

# **RESULTS OF THE BURLINGTON 2013 ASIAN CARP EARLY DETECTION FIELD SURVEILLANCE PROGRAM**

Dave Marson, Erin Gertzen, and Becky Cudmore

Asian Carp Program  
Fisheries and Oceans Canada  
867 Lakeshore Road  
Burlington, ON L7S 1A1

2014

**Canadian Manuscript Report of  
Fisheries and Aquatic Sciences 3054**

## **Canadian Manuscript Report of Fisheries and Aquatic Sciences**

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901-1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426-1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

## **Rapport manuscrit canadien des sciences halieutiques et aquatiques**

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent de problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Manuscript Report of  
Fisheries and Aquatic Sciences 3054

2014

RESULTS OF THE BURLINGTON 2013 ASIAN CARP EARLY DETECTION FIELD  
MONITORING PROGRAM

by

Dave Marson, Erin Gertzen, and Becky Cudmore

Asian Carp Program  
Fisheries and Oceans Canada  
867 Lakeshore Road  
Burlington, ON L7S 1A1  
david.marson@dfo-mpo.gc.ca

© Her Majesty the Queen in Right of Canada, 2014.  
Cat. No. Fs97-4/3054E-PDF ISBN 978-1-100-25339-8 ISSN 1488-5379

Correct citation for this publication:

Marson, D., Gertzen, E, and Cudmore, B. 2014. Results of the Burlington 2013 Asian carp early detection field monitoring program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3054: vii + 27 p.

## TABLE OF CONTENTS

ABSTRACT/RÉSUMÉ .....	vi
INTRODUCTION .....	1
METHODS .....	1
RESULTS .....	3
SUMMARY .....	5
ACKNOWLEDGMENTS .....	6
REFERENCES .....	6

## LIST OF FIGURES

<b>Figure 1.</b> 2013 Asian Carp Program (including Burlington and Sault Ste. Marie crews) early detection surveillance sites in lakes Huron and Erie on the Canadian side of the Great Lakes. ....	7
<b>Figure 2.</b> 2013 Asian carp early detection surveillance sites in Grand River .....	8
<b>Figure 3.</b> 2013 Asian carp early detection surveillance sites in Nanticoke Creek .....	8
<b>Figure 4.</b> 2013 Asian carp early detection surveillance sites in Long Point Bay .....	9
<b>Figure 5.</b> 2013 Asian carp early detection surveillance sites in Big Otter Creek .....	9
<b>Figure 6.</b> 2013 Asian carp early detection surveillance sites in Kettle Creek .....	10
<b>Figure 7.</b> 2013 Asian carp early detection surveillance sites in Rondeau Bay .....	10
<b>Figure 8.</b> 2013 Asian carp early detection surveillance sites in Cedar Creek.....	11
<b>Figure 9.</b> 2013 Asian carp early detection surveillance sites in the Lower Detroit River and Canard River .....	11
<b>Figure 10.</b> 2013 Asian carp early detection surveillance sites in the Upper Detroit River .....	12
<b>Figure 11.</b> 2013 Asian carp early detection surveillance sites in Ruscom River.....	12

<b>Figure 12.</b> 2013 Asian carp early detection surveillance sites in Thames River and Jeanette's Creek .....	13
<b>Figure 13.</b> 2013 Asian carp early detection surveillance sites in Ausable River.....	13
<b>Figure 14.</b> 2013 Asian carp early detection surveillance sites in Bayfield River .....	14
<b>Figure 15.</b> 2013 Asian carp early detection surveillance sites in Maitland River .....	14
<b>Figure 16.</b> 2013 Asian carp early detection surveillance sites in Pine River.....	15
<b>Figure 17.</b> 2013 Asian carp early detection surveillance sites in Nottawasaga River ...	15
<b>Figure 18.</b> 2013 Asian carp early detection surveillance sites in Sauble River .....	16
<b>Figure 19.</b> Number of sites sampled in each of the 17 waterbodies sampled during the 2013 Asian Carp Program's early detection surveillance program .....	16
<b>Figure 20.</b> Number of fish species caught in each of the 17 waterbodies sampled during the 2013 Asian Carp Program's early detection surveillance program .....	17
<b>Figure 21.</b> Number of fishes caught in each of the 17 waterbodies studied during the 2013 Asian Carp Program's early detection surveillance program .....	17
<b>Figure 22.</b> Percentage of sites sampled by each gear type for the 2013 Asian Carp Program's early detection surveillance program .....	18
<b>Figure 23.</b> Number of fish species caught by each gear type used in the 2013 Asian Carp Program's early detection surveillance program .....	18
<b>Figure 24.</b> Percentage of fishes caught by each gear type in 2013 .....	19
<b>Figure 25.</b> Boat electrofisher sampling effort, in seconds, for each of the eight waterbodies sampled in 2013.....	19
<b>Figure 26.</b> Fyke net sampling effort, in hours, for each of the 10 waterbodies sampled in 2013.....	20
<b>Figure 27.</b> Seine net sampling effort, in number of hauls, for each of the eight waterbodies sampled in 2013.....	20
<b>Figure 28.</b> Trammel net sampling effort, in yards, for each of the 12 waterbodies sampled in 2013 .....	21
<b>Figure 29.</b> Number of surrogate fishes caught in each of the 17 waterbodies in 2013..	21

<b>Figure 30.</b> Percentage of surrogate fishes caught by each gear type in the 2013 early detection surveillance program. ....	22
--	----

## LIST OF TABLES

<b>Table 1.</b> Summary of species captured during the 2013 Asian Carp Program early detection surveillance field season.....	23
<b>Table 2.</b> Summary of catch data for the 2013 Asian Carp Program .....	25
<b>Table 3.</b> Catch data by waterbody for the 2013 Asian Carp Program .....	26
<b>Table 4.</b> Summary of catch data by gear type for the 2013 Asian Carp Program.....	26
<b>Table 5.</b> Sampling type and effort by waterbody for the 2013 Asian Carp Program.....	27

## ABSTRACT

In 2013, a formal, traditional gear-based early detection field surveillance program for Asian carps in the Great Lakes and its watersheds was started through Fisheries and Oceans Canada's Asian Carp Program. The field program uses various fish sampling techniques and eDNA methods to monitor sites identified as high risk for Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*), Bighead Carp (*H. nobilis*) and Black Carp (*Mylopharyngodon piceus*) arrival and establishment in the Great Lakes. In the summer and fall of 2013, 195 sites at 17 locations on the Canadian side of the Great Lakes (lakes Huron and Erie) and their tributaries were sampled by the Burlington group as part of the early detection program. Using a combination of boat electrofishing, seining, fyke netting and trammel netting, a total of 15,849 specimens representing 90 fish species were captured. The most species were caught in the Grand River and the most individuals were caught in Rondeau Bay. All gear types caught Asian carp surrogate species, buffalos (*Ictiobus* spp.) and Common Carp (*Cyprinus carpio*), which occupy similar habitats to Asian carps, supporting that the early detection surveillance program is using the correct gears and targeting the correct locations and habitats. One triploid Grass Carp was captured in the Grand River in August with a trammel net. The established early detection sites will be used as long-term monitoring sites in subsequent years of the Asian Carp Program. Additional gear types and sites in lakes Ontario and Superior will be incorporated in 2014.

## RÉSUMÉ

En 2013, on a mis en oeuvre un programme officiel de surveillance sur le terrain au moyen d'engins traditionnels pour la détection rapide de la carpe asiatique dans les Grands Lacs et leurs bassins versants, dans le cadre du Programme sur la carpe asiatique de Pêches et Océans Canada. Le programme de surveillance sur le terrain s'appuie sur diverses techniques d'échantillonnage de poissons et de méthodes de prélèvement d'ADN environnemental pour surveiller les sites réputés à haut risque pour la présence de la carpe de roseau (*Ctenopharyngodon idella*), de la carpe argentée (*Hypophthalmichthys molitrix*), de la carpe à grosse tête (*H. nobilis*) et de la carpe noire (*Mylopharyngodon piceus*) et leur établissement dans les Grands Lacs. À l'été et à l'automne 2013, 195 sites en 17 endroits sur le côté canadien des Grands Lacs (lacs Huron et Érié), et leurs tributaires, ont été échantillonnés par le groupe de Burlington dans le cadre du Programme de détection rapide. À l'aide d'une combinaison de pêche à l'électricité en bateau, de pêche à la senne, de pêche au verveux et de pêche au trémail, on a pris au total 15 849 spécimens de 90 espèces de poissons. La plus grande partie des espèces a été pêchée dans la rivière Grand et la majeure partie des individus a été pêchée dans la baie de Rondeau. Tous les types d'engins ont pris des espèces de substitution de la carpe asiatique, soit des buffalos (*Ictiobus* spp.) et des carpes communes (*Cyprinus carpio*), qui occupent des habitats semblables à ceux des carpes asiatiques, ce qui appuie le fait que le programme de surveillance et de détection rapide utilise les bons engins et cible les bons endroits et les bons habitats. Une carpe de roseau triploïde a été prise dans la rivière Grand au mois d'août à l'aide d'un trémail. Les sites de détection rapide établis serviront



de sites de surveillance à long terme au cours des prochaines années pour le Programme sur la carpe asiatique. D'autres types d'engins et d'autres sites dans les lacs Ontario et Supérieur seront visés par le programme en 2014.

## INTRODUCTION

Fisheries and Oceans Canada's (DFO) Asian Carp Program aims to prevent the entry and minimize the impacts of non-indigenous Asian carps to the Great Lakes through outreach, early warning, response and management. As part of the early warning pillar of the Program, a traditional gear early detection surveillance field program was developed and initiated in 2013. Early detection of aquatic invasive species is a key element in the prevention of their establishment in the aquatic environment, as the sooner a species is detected in the environment, the more options there are for management to address the issue (Lodge et al. 2006; Vander Zanden et al. 2010). Using various fish sampling techniques, the field program monitors sites identified as highest risk for Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*), Bighead Carp (*H. nobilis*) and Black Carp (*Mylopharyngodon piceus*) arrival and establishment in the Great Lakes (Cudmore et al. 2012). The monitoring sites include nearshore areas and tributaries on the Canadian side of the Great Lakes. From July to October, 2013, 17 waterbodies in the south-western Ontario watersheds of the Great Lakes were sampled by the Burlington Asian carp crews for the fish community, Asian carps and surrogate species (Figure 1).

## METHODS

With limited resources, it was important to identify the most suitable areas for detecting Asian carps. Using environmental conditions and ecological needs of Asian carps, computer modelling was conducted to identify those tributaries in the Canadian waters of the Great Lakes that were best suited for these species (Cudmore et al. 2012; methodology from N. Mandrak, unpublished). High and medium matches were selected as potential early detection surveillance sample sites.

In 2013, the focus was on lakes Huron and Erie as those lakes were identified by the Asian Carp Program as the highest priority of the four Canadian Great Lakes following the advice stemming from Cudmore et al. (2012).

Overall, 24 early detection sites were identified (Figure 1). Burlington field crews sampled 17 of these early detection sites (or "waterbodies") and Sault St. Marie crews sampled an additional 7 sites. Ground truthing was conducted to confirm site suitability for Asian carp potential habitat and ability to use traditional fisheries gears.

Four gear types were used to sample the early detection surveillance sites, including a boat electrofisher, fyke net, seine net and trammel net. The complement of gear types was used to capture a wide range in sizes of fishes in different habitats such that we would have the greatest detectability of all four species of Asian carps at different sizes, if present. Descriptions of each gear type and their total effort are found below.

### BOAT ELECTROFISHER

Boat electrofishing for the 2013 early detection surveillance program was conducted using a 21 foot, Smith-Root, 7.5 gas powered pulsator (GPP), dual boom electrofishing

boat. Two netters retrieved stunned fishes and transferred them to a live-well in the boat. Sampling time was recorded in seconds shocked for each site. Electrofishing effort was approximately 600 seconds at each site. The electrofisher was used at 45 sites in 8 waterbodies with a total effort of 25,798 seconds of shocking.

### **FYKE NET SAMPLING**

Box mini fyke nets with a 0.32 mm ace mesh size, 0.61 m hoop diameter, 0.61 by 4.6 m lead length, and 0.61 x 1.2 m wing length were deployed. Fyke nets were set for approximately 24 hours in shallow water (<2.5 m water depth) over a variety of vegetation and substrate types. Fyke nets were set by wading in shallow waters and setting the lead as close to shore as possible. In water depths greater than 0.6 m a float was added to the net to keep the bag end of the net at the water's surface. The float was added to ensure any captured turtles would be able to access the water's surface for respiration. Fyke nets were used to sample 93 sites in 10 waterbodies, with a total netting time of 1,768.46 hours.

### **SEINE NET SAMPLING**

The bag seine net was 9.14 m long and had a 3.18 mm bag mesh size and 4.76 mm wing mesh size. Seining was done in wadeable and moderately vegetated habitats. In flowing waters the seine hauls were performed in the direction of flow. Captured fishes were transferred from the seine into bins filled with water. Water depth and obstructions in nearshore habitats limited the number of seining sites. The seine net was used to sample 19 sites in 8 waterbodies, with a total effort of 54 seine hauls.

### **TRAMMEL NET SAMPLING**

The trammel net used for the early detection surveillance sampling was 3 m deep and 182.9-274.3 m long with a 7.6 cm bar inner mesh size and 45.7 cm outer walls. The trammel nets were used to target large-bodied fishes. They were set in areas free of heavy vegetation for a maximum of two hours. The nets were set by boat and deployed in a manner to block off an area of suitable habitat by setting both ends of the net onshore. The first end of the net was deployed onshore and the boat reversed perpendicular to the shoreline approximately 10-20 m, the boat is then turned and the net deployed parallel to shore up to the last 10-20 m where the net was again set to shore. The crew then boated within the blocked-off area revving the engine and pounding the hull of the vessel to frighten fishes within the enclosed area and increase the likelihood of them encountering the net. This activity is referred to as pounding, and has been found to be an effective technique in the Mississippi watershed for driving Asian carps (net sensitive species) into nets (ACRCC 2014). This method has several advantages to traditional overnight gill-net sets: it allows for much shorter set-times by increasing the movement of sedentary fishes, which in turn decreases the stress on captured fishes by removing them from the net much sooner than in traditional overnight gillnet sets; and it allows for multiple sampling sites per net in a day. Since the set times are relatively short and fishes are actively driven into the nets, the effort for trammel netting was recorded as the length of net deployed.

The trammel nets were used to sample 38 sites in 12 waterbodies with a total effort of 6,584 m of trammel netting.

## **FISH AND HABITAT DATA COLLECTION**

Fishes captured in the sampling gears were identified, measured and returned to the water close to where they were collected. Voucher specimens were preserved in 10% formalin and kept according to vouchering protocols developed by the Biodiversity Science Section at DFO's Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS) (J. Barnucz, pers. comm.). At each sampling site, GPS coordinates and habitat data, including water and air temperature (°C), dissolved oxygen (mg/L), conductivity (µS/cm), pH, turbidity (NTU), wind speed (km/hour), water depth (m), distance to shore (m), substrate percent composition (Wentworth scale), and aquatic vegetation type and percent cover, were recorded. All data were checked for quality assurance and inputted into the Biodiversity Science Section's master fish database.

## **RESULTS**

During the 2013 Asian Carp Program's early detection surveillance sampling by Burlington crews, a total of 15,849 specimens representing 90 species were captured (Table 1). The field program included 195 sites (Figures 2 to 18) from 17 waterbodies in south-western Ontario portion of the Great Lakes basin and tributaries (Table 2; Figure 1). The mean number of fishes caught over the 17 waterbodies was 932.82 and the mean number of fishes caught per site was 81.27. The maximum number of sites sampled occurred in the Grand River at 37 (Figure 2), with a minimum number of one site being sampled in both the Maitland and Sauble rivers by the Burlington crews (Table 3, Figures 15, 18-19). The greatest number of species was caught in the Grand River at 51 species, with the fewest caught in the Maitland and Sauble rivers at two species each (Figure 20). The greatest number of fishes was caught in Rondeau Bay at 5,062 individuals, and the smallest number was caught in the Maitland River at two fishes (Table 3, Figure 21).

Of the four gear types, the fyke net was used at the most number of sites (48% or 93 sites) while the seine net was utilized the least frequently at only 10% or 19 sites (Table 4, Figure 22). The fyke net caught the greatest number of species at 66, while the trammel net caught the least at 25 species (Table 4, Figure 23). The fyke net captured the greatest number of fishes at 68% or 10712 fishes, while the trammel net captured the least at 4% or 577 fishes (Table 4, Figure 24).

## **BOAT ELECTROFISHER**

The electrofisher was used at 45 sites in 8 waterbodies. A total of 2,442 fishes representing 58 species were captured (Table 4). There was a total sampling effort of 25,798 seconds (average 573 seconds per site), with the greatest effort in the Grand River at 18,726 seconds and the smallest effort in the Thames River at 1531 seconds (Table 5, Figure 25). Ongoing mechanical issues with the electrofishing boat generator prevented sampling as much as was planned for the field season.

## **FYKE NET**

The fyke net was used to sample 93 sites in 10 waterbodies. A total of 10,208 fishes representing 65 species were captured (Table 4). The total sampling effort was 1,768.46 hours, with Long Point Bay having the greatest effort at 362.78 hours and the Pine River having the smallest effort at 75.75 hours (Table 5, Figure 26).

## **SEINE NET**

There were 19 sites sampled in 8 waterbodies by bag seine. A total of 2,374 fishes representing 53 species were captured (Table 4). Total sampling effort was 54 hauls, with a maximum effort of 27 hauls in Cedar Creek and a minimum effort of 3 hauls in each of Big Otter Creek, Long Point Creek, Nanticoke Creek, Ruscom River and the Thames River. Six hauls were done in each of the Pine River and Rondeau Bay (Table 5, Figure 27).

## **TRAMMEL NET**

The trammel net was used to sample 38 sites in 12 waterbodies. A total of 577 fishes representing 25 species were captured (Table 4). Total sampling effort was 6,584 m, with the greatest effort in the Grand River at 2,195 m and the least effort in Cedar Creek and the Maitland, Nottawasaga and Sauble rivers at 183 m each (Table 5, Figure 28).

## **SURROGATE SPECIES**

All sucker species of the genus *Ictiobus* (buffalos) and Common Carp (*Cyprinus carpio*) were designated as surrogate species for Asian carps in the 2013 early detection surveillance program. A total of 629 surrogate specimens were caught in the 17 waterbodies. The greatest number of surrogates was captured in Cedar Creek at 226 surrogate fishes and the fewest were captured in the Maitland and Nottawasaga rivers at one surrogate each (Table 3, Figure 29). All four gear types captured surrogates, with the trammel net catching the most at 53% (or 315 surrogates) and the seine net catching the least at 10% (or 63 surrogates) (Table 4, Figure 30).

## **ASIAN CARPS**

During the 2013 early detection surveillance field season, DFO's Asian Carp Program captured one Grass Carp in a trammel net. This specimen was captured on August 16, 2013 in the Grand River in Dunnville, Ontario. The fish had a total length of 104 cm, a weight of 14 kg and was triploid (sterile). Site collection data was not collected as upon capture of the Grass Carp; the field crews and Asian Carp Program immediately initiated Response Protocols to ensure no further specimens were in the area. After intensive sampling for Grass Carp, no additional individuals were observed.

## SUMMARY

In 2013 during the inaugural year of the Asian carp early detection field surveillance program, Burlington field crews sampled 195 sites at 17 high priority locations on the Canadian side of the Great Lakes basin. Sault Ste. Marie field crews sampled an additional 7 high priority locations (Figure 1). The complement of gear types was important and useful for capturing a range of fish sizes and species in a range of habitat types. All gear types were able to capture surrogate species (buffalos and Common Carp), which is critical. This result suggests that the monitoring program is sampling in the correct locations with the correct gear types. This, along with the capture of a single Grass Carp in the Grand River, suggests that if any additional Asian carps were present, the field crews would have likely captured them.

The boat electrofisher was able to sample in highly vegetated and non-wadeable waters where the seine and trammel net would be less successful because of becoming snagged and tangled over the vegetation. The seine net was able to capture smaller-bodied fishes, and should be able to capture young-of-the-year Asian carps, if present. The fyke net captured fishes of various sizes near leading edges of emergent vegetation beds. The trammel net targets larger fishes over a large area and was the most successful gear type at capturing surrogates. These nets catch large quantities of Asian carps in the United States (ACRCC 2014), where the species are established. These trammel nets would be very useful during rapid response and eradication efforts for Asian carps.

All gear types will continue to be used in future years of sampling; however, following the first year of the program we have identified areas where modifications will be implemented to improve sampling. For boat electrofishing, 2014 sampling will continue being conducted using a standard 600 second site sampling effort along a straight transect. Additional targeted sampling will also be conducted at the discretion of the crew leader. This will allow the crew leader to power on and off the electrofisher to focus effort in heavy cover, and will not restrict the effort to a straight transect direction. For fyke nets, turtle exclusion netting will be added to minimize the amount of turtle by-catch in the nets. Coarse netting (7.6-10.2 cm bar mesh) over the entrance of the net will be installed to exclude large turtles that enter the nets and consume the fishes trapped inside. For trammel nets, a larger mesh size (9-10 cm) will be used for the inner panels to allow small, non-target fishes to pass through the net. Tied-down gill nets will be added into the sampling program as an alternative to trammel nets in areas that are highly vegetated (e.g., Long Point Bay and Rondeau Bay). Tied-down gill nets are easier to remove fishes from quickly, and are easier to fish in heavily vegetated areas since there is less material for the vegetation to foul. Further, in addition to standard pounding techniques, electrofishing will be used to help drive fishes in the blocked off area into the trammel and gill nets. This technique will be helpful in complex habitats, such as log-jams, where the anodes of the electrofishing boat can be worked into the heavy cover to drive fishes out. Finally, an additional net type, 1.2 m trap nets, will be included to help catch large-bodied fishes in heavily vegetated areas. Since trammel and gill nets cannot be effectively deployed in heavy vegetation it is essential to deploy a different gear type to sample. Overall the variety of gear types will enable the program to survey the fish community, surrogates and Asian carps in the range of habitats they may inhabit.

In future years, the early detection sites in lakes Huron and Erie will be revisited and additional sites in lakes Ontario and Superior will be scouted using the same sampling methodologies to identify potential additional early detections sites. Overall, the combination of gear types was important and successful, and will be continued into future years of the early detection surveillance program because the risk of Asian carp invasion into the Great Lakes continues to be high.

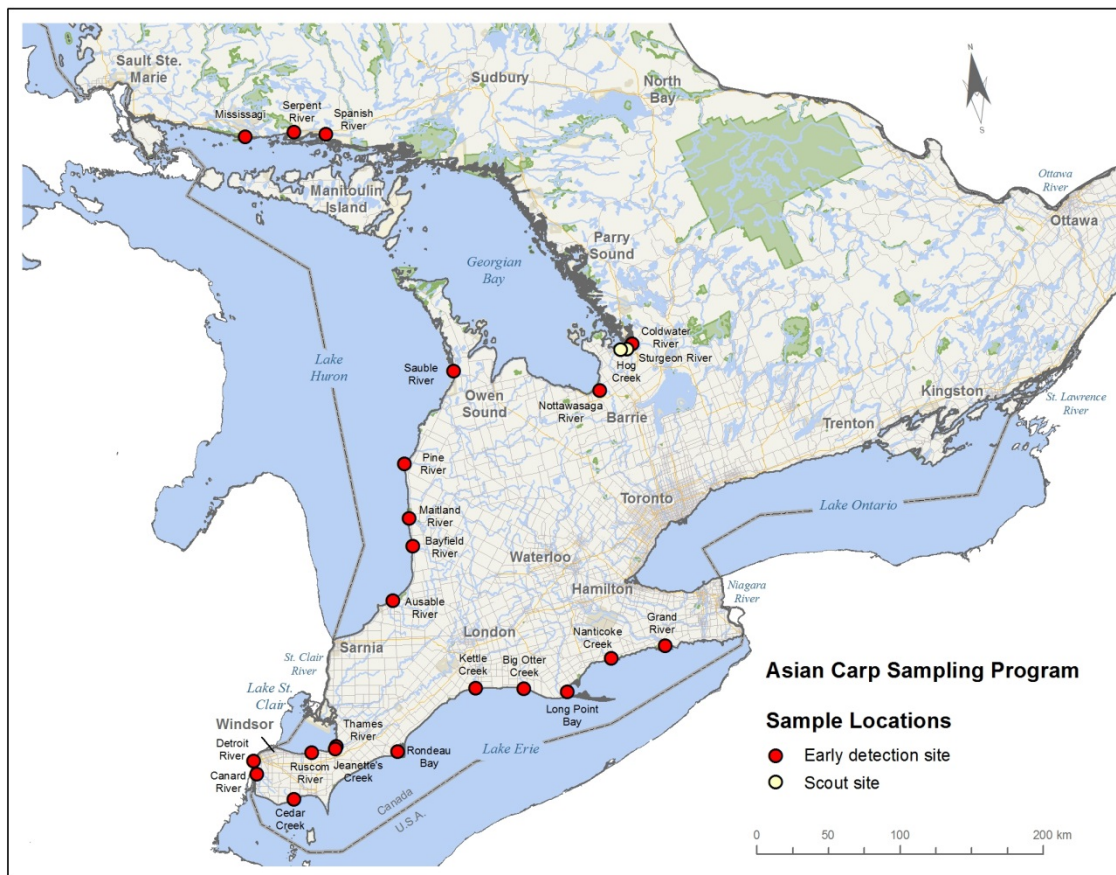
## ACKNOWLEDGMENTS

We thank the 2013 summer and fall field staff for the Asian Carp Program, including Justin Barbati, D'Arcy Campbell, Mike Clark, Katarina Doughty, Bradley Doyle, Michael Gioseffi, Julie Henry, Meagan Kindree, Elizabeth Miller, Alexandra Noel, Michael Parna, Natalie Rook, Ashna Tanna and Nichole Wiemann. This project was funded through the DFO Asian Carp Program.

## REFERENCES

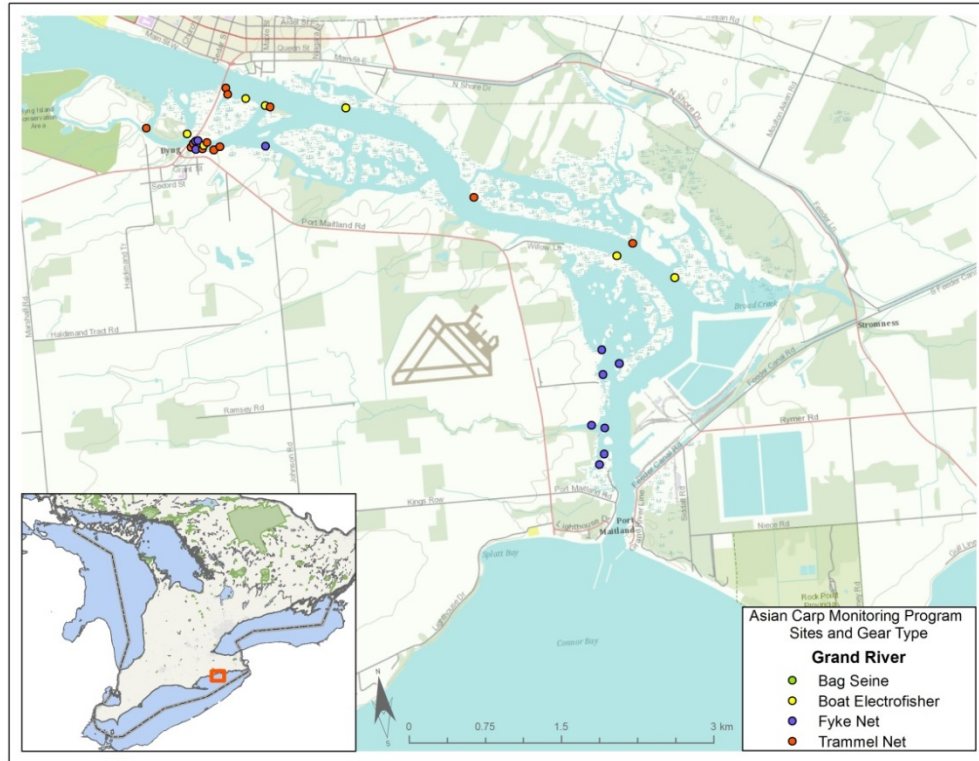
- Asian Carp Regional Coordinating Committee (ACRCC) Monitoring and Response Workgroup. 2014. Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System.  
<http://www.asiancarp.us/documents/MRP2014.pdf> (accessed 6 October, 2014).
- Cudmore, B., Mandrak, N.E., Dettmers, J., Chapman, D.C., and Kolar, C.S. 2012. Binational Ecological Risk Assessment of Bigheaded Carps (*Hypophthalmichthys spp.*) for the Great Lakes Basin. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/114. vi+57 p.
- Holm, E., Mandrak, N.E., and Burridge, M.E. 2010. ROM field guide to freshwater fishes of Ontario. Royal Ontario Museum, Toronto, Ontario. 464 pp.
- Lodge, D.M., Williams, S.L., MacIsaac, H., Hayes, K., Leung, B., Reichard, S., Mack, R.N., Moyle, P.B., Smith, M., Andow, D.A., Carlton, J.T., and McMichael, A. 2006. Biological invasions: recommendations for U.S. policy and management. *Ecol. Appl.* 16: 2035–2054.
- Nelson, J.S., Crossman, E.J., Espinosa-Pérez, H., Findley, L.T., Gilbert, C.R., Lea, R.N., and Williams, J.D. 2003. The "Names of Fishes" list, including recommended changes in fish names: Chinook salmon for chinook salmon, and *Sander* to replace *Stizostedion* for the sauger and walleye. *Fisheries* 28: 38-39.
- Page, L.M., and Burr, B.M. 2011. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Harcourt, Boston, MA. 663 pp.
- Vander Zanden, M.J., Hansen, G.J.A., Higgins, S.N., and Kornis, M.S. 2010. A pound of prevention, plus a pound of cure: early detection and eradication of invasive species in the Laurentian Great Lakes. *J. Great Lakes Res.* 36: 199-205.

## FIGURES



**Figure 1.** 2013 Asian Carp Program (including Burlington and Sault Ste. Marie crews) early detection surveillance sites in lakes Huron and Erie on the Canadian side of the Great Lakes.

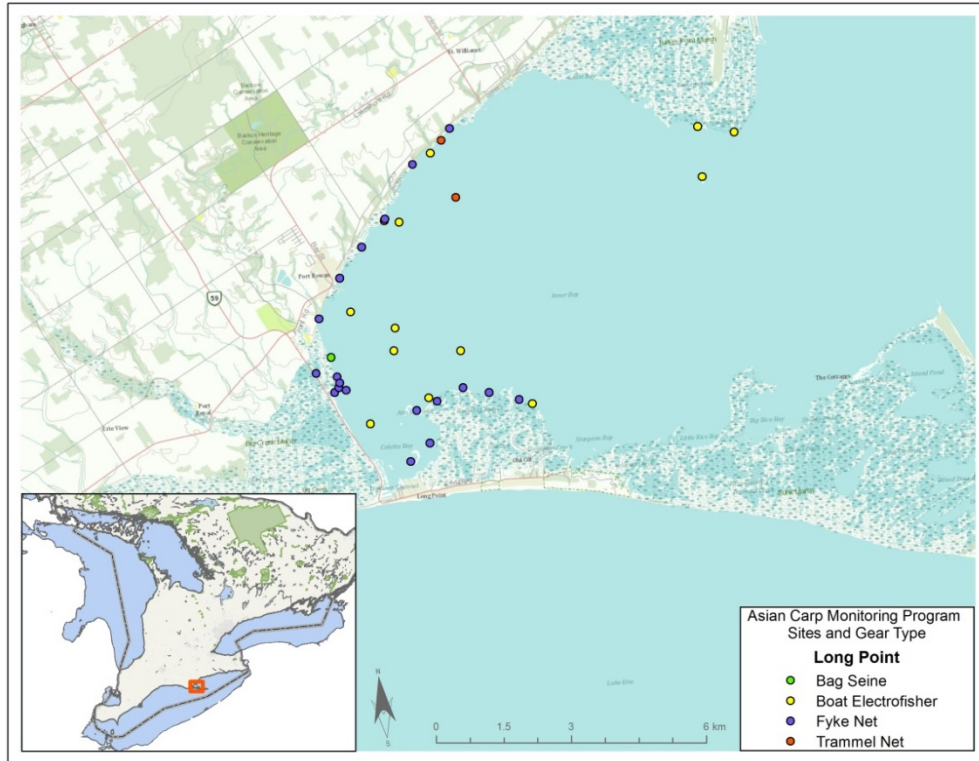




**Figure 2.** 2013 Asian carp early detection surveillance sites in Grand River.



**Figure 3.** 2013 Asian carp early detection surveillance sites in Nanticoke Creek.



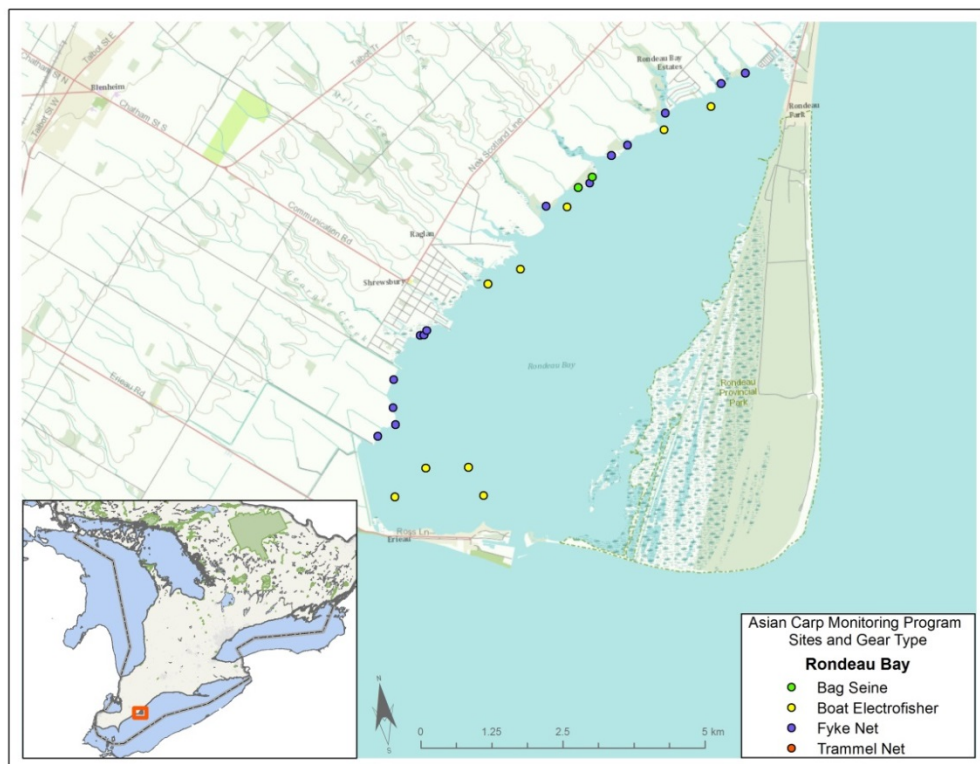
**Figure 4.** 2013 Asian carp early detection surveillance sites in Long Point Bay.



**Figure 5.** 2013 Asian carp early detection surveillance sites in Big Otter Creek.

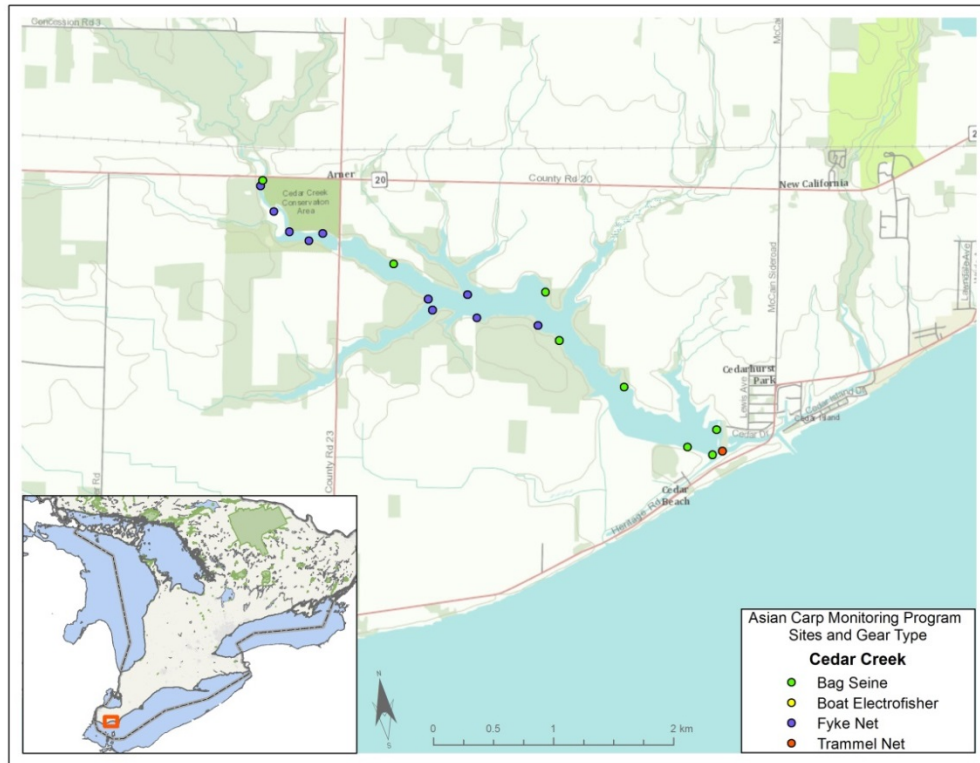


**Figure 6.** 2013 Asian carp early detection surveillance sites in Kettle Creek.

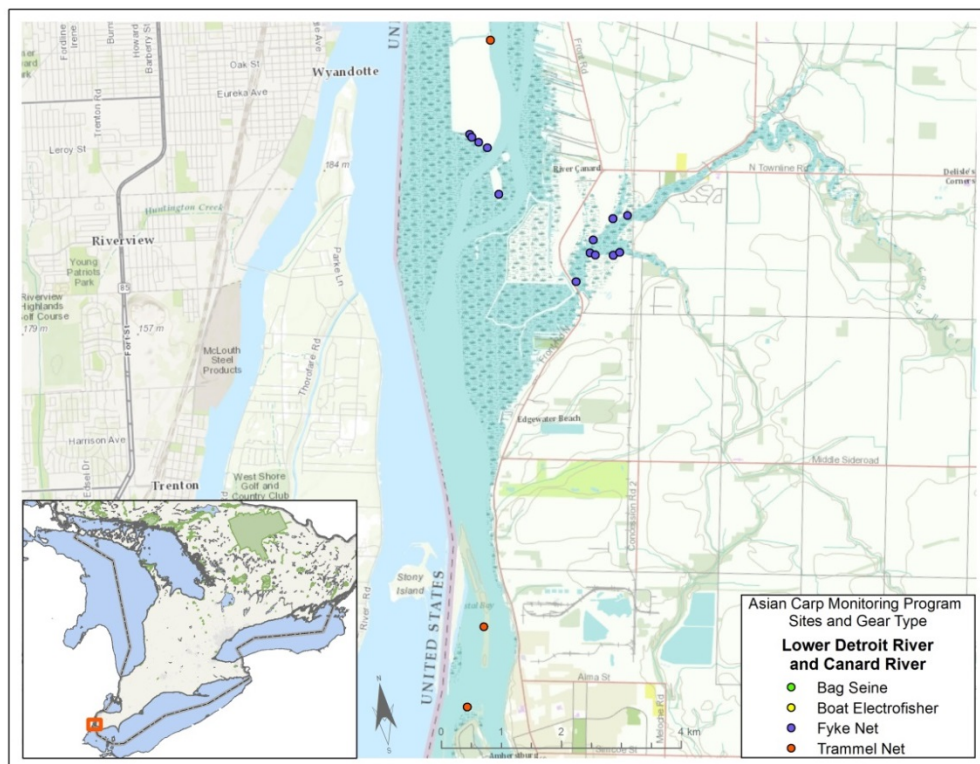


**Figure 7.** 2013 Asian carp early detection surveillance sites in Rondeau Bay.

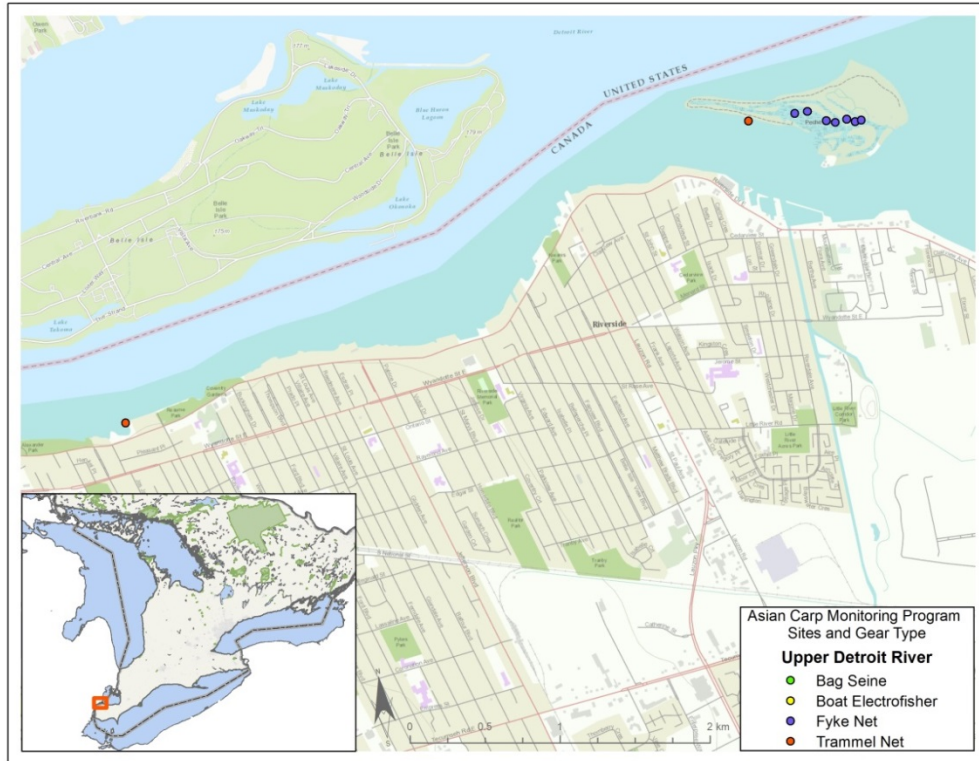




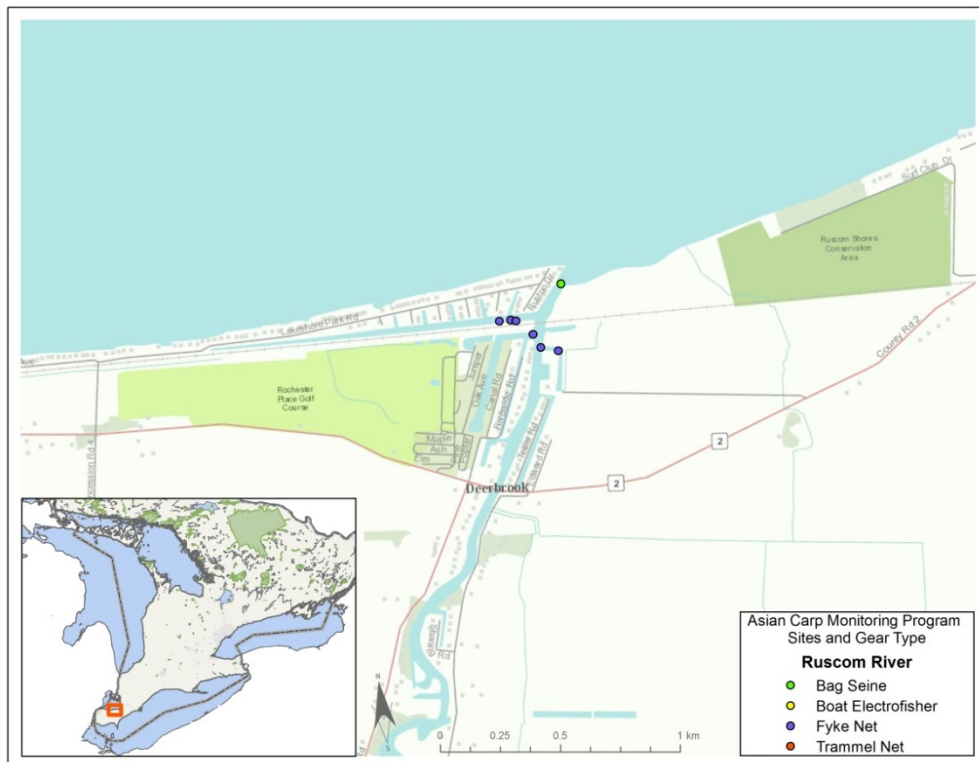
**Figure 8.** 2013 Asian carp early detection surveillance sites in Cedar Creek.



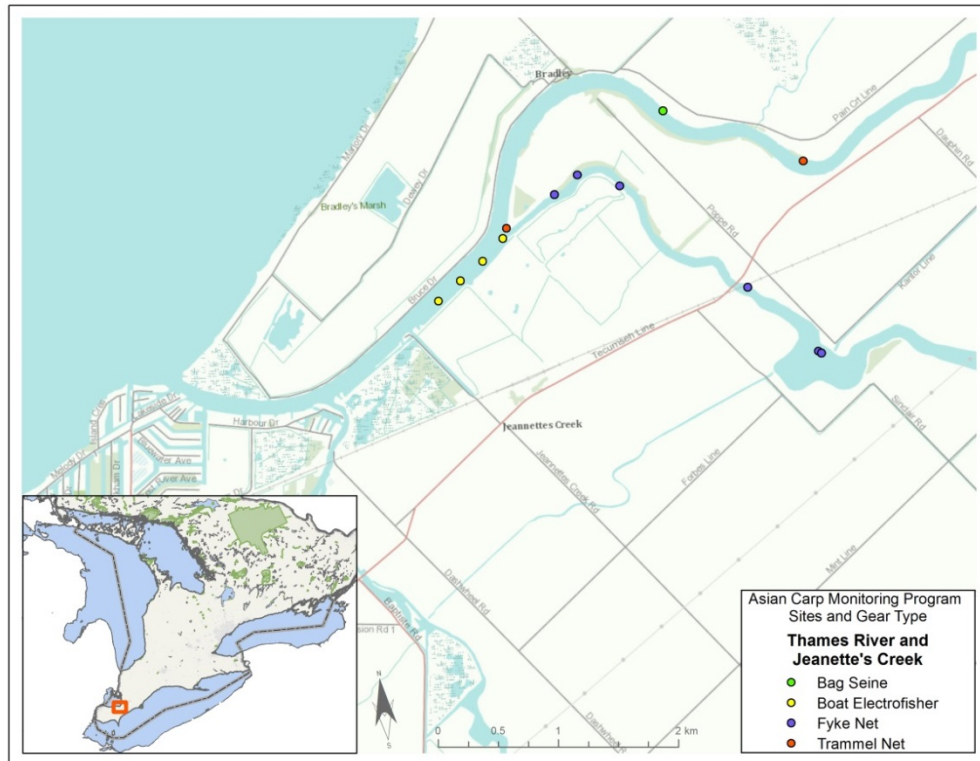
**Figure 9.** 2013 Asian carp early detection surveillance sites in the Lower Detroit River and Canard River.



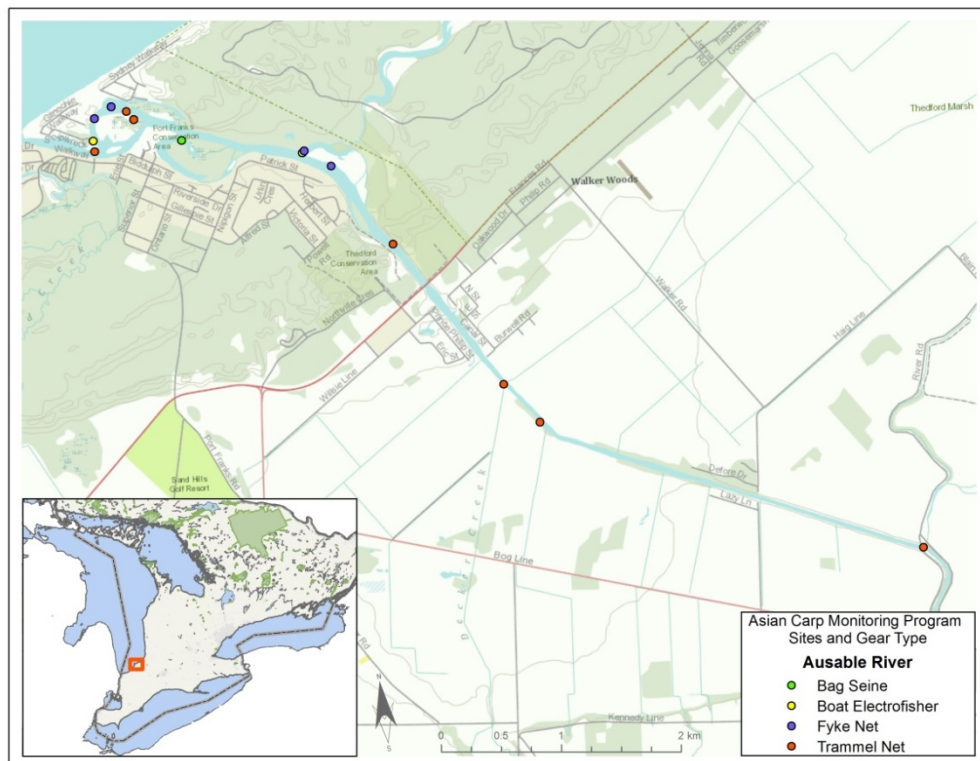
**Figure 10.** 2013 Asian carp early detection surveillance sites in the Upper Detroit River.



**Figure 11.** 2013 Asian carp early detection surveillance sites in Ruscom River.

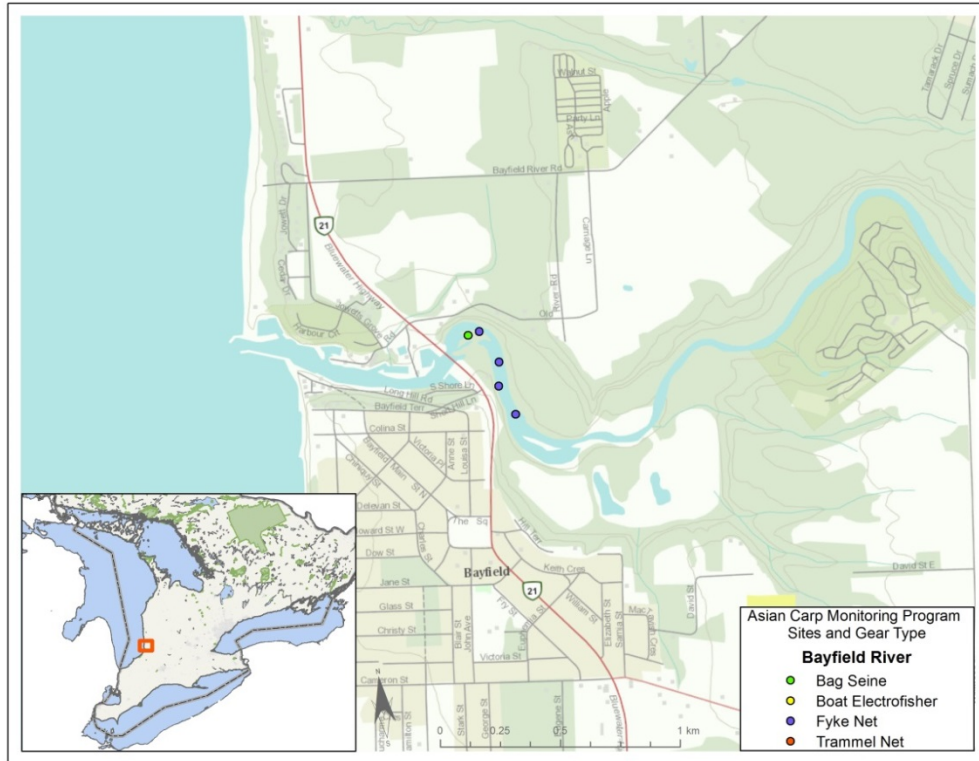


**Figure 12.** 2013 Asian carp early detection surveillance sites in Thames River and Jeanette's Creek.



**Figure 13.** 2013 Asian carp early detection surveillance sites in Ausable River (Burlington and Sault Ste. Marie crews).

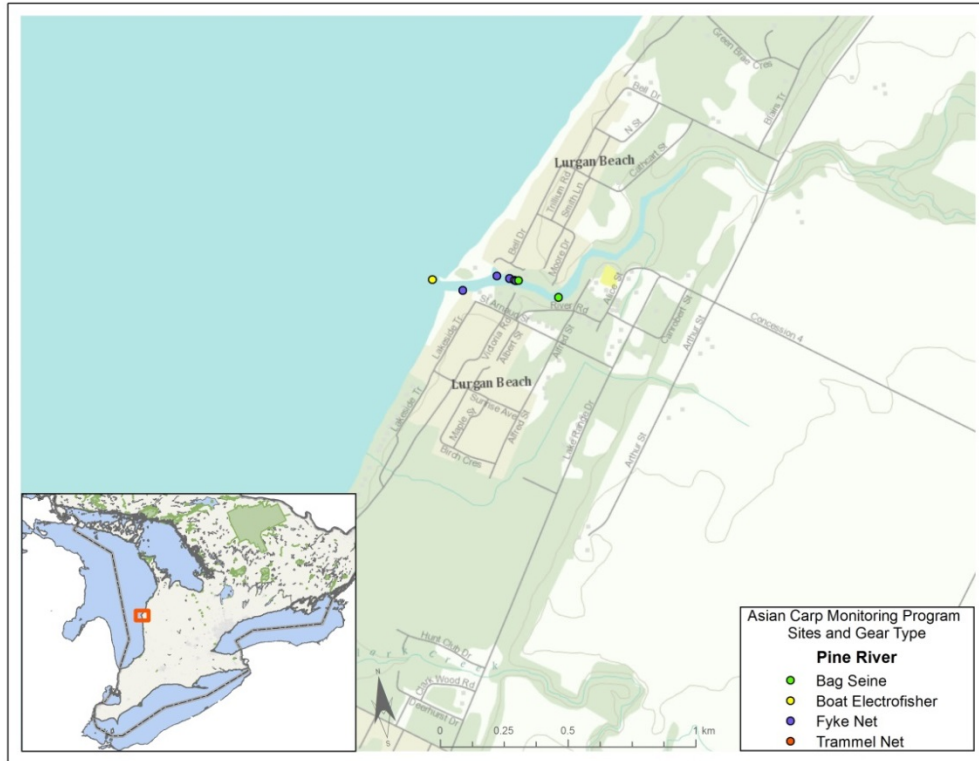




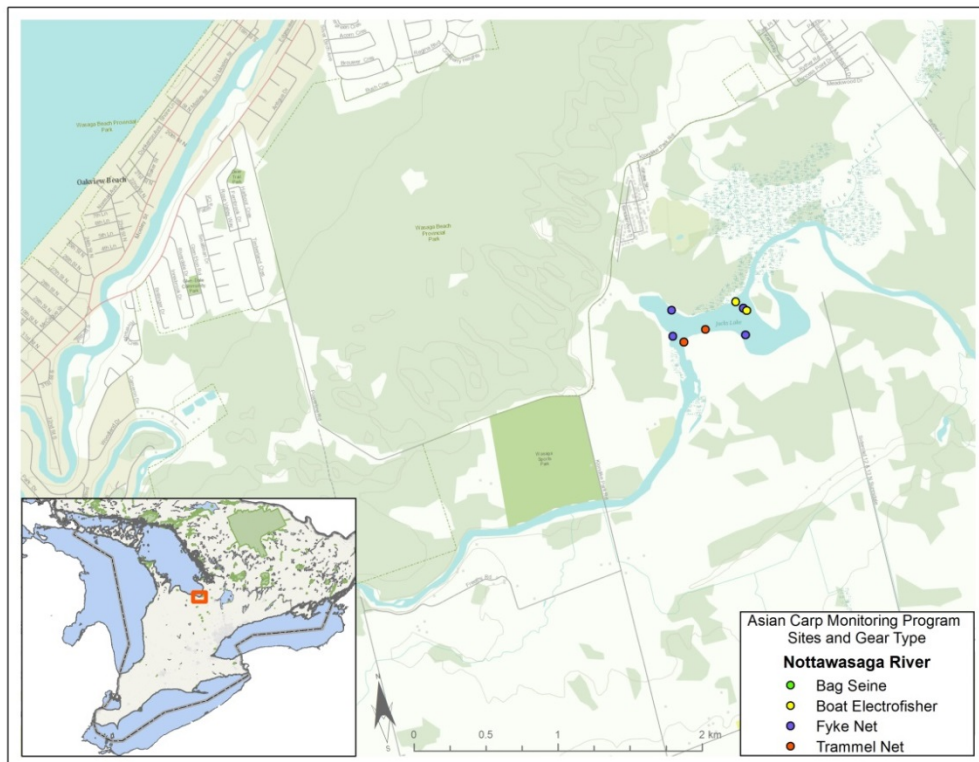
**Figure 14.** 2013 Asian carp early detection surveillance sites in Bayfield River.



**Figure 15.** 2013 Asian carp early detection surveillance sites in Maitland River. The Burlington crew did one seine; other sites were by sampled by Sault-Ste. Marie crews.

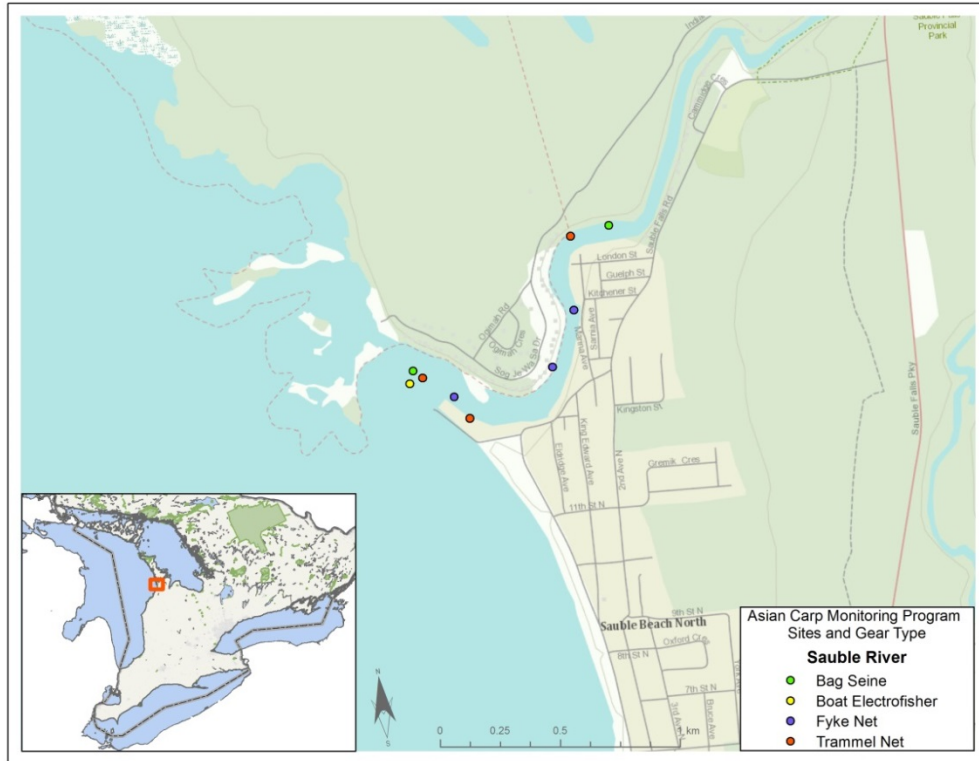


**Figure 16.** 2013 Asian carp early detection surveillance sites in Pine River.

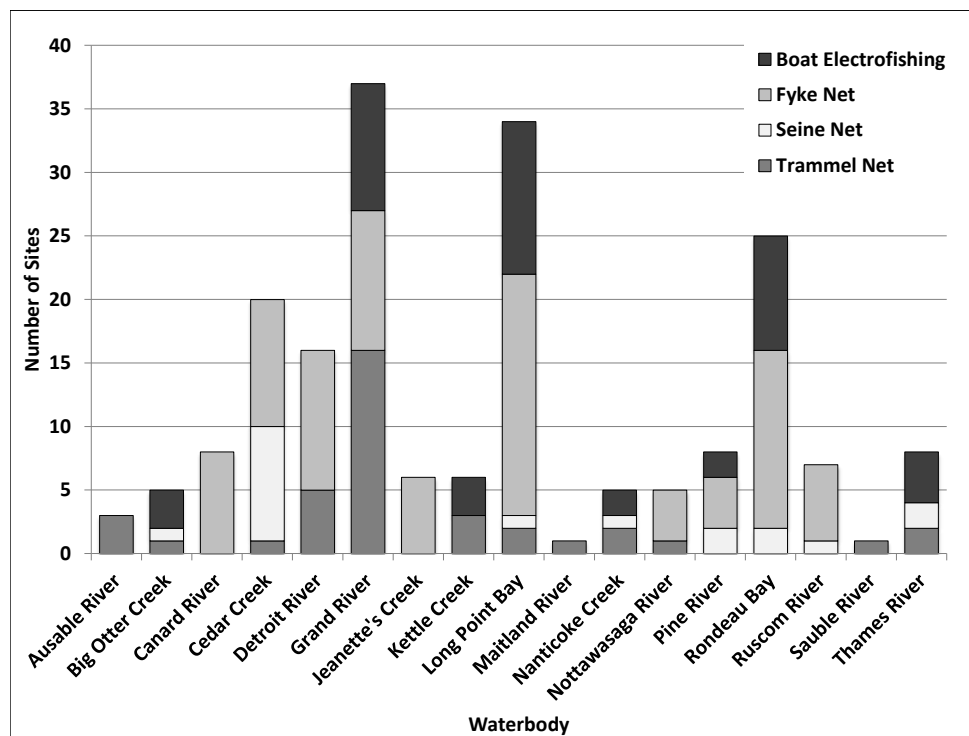


**Figure 17.** 2013 Asian carp early detection surveillance sites in Nottawasaga River (Burlington and Sault Ste. Marie crews).

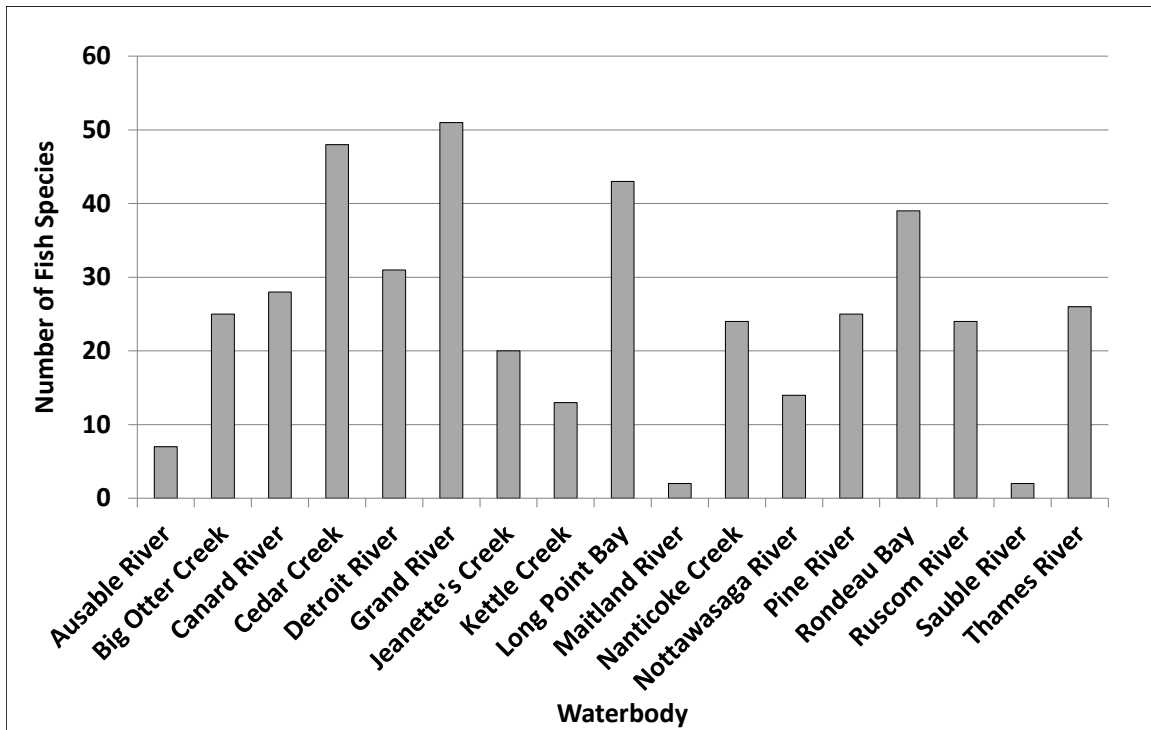




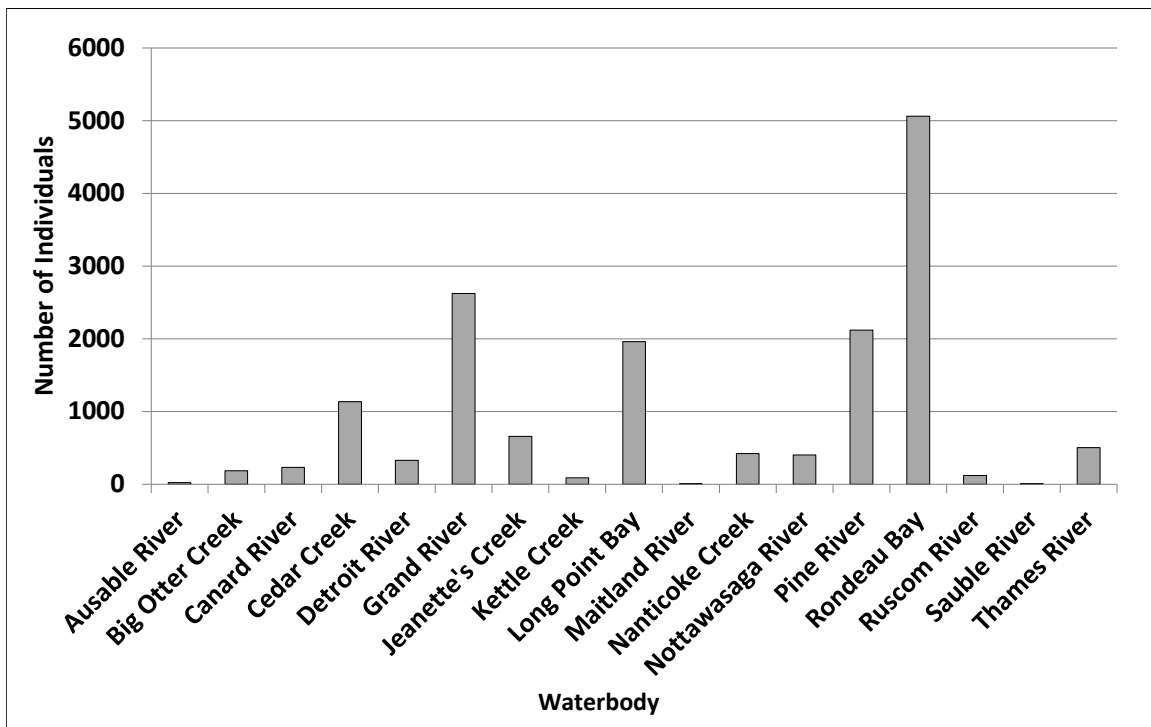
**Figure 18.** 2013 Asian carp early detection surveillance sites in Sauble River. The Burlington crew did one site; other sites were by sampled by Sault-St. Marie crews.



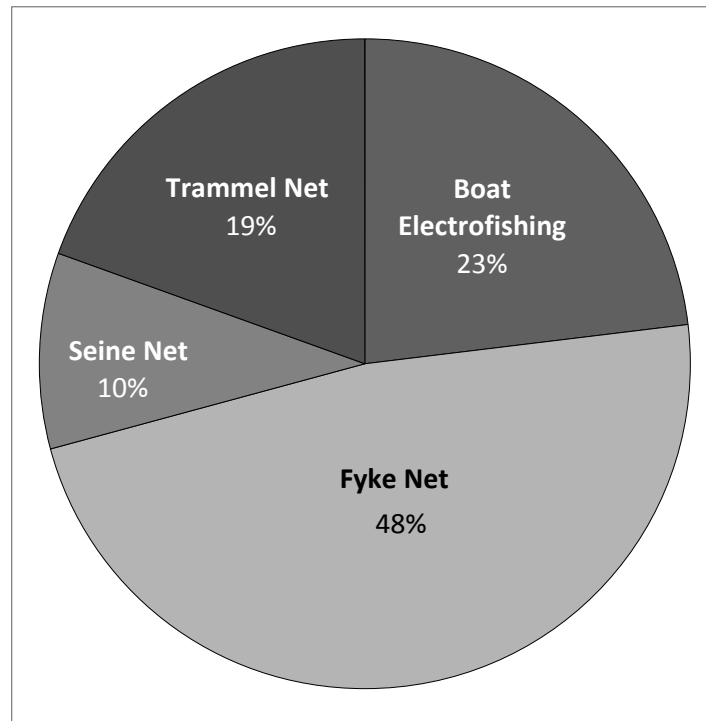
**Figure 19.** Number of sites sampled in each of the 17 waterbodies sampled by gear type during the 2013 Asian Carp Program's early detection surveillance program. The total number of sites sampled in all waterbodies was 195.



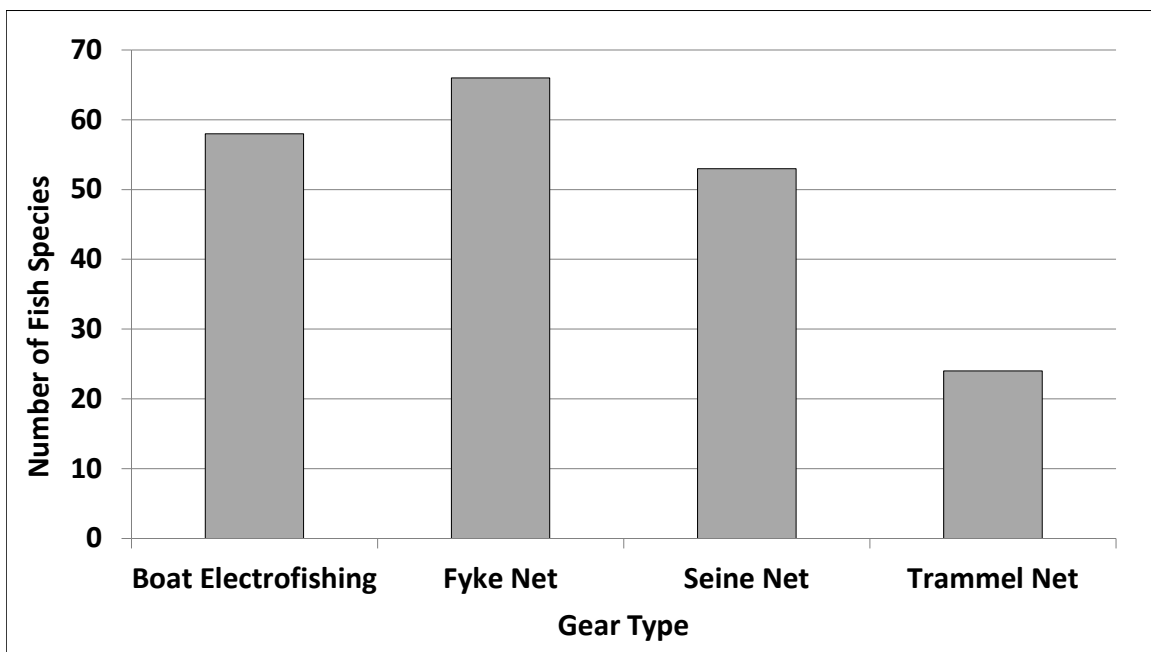
**Figure 20.** Number of fish species caught in each of the 17 waterbodies sampled during the 2013 Asian Carp Program's early detection surveillance program. The total number of species caught in all waterbodies was 90.



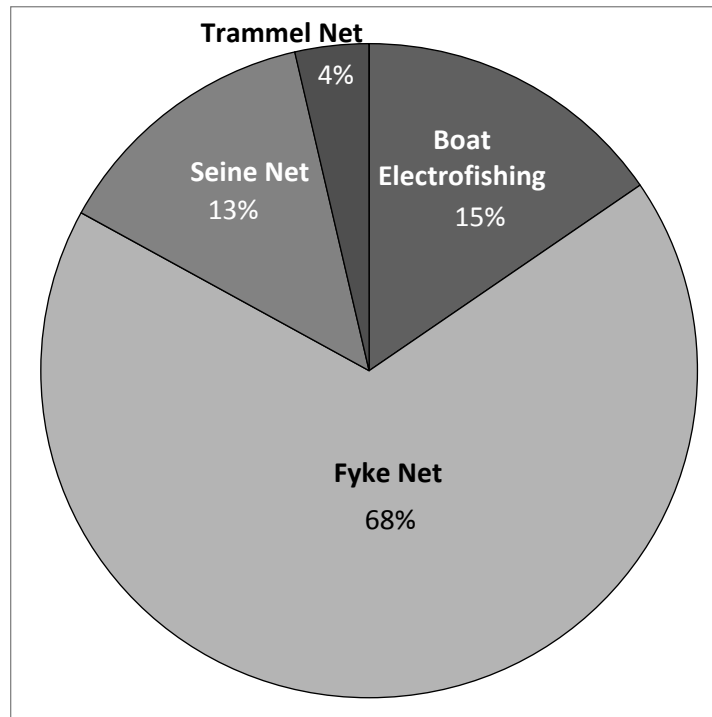
**Figure 21.** Number of fishes caught in each of the 17 waterbodies studied during the 2013 Asian Carp Program's early detection surveillance program. The total number of fishes caught in all waterbodies was 15,849.



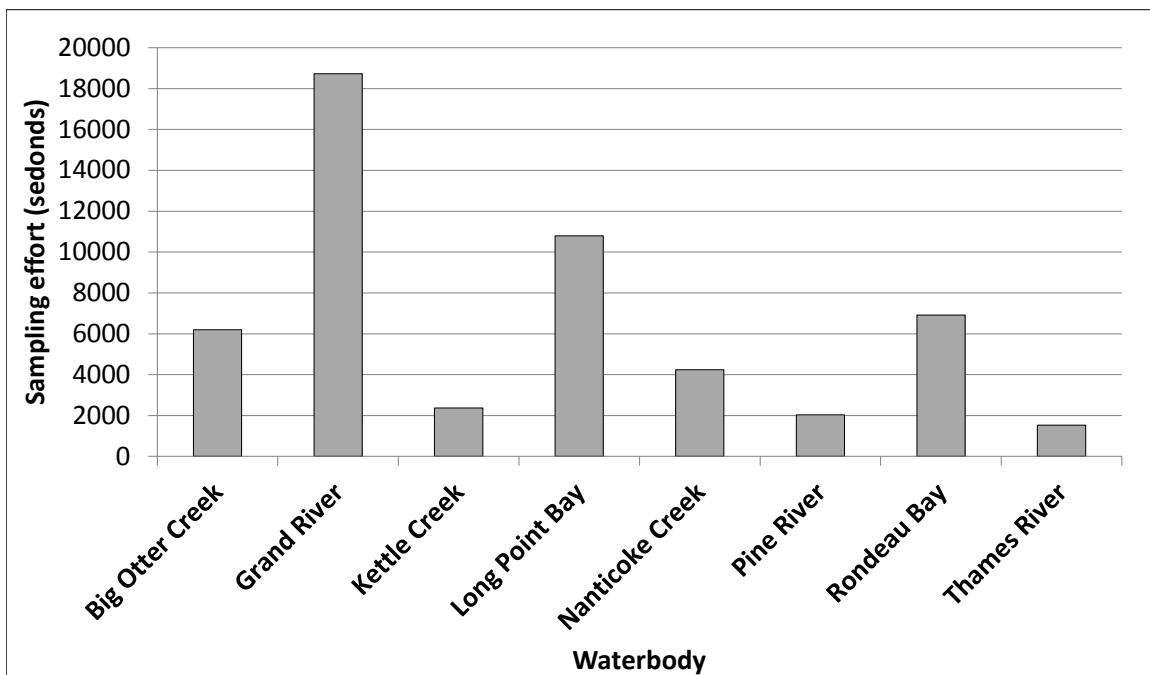
**Figure 22.** Percentage of sites sampled by each gear type for the 2013 Asian Carp Program's early detection surveillance program. The total number of sites sampled by all gear types was 195.



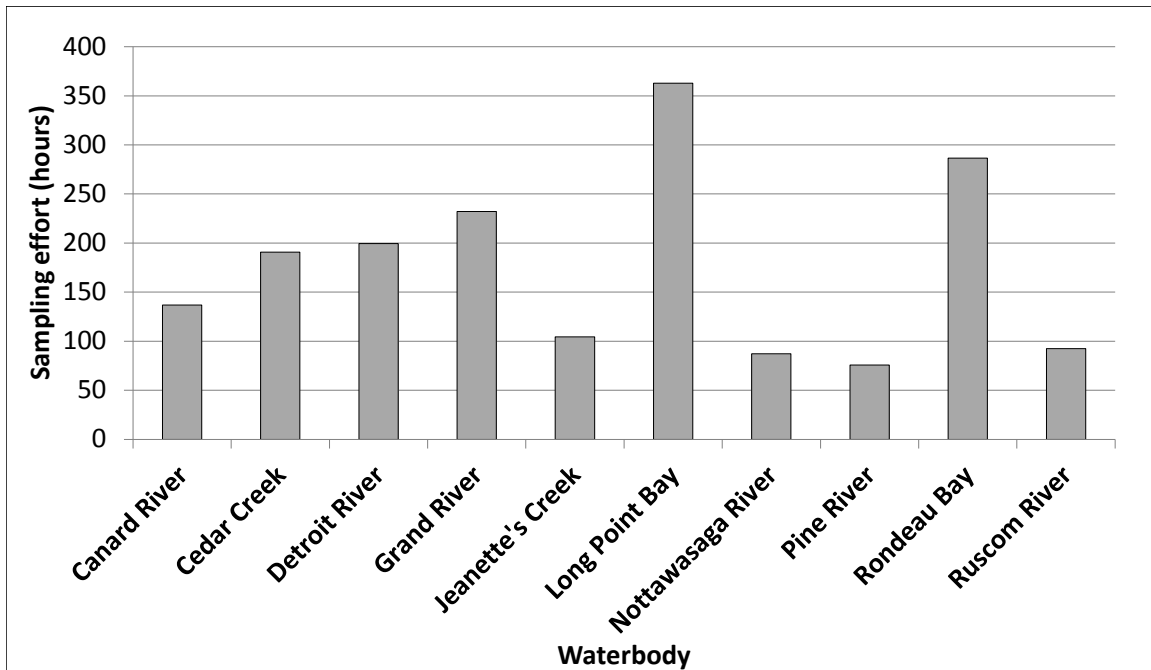
**Figure 23.** Number of fish species caught by each gear type used in the 2013 Asian Carp Program's early detection surveillance program. The total number of species caught by all gear types combined was 90.



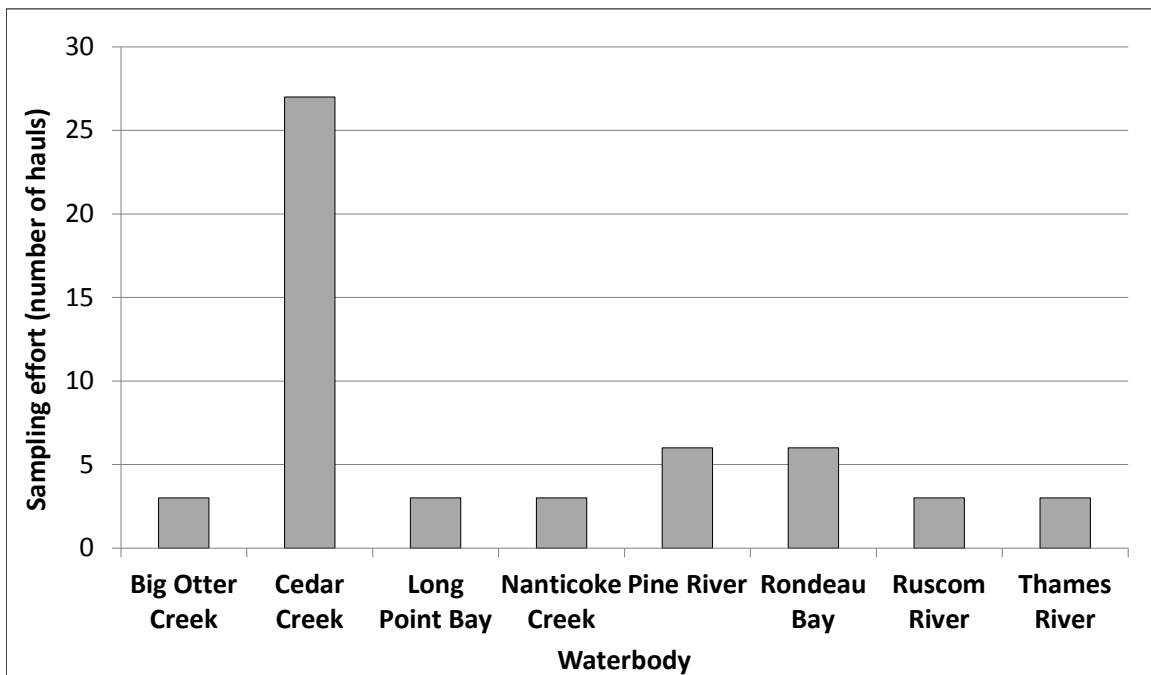
**Figure 24.** Percentage of fishes caught by each gear type in 2013. The total number of fishes caught by all gear types was 15,849.



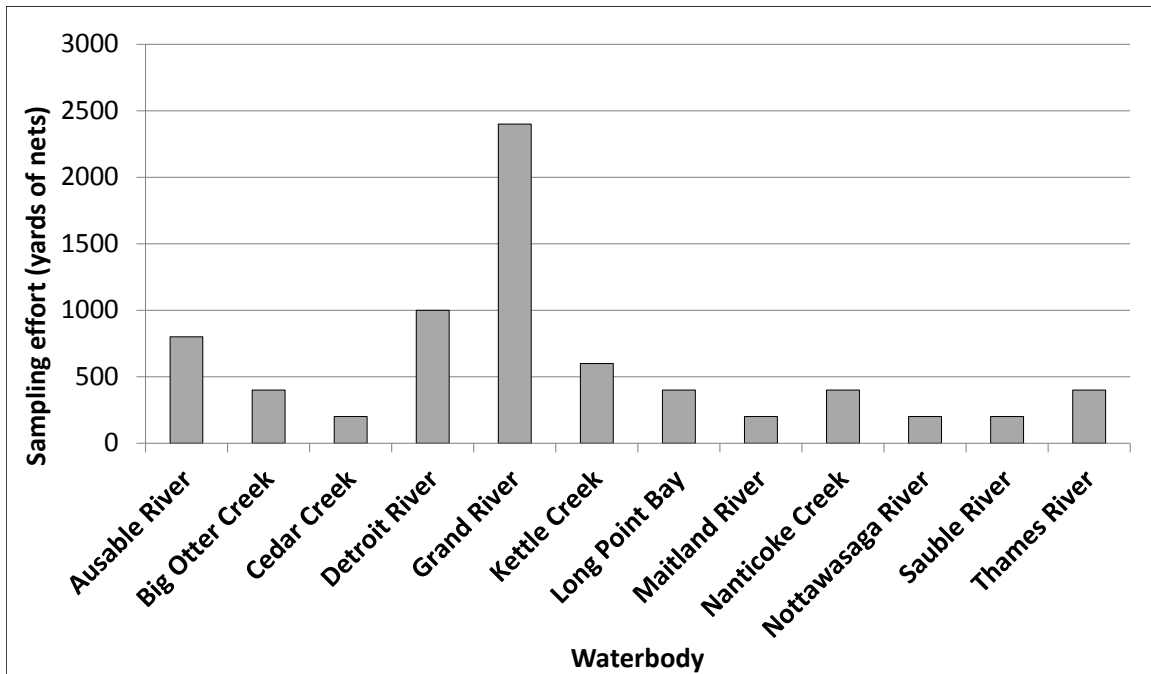
**Figure 25.** Boat electrofisher sampling effort, in seconds, for each of the eight waterbodies sampled in 2013. The total sampling effort with the boat electrofisher was 52,798 seconds.



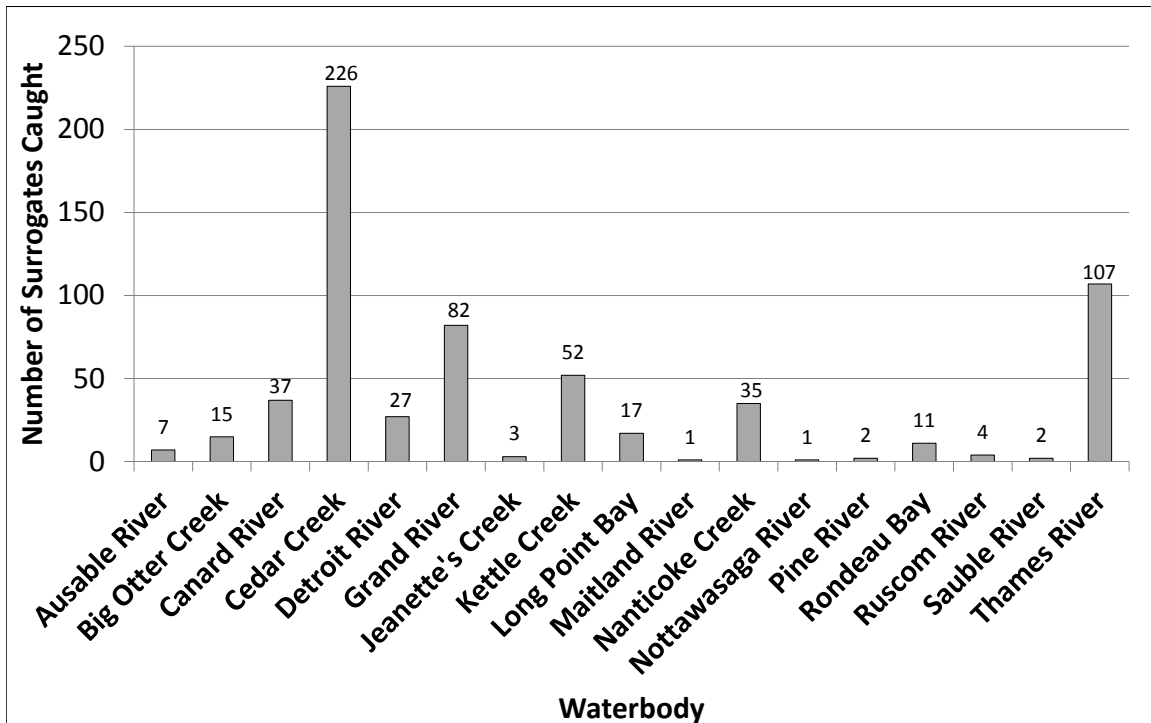
**Figure 26.** Fyke net sampling effort, in hours, for each of the 10 waterbodies sampled in 2013. The total sampling effort with the fyke net was 1768.46 hours.



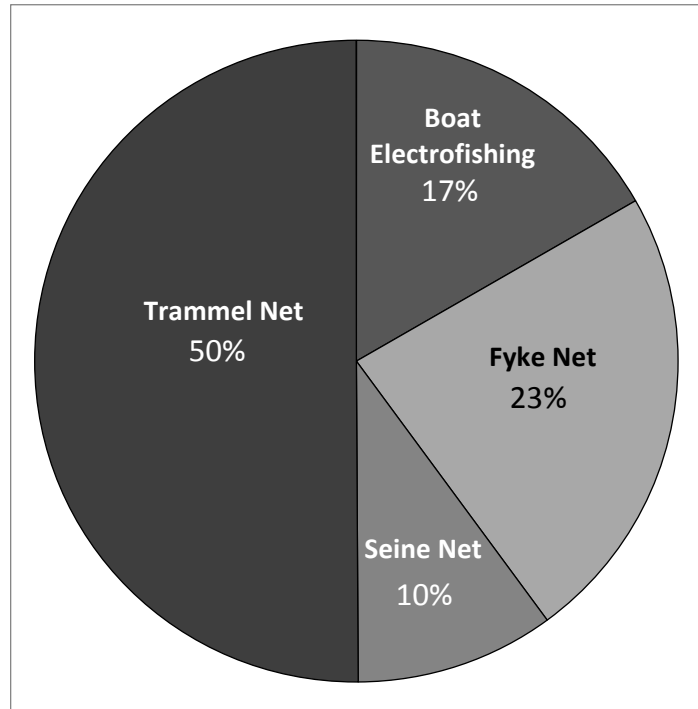
**Figure 27.** Seine net sampling effort, in number of hauls, for each of the eight waterbodies sampled in 2013. The total sampling effort with the seine net was 54 hauls.



**Figure 28.** Trammel net sampling effort, in yards, for each of the 12 waterbodies sampled in 2013. The total sampling effort with the trammel net was 7,200 yards (6,584 m).



**Figure 29.** Number of surrogate fishes caught in each of the 17 waterbodies in 2013. Surrogates include all buffalo species (*Ictiobus* spp.) and Common Carp (*Cyprinus carpio*). The total number of surrogate fishes caught was 629.



**Figure 30.** Percentage of surrogate fishes caught by each gear type in the 2013 early detection surveillance program. Surrogates include all buffalo species (*Ictiobus* spp.) and Common Carp (*Cyprinus carpio*). The total number of surrogate fishes caught was 629.

## TABLES

**Table 1.** Summary of species captured during the 2013 Asian Carp Program early detection surveillance field season. Common and scientific names according to Holm *et al.* 2010 and Nelson *et al.* 2003.

Common Name	Scientific Name	Total # Caught
Alewife	<i>Alosa pseudoharengus</i>	52
Banded Killifish	<i>Fundulus diaphanus</i>	49
Bigmouth Buffalo*	<i>Ictiobus cyprinellus</i>	20
Black Bullhead	<i>Ameiurus melas</i>	32
Black Crappie	<i>Pomoxis nigromaculatus</i>	700
Black Redhorse	<i>Moxostoma duquesnei</i>	5
Blackchin Shiner	<i>Notropis heterodon</i>	290
Blacknose Shiner	<i>Notropis heterolepis</i>	28
Blackside Darter	<i>Percina maculate</i>	5
Bluegill	<i>Lepomis macrochirus</i>	492
Bluntnose Minnow	<i>Pimephales notatus</i>	1195
Bowfin	<i>Amia calva</i>	60
Brook Silverside	<i>Labidesthes sicculus</i>	142
Brown Bullhead	<i>Ameiurus nebulosus</i>	239
Brown Trout	<i>Salmo trutta</i>	3
buffalo species*	<i>Ictiobus</i> sp.	170
bullhead species	<i>Ameiurus</i> sp.	7
catfish species	<i>Ictalurus</i> sp.	11
Central Stoneroller	<i>Campostoma anomalum</i>	1
Channel Catfish	<i>Ictalurus punctatus</i>	107
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	9
Coho Salmon	<i>Oncorhynchus kisutch</i>	2
Common Carp*	<i>Cyprinus carpio</i>	427
Common Shiner	<i>Luxilus cornutus</i>	10
crappie species	<i>Pomoxis</i> sp.	194
Creek Chub	<i>Semotilus atromaculatus</i>	1
darter species	<i>Etheostoma</i> sp.	1
Emerald Shiner	<i>Notropis atherinoides</i>	548
Fathead Minnow	<i>Pimephales promelas</i>	73
Freshwater Drum	<i>Aplodinotus grunniens</i>	93
gar species	<i>Lepisosteus</i> sp.	2
Ghost Shiner	<i>Notropis buchanani</i>	750
Gizzard Shad	<i>Dorosoma cepedianum</i>	1589
Golden Redhorse	<i>Moxostoma erythrurum</i>	39
Golden Shiner	<i>Notemigonus crysoleucas</i>	312
Goldfish	<i>Carassius auratus</i>	170
Goldfish x Common Carp hybrid	<i>Carassius auratus</i> X <i>Cyprinus carpio</i>	26
Grass Carp <sup>†</sup>	<i>Ctenopharyngodon idella</i>	1



Common Name	Scientific Name	Total # Caught
Greater Redhorse	<i>Moxostoma valenciennesi</i>	1
Green Sunfish	<i>Lepomis cyanellus</i>	28
Green Sunfish x Bluegill	<i>Lepomis cyanellus X L. macrochirus</i>	1
herring species	<i>Clupeidae</i>	200
Johnny Darter	<i>Etheostoma nigrum</i>	57
Lake Trout	<i>Salvelinus namaycush</i>	18
Largemouth Bass	<i>Micropterus salmoides</i>	2090
Least Darter	<i>Etheostoma microperca</i>	13
Logperch	<i>Percina caprodes</i>	10
Longear Sunfish**	<i>Lepomis megalotis</i>	2
Longnose Gar	<i>Lepisosteus osseus</i>	58
Mimic Shiner	<i>Notropis volucellus</i>	178
minnow species	<i>Cyprinidae</i>	38
morone species	<i>Morone sp.</i>	24
Northern Hog Sucker	<i>Hypentelium nigricans</i>	1
Northern Pike	<i>Esox lucius</i>	20
Orangespotted Sunfish	<i>Lepomis humilis</i>	55
pimephales species	<i>Pimephales sp.</i>	12
Pugnose Minnow	<i>Opsopoeodus emiliae</i>	3
Pugnose Shiner	<i>Notropis anogenus</i>	7
Pumpkinseed	<i>Lepomis gibbosus</i>	657
Pumpkinseed x Bluegill	<i>Lepomis gibbosus X L. macrochirus</i>	3
Quillback	<i>Carpiodes cyprinus</i>	31
Rainbow Darter	<i>Etheostoma caeruleum</i>	48
Rainbow Trout	<i>Oncorhynchus mykiss</i>	26
redhorse species	<i>Moxostoma sp.</i>	10
River Chub	<i>Nocomis micropogon</i>	1
Rock Bass	<i>Ambloplites rupestris</i>	156
Rosyface Shiner	<i>Notropis rubellus</i>	1
Round Goby	<i>Neogobius melanostomus</i>	602
Rudd	<i>Scardinius erythrophthalmus</i>	4
Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	38
Silver Lamprey	<i>Ichthyomyzon unicuspis</i>	1
Silver Redhorse	<i>Moxostoma anisurum</i>	25
Smallmouth Bass	<i>Micropterus dolomieu</i>	19
Smallmouth Buffalo*	<i>Ictiobus bubalus</i>	2
Spotfin Shiner	<i>Cyprinella spiloptera</i>	810
Spottail Shiner	<i>Notropis hudsonius</i>	193
Spotted Gar	<i>Lepisosteus oculatus</i>	294
Spotted Sucker	<i>Minytrema melanops</i>	6
sucker species	<i>Catostomus sp.</i>	188
sunfish hybrids	<i>Lepomis hybrid</i>	2

Common Name	Scientific Name	Total # Caught
sunfish species	<i>Lepomis</i> sp.	1415
Tadpole Madtom	<i>Noturus gyrinus</i>	32
Walleye	<i>Sander vitreus</i>	17
Warmouth	<i>Lepomis gulosus</i>	12
White Bass	<i>Morone chrysops</i>	27
White Crappie	<i>Pomoxis annularis</i>	59
White Perch	<i>Morone americana</i>	241
White Sucker	<i>Catostomus commersonii</i>	18
Yellow Bullhead	<i>Ameiurus natalis</i>	50
Yellow Perch	<i>Perca flavescens</i>	190
<b>Total Fishes Captured</b>		<b>15,849</b>

\* surrogate species for Asian carps

\*\* Longear Sunfish has recently been renamed Northern Sunfish (*Lepomis peltastes*) in Ontario (Page and Burr 2011).

† one triploid Grass Carp was captured in the Grand River

**Table 2.** Summary of catch data for the 2013 Asian Carp Program.

Catch Data	Total # Fishes Caught
Total number of sites	195
Total number of waterbodies	17
Total species caught	90
Total fishes caught	15,849
Total number of surrogates caught	629
Total number of Asian carps caught	1
Mean fishes caught per waterbody	932.24
Mean fishes caught per site	81.27
Minimum fishes caught per waterbody	2
Maximum fishes caught per waterbody	5062

**Table 3.** Catch data by waterbody for the 2013 Asian Carp Program. Note that the single triploid Grass Carp caught in the Grand River by the Asian Carp Program was outside of routine monitoring.

<b>Waterbody</b>	<b>Total # Fish Species</b>	<b>Total # Fishes</b>	<b>Total # Sites</b>	<b>Total # Surrogates</b>	<b>Total # Asian Carps</b>
Ausable River	7	23	3	7	0
Big Otter Creek	25	183	5	15	0
Canard River	28	230	8	37	0
Cedar Creek	48	1133	20	226	0
Detroit River	31	326	16	27	0
Grand River	51	2622	37	82	1
Jeanette's Creek	20	657	6	3	0
Kettle Creek	13	88	6	52	0
Long Point Bay	43	1959	34	17	0
Maitland River	2	2	1	1	0
Nanticoke Creek	24	419	5	35	0
Nottawasaga River	14	402	5	1	0
Pine River	25	2120	8	2	0
Rondeau Bay	39	5062	25	11	0
Ruscom River	24	118	7	4	0
Sauble River	2	3	1	2	0
Thames River	26	501	8	107	0
<b>Total</b>		<b>15,849</b>	<b>195</b>	<b>629</b>	<b>1</b>

**Table 4.** Summary of catch data by gear type for the 2013 Asian Carp Program. Note that the single triploid Grass Carp caught in the Grand River by the Asian Carp Program was outside of routine monitoring.

<b>Gear Type</b>	<b>Total # Water-bodies</b>	<b>Total # Sites</b>	<b>Total # Fish Species</b>	<b>Total # Fishes</b>	<b>Total # Surrogates</b>	<b>Total # Asian Carps</b>
Boat Electrofisher	8	45	58	2442	105	0
Fyke Net	10	93	66	10712	146	0
Seine Net	8	19	53	2118	63	0
Trammel Net	12	38	25	577	315	1
<b>Total</b>		<b>195</b>		<b>15,849</b>	<b>629</b>	<b>1</b>

**Table 5.** Sampling type and effort by waterbody for the 2013 Asian Carp Program.

<b>Gear Type</b>	<b>Waterbody</b>	<b>Effort</b>	<b>Effort Unit</b>
Boat Electrofisher	Big Otter Creek	6,194	seconds
Boat Electrofisher	Grand River	18,726	seconds
Boat Electrofisher	Kettle Creek	2,371	seconds
Boat Electrofisher	Long Point Bay	10,795	seconds
Boat Electrofisher	Nanticoke Creek	4,237	seconds
Boat Electrofisher	Pine River	2,031	seconds
Boat Electrofisher	Rondeau Bay	6,913	seconds
Boat Electrofisher	Thames River	1,531	seconds
Fyke Net	Canard River	136.8	hours
Fyke Net	Cedar Creek	190.8	hours
Fyke Net	Detroit River	199.5	hours
Fyke Net	Grand River	232.13	hours
Fyke Net	Jeanette's Creek	104.5	hours
Fyke Net	Long Point Bay	362.78	hours
Fyke Net	Nottawasaga River	87.2	hours
Fyke Net	Pine River	75.75	hours
Fyke Net	Rondeau Bay	286.5	hours
Fyke Net	Ruscom River	92.5	hours
Seine Net	Big Otter Creek	3	hauls
Seine Net	Cedar Creek	27	hauls
Seine Net	Long Point Bay	3	hauls
Seine Net	Nanticoke Creek	3	hauls
Seine Net	Pine River	6	hauls
Seine Net	Rondeau Bay	6	hauls
Seine Net	Ruscom River	3	hauls
Seine Net	Thames River	3	hauls
Trammel Net	Ausable River	731.5	metres
Trammel Net	Big Otter Creek	365.8	metres
Trammel Net	Cedar Creek	182.9	metres
Trammel Net	Detroit River	914.4	metres
Trammel Net	Grand River	2,194.6	metres
Trammel Net	Kettle Creek	548.6	metres
Trammel Net	Long Point Bay	365.8	metres
Trammel Net	Maitland River	182.9	metres
Trammel Net	Nanticoke Creek	365.8	metres
Trammel Net	Nottawasaga River	182.9	metres
Trammel Net	Sauble River	182.9	metres
Trammel Net	Thames River	365.8	metres