SEA LAMPREY CONTROL IN THE GREAT LAKES 2022

ANNUAL REPORT TO
THE GREAT LAKES FISHERY COMMISSION

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Cover: Tim Granger (U.S Fish and Wildlife Service) collecting larval sea lamprey to be used for a chemical resistance study on the Muskegon River, a tributary of Lake Michigan.
Photo credit: Matt Lipps (U.S. Fish and Wildlife Service).

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EXECUTIVE SUMMARY

This report summarizes sea lamprey control operations conducted by Fisheries and Oceans Canada and the United States Fish and Wildlife Service in the Great Lakes during 2022, which were consistent with those prescribed in the Great Lakes Sea lamprey Control Plan (2011) to achieve sea lamprey abundance and marking targets. Lampricide treatments were conducted on 79 tributaries and 13 lentic areas. Operation of 73 barriers, (47 purpose-built, 26 modified to serve as a sea lamprey barrier) to block sea lamprey migration and serve as an alternative control to the use of lampricides. Larval assessment crews surveyed 585 Great Lakes tributaries and 57 lentic areas to assess control effectiveness, plan future lampricide treatments, and establish the capacity of streams to produce sea lampreys. Assessment traps were operated in 29 tributaries across the Great Lakes to estimate the index of adult sea lamprey abundance in each Great Lake.

Indices of adult sea lamprey abundance were evaluated relative to fish community objectives for each of the lakes. In Lake Superior, the index of adult abundance was estimated to be 19,313 (95% CI: 17,376 – 21,250), which is greater than the index target of 10,421. In Lake Michigan, the index of adult abundance was estimated to be 49,007 (95% CI: 38,610 – 59,404), which is greater than the target of 34,982. In Lake Huron, the index of adult abundance was estimated to be 57,054 (95% CI: 55,265 – 58,843), which is greater than the target of 31,274. In Lake Erie, the index of adult abundance was estimated to be 7,198 (95% CI; 5,975 – 8,421), which is greater than the target of 3,263. In Lake Ontario, the index of adult abundance was estimated to be 18,731 (95% CI; 17,764 – 19,697), which is greater than the target of 14,065.

INTRODUCTION

The sea lamprey (*Petromyzon marinus*) is a destructive, invasive species in the Great Lakes that contributed to the collapse of lake trout (*Salvelinus namaycush*) and other native species in the mid-20th century and continues to impede efforts to restore and rehabilitate the fish community. Sea lampreys subsist on the blood and body fluids of large-bodied fish. It is estimated that about half of sea lamprey attacks result in the death of their prey and up to 18 kg (40 lbs) of fish production is lost to every sea lamprey that reaches adulthood. The Sea Lamprey Control Program (SLCP) is administered by the Great Lakes Fishery Commission (Commission) and implemented by two control agents: Fisheries and Oceans Canada (Department) and the United States Fish and Wildlife Service (Service). The SLCP is a critical component of fisheries management in the Great Lakes because it facilitates the rehabilitation of important fish stocks by significantly reducing sea lamprey-induced mortality.

As part of *A Joint Strategic Plan for Management of Great Lakes Fisheries,* the lake committees developed fish community objectives for each of the Great Lakes. The fish community objectives include goals for the SLCP that, if achieved, should help establish and maintain self-sustaining stocks of lake trout and other salmonids by minimizing sea lamprey impacts on these stocks. This report outlines the program's efforts during 2022 to meet these goals.

FISH COMMUNITY OBJECTIVES

Each lake committee has identified qualitative goals for sea lamprey control, which are published in lake-specific fish community objectives. During 2004, each lake committee agreed to explicit sea lamprey suppression targets designed to meet their fish community objectives. In lakes Superior, Michigan and Erie, the targets were developed from a consecutive five-year period when sea lamprey marking rates were closest to 5 A1-A3 marks per 100 lake trout >532 mm, considered to represent a tolerable annual rate of sea lamprey induced lake trout mortality. A target of adult sea lamprey abundance was calculated for these lakes from the average index of abundance over the same five-year period. Similarly, a target was developed for Lake Ontario from the estimated average sea lamprey abundance over a five-year period when marking rates were closest to 2 A1 marks per 100 lake trout >431 mm. In Lake Huron, the abundance target was calculated as 25% of the estimated average during the consecutive five-year period with the lowest sea lamprey marking rate prior to the completion of the fish community objectives (1989–1993).

The annual performance of the SLCP is evaluated by comparing lake-specific adult sea lamprey abundance indices and lake trout marking rates against established targets. Adult sea lamprey abundance indices are estimated by the Service and Department by tallying mark-recapture estimates from a sub-set of streams within each lake that were selected based on a consistent trapping history and reliable sea lamprey spawning runs. Lake trout marking rates are assessed and collected by member agencies that comprise the lake committees and their technical committees.

Lake Superior

The Lake Superior Committee established the following goal for sea lamprey control in Lake Superior:

- *Suppress sea lampreys to population levels that cause only insignificant mortality on adult lake trout.*

Sea lamprey control supports fish community objectives for lake trout and other species:

- *Achieve and maintain genetically diverse self-sustaining populations of lake trout that are similar to those found in the lake prior to 1940, with lean lake trout being the dominant form in nearshore waters, siscowet lake trout the dominant form in offshore waters, and humper lake trout a common form in eastern waters and around Isle Royale.*

- *Maintain self-sustaining populations of lake whitefish within the range of abundance observed during 1990-99.*

The adult index target for Lake Superior of 10,421 sea lamprey was estimated as the mean of indices during the 5-year period, 1994-1998, when marking rates were closest to 5 marks per 100 lake trout >532 mm (5.2 A1-3 marks per 100 fish >532mm). The 2022 index of adult abundance for Lake Superior was 19,313 (*95% CI: 17,376 – 21,250*), which is greater than the index target. The number of A1-A3 marks on lake trout from spring assessments in 2021 was 5.8 marks per 100 lake trout >532mm. The spring 2022 assessment data is currently being compiled.

Lake Michigan

The Lake Michigan Committee established the following goal for sea lamprey control in Lake Michigan:

- *Suppress sea lamprey abundance to allow the achievement of other fish community objectives.*

Sea lamprey control can have a direct effect on objectives for lake trout and other salmonines:

- *Establish self-sustaining lake trout populations.*

- *Establish a diverse salmonine community capable of sustaining an annual harvest of 2.7 to 6.8 million kilograms (6 to 15 million pounds), of which 20-25% is lake trout.*

The adult index target for Lake Michigan of 34,982 sea lamprey was estimated as the mean of indices during the 5-year period, 1995-1999, when marking rates were closest to 5 marks per 100 lake trout >532 mm (8.9 A1-3 marks per 100 fish >532mm), and multiplied by 5/8.9. Unlike the other Great Lakes, this target was not based on observed consecutive years of marking rates that resulted in a tolerable annual lake trout mortality rate. The 2022 index of adult abundance for Lake Michigan was 49,007 (*95% CI: 38,610 – 59,404*), which is greater than the target. The number of A1-A3 marks on lake trout from fall assessments in 2021 was 2.9 marks per 100 lake trout >532mm. The fall 2022 assessment data is currently being compiled.

Lake Huron

The Lake Huron Committee established the following specific goals for sea lamprey control in Lake Huron:

- *Reduce sea lamprey abundance to allow the achievement of other fish community objectives.*

- *Obtain a 75% reduction in parasitic-phase sea lampreys by the year 2000 and a 90% reduction by the year 2010 from present levels.*

The sea lamprey objective supports the other fish community objectives, specifically the salmonine objective:

- *Establish a diverse salmonine community that can sustain an annual harvest of 2.4 million kg, with lake trout the dominant species and anadromous (stream-spawning) species also having a prominent place.*

The adult index target for Lake Huron of 31,274 sea lamprey was estimated as 0.25 times the mean of indices during the 5-year period of lowest sea lamprey abundance prior to the publication of the fish community objectives (1989-1993). Unlike the other Great Lakes, this target was not based on observed consecutive years of marking rates that resulted in a tolerable annual lake trout mortality rate. The 2022 index of adult abundance in Lake Huron was estimated to be 57,054 (*95% CI: 55,265 – 58,843*), which is greater than the index target. The number of A1- A3 marks on lake trout from spring assessments in 2021 was 4.0 marks per 100 lake trout >532mm. The spring 2022 assessment data is currently being compiled.

Lake Erie

The Lake Erie Committee established the following goal and indicator of success for sea lamprey control in Lake Erie:

- *Suppress abundance of sea lamprey to levels that will not impede achievement of any fish community objective, especially for coldwater species of low abundance.*

- *Reduce sea lamprey abundance to levels specified in the sea lamprey management plan administered by the Commission.*

The lake trout management plan for rehabilitation of self-sustaining stocks in the eastern basin of Lake Erie prescribed a maximum annual mortality of less than 40% to permit the establishment and maintenance of suitable stocks of spawning adults. Mortality was to be controlled through management of fishery exploitation and continued suppression of sea lamprey.

The adult index target for Lake Erie of 3,263 sea lamprey was estimated as the mean of indices during the 5-year period, 1991-1995, when marking rates were closest to 5 marks per 100 lake trout >532 mm (4.4 A1-3 marks per 100 fish >532 mm). The 2022 index of adult abundance in Lake Erie was estimated to be 7,198 (*95% CI; 5,975 – 8,421*), which is greater than the index target. The number of A1-A3 marks on lake trout from fall assessments in 2021 was 4.3 marks per 100 lake trout >532mm. The fall 2022 assessment data is currently being compiled.

Lake Ontario

The Lake Ontario Committee established the following goal and indicators of success for sea lamprey control in Lake Ontario:

- *Control sea lamprey—suppress abundance of sea lamprey to levels that will not impede achievement of objectives for lake trout and other fish.*

- *Spawning-phase adult sea lamprey abundance in Lake Ontario tributaries below targets identified in the sea lamprey management plan.*

- *Number of A-1 marks on lake trout and other species below targets.*

The Lake Ontario Committee recognized that continued control of sea lamprey is necessary for lake trout rehabilitation and stated a specific objective for sea lamprey:

- *Control sea lampreys so that fresh wounding rates (A1) of lake trout larger than 431 mm is less than 2 marks/100 fish*

This objective is intended to maintain the annual lake trout survival rate of 60% or greater to support a spawning stock of 0.5 to 1.0 million adults of multiple year classes. Along with sea lamprey control, angler and commercial exploitation will also be controlled so that annual harvest does not exceed 120,000 fish in the near term.

The target for Lake Ontario sea lamprey abundance is calculated using A1 marks exclusively, which have been more consistently recorded on Lake Ontario. The target-marking rate of less than 2 A1 marks per 100 lake trout was explicitly identified as producing tolerable mortality in the lake trout rehabilitation plan.

The adult index target for Lake Ontario of 14,065 sea lamprey was estimated as the mean of indices during the 5-year period, 1993-1997, when marking rates were closest to 2 marks per 100 lake trout >431 mm (1.6 A1 marks per fish >431 mm). The 2022 index of adult abundance in Lake Ontario was estimated to be 18,731 *(95% CI; 17,764 – 19,697)*, which is greater than the index target. The number of A1 marks on lake trout from fall assessments in 2021 was 1.8 marks per 100 lake trout >431mm. The fall 2022 assessment data is currently being compiled.

LAMPRICIDE CONTROL

Tributaries harboring larval sea lamprey are treated periodically with lampricides to eliminate or reduce larval populations before they recruit to the lake as feeding juveniles. During stream treatments, Department and Service control units administer and analyze several lampricide formulations including TFM or TFM mixed with Bayluscide (20% emulsifiable concentrate). Specialized equipment and techniques are employed to maintain lampricide concentrations at levels that eliminate approximately 93% of resident sea lamprey larvae while minimizing risk to non-target organisms. To control larval populations that inhabit lentic areas and interconnecting waterways, field crews apply a bottom-release formulation of lampricide, Bayluscide 3.2% granular (gB), which is 75% effective on average.

Reporting to the Sea Lamprey Control Board (SLCB), the Lampricide Control Task Force (LCTF) was established by the Commission during December 1995 and charged to improve the efficiency of lampricide control, maximize sea lamprey killed in stream and lentic treatments (while minimizing lampricide use, costs, and impacts on aquatic ecosystems), and define lampricide control options for near and long-term stream selection and target setting. Progress on SLCB charges during 2022 is presented in the LCTF section of this report.

During 2022, lampricide treatments were conducted on 79 tributaries and 13 lentic areas of the Great Lakes (Table 1). The time series of control effort metrics are presented in Figure 1.

Table 1. Summary of lampricide applications in tributaries of the Great Lakes in 2022.

Lake	Number of Streams	Number of Lentic Areas	Discharge (m^3/s)	Distance Treated (km)	TFM (kg) [1,2]	Bayluscide (kg) [1,3]
Superior	34	11	130	692	11,580	466
Michigan	11	1	100	957	21,700	277
Huron	16	1	75	445	15,999	1,422
Erie	3	0	28	129	6,768	0
Ontario	15	0	89	258	9,662	49
Total	**79**	**13**	**422**	**2,481**	**65,709**	**2,214**

[1]Lampricide quantities are reported in kg of active ingredient, [2]Includes solid formulation of TFM, [3]Includes 3.2% granular Bayluscide applied to lentic areas.

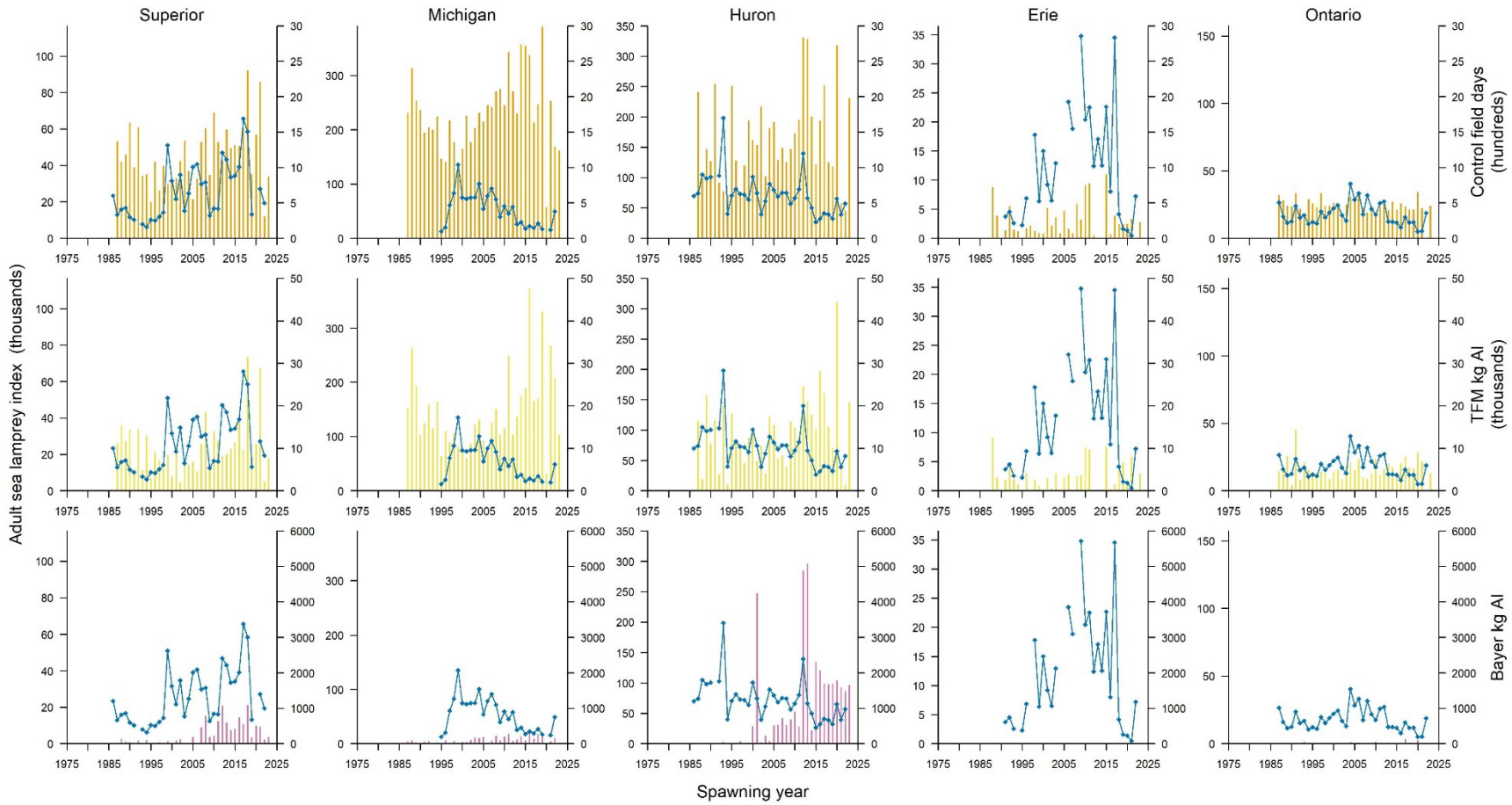

Figure 1. Top Row: Number of control field days (orange bars). Middle Row: TFM used (kg active ingredient, yellow bars). Bottom Row: Bayluscide used (kg active ingredient, purple bars). All rows: Index of adult sea lampreys is shown with blue lines. All metrics plotted against the sea lamprey spawning year. Control metrics are offset by 2 years, e.g., control applied during 2006 is plotted on the 2008 spawning year - the year the treatment effect would first be observed in the adult sea lamprey population. No treatment effort occurred in lakes Erie and Ontario during 2020 due to the COVID-19 pandemic.

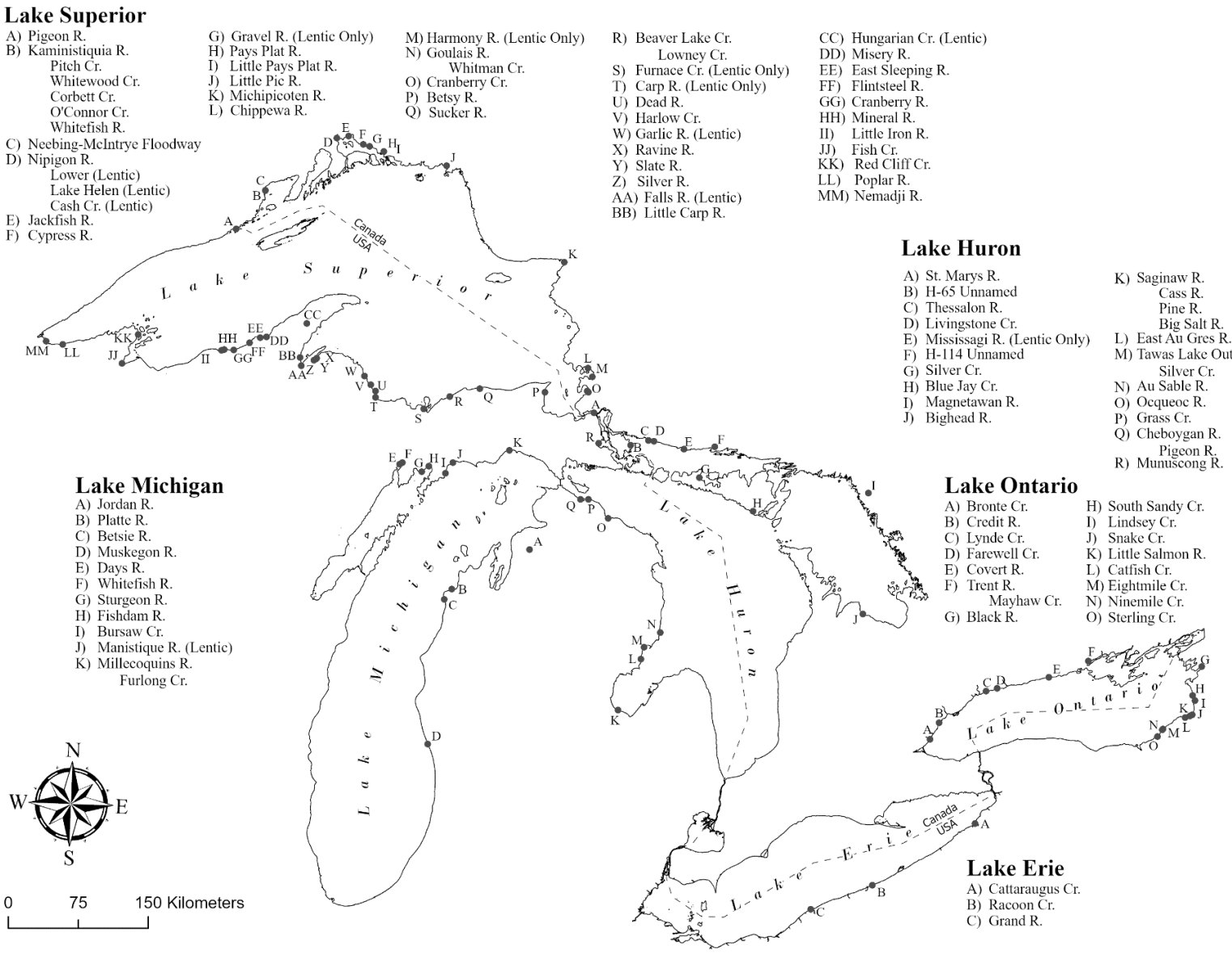

Figure 2. Location of tributaries treated with lampricides during 2022.

Lake Superior

Lake Superior has 1,566 tributaries (833 Canada, 733 U.S.). One hundred sixty-nine tributaries (58 Canada, 111 U.S.) have records of larval sea lamprey production. Of these, 126 tributaries (45 Canada, 81 U.S.) have been treated with lampricides at least once during 2013-2022. Sixty tributaries (22 Canada, 38 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Superior tributaries and lentic areas during 2022 and tributary locations are found in Table 2 and Figure 2, respectively.

- Lampricide treatments were completed in 34 tributaries (12 Canada, 22 U.S.) and in 11 lentic areas (5 Canada, 6 U.S.; Table 2).

- Cloud, Jarvis, Gargantua, and Goulais rivers, Blende Creek, and lentic areas associated with the Kaministiquia, Nipigon, Gravel, and Knife rivers were not treated during 2022 due to timing and problematic environmental conditions and have been scheduled for treatment during 2023.

- Pays Plat, Little Pays Plat, Jackfish, and McIntyre rivers were treated after being deferred since 2019.

- The Michipicoten River was treated in October, following four years of deferred lampricide application. High numbers of sea lamprey larvae and juveniles were observed. Although some TFM-induced mortality of spawning pink and chinook salmon was identified, successful spawning was observed prior to and following the treatment.

- The Dog River estuary (0.5 hectares) was treated with gB after surveys detected a large population of larval sea lamprey.

- South Fork Fish Creek (Bayfield County) and the Little Iron River (Ontonagon County) were treated for the first time since 1967 and 1975, respectively.

- Service treatment personnel collaborated with the U.S. Geological Survey - Hammond Bay Biological Station (HBBS) to conduct supplemental control (SupCon) surveys during the lampricide treatment in the Cranberry River (Ontonagon County). High densities of large sea lamprey larvae and juveniles were collected and will be used for sibling/cohort analysis using genetic techniques.

- High numbers of sea lamprey juveniles and large larvae were eliminated in several streams including South Fork Fish and Hungarian creeks, Mineral, East Sleeping, Little Iron, Hungarian, Cranberry, and Flintsteel rivers.

Table 2. Details on the application of lampricides to tributaries and lentic areas of Lake Superior during 2022 (letter in parentheses corresponds to location of stream in Figure 2). Lampricide quantities are reported as kg of active ingredient.

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)	Granular Bayluscide (kg)
Canada							
Pigeon R. (A)	Sep-13	3.1	4.9	393.4	---	---	0.1
Kaministiquia R. (B)	Jul-15	31.3	89.7	2,308.3	4.4	19.6	0.5
McIntyre Floodway (C)	Jul-14	0.5	3.9	83.9	---	---	0.1
Nipigon R. (D)							
Cash Cr. Lentic	Oct-15	---	---	---	---	---	23.9
Lake Helen Lentic	Oct-14	---	---	---	---	---	92.5
Lower Lentic	Oct-16	---	---	---	---	---	55.7
Jackfish R. (E)	Jul-08	4.8	10.9	363.9	0.2	---	0.2
Cypress R. (F)	Jul-11	1.4	6.0	78.9	---	---	0.1
Gravel R. (G)							
Lentic	Oct-13	---	---	---	---	---	74.7
Pays Plat R. (H)	Jun-25	2.5	10.4	169.8	---	---	0.1
Little Pays Plat R. (I)	Jun-27	0.1	3.1	4.9	---	---	0.1
Little Pic R. (J)	Aug-13	5.0	33.4	1,195.7	9.7	---	0.2
Michipicoten R. (K)	Oct-06	47.9	22.3	2,735.6	---	32	0.1
Chippewa R. (L)	Aug-19	4.5	3.0	266.5	---	---	---
Harmony R. (M)							
Lentic	Oct-22	---	---	---	---	---	31.2
Goulais R. (N)							
Whitman Cr.	Sep-21	0.7	4.8	43.6	0.4	---	0.1
Cranberry Cr. (O)	Aug-21	0.1	7.4	11.9	---	---	0.1
Total (Canada)		**101.9**	**199.8**	**7,656.4**	**14.7**	**51.6**	**279.7**
United States							
Betsy R. (P)	Sep-06	1.3	16.4	123.4	---	---	---
Sucker R. (Q)	Aug-05	2.0	59.5	333.8	1.3	---	---
Beaver Lake Cr. (R)							
Lowney Cr.	Aug-18	0.5	3.2	77.3	1.5	---	0.2

Table 2. *Continued*

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)
Furnace Cr. (S)							
Lentic	Aug-09	---	---	---	---	---	34.9
Carp R. (T)							
Lentic	Aug-22	---	---	---	---	---	31.6
Dead R. (U)	Aug-23	3.8	1.9	308.5	---	---	30.0
Harlow Cr. (V)	Aug-18	0.2	8.4	32.0	---	---	---
Garlic R. (W)	Aug-18	1.3	11.6	188.1	0.6	---	---
Saux Head Lake Lentic	May-10	---	---	---	---	---	6.5
Ravine R. (X)	Sep-01	0.9	11.7	49.0	---	---	---
Slate R. (Y)	Sep-03	0.1	1.0	16.3	---	---	---
Silver R. (Z)	Sep-04	0.7	6.6	83.0	0.4	---	---
Falls R. (AA)	Aug-31	1.1	0.5	213.6	---	---	---
Lentic	Sep-06	---	---	---	---	---	6.7
Little Carp R. (BB)	May-15	0.2	7.1	16.4	0.2	---	---
Hungarian Cr. (CC)	May-13	0.7	1.3	41.6	---	---	---
Lentic	Jun-08	---	---	---	---	---	25.1
Misery R. (DD)	Jul-11	0.9	2.9	130.1	---	---	---
East Sleeping R. (EE)	Jul-08	1.2	26.9	173.1	1.4	---	---
Flintsteel R. (FF)	Sep-30	0.2	29.6	49.8	0.1	---	---
Cranberry R. (GG)	Sep-30	0.2	27.5	55.0	0.5	---	---
Mineral R. (HH)	Jul-08	1.0	8.9	106.8	---	---	---
Little Iron R. (II)	Jul-09	0.3	2.6	30.5	---	---	---
Fish Cr. (JJ)	May-30	4.4	45.5	671.3	2.6	---	---
Red Cliff Cr. (KK)	May-27	0.3	7.7	36.4	0.9	---	---
Poplar R. (LL)	Jun-10	0.3	25.1	57.2	1.1	---	---
Nemadji R. (MM)	Jun-10	6.0	186.2	1,103.0	2.3	---	---
Total (United States)		**27.6**	**492.1**	**3,896.2**	**12.9**	---	**135.0**
Total for Lake		**129.5**	**691.9**	**11,552.6**	**27.6**	**51.6**	**414.7**

[1]Stream discharges of <0.05 are recorded as 0.0.

Lake Michigan

Lake Michigan has 511 tributaries. One hundred twenty-nine tributaries have records of larval sea lamprey production, and of these, 85 tributaries have been treated with lampricides at least once during 2013-2022. Thirty-five tributaries are treated every 3-5 years. Details on lampricide applications to Lake Michigan tributaries and lentic areas during 2022 and tributary locations are found in Table 3 and Figure 2, respectively.

- Lampricide treatments were completed in 11 tributaries and 1 lentic area (Table 3).

- Department and Service personnel collaborated to treat just over 490 km of the Manistique River. A portion of the upper West Branch was not treated due to low stream discharge and has been rescheduled for 2023.

- High densities of large sea lamprey larvae were observed during the lentic treatment near the mouth and offshore from the Manistique River.

- Furlong Creek (Millecoquins River), one of the streams being considered for SupCon, was successfully treated. During treatment, staff walked a large portion of the watershed and collected numerous large sea lamprey larvae.

- The Muskegon River was treated in close coordination with the Michigan Department of Natural Resources (MIDNR), Little River Band of Ottawa Indians (LRBOI), and Consumers Energy.

Table 3. Details on the application of lampricides to tributaries and lentic areas of Lake Michigan during 2022 (letter in parentheses corresponds to location of stream in Figure 2). Lampricide quantities are reported as kg of active ingredient.

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)	Granular Bayluscide (kg)
Jordan R. (A)	Jul-08	5.1	36.0	1,959.9	12.7	9.0	---
Platte R. (B)	Jun-09	4.5	22.5	2,779.7	6.8	18.4	---
Betsie R. (C)	Jun-11	8.5	13.8	1,226.7	4.3	12.1	---
Muskegon R. (D)	Aug-18	32.6	175.6	8,015.1	36.3	83.2	---
Days R. (E)	Sep-21	0.2	6.8	91.2	---	---	---
Whitefish R. (F)	Jun-24	6.7	82.1	1,657.2	6.2	5.0	---
Sturgeon R. (G)	Jul-21	2.0	87.5	825.2	1.1	---	---
Fishdam R. (H)	May-01	2.1	24.3	334.7	1.5	---	---
Bursaw Cr. (I)	May-13	0.3	4.2	43.9	0.1	---	---
Manistique R. (J)	Sep-15	37.4	490.8	4,536.3	11.4	19.3	68.6
Lentic	Oct-03	---	---	---	---	---	61.2
Millecoquins R. (K)							
Furlong Cr.	May-15	0.9	13.2	149.4	0.3	---	---
Total for Lake		**100.3**	**956.8**	**21,619.3**	**80.7**	**147.0**	**129.8**

[1]Stream Discharge of <0.05 are recorded as 0.0.

Lake Huron

Lake Huron has 1,761 tributaries (1,334 Canada, 427 U.S.). One hundred twenty-seven tributaries (59 Canada, 69 U.S.) have records of larval sea lamprey production. Of these, 83 tributaries (39 Canada, 44 U.S.) have been treated with lampricide at least once during 2013-2022. Forty-two tributaries (22 Canada, 20 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Huron tributaries and lentic areas during 2022 and tributary locations are found in Table 4 and Figure 2.

- Lampricide treatments were completed in 16 tributaries (8 Canada, 8 U.S.) and in 1 lentic area (1 Canada, 0 U.S.; Table 4).

- Naiscoot and Nottawasaga rivers and Beaudin Creek (Spanish River) were not treated during 2022 due to insufficient discharge and have been scheduled for treatment during 2023.

- Two lentic gB plots in the Mississagi River delta area were only partially completed due mechanical failure of application equipment and have been scheduled for treatment during 2023.

- Two hundred and seventy hectares of the St. Marys River were treated using gB (Table 4).

- The East Branch Munuscong River was treated for the first time since 1982. Stream discharge was extremely low at the time of treatment making it difficult to achieve lethal concentrations throughout the system.

- Grass Creek was treated for the first time since 1978.

- The East Au Gres River was treated upstream of the sea lamprey barrier for the first time since 1987.

- The Thessalon River was treated, however McDonald Creek (Thessalon River) has not been treated since 2014 due to access issues. High numbers of sea lamprey larvae and juveniles were observed during treatment.

Table 4. Details on the application of lampricides to tributaries and lentic areas of Lake Huron during 2022 (letter in parentheses corresponds to location of stream in Figure 2). Lampricide quantities are reported as kg of active ingredient.

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)	Granular Bayluscide (kg)
Canada							
St. Marys R. (A)	Jun-21	---	---	---	---	---	1,235.7
Unnamed (H65) (B)	May-19	0.1	0.9	7.7	---	---	---
Thessalon R. (C)	Sep-18	6.2	32.7	441.5	1.2	---	0.2
Livingstone Cr. (D)	May-17	0.0	1.5	5.5	---	---	---
Mississagi R. (E)							
Lentic	Jul-25	---	---	---	---	---	100.4
Unnamed (H114) (F)	May-17	0.0	0.5	1.6	---	---	---
Silver Cr. (G)	Sep-10	0.0	2.9	12.8	---	---	---
Blue Jay Cr. (H)	Sep-08	0.5	8.7	94.9	0.6	---	---
Magnetawan R. (I)	Jul-10	11.7	6.9	490.2	0.2	---	---
Bighead R. (J)	Jun-23	1.7	41.3	716.3	---	---	0.1
Total (Canada)		**20.2**	**95.4**	**1,770.5**	**2.0**	**---**	**1,336.5**
United States							
Saginaw R. (K)							
Cass R.	Jun-24	2.7	65.5	1,684.5	---	---	---
Big Salt R.	May-27	4.0	55.5	1,692.1	0.6	---	---
Pine R.	May-30	9.9	50.5	2,469.7	---	22.9	---
East Au Gres R. (L)	Oct-01	0.9	43.0	369.4	---	---	---
Tawas Lake Outlet (M)							
Silver Cr.	Aug-08	1.3	10.5	316.7	0.2	---	---
AuSable R. (N)	Aug-06	31.2	24.9	5,752.0	3.6	62.3	---
Ocqueoc R. (O)	Aug-04	1.4	5.6	498.1	3.2	---	---
Grass Cr. (P)	Aug-03	0.1	0.2	17.1	---	---	---
Cheboygan R.(Q)							
Pigeon R.	Sep-02	2.6	74.7	1,316.0	5.7	---	---
Munuscong R. (R)							
East Br.	Sep-02	0.2	19.6	97.4	---	---	---
Total (United States)		**54.3**	**350.0**	**14,213.0**	**13.3**	**85.2**	---
Total for Lake		**74.5**	**445.4**	**15,983.5**	**15.3**	**85.2**	**1,336.5**

[1]Stream Discharge of <0.05 are recorded as 0.0.

Lake Erie

Lake Erie has 842 tributaries (525 Canada, 317 U.S.). Thirty tributaries (11 Canada, 19 U.S.) have records of larval sea lamprey production. Of these, 18 tributaries (7 Canada, 11 U.S.) have been treated with lampricides at least once during 2013-2022. Seven tributaries (2 Canada, 5 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Erie tributaries and lentic areas during 2022 and tributary locations are found in Table 5 and Figure 2. In addition, larval production has been documented in the St. Clair River, three of its U.S. tributaries, and two tributaries to Lake St. Clair (1 Canada, 1 U.S.).

- Lampricide treatments were completed in 3 tributaries (0 Canada, 3 U.S.; Table 5).

Table 5. Details on the application of lampricides to tributaries and lentic areas of Lake Erie during 2022 (letter in parentheses corresponds to location of stream in Figure 2). Lampricide quantities are reported as kg of active ingredient.

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)	Granular Bayluscide (kg)
United States							
Cattaraugus Cr. (A)	May-12	13.6	90.9	5,373.0	---	---	---
Raccoon Cr. (B)	Apr-30	0.2	4.2	38.8	---	---	---
Grand R. (C)	Apr-29	14.2	33.5	1,355.7	---	---	---
Total for Lake		**28.0**	**128.6**	**6,767.5**	---	---	---

[1]Stream Discharge of <0.05 are recorded as 0.0.

Lake Ontario

Lake Ontario has 659 tributaries (405 Canada, 254 U.S.). Sixty-six tributaries (31 Canada, 35 U.S.) have historical records of larval sea lamprey production, and of these, 36 tributaries (19 Canada, 17 U.S.) have been treated with lampricides at least once during 2013-2022. Twenty-nine tributaries (15 Canada, 14 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Ontario tributaries and lentic areas during 2022 and tributary locations are found in Table 6 and Figure 2.

- Lampricide applications were completed in 15 tributaries (6 Canada, 9 U.S.; Table 6).

- The upper section of Little Salmon River was not treated due to insufficient discharge and impoundment issues and has been scheduled for treatment in 2023.

- The Black River gB lentic treatment was not completed due to equipment issues and has been rescheduled for 2023.

Table 6. Details on the application of lampricides to tributaries of Lake Ontario during 2022 (letter in parentheses corresponds to location of stream in Figure 2). Lampricide quantities are reported as kg of active ingredient.

Tributary	Date	Discharge (m^3/s) [1]	Distance Treated (km)	Liquid TFM (kg)	Solid TFM (kg)	Emulsifiable Concentrate Bayluscide (kg)	Granular Bayluscide (kg)
Canada							
Bronte Cr. (A)	Apr-28	2.9	40.4	1,206.2	0.9	---	0.3
Credit R. (B)	Jul-14	4.0	40.3	1,192.8	2.4	---	0.2
Lynde Cr. (C)	Apr-24	1.3	23.5	400.4	---	---	0.1
Farewell Cr. (D)	Apr-22	1.7	6.2	455.5	---	---	---
Covert Cr. (E)	Jul-19	0.1	4.6	69.1	0.4	---	---
Trent R (F)							
Mayhew Cr.	Jul-20	0.3	2.5	57.0	---	---	---
Total (Canada)		**10.3**	**117.5**	**3,381.0**	**3.7**	---	**0.6**
United States							
Black R. (G)	Aug-11	58.9	9.3	3,464.9	2.1	43.4	---
South Sandy Cr. (H)	Jun-05	4.8	14.8	409.1	1.7	4.2	---
Lindsey Cr. (I)	Jun-03	1.1	13.8	118.9	1.2	---	0.2
Snake Cr. (J)	Jun-02	0.7	4.8	65.7	---	---	---
Little Salmon R. (K)	Jun-06	4.5	39.9	599.6	0.8	---	---
Catfish Cr. (L)	Jun-01	3.4	1.2	298.1	---	---	---
Eightmile Cr. (M)	May-30	0.4	8.6	78.9	---	---	---
Ninemile Cr. (N)	Jun-03	1.8	19.7	307.7	1.7	---	0.3
Sterling Cr. (O)	May-31	2.9	28.0	925.6	1.7	---	0.3
Total (United States)		**78.5**	**140.1**	**6,268.5**	**9.2**	**47.6**	**0.8**
Total for Lake		**88.8**	**257.6**	**9,649.5**	**12.8**	**47.6**	**1.4**

[1]Stream Discharge of <0.05 are recorded as 0.0.

ALTERNATIVE CONTROL

The Service and Department continue to coordinate with the Commission and other partners to research and develop alternatives to lampricides to provide a broader spectrum of tactics to control sea lamprey. During 2022, barriers and juvenile trapping were the alternative control methods deployed. Nest destruction was explored as a potential alternative method. Other methods that are currently being investigated include attractants (e.g. pheromones), repellents (e.g. alarm cues), and new trap designs.

Barriers

The sea lamprey barrier program priorities are:

1. Operate and maintain existing sea lamprey barriers that were built or modified by the SLCP.
2. Ensure sea lamprey migration is blocked at important barrier sites not operated or maintained by the SLCP.
3. Construct new structures in streams where they:
    a. Provide control where other options are impossible, excessively expensive, or ineffective.
    b. Provide a cost-effective alternative to lampricide control.
    c. Improve cost-effective control in conjunction with attractant and repellent based control, trapping, and lampricide treatments.
    d. Where structures are compatible with a system's watershed plan.

Reporting to the SLCB, the Barrier Task Force (BTF) was established by the Commission during April 1991 to coordinate efforts of the Service, Department, and U.S. Army Corps of Engineers (USACE) on the construction, operation, and maintenance of sea lamprey barriers. Progress on SLCB charges during 2022 is presented in the BTF section of this report.

The Commission has invested in 73 barriers in the Great Lakes basin (Figure 3). Of these, 47 were purpose-built as sea lamprey barriers and 26 were constructed for other purposes but have been modified to block sea lamprey migrations.

Data gathered during field visits to assess the status of other dams and structures were recorded in the SLCP's Barrier Inventory and Project Selection System (BIPSS) database and may be used to: 1) select barrier projects; 2) monitor inspection frequency; 3) schedule upstream larval assessments; 4) assess the effects of barrier removal or modifications on sea lamprey populations; or 5) identify structures that are important in controlling sea lamprey.

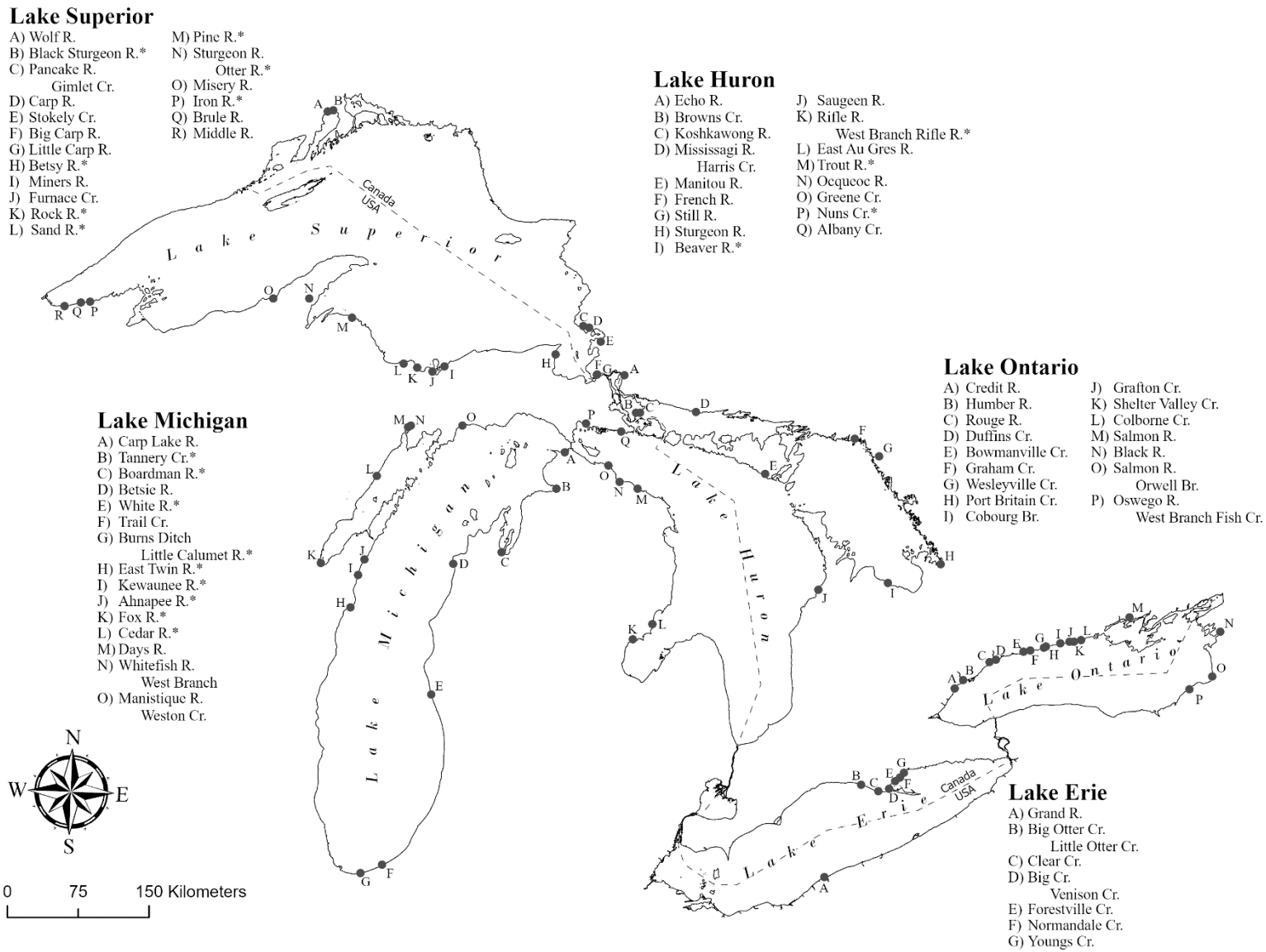

Figure 3. Locations of tributaries with sea lamprey barriers. An asterisk indicates structures that have been modified or constructed by others to prevent the upstream migration of sea lamprey.

Lake Superior

The Commission has invested in 18 barriers on Lake Superior (Figure 3). Of these, 11 were purpose-built as sea lamprey barriers and 7 were constructed for other purposes but have been modified to block sea lamprey migrations.

Barrier Inventory and Project Selection System (BIPSS)

Barrier inspections are scheduled on a four-year rotation. Field crews inspected 4 structures in the Lake Superior watershed during 2022. This data will be used to evaluate sea lamprey blocking potential and update the BIPSS.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 8 barriers (6 Canada, 2 U.S.).

Ensure Blockage to Sea Lamprey Migration

- Brule River – The Commission, Service, and Wisconsin Department of Natural Resources (WIDNR) partnered to repair the Brule River sea lamprey barrier. Concrete resurfacing within the Brule River fishway was completed in July 2022.

- Partner agencies were consulted to ensure sea lamprey blockage at barriers at 3 sites in 2 streams during 2022 (Table 7).

Table 7. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Superior tributaries during 2022.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Brule R.	Wilson Cr.	TU[1]	County Rd. P culvert #1	Concur	Upstream of blocking barrier
Brule R.	Wilson Cr.	TU[1]	County Rd. P culvert #2	Concur	Upstream of blocking barrier
Bad R.	18 Mile Cr.	TU[1]	North Sweden Rd. culvert	Concur	Ineffective barrier

[1]Trout Unlimited

New Construction

- Bad River – The Service continues to work with the Mashkiiziibii (Bad River) Natural Resources Department in pursuing the feasibility of constructing a sea lamprey barrier within the Bad River watershed. The Service supports the Band's interest in applying SupCon techniques to reduce sea lamprey recruitment in the river while project partners investigate options and locations for the barrier.

- Sucker River – A collaborative project on the Sucker River near Grand Marias, MI will replace perched culverts on the H-58 road crossing with a free span bridge while a new seasonal sea lamprey barrier will be constructed upstream to block sea lamprey from accessing 95 stream miles of critical spawning and rearing habitat.

- Neebing River – Final engineering was completed in 2022 to support the installation of a permanent sea lamprey trap at the existing Neebing River barrier, Thunder Bay in 2023.

- Big Carp River – Procurement to upgrade the obsolete inflatable crest barrier control system was initiated during 2022.

Lake Michigan

The Commission has invested in 15 barriers on Lake Michigan (Figure 3). Of these, 6 were purpose-built as sea lamprey control barriers and 9 were constructed for other purposes but have been modified to block sea lamprey migrations.

Barrier Inventory and Project Selection System

Barrier inspections are scheduled on a four-year rotation. Lake Michigan inspections will be completed during 2023 and the data will be used to evaluate sea lamprey blocking potential and update the BIPSS.

Operation and Maintenance

- Routine maintenance, spring start-up, and a safety inspection was performed on one barrier.

Ensure Blockage to Sea Lamprey Migration

- Boardman River – The Commission and its partners are working to develop fish passage technologies to pass desirable fishes while blocking sea lamprey. A selective, bi-directional fish passage experimental research facility (FishPass) is planned for construction at the Union Street Dam. The FishPass Project is on hold pending the outcome of litigation. Fish community surveys, telemetry studies, automated surveillance of fish jumping behavior, and hydrodynamic measurements using infrared cameras continue to be performed while construction is on hold. Additionally, a guild analysis is underway to support decisions on sorting tools that could be used in passing Great Lakes and Boardman River fish species.

- Grand River – Work continued on the Grand River 6th Street Dam project with the USACE drafting an environmental impact statement (EIS) that included 14 design alternatives. Progress has slowed as permitting issues in the downstream reach are being addressed. Once the downstream issues are resolved, it will take up to a year to complete the EIS process prior to public review. In addition to this work, members of the SLCP completed site visits in the upper Grand River watershed to investigate the deployment of NEMO, portable electric sea lamprey barriers, as a backup system in the event of future escapement events.

- Barrier removals/modification – Partner agencies were consulted to ensure blockage at barriers at 53 sites in 16 streams (Table 8).

Table 8. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Michigan tributaries during 2022.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Black R.	South Br. Black R.	MIDNR[1]	Breedsville Dam	Concur	Upstream of blocking barrier
Boardman R.	Parsons Cr.	CRA[2]	Lake Rd. culvert	Concur	Upstream of blocking barrier
Boardman R.	Jackson Cr.	CRA[2]	Pierce Rd. culvert	Concur	Upstream of blocking barrier
Boardman R.	Jackson Cr.	CRA[2]	Marsh Rd. culvert	Concur	Upstream of blocking barrier
Jordan R.	Deer Cr.	CRA[2]	Barber Rd. culvert	Concur	Upstream of blocking barrier
Jordan R.	Brown Cr.	CRA[2]	Pesek Rd. culvert #1	Concur	Upstream of blocking barrier
Jordan R.	Marvon Cr.	CRA[2]	Pesek Rd. culvert #2	Concur	Upstream of blocking barrier
Jordan R.	Marvon Cr.	CRA[2]	Marvon Rd. culvert	Concur	Upstream of blocking barrier
Jordan R.	Green R.	CRA[2]	Green River Hatchery Dam	Concur	Ineffective barrier
Jordan R.	Jordan R.	CRA[2]	Jordan R. Rd. culvert #1	Concur	Ineffective barrier
Leland R.	Cedar Run Cr.	CRA[2]	Alpine Rd. culvert	Concur	Upstream of blocking barrier
Leland R.	Cedar Run Cr.	CRA[2]	White Rd. culvert	Concur	Upstream of blocking barrier
Leland R.	Cedar Run Cr.	CRA[2]	South Cedar Rd. culvert	Concur	Upstream of blocking barrier
Leland R.	Victoria Cr.	CRA[2]	Good Harbor Trail culvert	Concur	Upstream of blocking barrier
Manistee R.	Adams Cr.	CRA[2]	W 14 Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Buttermilk Cr.	CRA[2]	N 37 Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Fletcher Cr.	CRA[2]	W 4 Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Fife Lake Cr.	CRA[2]	E 2 Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Maple Cr.	CRA[2]	Sharon Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Coe Cr.	CRA[2]	E 7 Mile Cr. Culvert	Concur	Upstream of blocking barrier
Manistee R.	Coe Cr.	CRA[2]	Raymond Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Coe Cr.	CRA[2]	10 Mile Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Trib. to Pine R.	CRA[2]	Lincoln Hills Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Trib. to Pine R.	CRA[2]	E 3 Mile Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Trib. to Pine R.	CRA[2]	E 46 Mile Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Trib. to Pine R.	CRA[2]	Gopher Run Rd. culvert	Concur	Upstream of blocking barrier

Table 8. *Continued*

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Manistee R.	Silver Cr.	CRA[2]	E 9 Mile Rd. culvert	Concur	Upstream of blocking barrier
Manistee R.	Trib. to Silver Cr.	CRA[2]	E 10 Mile Rd. culvert	Concur	Upstream of blocking barrier
Mitchell Cr.	Mitchell Cr.	CRA[2]	TART culvert #1	Concur	Ineffective barrier
Mitchell Cr.	East Br. Mitchell Cr.	CRA[2]	TART culvert #2	Concur	Ineffective barrier
Northport Cr.	Northport Cr.	CRA[2]	Northport Dam	Concur	Ineffective barrier
Platte R.	Carter Cr.	CRA[2]	Brownell Rd. culvert	Concur	Upstream of blocking barrier
Muskegon R.	Buckhorn Cr.	MRWA[3]	Buckhorn Cr. Dam	Concur	Upstream of blocking barrier
Muskegon R.	Little Muskegon R.	MRWA[3]	Altona Dam	Concur	Upstream of blocking barrier
St. Joseph R.	Elkhart R.	Stantec	Brainertown Dam	Concur	Upstream of blocking barrier
St. Joseph R.	Elkhart R.	Stantec	Benton Dam	Concur	Upstream of blocking barrier
Fox R.	West Br. White R.	FVTU[4]	13th Avenue culvert	Concur	Upstream of blocking barrier
Fox R.	Lily R.	TU[5]	County Rd. DD culvert	Concur	Upstream of blocking barrier
Menominee R.	Kaine Cr.	TU[5]	Forest Service Rd. 3888 culvert	Concur	Upstream of blocking barrier
Menominee R.	Wisconsin Cr.	TU[5]	Wisconsin Cr. Rd. culvert	Concur	Upstream of blocking barrier
Menominee R.	Alvin Cr.	TU[5]	Windsor Dam Rd. culvert	Concur	Upstream of blocking barrier
Menominee R.	Kingstone Cr.	TU[5]	Long Lake Rd. culvert	Concur	Upstream of blocking barrier
Oconto R.	North Br. Oconto R.	TU[5]	Rusch Dam	Concur	Upstream of blocking barrier
Oconto R.	South Br. Oconto R.	TU[5]	Sauls Spring Rd. culvert	Concur	Upstream of blocking barrier
Peshtigo R.	McDonald Cr.	TU[5]	Parkway Rd. culvert	Concur	Upstream of blocking barrier
Peshtigo R.	Armstrong Cr.	TU[5]	Forest Service Rd. 2131 #2 culvert	Concur	Upstream of blocking barrier
Portage Lake Outlet	Portage Lake Outlet	VO[6]	M-22 culvert	Concur	Ineffective barrier
Muskegon R.	Bear Cr.	WMSRDC[7]	Roberts Rd. culvert	Concur	Ineffective barrier
Muskegon R.	Bear Cr.	WMSRDC[7]	Tyler Rd. culvert	Concur	Ineffective barrier
Muskegon R.	Green Cr.	WMSRDC[7]	Buys Rd. culvert #1	Concur	Ineffective barrier
Muskegon R.	Green Cr.	WMSRDC[7]	Buys Rd. culvert #2	Concur	Ineffective barrier

[1]Michigan Department of Natural Resources,, [2]Conservation Resource Alliance, [3]Muskegon River Watershed Assembly, [4]Fox Valley Trout Unlimited , [5]Trout Unlimited, [6]Village of Onekama, [7]West Michigan Shoreline Regional Development Commission

New Construction

- Manistique River – The USACE continues to work with the Commission and its partners to construct a sea lamprey barrier in the Manistique River. Coordination of land acquisition for the sea lamprey barrier project has resulted in several options to address real estate tasks. The Service is working with the City of Manistique to relocate the city's waterline, which currently runs across the existing dam. Timeline to award a construction contract is estimated for December 2025.

- Little Manistee River – The Service continues to work with the MIDNR and USACE staff to improve the blocking capability of the Little Manistee River weir and egg take facility through the construction of a new spillway and permanent sea lamprey trap. The project has reached the 65% design phase and construction is tentatively planned for 2023.

- Pere Marquette River – The Service continues to work with the Village of Baldwin, MIDNR and Conservation Resource Alliance on identifying options for replacing the failing Baldwin River Hatchery Dam with a sea lamprey barrier. The engineering firm, AECOM, has identified four barrier alternatives for blocking sea lampreys from infesting the upper reaches of the Baldwin River.

Lake Huron

The Commission has invested in 17 barriers on Lake Huron (Figure 3). Of these, 13 were purpose-built as sea lamprey barriers and 4 were constructed for other purposes but have been modified to block sea lamprey migrations.

Barrier Inventory and Project Selection System (BIPSS)

Barrier inspections are scheduled on a four-year rotation. Field crews inspected three structures in Lake Huron during 2022 and the data will be used to evaluate sea lamprey blocking potential and update the BIPSS.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 9 barriers (5 Canada, 4 U.S.).

- The combination low-head/electrical barrier in the Ocqueoc River was activated April 1, through April 28, 2022 to prevent sea lamprey passage during elevated stream discharge. The electrical barrier operated continually during this time. Improvements in 2022 included the installation of a new battery backup system and water level sensor. The streambank adjacent to the electrical weir was filled and graded to improve drainage when the weir is inundated during elevated stream discharge events.

- Koshkawong River – An engineering firm was contracted to assess condition and life extension feasibility for the Koshkawong River barrier. Remediation of the barrier is expected to be completed in 2023.

Ensure Blockage to Sea Lamprey Migration

- Cheboygan River – Plans to block adult sea lamprey at the Cheboygan lock and dam complex and to eradicate lampreys from the upper river included:

    - The Service continues to work with GEI Consultants, Inc. (GEI), the MIDNR, and others to identify alternatives for preventing sea lamprey passage at the Cheboygan River lock. The MIDNR is pursuing the refurbishment of the aging structure and the federal partners are interested in making the lock "lamprey proof." GEI is currently investigating the use of anti-suction material on the surfaces of the lock. Construction for this project is expected to begin in 2023.

    - The Lake Kathleen Dam on the Maple River was removed during fall 2018. Annual monitoring to document changes in native and sea lamprey populations throughout the Maple River continued during 2022. Larval sea lamprey were detected upstream of the Lake Kathleen Dam site in the West Branch of the Maple River at the US-31 highway crossing. The Service will continue to monitor this population during the 2023 field season.

- Trout River – The Service continues to work with partners including the Presque Isle Conservation District, and MIDNR on a long-term plan for the aging Trout River dam. The Michigan Department of Environment, Great Lakes, and Energy completed a dam safety inspection, issuing a categorical rating of poor. Emergency repairs are required before spring to fix a collapsed wing wall on the primary spillway. The firm OHM has provided engineering services related to the emergency repairs while long-term repairs continue to be identified.

- Partner agencies were consulted to ensure blockage at barriers for 6 sites in 4 tributaries during 2022 (Table 9).

Table 9. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Huron tributaries during 2022.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Grebe Cr.	Grebe Cr.	MDOT[1]	US-23 culvert	Concur	Low chance of infestation
Saginaw R.	Flint R.	Stantec	Hamilton Dam	Concur	Low chance of infestation
McKay Cr.	McKay Cr.	Huron Pines	Swede Rd. culvert	Concur	Ineffective barrier
Beavertail Cr.	Beavertail Cr.	Huron Pines	South Prentiss Bay Rd. culvert #1	Concur	Ineffective barrier
Beavertail Cr.	Beavertail Cr.	Huron Pines	South Prentiss Bay Rd. culvert #2	Concur	Ineffective barrier
Beavertail Cr.	Beavertail Cr.	Huron Pines	State Forest Rd. culvert	Concur	Ineffective barrier

[1]Michigan Department of Transportation

Lake Erie

The Commission has invested in 7 purpose-built sea lamprey barriers on Lake Erie (Figure 3).

Barrier Inventory and Project Selection System (BIPSS)

Barrier inspections are scheduled on a four-year rotation. Field crews inspected 21 structures in Lake Erie during 2022 and the data will be used to evaluate sea lamprey blocking potential and update the BIPSS.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 7 barriers (7 Canada, 0 U.S.).

- Field engineering, fabrication, and installation of a water intake deflector screen was completed at Little Otter Creek Dam.

Ensure Blockage to Sea Lamprey Migration

- Black River – The MIDNR and Service-Alpena Fish and Wildlife Conservation Office completed a feasibility study in 2019 for the removal of Wingford Dam. Project partners are currently working to find a mutually beneficial solution to allow fish passage while preventing sea lamprey escapement. Larval assessment data collected for the upper Black River is currently being analyzed to determine the sea lamprey production potential for this area should escapement occur.

- Clinton River – The MIDNR and Clinton River Watershed Council collaborated with the Service to repair a bypass around the Yates Mill Dam. Since the repair, the bypass has reopened. A stream geomorphic study was recently conducted upstream of the dam, which provided recommendations for river channel modifications to alleviate future bypass channel formation. Project partners are working together to review the recommendations and plan a course of action.

- Partner agencies were consulted to ensure blockage at 1 barrier site in 1 tributary (Table 10).

Table 10. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Erie tributaries during 2022.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Portage R.	Rocky Ford	OHDNR[1]	Van Buren Lake Dam	Concur	Low chance of infestation

[1]Ohio Department of Natural Resources

New Construction

- Cattaraugus Creek – The USACE, along with project partners Erie County and New York Department of Environmental Conservation (NYDEC) have approved the selected plan for the Springville Dam Ecosystem Restoration Project. Initially, the project included lowering the height of the dam, installing a Denil fishway with a seasonal trap and sort facility, and a sea lamprey trap. The project was temporarily put on hold so the USACE and NYDEC could initiate a Value Engineering Design Review to reduce costs and identify additional paths toward project completion.

- Grand River – Construction of the sea lamprey barrier replacing the deteriorated structure in the Grand River was completed in summer 2020. Project partners included the Commission, Service, Ohio Department of Natural Resources (OHDNR), and Ashtabula County. Recently, the USACE installed a second steel lip to the upper barrier step remediating a nappe vibration which occurred under certain stream discharge rates. The Service has installed a pipe across the lower step of the barrier which will be used to effectively spread lampricide across the width of the river during sea lamprey treatments.

- Conneaut Creek – The Pennsylvania Fish and Boat Commission (PAFBC) and the OHDNR have expressed interest in constructing a new barrier on Conneaut Creek. The goal of the project is to reduce the amount of stream miles requiring lampricide application and thus limit lampricide exposure to sensitive, native species (mudpuppies, hellbenders, and Northern brook lamprey). A feasibility study is underway and is focusing on a potential location in Pennsylvania with four alternative barrier designs. Outreach meetings were held in May and November 2022 outlining project goals and objectives. Monthly virtual meetings continue as the project moves forward. A finalized feasibility study is scheduled to be completed by the end of 2023.

Lake Ontario

The Commission has invested in 16 barriers on Lake Ontario (Figure 3). Of these, 10 were purpose-built as sea lamprey barriers and 6 were constructed for other purposes but have been modified to block sea lamprey migrations.

Barrier Inventory and Project Selection System (BIPSS)

Barrier inspections are scheduled on a four-year rotation. Field crews inspected 81 structures in Lake Ontario during 2022 and the data will be used to evaluate sea lamprey blocking potential and update the BIPSS.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 11 barriers (10 Canada, 1 U.S.).

- The NYDEC completed startup and shutdown of the seasonal barrier at Orwell Brook in 2022.

Ensure Blockage to Sea Lamprey Migration

- Partner agencies were consulted to ensure blockage at barriers for 2 sites in 1 tributary during 2022 (Table 11).

Table 11. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Ontario tributaries during 2022.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Black R.	Warner Cr.	TU[1]	Long Pond Rd. culvert	Concur	Upstream of blocking barrier
Black R.	Trib. to Black Cr.	TU[1]	Brewery Rd. culvert	Concur	Upstream of blocking barrier

[1]Trout Unlimited

New Construction

- Beaverdam Brook – A consultant was contracted to evaluate the feasibility of constructing a sea lamprey barrier on a tributary of the Salmon River at the Salmon River Fish Hatchery. The study is expected to be completed in 2023.

Juvenile Trapping For Control

Out-migrating juvenile sea lamprey were trapped in 7 tributaries of Lake Superior, 2 tributaries of Lake Michigan, and 6 tributaries of Lake Huron from September through December using elver nets, fyke nets, hoop nets, and screw traps to mitigate escapement due to treatment deferrals, and in streams in close proximity to program headquarters (Table 12).

- Traps were operated in the Marengo and Potato rivers (Bad River) through a cooperative agreement with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) to capture out-migrating juvenile sea lamprey that survived the 2021 lampricide treatment.

Table 12. Sea lamprey catch from juvenile trapping during 2022.

Lake	Stream	Field Station	Juveniles
Superior	Cranberry Cr.*	DFO[1]	12
Superior	Lower Marengo R. (Bad River)	GLIFWC[2]	145
Superior	Upper Marengo R. (Bad River)	GLIFWC2	1
Superior	Potato R. (WI, Bad River)	GLIFWC[2]	1
Superior	Cranberry R.*	KBIC[3]	0
Superior	Little Carp R.*	KBIC[3]	0
Superior	Potato R. (MI)	KBIC[3]	0
Superior	Traverse R.	KBIC[3]	2
Superior	Flintsteel R.	KBIC[3]	6
Michigan	Bills Cr.*	USFWS[4]	4
Michigan	Furlong Cr.*	USFWS[4]	0
Michigan	Furlong Cr.* (Spring Trapping)	USGS[5]	0
Huron	Root R.	DFO[1]	10
Huron	Garden R.	DFO[1]	10
Huron	Black Mallard Cr.	USGS[5]	0
Huron	Long Lake Outlet	USGS[5]	0
Huron	Maple R. (Cheboygan River)	USGS[5]	1
Huron	Pigeon R.* (Cheboygan River)	USGS[5]	0
Huron	Silver Cr.	USGS[5]	0
Huron	Sturgeon R. (Trib. to Cheboygan River)	USGS[5]	4
	Totals		**196**

[*] Streams treated with lampricide in 2022, [1] Fisheries and Oceans Canada, [2] Great Lakes Indian Fish and Wildlife Commission, [3] Keweenaw Bay Indian Community, [4] U.S. Fish and Wildlife Service, [5] U.S. Geological Survey

Supplemental Control

Supplemental controls are tactics that supplement the two primary sea lamprey control strategies, lampricides and sea lamprey barriers, by reducing reproduction or capturing transformed sea lamprey. During 2020, the Commission initiated a long-term study to evaluate supplemental control on up to 12 streams where lampricide treatments are challenging or barriers were recently removed (Figure 4).

Supplemental controls were deployed in 4 Lake Huron streams during 2020-2022:

- Black Mallard River – A seasonal electric sea lamprey barrier has been operated since 2016. During 2020-2022, enhanced trapping of adult sea lamprey occurred downstream of the

electrical barrier. In 2021 and 2022, about 100 sterile males were released upstream of the electrical barrier to reduce recruitment from any lampreys that may have escaped upstream. Larval recruitment has not been documented upstream of the seasonal barrier since 2017.

- Pigeon, Sturgeon, Maple rivers (Cheboygan River Watershed): Sterile male release occurred during 2017-2019. The sterilization facility was not operated in 2020 due to COVID-19 travel restrictions. Sterile males were released in 2021 (2,000) and 2022 (3,325).

    - In the Maple River, evidence of the 2020 year class upstream of the former Lake Kathleen Dam was documented. The stream has not been treated with lampricide since 2016, but treatment may be needed during 2024. The timing and extent of any treatments will be coordinated with partners and will need to consider the endangered Hungerford's Crawling Water Beetle (*Brychius hungerfordi*).

    - In the Sturgeon River, a year class of larvae recruited in 2020 and this population ranked for lampricide treatment in 2023. The Sturgeon River was last treated in 2016.

    - In the Pigeon River, multiple year classes of larvae were present in 2022 with larvae present upstream of the former Song of the Morning impoundment. The Pigeon River was treated with lampricide in 2022.

- Benefits to sea lamprey control – Deployment of supplemental controls on the Pigeon, Sturgeon, Maple, and Black Mallard rivers has delayed lampricide treatment and resulted in a redirection of $660,000 of lampricide control effort that was used to kill juvenile sea lamprey in other streams.

Baseline data were collected prior to supplemental control deployment in eight streams:

- Crews surveyed all life stages of sea lamprey in the Cranberry River, Potato River, Traverse River, Bills Creek (Whitefish River), Furlong Creek (Millecoquins River), Bellevue Creek (Goulais River), Root River, Long Lake Outlet, and Tawas Lake Outlet (Table 13). Supplemental controls will begin in these rivers in 2024 or 2025. Future supplemental control deployments are being planned with stakeholders and researchers using structured decision making.

- A novel aspect of this work is the application of close-kin mark-recapture to characterize changes in recruitment and larval growth and survival when supplemental controls are applied. Pedigree analysis is being used to estimate the number of effective spawners and to track known-age larval family groups over multiple years as they grow, drift downstream, and die of natural or control program-induced mortality (trapping or lampricide). Detailed descriptions of sea lamprey population demographics have been hampered in the past by an inability to reliably age large larvae and juveniles.

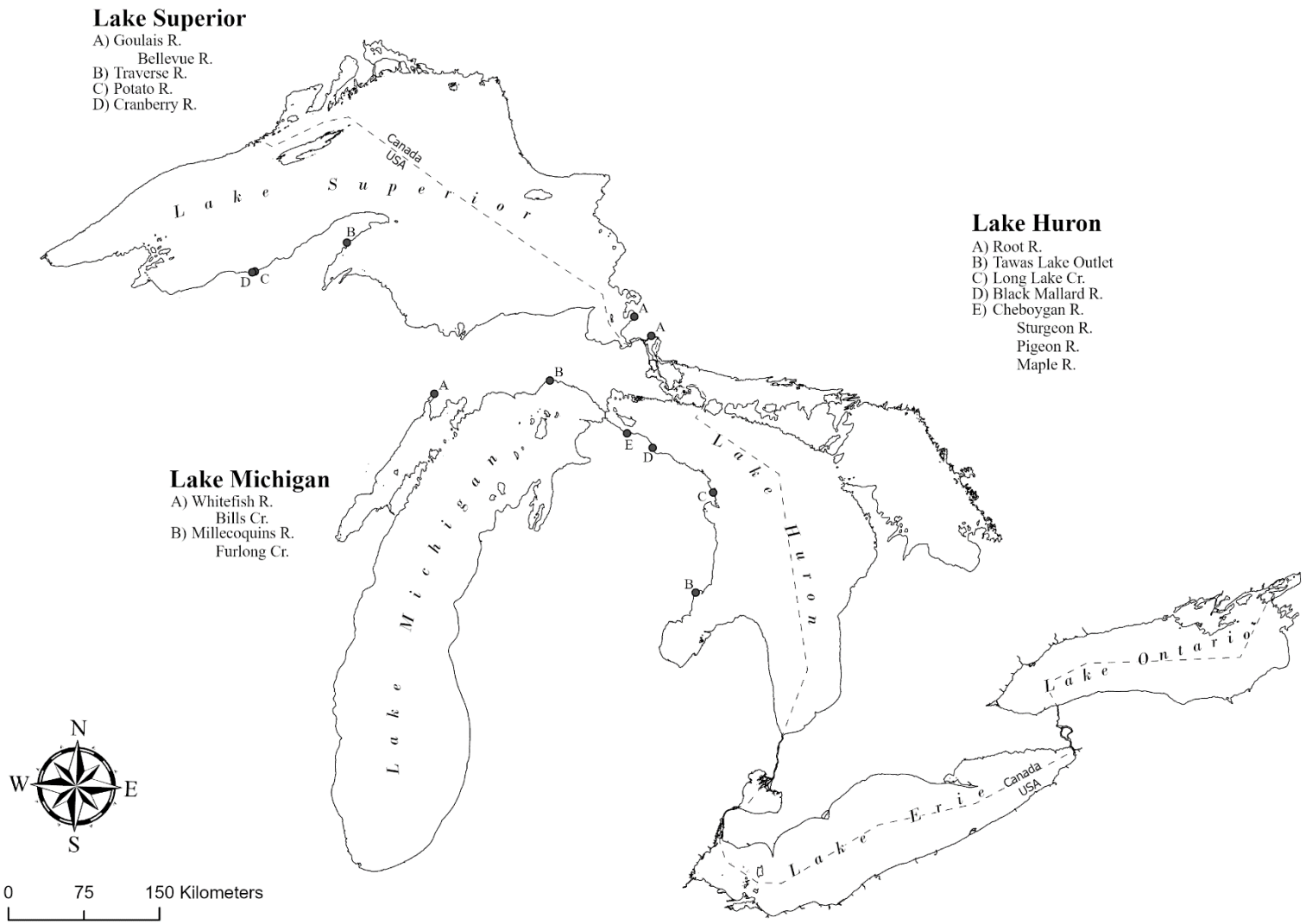

Figure 4. Location of streams where supplemental sea lamprey controls are likely to be tested and evaluated in an adaptive management framework. These streams regularly produce larval sea lamprey, are wadable, near cooperator field offices, and are places where larval production is difficult to control using barriers or lampricides. Furlong Creek is a tributary to the Millecoquins River. Bills Creek is a tributary to the Whitefish River. Bellevue Creek is a tributary to the Goulais River.

Table 9. Streams where adult abundance, larval sea lamprey, juvenile sea lamprey, and habitat were assessed during 2020-2022 to describe effectiveness of ongoing supplemental controls (streams in bold) or collect baseline conditions before application of additional supplemental controls.

Lake	Stream	Adult Abundance Range 2020 - 2022	# Larval surveys 2020 - 2022	Larvae Captured	Juveniles Trapped 2020 - 2022	Habitat Surveys	Last Lampricide Treatment	Next Expected Lampricide Treatment
Superior	Cranberry	22-614	30	504	15	0	Sep-22	Sep-25
Superior	Potato	10	26	1	1	109	Jun-21	Jun-25
Superior	Traverse	72-149	37	524	90	19	May-21	May-24
Michigan	Furlong	24-27	48	20	176	58	May-22	May-24
Michigan	Bills	14-29	34	479	10	74	Apr-22	Sep-26
Huron	Root	20-70	71	1284	29	12	Sep-21	Sep-23
Huron	Tawas Lake Outlet	< 10	52	382	0	0	Aug-22	Sep-25
Huron	Long Lake Outlet	37-310	44	560	0	4	Aug-21	Aug-25
Huron	**Black Mallard**	51-102	45	4	0	35	May-19	TBD
Huron	**Sturgeon**	10-60	76	97	7	0	Aug-16	Aug-23
Huron	**Pigeon**	20-107	88	731	58	105	Sep-22	TBD
Huron	**Maple**	< 10	60	163	8	23	Aug-16	TBD

Sterile Male Release Technique

The Sterile Male Release Technique (SMRT) was discontinued as an alternative control method in the St. Marys River in 2012 after being implemented during 1997-2011. Monitoring of embryo viability (proportion of embryos that were alive at stage 12 of development) continues to provide insight into the effectiveness of SMRT.

- In 2022, the mean embryo viability of 20 nests sampled was 64% (Figure 5).

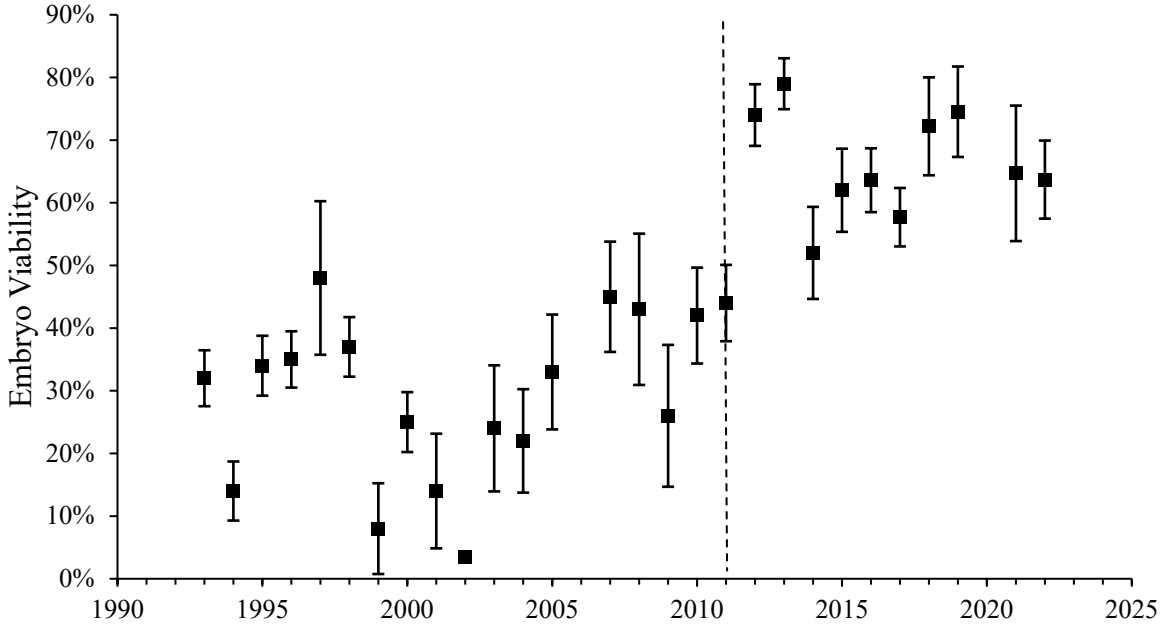

Figure 5. Mean annual embryo viability in the St. Marys River rapids during and after application of the sterile-male release technique (SMRT). The error bars represent SEs (not calculated for 2002 because only one sample was obtained). The vertical dashed line indicates the discontinuation of SMRT after 2011.

ASSESSMENT

The SLCP has three assessment metrics:

- Larval assessment, conducted by the Service and Department, determines the abundance and distribution of sea lamprey larvae in streams and lentic areas. These data are used to predict where larvae greater than 100 mm total length will most likely be found by the end of the growing season during the year of sampling. These predictions are used to prioritize lampricide treatments for the following year.

- Juvenile assessment, undertaken by other fishery management agencies, evaluates the lake-specific rate of lake trout marking inflicted by sea lamprey. These time series data are used in conjunction with adult assessment data to assess the effectiveness of the SLCP for each lake. In addition, several indices of relative abundance of feeding juveniles are used in some lakes to monitor sea lamprey populations over time.

- Adult assessment, conducted by the Service and Department, annually estimates an index of adult sea lamprey abundance in each lake. Because this life stage is comprised of individuals that have either survived or avoided exposure to lampricides, the time series of adult abundance indices is the primary metric used to evaluate the effectiveness of the SLCP.

Reporting to the SLCB, the Larval Assessment Task Force (LATF) and the Trapping Task Force (TTF) were established by the Commission in 2012. The LATF is responsible for ranking streams and lentic areas for sea lamprey control options and evaluating the success of lampricide treatments through assessment of residual larvae. The TTF is responsible for optimizing trapping techniques for assessing adult sea lamprey populations and removing adults and juveniles. Task Force progress on SLCB charges during 2022 are presented in the LATF and TTF sections of this report.

Larval Assessment

Tributaries considered for lampricide treatment during 2023 were assessed during 2021 and 2022 to define the distribution and estimate the abundance and size structure of larval sea lamprey populations. Assessments were conducted with backpack electrofishers in waters <0.8 m deep, while waters ≥0.8 m in depth were surveyed with gB or by deep-water electrofishing (DWEF). Additional surveys are used to define the distribution of sea lamprey within a stream, detect new populations, or evaluate lampricide treatments.

Lake Superior

- Larval assessments were conducted in 204 tributaries (62 Canada, 142 U.S.) and 33 lentic areas (4 Canada, 29 U.S.). The status of larval sea lamprey populations in historically infested Lake Superior tributaries and lentic areas is presented in Table 14.

- Surveys to estimate larval sea lamprey abundance were conducted in 44 tributaries (12 Canada, 32 U.S.) and 4 lentic areas (3 Canada, 1 U.S.).

- Surveys to detect the presence of new larval sea lamprey populations were conducted in 87 tributaries (30 Canada, 57 U.S.). Two new populations of larvae were discovered in Gooseberry (lentic) and Knife rivers in Minnesota, and one unnamed tributary to Goulais Bay in Ontario.

- Post-treatment assessments were conducted in 25 tributaries (0 Canada, 25 U.S.) and 3 lentic areas (0 Canada, 3 U.S) to determine the effectiveness of lampricide treatments conducted during 2021 and 2022. Harlow Creek, Little Garlic, Amnicon, and Sturgeon rivers are scheduled for treatment in 2023 based on residual populations following the most recent treatment.

- Surveys to evaluate barrier effectiveness were conducted in the Big Carp and Carp rivers (Canada). Both barriers were found to be effective in limiting sea lamprey infestations.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 67.73 kg active ingredient of 3.2% gB (Table 15).

Table 14. Status of larval sea lamprey in Lake Superior tributaries with a history of sea lamprey production.

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Canada			
East Davignon Cr.	May-72	Jun-21	May-72
West Davignon Cr.	Jun-14	Jul-20	Jun-16
Little Carp R.	May-16	Jun-22	Jun-22
Big Carp R.	Sep-07	Jun-22	Aug-08
Cranberry Cr.	Aug-22	Jul-21	Jul-21
Goulais R.	Sep-22	Jul-22	Jul-22
Goulais Bay	Oct-16	Jul-18	Jul-18
Boston's Cr.	Never	Aug-20	Aug-20
Horseshoe Cr.	Never	Aug-20	Aug-59
Havilland Cr.	Oct-19	May-22	Jun-19
Havilland Bay	Jun-15	Jun-21	Jun-21
Stokely Cr.	Jun-08	May-22	Sep-17
Havilland Bay	Aug-11	Jun-21	Jun-21
Tier Cr.	Never	Jul-19	Jun-61
Harmony R.	Jun-14	Jun-22	Jun-22
Batchawana Bay	Oct-22	Jul-21	Jul-21
Sawmill Cr.	Aug-18	Aug-22	Aug-22
Jones Landing Cr.	Never	Aug-20	Jun-66
Tiny Cr.	Never	Aug-20	Aug-19
Chippewa R.	Aug-20	Jul-21	Jul-21
Batchawana Bay	Jul-21	Sep-22	Sep-22
Unnamed (S-1009)	Oct-19	Aug-20	Aug-20
Unger Cr.	Jul-10	Aug-20	May-18
Batchawana R.	Jul-20	Oct-22	Oct-22
Batchawana Bay	Sep-21	Sep-21	Jul-21
Digby Cr.	Jun-13	Jul-21	Jul-19
Carp R.	Aug-20	Aug-22	Jul-19
Batchawana Bay	Jul-18	Jul-19	Jul-17
Pancake R.	Jun-19	Aug-22	Aug-22
Pancake Bay	Jun-19	Jul-18	Jul-18
Hibbard Bay Cr.	Never	Aug-20	Never
Westman Cr.	Jun-16	Aug-20	Jul-15
Agawa R.	Jul-19	Aug-22	Aug-21
Agawa Bay	Aug-10	Aug-22	Aug-22
Sand R.	Sep-71	Aug-22	Aug-22
Baldhead R.	Never	Aug-20	Sep-01
Gargantua R.	Sep-18	Aug-21	Aug-21
Old Woman R.	Jul-18	Aug-22	Aug-22
Michipicoten R.	Oct-22	Aug-20	Jul-19
Michipicoten R. (Estuary)	Aug-19	Aug-21	Aug-21
Dog R.	Aug-63	Aug-22	Aug-22
White R.	Jul-16	Aug-22	Jul-15
Pic R.	Jul-19	Aug-21	Jul-18
Nama Cr.	Jul-19	Jul-18	Jul-18
Little Pic R.	Aug-22	Aug-21	Aug-21
Prairie R.	Jul-19	Aug-22	Aug-22
Steel R.	Aug-19	Aug-22	Aug-22

Table 14. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Pays Plat R.	Jun-22	Aug-18	Aug-18
Pays Plat Bay	Never	Aug-18	Aug-16
Little Pays Plat Cr.	Jun-22	Aug-18	Aug-18
Gravel R.	Aug-19	Sep-22	Sep-22
Mountain Bay	Oct-22	Aug-21	Aug-21
Little Gravel R.	Jul-18	Sep-22	Sep-22
Mountain Bay	Oct-22	Aug-21	Aug-21
Little Cypress R.	Aug-14	Sep-22	Aug-17
Cypress Bay	Aug-16	Aug-15	Aug-15
Cypress R.	Jul-22	Aug-21	Aug-21
Cypress Bay	Jul-19	Sep-21	Aug-18
Jackpine R.	Never	Aug-21	Aug-21
Nipigon Bay	Sep-21	Sep-21	Aug-18
Jackfish R.	Oct-16	Aug-18	Jun-18
Nipigon Bay	Never	Aug-14	Aug-05
Nipigon R.			
Upper Nipigon R.	Aug-19	Aug-21	Aug-21
Lake Helen lentic	Oct-22	Sep-21	Sep-21
Lower Nipigon R.	Aug-06	Sep-22	Sep-22
Nipigon R (Lower) lentic	Oct-22	Sep-22	Sep-22
Cash Cr.	Oct-15	Sep-22	Sep-22
Lake Helen lentic	Oct-22	Sep-21	Sep-21
Polly Cr.	Jul-18	Sep-22	Sep-22
Polly Lake lentic	Jul-87	Aug-17	Jul-90
Stillwater Cr.	Aug-19	Sep-22	Sep-22
Nipigon Bay	Sep-18	Sep-22	Sep-22
Big Trout Cr.	Jul-18	Sep-22	Sep-22
Nipigon Bay	Oct-11	Aug-18	Aug-18
Otter Cove Cr.	Aug-19	Aug-19	Aug-19
Black Sturgeon R.	Aug-16	Aug-21	Aug-19
Black Bay	Never	Aug-21	Jul-04
Valley Cr.	Jun-72	Aug-18	Aug-71
Wolf R.	Jul-18	Sep-22	Sep-22
Black Bay	Aug-15	Aug-21	Aug-16
Coldwater Cr.	Jul-18	Sep-22	Sep-22
Black Bay	Aug-19	Aug-18	Aug-18
Pearl R.	Jul-19	Sep-22	Aug-18
D'Arcy Cr.	Jul-19	Aug-20	Aug-18
Black Bay	Jun-17	Aug-17	Aug-16
Blende Cr.	Jun-17	Sep-21	Sep-21
MacKenzie R.	Aug-16	Sep-22	Sep-22
MacKenzie Bay	Aug-19	Sep-21	Sep-21
Wild Goose Cr.	Jul-18	Sep-22	Aug-20
Current R.			
Thunder Bay	Sep-18	Sep-21	Sep-21
Neebing-McIntyre FW	Jul-22	Sep-22	Aug-19
Kaministiquia R.	Oct-22	Sep-22	Sep-22
Slate R.	Oct-22	Sep-21	Sep-21
Corbett Cr.	Oct-22	Sep-21	Sep-21

Table 14. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Kaministiquia R.			
Whitefish R.	Oct-22	Sep-21	Sep-21
Oliver Cr.	Oct-22	Sep-22	Sep-21
Jarvis R.	Jun-17	Aug-19	Aug-19
Cloud R.	Jun-17	Aug-19	Aug-19
Pine R.	Jul-18	Aug-16	Aug-17
Pigeon R.	Sep-22	Sep-21	Sep-21
Pigeon Bay	Aug-10	Sep-21	Sep-21
United States			
Waiska R.	Jul-07	Sep-22	Jun-18
West Branch	Jul-21	May-21	May-21
Sec. 11SW Cr.	Never	Jun-21	Jun-21
Pendills Cr.	Jul-12	May-21	May-21
Tahquamenon Bay	Never	Sep-22	Jul-12
Grants Cr.	Aug-15	Jun-22	Aug-21
Tahquamenon Bay	Jul-18	Jul-22	Jul-22
Halfaday Cr.	Jul-12	Jun-22	Aug-21
Tahquamenon Bay	Never	Sep-22	Jul-12
Mill Creek (Chippewa)	Never	Sep-22	Jun-22
Naomikong Cr.	Jul-18	Jun-22	Jun-22
Ankodosh Cr.	Aug-19	Jun-22	Jun-22
Tahquamenon Bay	Jul-18	Jul-22	Jul-22
Roxbury Cr.	Jul-17	Sep-22	Jun-22
Tahquamenon Bay	Never	Jul-22	Jul-22
Galloway Cr.	Aug-19	Sep-22	Sep-22
Tahquamenon Bay	Never	Aug-21	Aug-21
Tahquamenon R.	Aug-19	Aug-21	Aug-21
Betsy R.	Sep-22	Oct-21	Oct-21
Three Mile Cr.	Jul-18	Sep-22	May-22
Little Two Hearted R.	Jul-21	May-22	May-22
Two Hearted R.	Aug-19	Oct-22	Sep-22
Dead Sucker R.	Aug-13	Aug-21	May-19
Sucker R.	Aug-22	May-22	May-22
Grand Marais Harbor	Never	Sep-18	Sep-18
Chipmunk Cr.	Sep-62	Jun-21	Sep-61
Carpenter Cr.	Aug-15	Jun-22	Jun-22
West Bay	Aug-19	Oct-22	Oct-22
Sable Cr.	Sep-89	Jun-22	Jun-22
Hurricane R.	Never	Jun-21	Aug-08
Sullivans Cr.	Jul-19	Jun-22	Jun-22
Seven Mile Cr.	Jul-18	Jun-22	Jun-22
Beaver Lake Cr.			
Beaver Lk Outlet	Jul-18	Jun-22	Aug-17
Lowney Cr.	Aug-22	Jun-21	Jun-21
Little Beaver Cr.	Jul-18	Jun-22	Jun-22
Arsenault Cr.	Never	Jun-22	Jun-22
Beaver Lake	Never	Jun-21	Jun-21
Little Beaver Lake	Never	Jun-21	Jun-21

Table 14. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Mosquito R.	Jun-73	Jun-22	Oct-72
Miners R.			
Barrier downstream	Jul-16	Jul-19	Jun-21
Barrier upstream	Jul-13	Jun-21	May-12
Miners Lake Lentic	Jun-11	Sep-13	Sep-13
Munising Falls Cr.	Sep-64	Jun-20	Jun-14
Anna R.	Jul-19	Jul-22	Jul-22
Munising Bay	Jul-19	Jul-22	Jul-22
Tourist Park Cr.	Never	Jul-22	Jul-10
Furnace Cr.			
Lower	Jul-19	Jul-22	Jul-22
Upper	Sep-10	Sep-18	Aug-09
Furnace Bay	Aug-22	Jun-21	Jun-21
Furnace Lake – Near Outlet	Never	Jul-20	May-12
Furnace Lake – Offshore Hanson Cr.	Never	Jul-17	Jul-09
Furnace Lake – Offshore Gongeau Cr.	Never	Jul-17	Jul-09
Five Mile Cr.	Jul-16	Jul-22	Jul-22
Five Mile Cr. Lentic	Never	Jul-16	Jul-16
Au Train R.			
Lower	Jul-19	Sep-22	Oct-21
Upper	Jul-19	Jul-22	Jul-22
Au Train Lake	Never	Jul-22	Jul-20
Rock R.	Jul-02	Jul-22	Aug-97
Deer Lake Cr.	Aug-70	Sep-22	Aug-78
Laughing Whitefish R.	Jul-20	Oct-22	Oct-22
Sand R.			
Below Dam	Jul-19	Oct-22	Oct-22
Above Dam	Jul-15	Sep-18	Aug-17
Chocolay R.	Jul-19	Oct-22	Jul-22
Carp R.	Jul-20	Jul-22	Jul-22
Carp R. lentic	Aug-22	Jul-22	Jul-22
Dead R.	Aug-22	Jun-21	Jun-21
Presque Isle Harbor	Jul-19	Jun-21	Jun-21
Compeau Cr.	Never	Jun-22	Jun-12
Harlow Cr.	Aug-22	Nov-22	Nov-22
Harlow Lake – offshore Bismark Cr.	May-21	Jun-20	Jun-20
Little Garlic R.	Sep-21	Jun-22	Jun-22
Little Garlic R. lentic	Jun-12	Jul-20	Jul-20
Garlic R.	Aug-22	Sep-21	Sep-21
Garlic R. lentic	Never	Jul-12	Sep-05
Saux Head Lake	May-22	Jun-19	Jun-19
Iron R.	Sep-19	Jul-20	Sep-18
Salmon Trout R.	Jul-19	Jul-22	Jul-22
Pine R. (Marquette Co.)	Jun-18	Jul-22	Jul-22
Huron R.	Aug-19	Oct-22	Oct-22
Ravine R.	May-22	Jul-22	Jul-22
Huron Bay	Sep-15	Jul-20	Jul-20
Slate R.	Sep-22	Jul-22	Jul-22
Huron Bay	Aug-17	Oct-21	Oct-21

Table 14. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Silver R.	Sep-22	Jul-22	Jun-19
Huron Bay	Aug-17	Sep-19	Sep-17
Falls R.	Aug-22	Jul-22	Jun-06
L'anse Bay	Sep-22	Jun-21	Jun-21
Six Mile Cr.	Sep-18	Jul-22	Jun-17
L'anse Bay	Never	Jun-18	Jun-18
Little Carp R.	May-22	Jul-22	Jun-21
Kelsey Cr.	Never	Jul-20	Aug-16
Sturgeon R.	Aug-21	Oct-22	Oct-22
Pike River	Never	Jul-11	May-21
Pilgrim R.	Aug-21	Aug-21	Sep-20
Trap Rock R.	Jul-19	Aug-22	Jul-22
Torch Lake	Jun-21	May-22	May-22
McCallum Cr.	Aug-63	Sep-21	May-94
Traverse R.	May-21	Jul-22	Jul-22
Little Gratiot R.	Jun-16	Jun-22	May-15
Eliza Cr.	Jul-19	Jul-22	Jul-22
Eagle Harbor	Jul-20	Oct-19	Sep-19
Gratiot R.	Sep-18	Jul-22	Jul-22
Smiths Cr.	May-64	Sep-20	May-64
Boston-Lily Cr.	Jul-20	Oct-22	Oct-22
Schlotz Cr.	Oct-21	Aug-22	Sep-20
Salmon Trout R. (Houghton Co.)	Jun-16	Aug-22	Aug-22
Mud Lake Outlet	Sep-18	Aug-22	Aug-22
Hungarian Cr.	May-22	Apr-22	Sep-21
Torch Lake	May-22	Aug-22	Sep-21
Graveraet R.	Sep-18	Oct-22	Oct-22
Elm R.	Aug-16	Aug-21	Aug-21
Misery R.			
Barrier downstream	Jul-22	Sep-22	Aug-21
Barrier upstream	Aug-00	Aug-18	Sep-08
East Sleeping R.	Jul-22	Sep-22	Oct-21
West Sleeping R.	May-19	Jul-22	Jul-22
Firesteel R.	Jun-19	Oct-22	Oct-22
Flintsteel R.	Sep-22	May-22	Aug-21
Ontonagon R.	Oct-19	Oct-22	Oct-22
Potato R.	Jun-21	May-21	Sep-20
Floodwood R.	Never	Aug-22	Aug-85
Cranberry R. (Ontonagon Co.)	Jul-22	Aug-22	Sep-21
Mineral R.	Jul-22	Sep-22	Sep-22
Mineral R. lentic	Never	Aug-19	Sep-11
Big Iron R.	Never	Aug-22	Jul-15
Little Iron R.	Jul-22	Oct-21	Oct-21
Union R.	May-64	Oct-20	Aug-62
Black R.	Sep-21	Aug-22	Jul-17
Black River Harbor	Sep-19	Aug-22	Jul-19
Montreal R.	Jul-75	Aug-22	Jul-10
Washington Cr.	Jun-80	Jul-12	Sep-82
Bad R.	Sep-21	Aug-22	Aug-22

Table 14. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Fish Cr. (Eileen Twp)	May-22	Aug-22	Aug-22
Chequamegon Bay	Never	Jul-21	Aug-06
Sioux R.	Jul-19	Sep-19	Aug-18
Pikes Cr.	May-16	Aug-18	Aug-18
Red Cliff Cr.	May-22	Aug-22	Jul-21
Buffalo Bay	Never	Aug-11	Aug-03
Raspberry R.	May-16	Jul-19	Sep-15
Sand R. (Bayfield Co.)	Jul-16	Aug-22	Aug-22
Sand Bay	Aug-10	Jul-21	Aug-15
Cranberry R. (Bayfield Co.)	Jun-17	Jun-21	Sep-16
Iron R.			
Barrier downstream	Aug-16	Aug-22	Aug-22
Barrier upstream	Oct-64	Aug-22	Never
Reefer Cr	Oct-64	Jun-22	Jun-16
Fish Cr. (Orienta Twp)	Oct-64	Sep-16	Aug-63
Brule R.			
Barrier downstream	Jun-18	Apr-22	Apr-22
Barrier upstream	Jun-86	Jul-21	Sep-87
Brule R. Lentic	Never	Aug-22	Aug-22
Poplar R.	Jun-22	Aug-22	Aug-22
Middle R.			
Barrier downstream	Jun-21	Aug-22	Aug-22
Barrier upstream	Jun-02	Jul-18	Sep-09
Amnicon R.	Jun-21	Aug-22	Jun-22
Amnicon R. Lentic	Never	Aug-22	Aug-18
Nemadji R.	Jun-22	Aug-22	Aug-21
St. Louis R.	Sep-87	Aug-19	Aug-19
Sucker R. (St. Louis Co.)	Never	Aug-22	Sep-89
Knife River	Never	Aug-22	Aug-22
Knife R. Lentic	Never	Aug-22	Aug-22
Gooseberry R.	Aug-76	Aug-22	Aug-22
Gooseberry R. Lentic	Never	Aug-22	Aug-22
Splitrock R.	Aug-76	Aug-22	Aug-21
Poplar R.	Jun-18	Aug-22	Aug-21
Poplar R. Lentic	Never	Aug-22	Never
Arrowhead R.	Jun-09	Aug-22	Aug-22
Arrowhead R. Lentic	Never	Aug-22	Aug-22

Table 15. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Superior for larval assessment purposes during 2022.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Goulais River	0.47	0.10
Chippewa River (Lentic)	1.18	0.25
Agawa River (Lentic)	1.42	0.30
Dog River	3.04	0.64
White River	1.42	0.30
Prairie River	0.94	0.20
Nipigon River	3.31	0.70
Pearl River	1.42	0.30
Neebing-McIntyre Floodway	0.47	0.10
Kaministiquia River	1.89	0.40
Total (Canada)	**15.56**	**3.29**
United States		
Waiska River	1.71	0.36
Pendils Creek (Lentic)	1.47	0.31
Grants Creek (Lentic)	1.96	0.41
Halfaday Creek (Lentic)	1.47	0.31
Ankodosh Creek (Lentic)	1.96	0.41
Roxbury Creek (Lentic)	1.96	0.41
Carpenter Creek (Lentic)	1.96	0.41
Anna River (Lentic)	1.47	0.31
Au Train River (Au Train Lake)	1.96	0.41
Rock River (Lentic)	1.47	0.31
Laughing Whitefish River (Lentic)	1.47	0.31
Chocolay River	1.96	0.41
Chocolay River (Lentic)	1.47	0.31
Carp River (Lentic)	1.47	0.31
Huron River	0.49	0.10
Huron River (Lentic)	1.47	0.31
Trap Rock River (Lentic)	1.96	0.41
Traverse River	0.98	0.21
Hungarian Creek (Lentic)	1.47	0.31
Misery River	1.47	0.31
Firesteel River	1.47	0.31
Flintsteel River	1.47	0.31
Black River	1.96	0.41
Montreal River	0.98	0.21
Iron River	1.47	0.31
Brule River (Lentic)	1.96	0.41
Amnicon River	0.98	0.21
Amnicon River (Lentic)	1.96	0.41
Knife River	0.98	0.21
Knife River (Lentic)	1.47	0.31
Gooseberry River	1.47	0.31
Gooseberry River (Lentic)	1.22	0.26

Table 15. *Continued*

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Poplar River	0.98	0.21
Arrowhead River	1.47	0.31
Arrowhead River (Lentic)	0.73	0.16
Total (United States)	**52.17**	**10.99**
Total for Lake	**67.73**	**14.28**

[1]Lampricide quantities are reported in kg active ingredient.

Lake Michigan

- Larval assessments were conducted in 168 tributaries and 8 lentic areas. The status of larval sea lamprey populations in historically infested Lake Michigan tributaries and lentic areas is presented in Table 16.

- Surveys to estimate larval sea lamprey abundance were conducted in 11 tributaries.

- Surveys to detect the presence of new larval sea lamprey populations were conducted in 93 tributaries. One new infestation was identified, Fowler Creek in Menominee County, MI.

- Post-treatment assessments were conducted in 15 tributaries and 1 lentic area to determine the effectiveness of lampricide treatments conducted during 2021 and 2022. The Fishdam River is scheduled for treatment in 2023 based on residual larval populations.

- Surveys to evaluate barrier effectiveness were conducted in 3 tributaries. Sea lampreys were found in the Grand River upstream of the 6th Street Dam in the Rogue River and Prairie Creek. The Rogue River ranked for treatment in 2023.

- Larval assessment surveys were conducted in 8 non-wadable lentic and lotic areas using 10.02 kg active ingredient of 3.2% gB (Table 17).

Table 16. Status of larval sea lamprey in Lake Michigan tributaries with a history of sea lamprey production.

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Brevort R.			
Upper	May-21	Jul-21	Jul-21
Lower	May-21	May-22	Aug-19
Brevort Lake	May-21	May-22	Jun-19
Paquin Cr.	Jun-19	Jun-22	Sep-18
Paquin Cr. Lentic	Never	Sep-18	Sep-18
Davenport Cr.	Sep-13	May-22	Aug-11
Hog Island Cr.	May-21	Jun-22	Jun-22
Hog Island Cr. Lentic	Jun-07	Jul-21	Jul-18
Sucker R.	Jun-61	Jul-21	Jul-21
Black R.	May-21	Sep-21	Apr-21
Black R. lentic	Jun-76	Sep-22	Aug-11
Mattix Cr.	Aug-15	Sep-21	Jun-14
Mile Cr.	May-17	May-22	Jun-19

Table 16. *Continued*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Mile Cr. Lentic	Aug-68	Jun-18	Jun-08
Millecoquins R.	Jul-21	Oct-21	Jul-19
Furlong Cr.	May-22	Oct-21	Oct-21
Millecoquins Lake	Never	Jun-19	Jun-14
Rock R.	Jun-19	Aug-22	Aug-22
Crow R.	Jun-19	Aug-22	Aug-22
Cataract R.	Sep-19	May-22	May-22
Cataract R. lentic	Never	Jul-19	Jul-19
Pt. Patterson Cr.	Jul-13	May-22	May-22
Hudson Cr.	Aug-19	Sep-22	Sep-22
Swan Cr.	Sep-21	May-22	Jul-19
Seiners Cr.	Aug-17	Aug-22	Aug-22
Milakokia R.	Sep-21	May-22	Jul-19
Seul Choix Bay	Never	Jul-19	Jul-80
Bulldog Cr.	Jun-13	Aug-21	Sep-13
Gulliver Lake Outlet	Sep-19	May-22	Sep-18
Marblehead Cr.	Jun-19	Aug-22	Aug-22
Manistique R.	Sep-22	Aug-22	Jun-22
Inside Breakwalls	Oct-22	Aug-21	Aug-21
Outside Breakwalls	Oct-22	Aug-21	Aug-21
Southtown Cr.	Jul-13	Jul-19	Aug-12
Thompson Cr.	Never	Aug-22	Aug-22
Johnson Cr.	Jun-13	May-22	Sep-12
Deadhorse Cr.	Aug-18	Aug-22	Aug-22
Deadhorse Cr. Lentic	Never	Jul-11	Oct-64
Gierke Cr.	Never	May-22	Jun-04
Bursaw Cr.	May-22	Aug-22	Aug-22
Bursaw Cr. Lentic	Never	Jul-11	Jul-11
Parent Cr.	Aug-17	Sep-22	Sep-22
Poodle Pete Cr.	Aug-17	Aug-21	Aug-21
Valentine Cr.	May-21	Sep-21	Jul-19
Big Bay de Noc	Never	Sep-11	Aug-94
Little Fishdam R.	May-01	Jul-19	Jul-04
Big Fishdam R.	May-22	Aug-22	Aug-22
Sturgeon R.	Jul-22	May-22	May-22
Big Bay de Noc	Never	Aug-19	Aug-15
Ogontz R.	Sep-20	Sep-22	Sep-22
Big Bay de Noc	Sep-14	Aug-17	Jul-15
M 117 Cr.	Aug-17	Jul-20	May-16
Hock Cr.	May-17	Jun-21	May-16
Whitefish R.	Jun-22	Oct-22	Sep-22
Haymeadow Creek	Jun-22	Sep-22	Sep-22
Little Bay de Noc	Jun-83	Aug-18	Jul-11
Rapid R.	Oct-20	Jun-22	Jun-22
Little Bay de Noc	May-15	Aug-18	Jul-16
Tacoosh R.	Oct-14	Jun-21	Jul-14
Days R.			
Barrier downstream	Sep-22	Jun-22	Aug-18

Table 16. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Barrier upstream	Aug-17	Jun-20	Aug-17
Little Bay de Noc	Aug-14	Jun-20	Aug-13
Escanaba R.	Never	Aug-20	Jul-06
Portage Cr.	May-17	Jun-22	May-21
Portage Bay	Never	Aug-17	Aug-82
Ford R.	Aug-20	Oct-22	Sep-22
Green Bay	Oct-14	Jun-21	Aug-19
Sunnybrook Cr.	May-71	Aug-22	Aug-22
Bark R.	May-17	May-21	May-21
Green Bay	Never	Jul-16	Sep-98
Cedar R.	May-21	Oct-21	Sep-20
Green Bay	May-10	Aug-19	Jul-16
Sugar Cr.	May-21	Sep-21	Sep-21
Fowler Creek	Never	Aug-22	Aug-22
Arthur Bay Cr.	May-21	Aug-22	Sep-21
Rochereau Cr.	Apr-63	Jul-19	Jul-62
Johnson Cr.	Apr-17	Aug-22	Aug-22
Bailey Cr.	May-19	Aug-22	Aug-22
Green Bay	Never	Aug-18	Aug-18
Beattie Cr.	May-19	May-21	May-21
Springer Cr.	May-19	Aug-22	Aug-22
Menominee R.	Jul-16	May-21	Jun-19
Green Bay	Jul-16	Aug-17	Sep-15
Little R.	Aug-77	May-21	Aug-77
Peshtigo R.	Sep-20	Sep-21	Sep-21
Oconto R.	Sep-21	Sep-22	Sep-22
Pensaukee R.	Nov-77	May-21	Sep-85
Suamico R.	Never	May-21	May-67
Ephraim Cr.	Apr-63	May-22	Apr-61
Hibbards Cr.	May-07	May-22	Oct-09
Whitefish Bay Cr.	May-16	Aug-21	Jun-15
Shivering Sands Cr.	Apr-12	Aug-21	May-14
Lily Bay Cr.	Apr-63	Aug-21	May-63
Bear Cr.	May-75	May-22	May-22
Door Co. 23 Cr.	May-19	May-22	May-22
Silver Cr.	Never	Aug-21	Jul-15
Ahnapee R.	Apr-64	Jun-18	Apr-64
Three Mile Cr.	Apr-21	Aug-21	Jun-19
Kewaunee R.			
Barrier downstream	May-75	May-22	May-98
Barrier upstream	May-75	May-22	Aug-13
Casco Cr.	May-14	May-22	Aug-14
East Twin R.	Apr-17	Aug-21	Jun-19
Fischer Cr.	May-87	May-22	May-87
French Farm Cr.	Never	Oct-21	Jun-10
Carp Lake Outlet	Jun-17	Oct-21	Oct-21
Big Stone Cr.	Sep-13	Oct-21	Aug-10
Big Sucker R.	Sep-13	Oct-21	Sep-13
Wycamp Lake Outlet	Jul-17	Oct-21	Aug-16

Table 16. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Bear R.	Never	Sep-20	Never
Bear R. Lentic	Jun-07	Jun-19	Jun-08
Horton Cr.	Jun-17	May-22	May-22
Horton Cr. Lentic	Jun-19	Sep-22	Sep-22
Boyne R.	Aug-21	May-22	May-21
Boyne R. Lentic	Jun-17	Sep-22	Jun-14
Porter Cr.	Sep-13	May-22	May-22
Porter Cr. Lentic	Sep-13	Oct-22	Oct-22
Jordan R.	Jul-22	May-22	Oct-21
Jordan R. Lentic	Jul-18	Aug-21	Jun-14
Monroe Cr.	Aug-13	Jun-19	Jun-13
Loeb Cr.	Aug-13	Jun-19	Aug-11
McGeach Cr.	Oct-99	May-15	Jun-98
Elk Lake Outlet	Jun-17	Jun-22	Jun-16
Yuba Cr.	May-06	Jul-20	Aug-05
Acme Cr.	Aug-63	Jun-22	Jul-73
Mitchell Cr.	Jul-17	Sep-22	Aug-20
Boardman R. (lower)	Aug-15	Jun-22	Jun-14
Boardman R. (middle)	Aug-15	Jun-22	Sep-14
Boardman R. Lentic	Jun-17	Sep-22	Jun-16
Hospital Cr.	Jul-18	Sep-21	Jun-17
Leo Cr.	Never	Jun-22	Jul-95
Leland River Lentic	Never	Sep-22	Jun-13
Good Harbor Cr.	Jul-10	Sep-21	Sep-09
Crystal R.	Apr-19	Sep-21	Sep-18
Platte R. (upper)	Jun-22	Nov-22	Sep-22
Platte R. (middle)	Jun-22	Sep-22	Sep-20
Loon Lk. Lentic	Sep-22	Sep-22	Sep-22
Platte R. (lower)	Jun-22	Sep-21	Sep-18
Betsie R.	Jun-22	Sep-22	Nov-21
Bowen Cr.	Jun-09	Aug-19	Oct-19
Big Manistee R.	Aug-20	Jul-21	Oct-19
Bear Cr.	Aug-19	Oct-22	Oct-22
L. Manistee R.	Jun-21	Nov-21	Jul-20
L. Manistee R. Lentic	Jul-11	Jul-21	Sep-05
Gurney Cr.	Jun-16	Aug-19	Jul-15
Cooper Cr.	Jul-08	Jun-22	Sep-07
Lincoln R.	Jul-20	Jun-22	Sep-20
Pere Marquette R.	Aug-20	Jul-22	Jul-22
Bass Lake Outlet	Aug-78	Jun-22	Aug-75
Pentwater R. (N. Br.)	Sep-20	Jul-22	Jun-18
South Branch	Never	Jul-22	Jun-83
Lambricks Cr.	Sep-84	Jul-22	Sep-84
Stony Cr.	Sep-20	Jul-22	Aug-19
Flower Cr.	Jul-17	Jul-22	May-17
White R.	Sep-20	Sep-21	Sep-21
Duck Cr.	Jul-84	Jul-19	Aug-95
Muskegon R.	Aug-22	Oct-22	Sep-21
Brooks Cr.	Aug-22	Jul-22	Sep-21

Table 16. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Cedar Cr.	Aug-22	Jul-22	Sep-21
Bridgeton Cr.	Aug-22	Jul-22	Sep-21
Minnie Cr.	Aug-22	Jul-22	Sep-21
Bigelow Cr.	Aug-22	Jul-22	Sep-21
Big Bear Cr.	Aug-70	Jul-19	Aug-70
Mosquito Cr.	Jul-69	Aug-14	Jul-07
Black Cr.	Aug-08	Jul-19	Aug-08
Grand R.	Never	Aug-22	Never
Norris Cr.	Jun-17	Aug-22	Sep-16
Lowell Cr	Sep-65	Aug-22	Jun-65
Buck Cr.	Sep-65	Aug-22	Sep-65
Rush Cr.	Sep-65	Aug-22	Sep-62
Sand Cr.	Jun-07	Aug-22	Jun-07
Crockery Cr.	Jun-17	Aug-22	Sep-16
Bass R.	Aug-04	Aug-22	Sep-03
Rogue R.	Sep-09	Aug-22	Aug-22
Prairie Cr.	Never	Aug-22	Aug-22
Pigeon R.	Oct-64	Sep-19	May-62
Pine Cr.	Oct-64	Sep-19	May-62
Gibson Cr.	Jul-84	Sep-22	Jun-83
Kalamazoo R.	Oct-65	Aug-20	Never
Bear Cr.	Apr-19	Aug-19	Aug-19
Sand Cr.	Sep-10	Oct-21	May-17
Mann Cr.	Jul-16	Aug-19	Sep-15
Rabbit R.	Sep-15	Aug-19	Jul-14
Swan Cr.	Jun-21	Oct-21	Oct-21
Allegan 3 Cr.	Sep-65	Aug-22	Jun-62
Allegan 4 Cr.	Oct-78	Jul-21	Sep-19
Allegan 5 Cr.	Sep-15	Oct-21	Jul-14
Black R.			
North Branch	Jun-77	May-22	May-21
Middle Branch	Jul-21	May-22	May-21
South Branch	May-17	May-22	May-21
Brandywine Cr.	Aug-85	Sep-22	Jul-21
Rogers Cr.	May-18	May-22	Jun-16
St. Joseph R.	Never	Jul-19	Never
Lemon Cr.	Oct-65	Sep-19	Jun-65
Pipestone Cr.	May-21	Aug-22	Jul-21
Meadow Dr.	Oct-65	Oct-19	Apr-62
Hickory Cr.	May-21	Jul-21	Sep-19
Farmers Cr.	May-21	Jul-21	May-19
Paw Paw R.	Sep-21	May-22	May-22
Blue Cr.	Sep-15	Jul-21	Jun-15
Mill Cr.	Sep-21	May-22	May-22
Brandywine Cr.	Sep-17	Jul-21	Jul-17
Brush Cr.	Sep-15	Jul-21	Jun-15
Hayden Cr.	Sep-21	May-22	May-22
Campbell Cr.	Sep-18	Jul-21	Sep-18
Ritter Cr.	Sep-17	Jul-21	Oct-16

Table 16. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Galien R. (N. Br.)	Jun-16	Sep-19	Sep-15
E. Br. & Dowling Cr.	Oct-10	Sep-22	Sep-09
S. Br. & Galina Cr.	Aug-21	Sep-19	Sep-18
Spring Cr.	Aug-21	Sep-22	May-16
S. Br. Spring Cr.	Aug-21	Sep-22	Sep-19
State Cr.	Apr-14	May-19	Sep-13
Trail Cr.	Apr-14	Jul-19	Aug-18
Donns Cr.	May-66	May-19	May-66
Burns Ditch	Jul-99	Oct-21	Oct-21
Salt Cr.	May-18	Oct-19	Jun-19

Table 10. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Michigan for larval assessment purposes during 2022.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Brevort Lake	1.47	0.31
Black River (Lentic)	1.47	0.31
Horton Creek (Lentic)	1.66	0.35
Boyne River	0.47	0.10
Porter Creek (Lentic)	1.42	0.30
Boardman River (Lentic)	1.42	0.30
Leland River (Lentic)	0.71	0.15
Platte River (Loon Lk. Lentic)	1.40	0.25
Total for Lake	**10.02**	**2.07**

[1] Lampricide quantities are reported in kg of active ingredient.

Lake Huron

- Larval assessments were conducted in 126 tributaries (69 Canada, 57 U.S.) and 16 lentic areas (5 Canada, 11 U.S.). The status of larval sea lamprey populations in historically infested Lake Huron tributaries and lentic areas is presented in Table 18.

- Surveys to estimate larval sea lamprey abundance were conducted in 30 tributaries (12 Canada, 18 U.S.) and 12 lentic areas (1 Canada, 11 U.S.).

- Surveys to detect the presence of new larval sea lamprey populations were conducted in 73 tributaries (45 Canada, 28 U.S.). A new infestation was discovered in Beaver Dam Creek (Sugar Island).

- Post-treatment assessments were conducted in 15 tributaries (4 Canada, 11 U.S.) and 2 lentic areas (2 Canada, 0 U.S.) to determine the effectiveness of lampricide treatments conducted during 2021 and 2022. No streams were scheduled for treatment based on residual larval populations.

- Surveys to evaluate barrier effectiveness were conducted in the Thessalon River (Canada), and Greene Creek, Ocqueoc, Trout, and Saginaw rivers (U.S.). All barriers were found to be effective in limiting sea lamprey infestations.

- Larval sea lamprey surveys were conducted in the St. Marys River according to a stratified, systematic sampling design. Using a DWEF, 760 geo-referenced sites were sampled. The larval sea lamprey population in the St. Marys River was estimated to be 2.24 million (95% CI; 0.77 to 3.7 million).

- Larval assessments were conducted in non-wadable lentic and lotic areas using 22.71 kg active ingredient of 3.2% gB (11.81 kg Canada, 10.9 kg U.S.; Table 19).

Table 11. Status of larval sea lamprey in Lake Huron tributaries with a history of sea lamprey production.

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Canada			
St. Marys R.	Jul-22	Aug-22	Aug-22
Whitefish Channel	Jun-21	Nov-19	Nov-19
Root R.	Sep-21	Aug-22	Aug-22
Garden R.	Jul-20	Nov-22	Nov-22
Maud & Driving Cr.	Jul-20	Aug-21	Jul-14
Echo R.			
Main	Jul-11	Oct-19	Oct-19
Bar & Iron Cr.	Aug-20	Oct-21	Oct-17
Austin Cr.	Never	Jun-22	Jun-22
Echo Lake	Sep-20	Sep-21	Sep-17
Solar Lake	Jul-87	Jul-06	May-90
Stuart Lake	Jul-80	May-90	May-90
Bar R.	Oct-11	Jul-21	Jul-10
Stoby-Portlock Cr.	Never	July-20	Never
Sucker Cr.	May-18	Aug-20	Sep-17
Sucker Cr. (lentic)	Jul-84	Sep-16	Jun-13
Two Tree R.	May-15	May-22	Jul-14
Two Tree R. (lentic)	Never	Aug-81	Aug-81
Richardson Cr.	Sep-16	Jun-22	Jul-16
Watson Cr.	May-21	Jun-22	Jun-22
Gordon Cr.	May-18	Aug-20	Jul-19
Gordon Cr. (lentic)	Jul-84	Jul-18	Aug-91
Browns Cr.	May-16	Jun-22	Jun-22
Browns Cr. (lentic)	Aug-87	Jul-18	Aug-91
Koshkawong R.	May-18	Sep-22	Sep-22
Koshkawong R. (lentic)	Never	Jul-17	Aug-91
No Name (H-65)	May-22	Jul-21	Jul-21
No Name (H-68)	Jun-19	Jun-21	Jul-18
North Channel	Never	Apr-12	May-95
MacBeth Cr.	Jun-19	Aug-20	Jun-18
Thessalon R.			
Upper	Sept-18	Oct-22	Sep-17
Patten Lake Cr.	Jul-17	Sep-16	Sep-16
Lower	Oct-22	Jun-22	Aug-20
Livingstone Cr.	May-22	Sep-20	Sep-20
Mississagi R.	Jul-22	Oct-19	Oct-19
Harris/Bolton Cr.	Aug-19	Sep-20	Sep-20

Table 18. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
North Channel	Jul-16	Sep-19	Sep-19
Blind R.	May-84	Jun-19	Jun-05
Lauzon R.	Jun-15	Jul-22	Jul-22
North Channel	Jun-19	Jul-22	Jul-22
Spragge Cr.	Oct-95	May-18	Jun-98
No Name (H-114)	May-22	Jul-21	Jul-21
North Channel	Jun-15	Sep-18	Sep-14
Marcellus Cr.	Jun-13	May-17	Sep-11
Serpent R.			
Main	Jun-21	Jul-22	Jul-22
Grassy Cr.	Jun-19	Jul-22	Jul-22
Spanish R.			
Main	Sep-15	Jul-21	Sep-12
LaCloche Cr.	Oct-18	Sep-22	Sep-17
Birch/Beaudin Cr.	Jun-18	Sep-22	Sep-22
Aux Sables R.	Sep-15	Jul-21	Sep-20
Kagawong R.	Aug-67	Jul-21	Aug-16
Mudge Bay	Aug-87	Jun-19	Jun-15
Unnamed (H-267)	Apr-17	Jul-22	Sep-20
Silver Cr.	Sep-22	Jul-21	Jul-21
Sand Cr.	Jun-21	Jul-19	Jul-19
Mindemoya R.	May-17	Jul-21	Sep-20
Providence Bay	Jul-81	Jul-22	Jul-88
Timber Bay Cr.	Apr-17	Jul-21	Jul-21
Hughson Cr.	Sep-20	Jul-21	Jul-21
Manitou R.	Sep-20	Jul-21	Jul-21
Michael's Bay	Oct-20	Jul-21	Sep-17
Blue Jay Cr.	Sep-22	Jul-21	Jul-21
Blue Jay Cr. (lentic)	Jun-18	Jul-21	Sep-17
Kaboni Cr.	Oct-78	May-18	Jul-78
Chikanishing R.	Jun-18	Jun-21	Jun-21
French R. System			
O.V. Channel	Jun-12	Jun-19	Sep-15
Wanapitei R.	Jun-11	Jun-21	Jun-08
Key R. (Nesbit Cr.)	Sep-72	Jun-21	Aug-73
Still R.	Jul-17	Jun-21	May-16
Byng Inlet	Jun-12	Jun-21	Jun-21
Magnetawan R.	Jul-22	Jun-21	Jun-21
Naiscoot R.	May-18	Sep-20	Sep-20
Shebeshekong R.	Never	June-21	Aug-17
Boyne R.	Sep-18	June-21	May-18
Georgian Bay	Never	Aug-17	May-16
Musquash R.	Aug-13	Jun-22	Jun-21
Simcoe/Severn System	Never	Jun-22	May-19
Georgian Bay	Aug-18	Jun-22	May-19
Sturgeon R.	Apr-12	Jun-22	Sep-09
Sturgeon Bay	Never	May-14	Jun-99
Hog Cr.	Sep-78	Jun-22	Aug-78
Lafontaine Cr.	Jun-68	Jun-22	May-67

Table 18. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Nottawasaga R.			
Mainstream	Jul-21	Oct-21	Oct-21
Boyne R.	Jul-21	May-19	May-19
Bear Cr.	Jun-13	May-19	Apr-11
Pine R.	Jul-21	Jun-22	May-19
Marl Cr.	Apr-13	May-19	May-11
Pretty R.	May-72	Jun-22	May-72
Silver Cr.	Sep-82	Jun-22	Sep-82
Bighead R.	Jun-22	May-22	May-22
Bighead R. (lentic)	Aug-18	May-22	May-22
Bothwells Cr.	Jun-79	May-22	Aug-83
Sydenham R.	Jun-72	May-22	Jul-71
Sauble R.	Jun-04	May-22	May-18
Saugeen R.	Jun-71	May-22	May-95
Bayfield R.	Jun-70	May-22	Sep-73
United States			
Mission Cr.	Never	May-21	May-21
Frechette Cr.	Never	Sep-21	Jul-81
Ermatinger Cr.	Never	Sep-21	Jun-12
Charlotte R.	Oct-11	Sep-21	Jun-17
Beaver Dam Cr.	Never	Jun-22	Jun-22
Little Munuscong R.	Oct-21	May-22	Sep-21
Big Munuscong R.	Jun-99	Oct-21	Sep-21
Taylor Cr.	May-21	Sep-21	Sep-21
Gogomain R.	Jul-16	Sep-21	Jun-18
Carlton Cr.	Oct-18	Sep-21	Aug-19
Canoe Lake Outlet	May-70	Apr-13	May-69
Caribou Cr.	Oct-19	Aug-22	Aug-22
Caribou Cr. Lentic	May-18	Jul-21	Jul-21
Bear Lake Outlet	Sep-16	Sep-22	Sep-22
Carr Cr.	Jun-13	May-21	Jun-15
Joe Straw Cr.	Jun-13	May-21	May-21
Saddle Cr.	Never	Jul-21	May-02
Huron Point Cr.	May-18	Sep-22	Sep-22
Albany Cr.			
Barrier downstream	May-21	Jul-21	Jul-21
Barrier upstream	Sep-01	Jul-18	May-03
Albany Bay	May-18	Jul-21	Jul-21
Trout Cr.	Jul-15	May-21	Aug-19
Trout Cr. Lentic	Never	Aug-19	Jul-11
Beavertail Cr.	Jul-18	Jul-21	Jul-21
Prentiss Cr.	Oct-19	Sep-21	Sep-21
McKay Cr.	May-21	Jul-21	Apr-21
McKay Bay	Never	Sep-18	Jul-11
Flowers Cr.	Jun-13	May-21	May-11
Flowers Bay	Never	Jun-12	Jul-80
Ceville Cr.	Jul-16	May-21	Jul-15

Table 18. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Hessel Cr.	Sep-21	May-22	Aug-19
Steeles Cr.	Sep-21	May-22	Aug-19
Nunns Cr.			
Barrier downstream	Jul-16	May-21	May-14
Barrier upstream	Jul-16	May-19	Jun-15
St. Martin Bay	Never	Aug-14	Aug-87
Pine R.	Oct-21	Oct-22	Oct-22
St. Martin Bay	Jun-21	Jul-21	Jul-17
McCloud Cr.	Jul-15	May-21	May-17
St. Martin Bay	Never	Aug-15	Aug-15
Carp R.	Jul-21	May-22	May-22
St. Martin Bay	Jul-21	Jul-21	Aug-19
Martineau Cr.	Jul-16	May-21	May-17
Horseshoe Bay	Never	Aug-19	Sep-14
Hoban Cr.	Jun-12	Jul-21	May-11
266-20 Cr.	Aug-76	May-22	Sep-94
Beaugrand Cr.	Jun-16	Jun-18	Jul-15
Little Black R.	Oct-21	May-22	May-21
Cheboygan R.	Oct-83	Sep-22	May-21
Cheboygan R. lentic	Never	Jun-19	Aug-93
Laperell Cr.	May-00	Sep-22	Sep-22
Meyers Cr.	Jul-17	Sep-22	Sep-22
Maple R.	Aug-16	Sep-22	Sep-22
Pigeon R.	Sep-22	Oct-21	Oct-21
Little Pigeon R.	Aug-12	Sep-19	Jun-10
Sturgeon R.	Aug-16	Sep-22	Sep-22
Sturgeon R. lentic	Jun-19	Sep-22	Sep-22
Elliot Cr.	Oct-21	May-22	May-22
Duncan Bay	Never	Sep-22	Jul-12
Greene Cr.			
Barrier downstream	Jul-12	Sep-22	Sep-22
Barrier upstream	Jun-07	May-22	Jun-13
Grass Cr.	Aug-22	May-22	May-21
Mulligan Cr.	Jun-16	May-22	Jun-18
Mulligan Cr. lentic	Never	Aug-21	Aug-16
Grace Cr.	Oct-18	Sep-22	Sep-22
Black Mallard Cr.			
Lower	Jun-18	Sep-22	Jul-19
Black Mallard Lake	Never	Jul-12	Jun-10
Upper	May-15	Aug-21	Aug-21
Seventeen Cr.	Jul-12	May-21	Jul-12
Ocqueoc R.			
Hammond Bay lentic	Never	Aug-21	Aug-21
Barrier upstream	Sep-18	Aug-21	Jun-19
Barrier downstream	Aug-22	Aug-21	Aug-21
Johnny Cr.	Sep-70	May-21	Jun-19
Hammond Bay Cr. lentic	Never	Sep-17	Sep-17
Schmidt Cr.			
Lower	Sep-21	May-22	May-22

Table 18. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Upper	May-08	Jul-21	May-08
Nagels Cr.	Never	Jul-21	Jun-09
Trout R.			
Barrier downstream	Oct-21	Sep-22	Sep-22
Barrier upstream	Oct-07	Sep-22	Jun-07
Swan R.	Jun-10	Sep-21	Jun-10
Grand Lake Outlet	Never	Jul-21	May-03
Middle Lake Outlet	Jun-67	Jul-21	Aug-66
Long Lake Outlet	Aug-21	Sep-22	Sep-22
Devils Lake lentic	Never	Sep-22	Jun-21
Cranberry Cr.	Jun-13	Sep-21	Oct-11
Devils R.	Oct-14	Aug-22	Aug-13
Thunder Bay	Never	Jun-21	Aug-76
Black R.	Jun-18	Sep-22	Sep-22
Mill Cr.	Never	Sep-22	May-98
Au Sable R.	Aug-22	Sep-21	Sep-21
Au Sable. R lentic	Aug-15	Sep-21	Sep-14
Pine R.	May-87	Sep-19	Sep-94
Tawas Lake Outlet	Jun-15	Jul-21	Jun-14
Cold Cr.	Aug-18	Jun-22	May-17
Sims Cr.	Jul-09	Jun-22	Aug-08
Grays Cr.	Sep-05	Jun-22	Jul-04
Silver Cr.	Aug-22	Jun-22	Jun-22
East Au Gres R.	Oct-22	Jun-22	Jun-22
East Au Gres R. lentic	Never	Jun-22	Jun-86
Au Gres R.	Sep-18	Jun-22	Jun-19
Rifle R.	Aug-21	Jun-22	Oct-21
Saginaw R.			
Shiawassee R.	May-21	Jun-19	Jun-19
Cass R.	Jun-22	Sep-22	Sep-22
Flint R.	Never	Jun-22	Jul-14
Armstrong Cr.	May-15	Jun-22	Jul-14
Tittabawassee R.	Jun-18	Aug-22	Aug-22
Sanford Dam upstream	Never	Sep-22	Sep-22
Chippewa R.	Jun-21	Sep-22	Sep-22
Chippewa R. gravel pits	Jun-21	Aug-22	Aug-22
Pine R.	Jun-22	Aug-22	Aug-21
Carroll Cr.	May-17	Aug-22	Aug-22
Big Salt R.	Jun-22	Aug-22	Oct-21
Rock Falls Cr.	Never	Jun-19	Jun-69
Cherry Cr.	Never	Jun-16	Jul-77
Mill Cr.	May-85	Jun-19	Sep-13

Table 12. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Huron for larval assessment purposes during 2022.

Tributary	Bayluscide(kg)[1]	Area Surveyed (ha)
Canada		
Root River (Lentic)	0.71	0.15
Blind River	0.71	0.15
Lauzon River (Lentic)	0.95	0.20
Serpent River	0.47	0.10
Mindemoya River (Lentic)	0.95	0.20
Kirk Creek	0.24	0.05
Mahzenasing River	0.47	0.10
Beaverstone River	0.47	0.10
Miners Creek	0.47	0.10
Go Home River	0.47	0.10
Musquash River	0.95	0.20
Simcoe/Severn System	1.42	0.30
Bighead River (Lentic)	1.42	0.30
Sauble River	1.42	0.30
Saugeen River	0.71	0.15
Total (Canada)	**11.81**	**2.50**
United States		
Cheboygan River	0.47	0.10
Cheboygan River (Burt Lake -Sturgeon River)	1.42	0.30
Cheboygan River (Burt Lake – Maple and Bullhead Bays)	0.71	0.15
Elliot Creek	0.71	0.15
Greene Creek (Below Barrier)	0.24	0.05
Schmidt Creek (Lentic)	0.47	0.10
Long Lake Creek (Devils Lake)	0.95	0.20
Black River (Lentic)	0.71	0.15
Tawas Lake Outlet	0.24	0.05
East Au Gres River (Lentic)	0.95	0.20
Au Gres River (Lentic)	0.95	0.20
Rifle River (Lentic)	0.24	0.05
Saginaw River (Upper Chippewa River)	2.84	0.60
Total (United States)	**10.90**	**2.30**
Total for Lake	**22.71**	**4.80**

[1]Lampricide quantities are reported in kg active ingredient.

Lake Erie

- Larval assessments were conducted in 49 tributaries (20 Canada, 29 U.S.). The status of larval sea lamprey in historically infested Lake Erie tributaries and lentic areas is presented in Table 20.

- No surveys to estimate larval sea lamprey abundance were conducted.

- Surveys to detect the presence of new larval sea lamprey populations were conducted in 27 tributaries (8 Canada, 19 U.S.). No new sea lamprey infestations were detected.

- Surveys to evaluate barrier effectiveness were conducted in Young's Creek (Canada), and Cattaraugus Creek, and the Clinton and Grand rivers (U.S.). All barriers were found to be effective in limiting sea lamprey infestations.

- Larval assessment surveys were conducted in non-wadable lotic areas including the St. Clair River using 13 kg active ingredient of 3.2% gB (7.3 kg Canada, 5.7 kg U.S.; Table 21).

Table 13. Status of larval sea lamprey in Lake Erie tributaries with a history of sea lamprey production.

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Canada			
East Cr.	Jun-87	Jun-22	Jun-13
Catfish Cr.	Apr-16	Jun-22	Apr-15
Bradley Cr.	Apr-16	Jun-22	Oct-15
Silver Cr.	May-18	Jul-21	Jun-17
Big Otter Cr.	Sep-21	Oct-22	May-19
South Otter Cr.	Aug-10	Jun-22	Aug-09
Clear Cr.	May-91	Jun-22	May-91
Big Cr.	Jul-21	Jul-22	May-19
Forestville Cr.	Aug-13	Jun-22	Jun-13
Normandale Cr.	Jun-87	Jul-21	Apr-08
Fishers Cr.	Jun-87	Jun-22	May-04
Young's Cr.	Aug-13	Jun-22	Jul-12
Ussher's Cr.	Never	Jul-21	Jun-17
United States			
Buffalo R.			
Buffalo Cr.	Apr-19	Jul-21	Jul-18
Cayuga Cr.	Apr-19	Jul-21	Jul-18
Cazenovia Cr.	Apr-19	Jul-21	Jul-18
Big Sister Cr.	Apr-15	Jul-21	Jun-14
Delaware Cr.	Jun-13	Jul-21	Jul-12
Cattaraugus Cr.	May-22	May-22	Jul-21
Lentic Lake Erie	Never	Jul-17	Aug-12
Halfway Br.	Oct-86	Jul-21	Jul-85
Canadaway Cr.	May-16	Jul-21	May-16
Chautauqua Cr.	Never	Jul-21	Jul-12
Crooked Cr.	Apr-19	Aug-22	Jun-18
Racoon Cr.	May-22	Aug-22	Jul-21
Conneaut Cr.	Apr-19	Aug-22	Jul-21
Conneaut Harbour	Never	Sep-19	Jul-16
Wheeler Cr.	Never	Jul-19	Oct-87
Grand R.	Apr-22	Jun-22	Sep-21
Fairport Harbour	Never	Sep-19	Jun-87
Chagrin R.	Never	Jun-22	Sep-21
Huron R.	May-18	Sep-21	May-18

Table 20. *Continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Lake St. Clair			
St. Clair R.	Never	Aug-22	Aug-22
Black R.	Never	Sep-21	Jul-07
Pine R.	Apr-88	Jun-22	Jun-16
Belle R.	Never	May-21	May-96
Clinton R.	Never	Aug-22	May-17
Paint Cr.	May-15	Aug-22	May-14
Thames R.	Never	May-16	Never
Komoka Cr.	Aug-15	May-19	May-17
Pine R.	Jun-18	Aug-19	Sep-18
St. Martin Bay	May-18	Sep-18	Jul-17

Table 14. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Erie for larval assessment purposes during 2022.

Tributary	Bayluscide(kg)[1]	Area Surveyed (ha)
Canada		
St. Clair River	5.9	1.25
Grand River	1.4	0.30
Total (Canada)	7.3	1.55
United States		
St. Clair River	5.7	1.20
Total (United States)	5.7	1.20
Total for Lake	**13.0**	**2.40**

[1]Lampricide quantities are reported in kg active ingredient.

Lake Ontario

- Larval assessments were conducted in 38 tributaries (23 Canada, 15 U.S.). The status of larval sea lamprey in historically infested Lake Ontario tributaries and lentic areas is presented in Table 22.

- Surveys to estimate larval sea lamprey abundance were conducted in 8 tributaries (2 Canada, 6 U.S.).

- Surveys to detect new larval sea lamprey populations were conducted in 5 tributaries (4 Canada, 1 U.S.). No new sea lamprey infestations were identified.

- Surveys to evaluate barrier effectiveness were conducted in Port Britain and Grafton creeks (Canada) and Little Salmon River (North Branch; U.S.). Sea lampreys were captured upstream of the barrier in the North Branch of Little Salmon River in Parish.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas including the Niagara River using 14.8 kg active ingredient of 3.2% gB (9.5 kg Canada, 5.3 kg U.S; Table 23). No sea lamprey were caught on the Niagara River.

- No native or sea lamprey larvae were detected during larval assessment surveys in non-wadable areas of the Oswegatchie River, a tributary to the St. Lawrence River. The surveys were aimed at helping understand risk associated with removal of the Ogdensburg Dam, including the risk of infestation of the river by sea lampreys. Further assessments are planned.

Table 15. Status of larval sea lamprey in Lake Ontario tributaries with a history of sea lamprey production.

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Canada			
Niagara R.	Never	May-22	Jun-14
Ancaster Cr.	May-03	Jun-22	Jun-15
Grindstone Cr.	Never	Jul-21	Jun-14
Bronte Cr.	May-22	Aug-22	Aug-22
Sixteen Mile Cr.	Jun-82	Jul-21	May-05
Credit R.	Jul-22	Oct-21	Oct-21
Humber R.	Never	Aug-21	Never
Rouge R.	Jun-11	Jul-21	Jun-19
Little Rouge. R.	Jun-15	Jul-21	Aug-14
Petticoat Cr.	Sep-04	Jul-21	Jun-16
Duffins Cr.	Aug-21	Jun-22	Jun-22
Duffins Cr. (Lentic)	Never	Aug-15	Aug-15
Carruthers Cr.	Sep-76	Jul-21	Jul-78
Lynde Cr.	Apr-22	Jun-22	Oct-21
Oshawa Cr.	Aug-21	Oct-22	Oct-22
Oshawa Cr. (Lentic)	Never	Jul-13	Oct-81
Farewell Cr.	Apr-22	Jun-22	Aug-21
Bowmanville Cr.	Aug-21	Oct-22	Oct-22
Wilmot Cr.	Aug-21	Jun-22	Jun-22
Wilmot Cr. (Lentic)	Never	Aug-11	Aug-11
Graham Cr.	Aug-21	Jul-21	Jul-21
Wesleyville Cr.	Oct-02	Jun-21	May-04
Port Britain Cr.	Apr-19	Jun-22	Jun-21
Gage Cr.	May-71	Jun-22	Apr-71
Cobourg Br.	Oct-96	Jun-21	Jul-18
Covert Cr.	May-19	Jun-21	Jun-21
Grafton Cr.	Jun-17	Jun-22	Jun-16
Shelter Valley Cr.	Oct-21	May-22	May-22
Colborne Cr.	Apr-19	Jun-21	Jun-21
Salem Cr.	Aug-21	Jun-22	Jul-19
Proctor Cr.	Aug-21	Jun-22	Aug-21
Smithfield Cr.	Sep-86	Jun-22	May-86
Trent R. (Canal)	Sep-11	Sep-21	Sep-21
Mayhew Cr.	May-19	Jun-21	Jun-21
Moira R.	Jun-15	May-22	Jul-19
Salmon R.	Jun-16	Jun-22	Jul-19
Napanee R.	Never	Jun-22	Jul-15
United States			
Black R.	Aug-22	Aug-18	Aug-18
Black R. (Lentic)	Aug-18	Aug-18	Aug-18

Table 22. *Continued*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Stony Cr.	Sep-82	Aug-17	May-81
Sandy Cr.	Never	Aug-18	Apr-10
South Sandy Cr.	Jun-22	Aug-19	Aug-19
Skinner Cr.	Apr-05	Aug-19	Apr-06
Lindsey Cr.	Jun-22	Aug-19	Aug-19
Blind Cr.	May-76	Aug-17	Oct-75
Little Sandy Cr.	Jul-21	Jul-22	Jul-22
Little Sandy Cr. (Lentic)	Never	Aug-18	Aug-18
Deer Cr.	Apr-04	Jul-22	Sep-06
Salmon R.	Aug-21	Jul-22	Aug-21
Orwell Brook	Aug-21	Aug-19	Apr-14
Trout Brook	Jul-21	Aug-19	Aug-19
Altmar Cr.	Jun-18	Aug-19	Aug-19
Grindstone Cr.	Aug-21	Jul-22	Jul-22
Snake Cr.	May-22	Aug-19	Aug-19
Sage Cr.	May-78	Aug-19	May-88
Little Salmon R.	Jun-22	Jul-22	Jul-22
Butterfly Cr.	May-72	Jul-19	Jun-70
Catfish Cr.	Jun-22	Aug-19	Aug-19
Oswego R.			
Black Cr.	May-81	Aug-21	Jun-04
Big Bay Cr.	Sep-93	Aug-21	Aug-94
Scriba Cr.	May-19	Jul-22	Jul-22
Fish Cr.	Aug-19	Jul-22	Aug-21
Carpenter Br.	May-94	Aug-21	Apr-94
Putnam Br./ Coldsprings Cr.	May-96	Jul-22	Apr-05
Hall Br.	Never	Aug-21	Aug-77
Crane Br.	Never	Aug-21	Jun-81
Owasco Outlet	Jun-19	Jul-22	Jul-22
Rice Cr.	May-72	Aug-18	Jun-70
Eight Mile Cr.	May-22	Aug-21	Aug-21
Nine Mile Cr.	Jun-22	Jul-19	Jul-19
Sterling Cr.	May-22	Aug-19	Aug-19
Unnamed Cr.	May-19	Jul-22	Aug-19
Blind Sodus Cr.	May-78	Jul-19	May-78
Red Cr.	Apr-18	Aug-21	Aug-17
Wolcott Cr.	May-79	Aug-19	Aug-78
Sodus Cr.	Apr-15	Aug-21	Aug-19
Forest Lawn Cr.	Never	Aug-21	Aug-21
Irondequoit Cr.	Never	Jul-22	Apr-09
Larkin Cr.	Never	Jul-22	May-07
Northrup Cr.	Never	Jul-22	Aug-78
Salmon Cr.	Apr-05	Aug-19	Aug-17
Sandy Cr.	Apr-14	Aug-19	Aug-14
Oak Orchard Cr.			
Marsh Cr.	Apr-14	Aug-21	Aug-14
Johnson Cr.	Apr-10	Jul-18	Jun-09
Third Cr.	May-72	Aug-21	Sep-72
First Cr.	May-95	Jul-18	Sep-94

Table 16. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Ontario for larval assessment purposes during 2022.

Tributary	Bayluscide(kg)[1]	Area Surveyed (ha)
Canada		
Niagara River	4.3	0.90
Consecon Creek	0.5	0.10
Black Creek	0.5	0.10
Moira River	1.4	0.30
Salmon River	1.4	0.30
Napanee River	1.4	0.30
Total (Canada)	9.5	2.00
United States		
Niagara R.	3.2	0.70
Oswego R. (Fish Cr.)	0.7	0.15
Oswego R. (Scriba Cr.)	0.5	0.10
Oswegatchie R. (St. Lawrence R.)	0.9	0.20
Total (United States)	3.7	0.80
Total for Lake	**14.8**	**3.95**

[1]Lampricide quantities are reported in kg active ingredient.

Juvenile Assessment

The juvenile life stage is assessed through the interpretation of marking rates by feeding juvenile sea lamprey on lake trout. Used in conjunction with adult sea lamprey abundance to annually evaluate the performance of the SLCP, marking rates on lake trout are contrasted against the target set for each lake. Marking rates on lake trout are estimated from fisheries assessments conducted by state, provincial, tribal, and federal fishery management agencies associated with each lake, and are updated when the data become available. These data provide a metric of the mortality inflicted on lake trout on a lake-wide basis. The Commission contracts the Service's Green Bay Fish and Wildlife Conservation Office (GBFWCO) to calculate marking statistics and lake trout abundance estimates to assess the damage caused by sea lamprey.

Lake Superior

- Lake trout marking data for Lake Superior are provided by the MIDNR, Minnesota Department of Natural Resources (MNDNR), WIDNR, GLIFWC, Chippewa-Ottawa Resource Authority (CORA), Keweenaw Bay Indian Community (KBIC), Grand Portage Band of Lake Superior Chippewa Indians, and the Ontario Ministry of Natural Resources and Forestry (OMNRF), and analyzed by the Service's GBFWCO. Due to COVID-19 travel restrictions, lake trout marking data was not collected in 2020. Spring assessment data from 2022 is currently being analyzed.

- Based on standardized spring assessment data, the marking rate during 2021 was 5.8 A1-A3 marks per 100 lake trout >532mm, which is greater than the target of 5 marks per 100 fish (Figure 6).

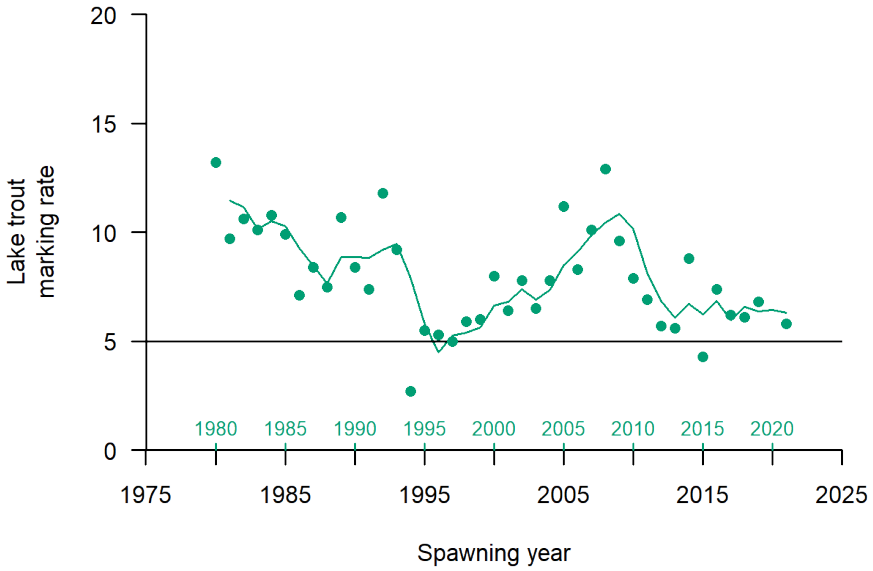

Figure 6. Number of A1-A3 marks per 100 lake trout > 532 mm from standardized assessments on Lake Superior plotted against the sea lamprey spawning year, including the three-year moving average (line). The three-year (2019-2021) average marking rate of 6.3 was above the target of 5 A1-A3 marks per 100 lake trout > 532 mm (horizontal line). A second x-axis shows the year the lake trout were sampled.

Lake Michigan

- Lake trout marking data for Lake Michigan are provided by MIDNR, WIDNR, Illinois Department of Natural Resources, Indiana Department of Natural Resources, CORA, Service, and USGS, and analyzed by the Service's GBFWCO.

- Based on standardized fall assessment data, the marking rate during 2021 was 2.9 A1-A3 marks per 100 lake trout >532mm, which is less than the target of 5 marks per 100 fish (Figure 7). Fall assessment data from 2022 is currently being analyzed.

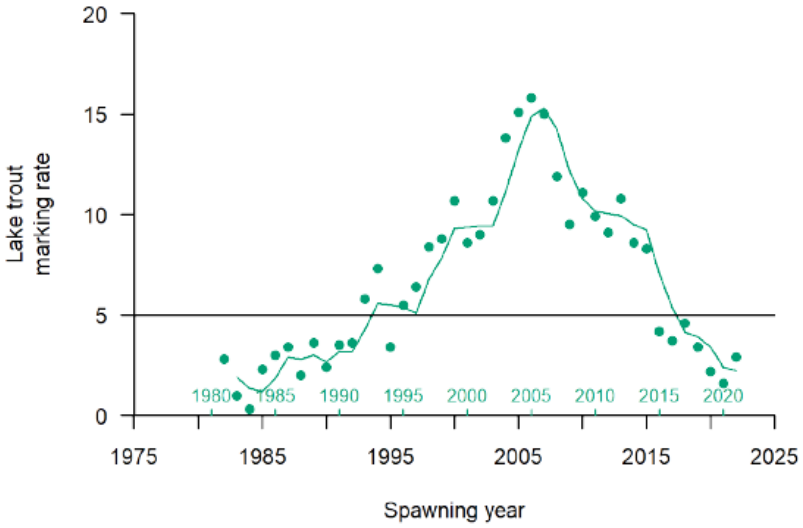

Figure 7. Number of A1-A3 marks per 100 lake trout > 532 mm from standardized assessments on Lake Michigan during August-November plotted against the sea lamprey spawning year, including the three-year moving average (line). The three-year (2020-2022) average marking rate of 2.2 is less than the target of 5 A1-A3 marks per 100 lake trout > 532 mm (horizontal line). A second x-axis shows the year the lake trout were sampled.

Lake Huron

- Lake trout marking data for Lake Huron are provided by the MIDNR, CORA, USGS, and OMNRF and is analyzed by the Service's GBFWCO. Spring assessment data from 2022 is currently being analyzed.

- Based on standardized spring assessment data, the marking rate during 2021 was 4.0 A1-A3 marks per 100 lake trout >532 mm, which is less than the target of 5 marks per 100 fish (Figure 8).

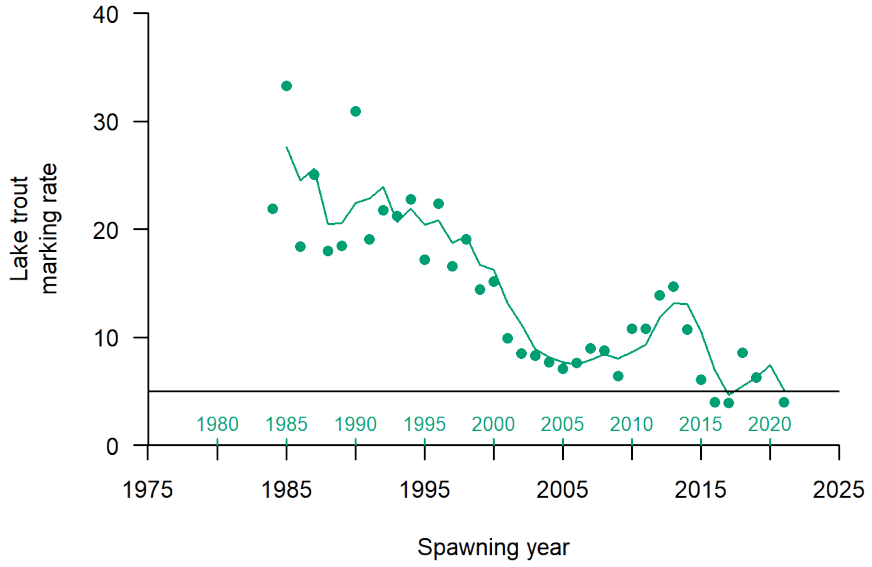

Figure 8. Number of A1-A3 marks per 100 lake trout > 532 mm from standardized assessments on Lake Huron plotted against the sea lamprey spawning year, including the three-year moving average (line). The three-year (2019-2021) average marking rate of 5.2 was above the target of 5 A1-A3 marks per 100 lake trout > 532 mm (horizontal line). A second x-axis shows the year the lake trout were sampled.

- Canadian commercial fisheries in northern Lake Huron continued to provide parasitic juvenile sea lamprey in 2022, along with associated catch information including date, location, and host species. The total number of sea lamprey captured each year, along with effort data provided by commercial fishers to the OMNRF, is used as an index of juvenile sea lamprey abundance in northern Lake Huron. The effort data from 2022 has yet to be analyzed (Figure 9).

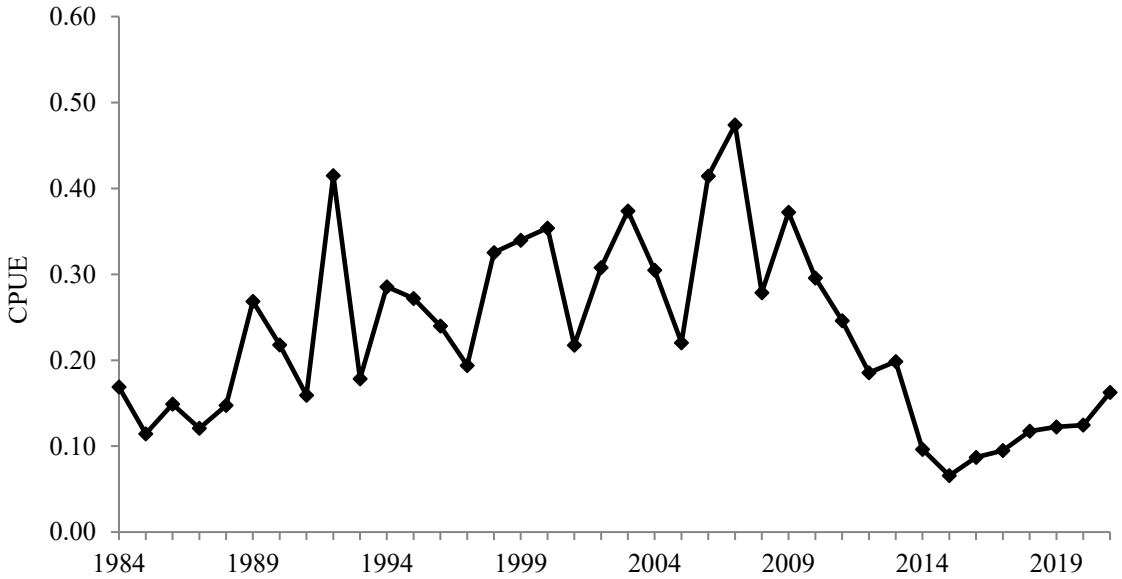

Figure 9. Northern Lake Huron commercial fisheries index showing CPUE (number of parasitic juvenile sea lamprey per km of gillnet per night) for 1984-2021.

- Standardized trapping for out-migrating juveniles in the St. Marys River has been discontinued due to safety concerns and low number of juveniles collected.

Lake Erie

- Lake trout marking data for Lake Erie are provided by the NYDEC, PAFBC, USGS, and OMNRF, and analyzed by the Service's GBFWCO.

- Based on standardized fall assessment data, the marking rate during 2021 was 4.3 A1-A3 marks per 100 lake trout >532 mm, which is less than the target of 5 marks per 100 fish. Fall assessment data from 2022 is currently being analyzed (Figure 10).

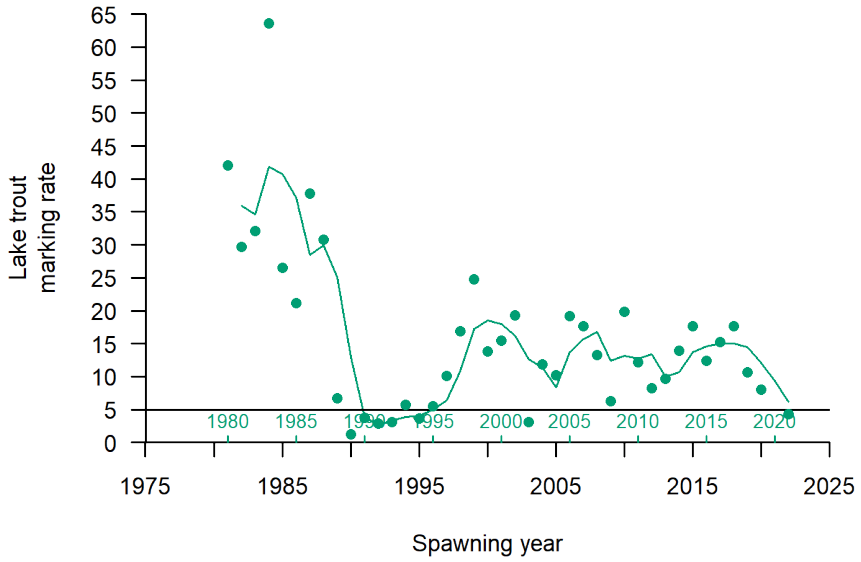

Figure 10. Number of A1-A3 marks per 100 lake trout > 532 mm from standardized assessments on Lake Erie plotted against the sea lamprey spawning year, including the three-year moving average (line). The three-year average marking rate of 6.2 was above the target of 5 A1-A3 marks per 100 lake trout > 532 mm (horizontal line). A second x-axis shows the year the lake trout were sampled.

Lake Ontario

- Lake trout marking data for Lake Ontario are provided by USGS, OMNRF, and NYDEC. The data is analyzed by the Service's GBFWCO.

- Based on standardized fall assessment data, the marking rate during 2021 was 1.8 A1 marks per 100 lake trout >431 mm which is less than the target of 2 A1 marks per 100 lake trout target. Fall assessment data from 2022 is currently being analyzed (Figure 11).

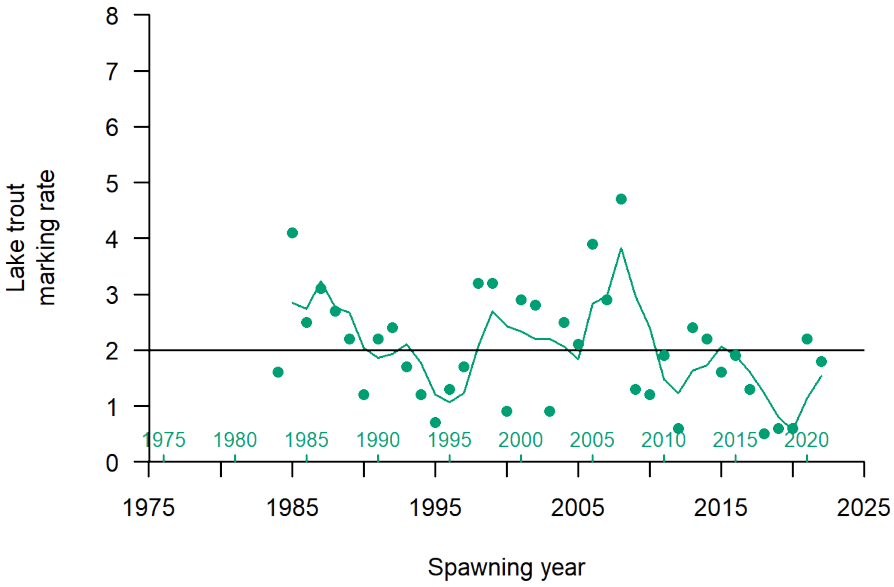

Figure 11. Number of A1 marks per 100 lake trout > 431 mm from standardized assessments on Lake Ontario plotted against the sea lamprey spawning year, including the three-year moving average (line). The three-year average marking rate of 1.5 is less than target of 2 A1 marks per 100 lake trout > 431 mm (horizontal line). A second x-axis shows the year the lake trout were surveyed.

Adult Assessment

Assessment traps used to intercept adult sea lamprey during the spawning migration are operated throughout the Great Lakes basin (Figure 12), to remove sea lamprey from rivers, facilitate passage of native fish, and generate mark-recapture estimates of adult sea lamprey populations. An annual lake-wide index of adult sea lamprey abundance is derived by summing individual abundance estimates from assessment traps operated in a specific suite of streams (index streams) during spring and early summer. Stream-specific abundance estimates are derived using Petersen mark-recapture methods. In the absence of a stream-specific estimate due to an insufficient number of marked or recaptured sea lamprey, population abundance for that stream and year is estimated using a model based on trap efficiency and dynamics of abundance from other tributaries. The index targets are estimated as the mean of indices during a period within each lake when marking rate was considered acceptable or the percentage of the mean that would be deemed acceptable.

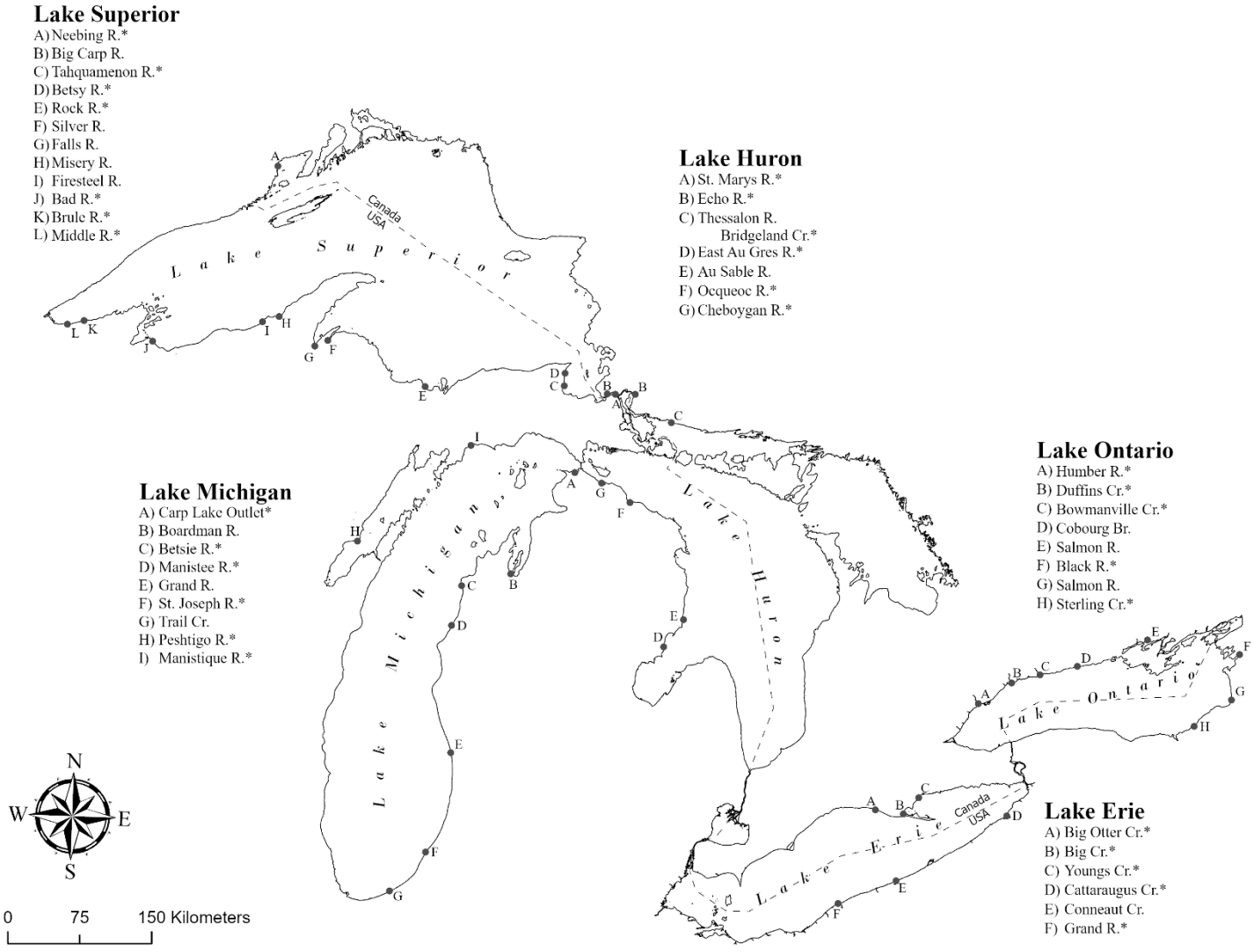

Figure 12. Locations of tributaries where assessment traps were operated during 2022. An asterisk indicates index locations.

Lake Superior

- 2,287 sea lampreys were captured in 12 tributaries during 2022 (Table 24, Figure 12), 7 of which were index locations. Adult population estimates based on mark-recapture data were obtained from 6 of the 7 index streams. The Brule River population estimate was modeled due to insufficient recaptures of marked sea lamprey.

- The index of adult sea lamprey abundance was 19,313 *(95% CI; 17,376-21,250)*, which is greater than the target of 10,421 (Figure 13).

- Adult sea lamprey migrations were assessed in the Bad, Brule, Firesteel, Middle, Misery, and Silver rivers through cooperative agreements with GLIFWC and KBIC.

- A barrier-integrated permanent trap is expected to replace portable traps on the Neebing River for the 2024 trapping season to improve trapping efficiency and safety.

Table 24. Information regarding adult sea lamprey captured in assessment traps or nets in tributaries of Lake Superior during 2022 (letter in parentheses corresponds to streams in Figure 12).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
Neebing R. (A)	23	86	27	5	60	484	451	274	197
Big Carp R. [3] (B)	10	---	---	10	40	493	500	280	270
Total or Mean (Canada)	**33**	---	---	**15**	**47**	**489**	**487**	**277**	**252**
United States									
Tahquamenon R. (C)	729	3,198	23	61	82	454	464	257	237
Betsy R. (D)	296	1,802	16	37	72	480	469	256	249
Rock R. (E)	261	493	52	68	50	452	461	202	240
Silver R.[3] (F)	24	254	5	1	0	---	426	---	220
Falls R.[3] (G)	22	65	29	6	50	444	407	230	159
Misery R.[3] (H)	183	328	52	90	60	447	449	225	221
Firesteel R.[3] (I)	128	456	24	21	47	489	471	276	273
Bad R. (J)	174	1,817	5	5	40	444	426	191	188
Brule R.[4] (K)	28	4,509	9	1	0	---	472	---	285
Middle R. (L)	409	7,408	5	12	25	427	440	216	216
Total or Mean (U.S.)	**2,254**	---	---	**302**	**61**	**457**	**455**	**236**	**233**
Total or Mean (for Lake)	**2,287**	**---**	**---**	**317**	**60**	**462**	**453**	**233**	**234**

[1]The number of recaptured adult sea lamprey used to determine percent males, mean length, and mean weight, [2]Gender was determined using external characteristics, [3]Not an index location, [4]Model used for population estimate

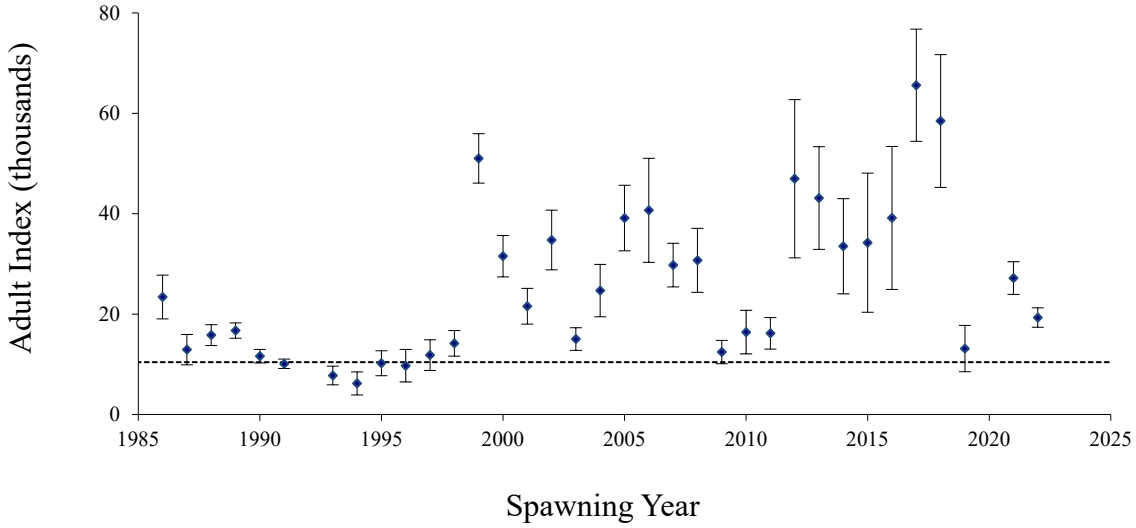

Figure 13. Index estimates with 95% confidence intervals of adult sea lampreys in Lake Superior. The target of 10,421 is represented by the dotted horizontal line. The index target was estimated as the mean of indices during a period with acceptable marking rates (1994-1998).

Lake Michigan

- 15,024 sea lampreys were captured in 9 tributaries during 2022 (Table 25, Figure 12), 6 of which were index locations. Adult population estimates based on mark-recapture data were obtained from all 6 index streams.

- The index of adult sea lamprey abundance was 49,007 *(95% CI; 38,610-59,404),* which is greater than the target of 34,982 (Figure 14).

- Adult assessment traps and fyke nets set on the Grand River captured 262 sea lampreys resulting in a stream-wide population estimate of 1,962 lampreys. All sea lampreys were captured at the 6th Street Dam trap location.

- Adult assessment traps operated in the Boardman and Betsie rivers through a cooperative agreement with the Grand Traverse Band of Ottawa and Chippewa Indians.

Table 25. Information regarding adult sea lamprey captured in assessment traps or nets in tributaries of Lake Michigan during 2022 (letter in parentheses corresponds to stream in Figure 12).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Carp Lake Outlet (A)	1,878	2,642	71	144	58	484	493	245	261
Boardman R. [3] (B)	71	130	54	38	54	478	494	258	275
Betsie R. (C)	628	2,122	29	33	55	477	481	264	273
Big Manistee R. (D)	409	26,593	1	5	80	424	467	314	283
Grand R.(E)[3]	262	1962	13	34	35	499	508	238	285
Manistique R.(F)	9,977	13,002	73	423	47	502	505	277	293
Peshtigo R. (G)	1,130	2,392	47	59	54	505	489	278	273
St. Joseph R. (H)	473	2,256	21	44	39	493	490	267	267
Trail Cr. [3] (I)	196	196	---	---	---	---	---	---	---
Total or Mean (for lake)	**15,024**	**---**	**---**	**780**	**50**	**494**	**499**	**267**	**282**

[1]The number of sea lamprey used to determine percent males, mean length, and mean weight, [2]Gender was determined by using external characteristics, [3]Not an index location.

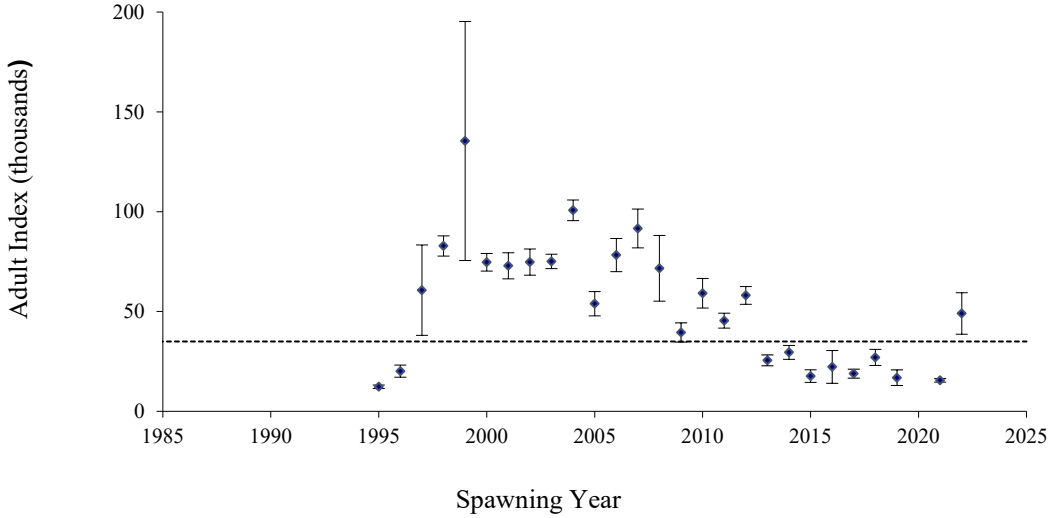

Figure 14. Index estimates with 95% confidence intervals of adult sea lampreys in Lake Michigan. The dotted horizontal line represents the target of 34,982. The index target was estimated as 5/8.9 times the mean of indices (1995-1999).

Lake Huron

- 27,565 sea lampreys were trapped in 7 tributaries during 2022, 6 of which were index locations (Table 26, Figure 12). Population estimates were generated for all 6 index streams using mark-recapture data.

- The index of adult sea lamprey abundance was 57,054 (95% CI; 55,265-58,843), which is greater than the target of 31,274 (Figure 15).

- The Service, MIDNR, and USACE will be moving forward on Great Lakes Fishery and Ecosystem Restoration (GLFER) funded construction projects including permanent sea lamprey traps on the Au Sable and East Au Gres rivers. Portable assessment traps on the Au Sable River were operated in 2022 and will continue to be operated until sufficient data is gathered to determine the optimum location for a permanent trap. Construction of the permanent trap on the East Au Gres River was completed in December of 2022. The Service will have a trap insert built and operate the new trap in 2023.

Table 26. Information regarding adult sea lamprey captured in assessment traps or nets in tributaries of Lake Huron during 2022 (letter in parentheses corresponds to stream in Figure 12).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
St. Marys R. (A)	2,769	10,351	27	48	56	492	493	275	286
Echo R. (B)	1494	7,897	19	50	58	486	495	260	273
Thessalon R. (C)									
Bridgeland Cr.	3,461	6,013	58	143	46	483	483	250	262
Total or Mean (Canada)	**7,724**	---	---	**241**	**51**	**486**	**487**	**258**	**268**
United States									
East Au Gres R. (D)	314	1791	17	19	100	440	---	252	---
Au Sable R.[3] (E)	282	4,008	6	16	55	476	466	268	275
Ocqueoc R. (F)	4,135	11,926	35	137	50	476	477	249	250
Cheboygan R. (G)	15,110	19,076	79	597	49	493	495	251	259
St. Marys R. (A)	(Canada)	(Canada)	(Canada)	28	70	526	526	322	326
Total or Mean (U.S.)	**19,841**	---	---	**797**	**51**	**491**	**492**	**254**	**258**
Total or Mean (for Lake)	**27,565**	**---**	---	**1,038**	**50**	**490**	**491**	**255**	**261**

[1]The number of sea lamprey used to determine percent males, mean length, and mean weight, [2]Gender was determined using external characteristics. [3] Not an index location.

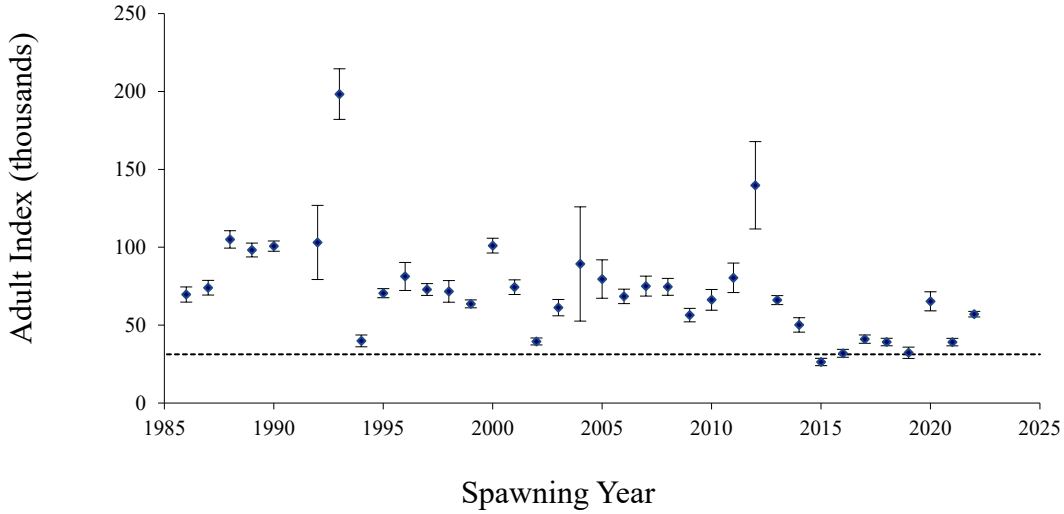

Figure 15. Index estimates with 95% confidence intervals of adult sea lampreys in Lake Huron. The horizontal dotted line represents the index target of 31,274. The index target was estimated as 0.25 times the mean of indices between 1989 and 1993.

Lake Erie

- 1,515 sea lampreys were trapped in 6 tributaries during 2022, 5 of which were index locations (Table 27, Figure 12). Adult population estimates based on mark-recapture data were obtained from 4 of 5 index streams. Population estimates were modeled for Cattaraugus Creek due to insufficient recaptures of marked sea lamprey.

- The index of adult sea lamprey abundance was 7,198 *(95% CI; 5,975-8,421)* in 2022, which is greater than the target of 3,263 (Figure 16).

- Fyke nets were set during 2022 in Conneaut Creek with assistance from the PAFBC and Pennsylvania Department of Environmental Protection (PADEP) to assess adult sea lamprey migration. Overall, 3 sea lampreys were captured during the trapping run with no recaptures. The Service, PAFBC, and PADEP staff plan to conduct trapping efforts again in 2023. A seasonal electric barrier was operated in 2022 to determine if it would be a feasible alternative control tool to block lamprey from infesting the upper reaches of the creek.

- Construction of the barrier-integrated traps on the Grand River was completed in 2020. During the 2022 trapping season, the attractant flow to the traps became clogged with debris and mud, likely reducing the trapping efficiency. The USACE removed debris from the attractant flow pipes in August to restore trap function. The Grand River was treated with lampricide during the adult sea lamprey spawning run, which likely affected the trapping efficiency.

- The adult sea lamprey migration in Cattaraugus Creek was monitored through a cooperative

agreement with the Seneca Nation of Indians. Trapping efficiency has been declining over the past several years. Service staff investigated and assisted with trapping on Cattaraugus Creek and found that the traps were operating correctly. Cattaraugus Creek was also treated with lampricide during the adult sea lamprey spawning run in 2022.

Table 27. Information regarding adult sea lamprey captured in assessment traps or nets in tributaries of Lake Erie during 2022 (letter in parentheses corresponds to stream in Figure 12).

						Mean Length (mm)		Mean Weight (g)	
Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Males	Females	Males	Females
Canada									
Big Otter Cr. (A)									
Little Otter Cr.[4]	91	465	20	17	29	442	482	218	286
Big Cr. (B)	1,140	1524	75	340	44	512	507	271	276
Young's Cr. (C)[4]	96	222	43	41	44	490	502	265	280
Total or Mean (Canada)	**1,327**	**---**	**---**	**398**	**43**	**507**	**505**	**269**	**277**
United States									
Cattaraugus Cr.[4] (D)	4	1,711	---	---	---	---	---	---	---
Grand R. (E)	181	3,276	4	8	38	502	468	300	303
Conneaut Cr.[3](F)	3	6	---	---	---	---	---	---	---
Total or Mean (U.S.)	**188**	**---**	**---**	**8**	**38**	**502**	**468**	**300**	**303**
Total or Mean (for Lake)	**1,515**	**---**	**---**	**406**	**43**	**507**	**504**	**270**	**278**

[1]The number of sea lamprey used to determine percent males, mean length, and mean weight, [2] Gender was determined using external characteristics, [3] Not an index location, [4] Model used for population estimate

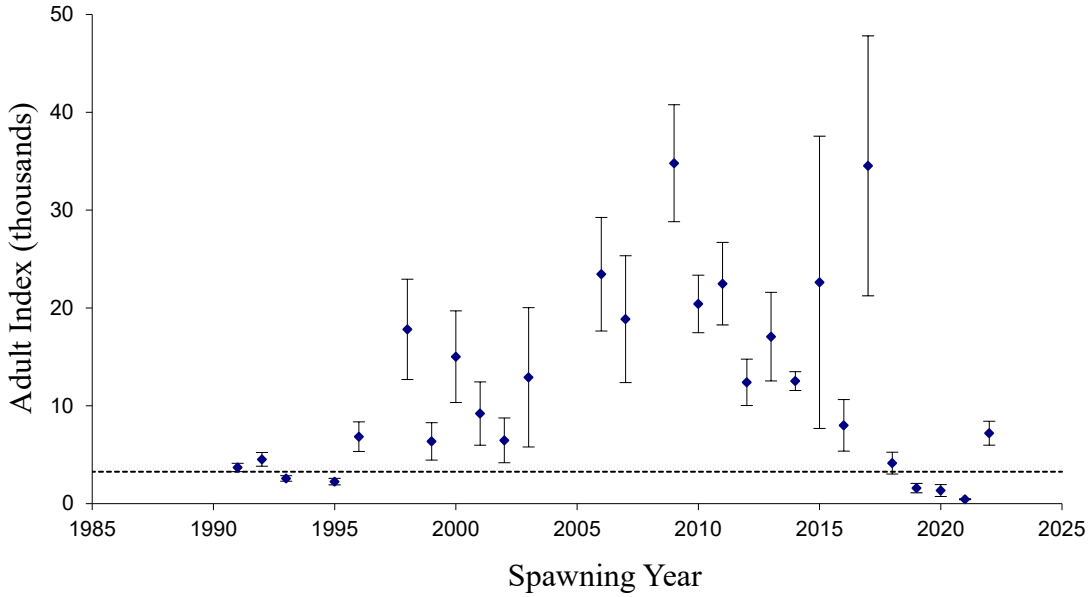

Figure 16. Index estimates with 95% confidence intervals of adult sea lampreys in Lake Erie. The dotted horizontal line represents the index target of 3,263. The index target was estimated as the mean of indices during a period with acceptable marking rate (1991-1995).

Lake Ontario

- 5,605 sea lampreys were trapped in 8 tributaries during 2022, 5 of which were index locations (Table 28, Figure 12). Adult population estimates based on mark-recapture data were obtained from 4 of the 5 index locations. Population estimates were modeled for the Black River due to insufficient recaptures of marked sea lamprey.

- The index of adult sea lamprey abundance was 18,731 *(95% CI; 17,764-19,697)* in 2022, which is greater than the target of 14,065 (Figure 17).

Table 28. Information regarding adult sea lamprey captured in assessment traps or nets in tributaries of Lake Ontario during 2022 (letter in parentheses corresponds to stream in Figure 12).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
Humber R. (A)	3,778	8,071	47	113	76	502	498	291	289
Duffins Cr. (B)	129	617	21	25	72	503	519	296	295
Bowmanville Cr. (C)	627	1,299	48	124	61	503	494	285	280
Cobourg Cr.[3] (D)	333	632	53	79	67	480	481	249	253
Salmon R.[3] (E)	2	---	---	---	---	---	---	---	---
Total or Mean (Canada)	**4,869**	**---**	**---**	**341**	**68**	**497**	**493**	**280**	**277**
United States									
Black R.[4] (F)	427	6,268	7	2	50	432	460	239	200
Salmon R.(G)									
Orwell Br.[3]	1	---	---	1	100	511	---	307	---
Sterling Cr. (H)	308	2,476	11	22	18	506	507	264	299
Total or Mean (U.S.)	**736**	**---**	**---**	**25**	**24**	**494**	**504**	**267**	**293**
Total or Mean (for lake)	**5,605**	**18,731**	**---**	**366**	**65**	**497**	**495**	**280**	**279**

[1]The number of sea lamprey used to determine percent males, mean length, and mean weight, [2]Gender was determined using external characteristics, [3]Not an index location, [4]Model used for population estimate

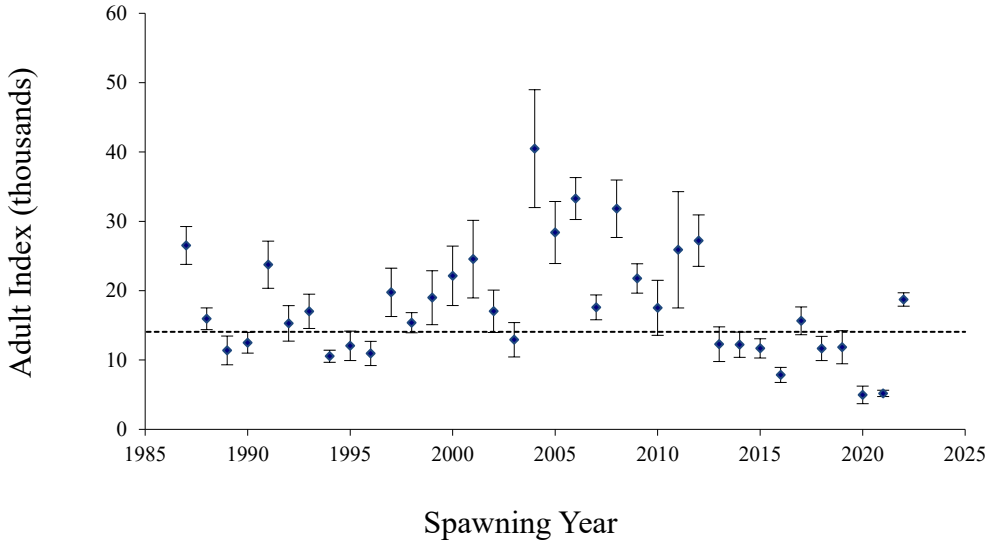

Figure 17. Index estimates with 95% confidence intervals of adult sea lamprey in Lake Ontario. The dotted horizontal line represents the index target of 14,065. The index target was estimated as the mean of indices during a period with acceptable marking rates (1993-1997).

RISK MANAGEMENT

Risk management addresses environmental and non-target issues related to the implementation of the SLCP in the United States and Canada. This involves coordination with many federal, provincial, state, and tribal and First Nation agencies, and working with others to minimize risk to non-target organisms.

Species at Risk Act

Section 73 of the Species at Risk Act (SARA) in Canada enables the competent minister to issue permits to for activities that may affect threatened or endangered species, provided that (a) all alternatives have been considered, (b) all feasible measures have been taken to minimize the impact on the species and its critical habitat, and (c) the activity will not jeopardize the survival or recovery of the species. During 2022, the SLCP sought and was issued a permit for lampricide applications in 12 waterbodies that overlapped with the known occurrence of the following species at risk:

Threatened

- Black redhorse (*Moxostoma duquesnei*)
- Eastern sand darter (*Ammocrypta pellucida*)
- Silver shiner (*Notropis photogenis*)

Endangered

- Channel darter (*Percina copelandi*)
- Lake chubsucker (*Erimyzon sucetta*)
- Northern madtom (*Noturus stigmosus*)
- Pugnose shiner (*Notropis anogenus*)
- Redside dace (*Clinostomus elongatus*)
- Fawnsfoot (*Truncilla donaciformis*)
- Hickorynut (*Obovaria olivaria*)
- Kidneyshell (*Ptychobranchus fasciolaris*)
- Lilliput (*Toxolasma parvum*)
- Round pigtoe (*Pleurobema sintoxia*)
- Threehorn wartyback (*Obliquaria reflexa*)

Monitoring for sick and dead organisms was conducted immediately after each lampricide application. Species at risk were not observed.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires that all U.S. federal agencies consult with the Service's Ecological Services (ES) to ensure that actions that are federally funded, authorized, permitted, or otherwise carried out will not jeopardize the continued existence of any federally listed (threatened, endangered, candidate) species or adversely modify designated critical habitat.

Annual Reviews

Endangered species reviews are conducted annually with ES to assess the potential risk of proposed lampricide applications to federally listed species and develop procedures to protect and avoid disturbance.

During 2022, the following ES offices reviewed the effect of scheduled lampricide applications to listed species within their jurisdiction. Concurrence with proposed conservation measures and determinations of "no effect" or "not likely to adversely affect" was received by:

- East Lansing Ecological Services Field Office
- Twin Cities Ecological Services Field Office
- Ohio Ecological Services Field Office
- Pennsylvania Department of Conservation and Natural Resources
- New York Field Office

Programmatic Review

Because of the broad scope of the SLCP, consultation under Section 7 of the ESA involves several states, many listed species, and hundreds of streams. To streamline the consultation process and add predictability for project planning, an informal, draft, SLCP-wide (programmatic) Section 7 review was prepared in coordination with the East Lansing Field Office and submitted to the Midwest Region ES Program for consideration during 2007. The programmatic review evaluates all SLCP activities, identifies potential impacts to protected species and critical habitats, and specifies conservation measures to eliminate or minimize disturbance. No further action has been taken on the SLCP programmatic Section 7 review due to limited staffing within the ES Program.

State-Listed Species

Annual Reviews

Reviews are annually conducted with state agencies to fulfill regulatory permit requirements, assess the potential risk to state listed (threatened, endangered, special concern) species, and develop procedures that protect and avoid disturbance.

During 2022, the following state regulatory offices reviewed listed species within their jurisdiction and issued permits to conduct lampricide applications:

- MIDNR
- WIDNR
- MNDNR
- Ohio Department of Environmental Protection (OHEPA)
- PADEP
- New York Department of Environmental Protection

Studies and Fieldwork

Non-target Surveys

Grand River: The Risk Management Team (RMT) participated with partner agencies (OHEPA, OHDNR) and local community volunteers to conduct non-target surveys in the Grand River during the lampricide treatment.

Muskegon River: The RMT participated in the partner-led effort (LRBOI, GBFWCO, MIDNR) to collect young-of-the-year (YOY) lake sturgeon (LST; *Acipenser fulvescens*) before and during the Muskegon River treatment.

- Forty-six YOY (157-215 mm) and 1 yearling (395 mm) LST were captured before and during treatment. Six of the YOY were captured (alive) about 12 hours into the treatment. No dead LST were observed during treatment and a post-treatment survey was not conducted.

- Each fish was weighed, measured, fin clipped for genetics, pit tagged, and returned to the river post-treatment.

Freshwater Mussel Toxicity Tests

- The U.S. Geological Survey-Upper Midwest Environmental Sciences Center (UMESC) conducted two toxicity tests in a streamside bioassay trailer (Oconto River, MI) to determine the toxicity of TFM to adult hickorynut mussels (HN; *Obovaria olivaria*) and blackside darters (BSD; *Percina maculata*), one of the known round hickorynut (RHN; *Obovaria subrotunda*) host fish. The RHN was proposed for federal listing as threatened during September 2020 and therefore, the adult HN was required as a surrogate for testing.

    - BSD's and HN adults were resistant to TFM at concentrations used to treat streams.

- UMESC conducted two toxicity tests in the laboratory to determine the toxicity of TFM to HN and RHN glochidia (larvae) and juveniles.

    - The glochidia of both species and HN juveniles were resistant to TFM at concentrations used to treat streams.

    - Propagation of RHN juveniles was unsuccessful and testing was not conducted. A second attempt will occur during fall 2023.

Aquatic Ecosystem Study

The Environmental Team (Canada), in conjunction with Garden River First Nation, continued a multi-year aquatic ecosystem study on Garden, Root, and Echo rivers (northern Lake Huron). The study involves collecting historical information as well as current baseline conditions, including physical (water chemistry and water temperature) and biological (fish assemblage and

distribution) data. The study will continue beyond the next planned lampricide treatment of the Garden River.

Fish Community Assessments

The Environmental Team (Canada) conducted fish community sampling to support the sea lamprey barrier program:

- Streams with purpose-built low-head barriers: sampling was conducted upstream and downstream of barriers on streams in Lake Ontario (3), Lake Huron (1) and Lake Superior (1). The purpose of this periodic sampling is to track long-term changes in fish community composition. Additional data is required before meaningful comparisons can be made.

- Candidate low-head barrier streams: sampling was conducted in two Lake Ontario watersheds in New York (Trout Brook and Grindstone Creek) that are being considered for new low-head barriers. The purpose of this sampling is to determine if there are any vulnerable, threatened, or endangered fish species in these watersheds prior to proceeding with barrier planning. No listed species were found. Sampling will continue in 2023.

Field Protocols

Field protocols are reviewed and revised annually to protect and avoid disturbance to federal and state listed species located near scheduled SLCP activities. The protocols provide information on each species, their known locations, and detailed conservation measures to be followed:

- Protocol to protect and avoid disturbance to federal- and state-listed endangered, threatened, candidate, proposed, or special concern species and critical, or proposed critical habitats in or near Great Lakes streams scheduled for lampricide treatments in the United States during 2022.

- Protocol to protect and avoid disturbance to federal- and state-listed endangered, threatened, candidate, proposed, or special concern species and critical or proposed critical habitats in or near Great Lakes streams scheduled for gB assessments in the United States during 2022.

Twenty-two federal and state listed species, 2 critical habitats, the federally de-listed bald eagle (*Haliaeetus leucocephalus*) and Kirtland's warbler (*Setophaga kirtlandii*) were identified in the 2022 protocols.

National Environmental Policy Act

Title I and Section 102 of the National Environmental Policy Act (NEPA) requires U.S. federal agencies to incorporate environmental considerations in their planning and decision making, which includes the details of the environmental impact of, and alternatives to, major federal actions significantly affecting the environment. During 2022, NEPA was required for cooperative agreements for the following actions:

Trapping for adult sea lampreys on the following streams:

- Bad River (Lake Superior)
- Cranberry River (Lake Superior)
- Potato River (Lake Superior)
- Boardman River (Lake Michigan)
- Traverse River (Lake Michigan)
- St. Marys River (Lake Huron)
- Cattaraugus Creek (Lake Erie)

Federal Insecticide, Fungicide and Rodenticide Act

Reports are prepared to comply with the U.S. EPA June 16, 1998 ruling of Section 6(a)(2) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). This section of FIFRA requires pesticide registrants to report unreasonable adverse effects of their products to the EPA. The Service must report unreasonable adverse effects on humans, domestic animals, fish, wildlife, plants, other non-target organisms, water, and damage to property. Incident reports are required with the observed mortality of a single federally-listed threatened, endangered, or candidate species, and with observed mortalities of ≥ 50 non-schooling or ≥ 1,000 schooling fish of any non-target species or taxa during a lampricide application (Table 29).

Table 29. Summary of 6(a)(2) reports submitted for incidents of non-target mortality during 2022 lampricide applications.

Lake	Stream	Species	Number	Comments
Michigan	Platte River[1]	Logperch (*Percina caprodes*)	1,044	Sensitive/ Spawning
Superior	Gravel River[3]	Round whitefish (*Prosopium cylindraceum*)	200	Spawning
	Saux Head Lake[3]	Bluegill (*Lepomis macrochirus*)	198	Schooling
	Michipicoten River[1]	Chinook salmon (*Oncorhynchus tshawytscha*)	200	Spawning
		Pink salmon (*Oncorhynchus gorbuscha*)	100	Spawning
Huron	Pine River[2]	Stonecat (*Noturus flavus*)	107	Sensitive species
Erie	Grand River[1]	Stonecat	697	Sensitive species
		Mudpuppy (*Necturus maculosus*)	50	Sensitive species
	Cattaraugus Creek[1]	Stonecat	54	Sensitive species
		Fantail darter (*Etheostoma flabellare*)	70	Spawning
Ontario	Lynde Creek[1]	Stonecat	87	Sensitive species
	Bronte Creek[1]	Stonecat	100+	Sensitive species

[1] TFM, [2] TFM/niclosamide, [3]granular Bayluscide

TASK FORCE REPORTS

The Commission has four task forces (Lampricide Control, Barrier, Larval Assessment and Trapping). The task forces include agents with expertise in specific program areas, researchers and academics, outside experts, Lake Committee representatives, Commission staff, and other experts as needed. The task forces report to the SLCB, which established their terms of reference and works with them to recommend program direction and funding to the Commission.

The following sections report the purpose, membership, and progress on objectives charged to each task force by the SLCB.

Lampricide Control Task Force

Purpose
Maximize the number of sea lamprey killed in individual streams and lentic areas while minimizing costs and impacts on aquatic ecosystems.

2022 Membership
Lori Criger (Chair), Cheryl Kaye, Chris Gagnon, Benson Solomon, Lauren Freitas, Chris Eilers, Aaron Jubar (Service); Bruce Morrison, Shawn Robertson, Al Rowlinson (Department), Jean Adams (USGS/Commission); Jim Luoma, Mike Boogaard, Karen Slaght (USGS); Michael Wilkie (Wilfred Laurier University); Mike Siefkes and Chris Freiburger (Commission Secretariat).

Progress towards goals described in the Commission Vision:

Goal 1: Suppress sea lamprey populations to target levels.

Strategy 1: Implement lampricide treatment strategies to suppress sea lamprey populations to target levels in each Great Lake.

2022 Outcomes:

1. Seventy-nine streams and 13 lentic areas were treated with lampricide. Treatments on eight streams and four lentic areas were deferred to 2023.
2. Where applicable, strategies were employed to reduce the number of sea lamprey that survive treatment and increase the effectiveness of individual stream treatments.
    - Backwaters and isolated areas in target streams (Betsie, Platte, Jordan, Ocqueoc, Au Sable, Muskegon, Manistique) were treated in conjunction with the main application to prevent survival and/or escapement in these refugia areas.
    - Lampricide concentrations were targeted to be greater than 10% above theoretical values due to some uncertainty with the prediction chart levels, particularly in streams that were treated late in the season.
    - While taking into account outside agency or endangered species requirements, streams were scheduled for treatment during the time of year when discharge and water chemistries were optimal for effective treatment.
3. Service and Department personnel collaborated to effectively treat the Manistique and Muskegon rivers.

4. Service personnel from the larval assessment and Alternate Control and Evaluation (ACE) units were deployed to control units as needed to augment treatment effort on complex, labor-intensive systems including the Manistique, Whitefish, Nemadji, Cattaraugus, Muskegon, and AuSable rivers and Silver Cr. (Tawas Lake Outlet).
5. Service and Department personnel worked together to successfully treat the St. Marys River plots with granular Bayluscide in early July before heavy vegetation reduced treatment efficacy.
6. Service Risk Management personnel participated in partner-led efforts to conduct non-target surveys in the Grand River (Ohio) and lake sturgeon collections in the Muskegon River.

2023 Objectives:

1. Treat all streams listed on the 2023 treatment schedule.
2. Review past treatment results and larval assessment data to implement treatment strategies to achieve improved efficacy for streams scheduled for treatment during 2023.
3. Deploy additional personnel from within the program to treat more streams in the spring when larvae are more susceptible and stream discharge and water chemistries are most favorable. Additionally, treatment supervisors will request additional personnel to augment treatment effort on complex, labor-intensive systems scheduled later in the season.
4. To increase treatment effectiveness of St. Marys River granular Bayluscide applications, Service and Department personnel will collaborate to ensure treatments are completed before aquatic vegetation becomes problematic.
5. Support lampricide research that investigates sea lamprey sensitivity and effects on non-target organisms with anticipation that it leads to improved control strategies that increase treatment efficacy while minimizing effects on non-target species.
    - Service Risk Management personnel will participate in the partner-led effort to collect YOY lake sturgeon during the Manistee River treatment.
    - Support Risk Management and UMESC as they continue to examine the risk of lampricide treatments to the round hickorynut.
    - Organize a toxicity workshop in conjunction with the Sea Lamprey Annual Working Session to discuss species-specific toxicity and determine how to best compile toxicity data.

Strategy 3: Measure the effectiveness of lampricide applications and account for its variation among streams.

2022 Outcomes:

1. Lampricide analysis and water chemistry data from streams treated in 2022 was reviewed to identify potential areas that did not receive lethal lampricide. concentrations during treatment. Information was provided to larval assessment to help guide treatment evaluation survey effort and recommend re-treatment.
2. Control agents cooperated with UMESC personnel to conduct a bioassay on the Muskegon River where there was concern that lampricide concentrations would not be effective late in the season due to elevated water temperatures and/or seasonality effects that increase larval sea lamprey condition, increasing the likelihood of survival.

3. Control agents provided logistical support to Schueller et al. (UMESC) as they conducted research to examine TFM efficacy and seasonality effect on sea lamprey larvae in three study streams (Black River, Chocolay River, Wilson Creek).
4. Supported and provided input to UMESC as they work with Battelle (UK) to develop a formulation of liquid Bayluscide that would eliminate tubing degradation and clogging and increase applicator safety by eliminating N-Methyl-2-pyrrolidone (NMP), a potential carcinogen.

2023 Objectives:

1. Review past treatment history and larval assessment information for streams scheduled for treatment in 2023 to identify impediments to effectiveness and develop strategies to increase efficacy.
2. Work with other task forces to measure effectiveness of lampricide applications.
   - Continue to assist LATF with evaluating the success of ongoing targeted treatment strategies.
   - Continue to review results of treatment evaluation surveys as they are completed to identify problem areas and improve success of future treatments.
3. Collaborate with UMESC to conduct bioassays on select systems where there is concern that lampricide concentrations may not be effective late in the season due to elevated water temperatures and/or seasonality effects that improve sea lamprey survival. The Tobacco River (Saginaw River) and the Sturgeon River (Baraga County) are probable candidates for 2023.
4. Cooperate with UMESC to field test a new formulation of liquid Bayluscide during treatment of the Pere Marquette River.

Goal 2: Increase the effectiveness and efficiency of sea lamprey control to maximize reductions in sea lamprey populations in each of the Great Lakes.

Strategy 4: Implement integrated strategies for sea lamprey control for each lake and evaluate their effectiveness.

2022 Outcomes:

1. Due to the high number of deferrals that resulted from the pandemic in 2020 and 2021, the targeted treatment strategy was put on hold for 2022. All streams, regardless of basin, were instead ranked to ensure that those with the highest densities of large larvae were treated during 2022. Streams that had been previously deferred were given priority to ensure they were successfully treated.
2. Treatment supervisors were diligent about noting the size and densities of larvae observed during treatments in attempt to provide anecdotal evidence of any effects from the pandemic.
3. Assisted the LATF with developing the 2023 rank list. Special consideration was given to streams deferred in 2022 and those to be included in the targeted treatment strategy focusing on tributaries to Lake Superior. Treatment supervisors reviewed and calculated treatment costs for all streams considered for treatment.

2023 Objectives:

1. Optimize stream treatment schedules to facilitate the implementation of the next the targeted treatment strategy targeting Lake Superior.
2. Assist LATF with planning for sequential targeted treatment effort in each of the upper Great Lakes. Input will be provided on streams selected for inclusion in the Lake Michigan targeted treatment strategy to occur in 2024.
3. Continue to assist LATF with evaluating the success of ongoing large-scale treatment strategies.

Barrier Task Force

Purpose
The task force was established during April 1991 to coordinate efforts of the Department, the Service, and the USACE on the construction, operation, and maintenance of sea lamprey barriers.

2022 Membership
Matt Symbal (Chair), Pete Hrodey, Kevin Mann, Cheryl Kaye, and Jessica Collier (Service); Bruce Morrison, Gale Bravener, Sam Matheson, and Tom Pratt (Department); Amanda Meyer and Carl Platz (USACE); Gary Whelan (MIDNR); David Gonder (OMNRF); Nicholas Johnson and Ted Castro-Santos (USGS); Dan Zielinski (Commission); Rob McLaughlin (University of Guelph); Mike Siefkes and Chris Freiburger (Commission Secretariat).

Progress towards goals described in the Commission Vision:

Goal 1: Suppress sea lamprey populations to target levels.

Strategy 5: Construct and maintain a network of barriers to limit sea lamprey access to spawning habitats.

2022 Outcomes:

1. Planning continued on 22 barrier construction projects to prevent sea lampreys from accessing spawning habitat.
2. Vibration mitigation features and TFM trolley were installed on Harpersfield Dam, Grand River (Lake Erie).
3. Land acquisition for the Manistique River (Lake Michigan) sea lamprey barrier has moved forward resulting in the initiation of a quitclaim deed for the property at the proposed barrier location.
4. Little Manistee River (Lake Michigan) sea lamprey barrier project has reached the 65% design phase, construction award is set for June 2023.
5. Feasibility study is underway to determine the best options for a sea lamprey barrier on Conneaut Creek (Lake Erie).
6. Feasibility study is underway focusing on modifying a fish hatchery guidance weir to prevent sea lamprey passage in Beaverdam Brook (Lake Ontario).
7. Members of the SLCP and Commission remain engaged in the Grand River (Lake Michigan) sea lamprey barrier project. Site visits were completed to investigate the

deployment of NEMO portable electric barriers in the event of future barrier failures or escapement events.

8. Routine maintenance at all purpose-built sea lamprey barriers was completed to ensure adult sea lampreys do not have access to spawning habitat. All seasonal sea lamprey barriers were installed.
9. Inspections of approximately130 existing barriers in lakes Erie and Ontario were conducted to assess whether structures would prevent upstream migration and to identify repairs necessary to minimize the number of parasitic lampreys originating from untreated sources.
10. Review of 48 fish passage projects was initiated or completed to determine the effect of fish passage and dam or culvert removals to sea lamprey control operations.
11. The sea lamprey barrier prioritization list continues to be refined with help from State government partners. The current list is comprised of 470 barriers important to the Sea Lamprey Control Program.
12. Completed larval sea lamprey electrofishing and habitat assessments to determine production potential on the Boyne, Trout, White and Salmon Trout rivers, Michigan as well as the Portage River, Ohio. Fish community sampling occurred on the Garden River, as well as Trout and Grindstone creeks. Surveys were continued upstream and downstream of low-head barriers in Canadian tributaries of Lake Huron and Lake Ontario for long term monitoring of barrier impacts on fish movement.

2023 Objectives:

1. Initiate construction of the Manistique River (Lake Michigan) sea lamprey barrier.
2. Initiate construction of the Little Manistee River (Lake Michigan) sea lamprey barrier.
3. Finalize feasibility study for a sea lamprey barrier on Conneaut Creek (Lake Erie).
4. Modify fish hatchery weir on Beaver Dam Brook (Lake Ontario) to block lamprey and improve fish guidance weir at NYDEC fish hatchery.
5. Initiate construction of the Sucker River (Lake Superior) sea lamprey barrier and free span bridge.
6. Members remain engaged in the analysis and review of options at the 6th Street Dam on the Grand River (Lake Michigan) to assess risk of adult sea lampreys migrating upstream of the proposed structure that will create a whitewater rapids area in downtown Grand Rapids.
7. Continue working on priority GLFER barrier projects with the U. S. Army Corps of Engineers to limit sea lamprey access to spawning habitat.
8. Investigate use of existing surrogate species and geographic information systems (GIS) data to predict infestation risk upstream of blocking barriers.
9. Deliver barrier program operation and maintenance to limit sea lamprey access to spawning habitat.
10. Continue refining the sea lamprey barrier prioritization list by seeking input from outside agencies.

Goal 2: Increase the effectiveness and efficiency of sea lamprey control to further reduce sea lamprey populations in each Great Lake.

Strategy 4: Implement integrated sea lamprey control strategies for each lake and evaluate their effectiveness.

2022 Outcomes:

1. Participated in laboratory experiments to identify alarm cue compounds and to determine the effect of sea lamprey alarm cue on native species. Work to identify the chemical nature of the alarm cue is ongoing and preliminary results indicate that the magnitude of the response to sea lamprey alarm cue in other species seems to be related to how close the species is to sea lamprey, phylogenetically. Testing of migratory pheromones were conducted in Carp Lake Outlet.
2. The Cheboygan Working Group (CWG) investigated wounding and adult capture reports from the upper Cheboygan River system and confirmed presence of a small adult sea lamprey population through monitoring of fyke nets. Trapping was conducted in 2022 in the upper Cheboygan River as a component of the SupCon project. Sterilized male sea lampreys (n=3,325) were released into Sturgeon, Pigeon, and Maple rivers during the spawning run.
3. Participated in a field experiment in the Black Mallard River to test NEMO as a seasonal barrier to block a natural sea lamprey run with the goal of eliminating the need for lampricide treatment. The electric field was operated in the Black Mallard River, March through August, 2016-2022. Based on trap catches, it blocked >99% of the adults each year. Sterilized male sea lamprey were released into the Black Mallard upstream of the NEMO as insurance in the event fertile sea lampreys had passed. No sea lamprey larvae have been discovered upstream of the NEMO since 2019.
4. Several BTF members and participants are involved with the SupCon project workgroup. During 2022, the group refined sampling protocols and conducted fieldwork on SupCon streams to collect baseline data. Additionally, a work group has formed and is applying structure decision analysis techniques to determine the most effective combination of SupCon tools for deployment in each stream. Trapping of adult sea lampreys occurred on 12 streams, while larval population and habitat surveys occurred on 12 streams.

2023 Objectives:

1. Remain involved in research regarding use of chemosensory techniques to block or guide sea lampreys to increase capture of adult sea lamprey at barrier/trap complexes.
2. Participate in research to further test alarm cue response and its utility in a push-pull scenario to direct lampreys toward a successful barrier/trap complex or effective treatment location.
3. The Cheboygan Work Group (CWG) will continue to assess the upper Cheboygan River population during 2023 to confirm that adult populations upstream of the Cheboygan Lock and Dam complex are small and to document the system response to the Lake Kathleen Dam removal on the Maple River.
4. Continue operation of the NEMO seasonal barrier on the Black Mallard River to prevent the migration of spawning sea lamprey to the upper river.
5. Provide support to the SupCon project in identifying assessment and control strategies (SMRT, pheromone, alarm cue, NEMO, etc.) for successfully controlling sea lampreys in streams difficult to treat with lampricide.

Larval Assessment Task Force

The task force was established in 2012 and combined some objectives from the LATF and the Larval Assessment Work Group (LAWG).

Purpose:
Rank streams and lentic areas for sea lamprey control options and evaluate success of lampricide treatments through assessment of residual larvae.

2022 Membership
Aaron Jubar (Chair); Tonia Van Kempen, Lexi Sumner, and Fraser Neave (Department); Lori Criger, Bob Frank, (Service); Chris Holbrook (USGS); Travis Brenden (Quantitative Fisheries Center, MSU); Mike Siefkes and Chris Freiburger (Commission Secretariat).

Progress towards goals described in the Commission Vision:

Goal 1: Suppress sea lamprey populations to target levels.

Strategy 2: Conduct detection and distribution surveys to identify all sources of larval sea lampreys.

2022 Outcomes:

1. New sea lamprey producing tributaries were detected in Lake Superior (Knife River mainstream), Lake Michigan (Fowler Creek), and Lake Huron (Beaver Dam Creek). Also, in Lake Michigan, Bear Creek (Door County, WI) was found infested for the first time since 1975. Larval sea lamprey populations in the Knife River and Beaver Dam Creek are scheduled for treatment during 2023.
2. Larval surveys were conducted in the Grand River (Lake Michigan) above Sixth Street Dam and led to the discovery of sea lamprey larvae in two tributaries to the Grand River: the Rogue River and Prairie Creek. The Rogue River will be treated during 2023.

2023 Objectives:

1. Conduct surveys to detect new infestations of sea lamprey when possible. When new infestations are found, rank streams for treatment based on larval population and size structure information.
2. Prioritize and conduct distribution surveys on all streams scheduled for treatment during 2023. Conduct distribution surveys on all streams expected to be treated during 2024.

Strategy 3: Measure the effectiveness of lampricide application and account for its variation among streams.

2022 Outcomes:

1. Post-treatment assessments were conducted on streams treated during 2021 and early 2022. The presence of large residual larvae in the Amnicon River, Sturgeon River, Little Garlic River, and Harlow Creek in Lake Superior led to re-ranking these systems for treatment during 2023. The Fishdam River in Lake Michigan will be treated during 2023 based on residual larvae. Treatment evaluation surveys also revealed residual larvae in the Carp River and Pine River in Lake Huron. Both the Carp and Pine rivers are scheduled for treatment during 2023.

2023 Objectives:

1. Continue to conduct post-treatment assessments on all treated streams and rank streams when problematic populations of residual sea lampreys are detected.

Goal 2: Increase the effectiveness and efficiency of Sea Lamprey control to further reduce sea lamprey populations in each Great Lake.

Strategy 3: Improve existing and develop new rapid assessment methods to determine the distribution and relative abundance of larval sea lamprey populations.

2022 Outcomes:

1. Multi-station larval habitat identification training that was planned for spring 2022 was postponed due to pandemic restrictions on regional and international travel. All larval habitat training for staff was conducted within the respective Service and Department offices in Marquette, Ludington and Sault Ste. Marie.
2. Larval Assessment staff continued to work with Commission Communications staff on the development of a larval lamprey identification guide, which will serve as an important resource for both new and experienced staff at all agent offices.
3. The second year of a multi-year study examining the feasibility of eDNA as a survey tool was completed by the Service's Marquette and Department offices.

2023 Objectives:

1. Larval habitat identification and quantification training will be held at each respective station during early spring 2023.
2. Continue to edit larval assessment protocols and operating procedures as necessary.
3. Provide larval assessment support to new and ongoing Commission-funded research projects including, but not limited to: larval pheromone extraction, eDNA techniques, and TFM resistance.
4. Work with Commission Communications staff to finalize the larval lamprey identification guide and facilitate distribution to control agents and partner agencies.

Strategy 4: Develop integrated strategies for sea lamprey control for each lake and evaluate their effectiveness.

2022 Outcomes:

1. The targeted treatment strategy was suspended during 2022. Streams from all five Great Lakes were ranked for treatment based on cost-per-kill of larvae >100 mm.
2. Ranking surveys, distribution surveys, and where required, habitat assessment were conducted for streams identified as candidates for the first year of the 2023-2025 Targeted Treatment Strategy, which begins with Lake Superior.
3. Larval assessment staff from the Service and Department assisted with larval and habitat surveys on streams that are a part of the SupCon research project. Service staff from Ludington provided lamprey identification training for HBBS SupCon crews.

2023 Objectives:

1. The lake-specific Targeted Treatment Strategy will continue in 2024. Extensive surveys are planned throughout Lake Michigan to identify streams for inclusion in the 2024 Targeted Treatment Strategy.
2. Continue to work with the Trapping Task Force to target streams for trapping out-migrating juveniles for control.
3. Continue to work with HBBS and ACE staff to survey and evaluate SupCon project streams.

Trapping Task Force

Purpose
Coordinate optimization of trapping techniques for assessing adult sea lamprey populations and removing adult and transforming sea lampreys from spawning and feeding populations.

2022 Membership
Scott Miehls (Chair), Ted Castro-Santos, and Carolyn Link (USGS), Ryan Booth and Tonia Van Kempen (Department), Sean Lewandoski and Matt Symbal (Service), Weiming Li and Michael Wagner (Michigan State University), Heather Dawson (University of Michigan), Rob McLaughlin (University of Guelph), Mike Siefkes and Chris Freiburger (Commission Secretariat).

Progress towards goals described in the Commission Vision:

Goal 1: Suppress sea lamprey populations to target levels.

Strategy 4: Quantify the relationship between the abundance of spawning-phase sea lampreys, lake trout abundance, and wounding rates on lake trout.

2022 Outcomes:

1. All 29 index streams were trapped during spring 2022 as well as 10 additional non-index streams. Collaboration with partners around the basin made this possible given continued COVID-19 travel restrictions. GLIFWC conducted trapping operations on the Bad and Marengo rivers and KBIC assisted with SupCon transformer trapping efforts on the Cranberry, Potato (MI), and Traverse rivers during Fall 2021. A total of

50,479 adult sea lamprey were captured at index trapping sites this year, above the 5-year average of 31,367 from 2017 to 2021. During 2022, population estimates were modeled for 3 of the index streams due to insufficient recaptures of marked sea lamprey. An index estimate was produced for all lakes.

2023 Objectives:

1. Operate and maintain 39 trap sites throughout the Great Lakes. These include the 29 index streams, for which populations will be estimated using mark-recapture, and another 10 non-index streams.
2. The Lake Michigan targets will be updated to bring the approach for development in line with the other lakes.
3. The data analysis protocol is being developed as a formal document (to complement the trapping protocol).

Strategy 6: Deploy trapping methods to increase capture of spawning-phase and recently metamorphosed sea lampreys.

2022 Objectives:

1. Continue trapping transformers for control in newly discovered, or deferred streams to mitigate escapement to the lakes, beginning in October 2020 if warranted.
2. Status: Transformer trapping will occur in 12 of the 13 SupCon streams for assessment (Tawas Lake Outlet, Long Lake Outlet, Black Mallard Creek, Pigeon River, Sturgeon River, Maple River, Furlong Creek, Bills Creek, Cranberry River, Potato River (MI), Traverse River, Bellevue Creek, Root River).

2022 Outcomes:

1. There are several recent and ongoing research projects aimed at improving the capture efficiency of adults and out-migrating juveniles for control purposes. Several projects were delayed due to the COVID-19 pandemic. Pheromone, alarm cue, and antagonist research was able to continue. No new methods were deployed in 2022.
2. The assessment phase of SupCon underway. Twelve of 13 streams were trapped and larval assessment complete on all study streams. Adult trapping and larval assessment work occurred in Cranberry River, Traverse River, Bills Creek, Furlong Creek, Bellevue Creek, Root River, Pigeon River, Sturgeon River, Maple River, Black Mallard River, Long Lake Outlet, and Tawas Lake Outlet. Transformer trapping was conducted in these streams for fall 2022.

2023 Objectives:

1. Continue trapping transformers for control in newly discovered, or deferred streams to mitigate escapement to the lakes.
2. Continue monitoring results from recent and ongoing research projects and be prepared to implement effective new technologies and methods into the sea lamprey control field program when they become available.
3. Continue to evaluate trapping for control options, including trapping adults and out-migrating juveniles in streams where TFM is less effective.

4. Continue assisting with SupCon by providing suggestions and advice to core group on study design and deployment options for each study stream.

Goal 2: Increase the effectiveness and efficiency of sea lamprey control to further reduce sea lamprey populations in each Great Lake.

Strategy 1: Increase the capture of sea lampreys by developing cost-effective trapping methods, including those based on release of pheromones.

2022 Outcomes:

1. Milt Pheromones –Milt compounds were tested on ovulated females since they are typically our limiting resources for behavioral experiments. Milt pheromones were not tested on spermiating males or migratory stage individuals. No further fractionation or chemical identification of milt compounds occurred. Data are still being analyzed and will be available at a later date. This is the final year of the milt compound research.

2023 Objectives:

1. Evaluate a repellent-based method to deter sea lampreys from spawning areas.

2022 Outcomes:

1. Ninety migratory sea lampreys equipped with acoustic transmitters were released into the White River, MI to evaluate responses to alarm cue that was added to one section of the channel. The goal was to discover how to apply the repellent to drive migrants toward a trap or other fishing device in a large, open river. The data are currently being analyzed by Ph.D. student Kandace Griffin and will be presented at the 2023 Great Lakes Acoustic Telemetry Observation System annual meeting.
2. A laboratory experiment was completed at the HBBS to evaluate the effect of alarm cue application on guiding migrating sea lamprey into an experimental fish sorting device. The work was completed in cooperation with Radmantis, a private company based in Toledo, Ohio whose focus is on fish-sorting technologies used in aquaculture.
3. A manuscript was published in the journal Conservation Physiology reporting the results of a series of experiments that disentangled the effects of habituation and sensory adaptation on sea lamprey responses to alarm cue and offers recommendation for application practices when used in sea lamprey control.
4. A manuscript has been accepted for publication in the Journal of Chemical Ecology that reports a series of laboratory experiments exploring the chemical nature of the sea lamprey alarm cue, identifying reactive odor fractions and tests of 32 isolated compounds.
5. A revised manuscript has been submitted to Scientific Reports evaluating migratory sea lamprey responses to putrescine and petromyzonacil, two compounds contained in the alarm cue extract.
6. Pheromone Antagonists – We tested additional candidate 3kPZS antagonists from phase 2 of the design-test-learn cycle to discover analogs with increased antagonistic activity. Nine analogs reduced the 3kPZS olfactory response by >50% but did not reduce the positive control L-arginine olfactory response, suggesting these analogs are

not general suppressants of all olfactory responses but are specifically reducing the 3kPZS response. Twenty-seven analogs neutralized female preference for 3kPZS in a flume. Results from electrophysiology recordings and behavioral experiments from phases 1 and 2 in 2021 and 2022, respectively, will collectively provide insights into structure-activity relationships and guide the next round of analog synthesis (phase 3) in the iterative design-test-learn cycle.

2023 Objectives:

1. Completion of the multi-year White River experiments and transfer of findings to the relevant Commission task forces. The projects goals are to identify application practices to prevent habituation to the alarm cue, and practices for its application in space to maximize encounters with fishing devices in large, undammed rivers. We anticipate submitting five manuscripts reporting the results of these efforts in the coming year.
2. A revised proposal has been submitted to the Commission to continue development of a selective fish passage device that utilizes the alarm cue to selectively guide and trap sea lamprey migrating with native fishes (MSU, U. of Michigan, Conte Lab collaboration). Selection for funding by the Commission is pending the SLRB review and recommendation. If funded, work will commence in 2023.
3. Submission of a research proposal to continue pursuit of the alarm cue chemical identity.
4. Pheromone Antagonists – Additional candidate antagonists will be synthesized and assessed for their pheromone antagonistic activity using electro-olfactogram recordings and flume assays for phase 3 of the project.

Strategy 4: Implement integrated sea lamprey control strategies for each lake and evaluate their effectiveness.

2022 Outcomes:

1. Worked with LATF members to identify and target streams for trapping out-migrating juveniles for control.
2. Evaluated the effects of integrated control strategies that have been implemented (e.g. large-scale treatment strategies) by tracking adult sea lamprey abundance.

2023 Objectives:

1. Continue to work with LATF to identify and target streams for trapping out-migrating juveniles for control.
2. Continue to evaluate the effect of integrated control strategies that have been implemented by developing adult sea lamprey abundance estimates.

COMMUNICATIONS AND OUTREACH

The Great Lakes Fishery Commission (Commission) and its partners, the Service's Ludington and Marquette Biological Stations (LBS, MBS), Fisheries and Oceans Canada (Department), and United States Geological Survey-Hammond Bay Biological Station (HBBS), conducts a comprehensive education and outreach program. The following is an update about recent activities.

Outreach and Education Events:

As part of the outreach and education program to inform the public about the Commission's programs, the health of the Great Lakes, and the importance of the fisheries to the region, the following is partial list of the shows and events that were attended:

Shows, events, and programs:

Debbie Dingell GLRI Event, Ann Arbor, MI—January 26 (Commission)
OAC Invasive Species Awareness Day, Detroit, MI—February 26 (Commission)
Grand River Open House, Geneva, OH—April 20 (Commission, LBS, MBS)
Jackson County Conservation District Earth Day Event, Jackson, MI—April 23 (Commission)
MEFI Kids Fishing Day, Detroit, MI—May 3 (Commission)
NOAA Great Lakes Maritime Heritage Center, Alpena, MI—May 4 (HBBS)
Blue Water Wonderland Festival, Columbus, MI—May 7 (Commission)
Joint Aquatic Sciences Meeting, Grand Rapids, MI—May 15-20 (Commission, HBBS)
Lake St. Clair Water Festival, Virtual—May 18 (HBBS)
MEFI Kids Fishing Day, Detroit, MI—May 24 (Commission)
Blue Water Sturgeon Festival, Port Huron, MI—June 3-4 (HBBS)
Pictured Rock Days, Munising, MI—June 11 (MBS)
Cheboygan Dam Earth Week Expo, Cheboygan, MI—June 11 (HBBS)
Detroit Riverfront Kids Fishing Day, Detroit, MI—June 12 (Commission)
Tall Ships Brockville, Brockville, ON—June 23-26 (Commission)
Grovefest, Fremont, OH—June 25 (Commission)
Besser Museum Log Cabin Day, Alpena, MI—June 25 (HBBS)
Hoeft State Park, Rogers City, MI—June 30 (HBBS)
Tall Ships Cleveland, Cleveland, OH—July 7-10 (Commission)
Lake Superior Days, Marquette, MI—July 17 (MBS)
Michigan Brown Trout Festival, Alpena, MI—July 17 (HBBS)
Tall Ships Midland, Midland, ON—July 22-24 (Commission)
Lumberman's Monument, Oscoda, MI—July 26 (HBBS)
Tall Ships Erie, Erie, PA—August 26-28 (Commission)
Owen Sound Salmon Spectacular, Owen Sound, ON—August 28-September 6 (Commission, Department)
Sportsmen for Youth, Muskegon, MI—September 10 (Commission)
Rouge River Water Festival, Bloomfield Hills, MI—September 13-16 (Commission)
Redpath Waterfront Festival, Toronto, ON—September 17-18 (Commission)
Trail Creek Week, Michigan City, IN—September 19-23 (Commission)
Sturgeon for Tomorrow, Port Algonac, MI—September 24 (Commission)
Agripalooza, Chatham, MI—September 30 (MBS)

PERMANENT EMPLOYEES OF THE SEA LAMPREY CONTROL PROGRAM

Fisheries and Oceans Canada

Hilary Oakman, Director, Aquatic Invasive Species and Species at Risk

Sea Lamprey Control Centre – Sault Ste. Marie, Ontario Canada

Mike Steeves, Program Manager

Team Leader, Control: Bruce Morrison

Lampricide Control Biologists:
Shawn Robertson, Treatment Supervisor
Alan Rowlinson, Treatment Supervisor
Barry Scotland, Assistant Supervisor
Stefanie Grand, A/Assistant Supervisor

Lampricide Application Coordinators:
Vacant
Vacant

Lampricide Analysis Technicians:
Stefanie Grand
Jerome Keen
Sean Morrison

Lampricide Application Technicians:
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D'Arcy Campbell (Assign)
Connor Chessman
Justin Colbourne
Sarah Daniher
Kevin Finlayson
Chad Hill
Agata Kolodziejczyk
Paul Kyostia
Melissa Leonard
Adam Loubert
Matt McAulay
Sean Nickle
Troy Pine
Chris Sierzputowski
Kathy Smith
Kevin Sullivan
Ryan Whitaker

Barriers:
Bhuwani Paudel, Barrier Engineering Coordinator (On Assignment)
Sam Matheson, Barrier Engineer
Joe Hodgson, Barrier Engineering Technologist
Jeff Turcotte, Technician

Team Leader, Assessment: Tonia Van Kempen

Assessment Biologists:
Ryan Booth, Adult Supervisor
Fraser Neave, Larval Supervisor (On Assignment)
Kevin Tallon, Larval Supervisor (On Assignment)
Lexi Sumner, A/Larval Supervisor (Lower Lakes)
Joe Lachowsky, A/Larval Supervisor (Upper Lakes)

Assessment Technicians:
Wes Armstrong
Stephanie Best
Jennifer Hallett (Assign)
Sarah Larden
Richard Middaugh
Andrea Phippen
Trevor Plumley
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Administrative Support:
Lisa Vine, Finance and Administrative Officer
Melanie McCaig, Administrative Clerk
Vivianne Messier, Field Support Clerk

Maintenance:
Brian Greene, Foreman

Environmental Biologist:
Gale Bravener, Environmental Supervisor

Environmental Technician:
Nathan Coombs

United States Fish and Wildlife Service

Amy McGovern, Aquatic Invasive Species Supervisor, Sea Lamprey Program Manager

Ludington Biological Station – Ludington, Michigan

Jenna Tews, Station Supervisor

Administrative Support:
Danya Sanders
Vacant (CS)

Database Management and IT Support:
Daniel McGarry (Fish Biologist)

Lampricide Control Fish Biologists:
Chris Eilers, Treatment Supervisor
Lauren Freitas, Treatment Supervisor
Vacant (Fish Biologist)
Vacant (Fish Biologist)

Lampricide Control Lead Physical Science Technician:
Barry Shier

Lampricide Control Physical Science Technicians:
Paul Seckora Vacant
Kevin Butterfield

Lampricide Control Biological Science Technicians:
Theresa Benton (CS) Vacant (CS)
Nick Corniuk (CS) Vacant (CS)
Justin Spear (CS) Vacant (CS)

Larval Assessment Fish Biologists:
Aaron Jubar, Larval Assessment Supervisor
Matthew Lipps Vacant (Fish Biologist)

Larval Assessment Biological Science Technicians:
John Ewalt Timothy Granger (CS)
Nick Scripps Callie Kopp (CS)
Vacant (CS) Vacant (CS)

Maintenance Worker:
Thomas McVay

United States Fish and Wildlife Service

Amy McGovern, Aquatic Invasive Species Supervisor, Sea Lamprey Program Manager

Marquette Biological Station – Marquette, Michigan

Jess Barber, Field Supervisor

Administrative Support:
Tracy Matthies, Administrative Officer
Lisa Dennis
Karla Godin
Vacant

Database Management and IT Support:
Christopher Roberts, Database and IT Supervisor
Lynn Kanieski (Fish Biologist)
Deborah Larson (Data Transcriber)

Risk Management:
Cheryl Kaye, Risk Management Supervisor
Christina Carter (Fish Biologist)
Chad Andresen (Biological Science Technician)

Chemist:
Benson Solomon

Maintenance Worker:
John Gilkenson

Unit Supervisor (Adult): Pete Hrodey

Barrier and Trapping Fish Biologists:
Matthew Symbal, Barrier and Trapping Supervisor
Samuel Hultberg
Sean Lewandoski
Kevin Mann

Barrier and Trapping Biological Science Technicians:
Kevin Letson
Dennis Smith
Vacant (CS)
Jason Pynnonen (CS)
Vacant (CS)

Unit Supervisor (Control, Larval): Shawn Nowicki

Lampricide Control Fish Biologists:
Lori Criger, Treatment Supervisor
Christopher Gagnon, Treatment Supervisor
Jesse Haavisto
Sara Ruiter

Lampricide Control Lead Physical Science Technician:
Jamie Criger

Lampricide Control Physical Science Technicians:
Daniel Kochanski
Justin Oster
Patrick Wick

Lampricide Control Biological Science Technicians:
Janet McConnell (CS)
Kevin Hensiak (CS)
Andrew Steffen (CS)
Tiffany Opalka-Myers (CS)
Randy Parker (CS)
Cory Racine (CS)
Sara Tilton (CS)
Vacant (CS)

Larval Assessment Fish Biologists:
Robert Frank, Larval Assessment Supervisor
Rebecca Philipps
Nikolas Rewald

Larval Assessment Biological Science Technicians:
Jarvis Applekamp
Nicholas Chartier
Mark Bash (CS)
Matt Elya (CS)
Alex Larson (CS)
Vacant (CS)

(CS) Career Seasonal