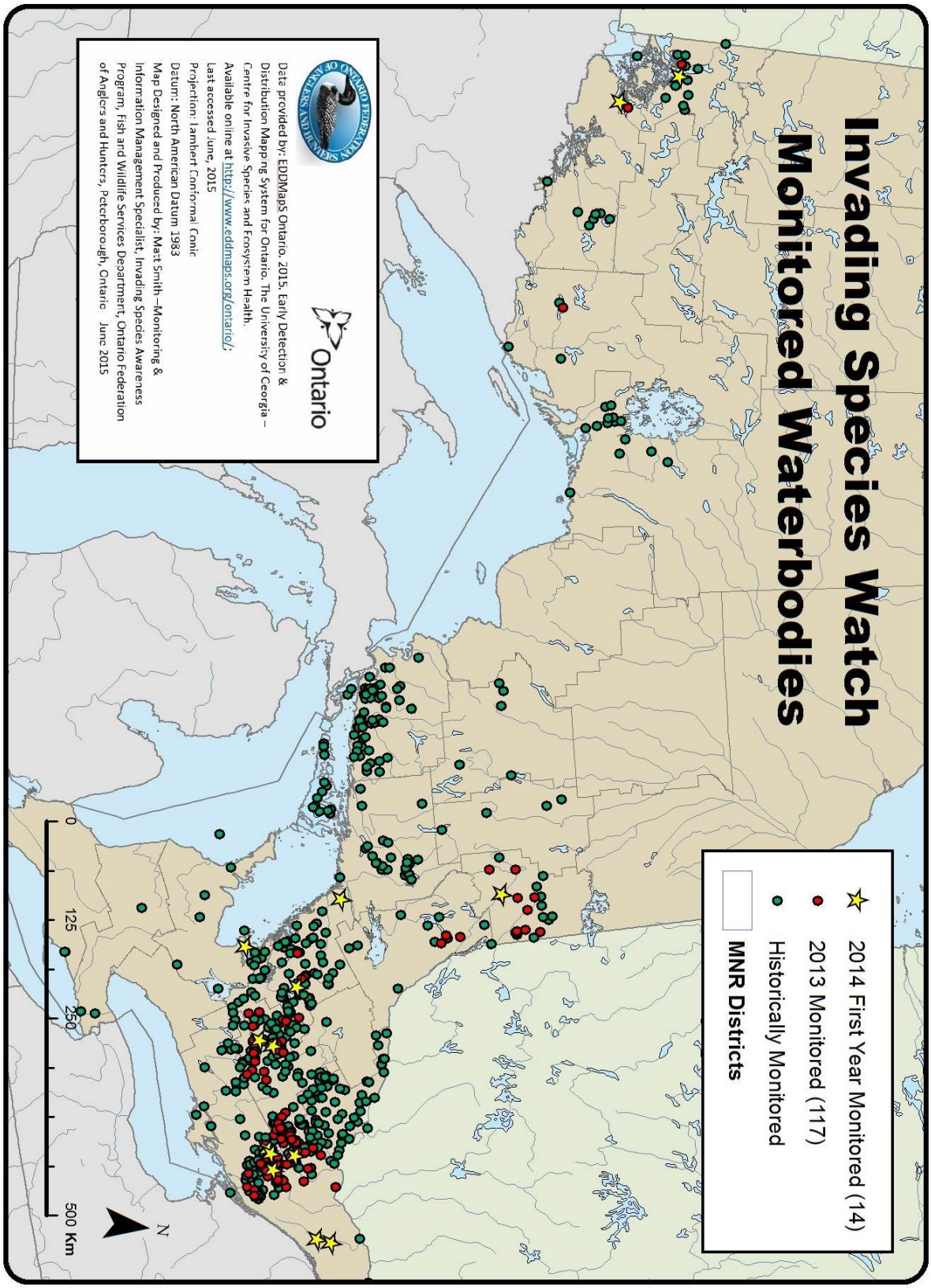
Spiny waterflea were discovered in the following lakes:

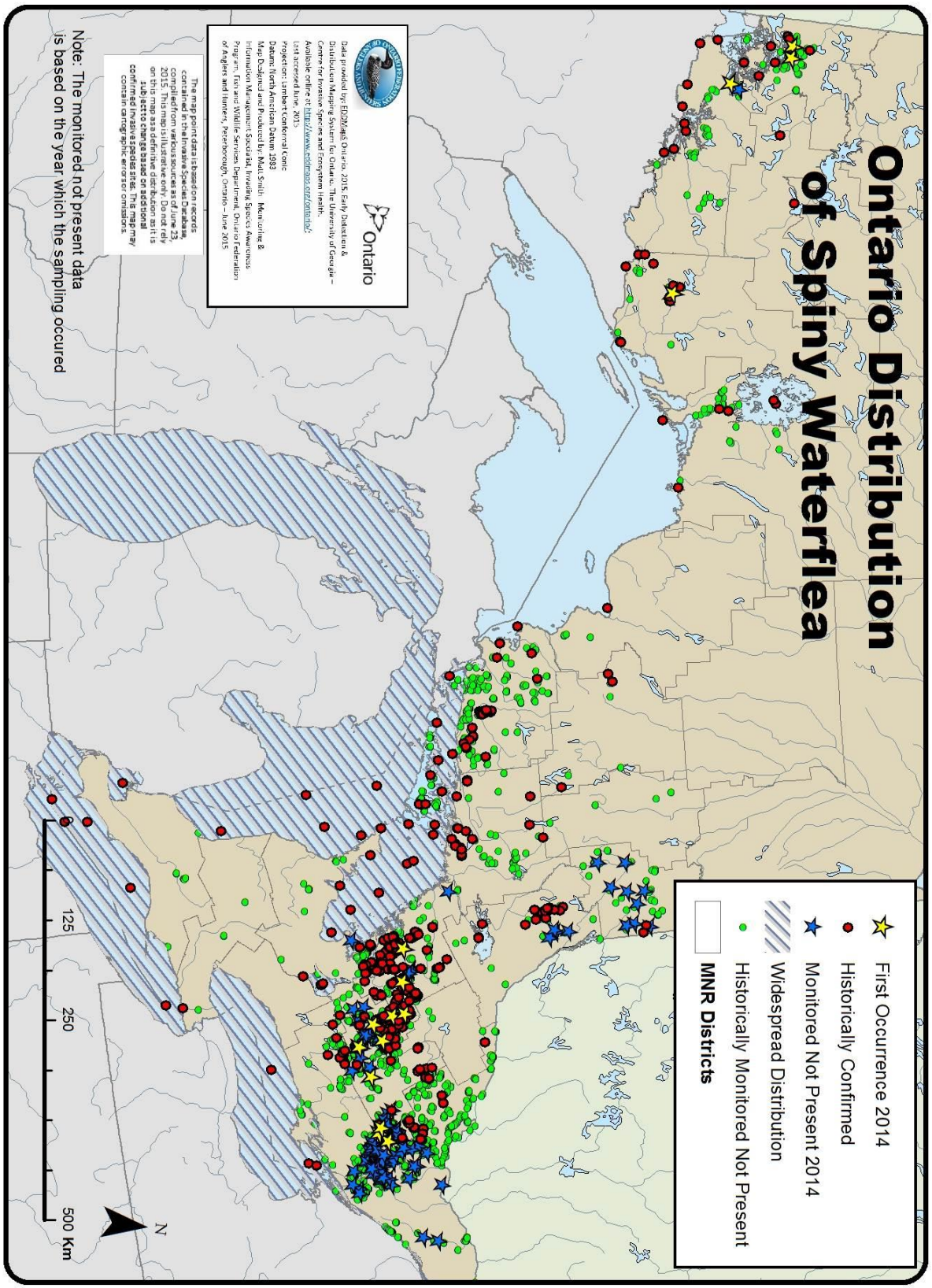
Spiny Waterflea (*Bythotrephes longimanus*)		
Waterbody	**County**	**Township**
Big Gull Lake	Frontenac	North Frontenac
Big Hawk Lake	**Haliburton**	**Algonquin Highlands**
Canning Lake	**Haliburton**	**Minden Hills**
Catchacoma Lake	**Peterborough**	**Trent Lakes**
Crotch Lake	**Frontenac**	**North Frontenac**
Crystal Lake	Peterborough	Trent Lakes
Halls Lake	Haliburton	Algonquin Highlands
Jack Lake	North Kawartha	Peterborough
Kashwakamak Lake	**Frontenac**	**North Frontenac**
Kawagama Lake	**Sherborne**	**Algonquin Highlands**
Lake Lulu	**Kenora District**	**Laclu**
Lake of the Woods	**Kenora District**	**Nestor Falls**
Lake of the Woods	**Kenora District**	**Kenora**
Little Hawk Lake	Haliburton	Algonquin Highlands
Loon Lake	**Haliburton**	**Dudley**
Shebandowan Lake	**n/a**	**Haine, Hacey, Connacher**
Sugar Lake	**Seguin**	**Christie**
Vernon Lake	**Chaffey**	**Muskoka**
Wollaston Lake	**Hastings**	**Wollaston**

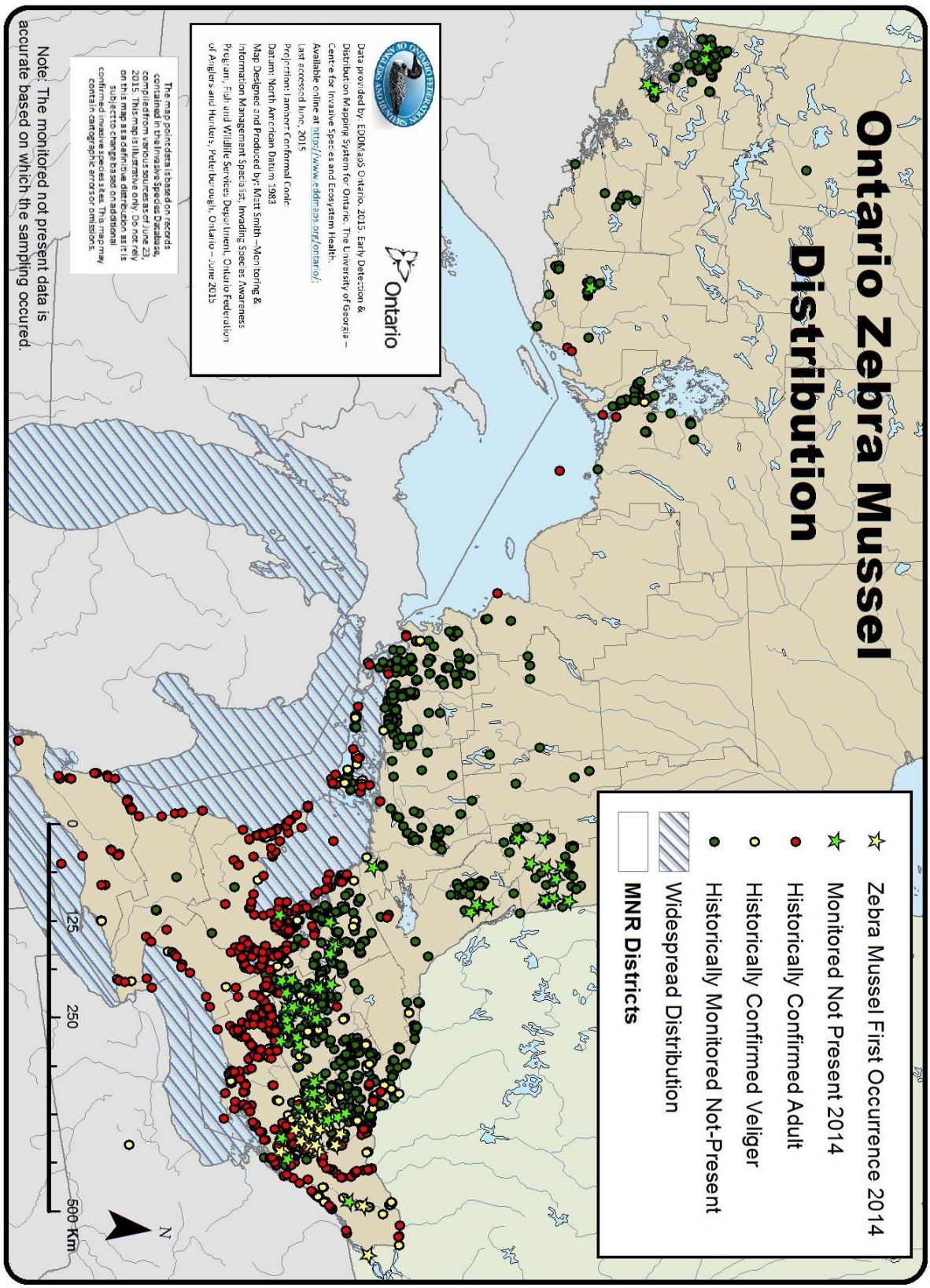
bolded names are first occurrences of reports within EDDMapS Ontario

All participants, regardless of their individual lake results were encouraged to use the extensive resources of the *Invading Species Awareness Program* to raise public awareness of invasive species and to encourage their involvement in prevention measures. A list of available resources and an order form is available on the OFAH website at www.invadingspecies.com.

Note* All data recorded through the *Invading Species Watch Program* is available for download or viewing through the interactive distribution maps at www.eddmaps.org/ontario. For more information on EDDMapS Ontario please contact Matt Smith, Monitoring and Information Management Specialist at 705-748-6324 ext. 247 or by email at matt_smith@ofah.org


Invading Species Watch
Monitored Waterbodies
2014 First Year Monitored (14)
2013 Monitored (117)
Historically Monitored
MNR Districts
0
125
250
500 Km
N
Ontario
Data provided by: EDDMapS Ontario. 2015. Early Detection & Distribution Mapping System for Ontario. The University of Georgia – Centre for Invasive Species and Ecosystem Health.
Available online at http://www.eddmaps.org/ontario/; Last accessed June, 2015
Projection: Lambert Conformal Conic
Datum: North American Datum 1983
Map Designed and Produced by: Matt Smith –Monitoring & Information Management Specialist, Invading Species Awareness Program, Fish and Wildlife Services Department, Ontario Federation of Anglers and Hunters, Peterborough, Ontario June 2015


Ontario Distribution
of Spiny Waterflea
First Occurrence 2014
Historically Confirmed
Monitored Not Present 2014
Widespread Distribution
Historically Monitored Not Present
MNR Districts
0
125
250
500 Km
N
Ontario
Data provided by: EDDMaps Ontario 2015. Early Detection & Distribution Mapping System for Ontario. The University of Georgia – Centre for Invasive Species and Ecosystem Health.
Available online at: http://www.eddmaps.org/ontario/.
Last accessed June, 2015.
Projection: Lambert Conformal Conic
Datum: North American Datum 1983
Map Designed and Produced by: Matt Smith - Monitoring & Information Management Specialist, Invading Species Awareness Program, Fish and Wildlife Services Department, Ontario Federation of Anglers and Hunters, Peterborough, Ontario – June 2015
The map point data is based on records contained in the Invasive Species Database, compiled from various sources as of June 23, 2015. This map is illustrative only. Do not rely on this map as a definitive distribution as it is confirmed invasive species sites. This map may contain cartographic errors or omissions.
Note: The monitored not present data is based on the year which the sampling occured


Ontario Zebra Mussel
Distribution
Zebra Mussel First Occurrence 2014
Monitored Not Present 2014
Historically Confirmed Adult
Historically Confirmed Veliger
Historically Monitored Not-Present
Widespread Distribution
MNR Districts
0
125
250
500 Km
N
Ontario
Data provided by: EDDMaps Ontario. 2015. Early Detection & Distribution Mapping System for Ontario. The University of Georgia – Centre for Invasive Species and Ecosystem Health.
Available online at http://www.eddmaps.org/ontario/.
Last accessed June, 2015
Projection: Lambert Conformal Conic
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The map point data is based on records contained in the Invasive Species Database, compiled from various sources as of June 23, 2015. This map is illustrative only. Do not rely on this map as a definitive distribution basis. Subject to change based on additional confirmed invasive species sites. This map may contain cartographic errors or omissions.
Note: The monitored not present data is accurate based on which the sampling occured.

SECTION 4:

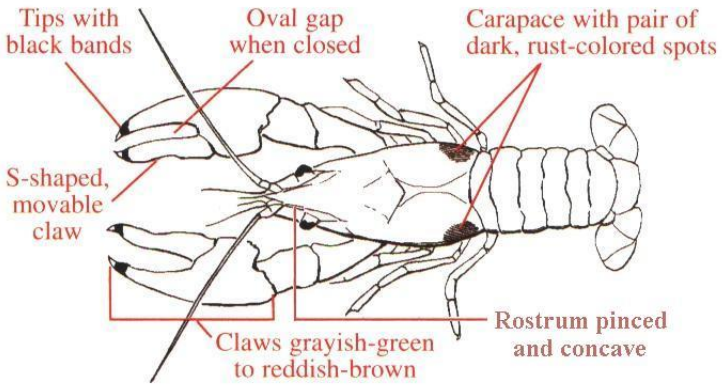
4.0 *INVADING SPECIES WATCH*

4.1 NEW SPECIES

The Invading Species Watch Program has primarily investigated the distribution of the spiny waterflea and zebra mussel. However, there are many other invasive species that are also of concern. With that in mind, the OFAH, in cooperation with the OMNR and Dr. Premek Hamr, has developed a new rusty crayfish (*Orconectes rusticus*) monitoring protocol. If you would like to assist us by monitoring for rusty crayfish, please contact the Invading Species Hotline at 1-800-563-7711.

Rusty crayfish are native to the United States. They degrade aquatic habitats by feeding heavily on aquatic vegetation and cause harm to native fish populations by feeding on their eggs and fry. Rusty crayfish are very aggressive and often outcompete native crayfish species for food and habitat. In areas of rusty crayfish invasion, native crayfish species have been known to decline or disappear.

General Characteristics of rusty crayfish are the rusty red patches on their body, black tips on their claws and their rostum (the area between the eyes) appears pinched and concave. Use the following illustration as a guide to identify rusty crayfish; please note that some characteristics may be absent in live specimens. If you see a rusty crayfish, keep a sample and report the sighting to the Invading Species Hotline.



In addition to monitoring for rusty crayfish, the *Invading Species Watch Program* will continue to expand the number of lakes it monitors and to make even more presentations to spread awareness of the threat of invasive species. There are many other species such as Eurasian water milfoil (*Myriophyllum spicatum*), round goby (*Neogobius melanostomus*), and European frogbit (*Hydrocharis morsus-ranae*) that pose a threat to Ontario's native species. If you would like to monitor for these or any other invasive species, you can contact ISAP using the Invading Species Hotline (1-800-563-7711) or check the ISAP website (invadingspecies.com) for staff contact information.

APPENDIX A: GENERAL INVASIVE SPECIES INFORMATION

INVADING SPECIES: REASONS FOR CONCERN

Invading species create serious ecological and economic problems in Ontario, Canada and the world. The introduction of new invading species occurs on a regular basis through various pathways. There are over 185 non-indigenous species found in the Great Lakes basin alone. Although most species may be benign, or have not been studied, approximately 10% of these species have had significant ecological and/or economic impacts.

Although the details of these impacts are not fully known, there is an agreement among the scientific community that invading species threaten biodiversity. The Committee on the Status of Endangered Wildlife estimated that 25% of Canada's endangered species, 31% of Canada's threatened species and 16% of Canada's vulnerable species are in some way at risk from non-native species (Lee, 2002). Other researchers predict that aquatic invasive species will contribute to extinction rates of 4% per decade, suggesting that fresh water organisms will go extinct 5 times faster than terrestrial organisms and 3 times faster than coastal species (Ricciardi & Rasmussen, 1999).

INVADING SPECIES: PATHWAYS OF INTRODUCTION

Invading species can enter new geographical areas by various means; both natural and human-made. Natural means of introduction include wind, water current, and animal assisted dispersal. Man-made pathways of introduction include shipping and ballast water, canals, the aquarium and horticultural trades, bait buckets and illegal fish transfers.

INVADING SPECIES: PATHWAYS OF SPREAD

Once these non-indigenous species are in Ontario waters, they can spread from waterbody to waterbody by both natural and human made pathways. Animals or water currents can carry and disperse invading species; however, the major pathway of spread involves human activities. Recreational boating and angling can inadvertently spread these invaders to new waterbodies. It is of critical importance to ensure that boats, trailers, motors etc. are properly cleaned and disinfected before leaving a waterbody. For more information regarding this procedure, please contact the Invading Species Hotline at 1-800-563-7711 or visit www.invadingspecies.com.

INVADING SPECIES: WHY DO THEY FLOURISH IN THEIR NEW HOMES?

Typically, invading species flourish in new waterbodies for a number of reasons. Most have few or no predators and/or diseases in their new habitats to keep their populations in balance. Furthermore these species reproduce quickly and in some cases more often than native species. Invading species often have an ability to adapt to various ecosystems and environmental conditions. These characteristics, combined with numerous mechanisms for spread, enable invasive species to rapidly become established when introduced to new locations.

Unfortunately, once an invading species becomes established there is often little that can be done to eradicate them from a waterbody. This reaffirms the importance of prevention efforts.

APPENDIX B: ZEBRA MUSSEL INFORMATION

THE ZEBRA MUSSEL: BIOLOGY OF INVASION

The zebra mussel was originally native to the Caspian Sea and Ural River in Asia. In the nineteenth century, it spread west and now occurs in most of Europe, the western portion of the Commonwealth of Independent States (formally the Soviet Union) and Turkey. In the mid 1980's, a Eurasian vessel released ballast water into the Great Lakes region that contained either adult or larval forms of the zebra mussel (*Dreissena polymorpha*). Zebra mussels were first discovered in water intake pipes in industrial and municipal water plants in Lake St. Clair near Detroit in 1988. Today, zebra mussels have successfully invaded all of the Great Lakes, the Rideau and Trent Severn waterways and a number of inland waterbodies in Ontario.

The most notable traits attributing to the rapid spread of the zebra mussel are its prolific reproductive capabilities and methods of dispersal by natural or human-induced means. The microscopic zebra mussel larva (veligers) are free swimming and rely on water currents and wave action to transport them to new locations downstream. Due to their microscopic size, veligers can be transferred to new waterbodies via the bilge water and bait buckets of unsuspecting boaters or anglers. Additionally, adult zebra mussels can attach to any hard surface and can be easily transferred to new waters via boat hulls as well as attached to aquatic plants on boat trailers. Recreational boating is generally recognized as being the main facilitator in the dispersal of zebra mussels to new locations within connected lakes or waterways (upstream systems) and inland lakes.

THE ZEBRA MUSSEL: BIOLOGY

The zebra mussel (*Dreissena polymorpha)* is a freshwater clam (mollusc) that can be distinguished from native clams by its brown and cream to yellow stripes and flat to concave shell bottom. The free-swimming microscopic planktonic veliger, also distinguish zebra mussels from the two families of native clams, *Unioniidea* and *Sphaeriidae*, which do not produce free-swimming larval forms.

Figure 2: Zebra Mussel
Source: The O.F.A.H.

Male and female zebra mussels participate in either one or two spawning events per year typically between May to September and possibly as late as October. Zebra mussels normally begin to reproduce when water temperatures reach 12° Celsius (Table 1). One female zebra mussel can produce between 40,000 and 1 million eggs per season. Microscopic eggs hatch and release veligers. Over a period of 3 weeks veligers grow a thin "D" shaped transparent shell and slowly settle to the bottom of the lake or waterway. They then attach to any firm surface using byssal (sticky) threads. "An individual zebra mussel can attach to an object

with more than 100 byssal threads that are secreted from a gland at the base of its foot."[3] These byssal threads also distinguish the zebra mussel from native North American fresh water clams that only have a single thread that is present only in the juvenile stage. Development from the egg stage to the settling stage is highly variable and is largely influenced by temperature, the warmer the water the faster the development.

After an immature mussel settles it can remain attached to a hard substrate for life. However, if conditions become unsuitable, from physical disturbance, poor water quality or water temperature changes, zebra mussels can release from their byssal threads. Individuals can then be carried passively, with the assistance of water currents and attach to new surfaces by secreting new byssal threads. Additionally, zebra mussels can crawl by extending a foot-like structure, anchoring it to substrate with mucus and then contracting the muscles to pull the body forward. Small individuals are more mobile than large mussels.

Will Zebra Mussels Survive In My Lake?

	No Survival		**Poor Growth**		**Mod. Growth**		**Good Growth**		**Best Growth**
Criteria	**From**	**To**	**From**	**To**	**From**	**To**	**From**	**To**	
Alkalinity (mg $CaCO_{3/l}$)	0	17	18	35	36	87	88	122	>122
Calcium (mg/l)	5	6	10	11	25	26	35	>35	
Total Hardness (mg $CaCO_{3/l}$)	0	22	23	41	43	90	91	125	>125
Conductivity (μ Siemens)	0	21	22	36	37	82	83	110	>110
PH	0	6.8	6.9	7.4	7.5	7.8	7.9	8.0	>8.0
Temperature (°C)[a]	<-2	>40	0-8	28-30	9-12	25-27	13-17	21-24	18-20

Table 1: Approximate Growth Performance of Zebra Mussels in Relation to Alkalinity, Calcium, Total Hardness, Conductivity, pH [4] and temperature.

Note: Temperature should be interpreted with caution here because it affects mussels at both high and low values. For example there is no survival at temperatures below –2 or above 40°C but there is survival between these temperatures; there is poor growth both between 0-8°C and 28-30°C but moderate to best growth between these extremes.

[3] US Army Corps of Engineers: Zebra Mussels: Biology, Ecology and Recommended Control Strategies. Technical Note ZMR-1-01

[4] Claudi, Renata and Mackie Gerald, L. 1994. Practical Manual for Zebra Mussel Monitoring and Control. Lewis Publishers: Boca Raton, Florida USA.

Zebra Mussels Under The Microscope!

One of the simplest and most efficient methods for analyzing the *Invading Species Watch* Program water samples involves the use of cross-polarized light. Zebra mussel larvae are one of the few reflective objects found in the samples. Larvae are reflected due to the calcium structure of the larval shell and they glow as bright spots under polarized light. Because of the arrangement of the calcium particles, portions of the shell do not reflect the light and thus the veligers appear with small glowing "Maltese" crosses. Under the polarized light zebra mussels can be confused with ostracods and are distinguished based on size, shape, or other features. However cross-polarized light provides a simple way to narrow the range of possibilities from hundreds of aquatic species captured in a plankton haul.

THE ZEBRA MUSSEL: IMPACTS OF THE INVASION IN ONTARIO

ECOLOGICAL IMPACTS

Aquatic ecosystems that have established zebra mussel populations can experience significant alterations from their natural state including food, habitat and biodiversity-related alterations.

Food Related Alterations

Zebra mussels are filter feeders, removing microscopic plant and animal matter from water as a source of food. Each mussel can filter about one litre of lake water per day. However, not all of what they consume is digested. What they don't eat is combined with mucus as "pseudo-feces" and is discharged onto the lake bottom where it accumulates.

A consequence of their filtering capabilities includes the reduction of phytoplankton (algae) diversity and numbers from the water column. Zebra mussels also remove, through filtering, small animals (i.e. rotifers, immature copepods). As phytoplankton and zooplankton are a source of food for larval fish and young fish, they may compete with zebra mussels for this important food source.

The zebra mussel has also been linked to the decline of *Diporeia*, a tiny shrimp-like amphipod, in the Great Lakes, which is an important food source for many fish species. Since the early 1990's, populations of *Diporeia* have either disappeared or dramatically declined in many areas of the Great Lakes. For example, in the Kingston basin of Lake Ontario, *Diporeia* abundance has fallen to near zero, from a previous level of 14,000 per square meter.[5] *Diporeia* is an organism that formerly represented up to 70% of the Great Lakes biomass of bottom-dwelling invertebrates. *Diporeia* decline has caused a major food chain disruption, affecting fish species such as whitefish.

[5] Lozano, S.J., Scharold, J.V., and Nalepa, T.F. 2001. Recent declines in benthic macroinvertebrate densities in Lake Ontario. Can. J. Fish. Aquat. Sci. **58**: 518-529.

Habitat Related Alterations

When zebra mussels filter water organisms, matter is removed from the water and as a result water clarity increases. Sunlight can then penetrate further into the water column, causing an increase in plant growth. This increase in sunlight is detrimental to light sensitive fish such as walleye and could force these fish to re-locate to darker and deeper areas of the lake or waterway. However, this increased light penetration can have positive effects for certain species including bass and pike, which flourish in high light environments.

Fish spawning habitats may also be altered by the colonization of zebra mussels on rocks. Many fish species depend on rocky or cobble surfaces and the crevices between them for suitable spawning habitat. Once the zebra mussel colonizes an area, these crevices disappear. In a typical zebra mussel infestation, adult zebra mussels can reach densities in the thousands per square metre. These high densities negatively impact both fish spawning habitats and smaller native aquatic organisms, which, feed on fine particles from the water, and have to compete with the zebra mussel for food. Additionally the sedimentation that results from the excretion of pseudo-feces and feces fills the preferred spawning areas and crevices between them that fish depend upon.

Contaminant Bioaccumulation

Recent studies in North America have demonstrated high levels of contaminant bioaccumulation in zebra mussels (Bioaccumulation is described as the accumulation of contaminants by aquatic organisms from sources such as water, food and in the case of zebra mussels, suspended sediment particles in the water column). These toxins may become available to zebra mussel predators higher in the food chain. Contaminants found in zebra mussel populations include hexachlorobenzene and pentachlorophenol. In the Netherlands, analysis of zebra mussels indicated that they had accumulated cadmium, mercury, lead, PCB's, pesticides, and petroleum hydrocarbons (Reeders and Bij de Vaate 1992). Not only does the zebra mussel absorb these deadly contaminants in their body tissues, but they can also release them into the sediment through their pseudo-feces.

Since zebra mussels have invaded the Great lakes, scientists have noted a decline in greater and lesser scaup duck populations. These waterfowl feed on zebra mussels and scientists are concerned that they may accumulate selenium in their tissue, possibly affecting lesser scaup reproductive ability. (Petrie, 2002)

Biodiversity Alterations

Zebra mussels have also severely affected native clam populations in the Great Lakes by interfering with their ability to feed, grow, move, and reproduce. Nine species of clams have disappeared or declined in Lake Erie since the introduction of zebra mussels. Data from Lake St. Clair indicated that in 1990, 100% of the clams were encrusted with zebra mussels with an average of 638 zebra mussels per clam. Many clams had between 1,000 and 2,000 zebra mussels. In 1991 the density of living clams was only one eightieth of 1990 levels and the number of living clam species had decreased from 11 to 4. (Gillis and Mackie 1992)

ECONOMIC IMPACTS

The most visible and dramatic effects of zebra mussels occur in industrial and municipal facilities. Intake pipes and screens of facilities i.e. power plants, factories, municipal drinking water facilities become clogged with large colonies of zebra mussels. The economic impacts of zebra mussels in Ontario are staggering. While exact figures are difficult to generate, the following figures are known:

Figure 2. A pipe clogged by zebra mussels (provided by Peter Yates)

- Ontario Power Generation spends approximately $20 million per year for zebra mussel control; and
- Canada spends an estimated $500 million annually on alien species control efforts in the Great Lakes (Commissioner of the Environment and Sustainable Development 2001).

In the Great Lakes region, industrial plants and public utilities have been shut down periodically to deal with damage caused by zebra mussels. This costs millions of dollars in repair costs and lost production.

Socio-economic impacts can occur on public and private beaches, which become littered with thousands of zebra mussels, which produce an unpleasant odour and zebra mussel shells are sharp which render beaches painful to walk on. The habitat changes caused by zebra mussels such as the promotion of aquatic weed growth can also restrict recreational boating and swimming activities.

Due to the ecological and economic impacts of the zebra mussel, it is recognized as one of the world's worst invaders. The zebra mussel has spread throughout the Great Lakes and numerous inland lakes in southern Ontario within a mere 15 years. This is an astounding fact considering this range spans across 3 different eco-zones, each with markedly different climates, geography and lake or waterways. There continues to be many unanswered questions about zebra mussels regarding their impacts and potential distribution in Ontario. The *Invading Species Watch* program is contributing to answering these critical questions by documenting the distribution of zebra mussels and providing resource managers with critical information about the dispersal and lake conditions necessary for invasion.

APPENDIX C: SPINY WATER FLEA INFORMATION

THE SPINY WATERFLEA: BIOLOGY OF INVASION

It is likely that the spiny waterflea (*Bythotrephes longimanus)*, like the zebra mussel, was introduced to the Great Lakes from the discharge of ship ballast water. The first recorded occurrence of the spiny water flea in North America was in Lake Ontario in 1982, and by 1987 it was present in all of the Great Lakes. Now you can also find spiny waterflea in many inland lakes and waterways throughout Ontario.

Due to their small size, eggs and adults are easily transferred to new lakes or waterways as stowaways in the bilge, and transom wells of boats and other personal watercraft, or spread through infested angling or boating equipment such as fishing lines, downrigger cables and anchor ropes.

THE SPINY WATER FLEA: BIOLOGY

Figure 4: The Spiny Water Flea
Source: Bell Museum, University of Minnesota

The spiny waterflea belongs to the class Crustacea, a group of animals such as crabs and shrimps that possess a hard exoskeleton (outer shell). This Eurasian animal is approximately 1 cm in length, and as its name suggests, has a long barbed tail spine that accounts for 80% of its length. The spine contains from one to four pairs of barbs, which can be used to determine the age of the animal (US Sea Grant, 2005). Like all other Crustacea, its exoskeleton moults in order to grow. The spiny water flea is unique because it sheds only the exoskeleton that covers its body, retaining the exoskeleton that covers the tail spine. The animal is never without its long, stout spine, which suggests that the tail serves a vital protective function. (US Sea Grant, 2005)

The head has a large black eye and a pair of swimming antennae. Also present are a pair of jaws which are used to pierce and shred its prey. This animal has four pairs of legs; the first, longer pair is used for catching prey, whereas the other pairs of limbs are designed for grasping prey while they are being consumed. Spiny water flea is a voracious predator and can eat up to 20 organisms of zooplankton daily.

SPINY WATER FLEA: IMPACTS OF THE INVASION IN ONTARIO

ECOLOGICAL IMPACTS

Like the zebra mussel, the spiny waterflea can have significant and rapid impacts on lake ecosystems, many of which still remain unknown. However recent research initiatives have identified several impacts including native zooplankton species reduction, food chain disruptions, and water clarity reductions

Spiny waterflea consumes up to three times as much as native species of zooplankton. Spiny waterflea consumes smaller species of native zooplankton such as *Daphnia,* which is an important food source for juvenile fish species. As a result the spiny water flea competes directly with these juvenile fish for food. When populations of this invader are high, consumption is significant, and the amount of food available to native species of predatory zooplankton, smaller forage fish, and juvenile fish is largely reduced.

Planktivorous fish such as whitefish and lake herring feed on spiny waterflea. However, studies have indicated that juvenile fish smaller than 10 cm in length are unable to use the spiny waterflea as a source of food due to the long tail spine, which prevents them from swallowing it. Research by Rae Barnhisel of Michigan Technological University found that young yellow perch cough up the spiny waterflea because of the long tail spine, which prevents that fish from swallowing it.

APPENDIX D: 2014 INVADING SPECIES WATCH RESULTS

Results from the *Invading Species Watch* in 2014

Sighting Waterbody	Sample County	Sample Township	Zebra mussels present	Spiny water flea present
Ardoch Lake	Frontenac	North Frontenac	no	No
Ardoch Lake	Frontenac	North Frontenac	no	No
Bagot Long Lake	Renfrew	Greater Madawaska	No	No
Bagot Long Lake	Renfrew	Greater Madawaska	No	No
Bagot Long Lake	Renfrew	Greater Madawaska	No	No
Bear Lake	Temiskaming	McGarry	No	No
Bear Lake	Temiskaming	McGarry	No	No
Bear Lake	Temiskaming	McGarry	No	No
Bennett Lake	Lanark	Tay Valley	Yes	No
Bennett Lake	Lanark	Tay Valley	Yes	No
Bennett Lake	Lanark	Tay Valley	Yes	No
Big Crosby Lake	Leeds Grenville	Rideau Lakes	No	No
Big Crosby Lake	Leeds Grenville	Rideau Lakes	No	No
Big Gull Lake	Frontenac	North Frontenac	No	No
Big Gull Lake	Frontenac	North Frontenac	No	Yes
Big Gull Lake	Frontenac	North Frontenac	No	No
Big Hawk Lake	Haliburton	Algonquin Highlands	No	Yes
Big Hawk Lake	Haliburton	Algonquin Highlands	No	Yes
Big Rideau Lake	Leeds Grenville	Rideau Lakes	Yes	No
Big Rideau Lake	Leeds Grenville	Rideau Lakes	Yes	No
Big Rideau Lake	Leeds Grenville	Rideau Lakes	Yes	No
Black Lake	Frontenac	Central Frontenac	no	No
Black Lake	Frontenac	Central Frontenac	no	No
Bobs Lake	Lanark	Tay Valley	no	No
Bobs Lake	Lanark	Tay Valley	No	No
Buck Lake	Parry Sound/Muskoka	McMurrich	No	No
Buck Lake	Parry Sound/Muskoka	McMurrich	No	No
Buckshot Lake	Frontenac	North Frontenac	No	No
Buckshot Lake	Frontenac	North Frontenac	No	No
Buckshot Lake	Frontenac	North Frontenac	No	No
Burridge Lake	Frontenac	South Frontenac	Yes	No
Burridge Lake	Frontenac	South Frontenac	Yes	No
Butterill Lake	Frontenac	South Frontenac	Yes	No
Canning Lake	Haliburton	Minden Hills	No	Yes
Canning Lake	Haliburton	Minden Hills	No	No

Canning Lake	Haliburton	Minden Hills	No	Yes
Canonto Lake	Frontenac	North Frontenac	Yes	No
Canonto Lake	Frontenac	North Frontenac	Yes	No
Canonto Lake	Frontenac	North Frontenac	Yes	No
Carnahan Lake	Frontenac	Central Frontenac	No	No
Carnahan Lake	Frontenac	Central Frontenac	No	No
Cassels Lake	Temiskaming	Cassels Township	No	No
Cassels Lake	Temiskaming	Riddel Township	No	No
Catchacoma Lake	Peterborough	Trent Lakes	No	Yes
Catchacoma Lake	Peterborough	Trent Lakes	No	Yes
Catchacoma Lake	Peterborough	Trent Lakes	No	Yes
Cavendish Lake	Peterborough	Trent Lakes	No	No
Cavendish Lake	Peterborough	Trent Lakes	No	No
Cavendish Lake	Peterborough	Trent Lakes	No	No
Chandos Lake	North Kawartha	Peterborough	No	No
Chandos Lake	North Kawartha	Peterborough	No	No
Chandos Lake	North Kawartha	Peterborough	No	No
Christie Lake	Lanark	Tay Valley	Yes	No
Christie Lake	Lanark	Tay Valley	Yes	No
Christie Lake	Lanark	Tay Valley	Yes	No
Clayton Lake	Lanark	Mississippi Mills and Lanark Highlands	Yes	No
Clayton Lake	Lanark	Mississippi Mills and Lanark Highlands	Yes	No
Clayton Lake	Lanark	Mississippi Mills and Lanark Highlands	Yes	No
Constance Lake	West Carleton	City of Ottawa	Yes	No
Crego Lake	Kawartha Lakes	Somerville	No	No
Crotch Lake	Frontenac	North Frontenac	No	No
Crotch Lake	Frontenac	North Frontenac	No	Yes
Crotch Lake	Frontenac	North Frontenac	No	No
Crow Lake	Lanark	Tay Valley	No	No
Crow Lake	Lanark	Tay Valley	No	No
Crystal Lake	Peterborough	Trent Lakes	no	Yes
Crystal Lake	Peterborough	Trent Lakes	No	No
Crystal Lake	Peterborough	Trent Lakes	No	No
Dalhousie Lake	Lanark	Lanark Highlands	no	No
Dalhousie Lake	Lanark	Lanark Highlands	no	No
Davern Lake	Lanark	Tay Valley	No	No
Davern Lake	Lanark	Tay Valley	No	No
Drag Lake	Haliburton	Dysart et al	No	No
Drag Lake	Haliburton	Dysart et al	No	No
Eagle Lake	Frontenac	Central Frontenac	No	No

Eagle Lake	Frontenac	Central Frontenac	No	No
Eagle Lake	Frontenac	Central Frontenac	No	No
Elbow Lake	Frontenac	South Frontenac	no	No
Elbow Lake	Frontenac	South Frontenac	No	No
Elbow Lake	Frontenac	South Frontenac	No	No
Esson (Big) Lake	Monmouth-Haliburton	Highlands East	No	No
Esson (Big) Lake	Monmouth-Haliburton	Highlands East	no	No
Farlain Lake	Simcoe	Tiny	No	No
Farlain Lake	Simcoe	Tiny	No	No
Farlain Lake	Simcoe	Tiny	No	No
Farren Lake	Lanark	Tay Valley	Yes	No
Farren Lake	Lanark	Tay Valley	No	No
Fawn Lake	Parry Sound/Muskoka	McMurrich	No	No
Fawn Lake	Frontenac	North Frontenac	no	No
Fermoy Lake	Frontenac	South Frontenac	No	No
Fortesque Lake	Haliburton	Highlands East	No	No
Fortesque Lake	Haliburton	Highlands East	No	No
Fortesque Lake	Haliburton	Highlands East	No	No
Fox Lake	Muskoka	Stisted	No	No
Fox Lake	Muskoka		No	No
Fox Lake	Muskoka		No	No
Glamor Lake	Haliburton	Highlands East / Glamorgan	No	No
Glamor Lake	Haliburton	Highlands East / Glamorgan	No	No
Glamor Lake	Haliburton	Highlands East / Glamorgan	No	No
Gowganda Lake	Temiskaming	Milner	No	No
Gowganda Lake	Temiskaming	Milner	No	No
Gowganda Lake	Temiskaming	Milner	No	No
Grace Lake	Haliburton	Dysant et al	No	No
Grace Lake	Haliburton	Dysant et al	No	No
Grace Lake	Haliburton	Dysant et al	No	No
Green Lake	Frontenac	South Frontenac	No	No
Grindstone Lake	Frontenac	North Frontenac	No	No
Grindstone Lake	Frontenac	North Frontenac	No	No
Grippen Lake (north)	Leeds Grenville	Leeds & 1000 Islands	No	No
Grippen Lake (north)	Leeds Grenville	Leeds & 1000 Islands	No	No
Grippen Lake (north)	Leeds Grenville	Leeds & 1000 Islands	No	No
Grundy Lake	Killarney	Mowatt	No	No

Halls Lake	Haliburton	Algonquin Highlands	No	No
Halls Lake	Haliburton	Algonquin Highlands	No	Yes
Halls Lake	Haliburton	Algonquin Highlands	No	No
Head Lake	Digby-Laxton	City of Kawartha Lakes	No	No
Head Lake	Digby-Laxton	City of Kawartha Lakes	No	No
Head Lake	Digby-Laxton	City of Kawartha Lakes	No	No
Hoggs bay	Lanark	Tay Valley	No	No
Jack Lake	North Kawartha	Peterborough	No	No
Jack Lake	North Kawartha	Peterborough	No	No
Jack Lake	North Kawartha	Peterborough	No	No
Jack Lake	North Kawartha	Peterborough	No	Yes
Kakagi Lake	Kenora District	Phillips	No	No
Kakagi Lake	Kenora District	Phillips	No	No
Kakagi Lake	Kenora District	Phillips	No	No
Kashwakamak Lake	Frontenac	North Frontenac	No	No
Kashwakamak Lake	Frontenac	North Frontenac	No	Yes
Kashwakamak Lake	Frontenac	North Frontenac	No	No
Kasshabog Lake	Peterborough	Havelock-Belmont-Meuthen	No	No
Kasshabog Lake	Peterborough	Havelock-Belmont-Meuthen	No	No
Kawagama Lake	Sherborne	Algonquin Highlands	No	No
Kawagama Lake	Sherborne	Algonquin Highlands	No	Yes
Kawagama Lake	Sherborne	Algonquin Highlands	No	No
Kenogami Lake	Temiskaming	Gvenfield	No	No
Kenogami Lake	Temiskaming	Gvenfield	No	No
Killenbeck Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Killenbeck Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Killenbeck Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Lake Lulu	Kenora District	Laclu	No	Yes
Lake Lulu	Kenora District	Laclu	No	No
Lake of the Woods	Kenora District	Nestor Falls	No	Yes
Lake of the Woods	Kenora District	Nestor Falls	No	Yes
Lake of the Woods	Kenora District	Nestor Falls	No	No
Lake of the Woods	Kenora District	Kenora	No	Yes
Lake of the Woods	Kenora District	Kenora	No	Yes
Lake of the Woods	Kenora District	Kenora	No	Yes
Lake of the Woods	Kenora District	Kenora	No	Yes
Lake of the Woods	Kenora District	Kenora	No	Yes
Lake of the Woods	Kenora District	Kenora	No	Yes

Leggat Lake	Frontenac	Central Frontenac	Yes	No
Leggat Lake	Frontenac	Central Frontenac	No	No
Leggat Lake	Frontenac	Central Frontenac	No	No
Little Crosby Lake	Leeds Grenville	Rideau Valley	No	No
Little Hawk Lake	Haliburton	Algonquin Highlands	No	No
Little Hawk Lake	Haliburton	Algonquin Highlands	No	Yes
Little Hawk Lake	Haliburton	Algonquin Highlands	No	Yes
Little Silver Lake	Lanark	Tay Valley	No	No
Little Silver Lake	Lanark	Tay Valley	No	No
Long (Fodey) Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Long (Fodey) Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Long (Fodey) Lake	Leeds Grenville	Leeds & 1000 Islands	No	No
Long Lake	Temiskaming	Shaves/ Rosillara	No	No
Long Lake	Temiskaming	Shaves/ Rosillara	No	No
Long Lake	Temiskaming	Shaves/ Rosillara	No	No
Long Lake	Frontenac	Central Frontenac	No	No
Long Lake	Frontenac	Central Frontenac	No	No
Long Lake	Frontenac	Central Frontenac	No	No
Long Pond	Frontenac	South Frontenac	No	No
Loon Call Lake	Peterborough	Anstruther	No	No
Loon Call Lake	Peterborough	Anstruther	No	No
Loon Call Lake	Peterborough	Anstruther	No	No
Loon Lake	Haliburton	Dudley	No	Yes
Loon Lake	Haliburton	Dudley	No	Yes
Loon Lake	Haliburton	Dudley	No	Yes
Loon Lake	Lanark	Tay Valley	Yes	No
Lower Rideau	Leeds Grenville	Rideau Lakes	Yes	No
Lower Rideau	Leeds Grenville	Rideau Lakes	Yes	No
Mackavoy Lake	Lennox & Addington	Addington Highlands	No	No
Mackavoy Lake	Lennox & Addington	Addington Highlands	No	No
Mackavoy Lake	Lennox & Addington	Addington Highlands	No	No
Malcolm Lake	Frontenac	North Frontenac	No	No
Malcolm Lake	Frontenac	North Frontenac	No	No
Mazinaw Lake	Lennox & Addington	Barrie & Addington Highlands	No	No
Mazinaw Lake	Lennox & Addington	Barrie & Addington Highlands	No	No
Mazinaw Lake	Lennox & Addington	Barrie & Addington Highlands	No	No
Mississagagon Lake	Frontenac	North Frontenac	no	No
Mississagagon Lake	Frontenac	North Frontenac	No	No
Mississagagon Lake	Frontenac	North Frontenac	No	No
Mississippi Lake	Lanark	Drummond,	Yes	No

Mississippi Lake	Lanark	Beckwith, Mississippi Mills	Yes	No
Mississippi Lake	Lanark	Drummond, Beckwith, Mississippi Mills	Yes	No
Mistinikon Lake	Temiskaming	Yarrow/Powell	No	No
Mistinikon Lake	Temiskaming	Yarrow/Powell	No	No
Mistinikon Lake	Temiskaming	Yarrow/Powell	No	No
Montreal River	Temiskaming	James Township	No	No
Montreal River	Temiskaming	James Township	No	No
Montreal River	Temiskaming	James Township	No	No
Mosque Lake	Frontenac	North Frontenac	No	No
Mosque Lake	Frontenac	North Frontenac	no	No
Mosque Lake	Frontenac	North Frontenac	no	No
O'Brien Lake	Lanark	Tay Valley	Yes	No
O'Reilly Lake	Frontenac	Central Frontenac	No	No
O'Reilly Lake	Frontenac	Central Frontenac	No	No
O'Reilly Lake	Frontenac	Central Frontenac	No	No
Otty Lake	Lanark	Tay Valley	Yes	No
Otty Lake	Lanark	Tay Valley	Yes	No
Otty Lake	Lanark	Tay Valley	Yes	No
Palmerston Lake	Frontenac	North Frontenac	No	No
Palmerston Lake	Frontenac	North Frontenac	No	No
Park Lake	Lanark	Lanark Highlands	No	No
Park Lake	Lanark	Lanark Highlands	No	No
Park Lake	Lanark	Lanark Highlands	no	No
Pike Lake	Lanark	Tay Valley	No	No
Pike Lake	Lanark	Tay Valley	No	No
Pike Lake	Lanark	Tay Valley	No	No
Pine Lake	Frontenac	North Frontenac	No	No
Pine Lake	Frontenac	North Frontenac	No	No
Pine Lake	Frontenac	North Frontenac	No	No
Rabbit Lake	Temiskaming	Askin Township	No	No
Rabbit Lake	Temiskaming	Askin Township	No	No
Rabbit Lake	Temiskaming	Milne Township	No	No
Rainbow Lake	Lanark	Tay Valley	No	No
Rib Lake	Latchford	Timiskaming	No	No
Rib Lake	Latchford	Timiskaming	No	No
Rib Lake	Latchford	Timiskaming	No	No
Robertson Lake	Lanark	Lanark Highlands	No	No

Robertson Lake	Lanark	Lanark Highlands	No	No
Robertson Lake	Lanark	Lanark Highlands	No	No
Round Lake	Temiskaming	Otto	No	No
Round Lake	Lanark	Tay Valley	No	No
Salerno Lake	Haliburton	Highlands East	No	No
Salerno Lake	Haliburton	Highlands East	No	No
Salerno Lake	Haliburton	Highlands East	No	No
Salmon Lake	Haliburton	Highlands East	No	No
Salmon Lake	Haliburton	Highlands East	No	No
Salmon Lake	Haliburton	Highlands East	No	No
Sand Lake	Frontenac	North Frontenac	No	No
Sand Lake	Frontenac	North Frontenac	No	No
Sand Lake	Frontenac	North Frontenac	No	No
Shabomeka Lake	Frontenac	North Frontenac	Yes	No
Shabomeka Lake	Frontenac	North Frontenac	No	No
Shabomeka Lake	Frontenac	North Frontenac	no	No
Sharbot Lake	Frontenac	Central Frontenac	Yes	No
Sharbot Lake	Frontenac	Central Frontenac	Yes	No
Sharbot Lake; West basin	Frontenac	Oso	Yes	No
Sharbot Lake; West basin	Frontenac	Oso	Yes	No
Shawenegog Lake	Frontenac	North Frontenac	No	No
Shawenegog Lake	Frontenac	North Frontenac	No	No
Shawenegog Lake	Frontenac	North Frontenac	No	No
Shebandowan Lake	n/a	Haine, Hacey, Connacher	No	No
Shebandowan Lake	n/a	Haine, Hacey, Connacher	No	Yes
Shebandowan Lake	n/a	Haine, Hacey, Connacher	No	No
Silver Lake	Frontenac	Central Frontenac	Yes	No
Silver Lake	Frontenac	Central Frontenac	Yes	No
Silver Lake	Frontenac	Central Frontenac	Yes	No
Snake Island Lake	Temiskaming	Strathy Township	No	No
South Lake	Leeds Grenville	Leeds & 1000 Islands	Yes	No
South Lake	Leeds Grenville	Leeds & 1000 Islands	Yes	No
South Lake	Leeds Grenville	Leeds & 1000 Islands	no	No
South Nation River	South Dundas and Grenville	North Dundas	No	No
South Nation River	South Dundas and Grenville	North Dundas	Sample not present	na
South Nation River	South Dundas and Grenville	North Dundas	No	No

South Nation River	Prescott Russell	Alfred and Plantageret	Sample not present	na
South Nation River	Prescott Russell	Alfred and Plantageret	Sample not present	na
South Nation River	Prescott Russell	Alfred and Plantageret	Sample not present	na
South Nation River			Yes	Too Murky
South Nation River			Yes	No
South Nation River	South Dundas and Grenville	North Stormont	Yes	No
South Nation River	South Dundas and Grenville	North Stormont	Yes	No
South Nation River	South Dundas and Grenville	North Stormont	Yes	No
Spectacle Lake	Leeds Grenville	Rideau Lakes	No	No
Spectacle Lake	Leeds Grenville	Rideau Lakes	Sample not present	na
St. Anthony Lake	Temiskaming	Skead	No	No
St. Anthony Lake	Temiskaming	Skead	No	No
St. Anthony Lake	Temiskaming	Skead	No	No
St. Lawrence and South Nation River	South Dundas and Grenville	South Dundas	Yes	No
St. Lawrence and South Nation River	South Dundas and Grenville	South Dundas	Yes	No
St. Lawrence and South Nation River	South Dundas and Grenville	South Dundas	Sample not present	na
Stormy Lake	Highlands East	Glamorgan	no	No
Stormy Lake	Highlands East	Glamorgan	No	No
Stormy Lake	Highlands East	Glamorgan	No	No
Sugar Lake	Seguin	Christie	No	No
Sugar Lake	Seguin	Christie	No	No
Sugar Lake	Seguin	Christie	No	Yes
Taylor Lake	Lanark	Lanark Highlands	Yes	No
Taylor Lake	Lanark	Lanark Highlands	Yes	No
Taylor Lake	Lanark	Lanark Highlands	Yes	No
Tommy Lake	Leeds Grenville	Rideau Lakes	No	No
Upper Rideau	Leeds Grenville	Rideau Lakes	Yes	No
Vernon Lake	Chaffey	Muskoka	No	No
Vernon Lake	Chaffey	Muskoka	No	Yes
Vernon Lake	Chaffey	Muskoka	No	No
Wendigo Lake	Temiskaming	Bayly	No	No
Wendigo Lake	Temiskaming	Bayly	No	No
Wendigo Lake	Temiskaming	Bayly	No	No
Westport Sands	Leeds Grenville	Rideau Lakes	Yes	No

Westport Sands	Leeds Grenville	Rideau Lakes	Yes	No
Westport Sands	Leeds Grenville	Rideau Lakes	Yes	No
White Lake	Renfrew and Lanark Counties	Greater Madawaska and Lanark Highlands	Yes	No
White Lake	Renfrew and Lanark Counties	Greater Madawaska and Lanark Highlands	no	No
White Lake	Renfrew and Lanark Counties	Greater Madawaska and Lanark Highlands	No	No
White Lake	Haliburton	Highlands East	No	No
White Lake	Haliburton	Highlands East	No	No
White Lake	Haliburton	Highlands East	No	No
Wolf Lake	Kawartha	North Kawartha	No	No
Wolf Lake	Kawartha	North Kawartha	No	No
Wollaston Lake	Hastings	Wollaston	No	No
Wollaston Lake	Hastings	Wollaston	No	Yes
Wollaston Lake	Hastings	Wollaston	No	No

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