Asian Carp Occurrences in the Great Lakes and St. Lawrence River Basins, 1985–2023

Colin Illes and Matthew Cowley

Asian Carp Program
Aquatic Ecosystems
Ontario and Prairie Region
Fisheries and Oceans Canada
867 Lakeshore Road, Burlington, ON, L7S 1A1

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ABSTRACT

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Asian carp occurrence data from the Canadian side of the Laurentian Great Lakes and St. Lawrence River basins, 1985-2023, were obtained from citizen, commercial fisher, and government agency reports. Forty-four Asian carps have been caught in the wild in Canadian waters of both basins. Of the reported Asian carps, 43 were Grass Carp (*Ctenopharyngodon idella*) and one was a Bighead Carp (*Hypophthalmichthys nobilis*); no Silver Carp (*H. molitrix*) or Black Carp (*Mylopharyngodon piceus*) have been reported in Canadian waters. Information related to reproductive status (i.e., ploidy results) was available for 36 of the captured Grass Carp, 17 being fertile (diploid) and 19 being sterile (triploid). Otolith core microchemistry results were available for 23 of the captured Grass Carp indicating that three had a likely wild origin, while 20 had a likely aquaculture origin. Twelve Asian carp responses have triggered additional targeted sampling operations in the Great Lakes basin resulting in 13 Grass Carp captures.

RÉSUMÉ

Illes, C. and Cowley, M. 2024. Asian Carp Occurrences in the Great Lakes and St. Lawrence River Basins, 1985–2023. Can. Data Rep. Fish. Aquat. Sci. 1415: vi + 9 p.

Les données sur la présence de carpes asiatiques du côté canadien des bassins des Grands Lacs laurentiens et du fleuve Saint-Laurent, de 1985 à 2023, ont été obtenues auprès de citoyens, de pêcheurs commerciaux et d’organismes gouvernementaux. Quarante-quatre carpes asiatiques ont été capturées à l’état sauvage dans les eaux canadiennes de ces deux bassins. De ce nombre, 43 étaient des carpes de roseau (*Ctenopharyngodon idella*) et 1 était une carpe à grosse tête (*Hypophthalmichthys nobilis*); aucune carpe argentée (*H. molitrix*) ou carpe noire (*Mylopharyngodon piceus*) n’a été signalée dans les eaux canadiennes. Des renseignements sur l’état de reproduction (c.-à-d. les résultats des tests de ploïdie) étaient disponibles pour 36 carpes de roseau capturées; 17 étaient fertiles (diploïdes) et 19 stériles (triploïdes). Les résultats des études microchimiques sur les noyaux d’otolithe étaient disponibles pour 23 carpes de roseau capturées; 3 d’entre elles seraient probablement d’origine sauvage, tandis que les 20 autres provenaient probablement d’installations d’aquaculture. Douze interventions de lutte contre la carpe asiatique ont déclenché des opérations supplémentaires d’échantillonnage ciblé dans le bassin des Grands Lacs; celles-ci ont permis de capturer 13 captures de carpes de roseau.

INTRODUCTION

Asian carps [Grass Carp (*Ctenopharyngodon idella*), Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), and Black Carp (*Mylopharyngodon piceus*)] pose invasion risk to the Laurentian Great Lakes basin (Cudmore et al. 2012; Cudmore et al. 2017). Fisheries and Oceans Canada (DFO) has an Asian Carp Program focusing on preventing the entry and establishment of Asian carps in Canadian waters of the Great Lakes basin through outreach, early warning, response, and management.

As of now, Asian carps are not established in Canadian waters of the Great Lakes or St. Lawrence River basins; however, Grass Carp have been captured in the Lake Erie, Lake Huron, and Lake Ontario basins, and a single Bighead Carp in Lake Erie (Morrison et al. 2004). Ecological risk assessments of Grass Carp, Silver Carp, and Bighead Carp have concluded that the Great Lakes basin is suitable to support the successful establishment of these species (Cudmore et al. 2012; Cudmore et al. 2017).

A Grass Carp invasion into Canadian waters is a growing concern because reproduction has occurred in the Maumee and Sandusky rivers in Lake Erie, Ohio (Chapman et al. 2021). This highlights the continued need for robust surveillance and response efforts in Canadian waters. This data report summarizes Asian carp occurrences in Canadian waters, biological data of captured Asian carps, and response efforts following confirmed reports.

METHODS

ASIAN CARP OCCURENCES

Occurrences of Asian carps (n=44) in the Great Lakes and St. Lawrence River basins, 1985-2023, were compiled from citizen, commercial fisher, and government agency reports. Date and coordinates were collected for each occurrence. Measurements including fork length (m), total length (m), girth (m), weight (kg), and individual gonad weight (g) were taken from captured fish, when possible. A visual inspection of the gonads was conducted to determine sex. Gonad samples were also collected and sent fresh or fixed in formalin for histology testing to confirm sex and reproductive potential.

To estimate the age of captured fish, vertebrae were removed, dried, and fixed in Specific 40 media. Vertebrae were sectioned in a transverse plane to a thickness of 0.5 mm using a low-speed IsoMetTM saw with a diamond-tipped blade. Vertebrae sections were then polished and mounted on a slide for age estimation using transmitted light.

Otoliths were removed for stable isotope and microchemistry analyses to estimate the origin of the captured Grass Carp. The analyses followed the standardized assessment methods outlined by Whitledge et al. (2020). Grass Carp with δ18O otolith core microchemistry signatures ranging from -0.19‰ to -4.92‰ were considered to have an aquaculture origin, while those with δ18O otolith core microchemistry signatures between -5.12‰ and -13.55‰ were considered to be of wild (i.e., northeastern North America) origin (Whitledge et al. 2020). If the δ18O otolith core microchemistry signature fell between -4.93‰ and -5.11‰, local water δ18O and otolith δ18O microchemistry were considered to estimate the origin.

Flow cytometric analysis of blood or vitreous humor cells was used to determine the ploidy (i.e., inferred reproductive status) of the captured Grass Carp. Eye balls were removed and preserved in a 10% saline solution and vitreous fluid was extracted and stored in Acid Citrate Dextrose, while blood was taken and stored in Acid Citrate Dextrose. Vitreous humor cells from the eye were used if a blood sample was unavailable or of poor quality. Flow cytometry was conducted using a BD Accuri™ C6 Flow Cytometer or BD Accuri™ C6 Plus Flow Cytometer,

with chicken nuclei standard and/or Nile Tilapia (*Oreochromus niloticus*) blood as controls, following the standardized ploidy assessment methods outlined by Jenkins et al. (2019). Grass Carp with a genome size of 1.7-2.15 pg were considered fertile, and those with a genome size of 2.58-3.35 pg were considered sterile (Gregory 2023). If the genome size fell between 2.16 and 2.57 pg, the condition of the gonads and genome size were both considered to infer reproductive status.

Additional biological samples were collected from specimens where possible, including fin clips for future genetic analysis; post-cleithra and dorsal and pectoral fin rays for aging structure comparison; and stomach contents.

ASIAN CARP RESPONSES

Records of Asian carp response operations (n=12) from across the Great Lakes basin between 2013 and 2023 were obtained from government agency reports. Date, sampling coordinates, agencies involved, effort by gear type, and number of Asian carps captured were collected during each response and summarized here. The decision tree developed by the Asian Carp Program and used to determine whether operations should be activated in response to an Asian carp occurrence is shown in Figure 1.

RESULTS

ASIAN CARP OCCURENCES

Forty-four Asian carps have been reported in Canadian waters of the Great Lakes and St. Lawrence River basins, with 43 reported in the Great Lakes basin and one in the St. Lawrence River basin (Figure 2; Table 1). This report does not include Asian carps that occurred in aquariums, fountains, or markets. Forty-three of the reported Asian carps were Grass Carp and one was a Bighead Carp; no Silver Carp or Black Carp have been detected in Canada.

Fifteen Grass Carp and the single Bighead Carp were captured by commercial fishers, 21 Grass Carp were captured by government agencies, and six Grass Carp were reported by citizens. The total lengths of the Grass Carp captured ranged between 0.44 m and 1.26 m, and the total length of the Bighead Carp captured was 0.94 m. The weights of the Grass Carp ranged between 8.1 kg and 29.03 kg, and the weight of the Bighead Carp was 17.5 kg. Age estimates of Grass Carp for which structures were available ranged from five years and 16 years. Twelve Grass Carp were female, 23 were male, and eight were unidentifiable (likely juvenile or triploid); the Bighead Carp was female. Otolith core microchemistry results were available for 23 of the reported Grass Carp, indicating that three had a presumed wild origin, while 20 had a presumed aquaculture origin. Results regarding reproductive status were available for 36 of the captured Grass Carp, with 17 being diploid and 19 being triploid.

ASIAN CARP RESPONSES

Twelve Asian carp responses included targeted sampling operations in Canadian waters of the Great Lakes basin (Figure 3), resulting in 13 additional Grass Carp captures. Ten of the additional captures occurred in Lake Gibson, two were in Lake Ontario near the Toronto Islands, and one was in a pond in Tommy Thompson Park. Data collected from two of these Asian carp responses are included in Appendix A.

ACKNOWLEDGEMENTS

We thank all agencies, commercial fishers, and citizens/recreational anglers for reporting captures, helping preserve and transfer specimens to DFO, and for assistance during response operations.

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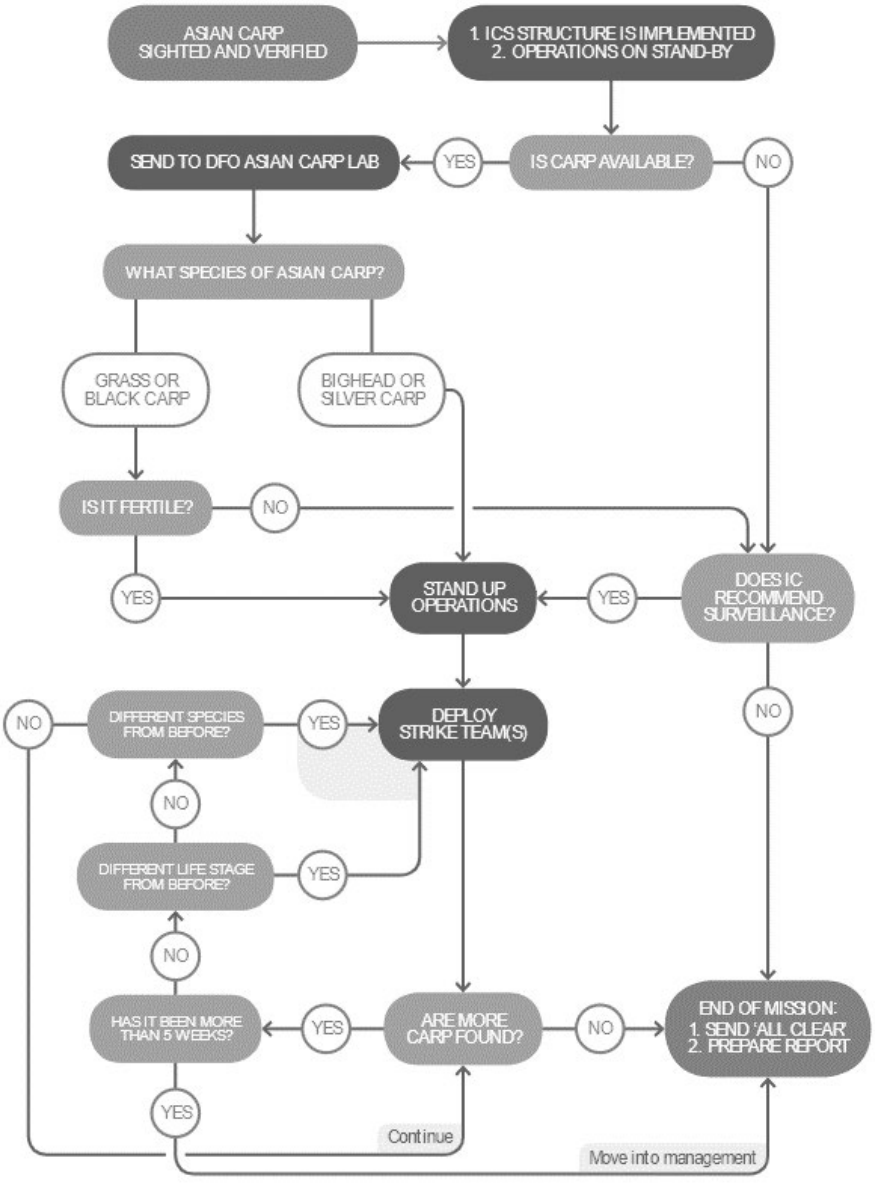

Figure 1. Asian Carp Program response decision tree. On-the-water operations and deployment of additional crews or agencies are contingent on multiple factors, including the type of species and number of specimens caught, the life stage of the captured individual, and whether the individual is fertile or sterile.

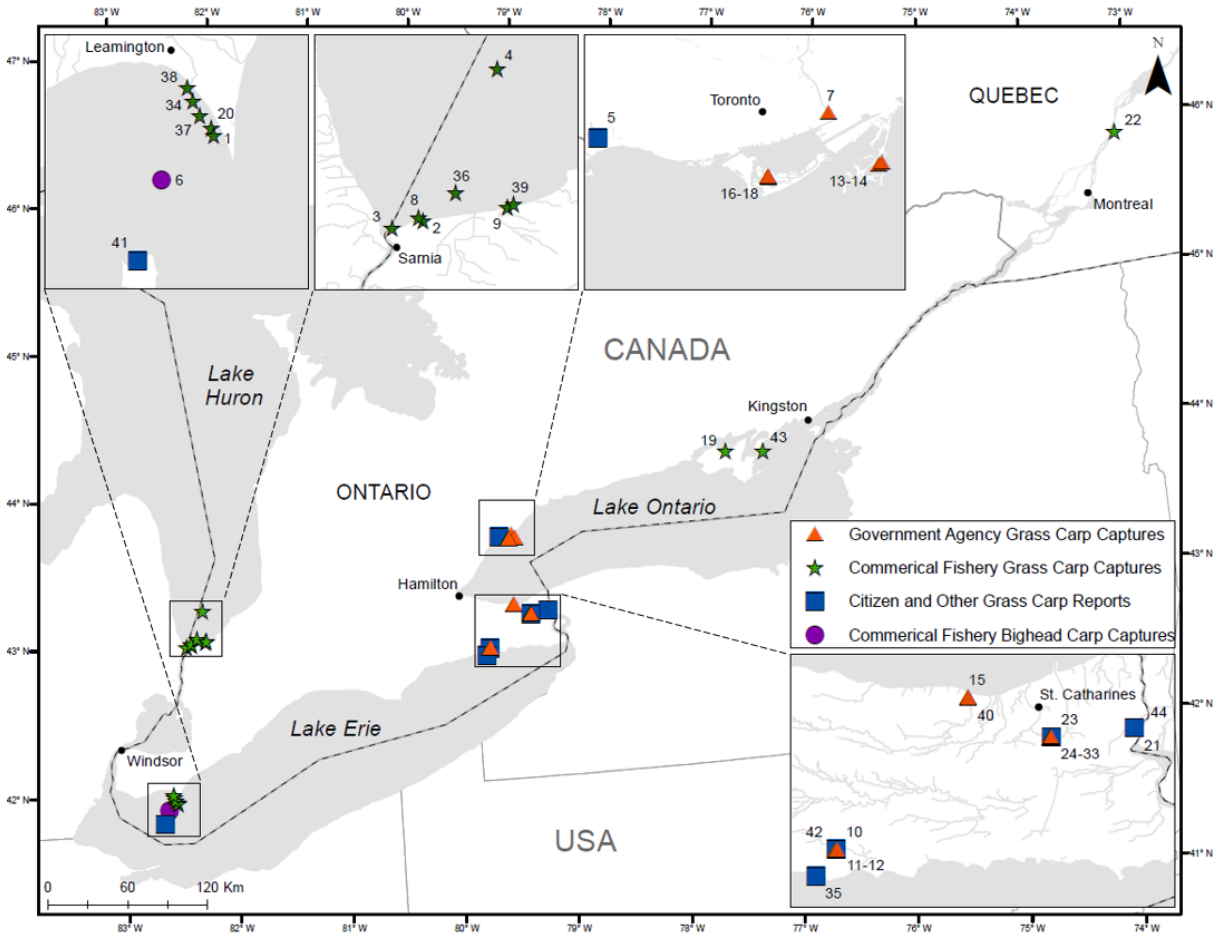

Figure 2. Locations of Asian carp captures in Canadian waters of the Laurentian Great Lakes basin and the St. Lawrence River basin, 1985-2023.

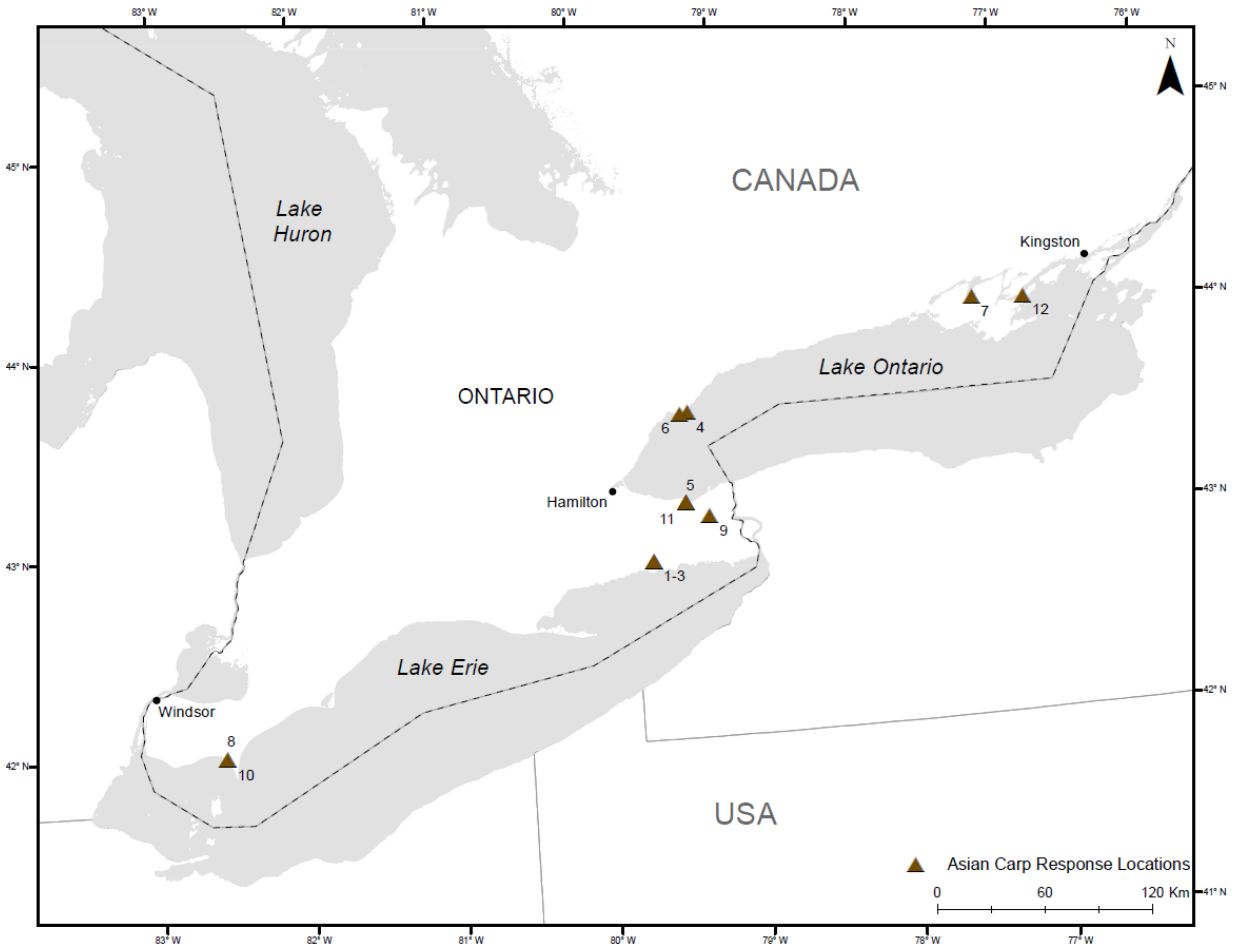

Figure 3. Location of Asian carp response operations in Canadian waters of the Laurentian Great Lakes basin. 1. Grand River, 2013. 2. Grand River, 2013. 3. Grand River, 2014. 4. Tommy Thompson Park ponds, 2015. 5. Jordan Harbour, 2015. 6. Toronto Harbour, 2015. 7. Bay of Quinte, 2015. 8. Lake Erie (Point Pelee), 2015. 9. Lake Gibson, 2016. 10. Lake Erie (Point Pelee), 2018. 11. Jordan Harbour, 2020. 12. Bay of Quinte, 2023.

Table 1. Summary of Asian carp occurrences in Canada and corresponding biological data, 1985-2023. Question marks and hyphens reflect data that were not collected, unable to be collected, erroneous, or not yet available. TRCA = Toronto and Region Conservation Authority and DFO = Fisheries and Oceans Canada.

ID	Species	Date of Report (dd-mm-yyyy)	Waterbody	Latitude (°)	Longitude (°)	Method	Reporter	Weight (kg)	Total Length (m)	Fork Length (m)	Girth (m)	Sex	Left Gonad Weight (g)	Right Gonad Weight (g)	Ploidy	Genome Size (pg)	Estimated Age (Vertebrae)	Otolith Core Mircochemistry (δ18O)	Origin
01	Grass Carp	27-09-1985	Lake Erie	41.96111	-82.54167	Trap net	Commercial fisher	-	0.76	-	-	Male	-	-	-	-	-	-	-
02	Grass Carp	??-08-1989	Lake Huron	43.01667	-82.36667	Trap net	Commercial fisher	-	0.88	-	-	Female	-	-	2N *	-	-	-	-
03	Grass Carp	??-09-1989	Lake Huron	43.00588	-82.41325	Trap net	Commercial fisher	-	0.72	-	-	Female	-	-	2N *	-	-	-	-
04	Grass Carp	??-??-1998	Lake Huron	43.24756	-82.25455	Trap net	Commercial fisher	-	0.84	-	-	Male	-	-	2N *	-	-	-	-
05	Grass Carp	??-??-1999	Grenadier Pond	43.64164	-79.46713	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06	Bighead Carp	16-10-2000	Lake Erie	41.90341	-82.61911	Trap net	Commercial fisher	17.5	0.94	-	-	Female	-	-	2N *	-	-	-	-
07	Grass Carp	30-10-2003	Don River	43.65458	-79.35102	Boat electrofisher	TRCA	-	0.44	-	-	Male	-	-	-	-	-	-	-
08	Grass Carp	25-07-2007	Lake Huron	43.02168	-82.37351	Trap net	Commercial fisher	-	1	-	-	-	-	-	-	-	-	-	-
09	Grass Carp	22-09-2008	Lake Huron	43.03849	-82.23979	Trap net	Commercial fisher	-	0.8	-	-	-	-	-	2N *	-	-	-	-
10	Grass Carp	27-04-2013	Grand River	42.89476	-79.62433	Angler	Citizen	18.52	1.1	1	0.72	-	-	-	3N	-	-	-	-
11	Grass Carp	16-08-2013	Grand River	42.89453	-79.62469	Trammel net	DFO	14	1.04	-	-	Female	-	-	3N	-	-	-	-
12	Grass Carp	23-09-2014	Grand River	42.89446	-79.62204	Trammel net	DFO	11.68	0.99	-	-	Male	8	8	3N	2.4	-	-	-
13	Grass Carp	27-07-2015	Tommy Thompson Park pond	43.62818	-79.32574	Boat electrofisher	TRCA	14.7	1.02	0.96	0.63	Male	-	-	2N	1.86	13	-4.19	Aquaculture
14	Grass Carp	28-07-2015	Tommy Thompson Park pond	43.62924	-79.32407	Trammel net	DFO	10.2	0.97	0.89	0.51	Male	-	-	2N	1.91	14	-4.5	Aquaculture
15	Grass Carp	26-08-2015	Jordan Harbour	43.17949	-79.37855	Trammel net	DFO	16.68	1.05	0.99	0.67	Male	-	-	2N	1.55	16	-4.33	Aquaculture
16	Grass Carp	01-09-2015	Toronto Harbour	43.62164	-79.38131	Boat electrofisher	TRCA	10.64	0.91	0.85	0.53	Male	-	-	2N	1.76	11	-5.09	Aquaculture
17	Grass Carp	01-09-2015	Toronto Harbour	43.62211	-79.38143	Boat electrofisher	TRCA	16.56	1.02	0.95	0.66	Female	-	-	2N	1.76	9	-3.65	Aquaculture
18	Grass Carp	02-09-2015	Toronto Harbour	43.62211	-79.38143	Boat electrofisher	DFO	9.1	0.89	0.81	0.51	Male	-	-	2N	1.8	13	-1.56	Aquaculture
19	Grass Carp	14-09-2015	Bay of Quinte	44.08328	-77.29002	Trap net	Commercial fisher	12.7	1.04	0.94	0.54	Female	8.23	6.87	3N	2.8	13	-4.06	Aquaculture
20	Grass Carp	16-09-2015	Lake Erie	41.95288	-82.53792	Trap net	Commercial fisher	10.61	0.98	0.89	0.52	Female	8.4	9.48	3N	2.76	8	-4.77	Aquaculture
21	Grass Carp	19-09-2015	Niagara River	43.12165	-79.06833	Dead on shore	Citizen	8.1	0.95	0.88	0.55	-	-	-	-	-	10	-3.63	Aquaculture
22	Grass Carp	27-05-2016	St. Lawrence River	45.90036	-73.2097	Gill net	Commercial fisher	29.03	1.26	-	-	Female	1,012	1,012	2N	2.14	-	-6.2	Wild
23	Grass Carp	10-06-2016	Lake Gibson	43.10383	-79.23128	Angler	Citizen	-	-	-	-	-	-	-	-	-	-	-	-
24	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	9.88	0.91	0.85	0.57	Male	43.84	49.96	3N	3.07	-	-	-
25	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	11.84	1.01	0.98	0.59	Male	55.25	69.61	3N	3.06	-	-2.67	Aquaculture
26	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	18.58	1.16	1.08	0.68	Male	108.53	195.72	2N	2.03	-	-7.37	Wild
27	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	19.98	1.21	1.1	0.7	Male	33.28	353.16	2N	2.02	-	-7.93	Wild
28	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	18.19	1.06	1	0.73	Male	51.11	85.27	3N	3.14	-	-4.03	Aquaculture
29	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	17.11	1.12	1.03	0.69	Male	2.73	116.09	3N	3.16	-	-3.53	Aquaculture
30	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	9.38	0.94	0.87	0.54	Male	19.52	39.72	3N	3.15	-	-	-
31	Grass Carp	16-06-2016	Lake Gibson	43.10399	-79.22464	Trammel net	DFO	20.8	1.22	1.16	0.68	-	4.08	7.06	3N	3.1	-	-1.78	Aquaculture
32	Grass Carp	17-06-2016	Lake Gibson	43.10307	-79.22461	Trammel net	DFO	18.06	1.15	1.07	0.69	Male	155.85	55.39	3N	3.33	-	-2.72	Aquaculture
33	Grass Carp	17-06-2016	Lake Gibson	43.10439	-79.22423	Boat electrofisher	DFO	17.85	1.12	1.11	0.65	Male	94.56	98.39	3N	3.33	-	-2.55	Aquaculture
34	Grass Carp	26-08-2016	Lake Erie	41.9918	-82.568	Trap net	Commercial fisher	10.13	1.01	0.92	0.54	Male	9.24	9.79	2N	2.07	-	-4.47	Aquaculture
35	Grass Carp	12-07-2017	Lake Erie	42.84491	-79.66153	Dead on shore	Citizen	18.04	1.26	1.16	0.7	Female	-	-	-	-	-	-3.97	Aquaculture
36	Grass Carp	18-07-2017	Lake Huron	43.05944	-82.31777	Trap net	Commercial fisher	9.82	0.93	0.87	0.58	Male	9.4	8.57	3N	2.53	5	-4.84	Aquaculture
37	Grass Carp	16-05-2018	Lake Erie	41.97478	-82.5583	Trap net	Commercial fisher	8.28	0.87	0.8	0.51	Female	1.96	2.74	3N	2.9	-	-1.19	Aquaculture
38	Grass Carp	03-07-2018	Sturgeon Creek	42.00775	-82.57596	Trap net	Commercial fisher	9.64	0.96	0.9	0.53	Male	21.96	14.02	3N	3.31	11	-0.19	Aquaculture
39	Grass Carp	19-07-2018	Lake Huron	43.04236	-82.23008	Trap net	Commercial fisher	13.41	1.06	1.02	0.57	Male	17.29	18.6	3N	3.18	13	-	-
40	Grass Carp	02-07-2020	Jordan Harbour	43.17732	-79.3785	Trammel net	DFO	16.32	1.06	1	0.65	Female	758	680	2N	2.09	9	-	-
41	Grass Carp	08-06-2023	Lake Erie	41.81303	-82.65939	Dead in water	Citizen	-	-	-	-	-	-	-	-	-	-	-	-
42	Grass Carp	20-06-2023	Grand River	42.89442	-79.62478	Tie-down gill net	DFO	8.29	0.9	0.84	0.53	Male	4.04	4.53	3N	3.15	-	-	-
43	Grass Carp	03-07-2023	Bay of Quinte	44.06218	-76.93800	Trap net	Commercial fisher	20.99	1.16	1.11	0.71	Female	1,462	1,408	2N	1.78	-	-	-
44	Grass Carp	16-08-2023	Niagara River	42.92598	-78.91286	Angler	Citizen	12.63	1.06	0.98	0.66	Female	8	6	3N	3.06	-	-	-

*Ploidy results likely inferred from visual examinations of reproductive organs (i.e., gonad development).

APPENDIX A

Table A1. Summary of the data collected from Asian carp response operations in Toronto Harbour, 2015 and Jordan Harbour, 2020. MNR = Ministry of Natural Resources, TRCA = Toronto and Region Conservation Authority, and DFO = Fisheries and Oceans Canada.

Response Location	Target Species	Agencies	Response Start Date (dd-mm-yyyy)	Response End Date (dd-mm-yyyy)	Number of Days Sampling	Number of Vessels Sampling	Boat Electrofisher Effort (h)	Trammel Net Effort (m)	Gill Net Effort (m)	Trap Net Effort (h)	Mini-fyke Net Effort (h)	Additional Asian Carp Captured
Toronto Harbour	Grass Carp	MNR, DFO, TRCA	02-09-2015	10-09-2015	4	4	34.13	2196	91	67	225.1	2
Jordan Harbour	Grass Carp	DFO	03-07-2020	08-07-2020	4	3	7.46	5121	NA	NA	NA	0