Results of Fisheries and Oceans Canada's 2015 Asian Carp Early Detection Field Surveillance Program

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RESULTS OF FISHERIES AND OCEANS CANADA'S 2015 ASIAN CARP EARLY DETECTION FIELD SURVEILLANCE PROGRAM

by

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Marson, D., Colm, J. and Cudmore, B. 2018. Results of Fisheries and Oceans Canada's 2015 Asian Carp Early Detection Field Surveillance Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3146: vii+ 63p.

In 2015, DFO's Asian Carp Program continued early detection field surveillance for Asian carps in the Canadian waters of the Great Lakes. Five crews sampled 1,056 sites from spring to fall at 36 locations in the Canadian waters of the Great Lakes and connecting channels. Eight gear types were used, allowing us to target large-bodied and small-bodied fishes in habitats well suited to different life stages of Asian carps. A total of 64,552 fishes were captured, representing 101 species. Surrogate species that share similar habitats and feeding preferences to Asian carps were used to assess the effectiveness of the gear types and sampling techniques. A total of 3,200 Common Carp (*Cyprinus carpio*) and 762 buffalo spp. (*Ictiobus* spp.) were captured in all gears except the trawl. One diploid Grass Carp was captured in a trammel net in Jordan Harbour, Lake Ontario, and intensive sampling yielded no additional Asian carps. In 2016, additional sites in eastern Lake Ontario, the Huron-Erie corridor, and connecting channels of lakes Erie and Ontario will be scouted, and an additional crew will be added to increase the capacity of DFO's Asian Carp Program to detect these invasive species.

RÉSUMÉ

Marson, D., Colm, J. and Cudmore, B. 2018. Results of Fisheries and Oceans Canada's 2015 Asian Carp Early Detection Field Surveillance Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3146: vii+ 63p.

En 2015, le Programme de lutte contre la carpe asiatique du MPO a continué ses activités de surveillance pour la détection rapide sur le terrain des carpes asiatiques dans les eaux canadiennes des Grands Lacs. Du printemps à l'automne, cinq équipes ont échantillonné 1 056 sites à 36 emplacements se trouvant dans les eaux canadiennes des Grands Lacs et les voies interlacustres. Huit types d'engins ont été utilisés, ce qui nous a permis de cibler des poissons de grandes et de petites tailles dans les habitats adaptés aux différents stades biologiques des carpes asiatiques. Un total de 64 552 poissons ont été capturés, soit 101 espèces. Des espèces de substitution partageant des préférences en matière d'alimentation et d'habitat semblables aux carpes asiatiques ont été utilisées pour évaluer l'efficacité des types d'engins et des techniques d'échantillonnage. Un total de 3 200 carpes communes (*Cyprinus carpio*) et de 762 buffalos (*Ictiobus* spp.) ont été capturés avec tous les engins, à l'exception du chalut. Une carpe de roseau diploïde a été capturée à l'aide d'un trémail dans le havre Jordan (lac Ontario), et un échantillonnage intensif n'a pas permis de déceler la présence d'autres carpes asiatiques. En 2016, des sites supplémentaires seront repérés dans l'est du lac Ontario et dans les corridors reliant les lacs Érié-Ontario et Huron-Érié. Une autre équipe sera également ajoutée afin d'accroître la capacité du Programme de lutte contre la carpe asiatique du MPO à détecter ces espèces envahissantes.

INTRODUCTION

The focus of Fisheries and Ocean's Canada's (DFO) Asian Carp Program is to prevent the entry and establishment of Asian carps in the Great Lakes through outreach, early warning, response and management. The Asian Carp Program's early detection surveillance field sampling program was developed in the winter of 2012 and sampling was initiated in the spring of 2013 (Marson et al. 2014). The early warning pillar of the program involves extensive sampling using traditional fisheries sampling gear. The early detection of aquatic invasive species is an essential component for the prevention of their establishment in the aquatic environment, as the sooner a species is detected, the more management response options are available to address the issue (Lodge et al. 2006; Vander Zanden et al. 2010). Using a variety of fish sampling equipment and techniques, the early detection field program surveys sites that have been identified as the most attractive and suitable for Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*), Bighead Carp (*H. nobilis*), and Black Carp (*Mylopharyngodon piceus*), as well as those sites that are at highest risk for arrival and establishment of these species in tributaries of the Canadian side of the Great Lakes (Cudmore et al. 2012). Members of the genus *Ictiobus* and Common Carp (*Cyprinus carpio*) are used as surrogate species to assess the effectiveness of sampling efforts, as they occupy similar habitats and have similar feeding strategies to Asian carp species. From May 25th to October 27th, 2015, 36 wetlands, tributary rivers, and interconnected waters were sampled by the Asian Carp Program's early detection surveillance field program in the Canadian waters of the Great Lakes (Figure 1). The fish community present in each area was sampled, with a focus on the collection of Asian carps and surrogate species.

METHODS

Using environmental conditions and the ecological needs of Asian carps, computer modelling identified areas of the Canadian waters of the Great Lakes most suited to, or attractive to, these species (Cudmore et al. 2012; N.E. Mandrak, 1265 Military Trail, Scarborough, ON, unpublished data). High and medium matches were selected as potential early detection surveillance sampling sites.

In 2015, the focus extended from the sites already selected in the 2013 and 2014 sampling seasons, concentrated in lakes Huron and Erie, to include more surveillance in Lake Ontario. Overall, 36 sites were sampled in 2015. Sites in Duffins Creek, Frenchman's Bay, Point Pelee, Rouge River and Sturgeon Creek were scouted in 2015 and all but Rouge River were sampled to determine their suitability as early detection sites. The Etobicoke Creek, Lake Henry on Pelee Island, Naiscoot River and Hog Creek were dropped from the sampling schedule after 2014 due to poor habitat suitability or access issues. Five field crews operated in 2015, four based out of Burlington, Ontario and one out of Sault Ste. Marie, Ontario.

Eight gear types were used to sample the early detection surveillance sites, including boat electrofishing units, fyke nets, hoop nets, seine nets, tied-down gill nets, trammel nets, trap nets, and trawls. The variety of gear types were used to target both large-bodied and small-bodied fishes in a variety of habitat types. Sampling the full breadth of

the fish community ensured the greatest likelihood of detecting all four species of Asian carps, at both juvenile and adult life-stages. Descriptions of each gear type and their total effort are found below.

BOAT ELECTROFISHER

Boat electrofishing for the 2015 early detection surveillance program was conducted using two sizes of Smith-Root Electrofishing vessels. A Burlington crew operated with a 21' extra-heavy duty model, with a 7.5 kilowatt Generator Powered Pulsator, and dual-anode boom. The Sault Ste. Marie crew and a second Burlington crew operated with the same style of 14' Smith-Root vessel, with a 5.0 kilowatt Generator Powered Pulsator, and dual-anode boom. All crews operated with two netters who would retrieve stunned fishes and transfer them into a live-well in the boat. Sampling effort was recorded in seconds shocked for each site. Electrofishing effort for the Burlington crew was standardized to approximately 600 seconds per site. The Sault Ste. Marie crew shocked for more seconds per site, as the catch rates were lower in the tributaries they were sampling.

FYKE NET SAMPLING

Box fyke nets with a 0.32 mm ace mesh size, 0.61 m hoop diameter, 0.61 m by 4.6 m lead length, and 0.61 m by 1.3 m wing length were deployed. A modification for the fyke nets in 2014 was to add a 10.16 cm square nylon mesh to the net entrance to reduce the catch of large snapping turtles. Fyke nets were set in wadeable habitat (<1.5 m water depth), with low or no flow, and on a variety of vegetation and substrate types. Fyke nets were set with the lead against shore and the net pulled taut perpendicular to the shoreline. When the water depth was greater than the net depth, a float was placed within the bag end of the net (cod-end), to ensure that turtles had access to air. Fyke nets were generally set for close to 24 hours and effort was recorded as the number of hours the net was deployed.

HOOP NET SAMPLING

Six foot diameter hoop nets, with a length of 6.71 m, two funnels and 6.35 cm bar mesh, were used to sample flowing water in depths greater than 3 m. Three foot diameter hoop nets with a length of 4.57 m, two funnels and 2.54 cm bar mesh were incorporated into the 2015 early detection surveillance work as they are less cumbersome to deploy and can be set in shallower flowing waters. Hoop nets were deployed in habitats that could not be sampled by other gear types, due to depth restrictions or flowing water. Hoop nets were set with the open end of the net facing downstream. The cod-end of the net was tied to an anchor that was set upstream, using the flow of the water to keep the net deployed. This gear type is frequently used in efforts in the Mississippi watershed for the removal of Asian carps. When possible, the nets were set for 48 hours. If bad weather or other circumstances precluded a 48 hour set, the nets were fished earlier.

SEINE NET SAMPLING

A bag seine 9.14 m long, 1.52 m tall, with 3.18 mm ace mesh in the bag and 4.76 mm ace mesh on the wings was used for sampling wadeable habitats in low flow, with

moderate vegetation. In flowing waters, seining was performed in the direction of the flow. Captured fishes were transferred into bins filled with water. Water depth and obstructions in the nearshore habitats limited the number of sites that were seined. Seining was used to target small-bodies fishes.

TIED-DOWN GILL NET AND TRAMMEL NET SAMPLING

Tied-down gill nets and trammel nets were deployed and fished in the same manner. The nets were deployed in lengths of either 182.9 m (200 yards) or 274.3 m (300 yards), with inner gill-net mesh sizes ranging from 7.62 cm to 10.16 bar mesh (15.24 cm to 20.32 cm stretch mesh sizes), and net depths of 3 m. The trammel nets differ from the tied-down gill nets in having two additional panels of netting that sandwich the inner gill net panels. The outer netting is 45.72 cm bar mesh nylon netting that works to bag large-bodied fishes in the net (those too large to be gilled in the inner monofilament gill netting). The nets were used to target large-bodied fishes. Trammel and gill nets were set for a short amount of time (approximately 30 minutes) in order to minimize the entanglement time of fishes.

The net is set to the shore and run perpendicular out from shore approximately 20-30 m, the boat is then turned and 120-214 m of net is deployed parallel to shore, and then the final 20-30 m is deployed perpendicular back into shore. This deployment technique blocks fishes into the encircled area. Heavily vegetated areas can be sampled, but the net would have to be deployed on the outer margins of the heavy vegetation so that it would deploy properly and cover the full depth of the water column. Setting the net in very heavy vegetation would limit its effectiveness as the lead-line would not always push through the vegetation, and would be held up off bottom, allowing fishes to escape below the lead-line.

Once the net is set, the crew enter the blocked off area with the boat and use its motor and modified plungers to “pound” the area. By revving the engine, banging the hull of the vessel, or pounding the water’s surface with plungers, the crew actively chases fishes in an attempt to get them to flee into the direction of the net. This method, referred to as “pounding” was developed by researchers working in the Mississippi watershed on the removal of Asian carps, which are known to be net avoidant species (ACRCC 2014). This sampling method provides several advantages over traditional gill netting methods, including reduced set times (reducing stress on captured fishes), increased catch of sedentary fishes, and allows for an increased number of sites to be sampled per day. Sampling effort was recorded as both the length of the net used and the amount of time (in minutes) the net was fully deployed, to the point where crews starting pulling the net back into the boat.

TRAP NET SAMPLING

Trap nets, with a mesh size of 2.54 cm, 1.2 m depth, 27.43 m long lead, and two wings 3 m long by 1.2 m deep were used to sample areas with low to no flow, and on a variety of substrate types. Trap nets were set in similar habitats as fyke nets, but the coarser mesh and larger net size targeted larger-bodied fishes. Trap nets required deeper water than fyke nets in order to deploy properly (minimum 1.2 m set depth). They were set with the lead attached to shore. The net was pulled taut and deployed perpendicular to

the shoreline. A float was added to the net to provide access to the surface for any captured turtles. Trap nets were set for approximately 24 hours and effort was recorded as the number of hours the net was deployed. Trap nets were introduced by the Burlington sampling crews, who had the vessel capacity in 2014 to set and fish the nets.

TRAWL SAMPLING

A 2.5 m Missouri trawl was used to sample fishes in areas where water clarity and depth minimized the effectiveness of other sampling gears such as fyke nets, tied-down gill nets, and trammel nets. Bottom trawling occurred primarily in Lake Huron and Lake Superior sites. The Missouri trawl was towed from the bow of the vessel in a downstream direction for approximately 100 m. The trawling speed was adjusted to ensure that the trawl did not dig into soft substrate, but stayed on bottom for proper collection of fishes. A small mesh size of 3.18 mm ace mesh was used to capture smaller bodied fishes.

FISH AND HABITAT DATA COLLECTION

Captured fishes were identified, measured, photographed, and returned to the water near the site of capture. Voucher specimens were preserved in 10% formalin for species requiring laboratory verification (based on DFO vouchering protocols). GPS coordinates and habitat data, including water and air temperature (°C), dissolved oxygen (mg/L), conductivity (µS/cm), pH, turbidity (NTU), wind speed (Km/h), water depth (m), sampling distance from shore (m), substrate percent composition (Wentworth Scale) and aquatic vegetation type and percent cover, were recorded for each site.

RESULTS

DFO's Asian Carp field program sampled 1,056 sites in tributaries and wetlands in Canadian waters of the Great Lakes using eight different gear types (Figures 1-37, Tables 1-3). The greatest number of sites sampled in a waterbody was the Grand River, where 187 sites were sampled (second greatest was Cedar Creek with 80 sites), and the lowest number of sampling sites in a waterbody was Duffins Creek where only two sites were sampled (Figure 38, Table 4).

During the 2015 early detection surveillance sampling, a total of 64,552 fishes were collected representing 101 species (Tables 1-2). The mean number of fishes captured per waterbody was 1,793.11 and the mean number of fishes captured per site was 61.30 (Table 1). The most fishes were captured in the Grand River (12,629), and the least were captured in Sturgeon Creek (3). The mean number of species captured per waterbody was 29, while the mean number of species per site was 6. The greatest species richness was observed in the Grand River with 50 species, and the lowest was in Sturgeon Creek with two species (Table 4). The most abundant species captured were Gizzard Shad with 10,928 individuals (17% of all fishes captured), Emerald Shiner with 6,680 individuals (10%), Bluegill with 5,072 individuals (8%), Mimic Shiner with 4,370 individuals (7%), and Yellow Perch with 3,869 individuals (6%) captured.

Boat electrofishing was the most used gear type, with 404 sampling sites (Figure 39, Table 4). Seine nets and hoop nets were the least deployed gear types, used at 20 and 27 sites, respectively. Seine netting was the most efficient gear type, though, with approximately 256 fishes captured per site, while hoop nets were the least efficient gear type, capturing approximately 3 fishes per site. The most fishes and species were captured boat electrofishing (26,985 fishes and 92 species), trammel and gill nets caught the fewest species (15 each), while hoop nets caught the fewest fishes (80 fishes) (Figures 40-41).

Habitat data were collected at all 1,056 sites (D. Marson, 867 Lakeshore Rd. Burlington, ON, unpublished data); however the results are outside the scope of this report.

BOAT ELECTROFISHER

Boat electrofishing was conducted at 404 sites in 34 waterbodies (Figure 39). A total of 272,034 seconds (75.57 hours) of shocking effort was conducted (Table 3), with an average of 678.4 seconds per site. The greatest amount of shocking effort was conducted in the Grand River, where 54,624 seconds of shocking effort were completed, while the least shocking was done in the Bayfield River, where 1,200 seconds were completed (Table 5).

A total of 26,985 fishes were captured representing 92 species using this gear. A total of 1,052 Common Carp and 184 buffalo species (surrogate species) were captured (Figures 40-43, Table 3).

FYKE NET

Fyke nets were fished at 207 sites in 28 waterbodies (Figure 39). A total of 4,338.90 hours of fishing were completed by fyke nets (Table 3), with an average of 21.59 hours per site. The greatest amount of fyke net effort was deployed in the Grand River with 543.55 hours across 27 net sets, and the least amount of effort was deployed in Serpent River, with 38 hours over two fyke net sets (Table 5).

Fyke nets successfully captured fish during every set. A total of 19,549 fishes representing 78 species were captured in fyke nets, including 82 Common Carp and one buffalo (Figures 40-43, Table 3).

HOOP NETS

Hoop nets were fished at 27 sites in seven waterbodies (Figure 39). Hoop nets were set for a total of 1,033.72 hours (Table 3), with a mean set time of 39.76 hours per site. The greatest amount of hoop net effort was deployed in the Grand River, with 348.3 hours across eight sites, and the least amount of effort was deployed in Kettle Creek with 20.0 hours at one site (Table 5).

A total of 80 fishes representing 23 species were captured in hoop nets, including four Common Carp and two buffalo spp. (Figures 40-43, Table 3).

There were few differences between the two sizes of hoop nets deployed in 2015. The three foot diameter nets were set at 19 sites and captured 40 fishes from 11 species (including Common Carp); no fishes were captured in nine of the sets. The six foot diameter nets were set at eight sites, captured 40 fishes from five species (including Common Carp and buffalo species), and failed to catch fish at five of the set sites.

SEINE NET

Seine netting was conducted at 20 sampling sites in seven waterbodies (Figure 39). A total of 45 seine hauls were conducted (Table 3), with a mean of 3 hauls per site. The greatest amount of seining effort took place in the Grand River with 12 seine hauls over four sites. The least amount of seining effort occurred in the Goulais River, with two seine hauls at two sites (Table 5).

Seine nets successfully captured fish at every site. A total of 5,128 fishes were captured representing 40 species, including two Common Carp (Figures 40-43, Table 3).

TIED-DOWN GILL NET

Tied-down gill nets were used to sample 71 sites in 17 waterbodies (Figure 39). Tied-down gill nets were set for a total of 2,018.49 minutes (33.64 hours) (Table 3), with a mean set time of 28.84 minutes per site. The greatest amount of sampling effort with tied-down gill nets occurred in the Grand River with 475 minutes of set time and 1,646 m of net across nine sites. The least amount of tied-down gill netting occurred in Long Point Bay, with 24 minutes and 183 m of net at one site (Table 5).

A total of 1,771 fishes representing 15 species were captured in tied-down gill nets. A total of 1,078 Common Carp and 273 buffalo spp. were captured in this gear (Figures 40-43, Table 3).

TRAMMEL NETS

Trammel nets were used to sample 108 sites in 23 waterbodies (Figure 39). Trammel nets were set for a total of 3,975.31 minutes (66.26 hours) (Table 3), with a mean set time of 36.81 minutes. The greatest amount of trammel net effort was deployed in the Grand River, with 739 minutes of sampling and 5,121 m of net across 26 sites. The least amount of effort was 10 minutes with 183 m of net in the Magnetawan, Mississagi, Nottawasaga, Serpent and Shebeshekong rivers at one site each (Table 5).

A total of 493 fishes representing 15 species were captured in trammel nets, including 187 Common Carp, 187 buffalo spp. and one Grass Carp during regular surveillance efforts (Figures 40-43, Table 3).

TRAP NETS

Trap nets were fished at 162 sites in 28 waterbodies (Figure 39). Trap nets fished for a total of 3,381.01 hours (Table 3), averaging 20.87 hours per site. The greatest amount of trap net fishing occurred in the Grand River, with a total of 465.9 hours of fishing

across 23 sites, while the least amount of trap net fishing occurred in the Serpent River, with a total of 18.0 hours at one set site (Table 5).

A total of 7,538 fishes representing 39 species were captured, including 795 Common Carp and 115 buffalo species (Figures 40-43, Table 3).

TRAWL

A trawl net was used to sample 57 sites in 10 waterbodies (Figure 39). A total of 186 hauls of trawling took place (Table 3), averaging 3 hauls per site. The greatest amount of trawling effort was employed in the Grand River, with 45 hauls across 12 sites, while the least effort was employed in the Coldwater River with nine hauls at three sites (Table 5).

A total of 3,008 fishes were captured representing 28 species. No surrogate species were detected with this gear type (Figures 40-43, Table 3).

SURROGATE SPECIES

All species of the genus *Ictiobus* (buffalo species) in the sucker family were considered surrogates for Bighead and Silver carps during the 2015 early detection surveillance program due to shared habitat and food preferences. A total of 762 buffalo species were captured during the 2015 sampling season (Tables 1-2). The greatest number was captured in the Thames River, where 152 were captured. Buffalo species were only captured in 13 of the waterbodies sampled (Table 4).

Tied-down gill nets caught the most buffalo spp. with 273 (36%), and trammel nets caught the next most, with 187 (25%). Buffalo species were not collected in the seine or trawl (Figures 42, Table 3).

Common Carp was also used as a surrogate species, primarily for Grass Carp. The detection of Common Carp illustrated that the sampling efforts were successful in detecting large-bodied, highly mobile fishes. A total of 3,200 Common Carp were captured during the 2015 sampling season. The greatest number of Common Carp was captured in Cedar Creek, where 1,246 were captured. Common Carp was detected in 30 waterbodies sampled (Table 4); it was not detected in tributaries or bays of Lake Superior or some parts of Georgian Bay.

Tied-down gill nets were the most effective gear type for catching Common Carp, as 1,078 (34%) individuals were captured in this gear; boat electrofishing was the next most effective gear type, catching 1,052 (33%) of the Common Carp. Common Carp was detected in all gear types except the trawl (Figures 43; Table 3).

ASIAN CARPS

On August 26, 2015, during the 2015 early detection surveillance program, field crews captured one Grass Carp in Jordan Harbour in a trammel net (Tables 1-4). Located in Lincoln, Ontario, Jordan Harbour is a large wetland habitat that drains into Lake Ontario.

The Grass Carp was 1,048 cm in total length, weighted 16.68 kg, and was diploid (capable of reproducing). The fish was captured at a depth of 1.4 m in an area with no aquatic vegetation. The fish was captured in a 183 m (200 yard) trammel net with 10 cm (4”) bar mesh that was set for 116 minutes, and was captured within 73 m of shore.

Following the capture of the Grass Carp, rapid response efforts were initiated on August 27, 2015. Two crews from Burlington blocked off Jordan Harbour and set 33 trammel net sets totalling 6,949.4 m of net and approximately 900 minutes of set time. Additionally, 18,000 seconds of boat electrofishing were conducted. Efforts resulted in the capture of 23 buffalo species, 38 Common Carp and five other large-bodied fishes by one netting crew (fishes captured by second netting crew and electrofishing crew were not recorded). The entire area of Jordan Harbour was intensely sampled and no additional Grass Carp were captured, thus, the rapid response was called off.

SUMMARY

In 2015, DFO’s Asian Carp Program early detection surveillance crews sampled in 36 waterbodies identified as highly suitable or high risk for entry of Asian carps. Sites were scouted in Duffins Creek, Frenchman’s Bay and Rouge River, which will be added to the early detection surveillance schedule in 2016. Point Pelee and Sturgeon Creek were also scouted in 2015 but were unsuitable for further sampling. Sites sampled in 2014 that were found to be unsuitable, including Etobicoke Creek, Lake Henry, Hog Creek, and Naiscoot River, were removed. One-thousand and fifty-six sites were sampled in 2015 using eight gear types targeting both large and small-bodied fishes in a variety of habitats. A total of 64,552 fishes were captured, representing 101 species. Surrogate species (Common Carp and buffalo spp.) were captured in all gear types except the trawl, but catches were low (i.e. two to six individuals) in the seine and hoop nets as well. Crews captured 762 *Ictiobus* spp. in 13 waterbodies either tributary to, or in lakes Erie, Huron, Ontario and St. Clair proper; and 3,200 Common Carp in 30 waterbodies including tributaries and connecting channels to all the Great Lakes except Lake Superior. In addition to catching 3,962 surrogates to Asian carps, a Grass Carp was captured in Jordan Harbour in August 2015, suggesting that our gear types are sampling effectively in the desired habitats, and that Asian carps should be detected if they are present.

The same gear types were used in 2015 as in 2014 (Marson et al. 2016), with the addition of a smaller, 3’ hoop net. The 6’ hoop nets can be cumbersome and difficult to deploy, but are the most effective gear type for targeting deep, medium to fast flowing stretches of river. There were few differences in the fishing effectiveness between the two sizes of hoop net. The smaller net detected more species of fish than the larger, but a greater number of fishes were captured in the larger net; the failure rate (no fishes captured) was approximately equal for both sizes, about 50%. Despite the smaller nets being easier to deploy, the use of both sizes of net continued (and will continue) to be limited to locations where other gear types would be unsuitable. Similarly, the use of seine nets was restricted to a few waterbodies that had wadeable, nearshore habitats with low flows and were relatively free of snags. Trawls continued to be used only in northern rivers where the water clarity reduces the success of gill and trammel nets.

Hoop nets, seining, and trawling were not overly effective at detecting surrogate species, but continue to be important for assessing community structure, particularly in habitats that are challenging to sample with other gears. Additionally, their use may become more important if juvenile Asian carps are detected or expected.

One challenge that arose while sampling in 2015, was that the 3 m tall trammel nets and tied-down gill nets were not tall enough to effectively sample the water column at deeper sites, and may have allowed fish to escape beneath the lead line. A taller, 4.2 m trammel net will be incorporated in 2016 to be used at these deeper sites.

Of note, a Grass Carp was captured during the 2015 early detection surveillance program in Jordan Harbour. This fish was captured in a trammel net set 73 m from shore. Despite much of the wetland habitat in Jordan Harbour being heavily vegetated, this fish was captured in an area devoid of vegetation. Intensive sampling followed the capture of this Grass Carp and no additional Asian carps were detected. This was the third Grass Carp captured during early detection surveillance efforts, and all were captured in trammel nets.

Following the capture of three Grass Carp in the Grand River in 2013 (n=2) and 2014 (n=1) (Marson et al. 2014, Marson et al. 2016), this waterbody continued to be a focus in the 2015 early detection surveillance program. All three Grass Carp were captured under the bridge at Highway 3, and this site was sampled most intensely. Given the length of time between these captures and the uncertainty surrounding the origins of these fish, the Grand River (and particularly the bridge site) will continue to be targeted at a greater rate than other sites in 2016.

It should be noted that other Grass Carp were captured in Ontario in 2015 by several agencies and private ventures. Each of these captures resulted in response efforts by DFO's Asian Carp Program and partner agencies, and several of these responses resulted in the capture of additional Grass Carp. Notably, five Grass Carp were captured in the Toronto Islands during two separate responses, both initiated by the capture of a single Grass Carp by the Toronto and Region Conservation Authority (TRCA). In 2016, TRCA will monitor these and other riverine habitats in their watersheds following DFO's protocol for early detection surveillance of Asian carps. DFO'S Asian Carp Program will also scout sites in the Bay of Quinte and tributary rivers (including the Napanee, Salmon and Trent rivers), and the Welland and Niagara rivers in 2016 as a result of captures of Grass Carp in 2015. Lastly, a sixth sampling crew, to be based out of Burlington, will be added in the summer of 2016 to increase the program's capacity to detect Asian carps, particularly during the summer months when water temperatures in Ontario reach a critical value at which spawning is predicted to be initiated and eggs successfully incubated (Kolar et al. 2007, Kocovsky et al. 2012).

The Asian Carp Program will continue to adapt its early detection surveillance field work to accommodate new information on the life history of Asian carps and potential new locations that are identified, in order to prevent the arrival, establishment and spread of Asian carps in Canadian waters.

ACKNOWLEDGMENTS

We thank the 2015 summer and fall field staff for the Asian Carp Program. From Burlington: D'Arcy Campbell, Erin Gertzen, Alex Price, Rebecca Aucoin, Stephanie Best, Brianna Bomback, Caitlyn Bondi, Jordan Boudreau, Alex Buse, Monica Choy, Katelynn Crawford, Sydonie Epifani, Vincent Frasca, Danielle Hosick, Colin Iles, Aaron Law, Ola Panczyk, Edyta Ratajczyk, Johnathon Seguin, and Elaine Su; and from Sault Ste. Marie: Lisa O'Connor, Bill Gardner, Tom Pratt, Erin Budgell, Trevor Plumley, Marla Thibodeau, Evan Timusk, and Evan Wrigley. This work was funded through the DFO Asian Carp Program.

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FIGURES

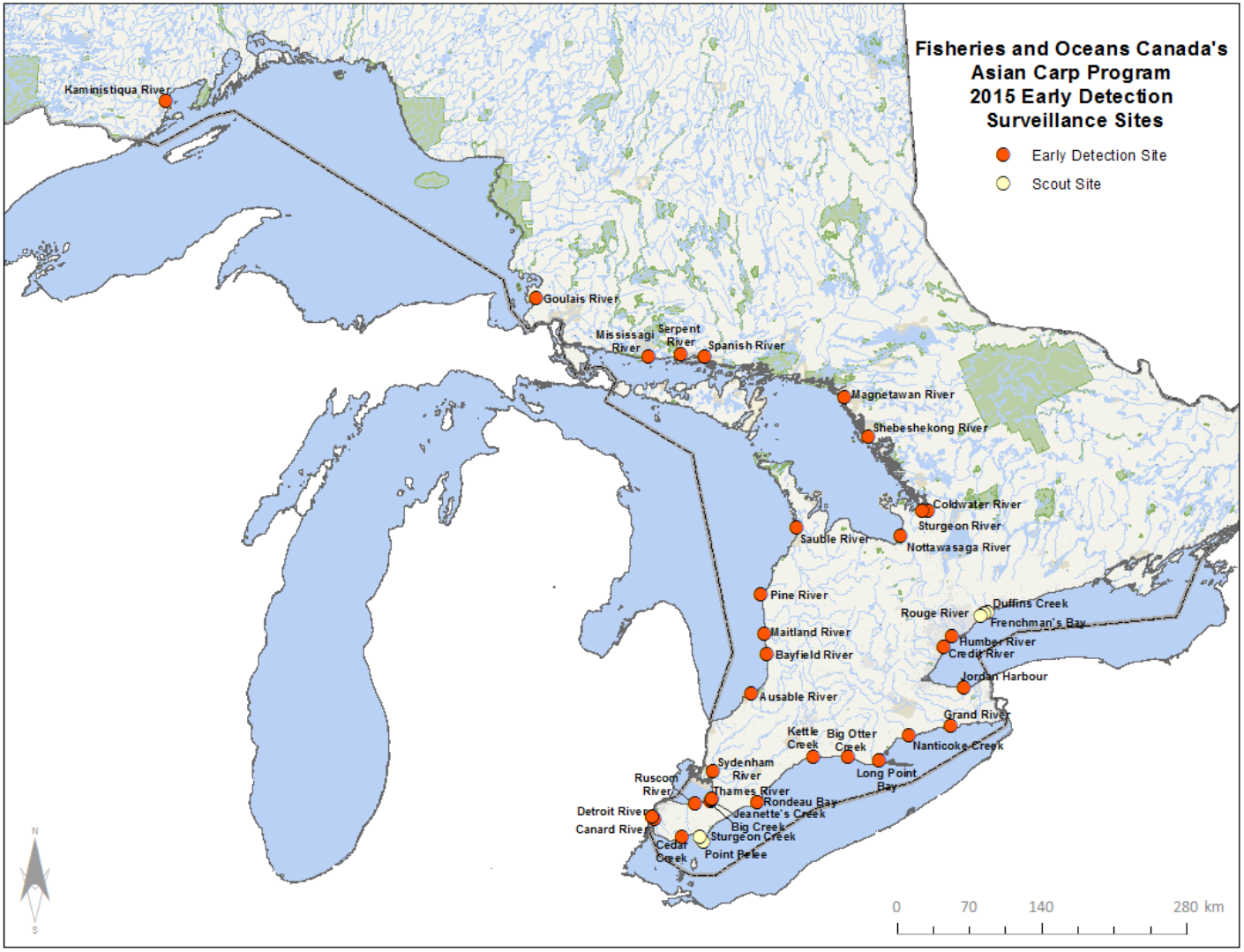

Figure 1. 2015 Asian Carp Program early detection surveillance sites on the Canadian side of the Great Lakes.

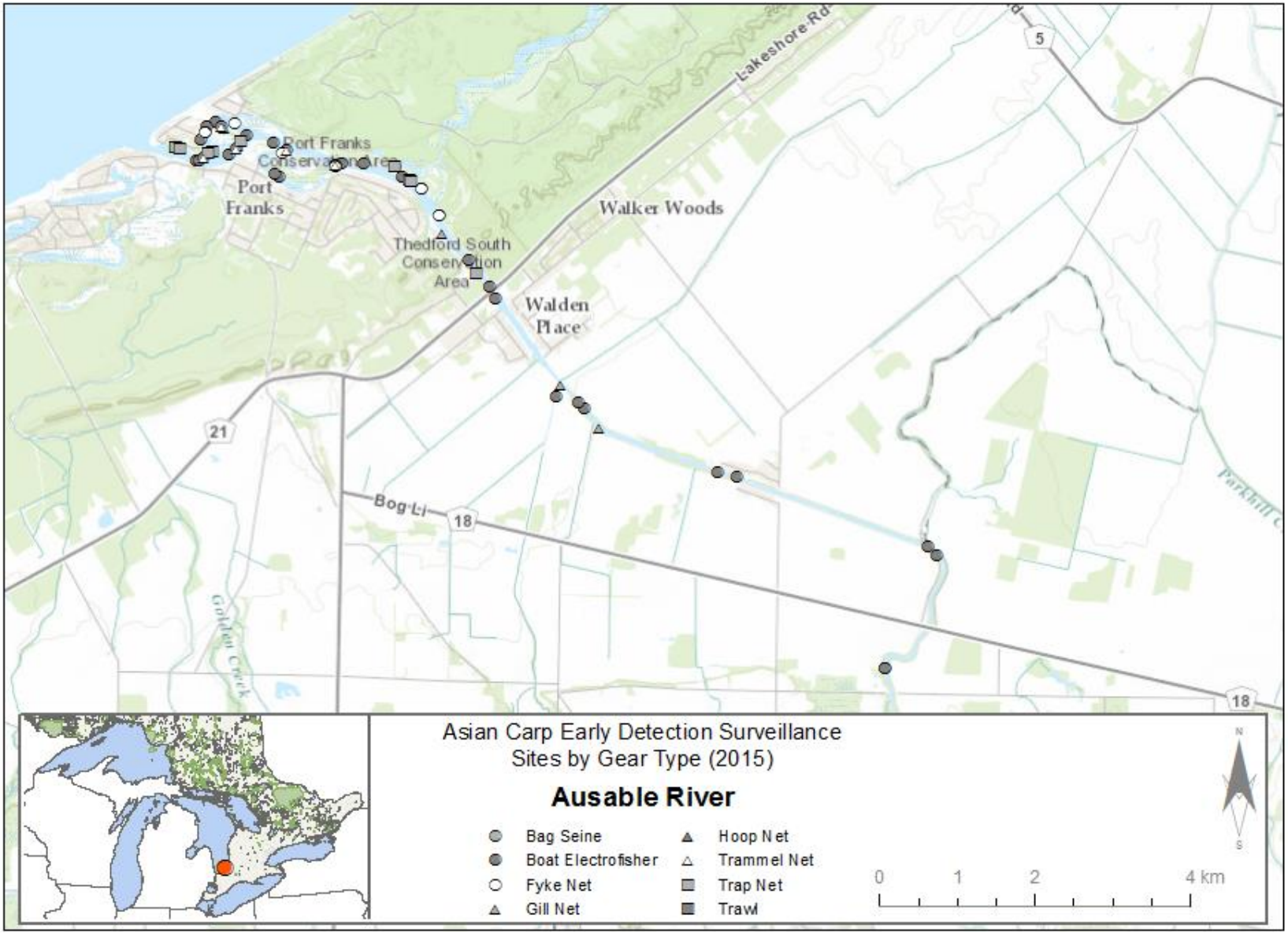

Figure 2. Asian Carp Program early detection surveillance sites and gear types used in the Ausable River in 2015.

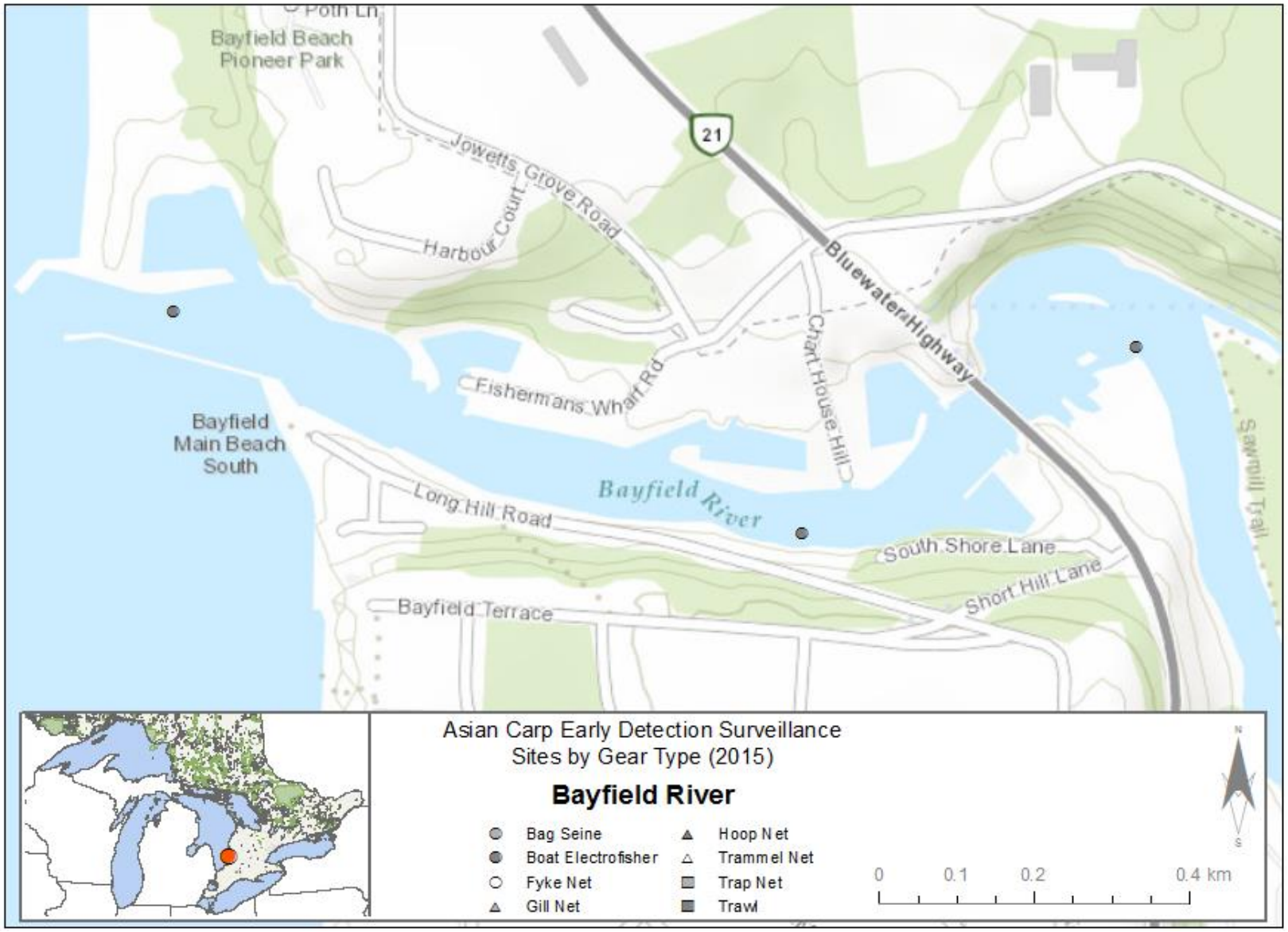

Figure 3. Asian Carp Program early detection surveillance sites and gear types used in the Bayfield River in 2015.

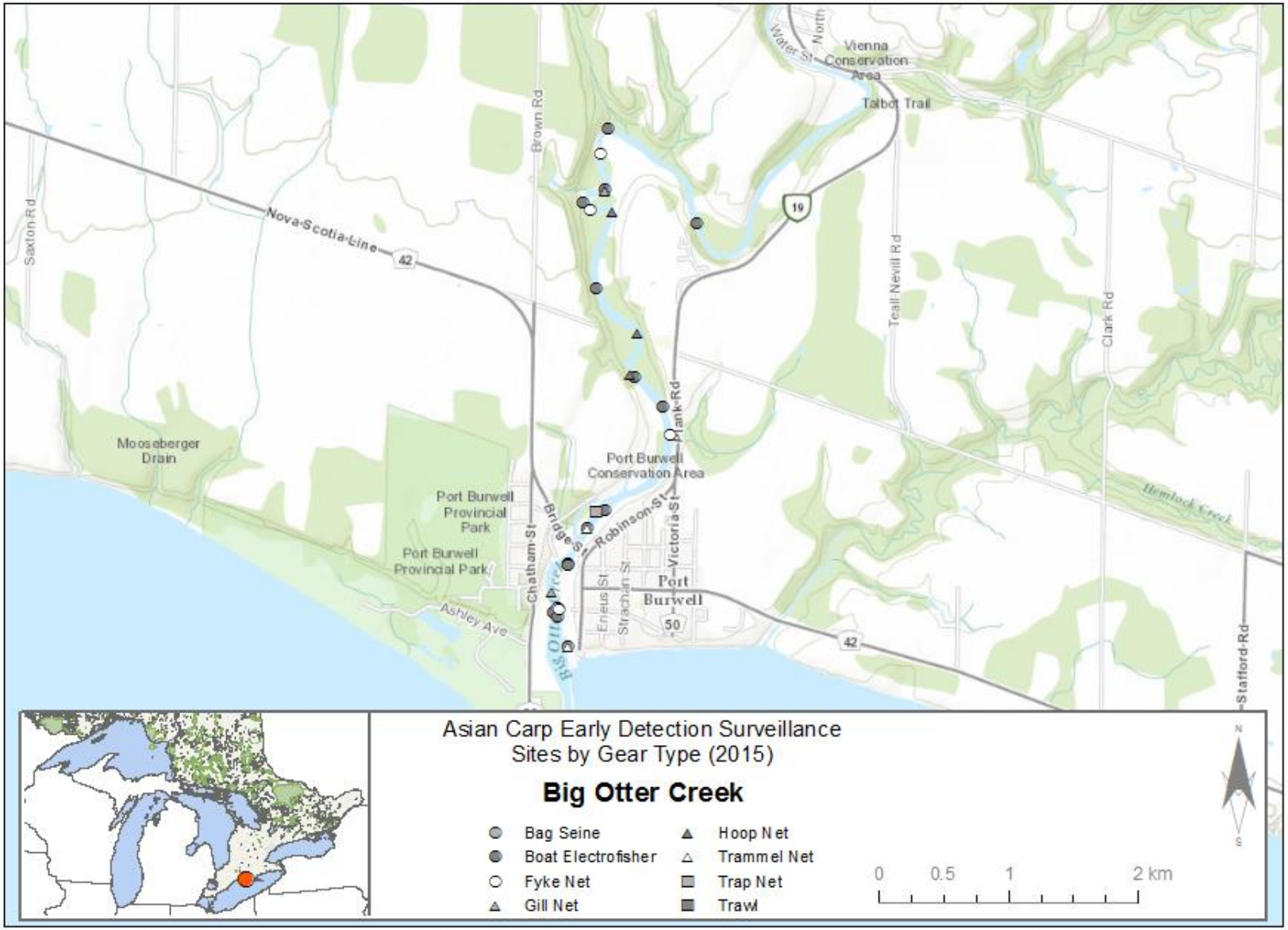

Figure 4. Asian Carp Program early detection surveillance sites and gear types used in Big Otter Creek in 2015.

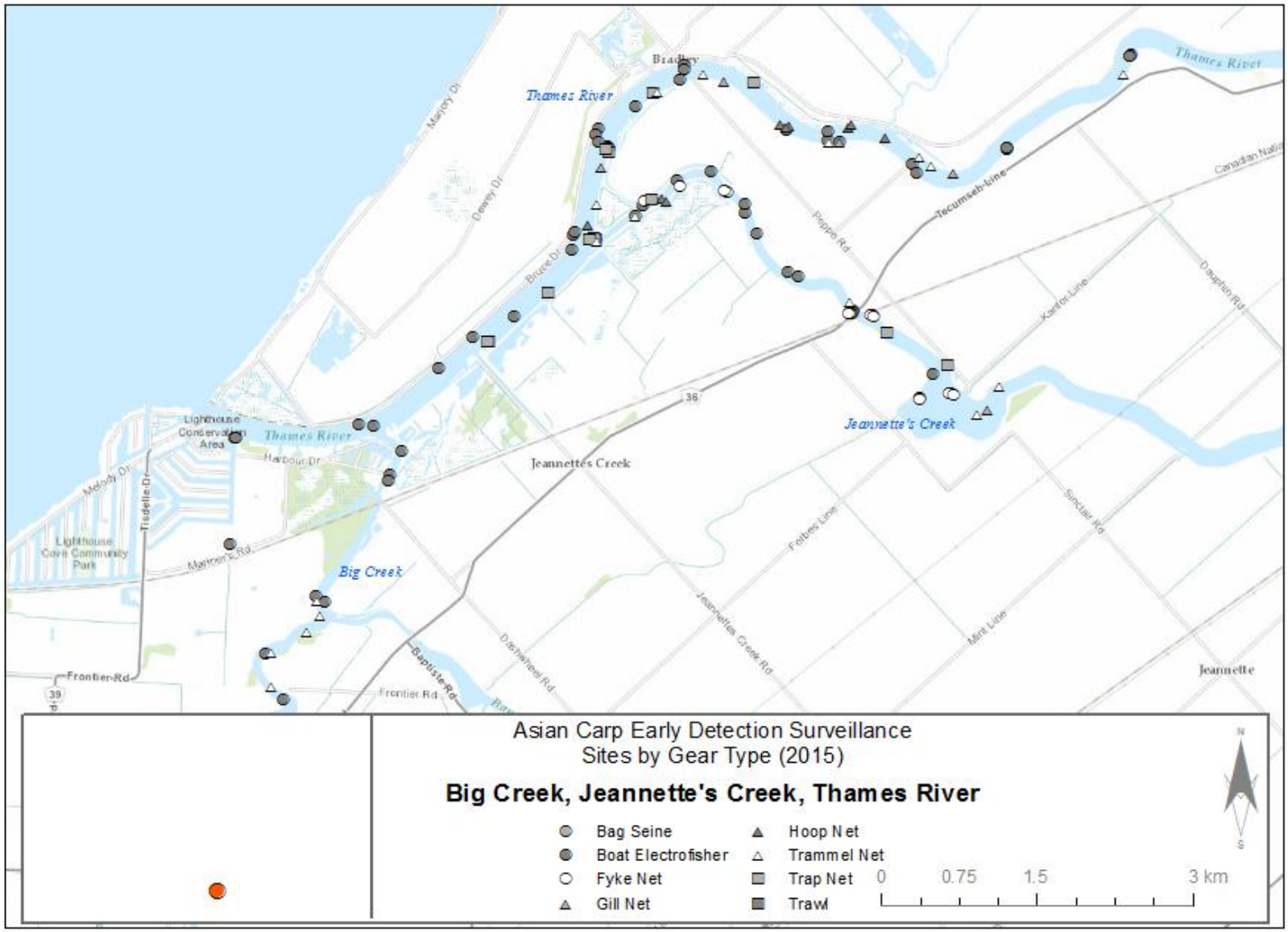

Figure 5. Asian Carp Program early detection surveillance sites and gear types used in Big Creek, Jeannette's Creek and the Thames River in 2015.

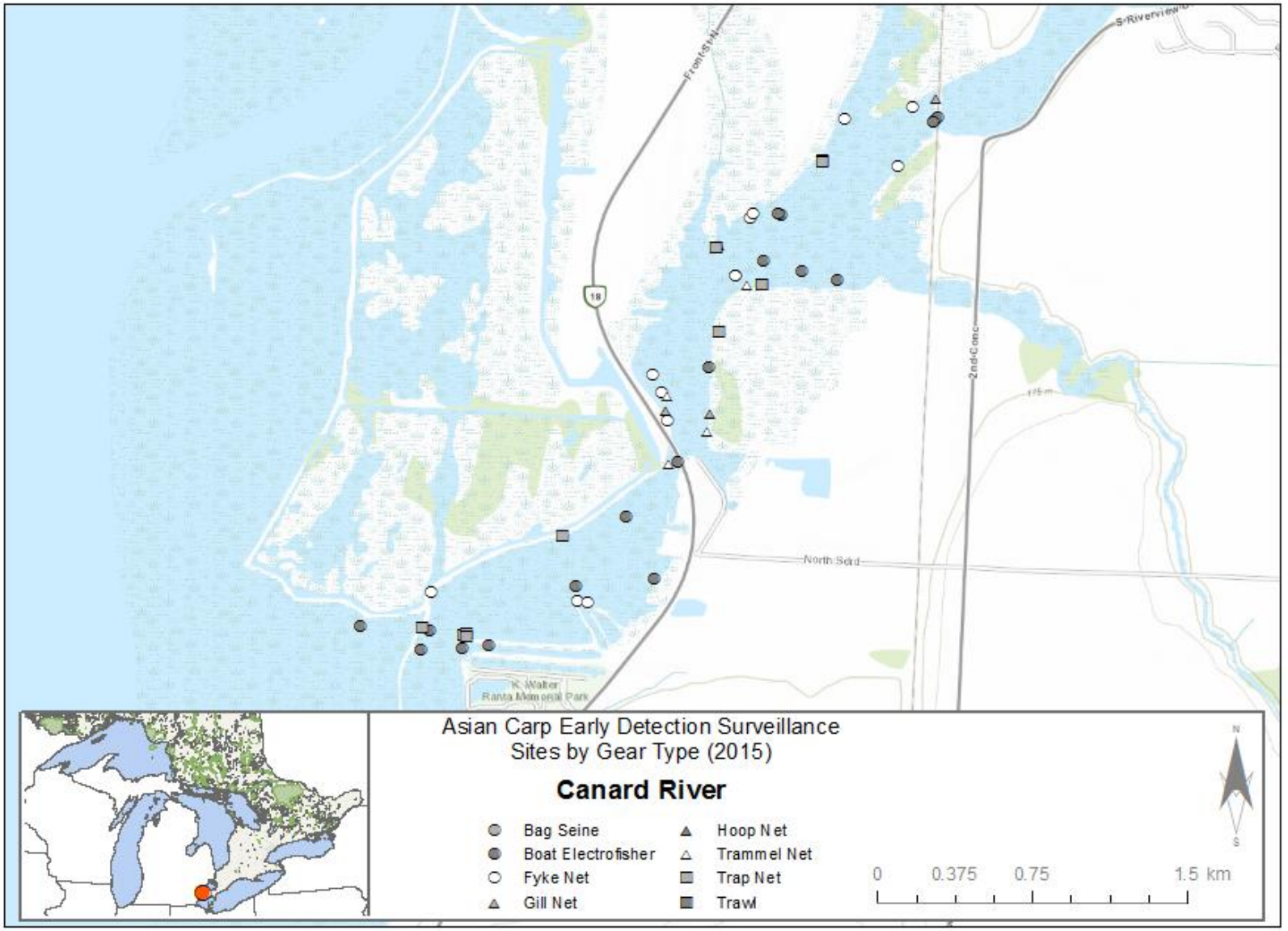

Figure 6. Asian Carp Program early detection surveillance sites and gear types used in the Canard River in 2015.

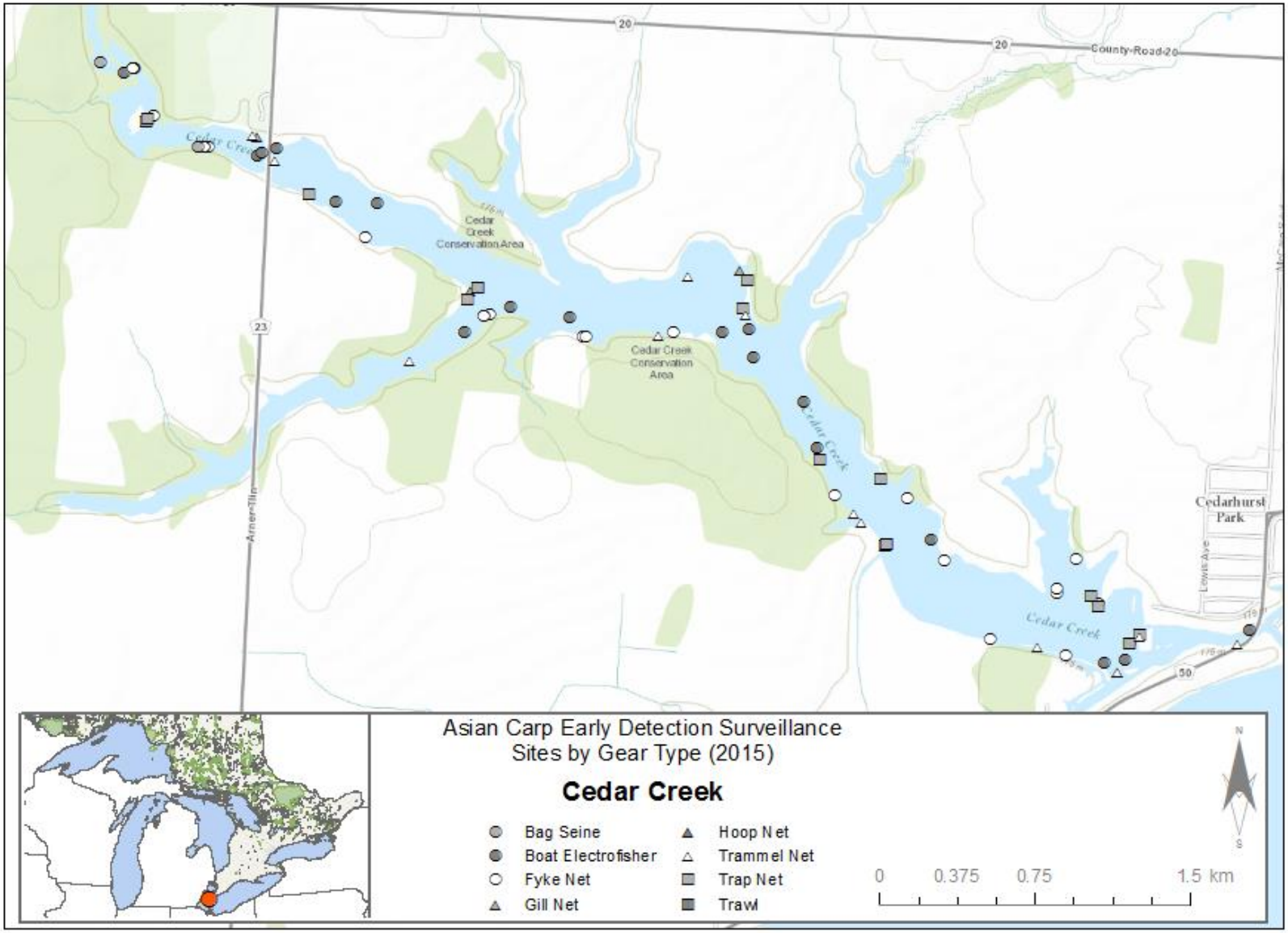

Figure 7. Asian Carp Program early detection surveillance sites and gear types used in Cedar Creek in 2015.

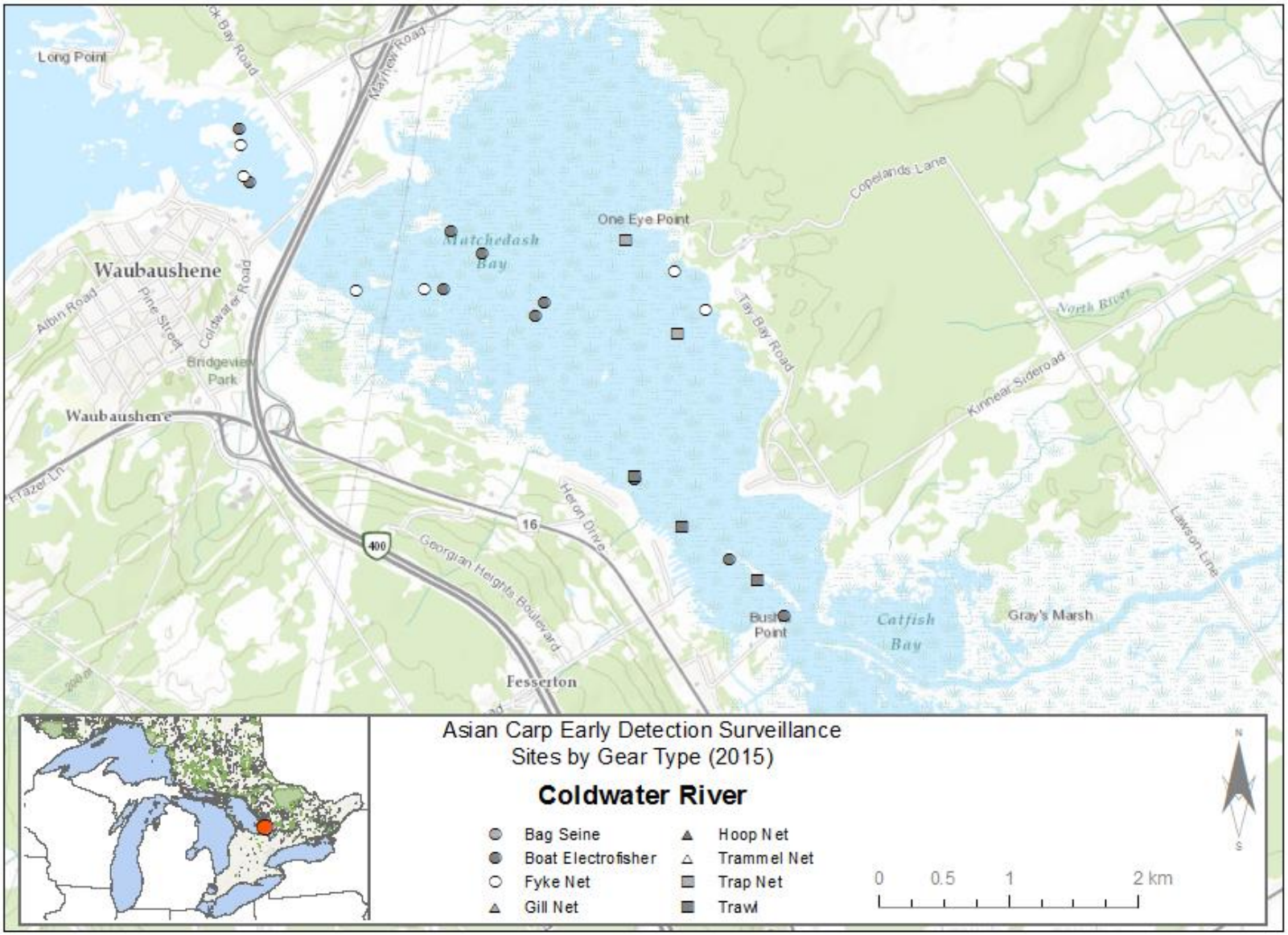

Figure 8. Asian Carp Program early detection surveillance sites and gear types used in the Coldwater River in 2015.

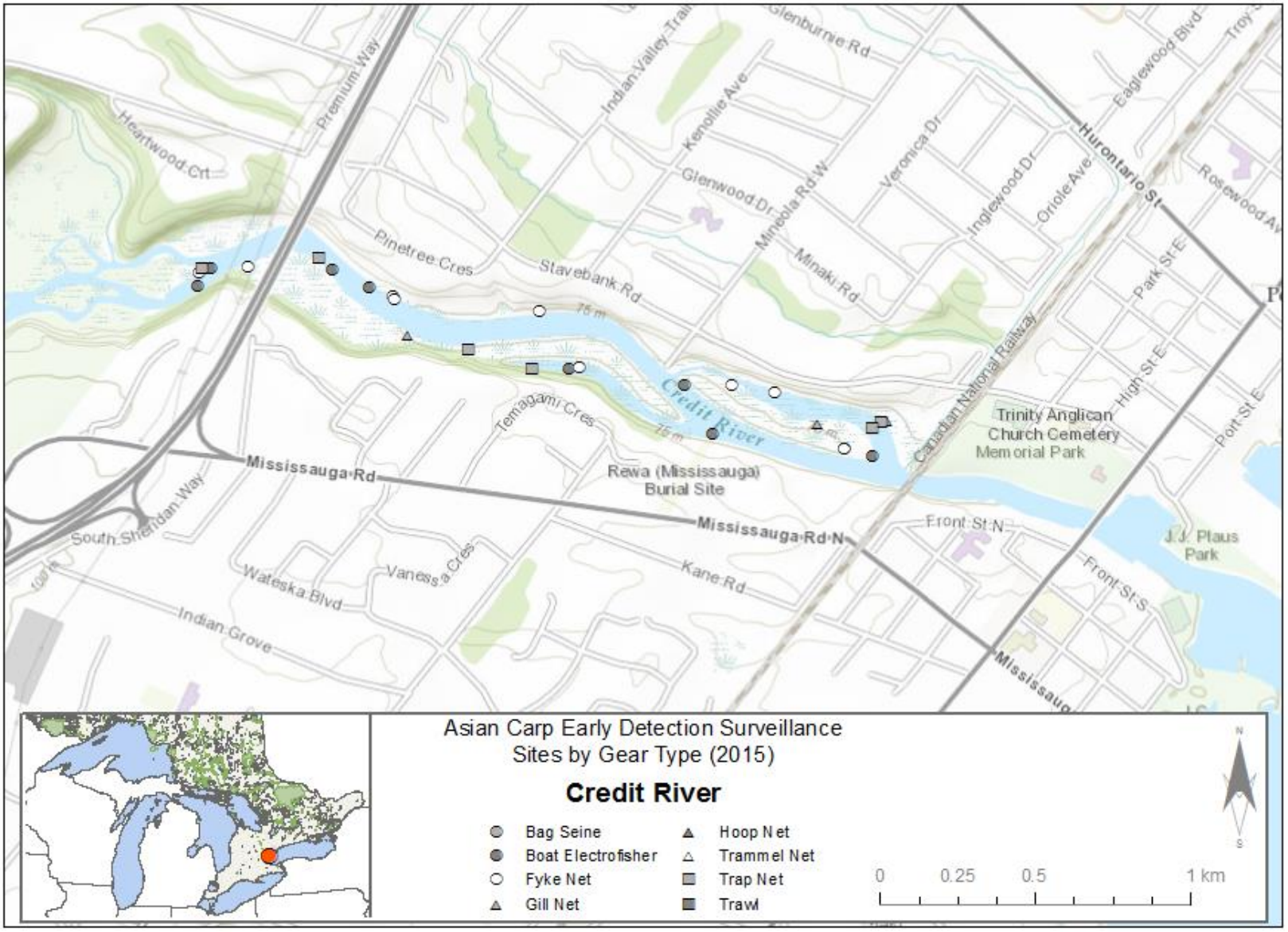

Figure 9. Asian Carp Program early detection surveillance sites and gear types used in the Credit River in 2015.

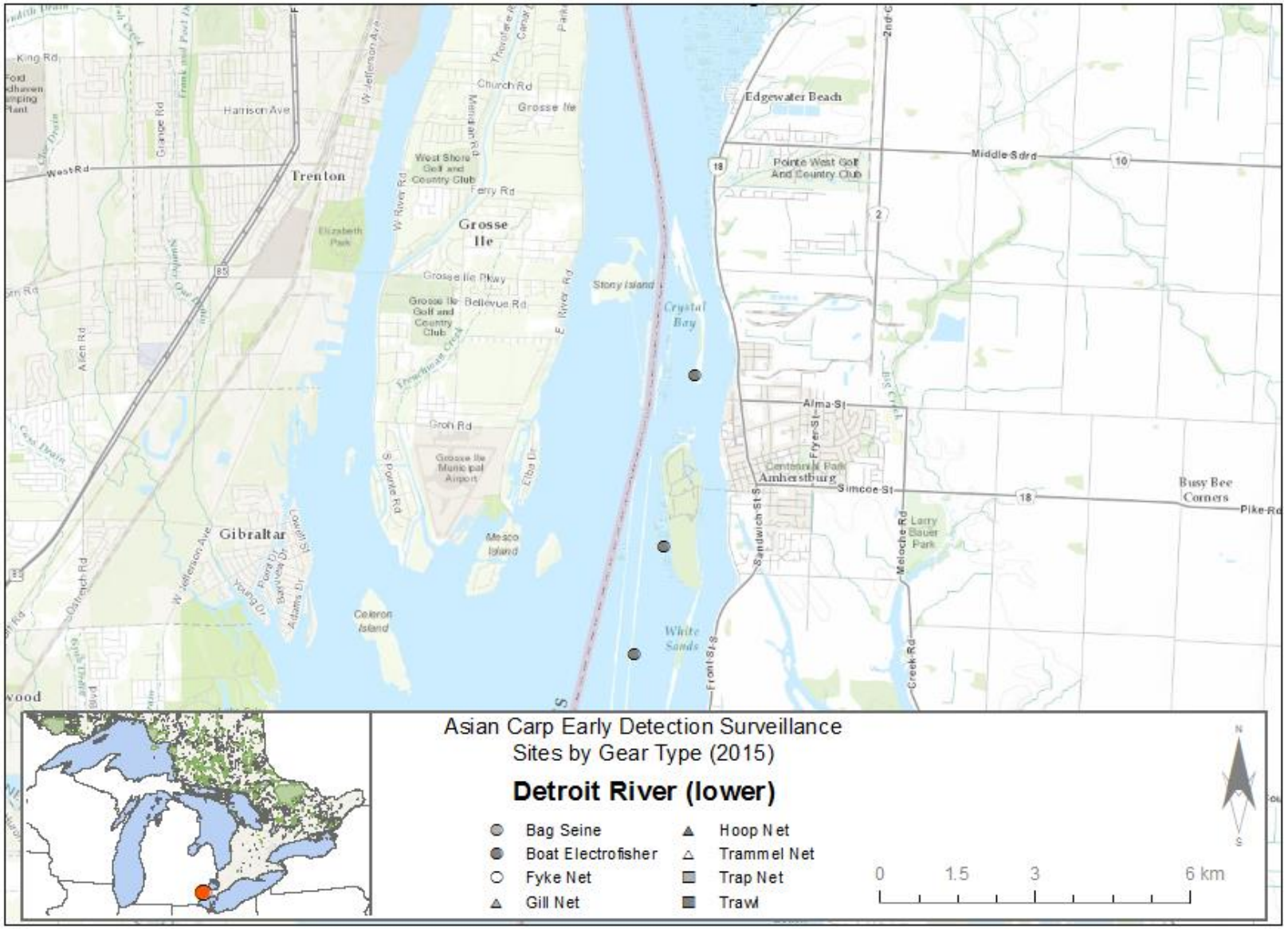

Figure 10. Asian Carp Program early detection surveillance sites and gear types used in the lower Detroit River in 2015.

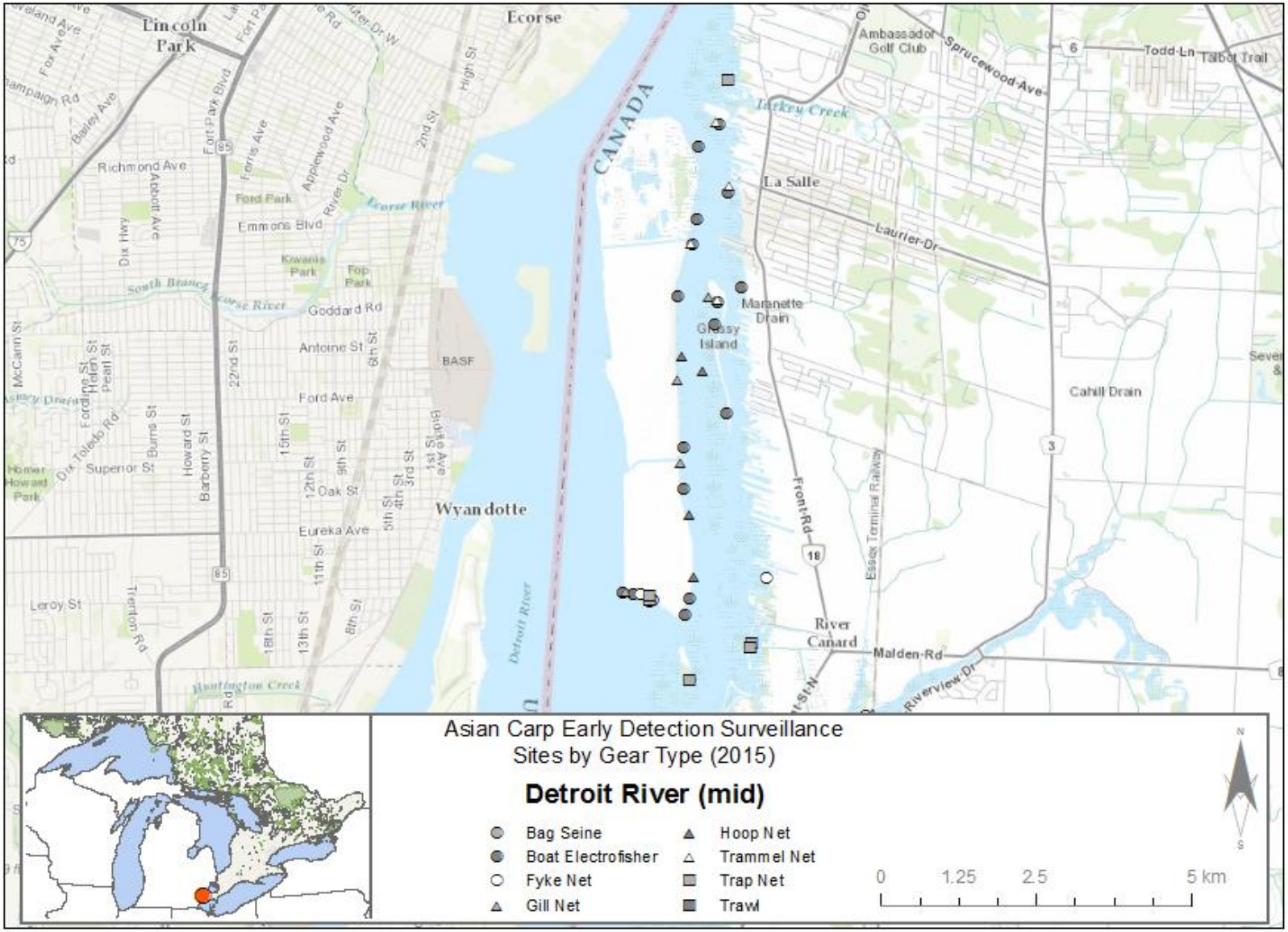

Figure 11. Asian Carp Program early detection surveillance sites and gear types used in the mid Detroit River in 2015.

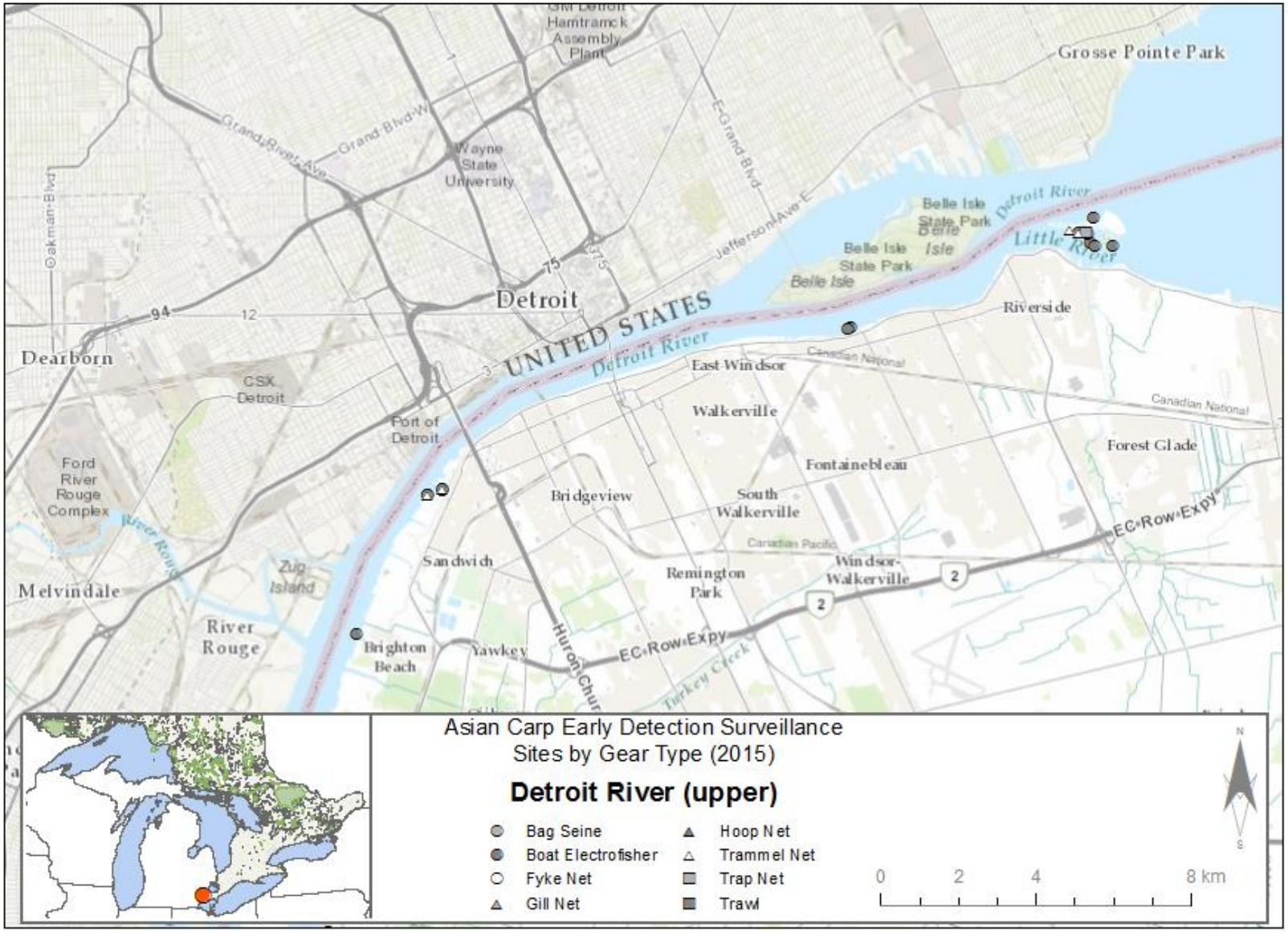

Figure 12. Asian Carp Program early detection surveillance sites and gear types used in the upper Detroit River in 2015.

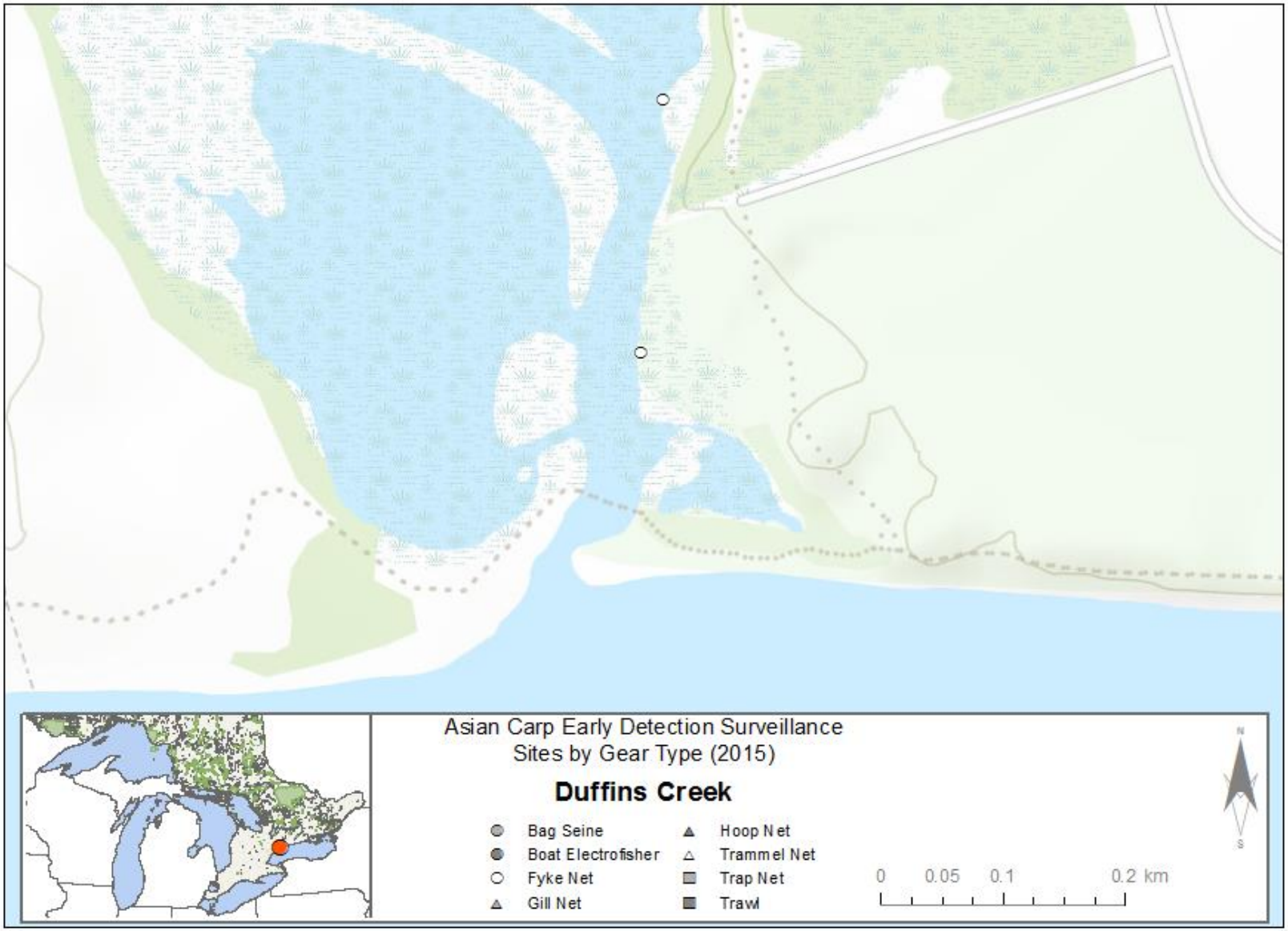

Figure 13. Asian Carp Program early detection surveillance sites and gear types used in Duffins Creek in 2015.

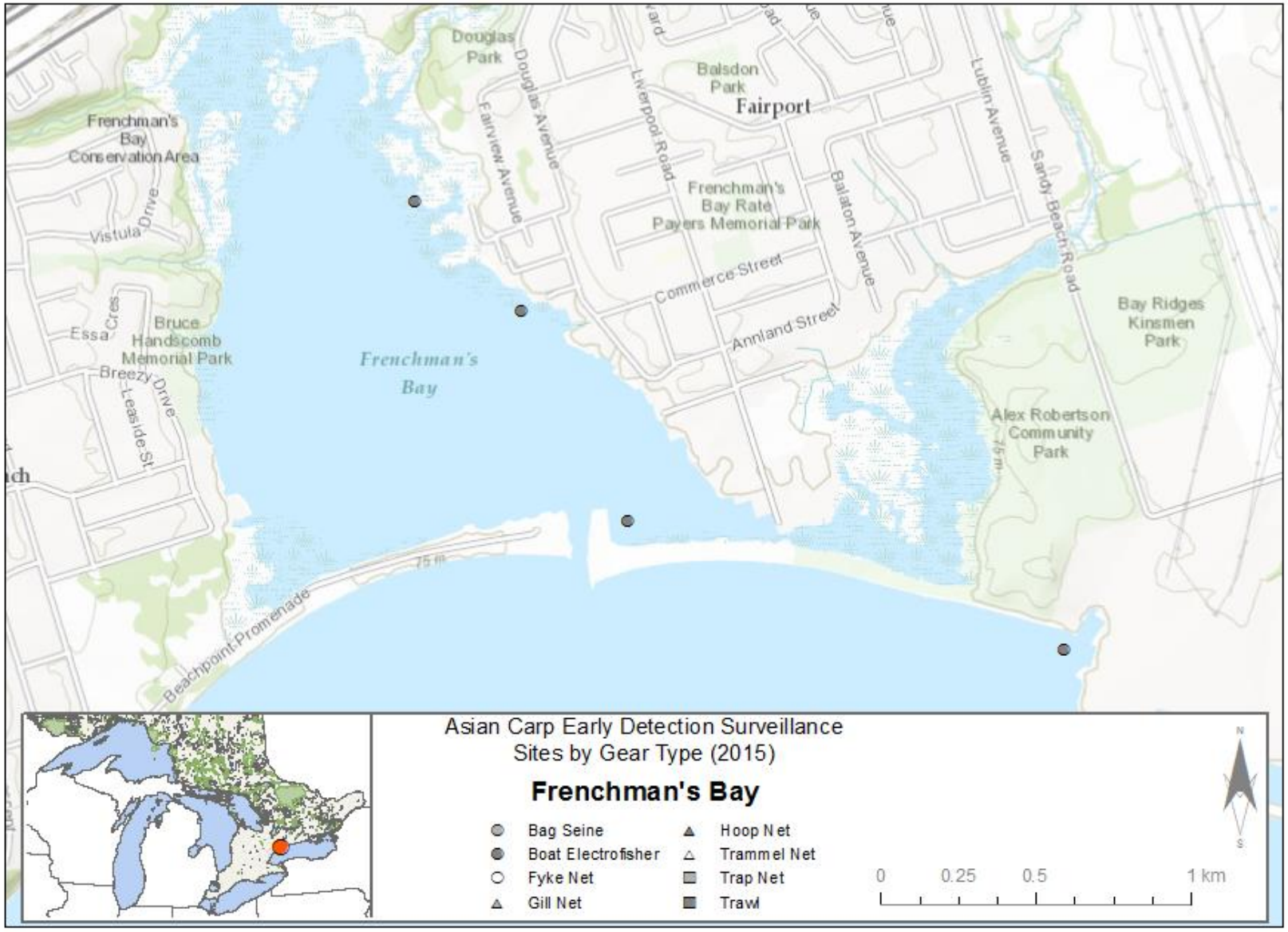

Figure 14. Asian Carp Program early detection surveillance sites and gear types used in Frenchman's Bay in 2015.

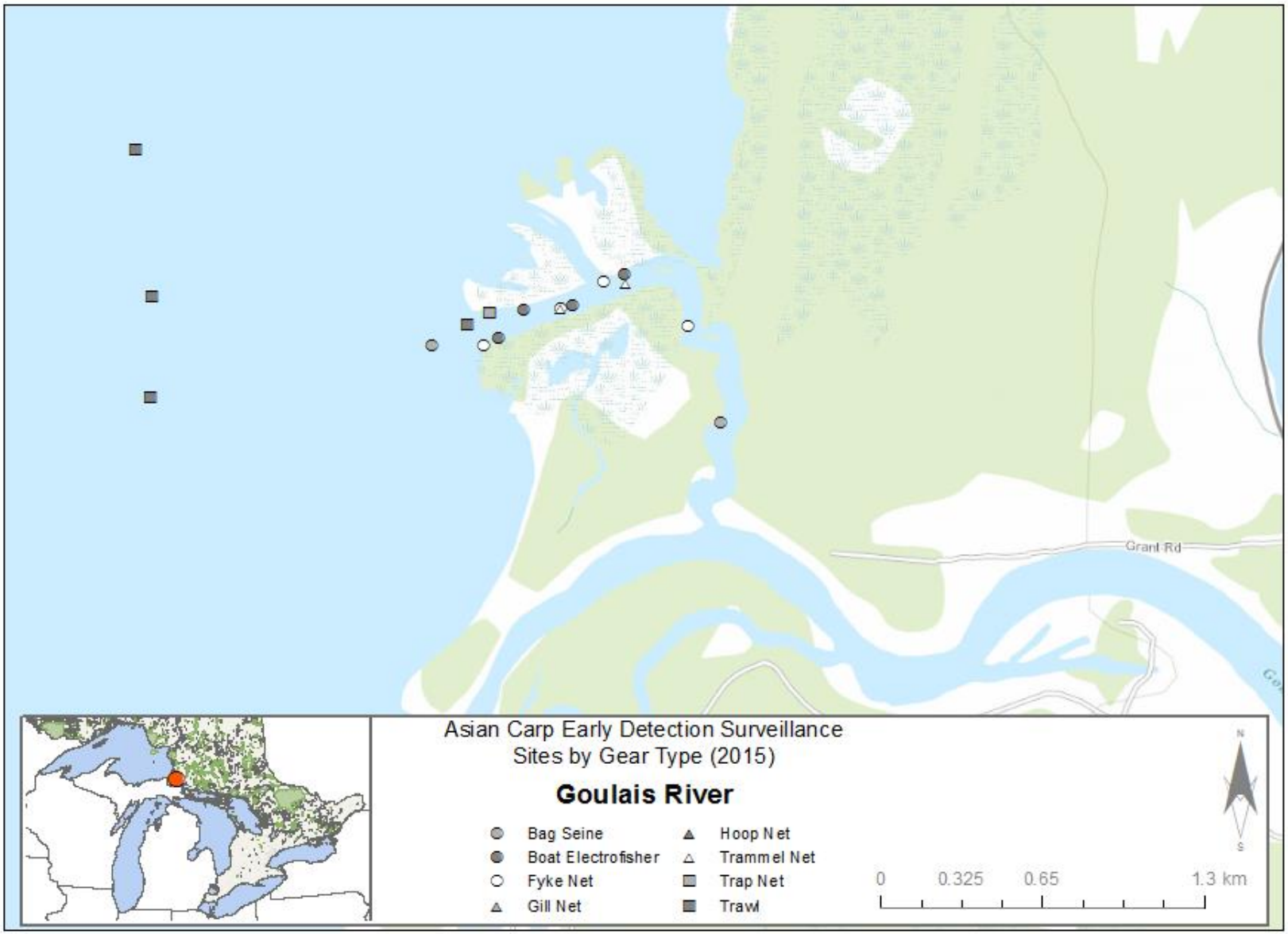

Figure 15. Asian Carp Program early detection surveillance sites and gear types used in the Goulais River in 2015.

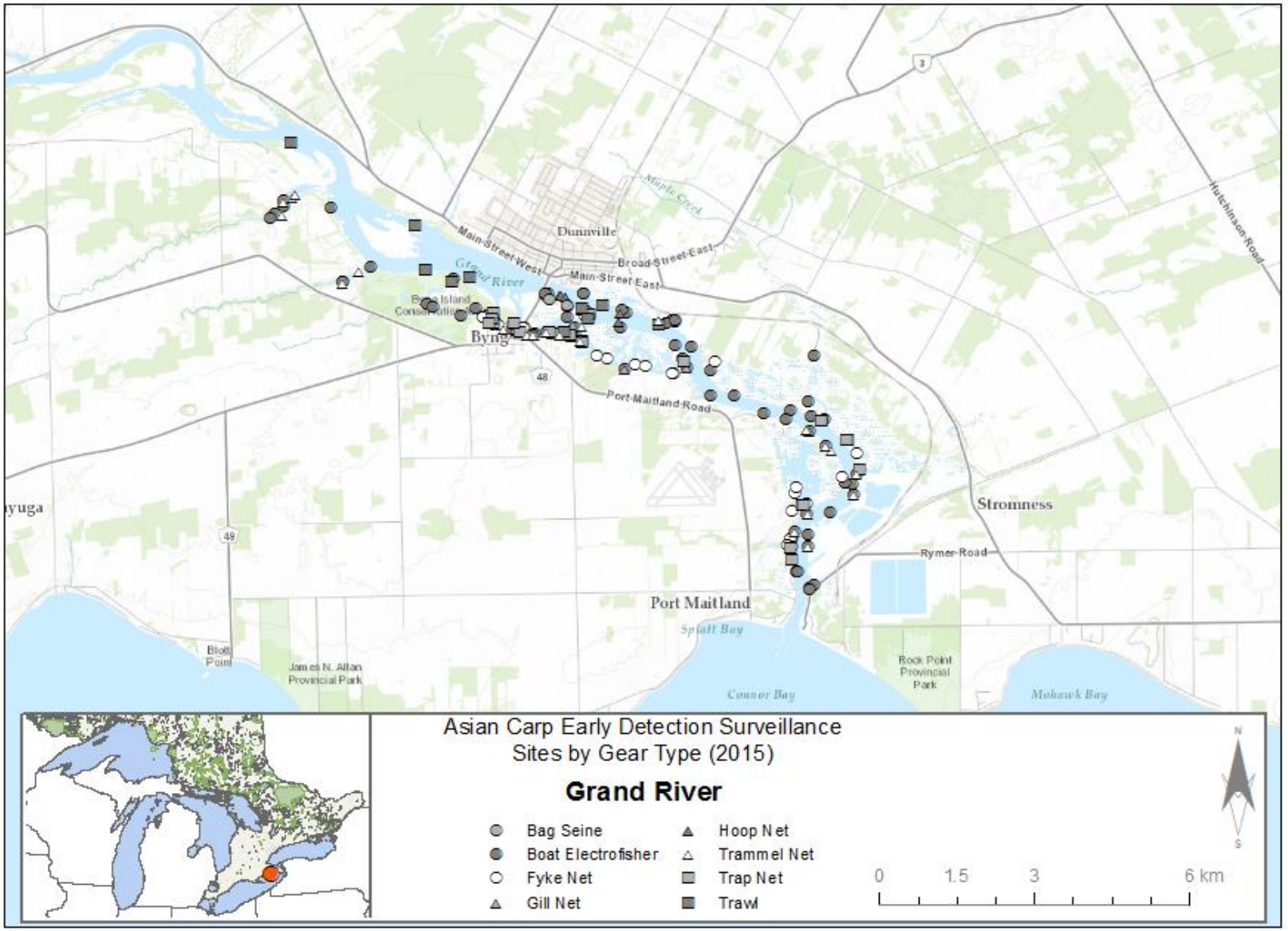

Figure 16. Asian Carp Program early detection surveillance sites and gear types used in the Grand River in 2015.

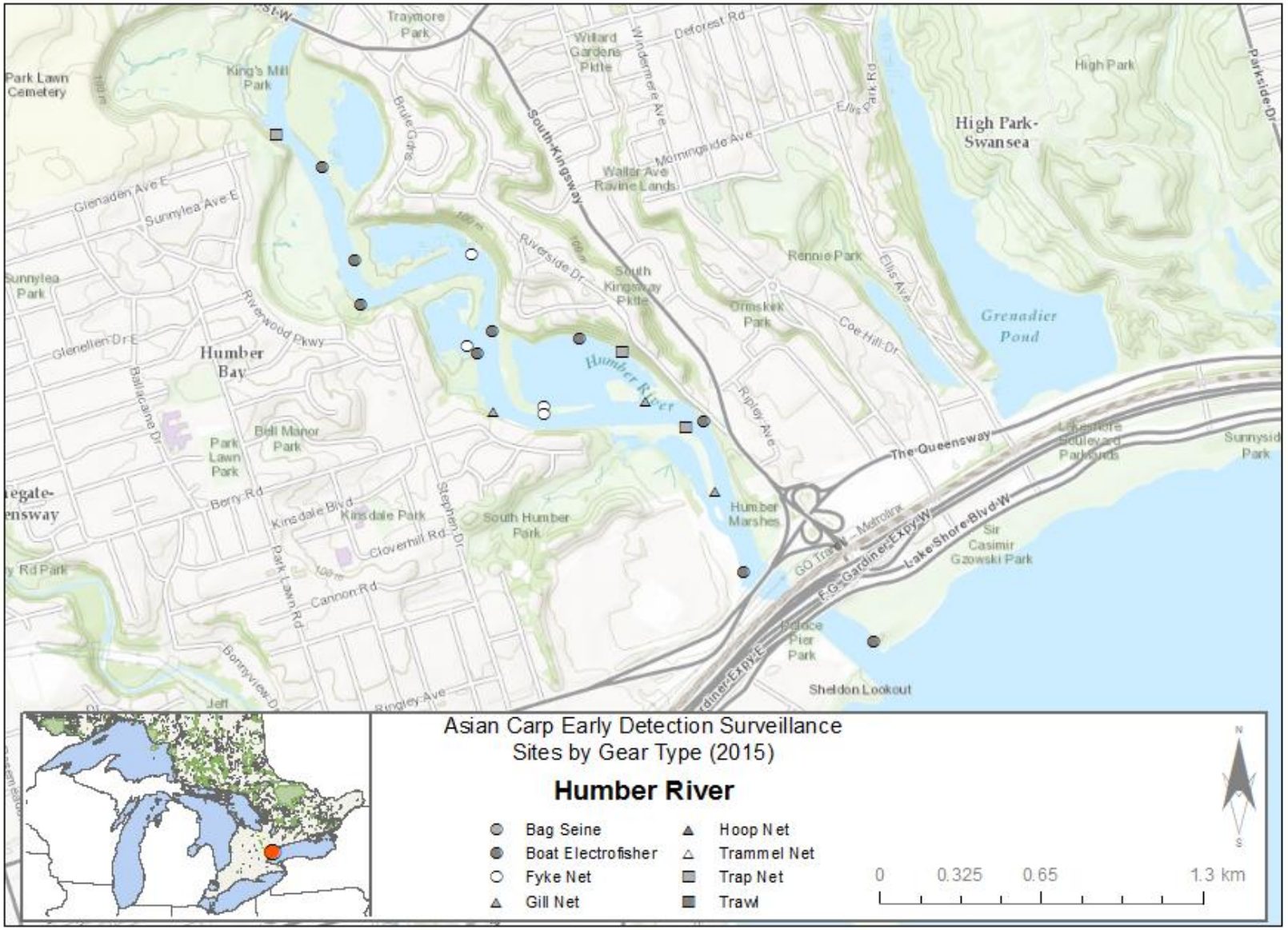

Figure 17. Asian Carp Program early detection surveillance sites and gear types used in the Humber River in 2015.

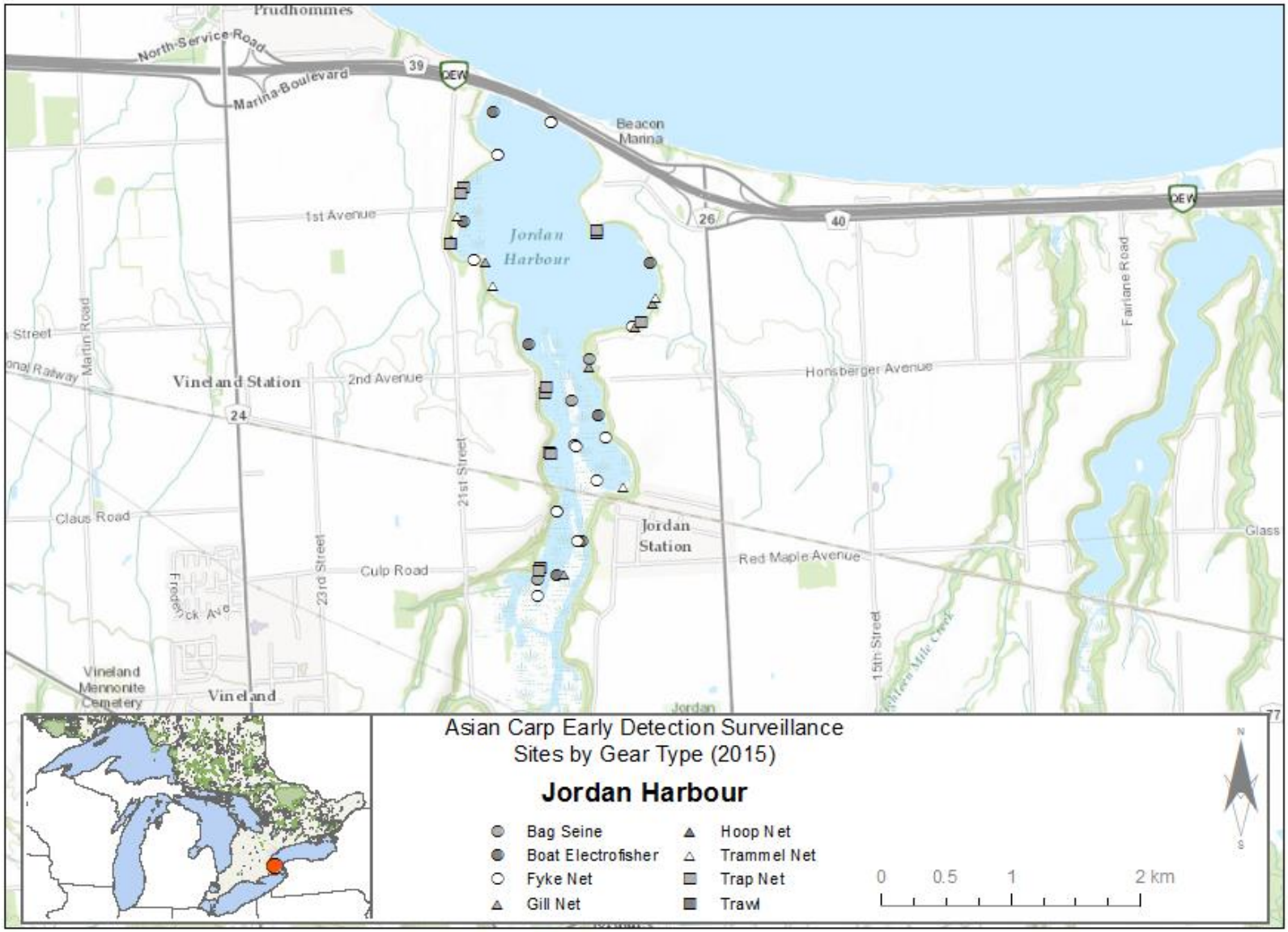

Figure 18. Asian Carp Program early detection surveillance sites and gear types used in Jordan Harbour in 2015.

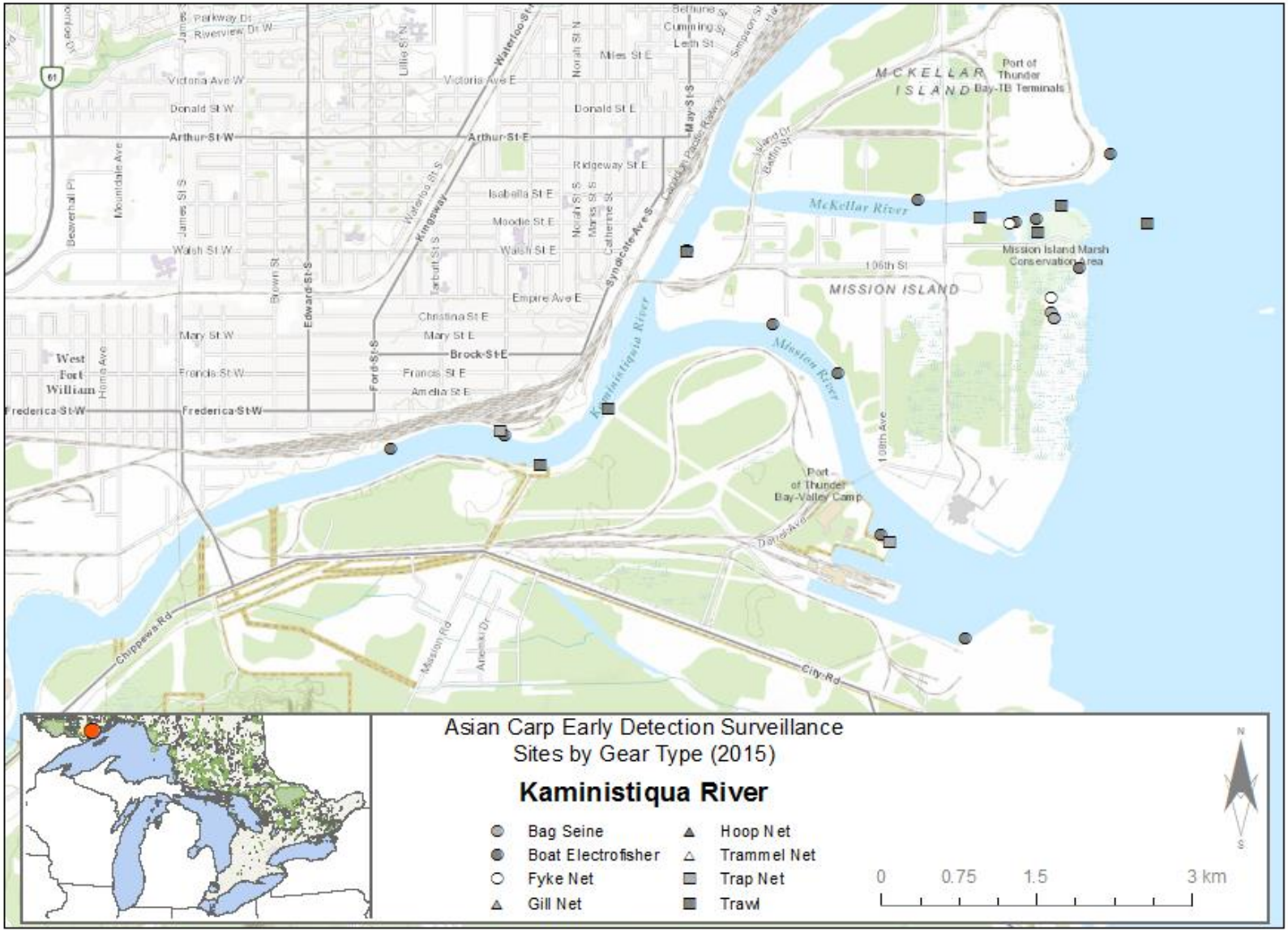

Figure 19. Asian Carp Program early detection surveillance sites and gear types used in the Kaministiqua River in 2015.

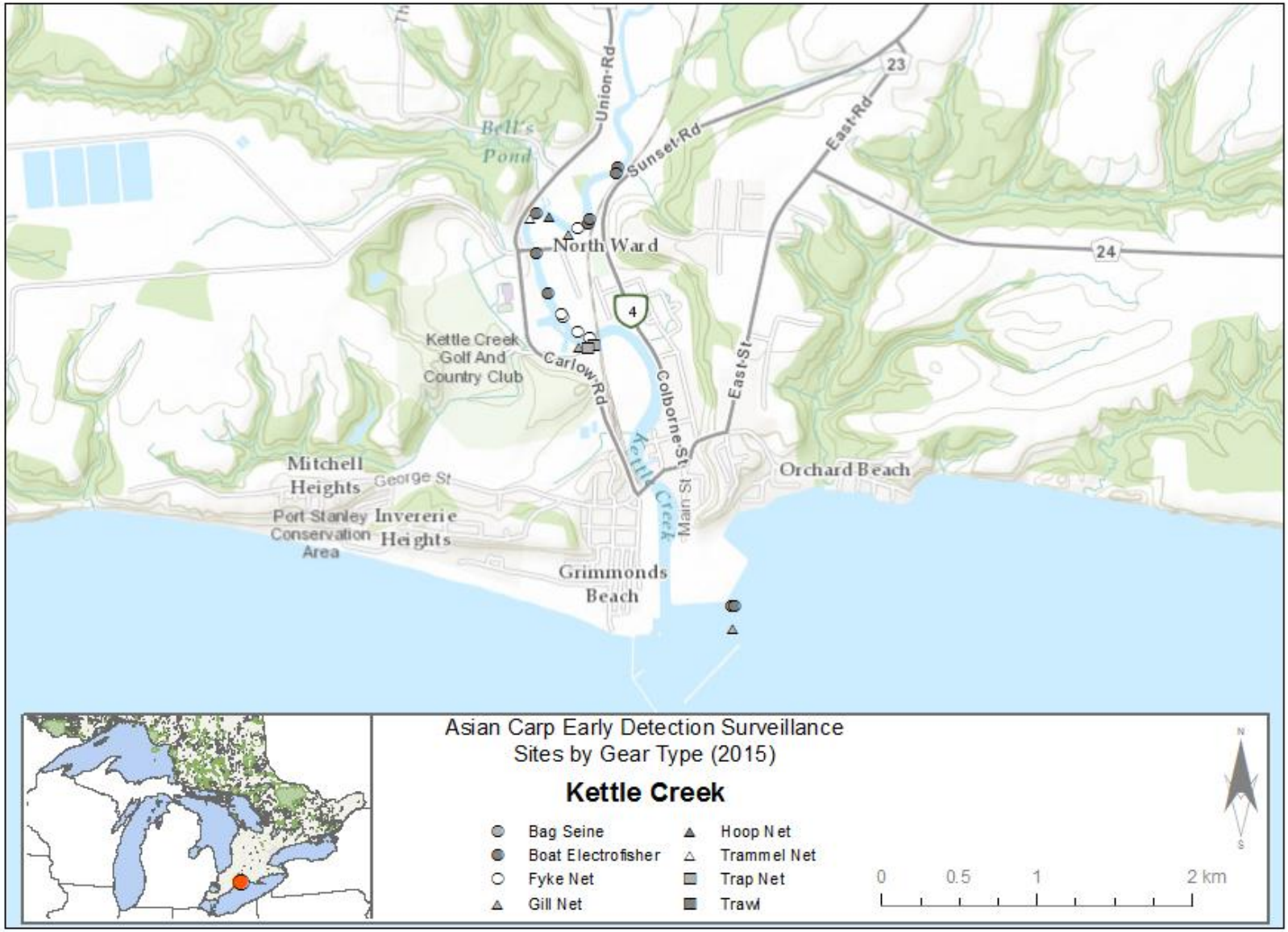

Figure 20. Asian Carp Program early detection surveillance sites and gear types used in Kettle Creek in 2015.

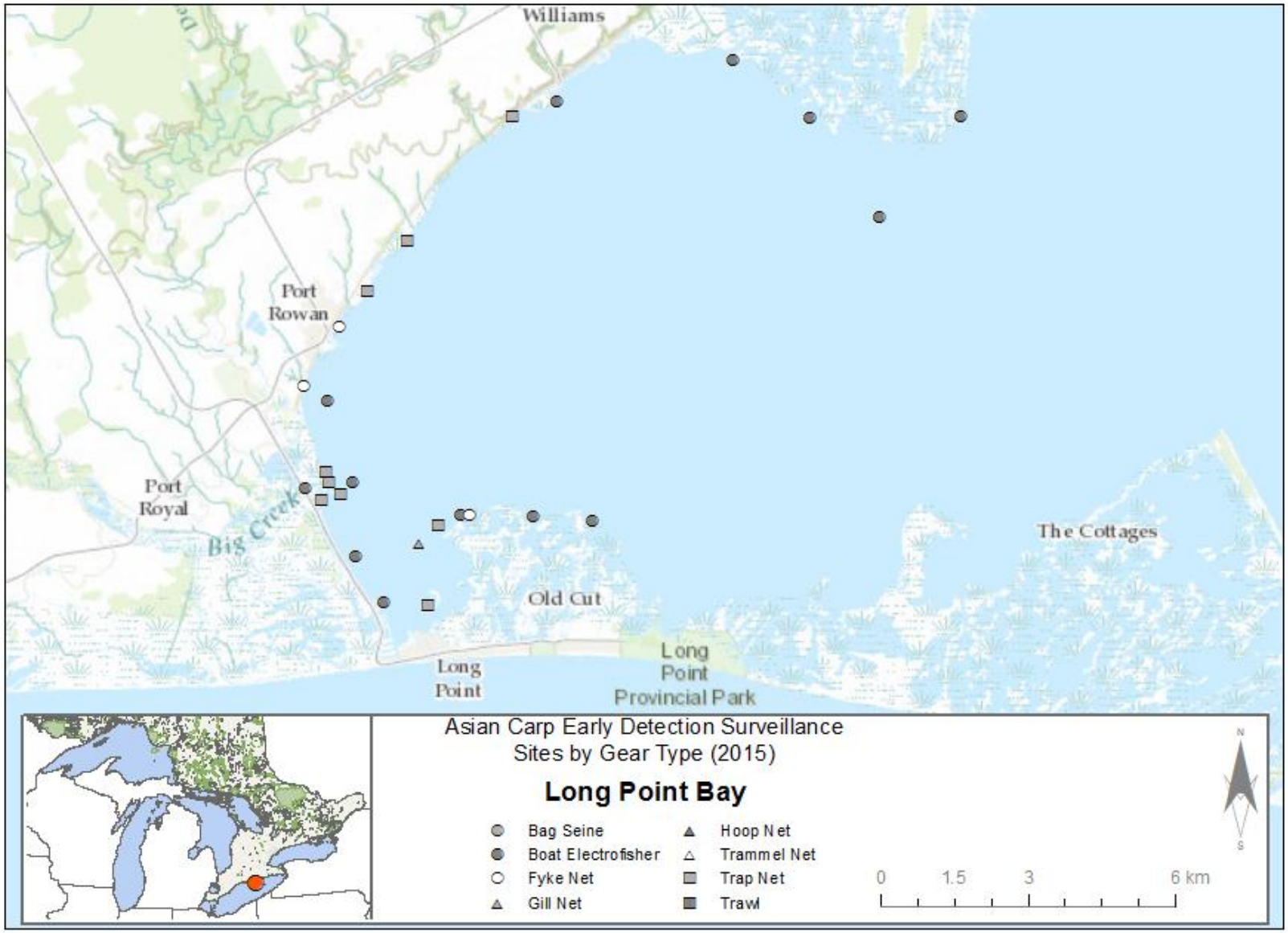

Figure 21. Asian Carp Program early detection surveillance sites and gear types used in Long Point Bay in 2015.

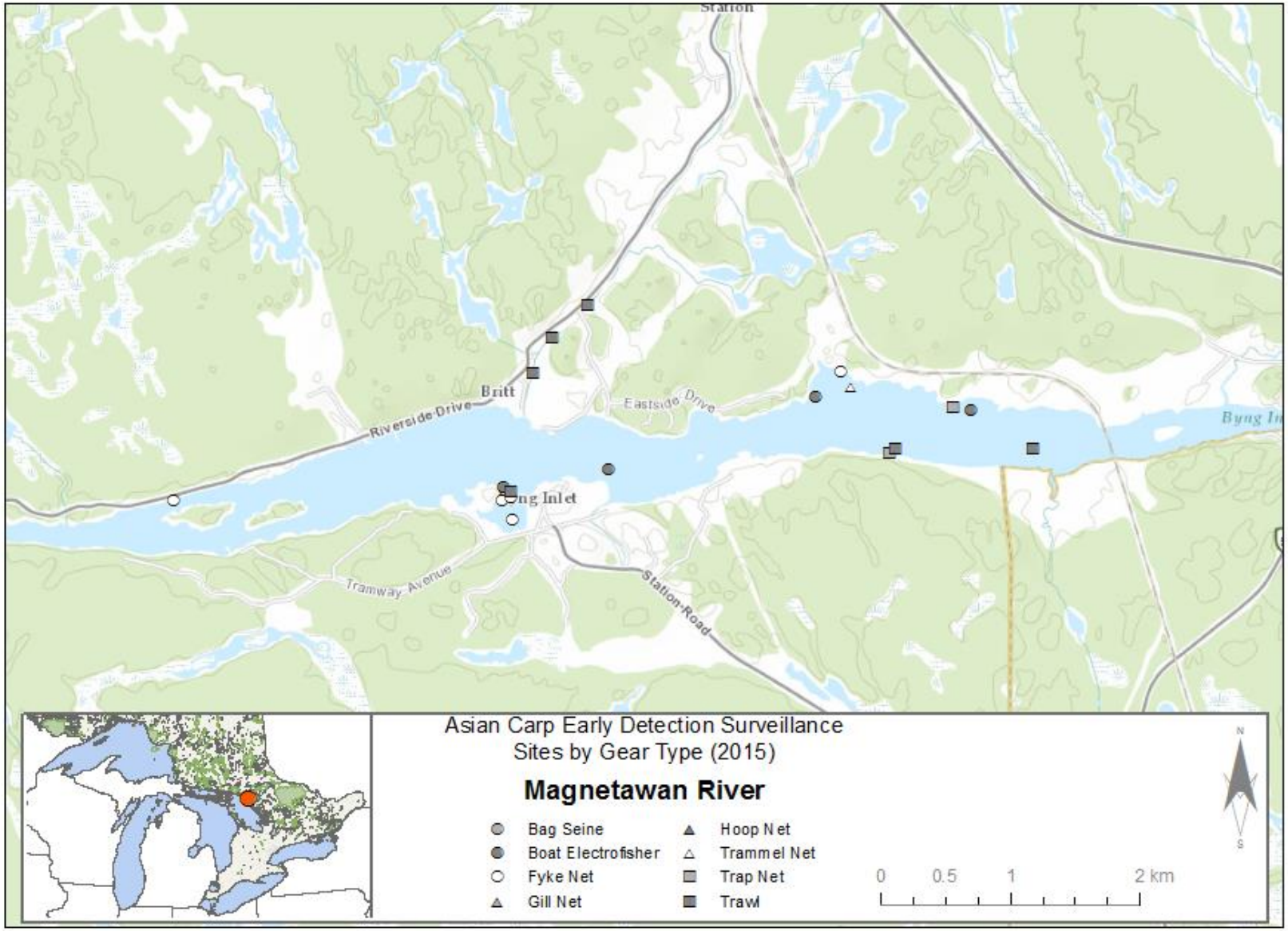

Figure 22. Asian Carp Program early detection surveillance sites and gear types used in the Magnetawan River in 2015.

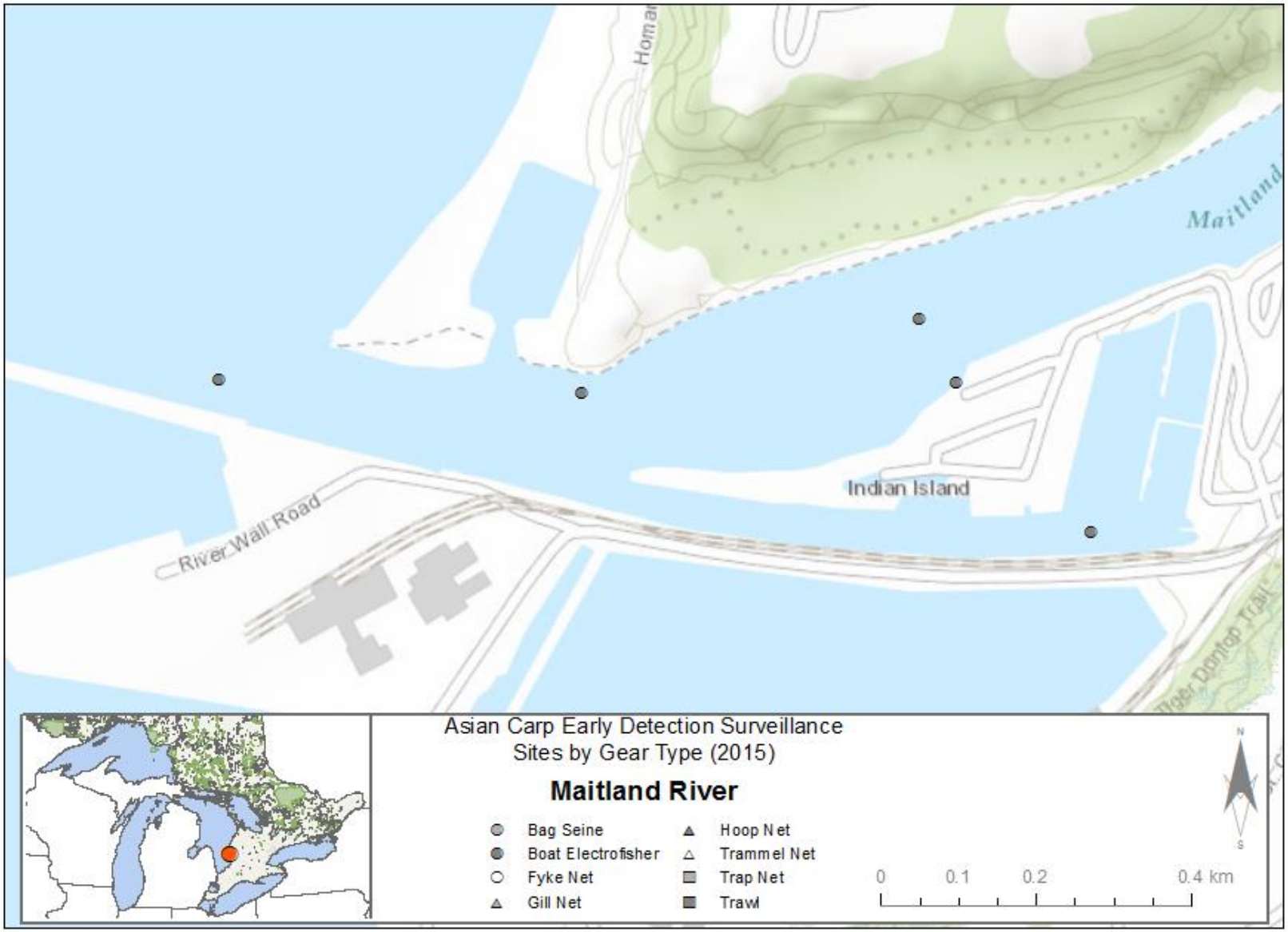

Figure 23. Asian Carp Program early detection surveillance sites and gear types used in the Maitland River in 2015.

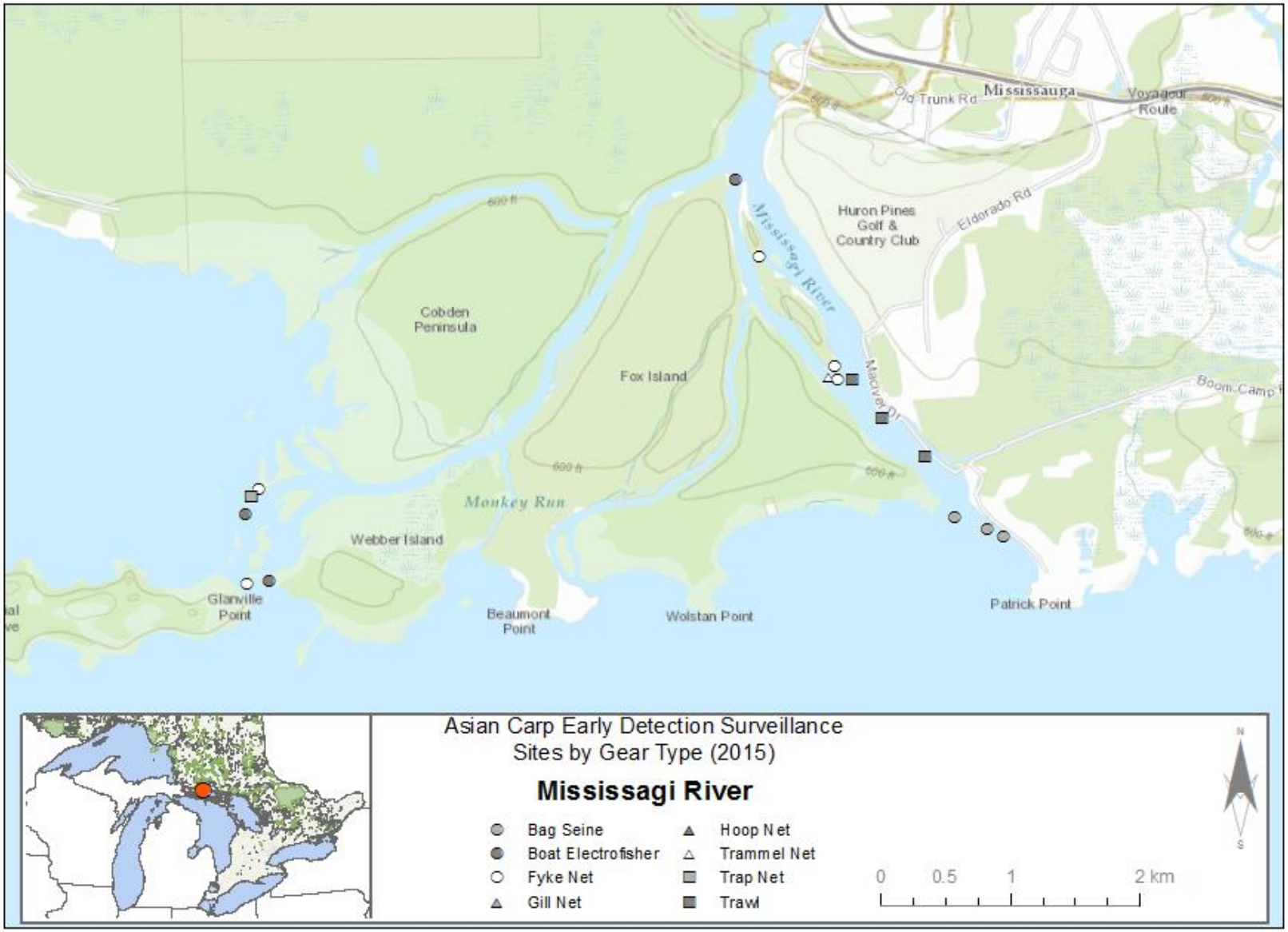

Figure 24. Asian Carp Program early detection surveillance sites and gear types used in the Mississagi River in 2015.

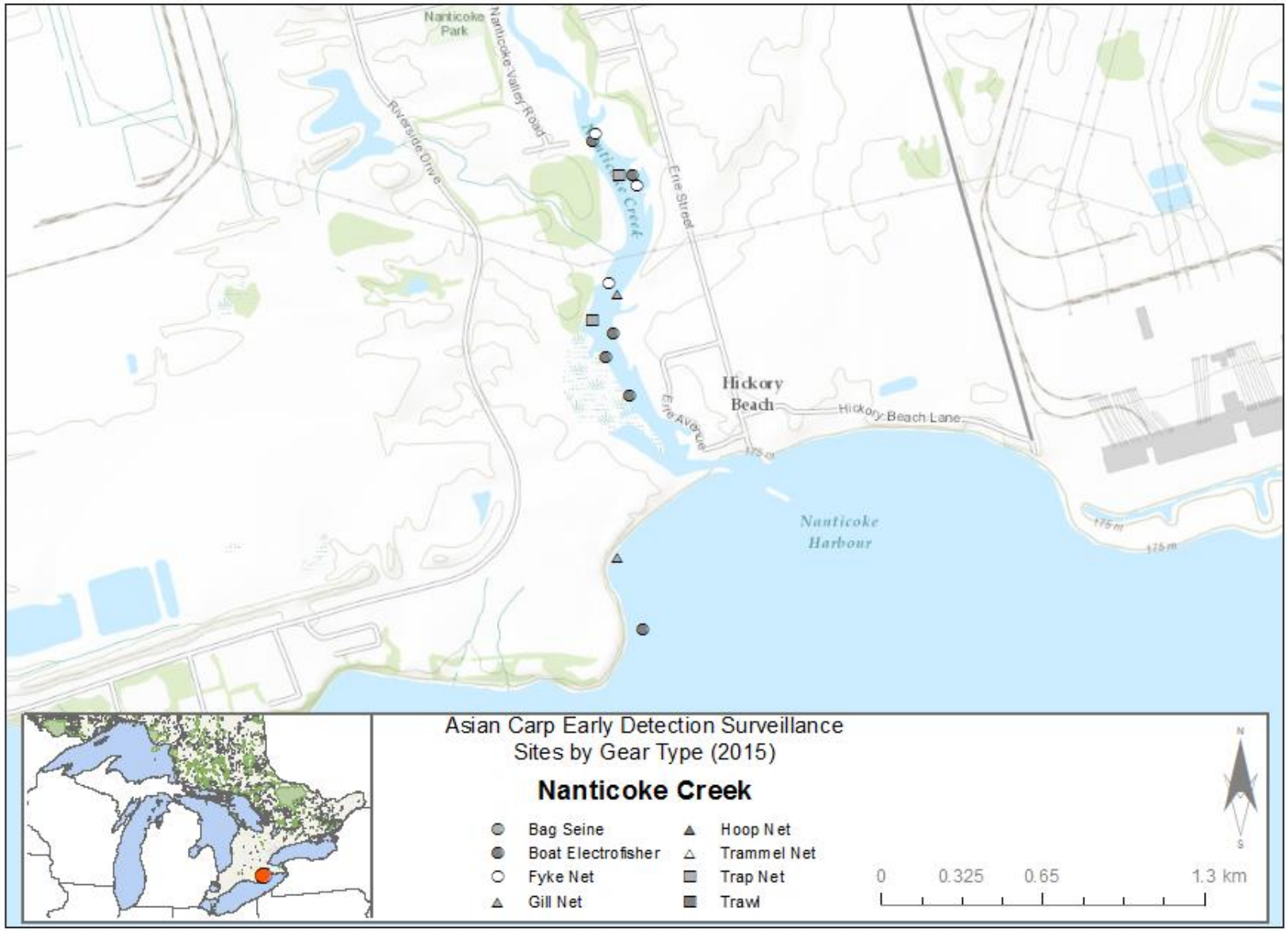

Figure 25. Asian Carp Program early detection surveillance sites and gear types used in Nanticoke Creek in 2015.

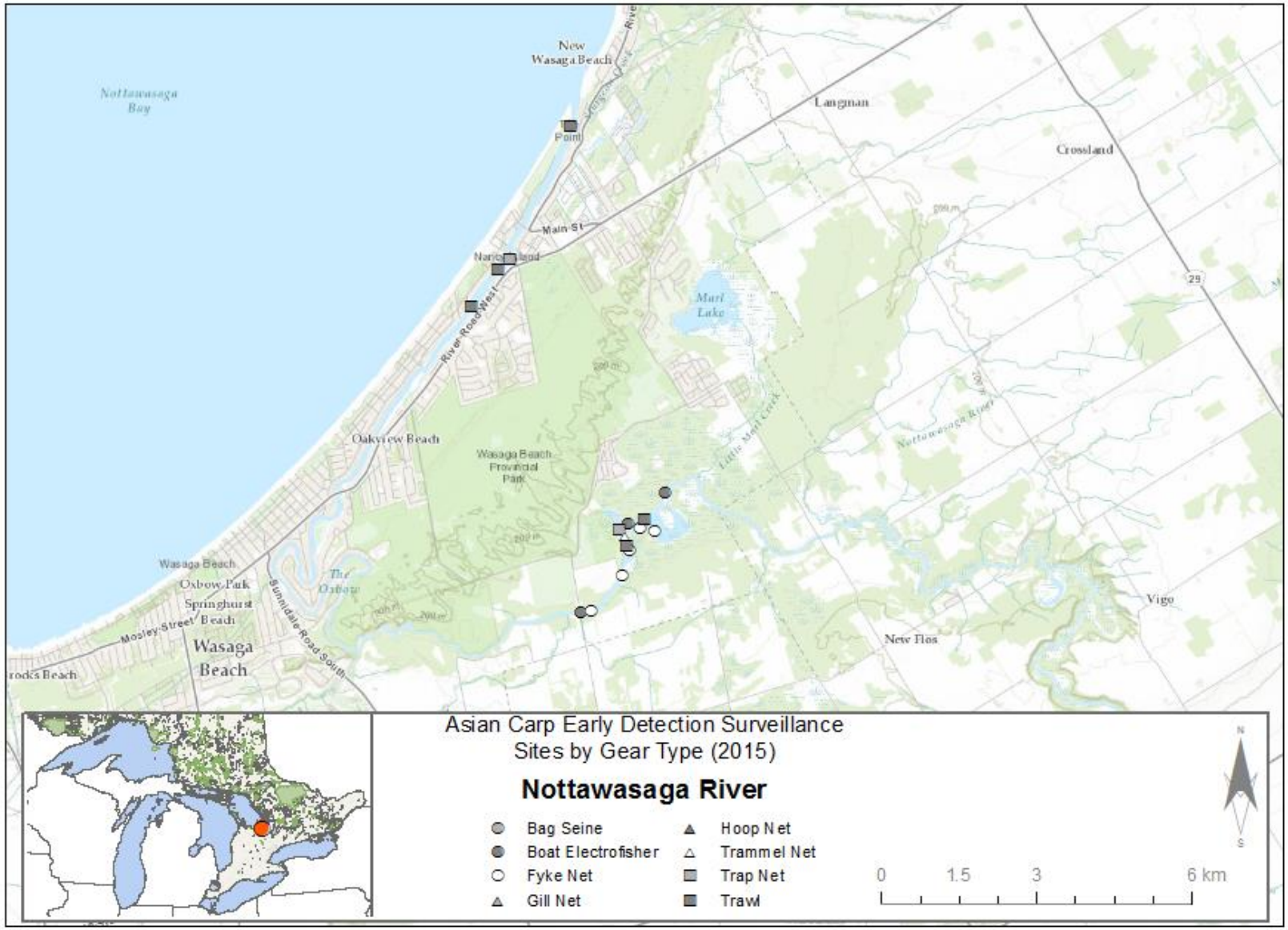

Figure 26. Asian Carp Program early detection surveillance sites and gear types used in the Nottawasaga River in 2015.

Figure 27. Asian Carp Program early detection surveillance sites and gear types used in the Pine River in 2015.

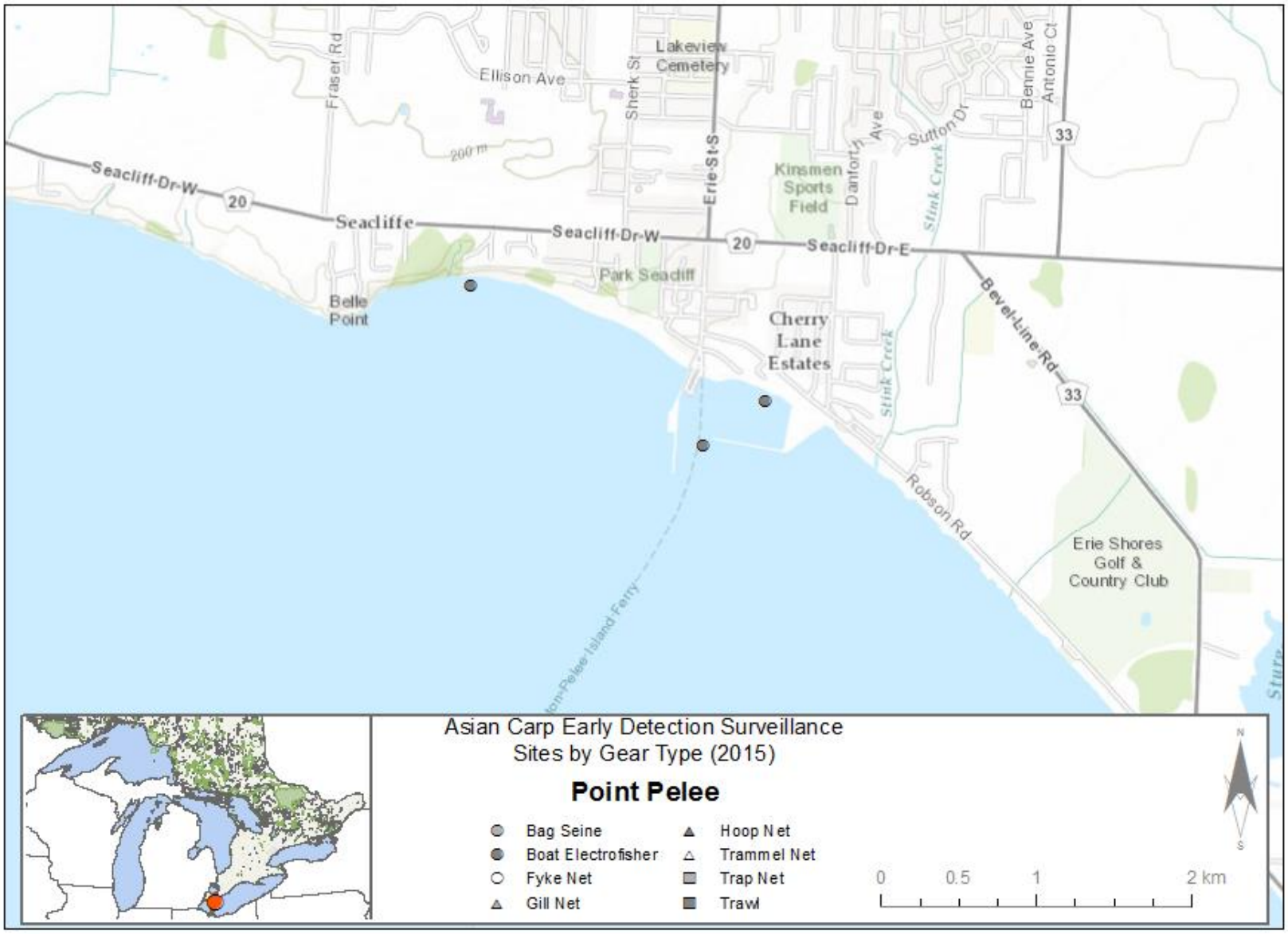

Figure 28. Asian Carp Program early detection surveillance sites and gear types used in Point Pelee in 2015.

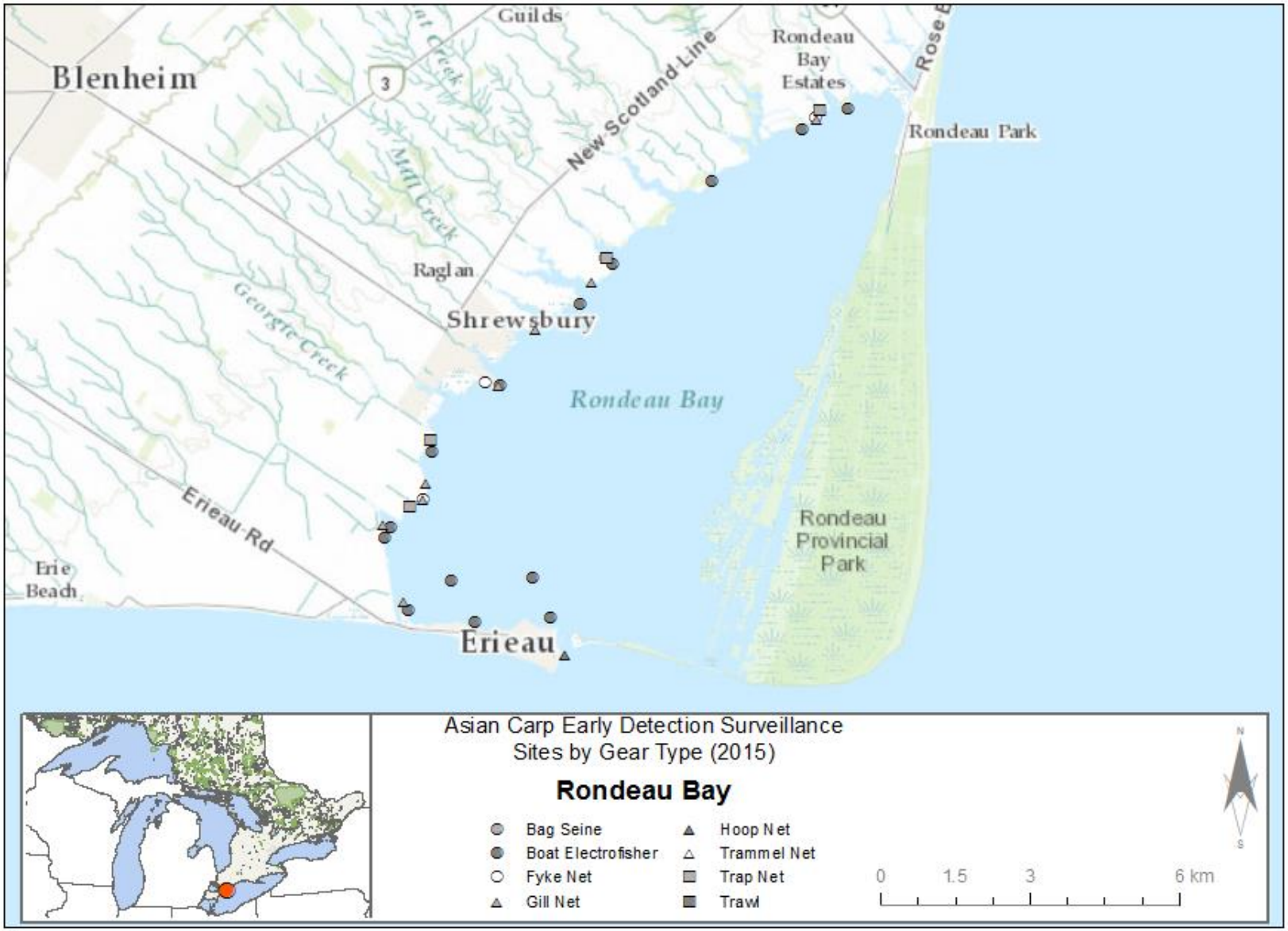

Figure 29. Asian Carp Program early detection surveillance sites and gear types used in Rondeau Bay in 2015.

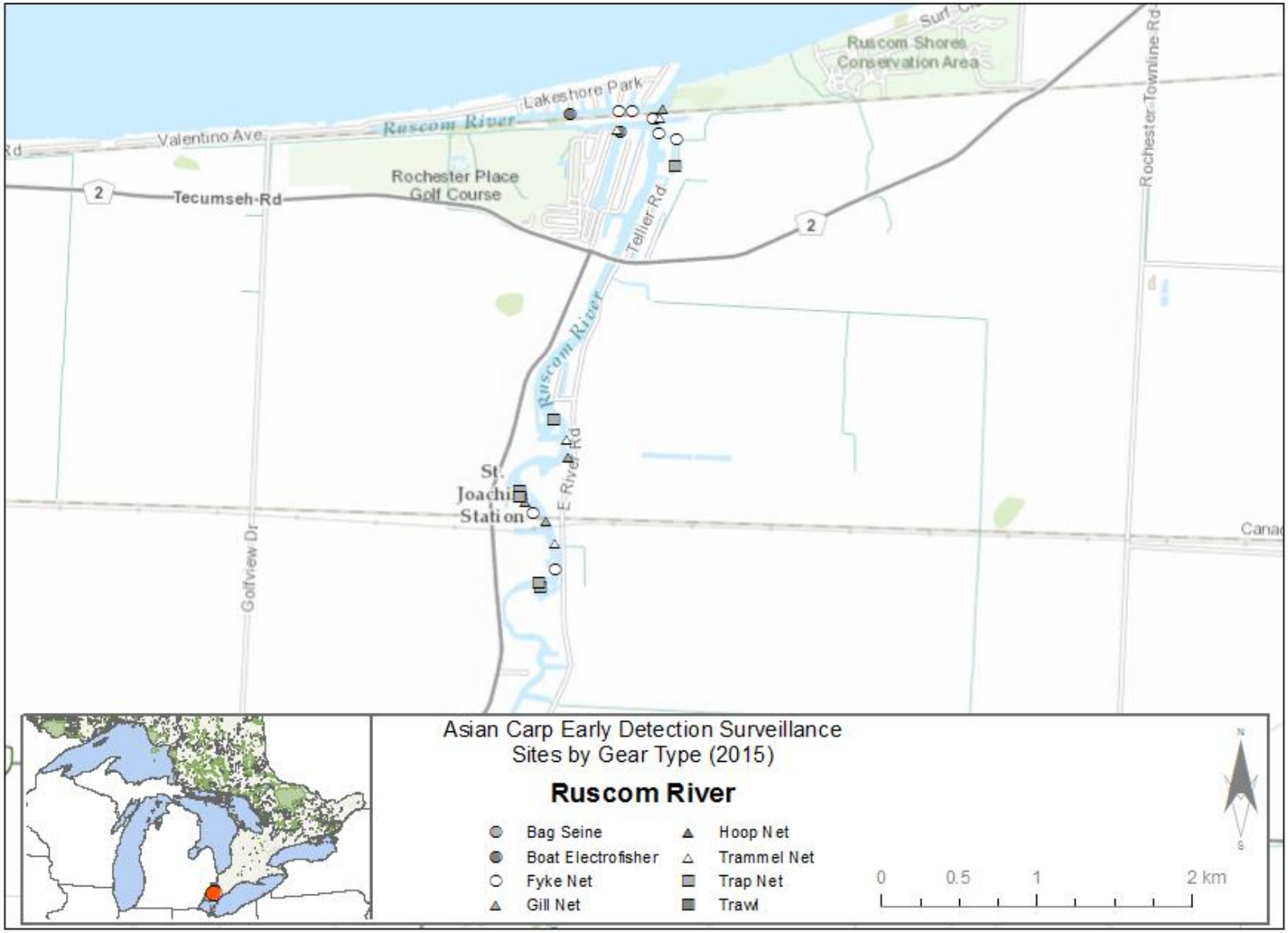

Figure 30. Asian Carp Program early detection surveillance sites and gear types used in the Ruscom River in 2015.

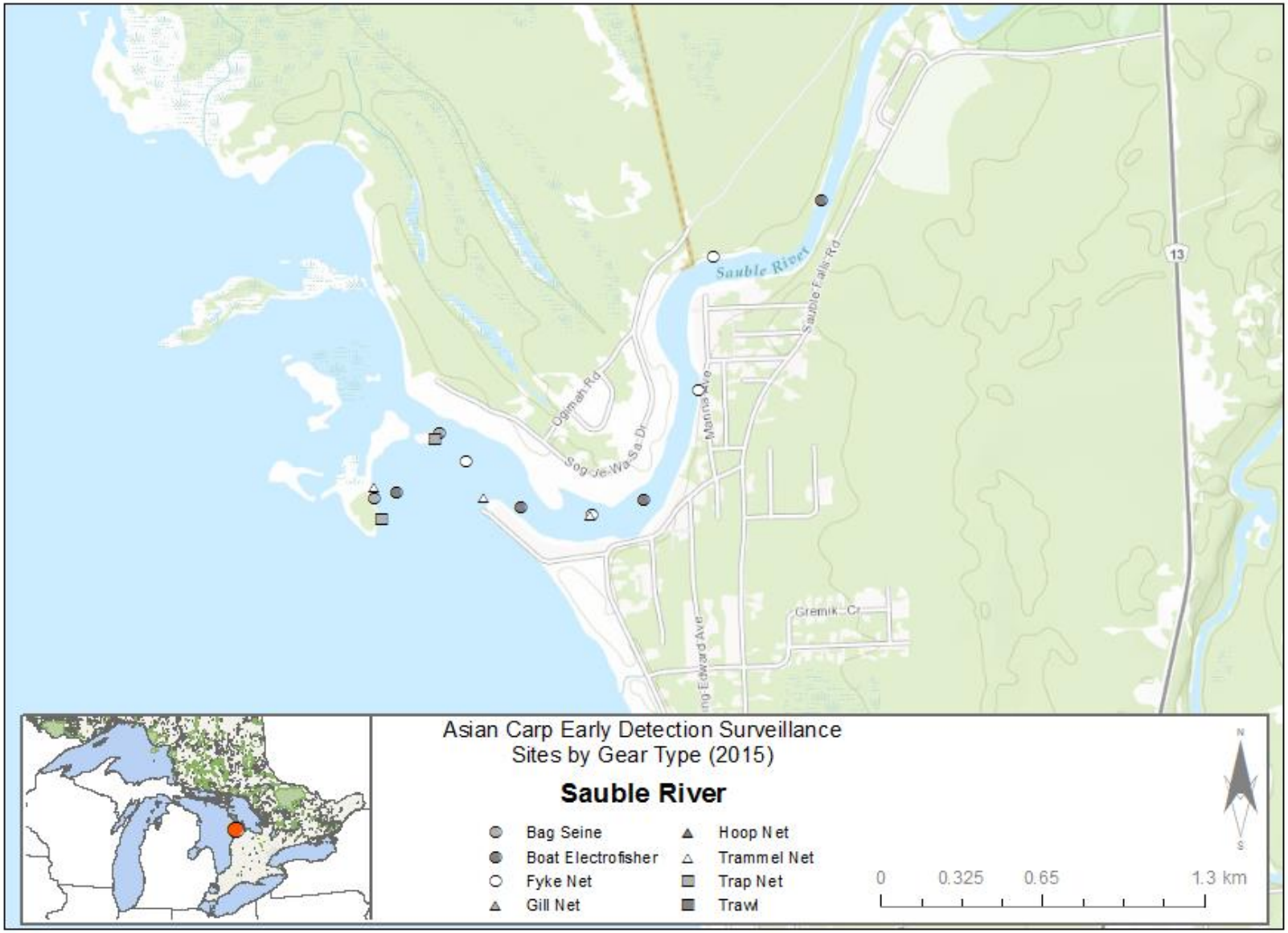

Figure 31. Asian Carp Program early detection surveillance sites and gear types used in the Sauble River in 2015.

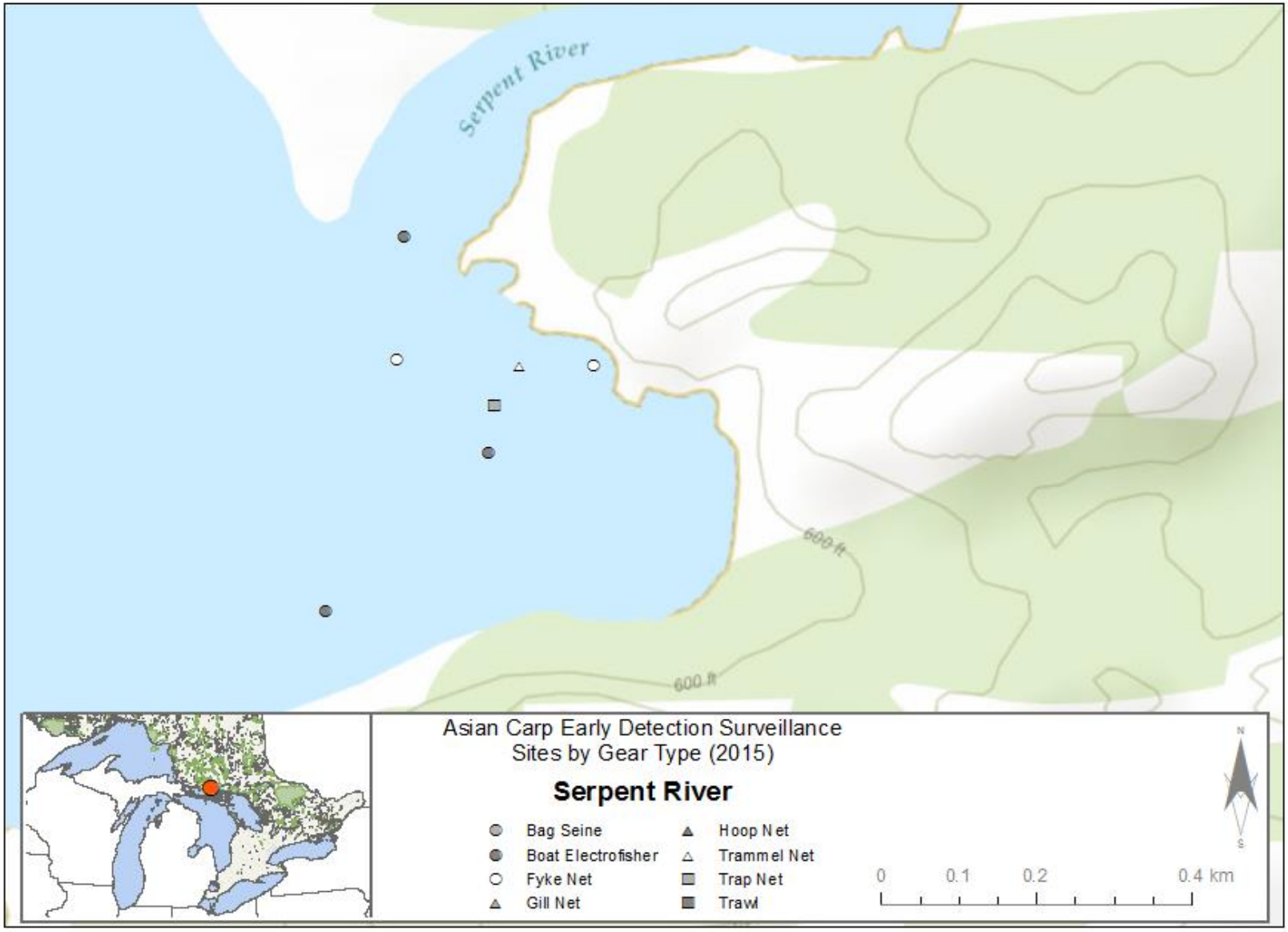

Figure 32. Asian Carp Program early detection surveillance sites and gear types used in the Serpent River in 2015.

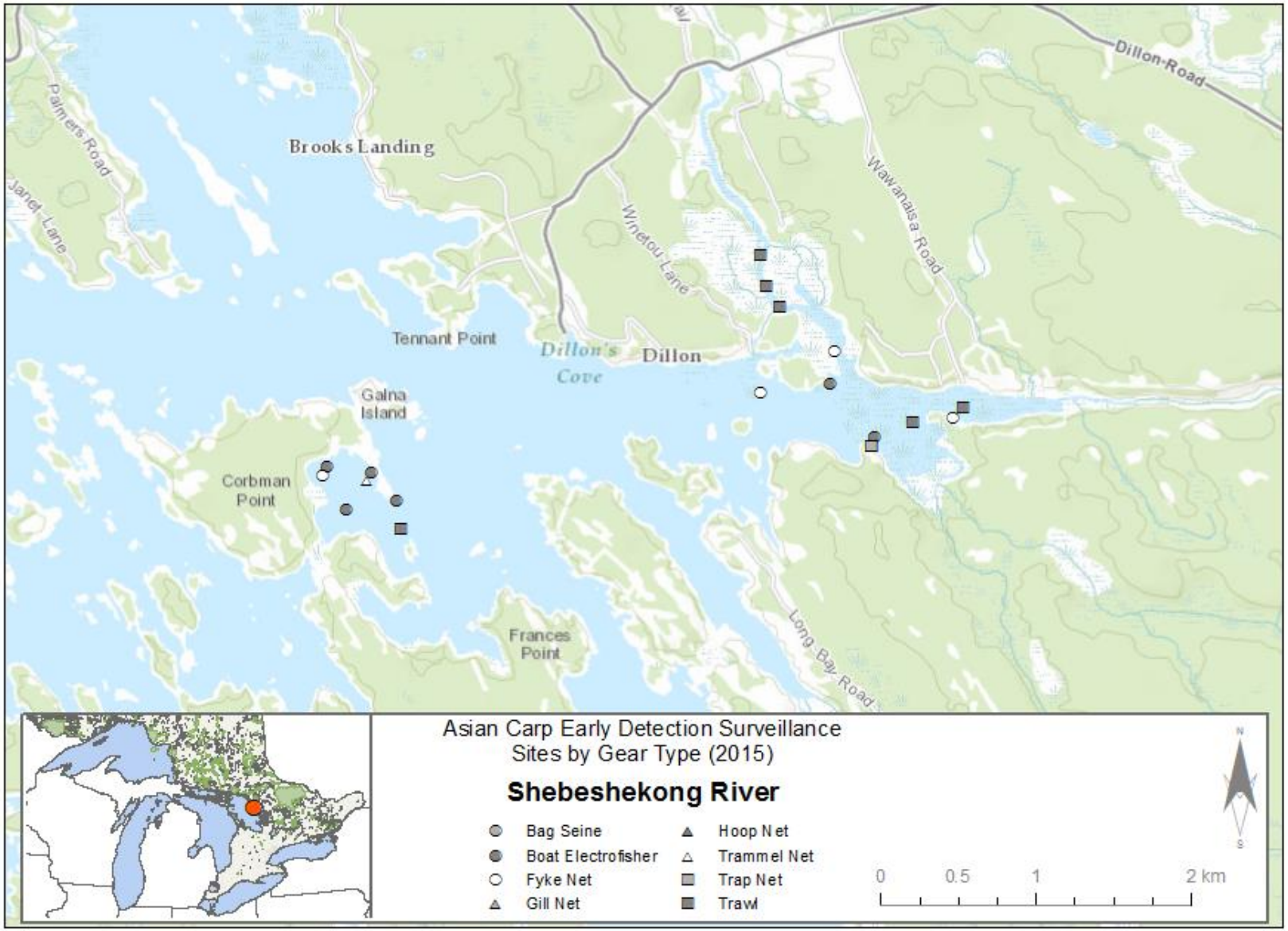

Figure 33. Asian Carp Program early detection surveillance sites and gear types used in the Shebeshekong River in 2015.

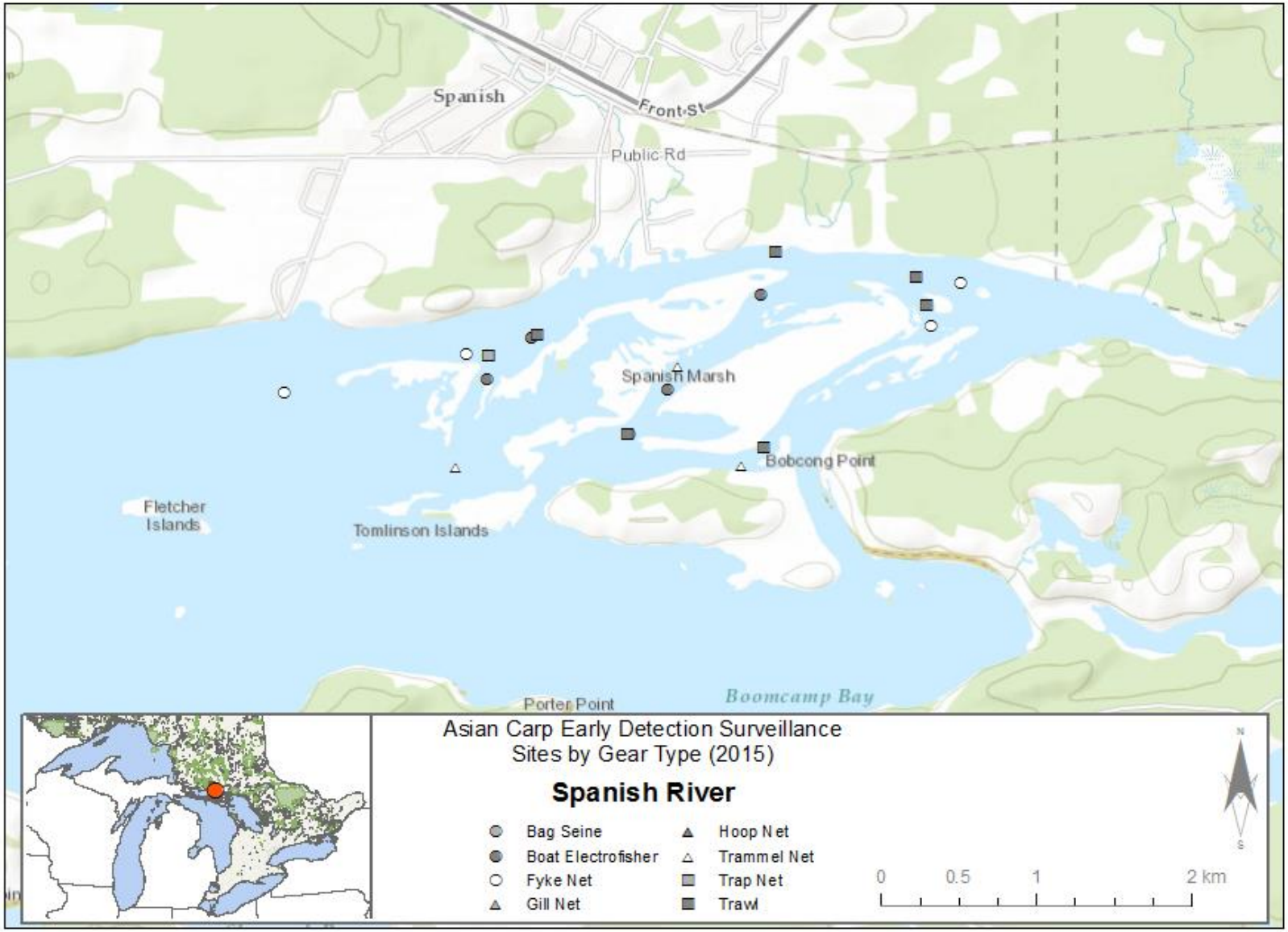

Figure 34. Asian Carp Program early detection surveillance sites and gear types used in the Spanish River in 2015.

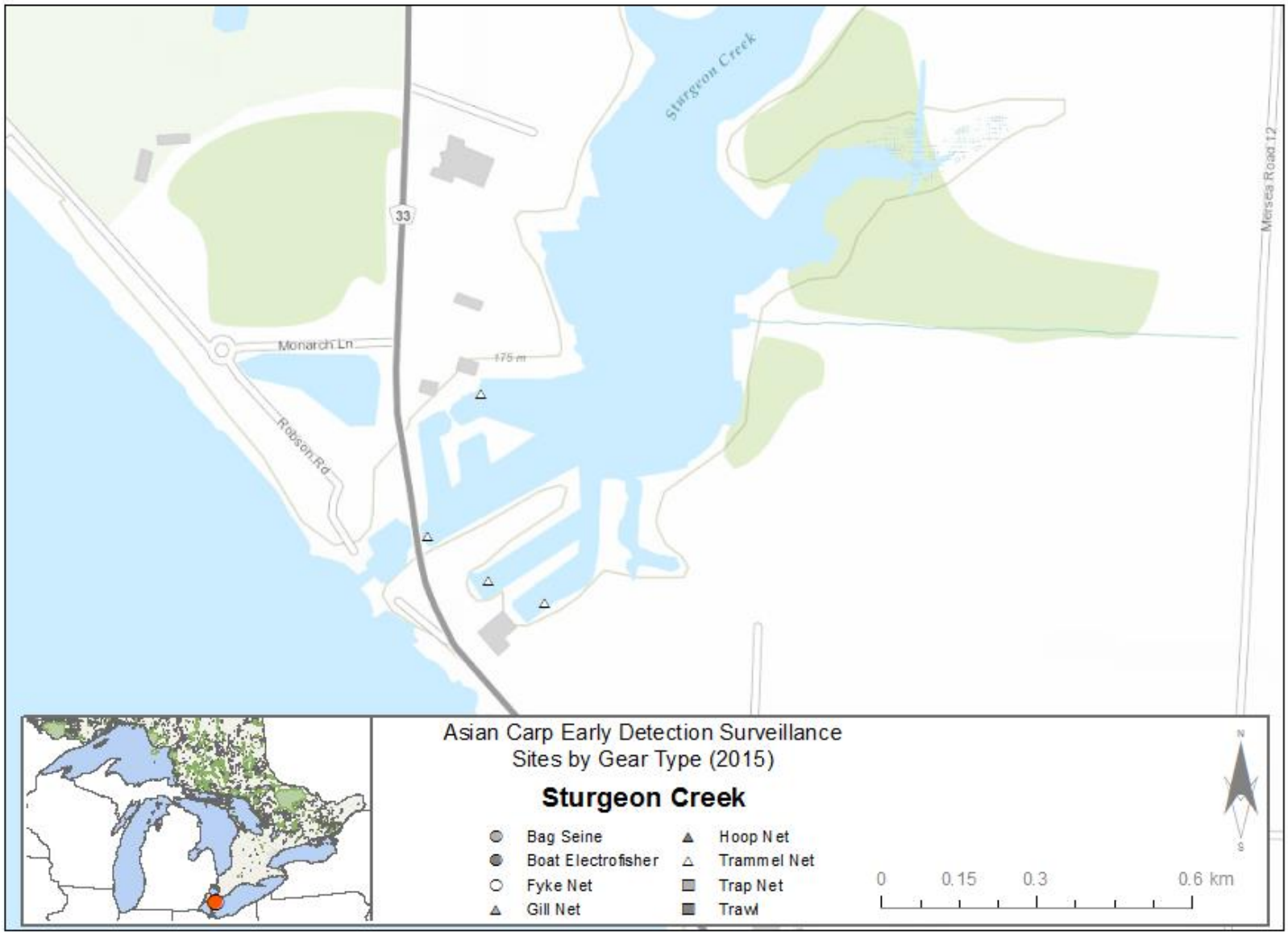

Figure 35. Asian Carp Program early detection surveillance sites and gear types used in Sturgeon Creek in 2015.

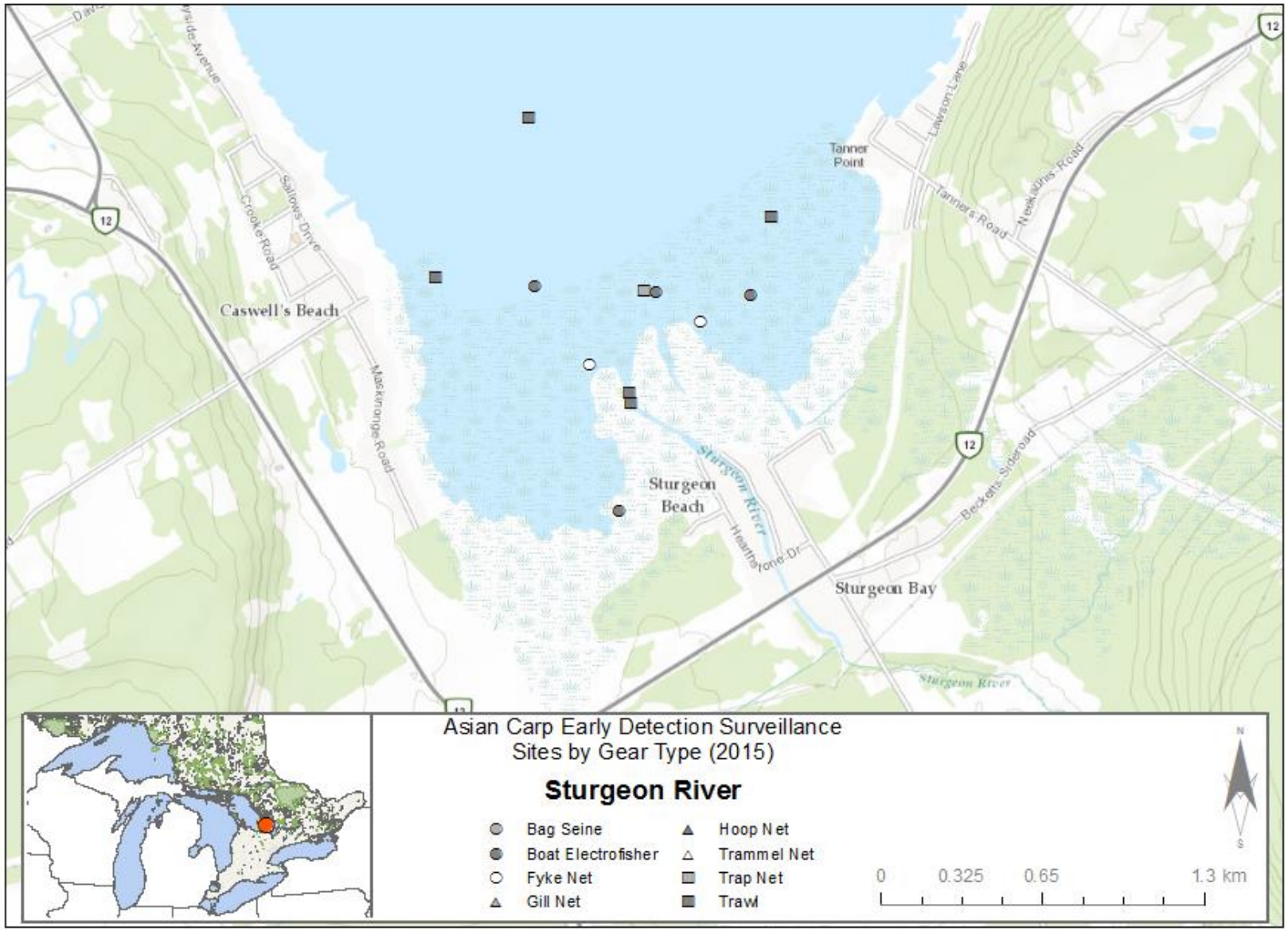

Figure 36. Asian Carp Program early detection surveillance sites and gear types used in the Sturgeon River in 2015.

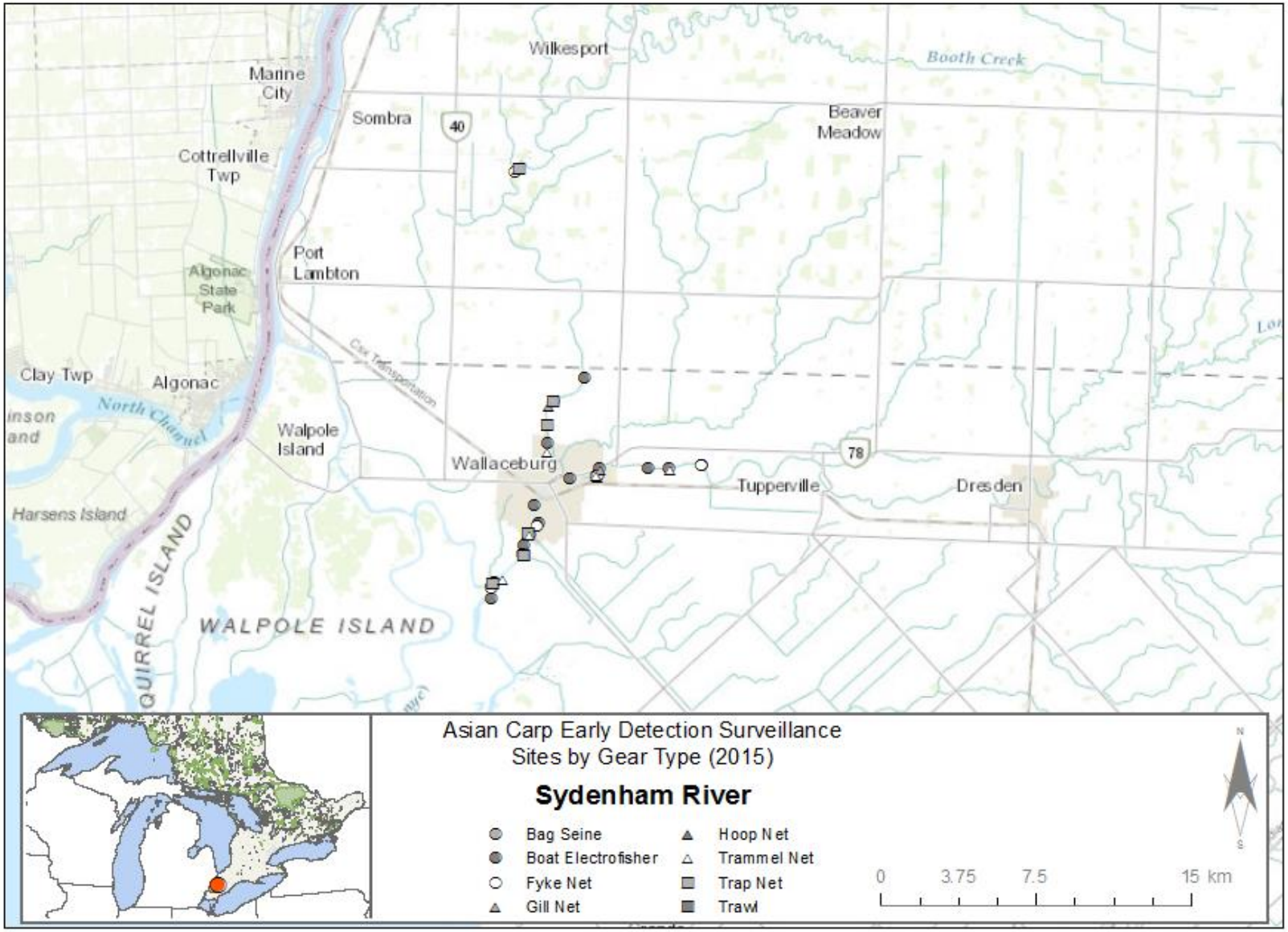

Figure 37. Asian Carp Program early detection surveillance sites and gear types used in the Sydenham River in 2015.

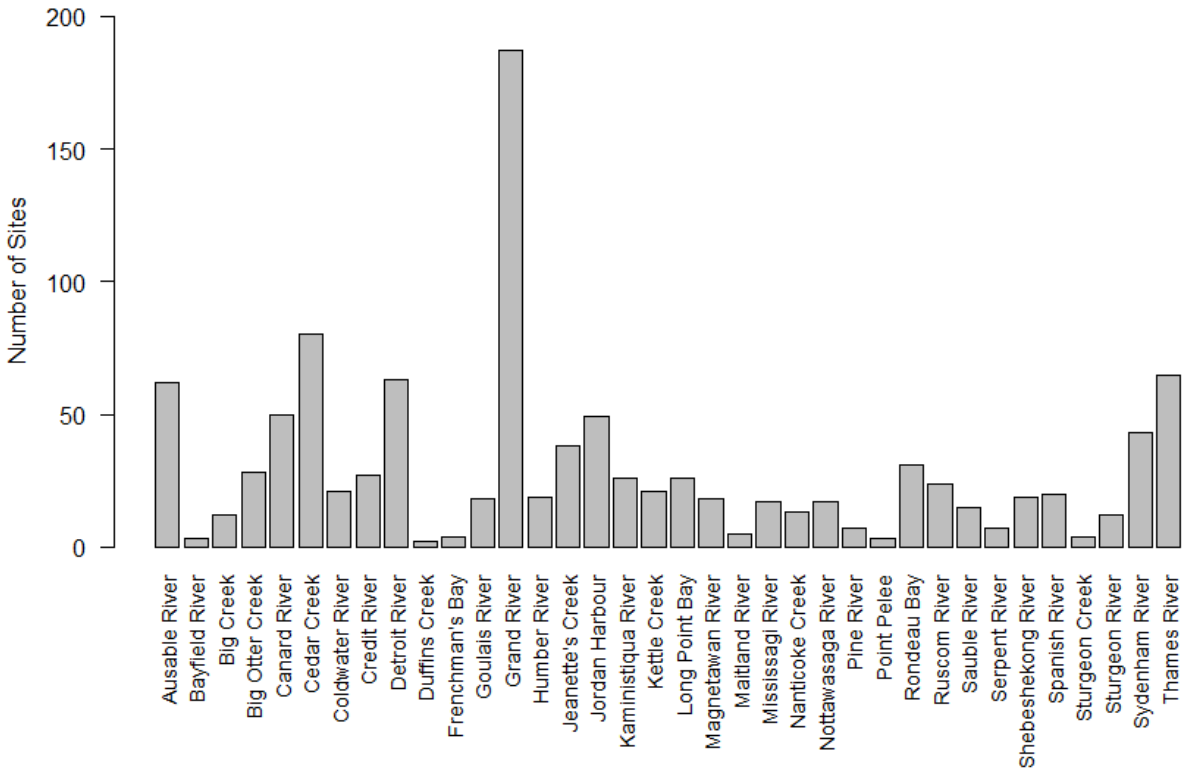

Figure 38. Number of sites sampled by waterbody in the 2015 Asian Carp Program's early detection surveillance.

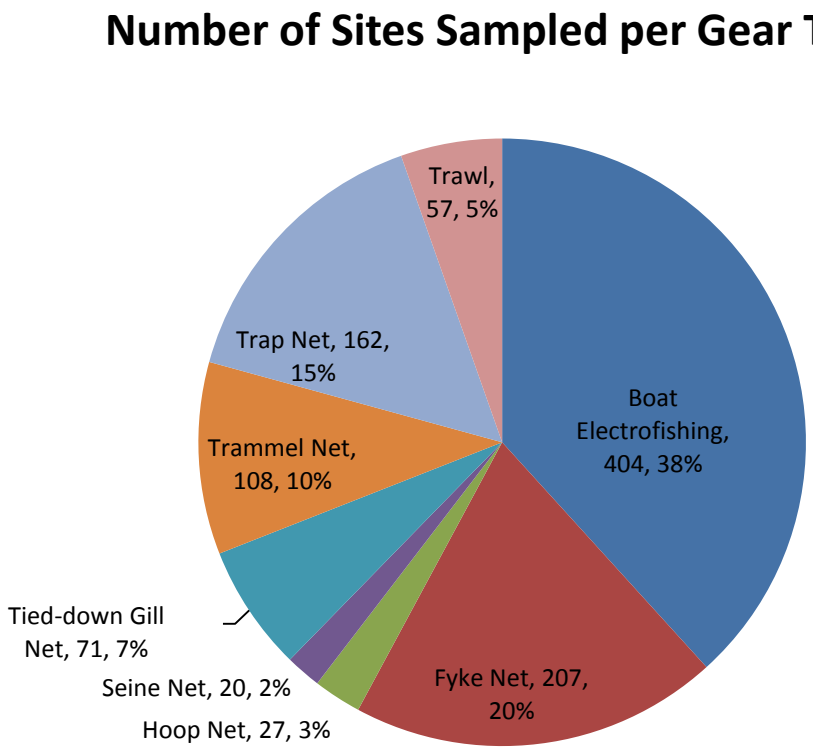

Figure 39. Number of sites sampled by gear type in the 2015 Asian Carp Program's early detection surveillance. Total number of sites sampled was 1,056.

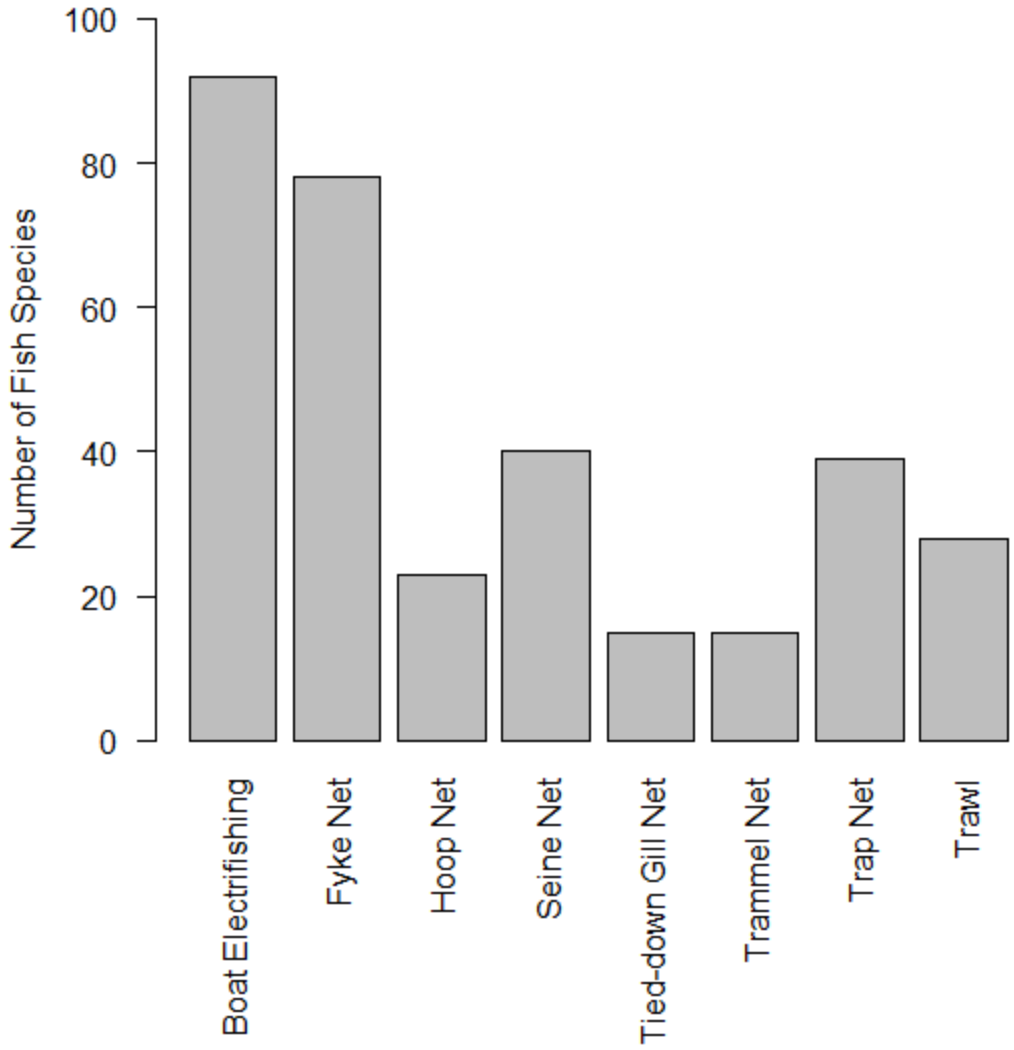

Figure 40. Number of species captured by gear type in the 2015 by the Asian Carp Program's early detection surveillance.

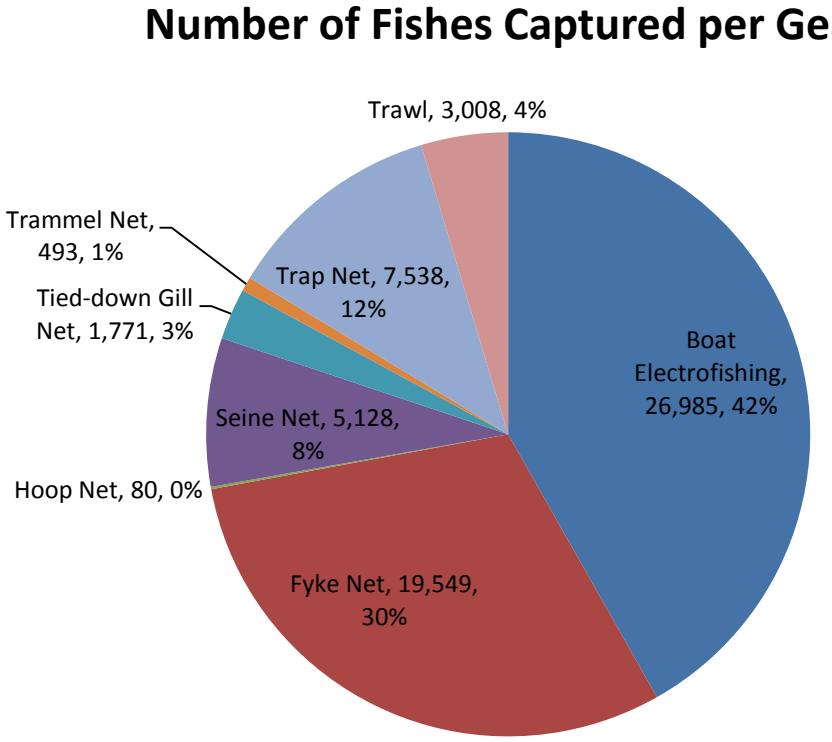

Figure 41. Number of fishes captured by gear type in 2015 Asian Carp Program's early detection surveillance. Total number of fishes captured was 64,552.

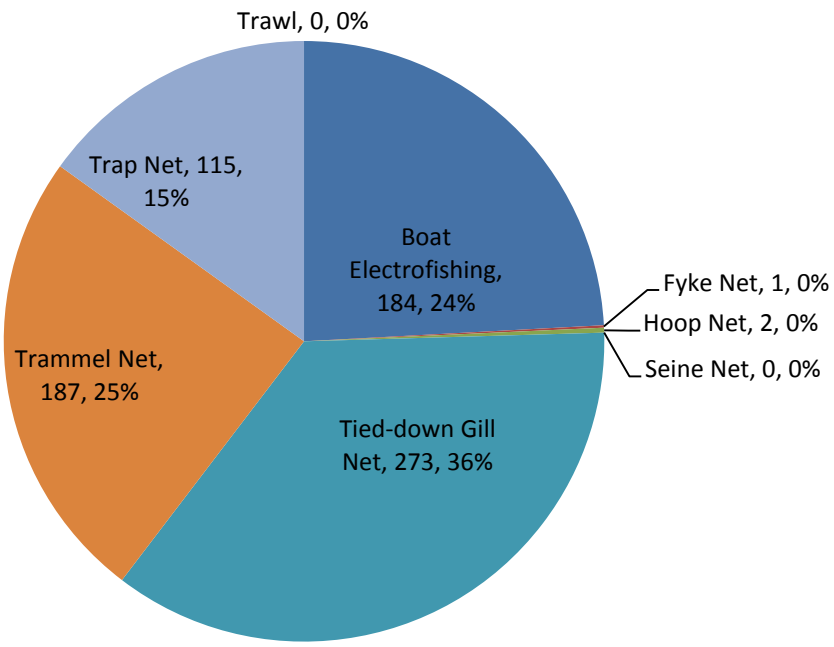

Figure 42. Number of buffalo species (*Ictiobus spp*.) captured by gear type in the 2015 by the Asian Carp Program's early detection surveillance. Total number of buffalo species captured was 762.

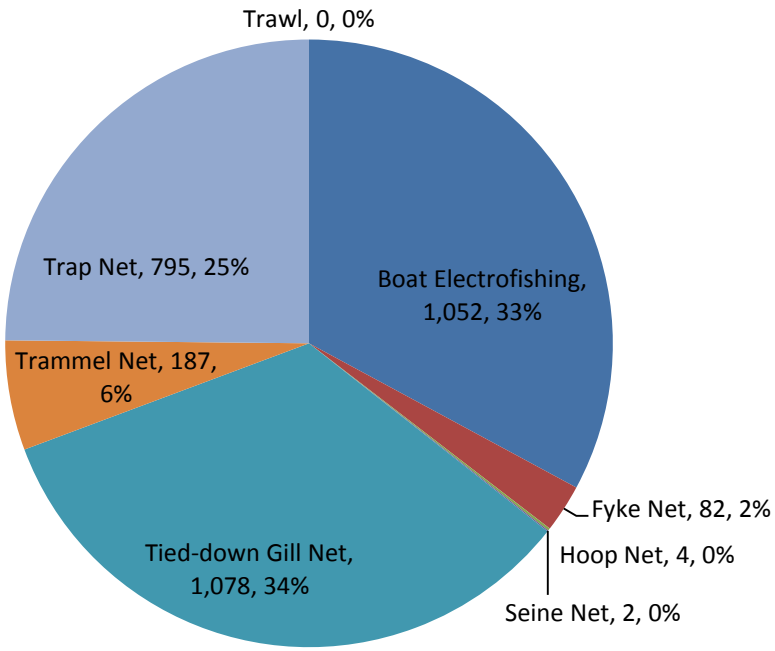

Figure 43. Number of Common Carp (*Cyprinus carpio*) captured by gear type in the 2015 by the Asian Carp Program's early detection surveillance. Total number of Common Carp captured was 3,200.

TABLES

Table 1. Summary of the 2015 catch data for the Asian Carp Program's early detection surveillance.

Catch Data	
Total number of sites	1,056
Total number of waterbodies	36
Total number of species detected	101
Total number of fishes caught	64,552
Total number of surrogates caught	3,962
Total number of Asian carps caught	1
Mean number of fishes caught per waterbody	1,793.11
Least fishes caught per waterbody	3
Most fishes caught per waterbody	12,629
Mean number of fishes caught per site	61.3
Maximum fishes caught per site	2,235

Table 2. Summary of the species captured during the 2015 Asian Carp Program's early detection surveillance field season. Common and scientific names according to Holm et al. 2010 and Nelson et al. 2003.

Rank abundance	Common Name	Scientific Name	Number of Specimens	SAR
52	Alewife	*Alosa pseudoharengus*	57	
77	American Brook Lamprey	*Lampetra appendix*	2	*
78	Atlantic Salmon	*Salmo salar*	1	
47	Banded Killifish	*Fundulus diaphanus*	84	
44	Bigmouth Buffalo	*Ictiobus cyprinellus*	97	*
51	Black Bullhead	*Ameiurus melas*	61	
25	Black Crappie	*Pomoxis nigromaculatus*	495	
65	Black Redhorse	*Moxostoma duquesnei*	15	
39	Blackchin Shiner	*Notropis heterodon*	154	
72	Blacknose Dace	*Rhinichthys atratulus*	7	
40	Blacknose Shiner	*Notropis heterolepis*	150	
77	Blackside Darter	*Percina maculata*	2	
70	Blackstripe Topminnow	*Fundulus notatus*	9	*
3	Bluegill	*Lepomis macrochirus*	5,072	
9	Bluntnose Minnow	*Pimephales notatus*	2,875	
32	Bowfin	*Amia calva*	290	
76	Brassy Minnow	*Hybognathus hankinsoni*	3	
28	Brook Silverside	*Labidesthes sicculus*	421	
67	Brook Stickleback	*Culaea inconstans*	13	
10	Brown Bullhead	*Ameiurus nebulosus*	2,593	
20	buffalo species	*Ictiobus sp*	665	
	Bullhead sp.	*Ameiurus sp*	2	
74	Central Mudminnow	*Umbra limi*	5	
76	Central Stoneroller	*Campostoma anomalum*	3	
13	Channel Catfish	*Ictalurus punctatus*	1,156	
66	Chinook Salmon	*Oncorhynchus tshawytscha*	14	
60	Coho Salmon	*Oncorhynchus kisutch*	25	
7	Common Carp	*Cyprinus carpio*	3,200	
15	Common Shiner	*Luxilus cornutus*	866	
66	Creek Chub	*Semotilus atromaculatus*	14	
2	Emerald Shiner	*Notropis atherinoides*	6,680	
23	Fathead Minnow	*Pimephales promelas*	515	
77	Fourspine Stickleback	*Apeltes quadracus*	2	
22	Freshwater Drum	*Aplodinotus grunniens*	539	

	gar	*Lepisosteidae*	1	
62	Ghost Shiner	*Notropis buchanani*	22	
1	Gizzard Shad	*Dorosoma cepedianum*	10,928	
33	Golden Redhorse	*Moxostoma erythrurum*	276	
18	Golden Shiner	*Notemigonus crysoleucas*	727	
27	Goldfish	*Carassius auratus*	456	
45	Goldfish X Common Carp hybrid	*Carassius auratus X Cyprinus carpio*	90	
78	Grass Carp	*Ctenopharyngodon idella*	1	
73	Grass Pickerel	*Esox americanus vermiculatus*	6	*
67	Greater Redhorse	*Moxostoma valenciennesi*	13	
55	Green Sunfish	*Lepomis cyanellus*	37	
78	Greenside Darter	*Etheostoma blennioides*	1	
48	Hornyhead Chub	*Nocomis biguttatus*	75	
61	Iowa Darter	*Etheostoma exile*	23	
17	Johnny Darter	*Etheostoma nigrum*	738	
72	Lake Chubsucker	*Erimyzon sucetta*	7	
78	Lake Sturgeon	*Acipenser fulvescens*	1	
69	Lake Trout	*Salvelinus namaycush*	11	
11	Largemouth Bass	*Micropterus salmoides*	1,411	
31	Logperch	*Percina caprodes*	305	
54	Longear Sunfish	*Lepomis megalotis*	44	
78	Longnose Dace	*Rhinichthys cataractae*	1	
16	Longnose Gar	*Lepisosteus osseus*	752	
4	Mimic Shiner	*Notropis volucellus*	4,370	
69	minnow	*Cyprinidae*	11	
	minnow	*Pimephales sp*	2	
78	Mooneye	*Hiodon tergisus*	1	
53	Mottled Sculpin	*Cottus bairdii*	54	
57	Muskellunge	*Esox masquinongy*	28	
71	Ninespine Stickleback	*Pungitius pungitius*	8	
74	Northern Hogsucker	*Hypentelium nigricans*	5	
38	Northern Pike	*Esox lucius*	213	
65	Northern Sunfish	*Lepomis peltastes*	15	
70	Orangespotted Sunfish	*Lepomis humilis*	9	
	pike	*Esocidae*	1	
72	Pugnose Minnow	*Opsopoeodus emiliae*	7	
72	Pugnose Shiner	*Notropis anogenus*	7	
8	Pumpkinseed	*Lepomis gibbosus*	3,105	
26	Quillback	*Carpiodes cyprinus*	457	

21	Rainbow Smelt	*Osmerus mordax*	587	
70	Rainbow Trout	*Oncorhynchus mykiss*	9	
56	redhorse	*Moxostoma sp*	34	
71	River Redhorse	*Moxostoma carinatum*	8	*
19	Rock Bass	*Ambloplites rupestris*	723	
50	Roseyface Shiner	*Notropis rubellus*	64	
6	Round Goby	*Neogobius melanostomus*	3,504	
43	Rudd	*Scardinius erythrophthalmus*	103	
68	Ruffe †	*Gymnocephalus cernua*	12	
75	Sand Shiner	*Notropis stramineus*	4	
77	Sauger	*Sander canadensis*	2	
76	Sea Lamprey	*Petromyzon marinus*	3	
	shiner	*Luxilus sp*	2	
	shiner	*Notropis sp*	1	
36	Shorthead Redhorse	*Moxostoma macrolepidotum*	227	
71	Silver Lamprey	*Ichthyomyzon unicuspis*	8	
37	Silver Redhorse	*Moxostoma anisurum*	218	
34	Smallmouth Bass	*Micropterus dolomieu*	273	
29	Spotfin Shiner	*Cyprinella spiloptera*	403	
12	Spottail Shiner	*Notropis hudsonius*	1,285	
63	Spotted Gar	*Lepisosteus oculatus*	21	*
42	Spotted Sucker	*Minytrema melanops*	106	*
46	Striped Shiner	*Luxilus chrysocephalus*	89	
65	sucker	*Catostomidae*	15	
	sunfish	*Lepomis sp*	10	
59	sunfish hybrid	*Lepomis hybrid*	26	
58	Tadpole Madtom	*Noturus gyrinus*	28	
76	Three-spined Stickleback	*Gasterosteus aculeatus*	3	
49	Trout-perch	*Percopsis omiscomaycus*	69	
64	Tubenose Goby	*Proterorhinus semilunaris*	18	
40	Walleye	*Sander vitreus*	150	
73	Warmouth	*Lepomis gulosus*	6	*
24	White Bass	*Morone chrysops*	515	
30	White Crappie	*Pomoxis annularis*	397	
35	White Perch	*Morone americana*	271	
14	White Sucker	*Catostomus commersonii*	1,052	
41	Yellow Bullhead	*Ameiurus natalis*	131	
5	Yellow Perch	*Perca flavescens*	3,869	

† All Ruffe were detected in the Kaministiqua River.

Table 3. Summary of the catch data by gear types used in the 2015 Asian Carp Program's early detection surveillance.

Gear Type	Acronym	Total Effort	Effort Unit	Number of Sites	Number of Waterbodies	Number of Fishes	Number of Species	Number of buffalo spp.	Number of Common Carp	Number of Asian carps
Boat Electrofishing	BEF	272,034	seconds	404	34	26,985	92	184	1,052	0
Fyke Net	FN	4,338.9	hours	207	28	19,549	78	1	82	0
Hoop Net	HN	1,033.72	hours	27	7	80	23	2	4	0
Seine Net	SN	45	hauls	20	7	5,128	40	0	2	0
Tied-down Gill Net	TGN	2,018.49	minutes	71	17	1,771	15	273	1,078	0
Trammel Net	TRM	3,975.31	minutes	108	23	493	15	187	187	1
Trap Net	TN	3,381.01	hours	162	28	7,538	39	115	795	0
Trawl	TRL	186	hauls	57	10	3,008	28	0	0	0

Table 4. Catch data by waterbody for the 2015 Asian Carp Program's early detection surveillance.

Waterbody	Number of Sites	Number of Species	Number of Fishes	Number of buffalo spp.	Number of Common Carp	Number of Asian carps
Ausable River	62	43	4,183	37	168	0
Bayfield River	3	23	220	0	23	0
Big Creek	12	20	1,289	28	60	0
Big Otter Creek	28	32	1,416	0	30	0
Canard River	50	39	3,055	118	207	0
Cedar Creek	80	41	4,969	126	1,246	0
Coldwater River	21	24	1,788	0	0	0
Credit River	27	34	2,012	0	13	0
Detroit River	63	47	3,117	8	126	0
Duffins Creek	2	17	230	0	8	0
Frenchman's Bay	4	18	292	0	6	0
Goulais River	18	17	520	0	0	0
Grand River	187	50	12,629	111	464	0
Humber River	19	30	1,488	0	64	0
Jeannette's Creek	38	41	2,776	43	71	0
Jordan Harbour	49	33	2,567	91	141	1
Kaministiqua River	26	17	1,065	0	0	0
Kettle Creek	21	29	483	1	23	0
Long Point Bay	26	35	1,930	1	41	0
Magnetawan River	18	19	743	0	0	0
Maitland River	5	24	224	0	10	0
Mississagi River	17	18	2,868	0	4	0
Nanticoke Creek	13	23	377	0	70	0
Nottawasaga River	17	23	607	0	11	0
Pine River	7	20	711	0	12	0
Point Pelee	3	19	196	0	47	0
Rondeau Bay	31	33	2,244	0	56	0
Ruscom River	24	28	551	1	42	0
Sauble River	15	31	2,018	0	3	0
Serpent River	7	16	122	0	0	0
Shebeshekong River	19	22	1,264	0	7	0
Spanish River	20	23	525	0	4	0
Sturgeon Creek	4	2	3	0	1	0
Sturgeon River	12	18	356	0	0	0
Sydenham River	43	45	1,726	45	66	0

Thames River	65	40	3,988	152	176	0

Table 5. Sampling effort by waterbody for boat electrofishing (BEF), fyke nets (FN), hoop nets (HN), seining (SN), tied-down gill nets (TGN), trammel nets (TRM), trap nets (TN), and trawling (TRL) during the 2015 Asian Carp Program's early detection surveillance.

Waterbody	# of BEF Sites	BEF Effort (sec)	# of FN Sites	FN Effort (hrs)	# of HN Sites	HN Effort (hrs)	# of SN Sites	SN Effort (hauls)	# of TGN Sites	TGN Effort (mins)	TGN Effort (m of net)	# of TRM Sites	TRM Effort (mins)	TRM effort (m of net)	# of TN Sites	TN Effort (hrs)	# of TRL Sites	TRL Effort (hauls)
Ausable River	30	18,062	10	177.88	0	0	0	0	6	75	1,097	5	296	914	11	224.95	0	0
Bayfield River	3	1,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Creek	7	4,531	0	0	0	0	0	0	0	0	0	5	77	366	0	0	0	0
Big Otter Creek	14	8,371	5	106.75	4	61.6	0	0	2	25	366	2	45	914	1	20.00	0	0
Canard River	17	10,361	13	255.44	0	0	0	0	4	63	732	4	139	732	12	225.02	0	0
Cedar Creek	19	12,654	25	516.63	0	0	2	6	4	87	732	13	523	2835	17	336.87	0	0
Coldwater River	10	6,000	6	105.00	0	0	0	0	0	0	0	0	0	0	2	42.00	3	9
Credit River	8	4,380	10	206.88	0	0	0	0	3	40	549	0	0	0	6	119.20	0	0
Detroit River	33	20,131	6	183.75	4	169.4	0	0	4	99	732	8	502	1463	8	204.50	0	0
Duffins Creek	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frenchman's Bay	4	2,107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goulais River	4	2,537	4	95.00	0	0	2	2	0	0	0	2	20	366	2	47.00	4	14
Grand River	78	54,624	27	543.55	8	348.3	4	12	9	475	1,646	26	739	5121	23	465.94	12	45
Humber	9	8,300	4	94.01	0	0	0	0	3	75	549	0	0	0	3	70.10	0	0

River																		
Jeannette's Creek	13	7,931	15	328.46	2	76.44	0	0	1	98	183	4	93	914	3	60.88	0	0
Jordan Harbour	7	4,500	14	291.65	0	0	3	9	7	262	1,280	4	292	732	14	285.11	0	0
Kaministiqua River	12	7,430	3	72.00	0	0	2	0	0	0	0	0	0	0	2	53.00	7	21
Kettle Creek	9	5,425	5	98.50	1	20	0	0	3	37	549	1	17	183	2	40.50	0	0
Long Point Bay	13	7,670	3	61.61	0	0	0	0	1	24	183	0	0	0	9	184.67	0	0
Magnetawan River	4	4,252	5	114.00	0	0	0	0	0	0	0	1	10	183	2	46.00	6	19
Maitland River	5	2,560	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mississagi River	3	5,078	5	75.00	0	0	3	4	0	0	0	1	10	183	2	41.00	3	10
Nanticoke Creek	6	3,600	2	43.00	0	0	0	0	3	54	549	0	0	0	2	43.50	0	0
Nottawasaga River	3	8,093	6	152.00	0	0	0	0	0	0	0	1	10	183	2	50.00	5	18
Pine River	4	3,514	0	0	0	0	2	6	0	0	0	1	125	274	0	0	0	0
Point Pelee	3	1,870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rondeau Bay	14	8,227	4	77.00	1	47	0	0	8	156	1,463	0	0	0	4	84.50	0	0
Ruscom River	3	1,800	7	135.96	0	0	0	0	4	78	732	4	100	732	6	125.87	0	0
Sauble River	4	3,357	4	105.25	0	0	2	6	0	0	0	3	55	549	2	48.50	0	0
Serpent River	3	1,810	2	38.00	0	0	0	0	0	0	0	1	10	183	1	18.00	0	0
Shebeshekong River	6	7,193	4	87.50	0	0	0	0	0	0	0	1	10	183	2	41.00	6	18

Spanish River	5	3,129	4	83.00	0	0	0	0	0	0	0	3	30	549	2	43.00	6	17
Sturgeon Creek	0	0	0	0	0	0	0	0	0	0	0	4	344	732	0	0	0	0
Sturgeon River	4	2,413	2	48.00	0	0	0	0	0	0	0	0	0	0	1	24.00	5	15
Sydenham River	14	8,800	10	243.09	0	0	0	0	5	102	914	5	252	1006	9	191.52	0	0
Thames River	33	20,124	0	0	7	311.1	0	0	4	268	732	9	276	1737	12	244.39	0	0